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FIFTY-SEVENTH REPORT

OF THE

CONNECTICUT AGRICULTURAL EXPERIMENT STATION

NEW HAVEN

FOR THE YEAR
1933

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CONNECTICUT AGRICULTURAL EXPERIMENT STATION

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LETTER OF TRANSMITTAL

AND

REPORT OF THE BOARD OF CONTROL

To His Excellency, Wilbur L. Cross, Governor of Connecticut:

The Board of Control of the Connecticut Agricultural Experiment Station submits herewith its Fifty-seventh Annual Report, for the year ended October 31, 1933.

The report this year consists of ten bulletins and twelve circulars, totalling 918 pages. Each deals with a particular investigation or with some phase of the statutory duties of the Station. Bulletin 357, pages 117 to 148, Report of the Director, presents a general summary of the activities of the year. This includes a list of projects and lists of all publications. Each of these bulletins, as issued, has been placed in your hands.

Special attention is called to Bulletin 358, which is Part II of the Plant Pest Handbook. Part I, Bulletin 344 of last year, dealt with Insects. This part covers Diseases and Injuries. Nothing published by the Station in recent years has been so well received as these handbooks.

The establishment of the C. C. C. camps, the C. W. A., and similar enterprises have brought new duties to many of the Station Staff. However, they have made possible a general attack on many pests along a wider front.

The financial statements included herewith are for the fiscal year ended June 30, 1933. It was during this year that you called on all state agencies to coöperate in reducing state expenditures. In response to this request, the Station, in its several accounts, turned back to the Treasurer some $35,000, or 15 per cent of the total amount appropriated by the General Assembly. Naturally many needed items were not purchased but, in general, the services of the Station to the state were not curtailed. In part, this saving was due to the low prices and wages then prevailing.

When the estimates for the period 1933-1935 were submitted, we voluntarily reduced these 16 per cent below the appropriation for 1931-1933. This was based on low prices and rigid economy. If prices rise materially, some work of the Station will have to be curtailed.

Respectfully submitted,

EDWARD C. SCHNEIDER,
Secretary.

REPORT OF THE TREASURER

July 1, 1932—June 30, 1933

W. L. Slate, Treasurer, in account with the **Connecticut Agricultural Experiment Station** (General Station Fund)

RECEIPTS

Balance on hand, July 1, 1932			$ 2,312.83
State Appropriation		$66,240.00	
Federal Appropriations:			
Hatch Fund		7,500.00	
Adams Fund		7,500.00	
Purnell Fund		30,000.00	
Clarke-McNary Fund		1,968.97	
Lockwood Trust Fund Income		5,000.00	
Fertilizer Fees		10,000.00	
Feed Fees		11,000.00	
Reimbursements:			
State Park and Forest Commission		1,200.00	
Miscellaneous		72.23	140,481.20
			$142,794.03
Miscellaneous Receipts:			
Balance on hand, July 1, 1932		$199.47	
Mileage for use of automobiles	3.24		
Sale of old paper	1.99		
Sale of bulletins	29.05		
Sale of stamps and postcards to Station Forester	1.50		
Interest on bank deposits	35.01	70.79	
Total		$270.26	
Less miscellaneous receipts deposited with State Treasurer		$270.26	
Balance in hands of Station Treasurer, June 30, 1933			———
			$142,794.03

DISBURSEMENTS

Salaries	$91,505.84	
Labor	21,320.21	
Stationery and office supplies	752.28	
Scientific supplies (consumable)	2,174.44	
Feeding stuffs	88.78	
Sundry supplies	1,264.99	
Fertilizers	625.88	
Telegraph and telephone	488.51	
Postage	790.97	
Travel	2,381.59	
Freight, express and parcel post	228.70	
Publications	199.24	
Coal	3,542.89	
Gas, electricity and water	3,079.19	
Furniture and fixtures	351.53	
Library	1,146.61	
Scientific equipment	1,272.35	
Livestock	1.44	
Tools, machinery and appliances	2,675.92	
New buildings and structures	26.99	
Buildings and grounds (repairs and alterations)	2,861.84	
Insurance (fire, burglary and automobile)	1,896.29	
Contingent	120.30	
Total disbursements		$138,796.78
Balance on hand June 30, 1933:		
State General Appropriation (in hands of State Comptroller)	3,997.25*	
Miscellaneous receipts in hands of Station Treasurer	———	3,997.25*
		$142,794.03

Reverted to State Treasury—part of the 15 per cent saved in response to the Governor's appeal for economy.

W. L. Slate, Treasurer, in account with **Insect Pest Appropriation** (Section 2124 of General Statutes, Revision of 1930) July 1, 1932, to June 30, 1933

RECEIPTS

Balance on hand July 1, 1932	$ 7,412.15	
Insect Pest Appropriation	65,000.00	
		$72,412.15

DISBURSEMENTS

Salaries	22,778.33	
Labor	18,659.64	
Stationery and office supplies	314.20	
Scientific supplies (consumable)	141.59	
Feeding stuffs	14.70	
Sundry supplies	495.39	
Fertilizer	10.48	
Telegraph and telephone	356.54	
Postage	122.44	
Travel	1,293.86	
Freight, express, parcel post, and carting	159.88	
Publications	12.21	
Gas, electricity and water	244.93	
Furniture and fixtures	1,157.05	
Library	157.23	
Scientific equipment	511.83	
Tools, machinery and appliances	1,632.68	
Buildings (repairs and alterations)	.08	
Insurance (automobile)	338.29	
Contingent	65.80	
Total disbursements		$48,467.15
Balance on hand June 30, 1933		23,945.00*
		$72,412.15

Reverted to State Treasury—part of the 15 per cent saved in response to the Governor's appeal for economy.

W. L. Slate, Treasurer, in account with **Mosquito Elimination Appropriation** (Sections 2415 and 2416 of General Statutes, Revision of 1930) July 1, 1932, to June 30, 1933

RECEIPTS

Balance on hand July 1, 1932	$ 111.90	
State Appropriation	15,000.00	
		$15,111.90

DISBURSEMENTS

Salaries	2,816.00	
Labor	8,089.45	
Scientific supplies (photographic supplies)	.65	
Sundry supplies	63.21	
Telegraph and telephone	8.70	
Travel	1,055.37	
Tools, machinery and appliances	163.04	
Tidegates (repairs and alterations)	69.39	
Insurance (automobile)	70.15	
Contingent	.10	
Total disbursements		$12,336.06
Balance on hand June 30, 1933		2,775.84*
		$15,111.90

Reverted to State Treasury—part of the 15 per cent saved in response to the Governor's appeal for economy.

W. L. Slate, Treasurer, in account with **Tobacco Research Appropriation** (Chapter III of General Statutes, Revision of 1930) July 1, 1932, to June 30, 1933

RECEIPTS

Balance on hand July 1, 1932	$ 891.51	
State Appropriation	20,000.00	
		$20,891.51

DISBURSEMENTS

Salaries	$13,400.00	
Labor	3,190.95	
Stationery and office supplies	31.47	
Scientific supplies (consumable)	366.16	
Sundry supplies	280.73	
Fertilizer	429.77	
Telegraph and telephone	102.06	
Postage	15.00	
Travel	596.13	
Freight, express and cartage	26.31	
Fuel (oil, charcoal and kerosene)	557.05	
Gas, electricity and water	283.75	
Furniture and fixtures	27.74	
Library (books and periodicals)	28.69	
Scientific equipment	102.30	
Tools, machinery and appliances	144.49	
New buildings and structures	41.00	
Buildings and grounds (repairs and alterations)	294.46	
Buildings (rent)	15.00	
Insurance (automobile and tobacco)	69.84	
Contingent	2.00	
Total disbursements		$20,004.90
Balance on hand June 30, 1933		886.61*
		$20,891.51

Reverted to State Treasury—part of the 15 per cent saved in response to the Governor's appeal for economy.

W. L. Slate, Treasurer, in account with **White Pine Blister Rust Appropriation** (Chapter III of General Statutes, Revision of 1930) July 1, 1932, to June 30, 1933

RECEIPTS

Balance on hand July 1, 1932		$ 221.83
State Appropriations	$7,500.00	
Additions	1,032.00	8,532.00
		$8,753.83

DISBURSEMENTS

Salaries	660.00	
Labor	5,577.98	
Stationery and office supplies	40.81	
Sundry supplies	195.78	
Telegraph and telephone	32.87	
Postage	10.00	
Travel	75.80	
Freight, express and cartage	2.17	
Publications	27.95	
Furniture and fixtures	120.29	
Tools, machinery and appliances	1,193.60	
Land (rent)	33.00	
Insurance (automobile)	139.19	
Contingent	2.00	
Total disbursements		$ 8,111.44
Balance on hand July 1, 1933		642.39*
		$ 8,753.83

Reverted to State Treasury—part of the 15 per cent saved in response to the Governor's appeal for economy.

W. L. Slate, Treasurer, in account with **Food and Drug Appropriation,** July 1, 1932—June 30, 1933

RECEIPTS

Food and Drug Appropriation	$7,500.00

DISBURSEMENTS

Salaries	$7,500.00

The financial statement for the **Gipsy Moth Appropriation** will be found in the "Report of the State Entomologist", page 432 of this report; for **Inspection of Apiaries,** on page 425.

Bulletin 355 October, 1933

COMMERCIAL FERTILIZERS

REPORT FOR 1933

E. M. BAILEY

Chemist in Charge
Department of Analytical Chemistry

Connecticut
Agricultural Experiment Station
New Haven

CONNECTICUT AGRICULTURAL EXPERIMENT STATION

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COMMERCIAL FERTILIZERS REPORT FOR 1933

STATUTE AND REGULATIONS REGARDING COMMERCIAL FERTILIZERS

The term "commercial fertilizers" as used in the Connecticut fertilizer statute includes any and every substance imported, manufactured, prepared or sold for fertilizing or manuring or soil amendment purposes, except barnyard manure and stable manure that have not been artificially treated or manipulated, marl, and lime.

The seller is responsible for the proper labelling of each package of fertilizer, for the registration of each brand sold or offered for sale, for the payment of the required analysis fee and for the payment of the tonnage tax. If, however, proper labelling, registration and payments of analysis fees and of tonnage tax have been provided for by the manufacturer or by another responsible person, all sellers of such brands are released from the above mentioned requirements. The retailer, therefore, should assure himself that the requirements of the law have been met by the manufacturer of the brands which he handles, or himself be prepared to meet all these requirements.

It frequently happens that a manufacturer or jobber sells fertilizer materials which are the products of, and which are registered by, another firm or individual. Distributors in such cases should sell such materials by the exact brand names under which they are registered in order that there may be no mistake as to the identity of the brands. Any change in the brand names, or failure to make the identity of the brand and its manufacturer clear makes the distributor liable for the registration of the product as his own brand.

The law exempts from registration, and from other requirements referred to, only (1) fertilizers passing through the state in transit; (2) fertilizers and fertilizer materials shipped to regular fertilizer factories to be used for manufacturing purposes; and (3) fertilizers and fertilizer chemicals sold to the Connecticut Agricultural Experiment Station for experimental purposes.

NOTE: Analyses reported in this bulletin were made by Messrs. Nolan, Mathis and Walden; microscopic examinations by Miss Shepard; inspection and sampling by Mr. Churchill; and compilations by Mrs. Vosburgh.

RECENT CHANGES AFFECTING FERTILIZER CONTROL

LABELLING

Mixed fertilizer offered for sale in this State during the year 1933 were held to the requirements of a regulation issued by this Station June 25, 1931. The regulation is as follows:

"In view of the resolution passed by the Fertilizer Control Officials of the thirteen Northeastern States favoring (1) the statement of 'grade' as a part of the brand name of mixed fertilizers, e.g., XX Potato Manure 4-8-4; (2) that the significance of 'grade' shall be nitrogen, available phosphoric acid, and water-soluble potash, and in that order, e.g., XX Potato Manure 4-8-4 meaning 4% nitrogen (not 4% ammonia), 8% available phosphoric acid and 4% water-soluble potash; (3) that statements of grade and of guaranteed analysis shall be in whole numbers; and (4) that statements of guaranties shall include only minimum percentages of nitrogen, available phosphoric acid and water-soluble potash; and inasmuch as these recommendations are in accord with rules adopted by the Association of Official Agricultural Chemists, which rules are required by Sec. 5 of the Connecticut fertilizer law to be followed in administering the act; this Station will, on and after January 1, 1932, observe the foregoing procedure and urge its adoption by all concerned with the manufacture, sale and distribution of fertilizers and by those charged with the dissemination of information concerning fertilizers and fertilizer problems.

"In accordance with this understanding and acceptance of terms and procedure this Station will expect (1) that mixed fertilizer offered for registration for the year 1932 and thereafter will carry as a part of the brand name, whenever possible, the grade of the mixture; (2) that the statement of the grade will be in whole numbers; (3) that the significance of the numerals expressing the grade, and the order of them, will be nitrogen (not ammonia), available phosphoric acid and water-soluble potash; (4) that the statement of guaranteed analysis will give the percentages, in whole numbers only, of nitrogen, available phosphoric acid and water-soluble potash, and in that order; and (5), that tags or stencils upon bags will agree with the registration.

"In the case of mixtures in which phosphoric acid is derived from sources (e.g., bone and tankage), in which available phosphoric acid cannot be adequately evaluated by present analytical methods, total phosphoric acid may be stated in the guaranteed analysis, and the statement of grade may be omitted. In the statement of grade, total phosphoric acid may not be substituted for available."

While this regulation applies to *mixed* fertilizers only, it is recommended that guaranties for raw materials follow the spirit of the ruling so far as may be. Nitrogenous raw materials, for example, should be guaranteed in terms of nitrogen, but not necessarily in whole numbers; bone and tankage should show guaranties expressed in terms of nitrogen and total phosphoric acid rather than ammonia and bone phosphate of lime as formerly.

In the case of mixed fertilizers in which the phosphoric acid is derived from materials such as bone, in which present analytical methods do not adequately evaluate available phosphoric acid, it was regarded as advisable to omit the statement of grade and allow total phosphoric to be given in the guaranteed analysis, preferably instead of available, but if desired, in addition to it. In any case the qualifying phrase, "All the phosphoric acid is derived from bone," is permitted.

METHODS OF ANALYSIS

Phosphoric acid insoluble in ammonium citrate solution has been determined this year according to the revised methods adopted by the Association of Official Agricultural Chemists at the annual meeting October, 1931, whereby a 1-gram charge of fertilizer is used instead of 2 grams and the time of digestion in ammonium citrate solution increased from 30 minutes to 1 hour.

DEFINITIONS OF FERTILIZER MATERIALS AND INTERPRETATION OF TERMS USED IN FERTILIZER CONTROL

For the purpose of bringing about a better understanding among control officials and the fertilizer industry as to the identity of fertilizer materials and the significance of terms used in interpreting results of analysis, a special committee of the Association of Official Agricultural Chemists was appointed in 1921 to consider this question and from time to time pronouncements have been made.

The following definitions and interpretations are now official.

DEFINITIONS

ACIDULATED FISH TANKAGE, ACIDULATED FISH SCRAP

Acidulated fish tankage, acidulated fish scrap, is the rendered product derived from fish and treated with sulfuric acid.

ACTIVATED SEWAGE PRODUCTS

Activated sewage products are those made from sewage freed from grit and coarse solids and aerated after being inoculated with micro-organisms. The resulting flocculated organic matter is withdrawn from the tanks, filtrated with or without the aid of coagulants, dried, ground, and screened.

AMMONIATED SUPERPHOSPHATE

Ammoniated superphosphate is a product containing superphosphate and/or dissolved bone and nitrogenous compounds, but without the addition of potash.

ANALYSIS

Analysis, as applied to fertilizers, designates the percentage composition of the product expressed in terms of nitrogen, phosphoric acid, and potash in their various forms.

ASHES FROM LEACHED WOOD

Ashes from leached wood are unleached ashes resulting from the burning of wood that has been exposed to or digested in water or other liquid solvent, as in the extraction of dyes, so that a part of the plant food has been dissolved and removed.

BASIC PHOSPHATE SLAG

Basic phosphate slag is a by-product in the manufacture of steel from phosphatic iron ores. The product shall be finely ground and shall contain no admixture of materials other than what results in the original process of manufacture. It shall contain not less than twelve per cent (12%) of total phosphoric acid (P_2O_5), not less than eighty per cent (80%) of which shall be soluble in two per cent (2%) citric acid solution according to the Wagner method of analysis. Any other phosphate slag not conforming to this definition shall be designated low grade.

BRAND AND BRAND NAME

A brand is a term, design, or trademark used in connection with one or several grades of fertilizers.

A brand name is a specific designation applied to an individual fertilizer.

CRUDE, INERT, OR SLOW-ACTING NITROGENOUS MATERIALS

Crude, inert, or slow-acting nitrogenous materials are unprocessed organic substances relatively high in nitrogen, but having a very low value as plant food and showing a low activity by both the alkaline and neutral permanganate methods (below fifty per cent (50%) and eighty per cent (80%) respectively.)

DISSOLVED BONE

Dissolved bone is ground bone or bone meal that has been treated with sulfuric acid.

DRIED BLOOD

Dried blood is the collected blood of slaughtered animals, dried and ground, and containing not less than twelve per cent (12%) of nitrogen in organic forms.

DRIED, PULVERIZED, OR SHREDDED MANURES

Dried, pulverized, or shredded manures are what the name indicates, and not mixtures of manures and other materials.

FERTILIZER GRADE

Fertilizer grade shall represent only the minimum guarantee of its plant food expressed in terms of nitrogen (not ammonia), available phosphoric acid, and water-soluble potash.

FISH TANKAGE, FISH SCRAP, DRY GROUND FISH, FISH MEAL FERTILIZER GRADE

Fish tankage, fish scrap, dry ground fish, fish meal fertilizer grade is the dried ground product derived from rendered or unrendered fish.

GARBAGE TANKAGE

Garbage tankage is the rendered, dried, and ground product derived from waste household food materials.

GROUND RAW BONE

Ground raw bone is dried ground animal bones that have not been previously steamed under pressure.

GROUND STEAMED BONE

Ground steamed bone is ground animal bones that have been previously steamed under pressure.

HOOF AND HORN MEAL

Hoof and horn meal is processed, dried, and ground hoofs and horns.

KAINIT

Kainit is a potash salt containing potassium and sodium chlorides and sometimes sulfate of magnesia with not less than twelve per cent (12%) of potash (K_2O).

LEACHED WOOD ASHES

Leached wood ashes are ashes from burned unleached wood with part of their plant food removed by artificial means or by exposure to rains, snows, or other solvent.

MANURE SALTS

Manure salts are potash salts containing high percentages of chloride and from twenty per cent (20%) to thirty per cent (30%) of potash (K_2O). The term double manure salts is discontinued.

MURIATE OF POTASH (COMMERCIAL POTASSIUM CHLORIDE)

Muriate of potash is a potash salt containing not less than forty-eight per cent (48%) of potash (K_2O), chiefly as chloride.

NITRATE OF POTASH (COMMERCIAL POTASSIUM NITRATE)

Nitrate of potash is a salt containing not less than twelve per cent (12%) of nitrogen and forty-four per cent (44%) of potash (K_2O).

NITRATE OF SODA (COMMERCIAL SODIUM NITRATE)

Nitrate of soda is commercial sodium nitrate containing not less than fifteen per cent (15%) of nitrogen, chiefly as sodium nitrate.

PRODUCTS SECURED BY HEATING CALCIUM PHOSPHATE WITH ALKALI SALTS CONTAINING POTASH

Products secured by heating calcium phosphate with alkali salts containing potash are non-acid phosphates with potash. They are not potassium phosphate.

SULFATE OF POTASH (COMMERCIAL POTASSIUM SULFATE)

Sulfate of potash is a potash salt containing not less than forty-eight per cent (48%) of potash (K_2O), chiefly as sulfate, and not more than two and one-half per cent (2.5%) of chlorine.

SULPHATE OF POTASH-MAGNESIA

Sulfate of potash-magnesia is a potash salt containing not less than twenty-five per cent (25%) of potash (K_2O), nor less than twenty-five per cent (25%) of sulfate of magnesia, and not more than two and one-half (2.5%) of chlorine.

SUPERPHOSPHATE

Superphosphate is a cured mixture of rock phosphate and sulfuric acid and/or phosphoric acid. The grade shall always be used as a prefix to the name. Example: [illegible] Superphosphate. The use of the term Acid Phosphate is discontinued.

TANKAGE

Tankage (without qualification) is the rendered, dried, and ground by-product, largely meat and bone from animals (slaughtered or that have died otherwise).

UNIT OF PLANT FOOD

A unit of plant food is twenty (20) pounds, or one per cent (1%) of a ton.

UNLEACHED WOOD ASHES

Unleached wood ashes are ashes from burned unleached wood that have had no part of their plant food removed and that contain four per cent (4%) or more of water-soluble potash (K_2O).

INTERPRETATIONS

ACTIVITY OF WATER-INSOLUBLE NITROGEN IN FERTILIZERS

The alkaline and neutral permanganate methods distinguish between the better and the poorer sources of water-insoluble nitrogen; they do not show the percentage availability of the material. The available nitrogen of any product is measured only by carefully conducted vegetation experiments.

(a) The methods shall be used on mixed fertilizers containing water-insoluble nitrogen amounting to three-tenths of one per cent (0.3%) or more of the weight of the material. If a total nitrogen exceeds the minimum guarantee and is accompanied by a low activity of the insoluble nitrogen, the over-run shall be taken into consideration in determining the classification of the water-insoluble nitrogen.

(b) The water-insoluble nitrogen in mixed fertilizers showing an activity below fifty per cent (50%) by the alkaline method and also below eighty per cent (80%) by the neutral method shall be classed as inferior. This necessitates the use of both methods, also the provision as to over-run in (a), before classifying as inferior.

AMOUNT OF CHLORINE PERMISSIBLE IN FERTILIZERS IN WHICH THE POTASH IS CLAIMED AS SULPHATE

Chlorine in mixed fertilizers in which the potash is claimed as sulfate shall not exceed one-half of one per cent (0.5%) more than what is called for in the minimum potash content based on the definition for sulfate of potash formulated by the committee. Calculate as follows: 0.05 times the percentage of potash found plus 0.5.

BRAND NAME TO INCLUDE ANALYSIS OR GRADE OF FERTILIZER

The analysis or grade of a fertilizer should be included with its brand name, and so used by the manufacturer on sacks and in printed literature and by the control official in his reports and publications.

FERTILIZER FORMULA

A fertilizer formula shall express the quantity and grade of the crude stock materials used in making a fertilizer mixture. For example: 800 pounds of 16 per cent superphosphate, 800 pounds of tankage (7.40 nitrogen and 9.15 total phosphoric acid), and 400 pounds of sulphate of potash-magnesia (twenty-six per cent (26%), potash).

FINELY GROUND AS APPLIED TO BASIC PHOSPHATE SLAG

Finely ground in the definition of basic phosphate slag shall refer to actual size of particles as determined by the use of standard sieves, as follows: seventy percent (70%) or more shall pass a 100-, and ninety per cent (90%) or more shall pass a 50-mesh sieve.

FORM OF NITROGEN IN CALCIUM CYANAMIDE

The nitrogen in calcium cyanamide shall be considered as being of organic nature.

THE TERM LIME AS APPLIED TO FERTILIZERS

The term lime shall not be used in the registration, labelling, or guaranteeing of fertilizers or fertilizing materials, unless the lime is in a form to neutralize soil acidity, such as the oxide, hydroxide, or carbonate, or equivalent magnesia compounds.

ORDER OF TERMS

The order of terms in mixed fertilizers shall be nitrogen first, phosphoric acid second, and potash third.

NAME OF A FERTILIZER MATERIAL USED AS THE BRAND NAME OR PART OF THE BRAND NAME OF A MIXED FERTILIZER

When the name of a fertilizer material is used as part of the brand name of a mixed fertilizer, as for example blood, bone or fish, the nitrogen or phosphoric acid shall be derived from or supplied entirely by the material named. When the name of a fertilizer material is used as a brand or as part of a brand and the nitrogen and phosphoric acid is not supplied by the material named, the word brand shall follow the name of the material. Example: Fish Brand Fertilizer.

STATEMENT OF GUARANTEE

The statement of guarantee of mixed fertilizers shall be given in whole numbers.

REGISTRATIONS

LATE REGISTRATIONS FOR 1932

To the brands registered for 1932 in our last report should be added:

Cairo Meal and Cake Co., Cairo, Ill.
"Miss Cairo" Brand 41% Cottonseed Meal

Summers Fertilizer Co., Inc., Baltimore, Md.
Summers's "Best on Earth" 16-20 Superphosphate

REGISTRATIONS FOR 1933

For 1933, 64 firms and individuals registered at this Station for sale in this State 334 brands of fertilizers. As required by statute the brands so registered are listed as follows.

American Agricultural Chemical Co., New Haven Sales Dept., Drawer H, West Haven, Conn.
AA Aroostook Potato Manure 5-8-7
AA Corn Favorite 3-10-4
AA General Crop Fertilizer 2-10-2
AA Hi-Grade Tobacco Manure 6-3-6
AA Monarch Fertilizer 4-8-4
AA Peerless Fertilizer 4-8-7
AA Prolific 10% Potash Fertilizer 2-8-10
AA Superphosphate 16%
AA Tobacco Starter 5-5-15
AA Top Dresser 7-6-6
Agrico for Aroostock 5-8-7
Agrico for Corn 3-10-6
Agrico for Lawns, Trees and Shrubs 7-6-6
Agrico for New England 4-8-10
Agrico for Tobacco 6-3-6
Agrico for Truck 4-10-5
Bowker's Market Garden Fertilizer 4-8-4
Bowker's Stockbridge Early Crop Manure 5-8-7
Bradley's Blood, Bone and Potash Brand 5-8-7
Bradley's XL Fertilizer 3-10-4
Castor Pomace
Double A Tobacco Fertilizer 5-3-5
Dry Ground Fish
Fine Ground Bone
Muriate of Potash
Pulverized Sheep & Goat Manure
Sanderson's Formula B 4-8-7 (Potash Derived from Sulphate)
Sulphate of Ammonia

American Cyanamid Co., 535 Fifth Ave., New York City
Aero Cyanamid
Ammo-Phos 11-48-0
Ammo-Phos 16-20-0

Apothecaries Hall Co., Waterbury, Conn.
Bone Meal 2.47%
Bone Meal 3.29%
Bone & Meat Tankage
Carbonate of Potash
Castor Pomace
Cotton Hull Ashes
Dry Ground Fish
Liberty Corn, 2-10-2
Liberty Fish, Bone & Potash, 3-10-4
Liberty High Grade Corn, 2-12-4
Liberty High Grade Market Gardeners, 5-8-7
Liberty High Grade Tobacco Manure, 6-3-7
Liberty Market Gardeners Special, 4-8-4
Liberty Onion Special (Potash as Sulphate) 4-8-7
Liberty Potato & General Crops, 4-8-10
Liberty Potato & Market Gardeners (Potash as Muriate), 4-8-7
Liberty Special Fertilizer for Fruit, 7-8-6
Liberty Special Fertilizer for Lawns, Gardens, Flowers, Shrubs, Trees, 4-4-0
Liberty Tobacco Special, 5-3-5
Liberty Tobacco Starter, 4-10-0
Liberty Tobacco Starter with Potash, 5-4-15
Liberty Top Dresser for Grass & Grain, 8-8-8
Linseed Meal
Nitrate of Potash, 13-44
Nitrate of Soda
Precipitated Bone
Sheep Manure
Sulphate of Potash & Magnesia
Superphosphate 16%
Superphosphate 18%
Tankage

Armour Fertilizer Works, 10 E. 40th St., New York City
Armour's Big Crop Fertilizers 4-8-4
Armour's Big Crop Fertilizers 5-8-7
Armour's Big Crop Fertilizers 6-11-10
Armour's Big Crop Fertilizers 7-6-6
Armour's Big Crop Fertilizers — 16% Superphosphate
Armour's Big Crop Fertilizers Tobacco Special 5-3-5
Armour's Bone Meal
Armour's Ground Tankage
Armour's Lawn & Garden Grower 5-8-6
Armour's Raw Bone Meal
Castor Pomace
Sheep & Goat Manure

Ashcraft-Wilkinson Co., Atlanta, Ga.
Helmet Brand Cottonseed Meal

Associated Seed Growers, Inc., 205 Church St., New Haven, Conn.
Acid Phosphate
Clark's Special Mixture for General Use, 3-8-4
Clark's Special Mixture 6% Potash, 3-8-6
Clark's Tip Top Brand, 4-8-7
Nitrate of Soda, Champion Brand

The Baker Castor Oil Co., 120 Broadway, New York City
Castor Pomace

Barrett Co., 40 Rector St., New York City
Arcadian Nitrate of Soda
Arcadian Sulphate of Ammonia
Sulphate of Ammonia

F. A. Bartlett Tree Expert Co., Inc., 60 Canal St., Stamford, Conn.
Bartlett Green Tree Food, 6-7-4

Berkshire Chemical Co., Bridgeport, Conn.
Berkshire 5-8-7 Fertilizer
Berkshire Castor Pomace
Berkshire Complete Fertilizer, 2-12-2
Berkshire Complete Tobacco Fertilizer, 4-3-5
Berkshire Dry Ground Fish
Berkshire Fine Ground Bone
Berkshire Grass Special Fertilizer, 6-6-5
Berkshire High Grade Tobacco Fertilizer, 5-3-6
Berkshire Long Island Special Fertilizer, 4-8-7
Berkshire Market Garden Fertilizer, 4-8-4
Berkshire Special Mixture, 3-10-6
Berkshire Sulphate of Ammonia
Berkshire Superphosphate 16%
Berkshire Tobacco Special, 6-3-7
Berkshire Tobacco Starter Fertilizer, 4-4-15
Berkshire Truck Fertilizer, 4-8-5

C. E. Buell, Inc., 6 Beacon St., Boston, Mass.
Two-In-One Peat Poultry Manure

Chilean Nitrate Sales Corp., 120 Broadway, New York City
Champion Brand Nitrate of Soda
Standard Chilean Nitrate of Soda

Cobwell Reduction Co., Inc., Syracuse, N. Y.
Coreco Chemically Balanced Fertilizer, 4-6-2

The Connecticut Fat Rendering & Fertilizer Corp., West Haven, Conn.
Tankage

Consolidated Rendering Co., Boston, Mass.
Castor Pomace
Corenco Sheep Manure
Corenco 8-16-14 Two-In-One
Ground Bone
Ground Tankage
Sulphate of Ammonia
Superphosphate 16%

Davey Tree Expert Co., Kent, Ohio
Davey Shredded Cattle Manure
Davey Tree Food, 10-3-3

Eastern States Farmers' Exchange, Springfield, Mass.
Eastern States 0-14-6
Eastern States 0-20-20
Eastern States 4-8-8
Eastern States 4-10-6
Eastern States 4-12-4
Eastern States 4-16-20
Eastern States 5-5-15 Tobacco
Eastern States 6-3-6 Tobacco
Eastern States 6-8-6
Eastern States 6-15-9
Eastern States 8-4-8 Tobacco
Eastern States 8-16-16
Eastern States 8-16-16 (Low Chlorine Special)
Eastern States 8-24-8

Eastern States 10-5-10 Tobacco
Eastern States 10-20-20
Eastern States 15-20-15
Eastern States Calurea
Eastern States Castor Pomace
Eastern States Dry Ground Fish
Eastern States Ground Animal Tankage
Eastern States Ground Steamed Bone
Eastern States Muriate of Potash
Eastern States Nitrate of Potash
Eastern States Precipitated Bone
Eastern States Sulphate of Ammonia
Eastern States Sulphate of Potash
Eastern States 16% Superphosphate
Eastern States 32% Superphosphate
Nitrophoska 10-20-20
Urea

Ed. Eggert, Hartford, Conn.
"Diamond EE" Cottonhull Ashes

Essex Fertilizer Co., Boston, Mass.
Essex 3-10-4 Fish Brand Fertilizer For All Crops
Essex 4-8-10 Peerless Potato Manure
Essex 5-8-7 Complete Manure

Ford Motor Co., 3674 Schaefer Road, Dearborn, Mich.
Ford Ammonium Sulphate

L. T. Frisbie Co., New Haven, Conn.
Frisbie's Corn & Grain 2-10-2
Frisbie's Fine Bone Meal
Frisbie's Market Garden 4-8-7
Frisbie's Special 5-8-7
Frisbie's Special Potato Fertilizer 4-8-4
Frisbie's Special Vegetable & Potato Grower 3-10-4
Frisbie's Tobacco Grower 5-3-5
Frisbie's Top Dresser 7-6-6

Paul M. Hubbard & Co., Bristol, Conn.
Hubbard's Special Lawn Food 10-6-4

Humphreys-Godwin Co., Memphis, Tenn.
Bull Brand 43% Protein Cottonseed Meal
Dixie Brand 41% Protein Cottonseed Meal

International Vegetable Oil Co., Inc., Savannah, Ga.
High Grade Cottonseed Meal 41%
High Grade Cottonseed Meal 43%

Spencer Kellogg & Sons, Inc., Buffalo, N. Y.
Castor Pomace
Kellogg's 37% Protein Pure Old Process Linseed Meal

Koppers Products Co., Koppers Building, Pittsburgh, Pa.
Koppers Velvet Lawn — Sulphate of Ammonia — Fertilizer

L. B. Lovitt & Co., Memphis, Tenn.
"Lovit Brand" 41% Cottonseed Meal
"Lovit Brand" 43% Cottonseed Meal

Lowell Fertilizer Co., Boston, Mass.
Lowell 2-10-2 Bone Brand
Lowell 3-10-4 Animal Brand, A High Grade Manure for All Crops
Lowell 4-8-4 Corn and Vegetable
Lowell 4-8-7 Old General Crop Manure for Potatoes and Market Garden Crops
Lowell 4-8-10 Potato Grower
Lowell 5-8-7 Market Garden Manure
Lowell 7-6-6 Top Dressing

Marianna Sales Co., Memphis, Tenn.
White Mule Brand 41% Cottonseed Meal

Millane Nurseries & Tree Experts Co., Cromwell, Conn.
Millane Shade Tree Food 8-8-4

The Miller Fertilizer Co., Baltimore, Md.
Miller's Crop Grower 5-8-7
Miller's Onion & Vegetable 4-8-4
Miller's Superphosphate 16%

Milwaukee Sewerage Commission, Milwaukee, Wis.
Milorganite

Natural Guano Co., Aurora, Ill.
"Sheep's Head" Pulverized Sheep Manure

New England Fertilizer Co., Boston, Mass.
New England 2-10-2 Corn Phosphate
New England 3-10-4 Super A High Grade Fertilizer for All Crops
New England 4-8-4 Potato and Vegetable Manure
New England 4-8-7 Old General Crop Manure for Potato and Market Garden Crops

New England 4-8-10 Complete Manure
New England 5-8-7 Market Garden Manure
New England 5-8-10 Aroostook Special for Potatoes
New England 7-3-7 High Analysis Tobacco
New England Tobacco 6-3-6

N. V. Potash Export My., Inc., Baltimore Branch, 2404 Baltimore Trust Bldg., Baltimore, Md.
Muriate of Potash
Sulphate of Potash

Old Deerfield Fertilizer Co., Inc., So. Deerfield, Mass.
Dry Ground Fish
Old Deerfield 4-6-10 Tobacco Starter
Old Deerfield 5-3-5 Tobacco
Valley Brand 4-8-4
Valley Brand 4-8-7

Olds & Whipple, Inc., Hartford, Conn.
Luxura 5-8-6
O & W 5-3-5 Complete Tobacco Fertilizer
O & W 6-3-6 Blue Label Tobacco Fertilizer
Olds & Whipple's 3-10-4 Corn Special Fertilizer
Olds & Whipple's 4-8-4 Market Garden Fertilizer
Olds & Whipple's 4-8-7 Potato and General Purpose Fertilizer
Olds & Whipple's 5-4-15 High Grade Tobacco Starter & Potash Compound
Olds & Whipple's 5-8-7 High Grade Potato & Vegetable Fertilizer
Olds & Whipple's 8-6-6 Top Dressing and Grass Fertilizer
Olds & Whipple's Bone Meal
Olds & Whipple's Castor Pomace
Olds & Whipple's Cotton Hull Ashes
Olds & Whipple's Dry Ground Fish
Olds & Whipple's Ground Tankage
Olds & Whipple's Nitrate of Potash
Olds & Whipple's Sulphate of Ammonia
Olds & Whipple's Superphosphate
Wilcox 3-10-4 Corn Special Fertilizer
Wilcox 4-8-4 Market Garden Fertilizer
Wilcox 4-8-7 Potato & General Purpose Fertilizer
Wilcox 8-6-6 Top Dresser Fertilizer

Pacific Manure & Fertilizer Co., 429 Davis St., San Francisco, Calif.
Groz-It Brand Pulverized Sheep Manure

Pedigreed Seed Co., Inc., 74 Reade St., New York City
Laguma Special Turf Fertilizer 5-8-6

Piedmont-Mt. Airy Guano Co., Inc., Baltimore, Md.
Piedmont Harvest Brand 4-8-4
Piedmont Harvest Brand 5-8-7
Piedmont Harvest Brand 7-6-6
Piedmont Harvest Brand 16% Superphosphate

Maurice Pincoffs Co., Houston, Texas
Pinco Brand 41% Cottonseed Meal

Plantspur Products Co., Ridgefield, N. J.
Plantspur Fertilizer 3-3-2

Frank S. Platt Co., New Haven, Conn.
Platco Special 4-8-7
Platt's Special Lawn Fertilizer 10-5-5

The Pulverized Manure Co., Chicago, Ill.
Wizard Brand Cattle Manure
Wizard Brand Pulverized Sheep Manure

Premier Poultry Manure Co., 327 South LaSalle St., Chicago, Ill.
Premier Brand Pulverized Poultry Manure
Premier Brand Pulverized Sheep Manure

John Reardon & Sons Co., Cambridge, Mass.
Ground Bone for Fertilizer

The Rogers & Hubbard Co., Portland, Conn.
Golf Course Fertilizer 8-6-2
Gro-Fast Fertilizer 5-6-6
Ground Bone
Hubbard's "Bone Base" Fertilizer for Seeding Down
Hubbard's "Bone Base" Oats and Top Dressing
Hubbard's "Bone Base" Soluble Corn Manure
Hubbard's "Bone Base" Soluble Potato Manure
Hubbard's "Bone Base" Soluble Tobacco Manure
Hubbard's All Soils-All Crops Fertilizer 4-8-4
Hubbard's Climax Tobacco Brand 5-3-5

Hubbard's Corn and Grain Fertilizer 2-12-4
Hubbard's High Potash Fertilizer 2-8-10
Hubbard's Potato Fertilizer 5-8-7
Hubbard's Pure Raw Knuckle Bone Flour
Hubbard's Rose Food 7-10-5
Hubbard's Strictly Pure Fine Bone
Hubbard's Tobacco Grower-Vegetable Formula 6-3-6
Red H Brand 4-8-4 Fertilizer
Red H Brand 4-8-7 Fertilizer
Red H. Brand 5-8-7 Fertilizer
Red H Brand 7-6-6 Fertilizer
Red H Brand 8-16-14 Fertilizer
Sheep and Goat Manure
Superphosphate 16%

F. Rynveld & Sons, 55 West 26th St., New York City

Rynveld's Bone Meal Fertilizer

O. M. Scott & Sons Co., Marysville, Ohio

Scott's Turf Builder 10-6-4

M. L. Shoemaker & Co., Inc., Philadelphia, Pa.

"Swift-Sure" Tobacco & General Use 3-10-3
"Swift-Sure" Tobacco Starter 4-10-0

Springfield Rendering Co., Springfield, Mass.

Springfield 3-10-4 Corn & Grain Fertilizer
Springfield 4-8-4 General Garden Fertilizer
Springfield 4-8-7 Potato & Vegetable Fertilizer
Springfield 4-8-10 Complete Manure
Springfield 5-5-5 Lawn & Shrub Fertilizer
Springfield 5-8-7 Market Garden Fertilizer
Springfield 6-3-6 Tobacco Special Fertilizer
Springfield 7-6-6 Top Dresser

Standard Wholesale Phosphate & Acid Works, Inc., Baltimore, Md.

Champion Nitrate of Soda
Standard United States 2-10-2
Standard United States 3-8-3
Standard United States 3-12-6
Standard United States 4-8-4
Standard United States 4-8-7
Standard United States 4-8-10
Standard United States 5-4-5
Standard United States 5-8-7
Standard United States 5-10-5
Standard United States 7-6-5
Standard United States 9-8-8
Standard United States Ground Animal Tankage
Standard United States Raw Bone Meal
Standard United States Sheep Manure
Standard United States Steamed Bone Meal
Standard United States Sulphate of Ammonia
Standard United States Sulphate of Potash
Standard United States 16% Superphosphate
Standard United States 20% Superphosphate

Summers Fertilizer Co., Inc., Baltimore, Md.

Lane's Sheep Manure (Manufactured for Chas. M. Lane, West Hartford, Conn.)
Summers's "Best On Earth" Brand 3-8-4 Fertilizer
Summers's "Best On Earth" Brand 4-8-4 Fertilizer
Summers's "Best On Earth" Brand 5-4-5 Tobacco Special
Summers's "Best On Earth" Brand 5-8-7 Fertilizer
Summers's "Best On Earth" Brand 8-8-8 Fertilizer
Summers's "Best On Earth" Brand Bone Meal
Summers's "Best On Earth" Brand Ground Fish Meal
Summers's "Best On Earth" Brand Sulphate of Ammonia
Summers's "Best On Earth" Brand 16% Superphosphate
Summers's "Best On Earth" Brand Tankage
Summers's Genuine Venezuelan Goat Manure

Swift & Co., Baltimore, Md.

Swift's Special Golf Fertilizer 12-6-4
Vigoro 4-12-4

Synthetic Nitrogen Products Corp., 285 Madison Ave., New York City

Calcium Nitrate (Nitrate of Lime)
Cal-Nitro 16%
Nitrophoska 15-30-15
Urea (Floranid-Urea)

Tennessee Corp., Lockland, Ohio

Loma (5-10-4)
Soil-Prep (4-2-2)

I. P. Thomas & Son Co., Philadelphia, Pa.

I. P. Thomas 5-8-7 Fertilizer
Long Island Special 4-8-7
16% Superphosphate
Tip Top Fertilizer 3-10-6

Tobacco By-Products & Chemical Corp., Louisville, Ky.

"Black Leaf" Tobacco-Stem Meal

Truempy, Faesy & Besthoff, Inc., 22 East 40th St., New York City

Bone Meal

Virginia-Carolina Chemical Corp., 406 National Marine Bank Bldg., Baltimore, Md.

Bloomaid 5-10-4
Fine Ground Bone
V-C Aroostook Potato Grower 5-8-7
V-C Fairway Fertilizer 8-6-5
V-C National Brand 4-8-10
V-C Owl Brand Fertilizer 2-12-4
V-C 16% Superphosphate
V-C Tip Top Top Dresser 7-6-6
V-C XXXX Fish & Potash 4-8-5

Walker-Gordon Farms, Juliustown, N. J.

Driconure

F. H. Woodruff & Sons, Milford, Conn.

Woodco (10-6-4) Lawn Food

S. D. Woodruff & Sons, Orange, Conn.

Woodruff's Home Mixed Fertilizer 4-8-7

Worcester Rendering Co., Auburn, Mass.

Prosperity All Crops Fertilizer 4-8-4
Prosperity Corn & Grain Fertilizer 2-10-2
Prosperity Market Garden 5-8-7
Prosperity Special Potato Fertilizer 4-8-10
Prosperity Superior Top Dressing 7-6-6

INSPECTION OF 1933

The Station Agent has visited 83 towns and villages in the state and has drawn 379 official samples of fertilizer, including all the registered brands that could be found. The classification of these and of other samples analyzed is given in the summary.

Classification of Fertilizer Materials, 1933

	Number samples	Page
I. *Containing Chiefly Nitrogen*		
Nitrate of soda	13	19
Calcium nitrate	5	20
Calurea	1	19
Urea	1	19
Cyanamid	1	20
Ammonium sulfate	13	19
Castor pomace	18	19
Cottonseed meal	105	19
Linseed meal	13	19
II. *Containing Chiefly Phosphoric Acid*		
Superphosphate	21	24
Precipitated bone phosphate	3	24
III. *Containing Chiefly Potash*		
Carbonate of potash	4	24
Muriate of potash	4	24
Sulfate of potash	9	24
Sulfate of potash and magnesia	1	24
Cottonhull ashes	47	28
IV. *Containing Nitrogen and Potash*		
Nitrate of potash	11	28
Nitrate of potash and soda	1	28
Ground tobacco stems	2	28
V. *Containing Nitrogen and Phosphoric Acid*		
Dry ground fish	40	28
Tankage	14	28
Ground bone	38	28
VI. *Mixed Fertilizers*		
Containing nitrogen and phosphoric acid	9	36
Containing phosphoric acid and potash	2	36
Containing nitrogen, phosphoric acid and potash	204	36
Special and home mixtures	35	54
VII. *Miscellaneous*		
Sheep manure	17	58
Lime	44	58
Other miscellaneous	27	58
Check meals and fertilizers	21	58
Total	724	

I. RAW MATERIALS CHIEFLY VALUABLE FOR NITROGEN

NITRATE OF SODA AND OTHER NITROGENOUS MATERIALS

Analyses of official samples of some materials used as a source of nitrogen are given in Tables 1 and 2. Unofficial samples are not listed.

Four of the six samples of nitrate of soda examined were distinctly under the minimum guaranty of 16 per cent. Seven unofficial samples were examined for purchasers. On one of these we found 15.60 per cent of nitrogen as compared with the guaranty of 16 per cent. A commercial chemist, to whom a portion of our sample was sent on request of the manufacturer, reported 15.96 per cent. A second portion was submitted to the experiment station of a neighboring State and a figure of 15.67 per cent was reported to us.

The one official sample of calurea examined likewise was found to be low in nitrogen. Portions of this sample were sent to two commercial laboratories who reported results that were 0.5 to 0.7 per cent higher than our figure of 32.96 per cent. The tonnage in this case was small and the adjustment involved not very considerable. It is evident that in spite of the unsatisfactory checks on the sample that the goods on the *as is* basis, did not satisfy the guaranty of 34 per cent. On the moisture free basis one of the analyses exceeded 34 per cent; the other two did not.

The sample of urea examined was also below guaranty. On the moisture free basis however, the guaranty was met.

Of the samples of ammonium sulfate Nos. 2344 and 2659 were notably deficient. No. 2591 was slightly low.

VEGETABLE PRODUCTS USED AS SOURCES OF NITROGEN

Analyses of castor pomace, cottonseed and linseed meals are given in Tables 3 and 4. Only official samples are listed. Ten unofficial samples of castor pomace, 11 of linseed meal, and 99 of cottonseed meal were analyzed for purchasers.

TABLE 1. ANALYSES OF NITRATE OF SODA AND OTHER NITROGENOUS MATERIALS

Station No.	Manufacturer or jobber	Sampled from stock of	Per cent nitrogen Found	Per cent nitrogen Guaranteed
	Nitrate of Soda			
2336	Apothecaries Hall Co., Waterbury	J. B. McArdle, Greenwich	15.50	16.00
2663	Champion. Associated Seed Growers, Inc., New Haven	Factory, Milford	15.84	16.00
2335	Arcadian. The Barrett Co., New York City	Davis Grain Co., Noroton	15.96	16.00
2774	Arcadian. The Barrett Co., New York City	Tobacco Station, Windsor	16.08	16.00
2332	Champion. Chilian Nitrate Sales Corp., New York City	T. W. Ryan, Stratford	15.70	16.00
2939	Champion. Standard Wholesale Phosphate & Acid Works, Inc., Baltimore, Md.	Jos. Adams, Westport	15.84	16.00
	Calcium Nitrate (Nitrate of Lime)			
2584	Synthetic Nitrogen Products Corp., New York City	Olds & Whipple, Inc., East Hartford	14.94	15.00
2768	Cal-Nitro 16%. Synthetic Nitrogen Products Co., New York City	Chester Beeman, Granby	16.16	16.00
	Calurea			
2873	Eastern States Farmers' Exchange, Springfield Mass.	E. D. Woolam, Warehouse Point	32.96[1]	34.00
	Urea			
2817	Eastern States Farmers' Exchange, Springfield Mass.	Paul Caldwell, New Milford	45.10[2]	46.00
	Cyanamid			
2337	Aero. American Cyanamid Co., New York City	H. D. Peters, Highwood	22.00	22.00

[1]Moisture 1.58 per cent; insoluble in water 0.80 per cent.
[2]Moisture 1.94 per cent.

TABLE 2. ANALYSES OF SULFATE OF AMMONIA

Station No.	Manufacturer or jobber	Sampled from stock of	Per cent nitrogen Found	Per cent nitrogen Guaranteed
2343	American Agricultural Chemical Co., West Haven	Factory, West Haven	20.82	20.56
2339	Arcadian. The Barrett Co., New York City	H. D. Peters, Highwood	20.64	20.56
2583	The Barrett Co., New York City	Valley Grain Co., Stafford Springs	20.64	20.56
2700	Berkshire Chemical Co., Bridgeport	H. E. Meeker, Danbury	20.76	20.56
2333	Consolidated Rendering Co., Boston, Mass.	L. T. Frisbie Co., New Haven	20.88	20.50
2593	Eastern States. Eastern States Farmers' Exchange, Springfield, Mass.	E. D. Woolam, Warehouse Point	20.84	20.50
2694	Ford. Ford Motor Co., Dearborn, Mich.	O'Meara Motor Co., East Hartford	20.88	20.80
2591	Koppers Velvet Lawn. Koppers Products Co., Pittsburgh, Pa.	Cadwell & Jones, Hartford	20.60	20.75
2342	Olds & Whipple's. Olds & Whipple, Inc., Hartford	Factory, Hartford	20.56	20.56
2334	Standard Wholesale Phosphate & Acid Works, Baltimore, Md.	Rippe Bros., Westport	19.20	20.56
2659	Summers's "Best on Earth." Summers Fertilizer Co., Baltimore, Md.	Rackliffe Bros., New Britain	18.97	20.56

TABLE 3. ANALYSES OF CASTOR POMACE

Station No.	Manufacturer or jobber	Sampled from stock of	Per cent nitrogen	
			Found	Guaranteed
2344	American Agricultural Chemical Co., West Haven	Factory, West Haven	4.62	4.53
2338	Apothecaries Hall Co., Waterbury	H. D. Peters, Highwood ...	5.17	4.52
2836	Baker Castor Oil Co., New York City	Mohn Bros., Warehouse Point	6.00	4.50
2331	Berkshire. Berkshire Chemical Co., Bridgeport	T. W. Ryan, Stratford	4.69	4.50
2740	Consolidated Rendering Co., Boston, Mass.	A. E. Shedd, Norwich	5.70	4.52
2652	Eastern States. Eastern States Farmers' Exchange, Springfield, Mass.	E. D. Woolam, Warehouse Point	4.63	4.50
2340	Kellogg's. Spencer Kellogg & Sons, Inc., Buffalo, N.Y.	Chas. C. Hart Seed Co., Wethersfield	5.79	4.52
2341	Olds & Whipple, Inc., Hartford	Factory, Hartford	4.88	4.50

TABLE 4. ANALYSES OF COTTONSEED MEAL AND LINSEED MEAL

Station No.	Manufacturer or jobber	Sampled from stock of	Per cent nitrogen	
			Found	Guaranteed
	Cottonseed Meal			
2874	Helmet Brand. Ashcraft-Wilkinson Co., Atlanta, Ga. ..	E. J. Bantle, Glastonbury..	6.68	6.58
2850	Bull Brand 43%. Humphreys-Godwin Co., Memphis, Tenn.	David McComb, Suffield...	6.64	6.88
2754	Dixie Brand 41%. Humphreys-Godwin Co., Memphis, Tenn.	Henry Cybulski, Somers ..	6.63	6.56
2830	"Lovit Brand" 41%. L. B. Lovitt & Co., Memphis, Tenn.	H. H. McKnight, Ellington	6.62	6.56
2764	"Lovit Brand" 43%. L. B. Lovitt & Co., Memphis, Tenn.	E. D. Woolam, Warehouse Point	6.91	6.88
2871	White Mule Brand 41% Cottonseed Meal. Marianna Sales Co., Memphis, Tenn.	Paul Caldwell, New Milford	6.65	6.58
	Linseed Meal			
3177	Apothecaries Hall Co., Waterbury	Factory, East Hartford	5.56	4.50
2735	Old Process. Spencer Kellogg & Sons, Inc., Buffalo, N. Y.	Hatheway & Steane, Inc., West Suffield	6.22	5.92

II. RAW MATERIALS CHIEFLY VALUABLE FOR PHOSPHORIC ACID

SUPERPHOSPHATE

Superphosphate is a raw material of basic importance in the fertilizer industry. It is made by a process originated by Liebig in 1840. In the United States superphosphate is made by treating phosphate rock with sulfuric acid. The finished product contains 16 per cent of available phosphoric acid. "Double superphosphate" is a similar product made by so treating phosphate rock that practically all of the calcium is converted into mono-calcium phosphate. Double phosphate contains 32 per cent of available phosphoric acid.

Analyses are given in Table 5.

PRECIPITATED BONE PHOSPHATE

Precipitated bone phosphate is made by dissolving the phosphate of bones in hydrochloric acid and neutralizing the acid solution with calcium hydroxide. The precipitated phosphate is largely dicalcium phosphate insoluble in water but soluble in ammonium citrate and hence classed as available phosphoric acid. Precipitated phosphate may be made from rock phosphate by a similar process. All of the samples of superphosphate, double superphosphate and precipitated bone phosphate met or exceeded guaranties.

Analyses are given in Table 5.

III. RAW MATERIALS CHIEFLY VALUABLE FOR POTASH

POTASH SALTS

Potash in mixed fertilizers is usually derived from carbonate of potash (62—65 per cent K_2O), muriate of potash (48—50 per cent K_2O), sulphate of potash (48—50 per cent K_2O), or double sulphate of potash and magnesia (25 per cent K_2O). The chlorine content of the sulfate and the double sulfate should not exceed 2.5 per cent.

Analyses of official samples of these materials are given in Table 6. All met or exceeded guaranties.

TABLE 5. ANALYSES OF SUPERPHOSPHATE (ACID PHOSPHATE), ETC.

Station No.	Manufacturer or wholesale dealer	Dealer or purchaser	Phosphoric acid: Citrate insoluble	Phosphoric acid: Total	Phosphoric acid: "Available": Found	Phosphoric acid: "Available": Guaranteed
			%	%	%	%
	Superphosphate					
2514	AA 16%. American Agricultural Chemical Co., West Haven	Geo. S. Phelps & Co., Thompsonville	0.82	16.95	16.13	16.00
2528	Apothecaries Hall Co., Waterbury	Cheshire Reformatory, Cheshire	0.42	17.34	16.92	16.00
2461	Apothecaries Hall Co., Waterbury	H. D. Peters, Highwood	0.55	19.11	18.56	18.00
2690	Armour's Big Crop Fertilizers 16%. Armour Fertilizer Works, New York City	Geo. S. Phelps & Co., Thompsonville	0.25	16.79	16.54	16.00
2771	Associated Seed Growers, Inc., New Haven	Dan Smith, Milford	0.28	17.18	16.90	16.00
2421	Berkshire 16%. Berkshire Chemical Co., Bridgeport	T. W. Ryan, Stratford	0.27	17.43	17.16	16.00
2443	Consolidated Rendering Co., Boston, Mass.	L. T. Frisbie Co., New Haven	0.07	18.28	18.21	16.00
2555	Eastern States 16%. Eastern States Farmers' Exchange, Springfield, Mass.	A. L. Lockwood, Clinton	0.93	17.50	16.57	16.00
2753	Eastern States 32%. Eastern States Farmers' Exchange, Springfield, Mass.	O. D. Tuller, West Simsbury	0.26	32.32	32.06	32.00
2522	Miller's 16%. Miller Fertilizer Co., Baltimore, Md.	C. A. Cowles, Plantsville	0.41	16.93	16.52	16.00
2484	Olds & Whipple's. Olds & Whipple, Inc., Hartford	Julius Lewis, Southington	0.20	19.17	18.97	16.00

TABLE 5. ANALYSES OF SUPERPHOSPHATE (ACID PHOSPHATE), ETC.—(*Concluded*)

Station No.	Manufacturer or wholesale dealer	Dealer or purchaser	Phosphoric acid: Citrate-insoluble	Phosphoric acid: Total	Phosphoric acid: "Available" Found	Phosphoric acid: "Available" Guaranteed
	Superphosphate—Concluded					
2531	The Rogers & Hubbard Co., Portland	Factory, Portland	0.55	17.26	16.71	16.00
2699	Standard United States 16%. Standard Wholesale Phosphate & Acid Works, Inc., Baltimore, Md.	F. C. Benjamin, Danbury	0.96	17.94	16.98	16.00
1393[1]	Summers's 16-20. Summers Fertilizer Co., Baltimore, Md.	Ben Webster, Litchfield	3.12	20.42	17.30	16.00
2565	Summers's "Best-On-Earth" 16%. Summers Fertilizer Co., Baltimore, Md.	Chas. Peabody, New London	3.65	20.37	16.72	16.00
2551	I. P. Thomas & Son, Philadelphia, Pa. ...	Fred C. Morse & Son, Guilford	0.40	17.84	17.44	16.00
2681	V-C 16%. Virginia-Carolina Chemical Co., Baltimore, Md.	P. Levson & Son, Middletown	2.35	18.50	16.15	16.00
	Precipitated Bone Phosphate					
2654	Apothecaries Hall Co., Waterbury	Factory, East Windsor	0.82	42.24	41.42	36.00
2686	Eastern States. Eastern States Farmers' Exchange, Springfield, Mass.	H. H. McKnight, Ellington	0.42	41.80	41.38	38.00

[1]Late registration for 1932, represents last year's stock.

TABLE 6. ANALYSES OF POTASH SALTS

Station No.	Manufacturer or jobber	Sampled from stock of	Potash: Found	Potash: Guaranteed
			%	%
	Carbonate of Potash			
2926	Apothecaries Hall Co., Waterbury	Factory, East Windsor	66.56	60.00
	Muriate of Potash			
2553	American Agricultural Chemical Co., West Haven	Factory, West Haven	48.82	50.00
2696	Eastern States. Eastern States Farmers' Exchange, Springfield, Mass.	Paul W. Caldwell, New Milford	51.56	50.00
2423	N. V. Potash Export My., Inc., Baltimore, Md.	T. W. Ryan, Stratford	51.08	48.00
	Sulfate of Potash			
2592	Eastern States. Eastern States Farmers' Exchange, Springfield, Mass.	E. D. Woolam, Warehouse Point	50.22	48.00
2517	N. V. Potash Export My., Inc., Baltimore, Md.	Geo. S. Phelps & Co., Thompsonville	49.31	48.00
2687	Standard Wholesale Phosphate & Acid Works, Baltimore, Md.	H. H. McKnight, Ellington	48.95	48.00
	Sulfate of Potash and Magnesia			
3175	Apothecaries Hall Co., Waterbury	Factory, East Windsor	26.75	26.00

COTTONHULL ASHES

Ashes of cottonhulls are used to a considerable extent in fertilizer mixtures for tobacco. They are quite variable in composition and are sold on a unit basis. Official samples examined this year continued from 18 to nearly 40 per cent of actual potash. Only four official samples were drawn; but 42 samples were examined for purchasers.

Analyses of official samples are given in Table 7.

IV. RAW MATERIALS CONTAINING NITROGEN AND POTASH

Official samples of materials of this group have been confined to 3 samples of nitrate of potash and one of tobacco stems. A number of others, including one of nitrate of potash and soda, have been examined for purchasers. One official sample of nitrate of potash, 3176, was somewhat below guaranty in both of the guaranteed items of plant food.

Analyses are given in Table 8.

V. RAW MATERIALS CONTAINING NITROGEN AND PHOSPHORIC ACID

FISH, TANKAGE, BONE

Dry ground fish will contain 8 per cent or more of nitrogen and 5 to 6 per cent of phosphoric acid.

All of the official samples of this material were of satisfactory quality and met or exceeded guaranties. Thirty-three unofficial samples were analyzed.

Chlorine content ranged from .08 to .25 per cent.

Analyses of official samples are given in Table 9.

Ten official samples of tankage were analyzed two of which were low grade but met their guaranties. Two samples, 2702 and 3081, failed to meet the guaranty of 8 per cent nitrogen by considerable amounts.

Analyses are given in Table 10. Four unofficial samples are not included.

Nineteen official samples of ground bone were analyzed, and a like number were examined for purchasers. All samples met or considerably exceeded the guaranteed content of nitrogen; and only two were considerably deficient in phosphoric acid.

Two of the unofficial samples contained calcium carbonate, but the amount was such as to suggest accidental contamination rather than adulteration.

Analyses of official samples are given in Table 11.

Table 7. Analyses of Cottonhull Ashes

Station No.	Manufacturer or wholesale dealer	Sampled from stock of	Phosphoric acid	Potash
			%	%
2656	Apothecaries Hall Co., Waterbury	Factory, East Windsor	2.25	36.55
2595	Ed. Eggert, Hartford	Hatheway & Steane, Inc., West Suffield	2.07	18.21
2596	Ed. Eggert, Hartford	Hatheway & Steane, Inc., West Suffield	1.98	20.54
2544	Olds & Whipple's, Olds & Whipple, Inc., Hartford ..	Factory, Hartford	2.22	39.63

TABLE 8. ANALYSES OF NITRATE OF POTASH, ETC.

Station No.	Manufacturer	Sampled from stock of	Nitrogen Found	Nitrogen Guaranteed	Potash Found	Potash Guaranteed
			%	%	%	%
	Nitrate of Potash					
3176	Apothecaries Hall Co., Waterbury	Factory, East Windsor	12.80	13.00	43.74	44.00
2653	Eastern States Farmers' Exchange, Springfield, Mass.	E. D. Woolam, Warehouse Point	12.92	13.00	44.42	44.00
2545	Olds & Whipple's. Olds & Whipple, Inc., Hartford	Factory, Hartford	13.92	13.00	44.58	44.00
	Ground Tobacco Stems					
2549	Black Leaf Tobacco Stem Meal. Tobacco By-Products & Chemical Corp., Louisville, Ky.	Olds & Whipple, Inc., East Hartford ..	1.50	1.16	4.79	4.00

TABLE 9. ANALYSES OF DRY GROUND FISH

Station No.	Manufacturer or wholesale dealer	Sampled from stock of	Nitrogen Total found	Nitrogen Total guaranteed	Phosphoric acid Total found	Phosphoric acid Total guaranteed	Chlorine
			%	%	%	%	%
2515	American Agricultural Chemical Co., West Haven	Geo. S. Phelps & Co., Thompsonville	9.04	9.00	8.44	6.00	0.08
2655	Apothecaries Hall Co., Waterbury	Factory, East Windsor	9.24	8.22	7.13	5.00	0.08
2420	Berkshire. Berkshire Chemical Co., Bridgeport	T. W. Ryan, Stratford	9.35	9.04	6.17	6.00	0.14
2750	Eastern States. Eastern States Farmers' Exchange, Springfield, Mass.	E. W. Woolam, Warehouse Point	9.50	9.00	8.55	6.00	0.25
2876	Old Deerfield Fertilizer Co., So. Deerfield, Mass.	L. B. Haas, Hazardville	9.12	9.05	8.24	5.00	0.15
2543	Olds & Whipple, Inc., Hartford	Factory, Hartford	9.94	9.00	7.00	5.00	0.16
2692	Summers's "Best-On-Earth." Summers Fertilizer Co., Baltimore, Md.	John Leonard, East Hartford	9.03	9.00	7.88	6.86	0.22

TABLE 10. ANALYSES OF TANKAGE AND SIMILAR MATERIALS

Station No.	Manufacturer	Sampled from stock of	Nitrogen		Phosphoric acid		Mechanical analysis		Station No.
			Total found	Total guaranteed	Total found	Total guaranteed	Finer than 1-50 inch	Coarser than 1-50 inch	
			%	%	%	%	%	%	
2820	Apothecaries Hall Co., Waterbury	J. A. Glassnapp, West Cheshire	4.12	3.29	20.92	20.00	58.1	41.9	2820
2460	Apothecaries Hall Co., Waterbury	H. D. Peters, Highwood	8.68	7.40	10.31	3.00	34.6	65.4	2460
2441	The Connecticut Fat Rendering & Fertilizer Corp., West Haven	Factory, West Haven	4.17	3.29	21.92	22.88	53.3	46.7	2441
2828	Consolidated Rendering Co., Boston, Mass.	John Luginbuhl, Ellington	10.03	7.41	8.26	9.15	25.6	74.4	2828
2432	Consolidated Rendering Co., Boston, Mass.	Paul M. Hubbard & Co., Bristol	7.26	7.41	8.45	9.15	57.0	43.0	2432
2442	Consolidated Rendering Co., Boston, Mass.	L. T. Frisbie Co., New Haven	7.67	7.41	9.90	9.15	40.5	59.5	2442
2709	Olds & Whipple's. Olds & Whipple, Inc., Hartford	J. B. Lewis, Southington	10.12	7.40	8.19	9.15	30.4	69.6	2709
2676	Standard United States. Standard Wholesale Phosphate & Acid Works, Inc., Baltimore, Md.	Rackliffe Bros., New Britain	6.26	6.00	11.37	9.15	46.8	53.2	2676
2702	Summers's "Best On Earth." Summers Fertilizer Co., Baltimore, Md.	Chas. M. Lane, West Hartford	7.30	8.00	6.72	4.57	36.6	63.4	2702
3081	Summers's "Best On Earth." Summers Fertilizer Co., Baltimore, Md.	Chas. M. Lane, West Hartford	7.37	8.00	7.16	4.57	37.4	62.6	3081

TABLE 11. ANALYSES OF GROUND BONE

Station No.	Manufacturer	Sampled from stock of	Nitrogen		Phosphoric acid		Mechanical analysis		Station No.
			Total found	Total guaranteed	Total found	Total guaranteed	Finer than 1-50 inch	Coarser than 1-50 inch	
			%	%	%	%	%	%	
2447	Fine Ground. American Agricultural Chemical Co., West Haven	F. H. Woodruff & Sons, Milford	2.68	2.47	24.09	23.00	68.0	32.0	2447
2459	Apothecaries Hall Co., Waterbury	H. D. Peters, Highwood	4.26	3.29	23.01	20.00	57.5	42.5	2459
2815	Armour's. Armour Fertilizer Works, New York City	Silliman Hardware Co., New Canaan	3.24	2.47	24.28	22.00	67.5	32.5	2815
2870	Armour's Raw. Armour Fertilizer Works, New York City	Silliman Hardware Co., New Canaan	3.73	3.70	18.98	20.00	35.7	64.3	2870
2538	Berkshire Fine Ground. Berkshire Fertilizer Co., Bridgeport	Seymour Grain & Coal Co., Seymour	3.02	2.47	23.40	20.00	57.7	42.3	2538
2481	Ground Bone. Consolidated Rendering Co., Boston, Mass.	Davis Grain Co., Noroton	4.04	2.05	23.38	22.90	51.1	48.9	2481
2748	Eastern States Ground Steamed. Eastern States Farmers' Exchange, Springfield, Mass.	J. E. Stoddard, Abington	3.40	2.50	24.32	23.00	54.7	45.3	2748
2761	Frisbie's Fine Bone. L. T. Frisbie Co., New Haven	Frank S. Platt Co., New Haven	4.19	3.28	23.90	22.00	29.5	70.5	2761
2547	Olds & Whipple's. Olds & Whipple, Inc., Hartford	Factory, Hartford	3.24	2.47	22.81	22.00	57.9	42.1	2547
2569	Ground Bone. John Reardon & Sons Co., Cambridge, Mass.	Norwich Grain Co., Norwich	4.13	2.47	22.05	22.88	57.4	42.6	2569

TABLE 11. ANALYSES OF GROUND BONE—(*Continued*)

Station No.	Manufacturer	Sampled from stock of	Nitrogen		Phosphoric acid		Mechanical analysis		Station No.
			Total found	Total guaranteed	Total found	Total guaranteed	Finer than 1-50 inch	Coarser than 1-50 inch	
			%	%	%	%	%	%	
2535	Ground Bone. The Rogers & Hubbard Co., Portland	Chas. C. Hart Seed Co., Wethersfield	2.94	2.47	23.43	22.85	72.4	27.6	2535
2587	Hubbard's Pure Raw Knuckle Bone Flour. The Rogers & Hubbard Co., Portland	Cadwell & Jones, Hartford	3.84	3.69	26.56	24.70	83.8	16.2	2587
2590	Hubbard's Strictly Pure Fine Bone. The Rogers & Hubbard Co., Portland	Cadwell & Jones, Hartford	3.70	3.29	26.18	20.50	56.3	43.7	2590
2814	Rynveld's Bone Meal Fertz. F. Rynveld & Sons, New York City	F. W. Woolworth, New Haven	2.74	1.85	22.95	22.88	70.3	29.7	2814
2685	Standard United States Raw. Standard Wholesale Phosphate & Acid Works, Inc., Baltimore, Md.	H. H. McKnight, Ellington	3.85	3.70	22.58	22.00	39.7	60.3	2685
2698	Standard United States Steamed. Standard Wholesale Phosphate & Acid Works, Inc., Baltimore, Md.	F. C. Benjamin, Danbury	2.92	2.47	22.35	22.00	52.7	47.3	2698
2658	Summers's "Best On Earth." Summers Fertilizer Co., Baltimore, Md.	Stanley Svea Coal Co., New Britain	4.37	4.00	23.64	22.88	42.9	57.1	2658
2878	Truempy, Faesy & Besthoff, New York City	Washington Supply Co., Washington Depot	3.00	2.40	22.24	22.50	64.8	35.2	2878
2541	Fine Ground. Virginia-Carolina Chemical Co., Baltimore, Md.	Thomaston Supply Co., Thomaston	2.78	2.47	23.22	23.00	72.5	27.5	2541

VI. MIXED FERTILIZERS

(A) MIXTURES SUPPLYING NITROGEN AND PHOSPHORIC ACID

Four official samples of this type were examined. Five samples were examined for a purchaser.

2548. Ammo-Phos, 11-48-0. American Cyanamid Co., New York City. Stock of Olds & Whipple, Inc., East Hartford, Conn.

2585. Ammo-Phos, 16-20-0. American Cyanamid Co., New York City. Stock of Olds & Whipple, Inc., East Hartford, Conn.

2490. Liberty Special Fertilizer for Lawns, Gardens, Flowers, Shrubs, Trees, 4-4-0. Apothecaries Hall Co., Waterbury, Conn. Stock of J. B. McArdle, Greenwich.

2513. "Swift-Sure" Tobacco Starter 4-10-0. M. L. Shoemaker & Co., Philadelphia, Pa. Stock of Spencer Bros., Suffield.

The analyses were as follows.

	2548	2585	2490	2513
	%	%	%	%
Nitrogen found	10.97	16.00	4.38	4.12
guaranteed	11.00	16.00	4.00	4.00
Available P_2O_5 found	48.00	20.73	8.76	10.12
guaranteed	48.00	20.00	4.00	10.00
Water-insoluble organic nitrogen	0.47	0.26	3.72	1.06
Activity water-insoluble organic nitrogen, alkaline method	100.00	——	64.80	67.60

(B) MIXTURE SUPPLYING PHOSPHORIC ACID AND POTASH

One official sample of this class was analyzed. One sample was examined for a purchaser.

2755. Eastern States 0-14-6. Eastern States Farmers' Exchange, Springfield, Mass. Stock of Chester Beeman, Granby. It contained 14.98 per cent of available phosphoric acid and 5.86 per cent of potash.

(C) MIXTURES SUPPLYING NITROGEN, PHOSPHORIC ACID AND POTASH

In this group there are 194 official samples of registered brands. Analyses are given in Table 12. Groups a, b and c may be summarized as follows:

Total number of samples		199
Samples deficient in:		
one item	39	
two items	8	
three items	0	47
Percentage of samples failing to meet guaranties in all respects		24
Total guaranties made		592
Guaranties not met:		
nitrogen	28	
available phosphoric acid	12	
potash	17	57
Guaranties substantially met or exceeded		535
Percentage of guaranties met		90
Samples showing commercial deficiencies exceeding $1.00 per ton		6
Percentage of samples deficient by more than $1.00 per ton		3

These data show that 24 per cent of the samples analyzed failed to meet guaranties for all of the three items of plant food guaranteed. Most of the samples were deficient in only one item; none were deficient in all three. Seventy-six per cent of the samples examined met guaranties in all respects. Of total guaranties made 90 per cent were substantially met or exceeded.

In those samples showing deficiencies the approximate commercial value represented exceeded $1.00 per ton in only 6 cases, or 3 per cent of the total number of samples analyzed. This estimate is based on valuations for nitrogen, available phosphoric acid and potash of 12 cents, 4 cents and 5 cents respectively; and shortages in one item are balanced against overages in another.

In spite of the generally satisfactory condition shown by this summary the reader will probably be chiefly impressed by the fact that only about three-fourths of the samples examined are found to meet their guaranties in all of the three items of plant food guaranteed. A study of similar data for the past 10 years shows, however, that marked improvement has been made in this particular and in other features summarized.

In 1923 the inspection showed that of 261 samples analyzed only 55 per cent met or exceeded guaranties in all particulars as compared with 76 per cent in 1933. In 1923 also the commercial values represented by deficiencies exceeded $1.00 per ton in 17 per cent of the samples analyzed as compared with 3 per cent in 1933. The improvement in these two respects has been progressive and notably consistent during this interval as shown by the following tabulation.

Year	Total number of samples	Substantially meeting guaranties in N, P_2O_5 and K_2O	Showing commercial deficiencies of $1.00 or more per ton
		%	%
1923	261	55	17
1924	282	60	7
1925	255	67	13
1926	247	66	11
1927	243	68	7
1928	250	71	13
1929	239	72	9
1930	236	80	3
1931	235	74	3
1932	222	76	3
1933	199	76	3

The distribution of chemical deficiencies found in the inspection this year is given in Table 12*a*. Mixed fertilizers of groups a, b and c are included. Samples showing commercial deficiencies estimated at $1.00 or more per ton are as follows.

2560	Standard Wholesale Phosphate & Acid Works	$3.33
2968	Standard Wholesale Phosphate & Acid Works	3.40
2454	Standard Wholesale Phosphate & Acid Works	1.30
2510	Swift & Co., 12-6-4	2.66
3318	Swift & Co., 12-6-4	1.47
2747	Synthetic Nitrogen Products Corp	1.78

Similar data compiled for the period 1921—1933 are given in Table 12*b*.

TABLE 12. ANALYSES OF MIXED FERTILIZER CONTAINING NITROGEN, PHOSPHORIC ACID AND POTASH

Station No.	Manufacturer and brand	Place of sampling	Nitrogen					Phosphoric acid			Potash		Station No.
			In nitrates	In ammonia	Organic water-soluble	Organic water-insoluble	Total	Citrate-insoluble	Total	So-called "Available"	As muriate	Total	
			%	%	%	%	%	%	%	%	%	%	
	American Agricultural Chemical Co., West Haven, Conn.												
2431	AA Aroostook Potato Manure 5-8-7	Milford	0.00	4.42	0.16	0.46	5.04	0.59	8.66	8.07	7.39	7.39	2431
2574	AA Corn Favorite 3-10-4	Lebanon	0.00	2.70	0.11	0.36	3.17	0.58	11.02	10.44	4.30	4.30	2574
2500	AA General Crop Fertilizer 2-10-2	Meriden	0.00	1.72	0.01	0.35	2.08	0.71	11.14	10.43	2.23	2.23	2500
2847	AA Hi Grade Tobacco Manure 6-3-6	Windsor	0.55	0.56	1.20	3.47	5.78	0.21	3.66	3.45	0.62	6.59	2847
3268	AA Hi Grade Tobacco Manure 6-3-6	West Haven	0.58	0.42	1.08	3.74	5.82	0.22	3.32	3.10	0.36	6.12	3268
2446	AA Monarch Fertilizer 4-8-4	Milford	0.00	3.42	0.20	0.51	4.13	0.55	8.98	8.43	4.16	4.16	2446
2501	AA Peerless Fertilizer 4-8-7	Meriden	0.00	3.42	0.17	0.57	4.16	0.57	8.92	8.35	6.80	6.80	2501
2492	AA Prolific 10% Potash Fertilizer, 2-8-10	North Haven	0.00	1.76	0.11	0.25	2.12	0.40	8.83	8.43	9.89	9.89	2492
2853	AA Tobacco Starter 5-5-15	Suffield	0.67	2.42	0.82	1.05	4.96	0.27	5.88	5.61	1.14	15.02	2853
2504	AA Top Dresser 7-6-6	New Britain	0.53	6.28	0.12	0.45	7.38	0.40	7.10	6.70	5.98	5.98	2504
2552	Agrico for Aroostook 5-8-7	Guilford	0.00	4.54	0.00	0.48	5.02	0.55	9.24	8.69	7.31	7.31	2552
2571	Agrico for Corn 3-10-6	Norwich	0.00	2.64	0.05	0.43	3.12	0.79	11.39	10.60	5.91	5.91	2571
2502	Agrico for Lawns, Trees and Shrubs 7-6-6	Meriden	0.31	6.00	0.16	0.43	6.90	0.38	7.15	6.77	6.00	6.00	2502
2892	Agrico for Lawns, Trees and Shrubs 7-6-6	Bloomfield	0.27	6.62	0.16	0.48	7.53	0.44	6.97	6.53	5.66	5.66	2892
2922	Agrico for Lawns, Trees and Shrubs 7-6-6	West Haven	0.24	6.06	0.18	0.32	6.80	0.32	6.65	6.33	5.81	5.81	2922
2923	Agrico for Lawns, Trees and Shrubs 7-6-6	Meriden	0.30	6.16	0.08	0.40	6.94	0.43	7.10	6.67	5.93	5.93	2923
2503	Agrico for New England 4-8-10	New Britain	0.00	3.36	0.18	0.49	4.03	0.32	9.03	8.71	10.29	10.29	2503
2491	Agrico for Truck 4-10-5	North Haven	0.00	3.36	0.18	0.46	4.00	0.70	10.98	10.28	5.22	5.22	2491
2524	Bowker's Market Garden Fertilizer 4-8-4	Plantsville	0.00	3.36	0.12	0.53	4.01	0.48	8.81	8.33	4.07	4.07	2524
2770	Bowker's Stockbridge Early Crop Manure 5-8-7	West Haven	0.38	3.16	1.08	0.38	5.00	0.48	9.30	8.82	6.93	6.93	2770
2433	Bradley's Blood Bone and Potash Brand 5-8-7	Plantsville	0.08	4.48	0.00	0.47	5.03	0.60	9.05	8.45	6.90	6.90	2433
2512	Bradley's XL Fertilizer 3-10-4	Windsor Locks	0.00	2.78	0.10	0.42	3.30	0.54	11.09	10.55	4.72	4.72	2512
2823	Double A Tobacco Fertilizer 5-3-5	Thompsonville	0.52	0.64	0.84	2.74	4.74	0.19	3.27	3.08	0.41	4.63	2823
3269	Double A Tobacco Fertilizer 5-3-5	West Haven	0.77	1.06	0.62	2.73	5.18	0.28	3.52	3.24	0.25	4.94	3269
2848	Sanderson Formula B 4-8-7 (Potash Derived from Sulfate)	Windsor	0.29	1.94	0.82	1.25	4.30	0.59	10.17	9.58	1.14	6.63	2848
3267	Sanderson Formula B 4-8-7 (Potash Derived from Sulfate)	West Haven	0.00	3.54	0.17	0.45	4.16	0.43	8.67	8.24	0.72	6.90	3267
	Apothecaries Hall Co., Waterbury, Conn.												
3180	Liberty Corn 2-10-2	East Windsor	0.28	1.44	0.34	0.55	2.61	0.72	10.91	10.19	3.12	3.12	3180
3179	Liberty Fish Bone and Potash 3-10-4	East Windsor	1.39	1.34	0.22	0.38	3.33	0.36	10.59	10.23	4.22	4.22	3179
2489	Liberty High Grade Corn 2-12-4	Greenwich	0.00	1.66	0.36	0.48	2.50	0.35	12.51	12.16	4.61	4.61	2489
2462	Liberty High Grade Market Gardeners 5-8-7	Highwood	1.31	2.28	0.58	0.93	5.10	0.26	8.05	7.79	8.08	8.08	2462
2925	Liberty High Grade Tobacco Manure 6-3-7	East Windsor	1.46	0.04	0.60	4.40	6.50	0.15	5.39	5.24	0.60	7.60	2925
2488	Liberty Market Gardeners Special 4-8-4	Greenwich	1.22	1.08	0.92	1.09	4.31	0.64	9.61	8.97	4.16	4.16	2488
2749	Liberty Onion Special (Potash Derived from Sulfate) 4-8-7	East Windsor	0.38	2.56	0.64	0.83	4.41	1.11	13.29	12.18	0.58	7.40	2749
3178	Liberty Potato and General Crop 4-8-10	East Windsor	0.21	2.54	0.30	1.13	4.18	0.57	8.25	7.68	10.51	10.51	3178
3181	Liberty Potato and Market Gardeners (Potash as Muriate) 4-8-7	East Windsor	1.08	2.54	0.32	0.22	4.16	0.57	8.46	7.89	7.84	7.84	3181
2572	Liberty Special Fertilizer for Fruit 7-8-6	Yantic	4.06	2.12	0.22	0.90	7.30	0.68	9.68	9.00	4.09	6.96	2572
2573	Liberty Top Dresser for Grass and Grain 8-8-8	Yantic	[illegible]	[illegible]	[illegible]	2.13	8.34	0.15	8.74	8.59	8.52	8.52	2573

TABLE 12. ANALYSES OF MIXED FERTILIZER CONTAINING NITROGEN, PHOSPHORIC ACID AND POTASH

Station No.	Manufacturer and brand	Place of sampling	Nitrogen: In nitrates	Nitrogen: In ammonia	Nitrogen: Organic water-soluble	Nitrogen: Organic water-insoluble	Nitrogen: Total	Phosphoric acid: Citrate-insoluble	Phosphoric acid: Total	Phosphoric acid: So-called "Available"	Potash: As muriate	Potash: Total	Station No.
			%	%	%	%	%	%	%	%	%	%	
	Armour Fertilizer Works, New York City												
2689	Armour's Big Crop Fertilizers 4-8-4	Thompsonville	0.34	3.00	0.12	0.35	**3.81**	0.42	8.29	**7.87**	4.13	**4.13**	**2689**
2742	Armour's Big Crop Fertilizers 5-8-7	Colchester	0.81	3.40	0.16	0.65	**5.02**	0.19	8.53	**8.34**	7.02	**7.02**	**2742**
2763	Armour's Big Crop Fertilizers 6-11-10	Colchester	0.53	5.20	0.18	0.09	**6.00**	0.36	12.30	**11.94**	9.10	**9.78**	**2763**
2741	Armour's Big Crop Fertilizers 7-6-6	Colchester	0.51	5.90	0.26	0.07	**6.74**	0.36	6.58	**6.22**	5.83	**5.83**	**2741**
2825	Armour's Big Crop Fertilizer Tobacco Special 5-3-5	Thompsonville	2.24	0.06	0.30	2.37	**4.97**	0.16	3.61	**3.45**	0.49	**5.10**	**2825**
	Associated Seed Growers, Inc., New Haven, Conn.												
2819	Clark's Special Mixture for General Use 3-8-4	Orange	0.00	2.50	0.45	0.38	**3.33**	0.25	8.89	**8.64**	4.64	**4.64**	**2819**
2662	Clark's Special Mixture 6% Potash 3-8-6	Milford	0.00	1.88	0.63	0.59	**3.10**	0.50	9.00	**8.50**	6.56	**6.56**	**2662**
2660	Clark's Special Super High Grade 5-8-7	Orange	0.00	4.20	0.74	0.49	**5.43**	0.45	8.75	**8.30**	7.36	**7.36**	**2660**
2449	Clark's Tip Top Brand 4-8-7	Milford	0.51	2.76	0.02	0.83	**4.12**	0.50	9.16	**8.66**	7.32	**7.32**	**2449**
	F. A. Bartlett Tree Expert Co., Stamford, Conn.												
2485	Bartlett Green Tree Food 6-7-4	Factory	0.00	5.28	0.00	0.95	**6.23**	1.76	10.10	**8.34**	4.93	**4.93**	**2485**
	Berkshire Chemical Co., Bridgeport, Conn.												
2511	Berkshire 5-8-7 Fertilizer	Plainville	0.00	3.94	0.62	0.84	**5.40**	0.12	8.23	**8.11**	7.26	**7.26**	**2511**
2456	Berkshire Complete Fertilizer 2-12-2	Norwalk	0.00	1.44	0.73	0.47	**2.64**	0.67	12.73	**12.06**	2.27	**2.27**	**2456**
2924	Berkshire Complete Tobacco Fertilizer 4-3-5	Wapping	1.82	0.20	0.36	1.73	**4.11**	0.09	3.35	**3.26**	0.47	**5.57**	**2924**
2661	Berkshire Grass Special Fertilizer 6-6-5	Milford	0.20	4.36	0.76	1.10	**6.42**	0.45	6.91	**6.46**	5.55	**5.55**	**2661**
2877	Berkshire High Grade Tobacco Fertilizer 5-3-6	Hazardville	2.01	0.08	0.44	2.70	**5.23**	0.25	3.69	**3.44**	0.54	**6.49**	**2877**
2526	Berkshire Long Island Special Fertilizer 4-8-7	Highwood	0.00	2.44	0.58	0.72	**3.74**	0.56	9.05	**8.49**	7.66	**7.66**	**2526**
2458	Berkshire Market Garden Fertilizer 4-8-4	Norwalk	0.18	2.56	0.52	0.74	**4.00**	0.22	8.73	**8.51**	4.28	**4.28**	**2458**
2525	Berkshire Special Mixture 3-10-6	Highwood	0.00	1.96	0.57	0.56	**3.09**	0.66	11.68	**11.02**	6.80	**6.80**	**2525**
2855	Berkshire Tobacco Special Fertilizer 6-3-7	Ellington	2.56	0.08	0.24	3.35	**6.23**	0.19	3.72	**3.53**	0.56	**7.29**	**2855**
2856	Berkshire Tobacco Starter Fertilizer 4-4-15	Ellington	2.65	0.16	0.32	0.97	**4.10**	0.06	4.08	**4.02**	1.05	**14.83**	**2856**
2812	Berkshire Truck Fertilizer 4-8-5	Factory	0.00	3.94	0.29	0.45	**4.68**	0.22	7.87	**7.65**	4.91	**4.91**	**2812**
	Consolidated Rendering Co., Boston, Mass.												
2760	Corenco 8-16-14 Two-in-One	Woodbury	0.74	6.00	0.70	0.53	**7.97**	0.42	15.86	**15.44**	13.91	**13.91**	**2760**
	Davey Tree Expert Co., Kent, Ohio												
2486	Davey Tree Food 10-3-3	Old Greenwich	1.10	7.56	0.20	1.88	**10.74**	0.27	3.44	**3.17**	2.23	**3.78**	**2486**
	Eastern States Farmers' Exchange, Springfield, Mass.												
2558	Eastern States 4-8-8	Clinton	0.77	3.32	0.14	0.27	**4.50**	0.45	8.98	**8.53**	8.58	**8.58**	**2558**
2832	Eastern States 4-10-6	Warehouse Point	0.63	3.08	0.28	0.32	**4.31**	0.40	11.09	**10.69**	4.08	**6.45**	**2832**
2559	Eastern States 4-12-4	Waterford	0.74	2.68	0.66	0.33	**4.41**	0.59	13.08	**12.49**	0.31	**4.39**	**2559**

TABLE 12. ANALYSES OF MIXED FERTILIZER CONTAINING NITROGEN, PHOSPHORIC ACID AND POTASH

Station No.	Manufacturer and brand	Place of sampling	Nitrogen					Phosphoric acid			Potash		Station No.
			In nitrates	In ammonia	Organic water-soluble	Organic water-insoluble	Total	Citrate-insoluble	Total	So-called "Available"	As muriate	Total	
			%	%	%	%	%	%	%	%	%	%	
2831	Eastern States 5-5-15 Tobacco	Warehouse Point	3.45	0.24	0.92	1.58	6.19	0.21	6.41	6.20	1.50	16.27	2831
2554	Eastern States 6-8-6	Clinton	1.83	3.94	0.02	0.37	6.16	0.23	9.55	9.32	0.77	6.67	2554
2695	Eastern States 6-15-9	New Milford	1.14	4.60	0.24	0.36	6.34	0.39	16.37	15.98	6.59	9.57	2695
2556	Eastern States 8-16-16	Clinton	1.77	6.06	0.20	0.31	8.34	0.32	16.77	16.45	12.80	16.78	2556
2688	Eastern States 8-16-16 (Low Chlorine Special)	Ellington	1.30	6.00	0.32	0.38	8.00	0.12	15.86	15.74	1.12	16.62	2688
2752	Eastern States 8-24-8	West Simsbury	2.17	5.56	0.22	0.43	8.38	0.45	25.88	25.43	0.94	8.29	2752
2845	Eastern States 10-5-10 Tobacco	Warehouse Point	3.46	0.40	4.14	2.80	10.80	0.10	5.66	5.56	0.66	10.85	2845
	Essex Fertilizer Co., Boston, Mass.												
2495	Essex 3-10-4 Fish Brand Fertilizer For All Crops	Wallingford	0.00	2.06	0.81	0.29	3.16	0.40	10.80	10.40	3.80	3.80	2495
2497	Essex 4-8-10 Peerless Potato Manure	Wallingford	0.27	2.82	0.62	0.37	4.08	0.40	8.79	8.39	10.08	10.08	2497
2496	Essex 5-8-7 Complete Manure	Wallingford	0.41	3.58	0.48	0.59	5.06	0.25	8.76	8.51	7.00	7.00	2496
	L. T. Frisbie Co., New Haven, Conn.												
2704	Frisbie's Corn and Grain 2-10-2	Woodbury	0.00	1.22	0.64	0.38	2.24	0.90	11.06	10.16	2.13	2.13	2704
2439	Frisbie's Market Garden 4-8-7	New Haven	0.34	2.68	0.60	0.61	4.23	0.41	9.04	8.63	7.18	7.18	2439
2463	Frisbie's Special 5-8-7	Cheshire	0.56	3.78	0.50	0.39	5.23	0.53	8.58	8.05	7.09	7.09	2463
2527	Frisbie's Special Potato Fertilizer 4-8-4	Cheshire	0.47	2.76	0.64	0.39	4.26	0.39	8.91	8.52	4.05	4.05	2527
2736	Frisbie's Special Vegetable and Potato Grower 3-10-4	Factory	0.00	2.06	0.86	0.38	3.30	0.88	10.75	9.87	4.32	4.32	2736
2851	Frisbie's Tobacco Grower 5-3-5	Granby	0.53	0.12	0.66	4.02	5.33	0.35	4.72	4.37	1.09	5.31	2851
2482	Frisbie's Top Dresser 7-6-6	Noroton	1.50	4.40	0.54	0.64	7.08	0.31	6.67	6.36	5.96	5.96	2482
	Paul M. Hubbard & Co. Bristol, Conn.												
2509	Hubbard's Special Lawn Food 10-6-4	Factory	0.00	5.76	0.51	4.14	10.41	0.24	7.67	7.43	5.07	5.07	2509
	Lowell Fertilizer Co., Boston, Mass.												
2520	Lowell 2-10-2 Bone Brand	Southington	0.00	1.16	0.75	0.35	2.26	0.51	10.93	10.42	1.83	1.83	2520
2518	Lowell 3-10-4 Animal Brand, A High Grade Manure for All Crops	Southington	0.00	2.05	0.94	0.29	3.28	0.32	10.85	10.53	4.09	4.09	2518
2732	Lowell 4-8-4 Corn and Vegetable	Shelton	0.00	2.82	0.95	0.39	4.16	0.42	8.90	8.48	4.19	4.19	2732
2669	Lowell 4-8-7 Old General Crop Manure for Potatoes and Market Garden Crops	Shelton	0.32	2.68	0.70	0.53	4.23	0.38	8.80	8.42	7.14	7.14	2669
2733	Lowell 4-8-10 Potato Grower	Shelton	0.41	2.92	0.60	0.57	4.50	0.26	9.35	9.09	9.77	9.77	2733
2519	Lowell 5-8-7 Market Garden Manure	Southington	0.36	3.58	0.42	0.60	4.96	0.32	8.78	8.46	6.82	6.82	2519
	Millane Nurseries & Tree Experts Co., Cromwell, Conn.												
2534	Millane Shade Tree Food 8-8-4	Factory	2.71	4.28	0.56	0.45	8.00	0.63	8.65	8.02	4.12	4.12	2534

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Station No.	Manufacturer and brand	Place of sampling	Nitrogen					Phosphoric acid			Potash		Station No.
			In nitrates	In ammonia	Organic water-soluble	Organic water-insoluble	Total	Citrate-insoluble	Total	So-called "Available"	As muriate	Total	
			%	%	%	%	%	%	%	%	%	%	
	Miller Fertilizer Co., Baltimore, Md.												
2521	Miller's Crop Grower 5-8-7	Plantsville	0.00	4.20	0.17	0.36	4.73	0.10	8.77	8.67	6.68	6.68	2521
2523	Miller's Onion and Vegetable 4-8-4	Plantsville	0.00	3.28	0.35	0.37	4.00	0.10	8.61	8.51	3.80	3.80	2523
	New England Fertilizer Co., Boston, Mass.												
2505	New England 2-10-2 Corn Phosphate	New Britain	0.42	1.28	0.19	0.41	2.30	0.73	10.65	9.32	2.07	2.07	2505
2691	New England 3-10-4 Super, A High Grade Fertilizer for All Crops	Unionville	0.00	2.28	0.48	0.36	3.12	0.85	10.85	10.00	4.26	4.26	2691
2499	New England 4-8-4 Potato and Vegetable Manure	Meriden	0.40	2.72	0.58	0.37	4.07	0.45	8.75	8.30	4.03	4.03	2499
2506	New England 4-8-7 Old General Crop Manure for Potato and Market Garden Crops	New Britain	0.43	2.60	0.46	0.57	4.06	0.46	9.13	8.67	6.85	6.85	2506
2703	New England 4-8-10 Complete Manure	Wallingford	0.68	2.64	0.42	0.49	4.23	0.33	9.19	8.86	9.96	9.96	2703
2498	New England 5-8-7 Market Garden Manure	Meriden	0.41	3.88	0.46	0.39	5.14	0.55	9.06	8.51	6.98	6.98	2498
2693	New England 5-8-10 Aroostook Special for Potatoes	Unionville	0.55	3.96	0.48	0.35	5.34	0.37	9.76	9.39	9.34	9.34	2693
2920	New England 6-3-6 Tobacco	Buckland	1.28	0.08	0.64	3.89	5.89	0.16	4.41	4.25	1.70	6.63	2920
2829	New England 7-3-7 High Analysis Tobacco	Silver Lane	2.44	0.12	0.76	3.66	6.98	0.24	4.55	4.31	0.66	7.02	2829
	Old Deerfield Fertilizer Co., South Deerfield, Mass.												
2826	Old Deerfield 4-6-10 Tobacco Starter	Somers	1.02	0.12	0.32	2.75	4.21	1.48	10.13	8.65	0.84	10.38	2826
2766	Old Deerfield 5-3-5 Tobacco	Somers	0.73	0.00	0.88	3.82	5.43	0.59	5.32	4.73	0.78	5.47	2766
2765	Valley Brand 4-8-4	Somers	0.00	3.28	0.78	0.17	4.23	0.40	9.25	8.85	4.33	4.33	2765
2872	Valley Brand 4-8-7	Somers	0.00	3.36	0.68	0.29	4.33	0.59	9.21	8.62	7.26	7.26	2872
	Olds & Whipple, Inc., Hartford, Conn.												
2546	Luxura 5-8-6	Factory	0.73	2.26	0.38	1.95	5.32	1.37	11.47	10.10	6.23	6.51	2546
2577	O & W 4-8-4 Market Garden Fertilizer	Willimantic	1.00	2.00	0.38	0.82	4.20	0.54	8.62	8.08	4.45	4.45	2577
2822	O & W 5-3-5 Complete Tobacco Fertilizer	Suffield	0.83	0.12	0.42	4.03	5.40	0.21	3.62	3.41	0.47	5.06	2822
2921	O & W 5-4-15 High Grade Tobacco Starter and Potash Compound	So. Windsor	2.15	0.12	0.64	2.29	5.20	0.34	5.04	4.70	1.09	15.39	2921
2576	O & W 5-8-7 High Grade Potato and Vegetable Fertilizer	Willimantic	0.83	2.20	0.36	1.75	5.14	0.13	8.58	8.45	7.58	7.58	2576
2835	O & W 6-3-6 Blue Label Tobacco Fertilizer	Warehouse Point	0.75	0.00	0.76	4.65	6.16	0.25	3.68	3.43	0.51	6.40	2835
2542	O & W 8-6-6 Top Dressing and Grass Fertilizer	Factory	4.28	1.84	0.00	2.07	8.19	0.12	6.34	6.22	6.30	6.30	2542
2684	O & W 3-10-4 Corn Special Fertilizer	Bloomfield	0.00	2.00	0.70	0.84	3.54	0.86	12.12	11.26	4.20	4.20	2684
2683	O & W 4-8-7 Potato and General Purpose Fertilizer	Bloomfield	0.68	2.12	0.64	0.82	4.26	0.20	8.54	8.34	7.44	7.44	2683
2738	Wilcox 3-10-4 Corn Special Fertilizer	Mystic	0.54	1.90	0.14	0.81	3.39	0.30	10.38	10.08	4.51	4.51	2738
2739	Wilcox 4-8-4 Market Garden Fertilizer	Mystic	0.95	2.04	0.36	0.79	4.14	0.42	8.66	8.24	4.20	4.20	2739
2737	Wilcox 4-8-7 Potato and General Purpose Fertilizer	Mystic	0.79	2.10	0.40	0.96	4.25	0.20	8.39	8.19	7.09	7.09	2737
2751	Wilcox 8-6-6 Top Dresser Fertilizer	Factory	4.47	1.68	0.00	2.04	8.19	0.10	6.26	6.16	6.22	6.22	2751

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			%	%	%	%	%	%	%	%	%	%	
	Piedmont-Mt. Airy Guano Co., Baltimore, Md.												
2427	Piedmont Harvest Brand 4-8-4	Groton	0.00	3.52	0.26	0.40	4.18	0.15	8.40	8.25	4.37	4.37	2427
2426	Piedmont Harvest Brand 5-8-7	Groton	0.00	4.06	0.38	0.38	4.82	0.10	8.27	8.17	7.18	7.18	2426
2428	Piedmont Harvest Brand 7-6-6	Groton	0.12	5.76	0.42	0.42	6.72	0.12	6.37	6.25	6.13	6.13	2428
	Plantspur Products Co., Ridgefield, N. J.												
2450	Plantspur Fertilizer 3-3-2	Stratford	0.00	3.00	0.00	0.53	3.53	0.30	3.85	3.55	2.09	2.09	2450
	Frank S. Platt Co., New Haven, Conn.												
2444	Platco Special 4-8-7	Factory	0.35	2.50	0.62	0.60	4.07	0.43	8.96	8.53	6.93	6.93	2444
2429	Platt's Special Lawn Fertilizer 10-5-5	Factory	0.00	6.92	1.03	2.58	10.53	0.33	7.29	6.96	5.34	5.34	2429
	The Rogers & Hubbard Co., Portland, Conn.												
2588	Golf Course Fertilizer 8-6-2	Hartford	0.32	1.52	2.08	4.22	8.14	0.51	7.63	7.12	2.37	2.37	2588
2438	Gro-Fast Fertilizer 5-6-6	New Haven	0.00	1.42	0.26	3.67	5.35	0.31	7.00	6.69	0.94	6.48	2438
2678	Hubbard's All Soils, All Crops Fertilizer 4-8-4	Higganum	0.00	2.92	0.81	0.34	4.07	0.57	8.94	8.37	4.15	4.15	2678
2816	Hubbard's Climax Tobacco Brand 5-3-5	New Milford	1.38	0.14	0.86	2.50	4.88	0.25	3.87	3.62	0.93	5.15	2816
2575	Hubbard's Corn and Grain Fertilizer 2-12-4	Willimantic	0.00	0.96	0.92	0.29	2.17	0.93	12.80	11.87	3.86	3.86	2575
2677	Hubbard's High Potash Fertilizer 2-8-10	New Britain	0.00	1.24	0.68	0.29	2.21	0.67	8.76	8.09	10.48	10.48	2677
2550	Hubbard's Potato Fertilizer 5-8-7	Branford	0.00	3.38	0.87	0.57	4.82	0.95	9.28	8.33	6.92	6.92	2550
2589	Hubbard's Rose Food 7-10-5	Hartford	0.00	0.48	2.38	4.36	7.22	1.70	13.24	11.54	0.81	5.49	2589
2852	Hubbard's Tobacco Grower Vegetable Formula 6-3-6	Granby	1.16	0.08	0.92	3.86	6.02	0.34	4.12	3.78	0.98	6.71	2852
2875	Hubbard's Tobacco Grower Vegetable Formula 6-3-6	Rockville	1.02	0.08	1.36	4.04	6.50	0.31	3.91	3.60	0.78	6.26	2875
2530	Hubbard's "Bone Base" Fertilizer for Seeding Down	Willimantic	0.00	1.44	0.27	1.31	3.02	1.81	12.30	10.49	6.58	6.58	2530
2582	Hubbard's "Bone Base" Oats and Top Dressing	Stafford Springs	7.73	0.08	0.08	0.57	8.46	0.95	8.31	7.36	6.18	7.63	2582
3244	Hubbard's "Bone Base" Oats and Top Dressing	Factory	6.98	0.32	0.00	0.58	7.90	1.73	9.06	7.33	4.80	7.80	3244
2581	Hubbard's "Bone Base" Soluble Corn Manure	Stafford Springs	0.60	1.92	1.06	0.39	3.97	0.40	10.34	9.94	7.27	7.27	2581
2679	Hubbard's "Bone Base" Soluble Potato Manure	Higganum	0.93	2.20	0.90	0.91	4.94	1.13	9.81	8.68	1.29	7.42	2679
2849	Hubbard's "Bone Base" Soluble Tobacco Manure	Suffield	1.77	0.63	1.67	0.89	4.96	1.17	9.87	8.70	1.04	10.40	2849
2536	Red H Brand 4-8-4	Wethersfield	0.00	3.64	0.48	0.14	4.26	0.31	8.60	8.29	4.97	4.97	2536
2680	Red H Brand 4-8-7	Factory	0.00	3.46	0.50	0.18	4.14	0.20	8.56	8.36	7.09	7.09	2680
2529	Red H Brand 5-8-7 Fertilizer	Milldale	0.18	4.60	0.06	0.22	5.06	0.45	8.63	8.18	7.15	7.15	2529
2570	Red H Brand 7-6-6	Norwich	0.21	6.32	0.60	0.19	7.32	0.40	6.49	6.09	6.17	6.17	2570
2767	Red H Brand 8-16-14	Cromwell	0.00	7.48	0.41	0.19	8.08	0.26	17.60	17.34	14.19	14.19	2767

TABLE 12. ANALYSES OF MIXED FERTILIZER CONTAINING NITROGEN, PHOSPHORIC ACID AND POTASH

Station No.	Manufacturer and brand	Place of sampling	Nitrogen					Phosphoric acid			Potash		Station No.
			In nitrates	In ammonia	Organic water-soluble	Organic water-insoluble	Total	Citrate-insoluble	Total	So-called "Available"	As muriate	Total	
			%	%	%	%	%	%	%	%	%	%	
	O. M. Scott & Sons, Marysville, Ohio												
2671	Scott's Turf Builder 10-6-4	Yalesville	0.00	6.22	0.45	3.45	**10.12**	0.24	6.38	**6.14**	3.28	**3.88**	2671
	M. L. Shoemaker & Co., Philadelphia, Pa.												
2769	"Swift-Sure" Tobacco and General Use 3-10-3	Granby	0.00	2.28	0.14	0.43	**2.85**	0.42	10.74	**10.32**	0.74	**3.45**	2769
	Springfield Rendering Co., Springfield, Mass.												
2580	Springfield 3-10-4 Corn and Grain Fertilizer	Stafford Springs	0.00	2.12	0.69	0.34	**3.15**	0.72	10.72	**10.00**	4.08	**4.08**	2580
2516	Springfield 4-8-4 General Garden Fertilizer	Thompsonville	0.33	2.66	0.72	0.27	**3.98**	0.30	7.81	**7.51**	4.17	**4.17**	2516
2846	Springfield 4-8-7 Potato and Vegetable Fertilizer	Windsor	0.33	2.74	0.56	0.35	**3.98**	0.41	8.84	**8.43**	7.09	**7.09**	2846
2579	Springfield 4-8-10 Complete Manure	Mansfield Depot	0.26	2.64	0.74	0.29	**3.93**	0.31	8.28	**7.97**	9.94	**9.94**	2579
2834	Springfield 5-5-5 Lawn and Shrub Fertilizer	Thompsonville	0.17	1.94	0.54	2.47	**5.12**	0.73	7.82	**7.09**	0.80	**6.10**	2834
2578	Springfield 5-8-7 Market Garden Fertilizer	Mansfield Depot	0.33	3.76	0.72	0.33	**5.14**	0.36	8.65	**8.29**	7.00	**7.00**	2578
2827	Springfield 5-8-7 Market Garden Fertilizer	Ellington	0.38	3.80	0.48	0.30	**4.96**	0.36	8.75	**8.39**	6.93	**6.93**	2827
2833	Springfield 6-3-6 Tobacco Special Fertilizer	Thompsonville	1.37	0.06	0.74	3.91	**6.08**	0.18	4.45	**4.27**	1.59	**6.38**	2833
	Standard Wholesale Phosphate & Acid Works, Inc., Baltimore, Md.												
2674	Standard United States 2-10-2	New Britain	0.00	1.36	0.21	0.23	**1.80**	0.69	12.21	**11.52**	3.18	**3.18**	2674
2697	Standard United States 3-8-3	Danbury	0.00	2.32	0.23	0.47	**3.02**	0.65	9.09	**8.44**	1.97	**3.15**	2697
2927	Standard United States 3-12-6	Hazardville	0.00	2.60	0.16	0.38	**3.14**	0.39	11.84	**11.45**	3.30	**5.61**	2927
2453	Standard United States 4-8-4	Westport	0.24	2.84	0.28	0.56	**3.92**	0.30	8.31	**8.01**	2.66	**3.91**	2453
2879	Standard United States Guano 4-8-7	So. Glastonbury	0.12	3.00	0.32	0.52	**3.96**	0.65	8.93	**8.28**	5.28	**6.63**	2879
2675	Standard United States 4-8-10	New Britain	0.00	3.24	0.24	0.50	**3.98**	0.50	9.04	**8.54**	8.67	**9.30**	2675
2954	Standard United States 5-4-5	Ellington	0.00	3.64	0.31	1.09	**5.04**	0.35	4.96	**4.61**	1.12	**4.92**	2954
2452	Standard United States 5-8-7	Westport	0.00	3.78	0.60	0.46	**4.84**	0.45	9.31	**8.86**	5.08	**7.06**	2452
2451	Standard United States 5-10-5	Westport	0.00	4.10	0.20	0.64	**4.94**	0.91	11.10	**10.19**	2.54	**4.80**	2451
2560	Standard United States 7-6-5	New London	0.37	3.96	0.44	0.32	**5.09**	0.35	7.81	**7.46**	2.67	**5.08**	2560
2968	Standard United States 7-6-5	New London	0.00	4.24	0.28	0.62	**5.14**	0.37	7.50	**7.13**	2.96	**5.16**	2968
2454	Standard United States 9-8-8	Westport	1.61	6.64	0.45	0.34	**9.04**	0.35	7.27	**6.92**	7.56	**7.56**	2454
2893	Standard United States 9-8-8	Ellington	0.00	7.36	0.68	0.35	**8.39**	0.36	8.42	**8.06**	8.67	**8.67**	2893
	Summers Fertilizer Co., Baltimore, Md.												
2762	Summers's "Best On Earth" 3-8-4 Fertilizer	West Hartford	0.83	2.20	0.02	0.15	**3.20**	2.15	10.00	**7.85**	4.26	**4.26**	2762
2657	Summers's "Best On Earth" 4-8-4 Fertilizer	New Britain	1.02	2.40	0.18	0.14	**3.74**	1.85	9.65	**7.80**	4.01	**4.01**	2657
2564	Summers's "Best On Earth" 5-8-7 Fertilizer	New London	1.83	3.24	0.00	0.16	**5.23**	2.12	9.84	**7.72**	6.71	**6.71**	2564
2566	Summers's "Best On Earth" 8-8-8 Fertilizer	New London	3.13	4.50	0.00	0.15	**7.78**	2.22	9.78	**7.56**	8.68	**8.68**	2566

TABLE 12. ANALYSES OF MIXED FERTILIZER CONTAINING NITROGEN, PHOSPHORIC ACID AND POTASH

Station No.	Manufacturer and brand	Place of sampling	Nitrogen					Phosphoric acid			Potash		Station No.
			In nitrates	In ammonia	Organic water-soluble	Organic water-insoluble	Total	Citrate-insoluble	Total	So-called "Available"	As muriate	Total	
			%	%	%	%	%	%	%	%	%	%	
	Swift & Company, Baltimore, Md.												
2510	Swift's Special Gold Fertilizer 12-6-4	Bristol	0.35	9.72	0.06	0.13	10.26	0.08	7.90	7.82	4.06	4.06	2510
3318	Swift's Special Golf Fertilizer 12-6-4	Waterford	....	....	....	....	11.01	0.11	6.91	6.80	4.19	4.19	3318
2440	Vigoro 4-12-4	New Haven	0.41	3.48	0.00	0.33	4.22	0.29	12.40	12.11	4.23	4.23	2440
	Synthetic Nitrogen Products Corp., New York City												
2747	Nitrophoska 15-30-15	Woodstock	1.63	12.48	....	....	14.53	0.05	30.08	30.03	14.34	14.34	2747
	Tennessee Corp., Lockland, Ohio												
2818	Loma 5-10-4	New Haven	0.25	4.38	0.04	0.46	5.13	0.31	11.36	11.05	4.32	4.32	2818
2953	Soil-Prep 4-2-2	Hartford	0.00	1.44	0.96	1.78	4.18	0.11	2.28	2.17	2.75	2.75	2953
	I. P. Thomas & Sons Co., Philadelphia, Pa.												
2668	I. P. Thomas 5-8-7 Fertilizer	Milford	0.16	4.88	0.04	0.35	5.43	0.25	8.54	8.29	7.09	7.09	2668
2854	Long Island Special 4-8-7	North Haven	0.00	3.36	0.47	0.35	4.18	0.90	9.13	8.23	6.89	6.89	2854
2734	Tip Top Fertilizer 3-10-6	North Haven	0.00	2.52	0.32	0.39	3.23	0.62	10.70	10.08	6.00	6.00	2734
	Virginia-Carolina Chemical Co., Richmond, Va.												
2746	Bloomaid 5-10-4	Putnam	0.00	3.68	0.69	0.40	4.77	0.46	11.78	11.32	4.19	4.19	2746
2533	V-C Aroostook Potato Grower 5-8-7	Middletown	0.00	4.46	0.49	0.17	5.12	0.04	8.54	8.50	7.31	7.31	2533
2745	V-C Fairway Fertilizer 8-6-5	Putnam	0.00	5.70	1.71	0.57	7.98	0.08	6.40	6.32	4.29	5.20	2745
2682	V-C National Brand 4-8-10	Middletown	0.00	3.40	0.41	0.16	3.97	0.23	8.71	8.48	9.68	9.68	2682
2539	V-C Owl Brand Fertilizer 2-12-4	Thomaston	0.00	1.64	0.13	0.23	2.00	0.77	12.47	11.70	3.78	3.78	2539
2540	V-C Tip Top Top Dresser 7-6-6	Thomaston	0.00	6.18	0.52	0.14	6.84	0.14	6.35	6.21	6.23	6.23	2540
2532	V-C XXXX Fish and Potash 4-8-5	Middletown	0.00	3.30	0.66	0.24	4.20	0.11	8.20	8.09	5.58	5.58	2532
	F. H. Woodruff & Sons, Milford, Conn.												
2448	Woodco 10-6-4 Lawn Food	Factory	0.31	3.28	2.94	3.47	10.00	0.59	7.55	6.96	4.00	4.00	2448
	S. D. Woodruff & Sons, Orange, Conn.												
2445	Woodruff's Home Mixed Fertilizer 4-8-7	Factory	0.30	3.08	0.16	0.84	4.38	0.07	8.28	8.21	6.52	6.52	2445
	Worcester Rendering Co., Auburn, Mass.												
2567	Prosperity All Crops Fertilizer 4-8-4	Groton	0.39	2.62	0.58	0.36	3.95	0.46	8.61	8.15	4.42	4.42	2567
2743	Prosperity Corn and Grain Fertilizer 2-10-2	Plainfield	0.00	1.24	0.58	0.34	2.16	0.20	10.35	10.15	2.48	2.48	2743
2561	Prosperity Market Garden 5-8-7	New London	0.46	3.64	0.44	0.38	4.92	0.34	8.16	7.82	7.66	7.66	2561
274	Prosperity Special Potato Fertilizer 4-8-10	Danielson	0.52	2.78	0.46	0.37	4.13	0.40	8.68	8.28	10.16	10.16	2744
256	Prosperity Superior Top Dressing 7-6-6	New London	0.48	4.60	0.40	0.80	6.28	0.33	6.90	6.57	6.72	6.72	2562
294	Prosperity Superior Top Dressing 7-6-6	Groton	0.40	2.60	3.44	0.40	6.84	0.21	6.35	6.14	5.83	5.83	2946

TABLE 12*a*. SUMMARY OF CHEMICAL DEFICIENCIES

Manufacturer	Number samples	Number guaranties	Deficiencies: Nitrogen	Deficiencies: Available P_2O_5	Deficiencies: Potash	Percentage of guaranties met
American Agricultural Chemical Co.	26	78	4	0	3	91
American Cyanamid Co.	2	4[1]	0	0	0	100
Apothecaries Hall Co.	12	35[2]	0	2	0	94
Armour Fertilizer Works	5	15	2	0	1	80
Associated Seed Growers, Inc.	4	12	0	0	0	100
Bartlett, F. A. Tree Expert Co.	1	3	0	0	0	100
Berkshire Chemical Co.	11	33	1	1	0	94
Consolidated Rendering Co.	1	3	0	1	0	67
Davey Tree Expert Co.	1	3	0	0	0	100
Eastern States Farmers' Exchange	11	32[2]	0	1	0	97
Essex Fertilizer Co.	3	9	0	0	0	100
Frisbie, L. T., Co.	7	21	0	0	0	100
Hubbard, Paul M., & Co.	1	3	0	0	0	100
Lowell Fertilizer Co.	6	18	0	0	1	94
Millane Nurseries & Tree Experts Co.	1	3	0	0	0	100
Miller Fertilizer Co.	2	6	1	0	1	67
New England Fertilizer Co.	9	27	1	1	1	89
Old Deerfield Fertilizer Co.	4	12	0	0	0	100
Olds & Whipple, Inc.	13	39	0	0	0	100
Piedmont-Mt. Airy Guano Co.	3	9	2	0	0	78
Plantspur Products Co.	1	3	0	0	0	100
Platt, Frank S., Co.	2	6	0	0	0	100
Rogers & Hubbard Co., The	21	63	1	0	1	97
Scott, O. M., and Sons Co.	1	3	0	0	0	100
Shoemaker, M. L., and Co.	2	5[2]	1	0	0	80
Springfield Rendering Co.	8	24	0	1	0	96
Standard Wholesale Phosphate and Acid Works, Inc.	13	39	5	2	4	72
Summers Fertilizer Co.	4	12	3	2	1	50
Swift & Co.	3	9	2	0	0	78
Synthetic Nitrogen Products Corp.	1	3	1	0	1	33
Tennessee Corp.	2	6	0	0	0	100
Thomas, I. P., and Sons Co.	3	9	0	0	0	100
Virginia-Carolina Chemical Co.	7	21	2	1	2	76
Woodruff, F. H., and Sons	1	3	0	0	0	100
Woodruff, S. D., and Sons	1	3	0	0	1	67
Worcester Rendering Co.	6	18	2	0	0	89
	199	592	28	12	17	90

[1]Two samples with two guaranties.
[2]One sample with only two guaranties.

TABLE 12*b*. COMMERCIAL DEFICIENCIES FOR THE PERIOD 1921-1933

Manufacturer	Total number samples	Number equalling or exceeding guaranties in money value	Percentage for 13-year period	Number samples for 1933	Percentage for 1933
American Agricultural Chemical Co.	513	495	96	26	100
American Cyanamid Co.	13	13	100[1]	2	100
Apothecaries Hall Co.	145	144	99	12	100
Armour Fertilizer Works	132	113	86	5	100
Associated Seed Growers, Inc.	18	18	100[2]	4	100
Bartlett, F. A. Tree Expert Co.	11	10	91[3]	1	100
Berkshire Chemical Co.	124	124	100	11	100
Bridge's, A. D., Sons Co.	23	23	100[4]	0	....
Eastern States Farmers' Exchange	144	124	100	10	100
Essex Fertilizer Co.	77	74	96	3	100
Frisbie, L. T., Co.	123	113	91	7	100
International Agricultural Corp.	69	63	91[4]	0	....
Lowell Fertilizer Co.	121	110	91	6	100
Mapes Formula and Peruvian Guano Co.	129	128	99[5]	0	....
Miller Fertilizer Co.	17	14	82[6]	2	100
New England Fertilizer Co.	94	90	96	9	100
Old Deerfield Fertilizer Co.	28	28	100[7]	4	100
Olds & Whipple, Inc.	108	108	100	13	100
Parmenter and Polsey	34	33	91[8]	0	....
Piedmont-Mt. Airy Guano Co.	37	28	76[9]	3	100
Platt, Frank S., Co.	18	17	94	2	100
Rogers & Hubbard Co., The	216	211	98	21	100
Royster, F. S., Guano Co.	67	54	81[10]	0	....
Shoemaker, M. L., and Co.	34	34	100	2	100
Springfield Rendering Co.	56	54	96	8	100
Standard Wholesale Phosphate and Acid Works, Inc.	69	60	87	13	77
Synthetic Nitrogen Products Corp.	11	10	91[11]	1	0
Thomas, I. P., and Sons Co.	63	63	100	3	100
Virginia-Carolina Chemical Co.	86	82	95	7	100
Woodruff, S. D., and Sons	11	9	82[12]	1	100
Worcester Rendering Co.	59	55	93	6	100
	2650	2502	94	182	97

[1]Includes 1925, 1926, 1928, 1930, 1931, 1932, and 1933 only.
[2]Includes 1930, 1931, 1932, and 1933 only.
[3]No samples for 1921, 1922, and 1923.
[4]No samples for 1932 and 1933.
[5]No samples for 1931, 1932, and 1933.
[6]Includes 1921, 1930, 1931, 1932 and 1933 only.
[7]Includes 1927, 1929, 1930, 1931, 1932, and 1933 only.
[8]No samples for 1933.
[9]No samples for 1922, 1923, 1924, 1930, 1931, and 1933.
[10]No samples for 1930, 1931, 1932, and 1933.
[11]Includes 1928, 1929, 1930, 1931, 1932, and 1933 only.
[12]No samples for 1928 and 1929.

INSOLUBLE ORGANIC NITROGEN

The quality of the organic nitrogen in mixed fertilizers is judged by the so-called "activity" of the portion which is insoluble in water, as measured by the alkaline and the neutral permanganate methods. Values of less than 50 per cent and 80 per cent respectively are regarded as indicating organic nitrogen of inferior quality. Values less than these have been found in nine samples this season, but in four of these the water-soluble nitrogen plus the active insoluble, or the water-insoluble alone, have substantially met or exceeded the guaranties and hence no question of inferior quality is raised. The samples in which such is not the case are as follows.

2453	Standard	United	States	4-8-4
2452	"	"	"	5-8-7
2968	"	"	"	7-6-5
2454	"	"	"	9-8-8
2893	"	"	"	9-8-8

SPECIAL AND HOME MIXTURES

Analyses of thirty-five special and home mixtures are given in Table 13. Four of these were sampled by the Station Agent.

TABLE 13. ANALYSES OF SPECIAL AND HOME MIXTURES

Station No.	Name of mixture	Place of sampling	Total nitrogen	Phosphoric acid			Potash		Chlorine	Station No.
				Citrate-insoluble	Total	So-called "Available"	As muriate	Total		
			%	%	%	%	%	%	%	
	Sampled by Station									
2424	Home Mixture for Corn 3-10-5	T. W. Ryan, Stratford	2.84	0.32	11.56	11.24	5.32	5.32	...	2424
2425	Home Mixture for Vegetables 5-7-5	T. W. Ryan, Stratford	5.23	0.44	8.64	8.20	5.57	5.57	...	2425
2880	Tobacco Fertilizer—No. 1	John Leonard, East Hartford	4.30	0.25	2.36	2.11	1.14	17.16	0.86	2880
2881	Tobacco Fertilizer—No. 2	John Leonard, East Hartford	5.80	0.50	4.50	4.00	0.57	8.26	0.43	2881
	Sampled by Purchaser									
2320	Formula A—1st sample	American Sumatra Tobacco Corp., Bloomfield	5.35	0.41	4.85	4.44	...	5.22	0.41	2320
2330	Formula A—2nd sample	American Sumatra Tobacco Corp., Bloomfield	5.45	0.39	4.57	4.18	...	5.45	0.41	2330
2385	Formula A—3rd sample	American Sumatra Tobacco Corp., Bloomfield	5.26	0.40	4.07	3.67	...	5.11	0.49	2385
2844	Formula B	American Sumatra Tobacco Corp., Bloomfield	9.92	0.28	3.19	2.91	...	1.14	0.27	2844
2353	Shedd's Special Mixture Fertilizer	Walter T. Clark, County Agent, Norwich	8.16	0.27	14.59	14.32	...	9.76	0.90	2353
1861	1933 Formula—Sample No. 2	Consolidated Cigar Corp., Hartford	5.94	0.41	4.47	4.06	...	6.08	0.28	1861
1862	1933 Formula—Sample No. 5	Consolidated Cigar Corp., Hartford	5.39	0.40	3.83	3.43	...	7.36	0.39	1862

TABLE 13. ANALYSES OF SPECIAL AND HOME MIXTURES—*Continued*

Station No.	Name of mixture	Place of sampling	Total nitrogen	Phosphoric acid: Citrate-insoluble	Phosphoric acid: Total	Phosphoric acid: So-called "Available"	Potash: As muriate	Potash: Total	Chlorine	Station No.
			%	%	%	%	%	%	%	
2295	1933 Formula—Sample No. 17	Consolidated Cigar Corp., Hartford	5.98	0.47	4.78	4.31	...	6.26	0.41	2295
2296	1933 Formula—Sample No. 25	Consolidated Cigar Corp., Hartford	5.74	0.44	1.58	1.14	...	6.32	0.33	2296
2372	Our Own 1933 Formula—Sample No. 1	Consolidated Cigar Corp., Hartford	5.44	0.36	4.18	7.82	...	7.34	0.51	2372
2373	Our Own 1933 Formula—Sample No. 2	Consolidated Cigar Corp., Hartford	5.70	0.30	4.33	4.03	...	6.20	0.41	2373
2374	Our Own 1933 Formula—Sample No. 4	Consolidated Cigar Corp., Hartford	5.98	0.39	4.61	4.22	...	6.36	0.44	2374
2375	Our Own 1933 Formula—Sample No. 6	Consolidated Cigar Corp., Hartford	6.12	0.37	4.06	3.69	...	6.72	0.48	2375
2376	Our Own 1933 Formula—Sample No. 11	Consolidated Cigar Corp., Hartford	6.00	0.45	4.75	4.30	...	6.09	0.33	2376
2718	1933 Formula Fertilizer—Lot No. 30	Consolidated Cigar Corp., Hartford	6.08	0.41	4.29	3.88	...	6.58	0.42	2718
2719	1933 Formula Fertilizer—Lot No. 31	Consolidated Cigar Corp., Hartford	5.58	0.50	3.98	3.48	...	7.24	0.47	2719
2720	1933 Formula Fertilizer—Lot No. 32	Consolidated Cigar Corp., Hartford	5.90	0.50	4.70	4.20	...	6.11	0.38	2720
2721	1933 Formula Fertilizer—Lot No. 33	Consolidated Cigar Corp., Hartford	6.00	0.41	4.85	4.44	...	6.20	0.38	2721
2722	1933 Formula Fertilizer—Lot No. 34	Consolidated Cigar Corp., Hartford	5.92	0.37	4.53	4.16	...	5.91	0.48	2722
			%	%	%	%	%	%	%	
2723	1933 Formula Fertilizer—Lot No. 35	Consolidated Cigar Corp., Hartford	5.94	0.39	4.55	4.16	...	6.29	0.44	2723
2724	1933 Formula Fertilizer—Lot No. 36	Consolidated Cigar Corp., Hartford	5.48	0.35	4.27	3.92	...	7.00	0.54	2724
2725	1933 Formula Fertilizer—Lot No. 37	Consolidated Cigar Corp., Hartford	5.95	0.30	4.37	4.07	...	6.09	0.41	2725
2726	1933 Formula Fertilizer—Lot No. 38	Consolidated Cigar Corp., Hartford	6.01	0.35	4.62	4.27	...	6.16	0.32	2726
2727	1933 Formula Fertilizer—Lot No. 39	Consolidated Cigar Corp., Hartford	5.81	0.45	4.50	4.05	...	6.19	0.34	2727
2967	5-3-6 Mixture	Fred Foishen, Broad Brook	5.04	0.15	3.30	3.15	0.51	6.53	0.38	2967
2640	Mixed Formula	The Gershel-Kaffenburgh Tobacco Co., Hartford	5.58	0.24	2.85	2.61	...	5.68	0.55	2640
2963	Special Mixture—Sample No. 1	The Gershel-Kaffenburgh Tobacco Co., Hartford	5.60	0.21	2.88	2.67	0.69	5.36	0.52	2963
2964	Special Mixture—Sample No. 2	The Gershel-Kaffenburgh Tobacco Co., Hartford	5.56	0.21	2.85	2.64	0.62	5.05	0.47	2964
2632	Formula III Fertilizers — Lots 7 and 8	C. K. & H. T. Hale, Gildersleeve	6.48	0.27	3.79	3.52	...	3.54	0.15	2632
2936	Special Mixture for Tobacco	Henry E. Wells, Warehouse Point	9.10	0.72	7.18	6.46	1.59	17.23	1.20	2936
2778	Home Mixture Fertilizer—No. 47	P. H. Woodford & Co., Avon	3.04	0.25	1.86	1.61	1.99	9.49	1.50	2778

VII. MISCELLANEOUS FERTILIZERS AND OTHER MATERIALS

SHEEP MANURE, ETC.

Analyses of seventeen official samples of sheep, cattle and poultry manures are given in Table 14.

LIMING MATERIALS

Analyses of limestone and other liming materials are given in Table 15.

OTHER MISCELLANEOUS MATERIALS

Twenty-seven samples of various materials, including deposits of peat, have been examined for individuals, the samples being submitted by them.

CHECK MEALS AND FERTILIZERS

Twenty-one samples of cottonseed meal and mixed fertilizers have been examined in the collaborative programs of the American Oil Chemists' Society and the F. S. Royster Guano Co.

TABLE 14. ANALYSES OF SHEEP MANURE AND OTHER MATERIALS

Station No.	Manufacturer or brand	Place of sampling	Nitrogen		Total phosphoric Acid		Potash		Station No.
			Found	Guaranteed	Found	Guaranteed	Found	Guaranteed	
			%	%	%	%	%	%	
2455	Pulverized Sheep and Goat Manure. American Agricultural Chemical Co., West Haven	Libner Grain Co., Norwalk	2.14	1.23	1.26	1.00	2.15	2.00	2455
2487	Sheep Manure. Apothecaries Hall Co., Waterbury	J. B. McArdle, Greenwich	2.13	2.00	2.10	1.00	3.45	2.00	2487
2821	Sheep & Goat Manure. Armour Fertilizer Works, New York City	C. A. Cowles, Plantsville	1.40	1.25	1.35	1.00	3.33	2.00	2821
2435	Two-In-One Peat Poultry Manure. C. E. Buell, Inc., Boston, Mass.	Lightborn & Pond Co., New Haven	3.12	2.75	2.96	2.50	1.25	1.25	2435
2483	Corenco Sheep Manure. Consolidated Rendering Co., Boston, Mass.	Davis Grain Co., Noroton	1.39	1.23	0.99	0.50	2.44	2.00	2483
2701	Davey Shredded Cattle Manure. Davey Tree Expert Co., Kent, Ohio	R. E. Landis, Old Greenwich	2.06	1.00	2.01	1.20	2.05	2.00	2701
2813	Lane's Sheep Manure. Chas. M. Lane, West Hartford	Wm. J. Rice, Stamford	1.11	1.00	1.25	1.00	2.98	2.00	2813
2586	Sheep's Head Pulverized Sheep Manure. Natural Guano Co., Aurora, Ill.	Cadwell & Jones, Hartford	2.05	2.00	1.50	...	1.76	2.00	2586
2430	Groz-it Brand Pulverized Sheep Manure. Pacific Manure & Fertilizer Co., San Francisco, Cal.	Frank S. Platt Co., New Haven	1.33	1.50	0.80	0.75	2.33	2.50	2430

TABLE 14. ANALYSES OF SHEEP MANURE AND OTHER MATERIALS—*Continued*

Station No.	Manufacturer or brand	Place of sampling	Nitrogen		Total Phosphoric Acid		Potash		Station No.
			Found	Guaranteed	Found	Guaranteed	Found	Guaranteed	
			%	%	%	%	%	%	
2436	Premier Brand Pulverized Poultry Manure. Premier Poultry Manure Co., Chicago, Ill.	Lightborn & Pond Co., New Haven	5.43	4.93	2.41	...[2]	1.11	1.30	2436
2437	Premier Brand Pulverized Sheep Manure. Premier Poultry Manure Co., Chicago, Ill.	Lightborn & Pond Co., New Haven	3.11	1.65	3.25	1.00	1.75	2.00	2437
2673	Wizard Brand Cattle Manure. The Pulverized Manure Co., Chicago, Ill.	S. P. Strople, New Britain	2.06	2.00	1.29	...[1]	0.85	1.00	2673
2672	Wizard Brand Pulverized Sheep Manure. The Pulverized Manure Co., Chicago, Ill.	S. P. Strople, New Britain	2.08	2.00	1.74	...[1]	3.55	2.00	2672
2537	Sheep & Goat Manure. The Rogers & Hubbard Co., Portland	Chas. C. Hart Seed Co., Wethersfield	1.48	1.35	1.05	0.75	3.76	3.75	2537
2568	Sheep Manure. Standard Wholesale Phosphate & Acid Works, Inc., Baltimore, Md.	Eldredge Hardware Co., Norwich	3.83	2.00	3.27	...[1]	2.15	2.00	2568
2670	Summers's Venezuelan Goat Manure. Summers Fertilizer Co., Baltimore, Md.	Seymour Grain & Coal Co., Seymour	1.00	1.00	0.88	1.00	2.78	3.00	2670
2457	Driconure. Walker Gordon Farms, Juliustown, N. J.	Libner Grain Co., Norwalk	2.19	1.00	1.12	1.00	1.31	1.00	2457

[1]Guaranteed 1 per cent available phosphoric acid.
[2]Guaranteed 2.5 per cent available phosphoric acid.

TABLE 15. ANALYSES OF LIMESTONE AND SIMILAR MATERIALS

Station No.	Manufacturer or brand	Sampled from stock of or sent by	Chemical analysis: Lime (CaO) Found	Lime (CaO) Guaranteed	Magnesia (MgO) Found	Magnesia (MgO) Guaranteed	Total oxides	Mechanical analysis: 20 mesh	40 mesh	50 mesh	80 mesh	100 mesh	Station No.
			%	%	%	%	%	%	%	%	%	%	
	Allyndale Lime Kilns and Quarries, East Canaan, Conn.												
716	Allyndale Agricultural Limestone ...	Louis E. Allyn, East Canaan	31.24	29.00	21.72	19.00	52.96	99.8	99.5	94.0	85.0	80.0	716
2898	Allyndale Agricultural Limestone ...	C. F. Cass, Wallingford	31.78	29.00	20.78	19.00	52.56	99.8	81.6	65.2	47.4	38.9	2898
	American Limestone Co., Bellefonte, Pa.												
2991	Bull Mine—Hydrated[1]	J. B. Lewis, Southington	72.77	63.00	0.86	1.00	73.63	....	....	....	....	....	2991
	Coe's Lime Works, Northford, Conn.												
1751	Lime	Factory	50.37	....	0.80	....	51.17	97.5	93.5	86.5	85.5	76.5	1751
3307	Ground Limestone	Factory	55.81	....	0.72	....	56.53	89.6	72.2	62.4	52.1	49.7	3307
	Connecticut Agstone Co., Danbury, Conn.												
1180	Limestone[2]	Factory	40.76	....	4.98	....	45.74	99.4	94.2	86.7	70.5	60.7	1180
1181	Phoenix Agricultural Limestone	Factory	....	....	....	....	....	99.5	92.1	82.1	64.7	61.6	1181
3289	Phoenix Agricultural Limestone	Meriden Grain & Coal Co., Meriden	41.31	....	5.36	....	46.67	97.1	84.4	80.9	71.4	65.4	3289
3401	Phoenix Ground Limestone	Factory	42.14	....	4.63	....	46.77	97.0	89.6	82.3	72.0	66.0	3401
	Granger's Lime Co., West Stockbridge, Mass.												
3288	Granger's Limestone	Laden Bros. Co., Inc., Wallingfo	38.80	....	9.34	....	48.14	98.9	89.2	77.3	62.3	56.0	3288
	Green Mt. Lime Co., New Haven Junction, Vt.												
3295	Producto Agricultural Hydrated Lime	Stafford Farmers' Co-op. Assoc Stafford Springs	67.67	60.00	9.05	1.00	76.72	....	....	....	....	....	3295
	Lee Lime Corp., Lee, Mass.												
1966	Lime—Batch No. 1	American Sumatra Tobacco Corp., Bloomfield	30.31	30.00	20.71	20.00	51.02	100.0	99.7	97.3	88.7	83.2	1966
1967	Lime—Batch No. 2	American Sumatra Tobacco Corp., Bloomfield	30.40	30.00	20.96	20.00	51.36	100.0	99.5	97.2	88.7	82.4	1967
1765	Hydrated Lime	Cullman Bros., Inc., Granby	47.57	....	33.33	....	80.90	....	....	....	....	....	1765
1828	Hydrated Lime	Cullman Bros., Inc., Simsbury ..	47.45	47.00	31.82	31.00	79.27	....	....	....	....	....	1828
2468	Lime—Lot No. 5	S. & Benj. L. Grabosky, Hartfo	47.88	....	33.87	31.00	81.75	....	....	....	....	....	2468
3292	Agricultural Pulverized Limestone ..	P. Levson & Son, Middletown ..	31.14	30.00	21.25	20.00	52.39	100.0	99.5	97.5	91.1	84.4	3292
3298	Agricultural Pulverized Limestone ..	Thomaston Supply Co., Thomaston	30.73	30.00	20.53	20.00	51.26	100.0	99.6	97.2	88.9	87.1	3298
3290	Agricultural Hydrated Lime	J. A. Smith & Son, Highwood ..	47.57	[illegible]	32.62	....	80.19	....	....	....	....	....	3290

[1]Passes 325 mesh, 95 per cent (wet method); weight of 500 c.c., 206.5 gms.
[2]Insoluble in acid 13.5 per cent.

TABLE 15. ANALYSES OF LIMESTONE AND SIMILAR MATERIALS

Station No.	Manufacturer or brand	Sampled from stock of or sent by	Chemical analysis: Lime (CaO) Found	Lime (CaO) Guaranteed	Magnesia (MgO) Found	Magnesia (MgO) Guaranteed	Total oxides	Mechanical analysis: 20 mesh	40 mesh	50 mesh	80 mesh	100 mesh	Station No.
			%	%	%	%	%	%	%	%	%	%	
	Miller Lime Products Corp., West Stockbridge, Mass.												
3286	Monarque Agricultural Hydrated Lime	E. O. Chapman, North Haven ..	56.02	60.00	16.47	4.00	72.49	....	....	....	....	....	3286
3293	Monarque Agricultural Limestone ..	Comstock Ferre Co., Wethersfi	38.13	35.00	12.27	6.00	50.40	96.8	86.4	79.8	73.2	72.2	3293
	New England Lime Co., Pittsfield, Mass.												
3291	Nelco Agricultural Hydrated Lime ..	H. A. Andrew, Milldale	41.81	40.00	27.84	15.00	69.65	....	....	....	....	....	3291
	Redding Marble Co., Redding, Conn.												
2897	Limestone No. 1	J. S. Owens, Storrs	30.36	....	20.21	....	50.57	100.0	99.6	93.6	61.0	46.7	2897
	Rockland & Rockport Lime Co., Rockland, Maine												
3297	R. R. Land Lime	Associated Seed Growers, Milfo	61.58	60.00	1.48	0.50	63.06	94.6	86.0	77.0	65.7	62.2	3297
	D. W. Smith & Bro., Ashley Falls, Mass.												
1394	Ashley White Dolomite Limestone ..	Benj. Webster, Litchfield	30.76	30.00	22.01	19.00	52.77	99.5	84.5	64.5	42.0	34.5	1394
3287	Ashley White Dolomite Agricultural Limestone	Laden Bros. Co., Inc., Walling	31.02	30.00	21.98	19.00	53.00	100.0	84.0	62.8	44.1	37.3	3287
	United States Gypsum Co., Falls Village, Conn.												
3294	Agricultural Limestone	A. L. Lockwood, Clinton	30.69	29.50	21.07	20.50	51.76	100.0	99.8	84.6	53.6	43.3	3294
3296	Eastern States Magnesium Limestone	E. D. Woolam, Warehouse Point	29.90	29.50	20.06	20.50	49.96	100.0	99.9	86.9	54.7	45.0	3296
3299	Eastern States Magnesium Limestone	Wm. Childs, Woodstock	30.27	29.50	19.81	20.50	50.08	100.0	99.8	86.1	51.4	44.2	3299
2993	Lime—A[3]	Warner-Miller Co., New Have ..	72.92	....	1.01	....	73.93	....	....	....	....	....	2993
2992	Lime—B[4]	Warner-Miller Co., New Have ..	72.41	....	0.93	....	73.34	....	....	....	....	....	2992
	Manufacturer Unknown												
3276	Limestone No. 1170—Car N.H. 162035	American Agricultural Chemical Co., West Haven	32.91	....	16.84	....	49.75	....	....	....	....	....	3276
1835	Fine Ground Limestone	American Agricultural Chemical Co., West Haven	30.39	....	20.78	....	51.17	100.0	99.4	97.0	89.4	84.0	1835
1782	Magnesium Lime	P. J. Anderson, Windsor	47.31	46.00	33.60	31.00	80.91	....	....	....	....	....	1782
371	Limestone, Sample A	Dr. W. E. Britton, Conn. Agr. Expt. Station, New Haven ...	52.47	....	0.58	....	53.05	....	....	....	....	....	371
372	Limestone, Sample B	Dr. W. E. Britton, Conn. Agr. Expt. Station, New Haven ...	30.81	....	21.58	....	52.39	....	....	....	....	....	372
1814	Ground Limestone	J. B. Cannon, Granby	32.35	....	21.96	....	54.31	100.0	76.0	55.0	35.2	28.2	1814
1687	Lime—Car N.H. 167338	Consolidated Cigar Corp., Hartford	47.74	....	32.73	....	80.47	....	....	....	....	....	1687

[3] Passes 325 mesh, 99.6 per cent (wet method); weight of 500 c.c., 242.5 gms.
[4] Passes 325 mesh 100 per cent (wet method); weight of 500 c.c., 248.5 gms.

TABLE 15. ANALYSES OF LIMESTONE AND SIMILAR MATERIALS

Station No.	Manufacturer or brand	Sampled from stock of or sent by	Chemical analysis: Lime (CaO) Found	Chemical analysis: Lime (CaO) Guaranteed	Chemical analysis: Magnesia (MgO) Found	Chemical analysis: Magnesia (MgO) Guaranteed	Total oxides	Mechanical analysis: 20 mesh	40 mesh	50 mesh	80 mesh	100 mesh	Station No.
1688	Lime—Car N.H. 171706	Consolidated Cigar Corp., Hartford	47.94	....	32.51	....	80.45	....	....	....	....	....	1688
1689	Lime—Car N.H. 170591	Consolidated Cigar Corp., Hartford	48.97	....	30.31	....	79.28	....	....	....	....	....	1689
2594	Land Plaster[5]—Truck No. 1	Hatheway & Steane, Inc., Hartford	34.20	....	....	....	....	....	....	....	....	....	2594
2326	Lime—Car 162215	Hatheway & Steane, Inc., Hartford	42.47	....	29.09	....	71.56	....	....	....	....	....	2326
363	Ground Limestone	Joseph Kempter, East Haven	29.82	....	18.98	....	48.80	96.0	91.0	87.0	72.0	61.0	363
1011	Limestone	H. Lewis, Westerly, R. I.	31.26	....	20.13	....	51.39	....	....	....	....	....	1011
1670	Clove Valley Limestone	James R. Place, Canaan	31.92	....	18.18	....	50.10	99.5	93.5	86.0	75.0	69.5	1670
2405	Land Plaster[6]	A. N. Shepard & Son, Inc., Hartford	33.69	....	....	....	....	....	....	....	....	....	2405
2409	Hydrated Lime—Car 162215	A. N. Shepard & Son, Inc., Hartford	42.14	....	28.98	....	71.12	....	....	....	....	....	2409

[5] SO_3, 45.24 per cent.
[6] SO_3, 44.30 per cent.

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STUDIES ON PARASITES OF THE ORIENTAL FRUIT MOTH

II. MACROCENTRUS

PHILIP GARMAN and W. T. BRIGHAM

Connecticut
Agricultural Experiment Station
New Haven

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STUDIES ON PARASITES OF THE ORIENTAL FRUIT MOTH

II. MACROCENTRUS ANCYLIVORUS

PHILIP GARMAN AND W. T. BRIGHAM

In conjunction with production of Trichogramma for control of the Oriental fruit moth, the results of which have already been reported, field and laboratory work was begun in 1929 on the larval parasite, *Macrocentrus ancylivorus* Roh. (Figure 1). This parasite was known to occur in limited numbers in Connecticut and to have survived in the Barnes peach orchard in Wallingford since 1926. Because of its general scarcity in many

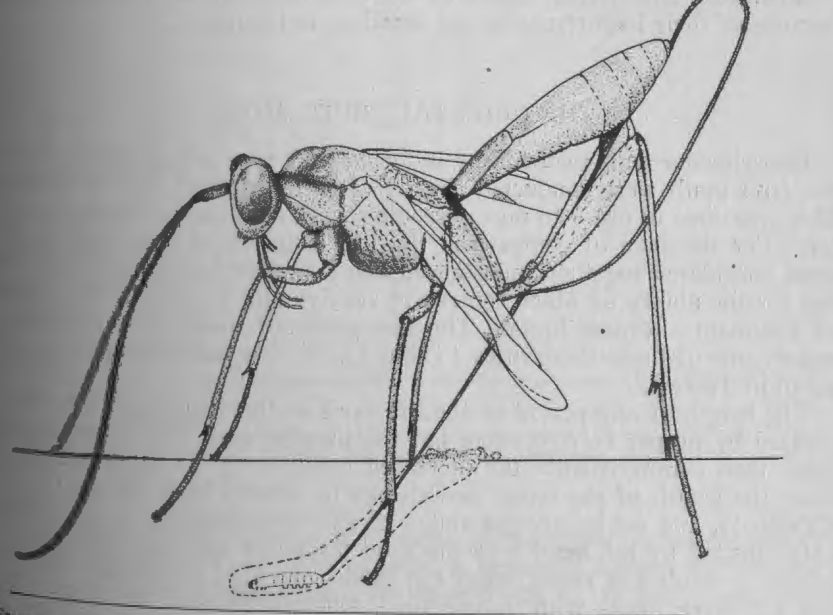

FIGURE 1. Side view of Macrocentrus female showing the method of depositing egg in the larvae of the Oriental fruit moth. The long antennae are apparently used to locate suitable larvae. (Greatly enlarged.)

Connecticut orchards and its entire absence from others, it was thought desirable to obtain them in considerable quantities for liberation. The strawberry leaf-roller[1] was first used as host for breeding but the Oriental fruit moth[2] was soon substituted because of serious difficulties in breeding leaf-

[1] *Ancylis comptana* Froel.
[2] *Grapholitha molesta* Busck.

rollers during the winter. The worst trouble was disease, which developed in the host larvae, and killed many before they could be utilized. Since this first attempt with the strawberry leaf-roller we have continued to use the Oriental fruit moth, but the difficulties preventing complete realization of our hopes with this host also seem to be numerous. Production of Macrocentrus on the same scale as Trichogramma is impossible at present, but we can see no reason for believing that Macrocentrus cannot be reared in much larger numbers than was possible during these studies.

Our work in the orchard, like that with Trichogramma, has been successful in some ways and unsuccessful in others. This has been due partly to the limited time given this phase of the problem. Our inability to establish the parasite in several important orchards indicates again the need of more extensive field operations. Observations in this state show that Macrocentrus is a distinctly desirable inhabitant of Connecticut peach orchards.

Before we were able to rear Macrocentrus successfully in any great numbers it was necessary to consider the host from a standpoint of its reaction to laboratory conditions. Some of the data obtained are included herein because of their importance in our breeding technique.

THE ORIENTAL FRUIT MOTH

Experiments with methods of inducing and preventing hibernation of the fruit moth were conducted shortly after the project was undertaken. This was done in order to make breeding work continuous during the winter. For the sake of comparison the life histories of host and parasite were considered together and showed many similarities probably accounting for the ability of Macrocentrus to survive our winters in the absence of abundant alternate hosts. The emergence of moths and parasites is merely one of these similarities (Table 1). A few other comparisons are given in Table 17.

The length of any period of the life cycle of the fruit moth may be increased by proper refrigeration, but the ill effects of this treatment may more than counterbalance the increased convenience in handling. Likewise, the length of the larval period may be altered by a change of food (Table 3), and we believe the ability to survive refrigeration is considerably affected by the quality of the food on which they are reared. The length of adult life varies when the moths are bred artificially, but may last for three weeks with proper food, temperature, and moisture. Egg deposition begins about two days after emergence from the cocoon, and may continue for four weeks (Table 17). In incubators and greenhouses during 1930 and 1931, egg deposition frequently reached a maximum four to six days after emergence, although in some cases this peak was not reached until 11 days afterwards (Figure 4). These facts are of some importance in breeding operations. For hibernating stocks it is essential to allow sufficient time to elapse for the hibernating instinct to be satisfied. Such larvae may be brought into higher temperatures after two to four months, and will usually pupate and emerge satisfactorily.

It is possible, however, to breed the fruit moth continuously throughout the season. This necessitates keeping the temperature high enough during the periods when the insect normally begins to hibernate, and continuing to breed at the same high temperatures during the winter. In 1932, our cage temperature averaged above 70° F. most of the time, and we regard the minimum for continuous work of this kind as around 75°.

TABLE 1. ORIENTAL FRUIT MOTHS AND MACROCENTRUS ADULTS FROM PARASITIZED OVERWINTERING LARVAE, 1931. SHOWING SIMILARITY IN PERIODS OF EMERGENCE

Date	Emergence of moths	Emergence of parasites
March 1	—	3
3	—	2
6	1	2
9	310	20
10	141	13
11	97	5
12	293	6
13	53	—
14	35	8
16	65	99
17	145	60
18	642*	28
19	363	78*
20	269	48
21	109	25
23	207	38
24	32	7
25	37	8
26	30	—
27	20	—
28	10	—
29	—	—

*Probable peaks of emergence.

NOTES: Placed in refrigerator in the fall of 1980 and kept there until February 17, 1931. Then put in an incubator at about 55° F. until February 25 when they were removed and placed at 75° F. until emergence.

It is also important to know the length of the different larval instars at constant temperatures in order to provide larvae of suitable age for the parasites. Some of our results are shown in Table 2. It will be seen that the first instar lasts two days in green apples at 80° F., that the second instar begins on the third day, and that the third begins on the fourth day. Larvae five days old are nearly all in the third stage. Those reared at 80° for four days will be largely in the second, but a part in the third instar, while those reared for three days will be in the second instar. In practice, owing to the irregularity of hatching, there is some variation in the larval stages. For the most part they have been uniform if eggs are used from a single lot, obtained in a single day. After six days at 80° the larvae are too old for parasitism because more than half are in the last instar.

FOOD REQUIREMENTS

Oriental fruit moth larvae may be reared on peaches (twigs and fruit), quinces, pears and apples. Green apples are the most practical from our standpoint, and are adapted to development of the fruit moth. The life cycle in apples is slightly longer than in peaches, but the advantage of the shorter cycle when reared in peaches, is negligible, especially when losses from fruit rots of the peach may more than balance the gain in time. By storing green apples in July, 1931 and 1932, it was possible to continue breeding work during the entire winter and spring of the following year.

Table 2. Oriental Fruit Moth Larvae Incubated at 80° F., 70 per cent Relative Humidity. Percentage of Each Instar Present on Successive Days

Instars	Days 1	2	3	4	5	6	7	8	9
First	100	100							
Second			100	76.4	2.0				
Third				23.5	97.9	75	10		
Fourth						3.8	21.6	10.9	
Fifth						21.1	68.3	89	100

Notes: Average of two experiments, 328 larvae measured. Based on width of head capsule. Reared in green immature apples.

Thinnings obtained in July from commercial orchards were used. To supplement this supply, which began to run short during late spring, we bought an additional quantity from a grower in Georgia. We have tried unsuccessfully, or with partial success, ripe or partly ripe apples and peach twigs grown in our greenhouse. Table 3 shows that the development period is considerably shorter, and that a much greater percentage of larvae mature in green apples than in ripe apples. When reared in green apple slices, the larvae will frequently mature within the slice if this is thick enough, but we have found it desirable, especially when large numbers of larvae are used, to provide extra food in the pans on which they may complete their development.

In the spring of 1931, we were partially successful in breeding Macrocentrus and its host, using peach twigs on seedling trees and transferring them with the larvae to pans containing sound storage apples. The rate of increase, however, was not great enough, and the method was discontinued after the first year.

ENEMIES

The chief enemies of the Oriental fruit moth reared under artificial conditions such as obtained at this Station during the course of these investigations were fruit rots, ants, and spiders. A secondary parasite also caused considerable trouble during the summer of 1932. Something has already been said about rots and development of the larvae. It has been noticed that apples from different sources rot differently, that is, some will produce a wet, slimy mess which apparently drowns the larvae before they have time to mature, while other apples rot with less moisture and become

Table 3. Tests of Different Foods for Rearing Oriental Fruit Moth Larvae

Food	Number eggs used	Number moths reared	Per cent maturing	Length of period, egg to adult, in days
Peach twigs	50	31	62	27.7
Ripe peaches	50	28	56	27.8
Green peaches	50	35	70	25.0
Green peaches	100	27	27	27.3
Green apples	50	50	100	30
Green apples	100	81	81	27.5
Green apples	500	229	45	31.2
Ripe apples	50	14	28	35
Ripe apples (western)	100	21	21	38.8
Ripe apples (western)	500	55	10	38.4

Notes: All experiments using 50 eggs were carried on simultaneously in similar containers. Those using 100 and 500 eggs were carried on simultaneously, but at a different time from those using 50 eggs.

pithy or corky, allowing the larvae to escape to new food when it becomes unsuitable for development. Most of our local fruit produces a wet rot, while some of the western fruit is considerably drier. However, with none of the ripe or partially ripe fruit, has production been entirely satisfactory from the standpoint of increase.

Ants of various species have caused trouble in our breeding cages by attacking and destroying the moths. During 1931 and 1932 measures were taken against them and they were eliminated as a factor in production. Likewise spiders gave and continue to give trouble, but only require watching and destruction before they become numerous enough to cut down production.

The secondary parasite, *Dibrachys boucheanus* Ratz., caused considerable difficulty in 1932 at a critical time. This parasite attacks the Macrocentrus larva after it has spun within the cocoon of the host. It will als parasitize the Oriental fruit moth, but seems to prefer Macrocentr larvae. In order to combat this enemy it appears to be necessary to rea all larvae in containers kept covered until emergence of the adult moth and parasites.

Larvae reared in peach twigs were subject to destruction by gum exuda tions, the cause of which is not fully understood. Trees in good growin condition support fruit moth larvae better than those in which growth partly or completely checked. Losses are frequently great if proper grow is not maintained and the twigs with larvae are not removed shortly afte exposure to parasites.

EFFECT OF WINTERING AND REFRIGERATION ON THE LARVAE

Hauessler states[1] that larval mortality of the fruit moth during the winter sometimes amounts to 70 per cent (in New Jersey) under field cond tions. Larvae reared in the insectary in New Haven did not average this much according to our data for 1928, 1929, and 1933. Stock reared in apples and stored in the refrigerator, however, may reach this figure and it was estimated that the average mortality of all stock kept over the winter in 1932 was 65 per cent. Moisture appears to be an important facto particularly in electric refrigerators, and all material kept here was plac in a moist box. Too much moisture so that the strips become damp is n desirable, for mold soon develops and destroys the larvae. If reared in rotting fruit, many undersized larvae spin in the strips and it is believ that these, being less hardy than the fully grown larvae, increase the mortality when attempts are made to carry them over the winter. Tests in 1932 seemed to indicate that larvae kept in an ordinary storage cellar were more successful in passing the winter than those carried through in a refrigerator. However, the most successful lot hibernated so far was one placed in an electric refrigerator in April, 1931, and removed in Septe ber of the same year. These showed a mortality of 10 per cent. Such d crepancies are difficult to explain but there are evidently many factors influencing the results that we do not fully understand. In 1933, there was much less mortality of fruit moth larvae reared in pans and hibernated in jelly glasses in an open insectary, than for those reared indoors and hibe nated in the storage cellar mentioned (Table 20).

Normally, during the summer the tendency to hibernate presents no difficulty in maintaining continuous breeding. During 1930 to 1931, hibernation began to be apparent in larvae from eggs laid about the first of August. Larvae produced under these conditions practically all hiberna after the first of September in 1930, even though moved to the greenho where temperatures were higher than prevailed in our insectary. Likew with material bred during the winter of 1930 there was no tendency to continue development and very few of the larvae transformed. In 1931 we began a new schedule. All larvae were brought indoors during Aug and kept at a uniformly high temperature. By this means we obtai continuous emergence of moths and a good egg yield throughout the wi

[1]Jour. Agr. Research, 41: 377. 1930.

ter. For example, in March, 1932, more than 6,000 moths emerged and we secured 112,000 eggs from our cages.

As already stated, hibernation of the insectary bred larvae is progres- greater after the first of August. Undoubtedly some temperature onship is connected with these changes in fruit moth habits, but from xperiments it is evident that short exposures of young larvae to cold do not necessarily produce hibernation (Table 4). Thus, in a series of four different treatments in which development was begun June 27 at 80° F. it is evident that four-day old larvae subjected to 45 to 50° F. for six days were not influenced. Larvae subjected to the same treatment, but

TABLE 4. EFFECT OF REFRIGERATION ON ORIENTAL FRUIT MOTH HIBERNATION

Refrigeration	Total larvae	Per cent hibernated
4-day old larvae hatching June 27		
None	54	11
2 days at 45–50° F.	144	11
4 days at 45–50° F.	82	1
6 days at 45–50° F.	231	6
6-day old larvae hatching July 15		
None	105	2
2 days at 45–50° F.	90	11
4 days at 45–50° F.	95	4
6 days at 45–50° F.	102	7
6-day old larvae hatching August 2		
None	14	0
2 days at 38–40° F.	34	8.8
4 days at 38–40° F.	67	5.9
6 days at 38–40° F.	55	3.6
4-day old larvae hatching August 10		
None	86	14
3 days at 38–40° F.	76	18
4 days at 38–40° F.	47	25
6 days at 38–40° F.	51	33

All larvae were reared on green apples, kept at 80° F. before and after refrigeration. emained at 80° for one month before examination after removal from the refrigerator.

six days old before being refrigerated, showed only a slight increase in the tendency to hibernate. For larvae refrigerated at 38 to 40° F. there was likewise a slight increase in hibernation of six-day old larvae hatching August 2. Material obtained and refrigerated in like manner August 10 showed a considerable increase in both check and refrigerated stock over those previously reared, but was greater for larvae subjected to cold in the refrigerator.

Our experience indicates that it is possible to carry larvae through the winter by placing them at 38 to 40° F. immediately after spinning. This method was largely followed in 1932.

EFFECT OF REFRIGERATION ON THE MOTHS AND EGGS OBTAINED FROM THEM

It became important at this point to know whether refrigeration of the moths, or the eggs obtained from them, would influence hibernation of the larvae in our breeding cages. A comparison of larvae from moths kept in refrigeration for three weeks with larvae from moths not subjected to refrigeration, showed no significant difference during the winter of 1932. Experiments were also conducted to learn if refrigeration has any effect upon egg-laying capacity of the females. A preliminary test indicated that three weeks' refrigeration at 38 to 40° F. considerably reduced the egg yield. A comparative test was then conducted in which moths of one, two, three and six weeks' refrigeration were placed in similar cages and kept under as nearly identical conditions as possible (Table 5). The egg

TABLE 5. EGG PRODUCTION FROM REFRIGERATED ORIENTAL FRUIT MOTHS, 1932

	Number days refrigerated				
	0	7	14	21	42
Egg-laying period, days	16	17	13	15*	3
Number of female moths used	50	56	58	102	50
Number eggs obtained	2,445	2,066	1,598	2,065*	41
Number eggs per female	48.8	36.8	27.5	20.2*	.8

*Average of two experiments.

NOTES: Moths confined in moist boxes in electric refrigerator at 40-45° F. Moths in egg production cages of similar size and shape kept in greenhouse under similar conditions. Period of tests January 12 to March 15, 1932.

yield was reduced for moths kept in the refrigerator for any and all periods in direct proportion to the length of cold exposure. Moths kept for seven days showed a much smaller decrease than those kept for longer periods, and in view of this it has been possible to keep moths for short periods in the course of breeding work when a surplus in this stage occurred.

During 1932 practically all egg stocks were placed at 40 to 45°, where they were kept for periods varying from a few days to two weeks. In spite of this treatment, there was no hibernation of the larvae and our moth production was not curtailed in any way. However, the egg mortality increases rapidly with prolonged exposure, as shown in Table 6, and it is consequently not advisable to keep them at this temperature more than two weeks.

EFFECT OF TEMPERATURE ON EGG-LAYING ACTIVITIES OF THE FRUIT MOTH

It was found shortly after the work was begun with the Oriental fruit moth as host for Macrocentrus, that temperature and moisture conditions had important effects upon the egg-laying phase of the moths' activities. Our first attempts at winter production were carried on in a greenhouse. Figures 2 and 3 show some of the effects of temperature variations in that

TABLE 6. EFFECT OF REFRIGERATION ON MORTALITY OF ORIENTAL FRUIT MOTH EGGS

40° F.

Number days refrigerated	Number eggs refrigerated	Date eggs were taken from refrigerator	Eggs dark spotted	Per cent eggs hatched
2	32	March 25	March 27	100
4	16	" 27	" 29	90
7	39	" 30	April 3	89
9	50	April 1	" 3	76
12	54	" 4	" 5	79
16	10	" 8	" 8	60
18	29	" 10	" 12	70
21	13	" 13	" 14	46
23	15	" 15	" 17	7
26	25	" 18	" 20	4
29	21	" 21	" 24	0
31	20	" 23	" 25	0

49° F.

Number days refrigerated	Number eggs refrigerated	Date eggs were taken from refrigerator	Eggs dark spotted	Per cent eggs hatched
2	18	March 25	March 27	100
4	20	" 27	" 29	90
7	53	" 30	April 1	92
9	35	April 1	" 3	97
12	20	" 4	" 5	95
16	50	" 8	" 8	82
18	86	" 10	" 11	81
21	17	" 13	In ref.	52
23	25	" 15	" "	60
26	31	" 18	" "	35
29	17	" 21	" "	23
31	17	" 23	" "	6
33	12	" 25	" "	0

NOTE: One larva emerged in 49° F. refrigerator on April 23. Eggs kept in jelly glasses with moist cotton in bottom. Electric refrigerator used.

house upon egg production. In view of these results, oviposition cages were moved to greenhouse incubators which were kept closed during the critical period of egg laying. The house was also kept warmer by special firing during late afternoon. Results were satisfactory. Later a special experiment was conducted in which the temperature was varied purposely and the effect noted on a number of caged fruit moths. It will be seen (Figure 4) that lowering of the temperature during the natural rise of egg laying, produced great fluctuations in the number of eggs obtained. From Figure 4 it is also evident that the peak of egg production is not reached sometimes until 11 days after emergence. Normally this occurs within a week. Our best results were obtained when the temperature was

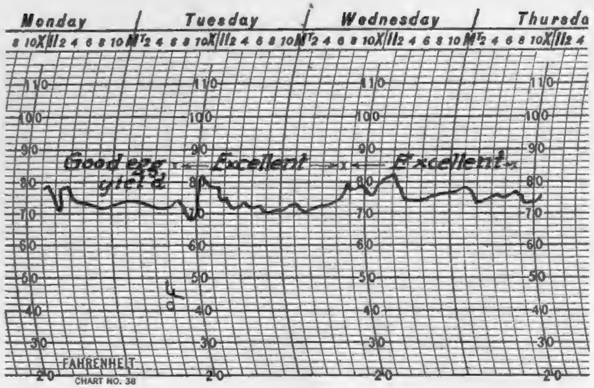

FIGURE 2. Thermograph chart showing variations in our greenhouse during favorable periods for obtaining eggs from the Oriental fruit moth.

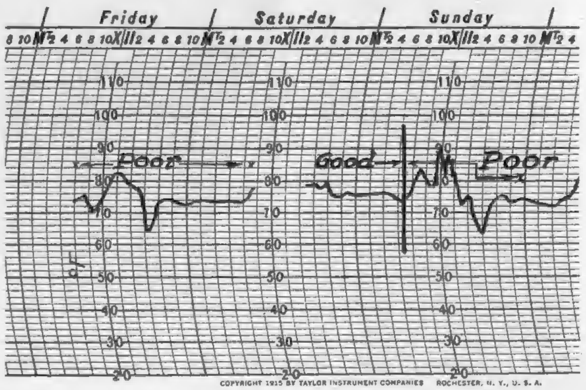

FIGURE 3. Thermograph chart showing two unfavorable and one moderately favorable period for egg-laying. The drop in temperature below 70° was responsible for almost complete failure although temperatures were high enough during the remainder of the day.

kept at 75° F. or above (not over 85°) most of the day, with special care not to allow a drop in temperature at sundown. Attempts were made at first to conduct the whole breeding work in basement incubators, but this was unsuccessful and all moths were moved to the greenhouse. With the

construction of the new Jenkins Laboratory, however, breeding has been more successful in basement laboratories and compares favorably with greenhouse production during the winter. However, we continued the use of greenhouse cages and incubators (Figure 7) for obtaining eggs from the fruit moth and find it to be the most satisfactory location for this work throughout the year.

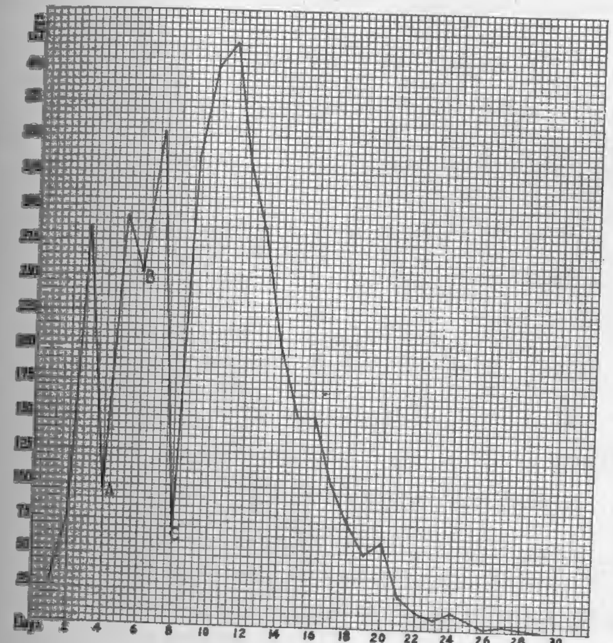

FIGURE 4. Chart showing the effects of lowering the temperature in a greenhouse where ovipositing fruit moths were kept. On days represented by A and C, the ventilators were opened enough to allow the temperature to drop below 65° F. in late afternoon. At B, the temperature dropped below 70° but not below 65°.

TIME OF EGG LAYING

When the temperature is properly regulated, egg laying takes place in general as the daylight fades. This naturally occurs in winter much earlier than in summer. Thus in November, 1932, 81 per cent of the eggs were apparently laid between 3 and 5 o'clock P. M. (Table 7), and about 89 per cent between 3 and 7 P. M. At other seasons, notably during the summer, the time of egg laying is somewhat later due to the light factor. Counts in August, 1933, showed the greatest number of eggs in our greenhouse cages were being laid between 5 and 7 P. M. Eastern standard time. On one very hot day oviposition did not take place until the temperature dropped in the evening. Little or no oviposition took place on this day until after 5 P. M. In August, the greatest number of eggs was laid between 6 and 7 P. M., but in September the most were obtained between 5 and 6 P. M. In both months by far the greater percentage was obtained between 5 and 7 P. M., standard time.

TABLE 7. TIME OF ORIENTAL FRUIT MOTH EGG PRODUCTION

Dates	10 A.M. TO 1 P.M.	1 P.M. TO 3 P.M.	3 P.M. TO 4 P.M.	4 P.M. TO 5 P.M.	5 P.M. TO 7 P.M.	7 P.M. TO 8:30 A.M.
Nov., 1932	0	17	257	1200	301	135
	4	191	1271	955	55	146
	0	0	92	603	101	5
Totals	4	208	1620	2758	457	286
Aug., 1933	0	5	1	4	825	955
	0	80	164	555	1505	117
Totals	0	85	165	559	2330	1072
Sept. 22, 1933	0	61	503	924	4970	90

METHODS OF HASTENING DEVELOPMENT AND INCREASING EMERGENCE AFTER BRINGING LARVAE FROM HIBERNATION

After bringing fruit moth larvae from hibernation, it has become apparent that frequent soaking is of some benefit in hastening development and transformation, but the difference is not very great in the total time before emergence of the moths. From Table 8 it may be seen that fre-

TABLE 8. EFFECT OF MOISTURE ON THE LARVAE OF THE FRUIT MOTH AFTER BRINGING FROM HIBERNATION

Moisture conditions	Average period in incubator 75–85° F.	Average period in incubator: 2–2½ hours in refrigerator daily	Average period before emergence in greenhouse
Paper cells without added moisture	31 days	34 days	35.5 days
Wet every other day	30 days	31 days	34.0 days
Difference	1 day	3 days	1.5 days

quent soaking with water, with a period for drying out, hastened the average development of the Oriental fruit moth one to three days. The best treatment recorded in the series of experiments (Table 9) were those in which the larvae were wet every other day and kept in an incubator at 75 to 80° F. after they were brought from hibernation.

MASS PRODUCTION

In order to rear large numbers of larvae, it is obviously essential to have plenty of moths and to place them in convenient cages with suitable air conditions. The most successful type of cage used consists of a cloth covered frame 21 by 30 by 15 inches, placed inside a celotex incubator below a glass window.[1] The cage is placed in a shallow pan of moistened sand and peach seedlings are put inside for oviposition. The leaves of the trees should come in contact with the cloth on top of the cage for best results.

TABLE 9. TESTS OF ORIENTAL FRUIT MOTH EMERGENCE, 1929–30, AFTER SHORT EXPOSURE TO COLD AND DIFFERENT MOISTURE TREATMENTS

Date brought from hibernation	Treatment	Moisture added	Per cent pupated on January 14	Average per cent transforming Jan. 14, 1930
December 23	Greenhouse overnight; next A.M. in incubator, thereafter in incubator 75–80° F.	(1) Dry	50	60.0
		(2) Wet every other day	72	
		(3) Wet every week	64	
		(4) Wet every other week	53	
December 23	Greenhouse overnight; next A.M. in incubator, 75–80° F. Thereafter in incubator except for 2–2½ hrs. daily in refrigerator at 38–40° F.	(1) Dry	34	41.2
		(2) Wet every other day	52	
		(3) Wet every week	47	
		(4) Wet every other week	31	
December 23	Greenhouse continually	(1) Dry	51	53.2
		(2) Wet every other day	62	
		(3) Wet every week	50	
		(4) Wet every other week	50	

NOTE: Twenty paper cells with larvae in each test; brought from hibernation to greenhouse.

The incubator is regulated to 75 to 80° F. and closed in the afternoon in order to keep up the temperature.

More than 630,000 fruit moth eggs were obtained in our cages during 1931 (Table 11). The work was continued and resulted in more than a million and a half eggs in 1932. Our maximum production was reached in August, 1933, when 376,000 were obtained in one month. The greatest number obtained in one month during the winter was 80,000 in January, 19

Heretofore it has been considered inadvisable to breed the fruit moth during the winter because of unfavorable ratios of increase, but the last

[1] Actual dimensions of the cage are not so important as having the entire inside surfaces covered with cloth. This prevents the moths from laying eggs on the smooth wood surface of the frame.

three seasons' work has shown that this is not a serious or insurmountable obstacle. While we do not have records for the entire period in which the breeding work was carried on, we have records of some 15,000 moths confined in our cages. Their ratio of increase averaged 17 to 1 (Table 10). However, more accurate tests indicated (Table 5) that we were getting as high as 24 to 1 for moths that had not been subjected to refrigeration, and a maximum of 30 to 1 was obtained in some of the cages.

TABLE 10. ORIENTAL FRUIT MOTH RATIO OF INCREASE DURING FALL, WINTER AND SPRING; GREENHOUSE, 1931

Month	Number moths	Number eggs obtained	Potential ratio of increase
January	514	4,773	9 to 1
February	321	3,358	10 to 1
March	2,706	40,000	14 to 1
April	2,272	70,000	30 to 1
October	4,969	63,243	12 to 1
November	3,583	54,538	15 to 1
December	1,371	39,160	28 to 1
Totals	15,736	275,072	17 to 1

TABLE 11. ORIENTAL FRUIT MOTH EGG PRODUCTION

Month	Eggs	Month	Eggs
1931			
January	4,773	July	107,000
February	3,358	August	42,355
March	40,000	September	74,800
April	70,000	October	63,243
May	65,405	November	54,538
June	67,430	December	39,140
		Total	632,042
1932			
January	81,817	July	202,100
February	96,320	August	85,000
March	112,960	September	95,160
April	146,365	October	66,900
May	211,000	November	81,036
June	234,000	December	121,800
		Total	1,534,358

SEX RATIO OF REARED MOTHS

Since there has been a general predominance of male Macrocentrus in our breeding cages during the winter months, we were interested to know

if this also held true for the fruit moth. It appears that the sexes of the fruit moths are more evenly divided both in collections from the field and in laboratory bred individuals, than the parasite. During July and August, 1932, the percentage of males emerging was 52. Counts made of a large number of bred overwintered stock emerging in the spring of 1932 averaged 53 per cent males, while counts made during the winter of this year showed 50 per cent males. It appears, therefore, that there is little difference between the ratio of laboratory stocks and field collected material.

OTHER HOSTS AND CLOSELY RELATED SPECIES OF MACROCENTRUS

Muesebeck[1] (1932) lists eight other hosts of *ancylivorus* besides the Oriental fruit moth. These are as follows: *Ancylis comptana* Froel., *Epiblema strenuana, Canarsia* sp., *Epagoge* sp. (Virginia 1910), *Carpocapsa pomonella* Linn. (New Mexico, 1912), and *Exartema sericorana* Walsingham (Westerly, R. I., 1917).

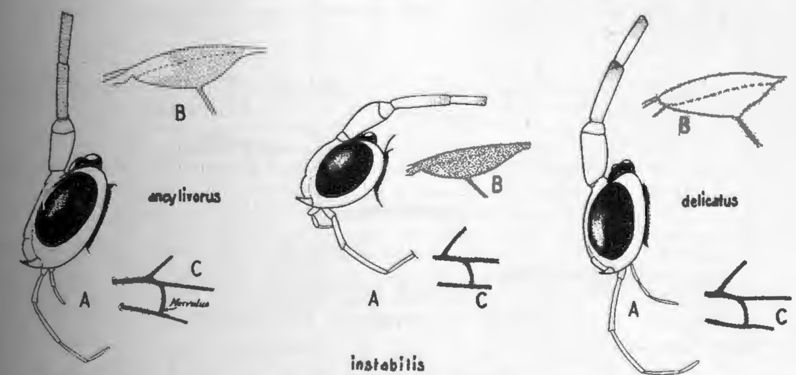

FIGURE 5. Structural differences between the three Connecticut species of Macrocentrus known to parasitize the Oriental fruit moth. A, head, showing comparative lengths of the maxillary palpi and the basal segments of the antennae; B, stigma showing absence or presence of brown color; C, structure of the nervulus of the front wing and associated veins.

These data would seem to answer the question as to whether *ancylivorus* is a native or introduced parasite, since collection records of the parasite were made prior to the date of fruit moth introduction. The record of recovery from *Exartema sericorana* is interesting because the locality is so near Connecticut. In fact, the host has been recorded al o from Connecticut and it is known that members of this genus are small leaf tiers about the size of the Oriental fruit moth. It might easily serve as an alternate host for *ancylivorus* during periods of fruit moth scarcity or inaccessibility.

Muesebeck has also analyzed the genus in detail and described several new species. The species occurring in the Oriental fruit moth are *M. an-*

[1]Muesebeck, C. F. W. Proc. U. S. Natl. Mus. 80. Art. 28, pp. 1-55. 1932.

cylivorus, M. delicatus, M. instabilis, and *M. laspeyresiae*[1]. Of these, we have reared *ancylivorus, delicatus,* and *instabilis* in Connecticut, although only *ancylivorus* is abundant. A tabular summary of some of the characters for separation based on the work of Muesebeck is given below.

TABLE OF CHARACTERS FOR SEPARATING THE SPECIES OF MACROCENTRUS INHABITING THE ORIENTAL FRUIT MOTH

Ancylivorus	Delicatus	Instabilis
Palpi: longest segment no longer, usually shorter than 2nd segment of antennal flagellum	Palpi: longest segment longer than 2nd segment of antennal flagellum	Palpi: longest segment longer than 2nd segment of antennal flagellum
Stigma brown with pale area at base	Stigma yellow	Stigma uniform brown
Male scape not strongly enlarged	Male scape strongly enlarged	Male scape strongly enlarged
First tergite of abdomen more or less impressed	First tergite of abdomen not impressed	First tergite of abdomen impressed
Nervulus never postfurcal by as much as its own length	Nervulus postfurcal by its own length, or nearly so	Nervulus postfurcal by its own length

Some of the characters mentioned are shown in Figure 5. The larvae will doubtless be more difficult to separate, but as a genus they appear to have prominent features.

THE LARVAL PARASITE, *MACROCENTRUS ANCYLIVORUS* ROHWER

LIFE HISTORY AND HABITS

Macrocentrus ancylivorus passes the winter within the hibernating larvae of the fruit moth or other related host. It emerges in the spring a little later than the adult fruit moth, the period of emergence lasting several weeks (May 28 to June 21, 1933). The emergence period continued for six days in our insectary in 1932 and for three weeks in 1933. Owing to the habit of delayed emergence in the fall, and to the fact that the fruit moth larvae infesting fruit are not heavily parasitized because they cannot be reached, there results a small parasite population in the spring, probably because alternate hosts are not present in abundance. The early summer percentage of parasitized fruit moth larvae is usually low in Connecticut, which may be connected in some way with scarcity of alternate hosts. During June and particularly July, fruit moth larvae are common available to the parasite in considerable numbers so that parasitism fre-

[1]*Laspeyresiae* is now regarded as a synonym of *instabilis* by Dr. Muesebeck.

quently increases during July. By August, 80 to 100 per cent of the twig feeding larvae may be parasitized.

It is evident in part from the length of the life cycle, which averages 28.8 days in midsummer, that three broods may develop under Connecticut conditions. There is considerable variation in time of emergence from stock parasitized at the same time so that there must be considerable overlapping of broods in the field, perhaps more so than is found in the case of its host, the fruit moth. Second and third generation adult emergence overlapped in our insectary work in 1932. Adults of the first generation emerged July 6 to July 23, those of the second generation August 1 to September 5, and the third generation from September 1 to November 15. There was no fall emergence from larvae parasitized after the first of September and in 1932 to 1933 adults emerged in June from stock parasitized the previous August, the earliest dates of parasitism being August 9 to 10 in 1931, and August 5 to 6 in 1932.

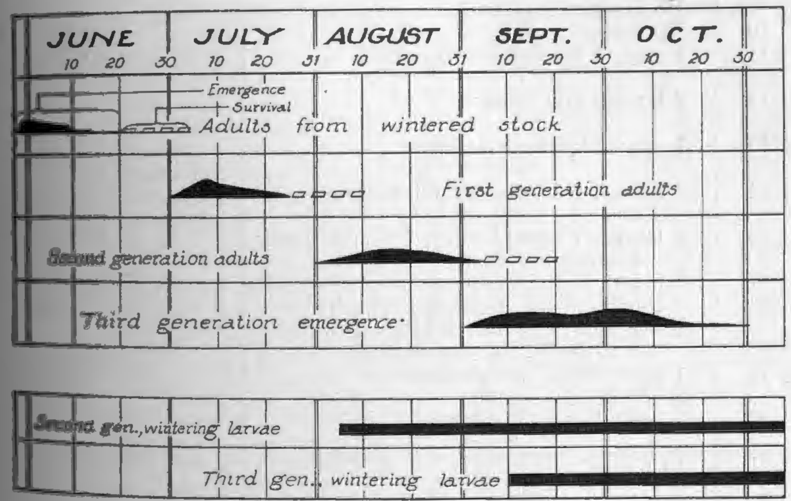

FIGURE 6. Graphic chart of Macrocentrus life history as determined by insectary breeding.

In general the life cycle from egg to adult consumes 21 to 49 days in summer, the average of 782 individuals reared during July and August 1931 being 28.8 days (Table 14). The average length of the cycle in June 1932 was 33 days, in July 29 days, in August 38 days and in September 70 days. The range according to our determinations is 19 to 88 days. There is usually a period of one to four days before egg-laying begins, which brings the total life cycle in midsummer to 30 to 33 days. The only observations on the different stages of development were made at 80° F. (Table 12). At this temperature, an incubation period of 4 to 5 days was observed and a period of 12 to 13 days from the day of exposure to the first pupation. It required 18 to 19 days to produce the first adult and the [illegible] period required 6 days for three individuals. The greatest emergence of parasite adults occurred two days after the greatest emergence of moths, which indicates a considerably shorter life cycle for the parasite than its host at 80°. From date of exposure to peak emergence required 20 to 21 days.

In general the life periods are very similar to those of the fruit moth. The greatest deviations are in the greater spread of the adult emergence in the case of Macrocentrus, and the longer period of emergence in the fall. Macrocentrus adults begin to emerge from overwintered parasitized

TABLE 12. COMPARISON OF LIFE HISTORY OF THE ORIENTAL FRUIT MOTH AND *Macrocentrus ancylivora* REARED AT 80° F.

Dates	Macrocentrus	Oriental fruit moth
April 6–7	Exposed on these dates	Larvae 4 days from black spot stage
April 7	No larvae found	
April 8	No larvae found	
April 9	No larvae found	
April 10	No larvae found	
April 11	1 egg; 2 larvae, first instar	Fruit moth larvae, just beginning to spin
April 12	2 larvae, first instar	Fruit moth larvae, spinning
April 13	1 egg; 5 larvae, first instar	Fruit moth larvae, spinning
April 14	7 larvae, 4 first, 3 second instar	Fruit moth larvae, spinning
April 16	4 larvae, 1 first, 1 third, 1 fourth instar feeding externally	2 fruit moth pupae
April 17	1 fourth instar, spun	4 fruit moth pupae
April 18	1 fourth instar, feeding internally 1 fourth instar, feeding externally 3 spun larvae, not pupated	6 fruit moth pupae
April 19	1 spun larva, not pupated 4 pupae	
April 20	2 spun larvae, 6 pupae	2 adult fruit moths removed
April 21	10 pupae	4 adult moths removed
April 22	....	4 adult moths removed
April 23	....	8 adult moths removed
April 25	1 ♂ 1 ♀ adult	18 adult moths removed
April 26	3 ♂ 2 ♀ adults	13 adult moths removed
April 27	7 ♂ 2 ♀ adults	5 adult moths removed
April 28	— 2 ♀ adults	1 adult moth removed
April 29	1 ♂ 1 ♀ adult	2 adult moths removed
April 30	1 ♂ 1 ♀ adult	3 adult moths removed

NOTE: These observations were made on a single lot of parasitized larvae from which samples were removed on consecutive days until April 21. The young larvae were dissected until all the parasite larvae were found to be feeding externally or were within their cocoons.

fruit moth larvae about a week after the moths begin to emerge, thus giving the host time to develop to a point where the parasite is ready to begin oviposition. The cycles of both host and parasite are so well synchronized that there would appear to be little difficulty for the parasite to survive in the fruit moth alone, especially when it is considered that larvae parasitized August 5 to 6 survived the winter successfully (Figure 6).

TABLE 13. MACROCENTRUS LENGTH OF EMERGENCE PERIODS, 1930 TO 1931

1930

Date exposed	Emerged	Length of emergence, days
July 6	August 2 — August 15	13
" 12	" 4 — " 29	25
" 15	" 5 — " 20	15
" 31	" 24 — Sept. 13	20
	Average	18

1931

Date exposed	Emerged	Length of emergence, days
March 17	April 12 — April 16	4
" 18	" 18 — " 30	12
April 21 — 2	" 13 — May 27	45
" 22 — 3	" 16 — " 28	43
" 23 — 4	" 16 — April 21	11
" 28 — 9	" 21 — May 31	40
" 11 — 12	May 9 — " 19	10
" 13 — 14	" 9 — June 2	23
" 15 — 16	" 11 — May 22	11
" 17 — 18	" 8 — " 31	23
" 20 — 21	" 15 — June 17	33
" 28 — 9	" 19 — " 17	29
May 1 (10–3 P.M.)	" 25 — " 8	14
" 12 (2 hrs.)	" 4 — " 19	15
" 16 — 17	June 8 — " 26	18
	Average of all records	21

TABLE 14. MACROCENTRUS: DATA ON LIFE CYCLE, SUMMER

Date of exposure	Number emerging	Egg to adult average, days	Egg to adult range, days
July 6	43	32	29–42
" 12	88	27.9	23–49
" 15	199	24.3	21–40
" 31	452	31.2	24–45
	782	28.8	21–49

The length of Macrocentrus adult life varies considerably. Studies on the maximum life under insectary and greenhouse conditions gave an average maximum of 15 days for both greenhouse and insectary with a range of 10 to 26 days for greenhouse and 8 to 22 days for insectary cages. The average length of life, however, probably does not exceed 10 days in midsummer. Some females live and oviposite much longer.

As indicated previously (Figure 4), the peak of fruit moth oviposition may not occur until more than a week after emergence. Similarly, the peak of Macrocentrus oviposition does not occur in midsummer until nearly a week after emergence (Tables 23 and 24). On this basis five to

TABLE 15. EMERGENCE OF ORIENTAL FRUIT MOTHS AND MACROCENTRUS FROM LARVAE EXPOSED TO MACROCENTRUS, JULY 31
Insectary Records

Species	August											September						
	17	19	21	22	24	25	27	28	29	30	31	1	3	5	7	10	12	13
Oriental fruit moths	6	1	18	29	69	50	58	2	31	30	4	7						
Macrocentrus adults					1	2	1	76	102	101	67	32	30	21	13	3	2	1

seven days would have to be added to the average length of the life cycle in midsummer, bringing the total to 34 to 36 days under favorable conditions. This would represent the time between peaks of abundance for successive generations reared from adult Macrocentrus emerging on a given date, or the time from the peak of one generation to the one following. On the other hand, as indicated, there is an unusual spread in the adult emergence of Macrocentrus from material exposed on the same day, so that different broods would soon overlap after initial spring emergence. Figure 6, based on insectary bred parasites, presents this condition graphically.

If the peak of emergence fell on June 1 as it did in 1933, then the following theoretical history would occur.

	Peak emergence		Peak oviposition		Peak emergence
1st generation	June 1	6 days	June 7	33 days	July 10
2nd generation	July 10	6 days	July 16	29 days	August 14
3rd generation	August 14	6 days	August 19	38 days	September 26

The majority of the third generation would hibernate as actually occurred, and the peak emergence of the different generations would coincide quite closely with the observed dates in our insectary. It should be pointed out that the period between emergence and peak oviposition is variable and might easily account for a shift in the length of the life period.

However this would be relatively small and would probably not greatly influence the life cycle.

TABLE 16. MAXIMUM LENGTH OF LIFE UNDER GREENHOUSE AND INSECTARY CONDITIONS

Dates of emergence		Maximum length of life
Greenhouse		
January	30	26
February	7	15
February	16	15
March	16	15
May	18	12
May	24	10
June	1	16
	Average	15 days
Insectary		
July	21	10
August	2	8
August	2	13
August	2	22
August	2	21
August	1	20
August	12	18
August	17	14
September	1	17
	Average	15 days

COMPARISON OF THE LIFE HISTORY OF MACROCENTRUS AND ITS HOST THE ORIENTAL FRUIT MOTH

The general similarity (of the different life periods) between the fruit moth and its parasite are indicated in the following table.

TABLE 17. COMPARISON OF LIFE PERIODS OF MACROCENTRUS AND FRUIT MOTH

Periods	Oriental fruit moth, days	Macrocentrus ancylivorus, days
Egg to adult (midsummer)	31	28.8
Pre-oviposition	2—4	1—4
Oviposition	11—28	7—18
Average period adult emergence from eggs of same date	10	27
Maximum ad[illegible]	30	26

MATING AND OVIPOSITION OF THE PARASITE

As stated by many authors, mating of the parasite takes place shortly after emergence from the cocoon. Males will mate, however, for at least four days after emergence, or after prolonged refrigeration. The most suitable temperatures appear to be between 70 and 80° F., with the humidity between 40 and 80 per cent. When the temperature rises much above 80° or drops below 65° F. there is a decrease in this activity. Very strong light is not desirable.

It has been stated that oviposition occurs mainly in late afternoon and night. Although this is true in midsummer, on the approach of cool weather oviposition may occur throughout the day and is much reduced or absent during the cooler periods of morning or evening. Oviposition is furthermore continuous in our indoor cages during the day whenever temperature, light and humidity are suitably adjusted.

Temperature Relationships

Below 60° F.	Inactive	no oviposition
60 — 65° F.	Sluggish	occasional oviposition
65 — 78° F.	Active	good oviposition
78 — 90° F.	Sluggish	occasional oviposition
90° F. or above		no oviposition

We consider 70 to 75° F. and 60 to 70 per cent relative humidity to be optimum atmospheric conditions for the various activities of adult *Macrocentrus ancylivorus.*

TABLE 18. EMERGENCE OF MACROCENTRUS FROM WINTERED MATERIAL

Date exposed	Emerged fall of 1930		Emerged spring of 1931		Per cent Spring emergence
	Males	Females	Males	Females	
September 1	114	64	16	8	11.9
" 2	120	39	22	6	15.0
" 3	31	10	7	2	18.0
Totals	266	113	45	16	13.9

WINTERING HABITS

On September 1 to 2, 1930 a number of fruit moth larvae were exposed to Macrocentrus. From this exposure three males and two females emerged in October and two males in June, 1931. A much larger emerged as shown below in Table 18. A still larger lot was carried through the winter in 1932 to 1933. The results indicated that a small percentage of those parasitized early in August pass the winter, whereas a much larger percentage of those parasitized in September carry over (Table 19).

TABLE 19. PERCENTAGE OF MACROCENTRUS PASSING THE WINTER FROM EXPOSURES IN 1932

[redacted]ates of exposure	Per cent passing winter
[redacted]ugust 1 — 2	0.0
" 3 — 4	0.0
" 5 — 6	0.7
" 7 — 8	0.9
" 10 — 11	3.8
" 18 — 19	9.9
" 19 — 20	14
" 23 — 24	65
" 24 — 25	40
" 25 — 26	14
" 27 — 28	56
" 28 — 29	50
" 29 — 30	21
Sept. 3 — 4	90
" 10 — 11	100
" 29 — 30	100

TABLE 20. RESULTS OF VARIOUS TREATMENTS ON WINTER SURVIVAL OF MACROCENTRUS AND ORIENTAL FRUIT MOTH, 1932 TO 1933

[redacted]ates exposed to [redacted]acrocentrus	Moths emerged	Dead larvae and pupae	Fruit moth mortality %	Parasitism %	Macrocentrus emerged, per cent of total larvae used	Estimated loss of Macrocentrus %
Ice refrigerator to May 10; May 10, insectary to emergence						
10/21 — 11/18	463	659	51	29	9	50
Common storage cellar at Mount Carmel to May 10; May 10, insectary to emergence						
[redacted]	416	292	31	35	23	37
...ectric refrigerator to July 10; Indoor cage July 10 to emergence						
3/13 — 3/29	298	697	69	31	12	58
Reared in insectary where they were kept until emergence						
8/7 — 10/14 [redacted]	423	126	18	28	12	42

Fink states that *Macrocentrus ancylivorus* passes the winter as a first stage larvae within the host. This is easily demonstrated by examination of overwintering larvae. It is also known that eggs or spun Macrocentrus larvae do not pass the winter successfully out of doors. In view of these facts, it appears necessary to get host larvae into hibernating quarters before the parasite larvae develop beyond the first instar, and to start this hibernation at a temperature high enough to allow all Macrocentrus eggs to hatch. In 1931 to 1932 larvae were removed from breeding pans soon after spinning and placed in refrigeration at 38 to 40° F. Some of these were later removed and put in storage at Mount Carmel in a common storage cellar. Others were removed to the insectary, where they were stored in an ordinary ice box provided with ice to keep down the temperature. None of these schemes were entirely satisfactory due to high winter mortality both of parasites and hosts, but were effective in preventing transformation before the desired time. In order to decrease winter mortality, paper strips waxed with beeswax were used for the larvae, but this likewise failed to increase the percentage wintering successfully. Results of some of this work is shown in Table 19.

LENGTH OF THE OVIPOSITION OR EGG-LAYING PERIOD

It has been noted that oviposition does not begin normally until several days after emergence from the cocoon. It is of some interest to know how long the adult parasite will continue to oviposit. The following table indicates that they will continue for 18 days under suitable conditions, but in general the maximum does not average more than 12 days. It will be seen from Table 31 that 50 to 60 per cent of the adults in cages die in five days, but in the orchard unless unfavorable conditions prevail, it is probable that the average is more nearly that of the maximum obtained in insectary cages (Table 21).

TABLE 21. MAXIMUM LENGTH OF OVIPOSITION PERIOD

Dates of exposure	Length of period, days
March 5—26	18
March 6—19	13
April 24—May 1	7
April 23—May 1	8
May 5—21	16
July 8—13	5
July 12—21	9
August 2—20	18
Average	12 days

The length of the oviposition period is affected in insectary and greenhouse cages by too high or too low a temperature. This also influences the longevity. Unlike some insects, whose life periods are increased in cool weather, Macrocentrus did not survive appreciably longer in the fall than in summer (August), nor was the oviposition period noticeably longer.

RATIO AND RATE OF INCREASE

Fink (7) has stated that 768 eggs have been dissected from the ovaries of a single adult Macrocentrus. This means a very high potential ratio

of increase provided every egg is deposited successfully in a larva containing no others. Since this maximum is seldom reached, either under natural or other conditions, it was considered desirable to find out just what increase might be expected from material bred in our laboratories. Table 22 shows that 50 reared adults per female may sometimes be obtained. This is the average of 15 individuals. There is little doubt that certain long-lived adults produce more than this. The average of 11 tests indicate that the increase obtained in our cages was not more than 24 for each female, or, if equal sexes were considered, 12 for each individual.

TABLE 22. MACROCENTRUS RATIO OF INCREASE, 1932

Dates	Females used	Macrocentrus reared	Number per female
*March 5—26	15	757	50
*March 6—22	15	575	38
*April 22—May 1	4	63	15
*April 22—May 1	9	113	12
*May 5—23	10	165	16
*May 5—23	10	128	13
June 28—July 5	12	44	3
June 27—July 13	17	248	14
July 11—21	9	279	31
July 21—31	11	153	14
August 2—24	40	1,159	29
Totals and averages	152	3,684	24

Tests in greenhouse.

These tests do not, of course, take into consideration losses in rearing. We know that the ratio of increase, for example, is considerably less when the fruit moth larvae are reared in seedling twigs and then transferred to apples. We also know that the ratio is considerably reduced when the fruit moth is reared in ripe instead of green apples. The figures in Table 22 are the best obtained using green apples according to our method.

Two experiments were conducted in 1932 to show the rate of increase from day to day, to learn when the greatest oviposition occurred and, if possible, how many larvae each female parasitized each day. It is evident that during the height of the oviposition period, 10 to 15 larvae may be parasitized each day by a single female (Table 23). Under the conditions of experiment the maximum oviposition occurred between the eighth and tenth day after emergence in one case, and between the seventh and tenth day in the other. After the tenth day, oviposition dropped off rapidly in both instances. The greatest mortality was evident after the first day, which was probably due to previous treatment of the adults. Two other tests (Table 24) indicated, however, that oviposition may continue at a maximum for 14 days under favorable conditions.

The ratio of increase was not influenced (Table 25) by refrigeration up to 13 days at 40 to 45° F. This treatment likewise had no effect upon the sex ratio. It is believed that longer periods of refrigeration at this temperature are not desirable since they tend to weaken the adult and shorten its life.

TABLE 23. RATE OF INCREASE ON SUCCESSIVE DAYS

Experiment 1

Dates	Number females present each day	Macrocentrus reared	Number per female	Per cent males
March 6	15			
" 7	9	65	4	69
" 8	9	58	7	63
" 9	9	57	7	59
" 10	7	84	9	79
" 11	7	40	5	85
" 12	7	50	7	62
" 13	—	40	5	60
" 14	5	45	9	85
" 15	5	51	10	82
" 16	4	60	12	93
" 17	3	3	.7	66
" 18	2	5	1	40
" 19	2	8	4	87
" 20	2	0	0	0
		575		74

Experiment 2

Dates	Number females present each day	Macrocentrus reared	Number per female	Per cent males
March 5	15			
" 6	8	93	6	46
" 7	—	90	11	63
" 8	—	78	—	65
" 9	6	73	—	45
" 10	5	82	13	53
" 11	5	60	12	53
" 12	4	76	15	42
" 13	4	36	9	61
" 14	4	53	15	45
" 15	4	51	15	78
" 16	4	37	9	78
" 17	4	5	1	80
" 18	3	3	.7	66
" 19	3	4	1	100
" 20	3	0	0	0
" 21	3	6	2	83
" 22	3	0	0	0
" 23	3	10	3	10
" 24	3	0	0	0
" 25	3	0	0	0
		757		56

[illegible]LY PARASITISM, LONGEVITY AND RATIO OF INCREASE EXPERIMENT, 1932

Date	Cage 1: Number Macrocentrus placed in cage — Males	Cage 1: Number Macrocentrus placed in cage — Females	Cage 1: Number Macrocentrus reared	Cage 2: Number mated females in cage	Cage 2: Number Macrocentrus reared
Nov. 1	10	10	1	10	4
" 2			11		23
" 3			46		21
" 4			37		39
" 5			47		43
" 6			35		31
" 7			18		16
" 8		8	10	3	28
" 9		8	26	3	17
" 10		8	21	3	23
" 11		7	28	2	9
" 12		7	34	2	7
" 13		5	13	1	2
" 14	3	4	16	1	0
" 15	2	3	30		
" 16	2	3	29		
" 17	2	3	12		
" 18	1	2	5		
" 19	1	2	9		
" 20	0	2	4		
" 21		1	1		
			435		263

NOTE: 63 per cent males; increase 43 per female; 16 females per female reared; longevity 21 days.

NOTE: 88 per cent males; increase 26 per female; 16 females per female reared; longevity 14 days.

TABLE 25. COMPARISON OF SEX RATIO, AND RATIO OF INCREASE, USING REFRIGERATED AND NON-REFRIGERATED MACROCENTRUS

Refrigeration[1]	Number Macrocentrus used	Number reared: Males	Number reared: Females	Ratio increase per individual	Increase per female	Females per female	Per cent males
None	30 ♂ 30 ♀	634	201	14	27	6	75
3 days	30 ♂ 30 ♀	464	216	11	22	7	68
None	30 ♂ 30 ♀	233	145	6	12	4.8	61
7 days	30 ♂ 30 ♀	294	221	8	16	7	57
None	30 ♂ 30 ♀	261	322	9.7	19	10	44
13 days	30 ♂ 30 ♀	304	152	7	14	5	66
Totals for none	90 ♂ 90 ♀	1128	668	9.9	19.9	7.4	62
Totals for refrig.	90 ♂ 90 ♀	1062	589	9	18.3	6.5	64

[1] 40–50° F.

EFFECT OF HIBERNATION ON SEX RATIO AND RATIO OF INCREASE

In order to learn if hibernation has any effect on the ratio of increase or upon the sex ratio, four cages of equal size were provided with adults, approximately the same number of females being used in each cage. These data are shown in Table 26, and indicate that the ratio of increase is not less in the case of hibernated stock. Accordingly, there should be no disadvantage in liberating hibernated Macrocentrus in orchard work.

TABLE 26. EFFECT OF HIBERNATION ON INCREASE AND SEX RATIO OF MACROCENTRUS

Treatment	Number females used	Number reared per female	Per cent males
Freshly reared	21	25	56 and 66
Hibernated	19	33	49 and 69

These tests were all made simultaneously during August. Cages of equal size were used and large quantities of fruit moth larvae were provided throughout in each cage. The hibernated stock was held over in a refrigerator until July.

SEX RATIO

It was observed during 1930 that approximately five females to every four males emerged from stock collected in the field in New Jersey during June and July. Since this ratio was based on a count of 9,000 individuals, it was considered significant. The count was, however, repeated again in 1931 and the ratio found to be the same within 1 per cent. Macrocentrus bred under artificial conditions in 1930 began with approximately the same number of males in midsummer, but the ratio of males increased as the summer advanced until three males to every female were often obtained. During the course of these experiments several factors have been investigated. Temperature seemed to play an important part, but a predominance of males often remained even when reared under controlled temperatures. It is true that mating occurs most readily between 70 and 80° F., so that the decrease of females noted in 1930 may have been due to temperatures below the optimum for this activity, in that an excess of unfertilized females resulted. However, in 1932, cages similar to some of our greenhouse cages kept in the insectary during August gave 57 per cent males for 1,159 individuals, whereas 15,000 Macrocentrus reared in our greenhouse between January and June gave exactly the same percentage.

It was thought possible that the age of the exposed fruit moth larvae might affect oviposition by unmated females. There is an indication that the age has some effect (Table 27), but results are variable and it is apparent that other factors are more important. Experiments were then made with special mating cages in which equal numbers of males and females were first placed, then excess males, and finally only known mated females. Results of these tests are shown in Table 28. It would appear from the figures that methods of handling the adults before placing them in the cage for exposure to fruit moth larvae, constitutes a very important means of reducing the unfavorable sex ratio of this species in the laboratory.

In view of the foregoing facts, attempts were made to breed Macrocentrus by means of a special mating cage that contained a large number of males, transferring the females after one day to a second cage with fruit moth larvae. This method was also directly compared (Table 24) with the method by which the sexes were equal in number and exposures to fruit moth larvae were made in the cages without transference of the females. It became evident that the extra operation was laborious, the loss of females even in the special mating cage for one day was considerable, and the final results in production were discouraging. Incidentally (Table 24) it became evident that the actual increase of females for each female was no greater in the case of the mated and transferred individuals as compared with parasites placed in the cage without previous mating. Finally a series of seven cages was used in the following way in order to increase the percentage of females reared.

TABLE 27. TESTS WITH DIFFERENT AGE OF FRUIT MOTH LARVAE FOR EXPOSURE TO MACROCENTRUS

Age of fruit moth larvae[a], days	Per cent male Macrocentrus	Number tests	Number Macrocentrus reared
7 to 9	82	5	92
6 to 7	64	13	396
5 to 6	59	8	193
4 to 5	60	10	243

[a]From black spot stage, held at 80° F.; reared in green apples.

All adults from emergence cages (stock emerging in one day) were placed together in cage 1. After one day the males were collected and placed in cage 2, together with the males and females emerging the second day. This gives an excess of males in cage 2, but in order to prevent losses of females from too large an excess, such as occurred in previous tests, only enough males are used to bring the ratio to 2 to 3 males for every female. On the third day this is continued with cage 3, and so on until the end of the week, when the process is repeated with cage 1. Results with this procedure so far have been satisfactory and indicate that 50 to 55 per cent females are easily secured with the method.

RATIO OF FRUIT MOTH EGGS TO NUMBER OF MACROCENTRUS REARED

In order to give some idea of the number of fruit moth eggs needed for rearing a stated number of parasites, it is interesting to note that during a successful breeding period (August, 1931) we used a total of 42,000 fruit moth eggs. With this number a total of approximately 3,000 Macrocentrus was reared, or in other words, 14 fruit moth eggs

TABLE 28. EFFECT OF DIFFERENT TREATMENTS ON THE PERCENTAGE OF MALES

Treatment	Dates	Number reared	Per cent males
Equal number males and females in mating cage; 1 day in mating cage; only females in exposure cage.	Feb. 9 – 16	338	70
Equal number males and females in mating cage; 2 days in mating cage; only females in exposure cage.	Feb. 9 – 16	457	70
Large excess males in mating cage; 1 day in mating cage; females only in exposure cage.	Mar. 5 – 26	757	56
Equal number males and females in mating cage; 1 day in mating cage; only females in exposure cage.	Mar. 6 – 22	575	81
10 known mated females in exposure cage without males.	May 5 – 21	128	46
10 females from screen of emergence cage with large excess males; only females in exposure cage.	May 5 – 21	165	52
10 females, 10 males in exposure cage.	Nov. 1 – 21	435	63
10 known mated females in exposure cage without males.	Nov. 1 – 13	263	38

were required for each adult parasite. Occasional lots of these eggs were used to keep up stocks of fruit moths, but there was apparently not too great a surplus of host material on which to draw. During other periods much larger quantities of host material have been used, but with greater skill and refinement of methods the ratio should be less, if anything, than that quoted. We have already shown that it is possible to obtain considerable numbers of fruit moth eggs during the winter.

As seen in Table 11, more than 800,000 eggs were obtained during the first six months of 1932. At a ratio of 14 to 1 it would be possible to rear 57,000 adult Macrocentrus in six months. From the practical standpoint, however, it appears difficult to produce them even at a ratio of 14 to 1 because of mortality in hibernation which we have so far been unable to prevent. Our total emergence for the first six months of the year was 26,299, or about half the number estimated. Nevertheless it is possible to rear the parasite in considerable numbers. Some of our production records are shown in Table 29. In 1932, we determined to rely mainly on our own laboratory bred Macrocentrus for distribution. We obtained for this purpose about 7,500. This required the entire time of one man throughout the season, but the possibility of greater production than has been realized hitherto, together with the advantage of obtaining the parasites at more favorable periods, made it seem desirable to continue the arrangement.

TABLE 29. MACROCENTRUS PRODUCTION BY ARTIFICIAL MEANS, 1930–1933

Month	Macrocentrus reared			
	1930	1931	1932	1933
January		187	1618	2480
February		33	2203	1591
March		456	3682	2362
April		678	3581	1284
May		596	4476	2160
June		1074	7639	8154
July	2038	351	2887	3210
August	2051	2398	3735	7444
September	1948	841	2809	6106
October	1599	836	2139	17829
November	303	859	2135	5035
December	237	744	2606	1247
	8,176	9,053	36,854	58,900
Total for four years	112,983			

During 1933 we made use of a basement room where attempts were made to regulate temperature and humidity within 70° to 78° F. and 60 to 70 per cent humidity. Production proceeded satisfactorily and reached 500 daily for a short period in June. Fruit rots then began to develop and it was necessary to place all slices in a drying cabinet kept around 50 per cent saturation with calcium chloride. Production again reached 300 daily in August but the most important time for liberation in the orchard was not covered.

Four thousand five hundred Macrocentrus were liberated in 1933. Our total production, however, was greater in 1933 than in any previous year. It totalled more than 58,000 reared adults, and about 15,000 estimated in storage December 1.

PERCENTAGE PARASITISM IN LABORATORY BREEDING

During 1930 we experimented with peach twigs and green apples to obtain data on the percentage of parasitism in our cages. Naturally the percentage was higher in twigs than in fruit because of the greater accessibility in twigs. Notwithstanding, it appears possible to obtain parasitism of the Oriental fruit moth as high as 76 per cent in apple slices. For quantity breeding, however, 50 per cent is high enough inasmuch as this allows considerable leeway for keeping up stocks of the host. During the fall of 1931 parasitism of larvae in apple slices averaged about 30 per cent, but during the winter of 1932 parasitism amounting to 40 to 50 per cent was frequently obtained. Table 30 shows some of the results obtained in parasitizing larvae in twigs and in apple slices.

TABLE 30. PERCENTAGE OF PARASITISM POSSIBLE WHEN TWIGS AND APPLE SLICES ARE USED FOR EXPOSURE TO MACROCENTRUS ADULTS, 1930

Oriental fruit moth larvae in	Dates of exposure	Moths emerging	Macrocentrus emerging	Per cent parasitism
Twigs	July 9–10	43	102	70
	July 12	12	87	87
	July 14	13	14	51
	July 16–18	20	80	80
	June 26—July 4	11	54	83
Totals		99	337	77.2
Apple slices	July 15	62	199	76
	July 15–17	206	217	51
	July 16–18	51	59	53
	July 18–19	55	72	56
	July 25	142	157	52
	July 24–25	22	20	47
	Aug. 1	65	32	33
	Aug. 6	185	54	22
Totals		788	810	51.3

ENEMIES

Ants, spiders, and secondary parasites cause considerable trouble in Macrocentrus production. We have had cages of parasites completely destroyed by ants; spiders show an equal fondness for the parasites if they get into a cage. Ant baits and repellents freely used on greenhouse benches, have prevented damage. Spiders may be kept in check by brushing them from the eaves and corners of the greenhouse and cages at frequent intervals. The secondary parasite, *Dibrachys boucheanus* Ratz., caused some trouble in 1932, reducing our summer production by about 2,000 reared adults. These enemies have a shorter life cycle than the parasite and work on both the fruit moth and Macrocentrus. Covered breeding pans and destruction of infested stock has largely but not entirely eliminated this pest from emergence cages.

EFFECT OF INSECTICIDE DUSTS ON MACROCENTRUS LONGEVITY

In a previous bulletin of this Station it was suggested that farm practices would probably be of considerable benefit in helping Macrocentrus maintain itself. For example, some means of carrying the insect over the winter is necessary and is doubtless provided in natural conditions surrounding many orchards. Natural cover and alternate hosts could, if necessary, be provided.

Another factor influencing parasite abundance lies in the effect of common spray practices on the length of life or egg laying ability. It would perhaps not be suspected that an insect of the size and activity of Macrocentrus could be affected by sulfur. However, laboratory experiments indicate that such is the case, though what effect it may have in the field has not yet been demonstrated. Our plan of experiment consisted of using cages of equal size in which were placed adults of the same age. Undusted peach seedling trees were put in half the cages. In the other half were placed trees of the same size dusted lightly with sulfur or other material. Since temperature plays an important part in such an experiment, care was taken to keep the temperature in all cages the same and not to allow it to go too high. After five days the living individuals in all cages were counted. It will be seen (Table 31) that the most injurious material was sulfur dust, one of the most commonly used fungicides in any commercial peach orchard. In experiments with this material only 10 per cent of the adults survived after five days, whereas 59 per cent of those in control cages were alive. Lime and talc had little or no effect in these tests, but lime—lead arsenate—oil dust increased the mortality considerably.

TABLE 31. EFFECT OF SEVERAL ORCHARD DUSTS ON THE LONGEVITY OF MACROCENTRUS ADULTS

Treatment	Number Macrocentrus used	Number tests	Per cent survival after 5 days
Sulfur dust	180	6	10
Check	180	6	59
Lime dust	120	4	52
Check	120	4	49
Talc dust	120	4	45
Check	120	4	57
Lime—lead arsenate—oil dust	300	10	28
Check	270	9	52

IMPORTANT CONSIDERATIONS IN BREEDING WORK

In our breeding program it appears that important considerati should be given to the following points.

ORIENTAL FRUIT MOTH

1. *Prevention of hibernation.* In order to prevent fruit moth larvae from hibernating in the fall when the tendency is strong, it is necessary to bring all stocks indoors in August and breed at 75° or above.

2. *Egg deposition.* Our best results in securing eggs of the Orient fruit moth have been from the use of greenhouse incubators with glas tops. These should be regulated to 75 to 80° F. Seedling peach trees are used within the cages and the eggs are laid on the leaves.

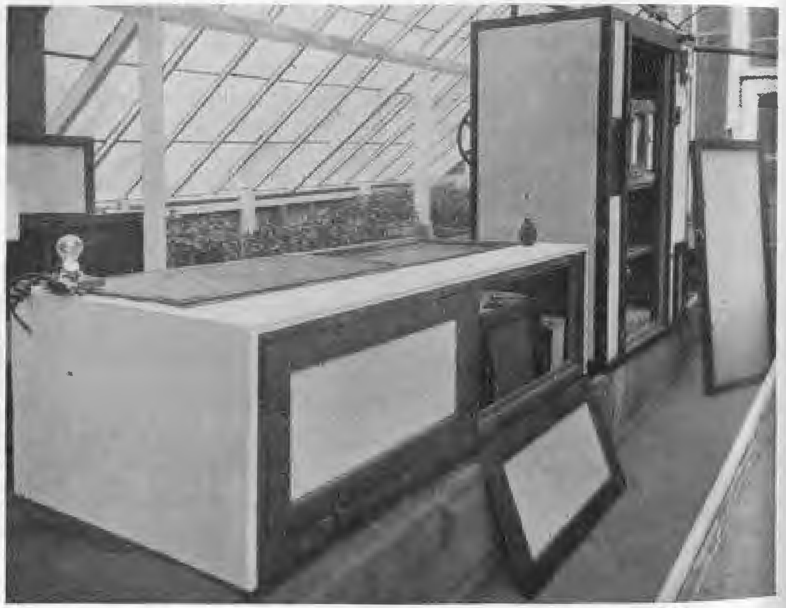

FIGURE 7. Two types of greenhouse incubators used for confining Oriental fruit moths. Both are provided with light bulbs for head, thermoregulators, and a small fan.

3. *Food for the larvae.* Food for the larvae appears to be as import if not more important, than the two preceding factors. Many more larv develop in green than in ripe fruit and the life cycle is shorter.

4. *Successful hibernation of the larvae.* This problem is not fully solved, but it is fairly simple to make the larvae enter hibernation by removing them from breeding pans soon after they have spun their cocoons and then placing in refrigeration at 38 to 40° F. Another successful plan as carried out in our laboratory consists of placing the apples contai half grown larvae in a 60° room where the larvae are allowed to spin th

FIGURE 8. Apple slices infested with Oriental fruit moth larvae ready for exposure to parasites.

FIGURE 9. Pan of green apples sliced and infested with larvae before separating as shown in Figure 8.

cocoons. The larvae are then removed at frequent intervals to full hibernating temperatures, that is 45° F. or below.

MACROCENTRUS ANCYLIVORUS

1. *Maintenance of temperature and moisture.* Proper heat, light and moisture are indispensable because they increase the life and promote the activities of mating and oviposition essential to maintenance of a high rate of increase. A temperature of 70 to 75° F. and a humidity of 60 to 70 per cent appear to be optimum. A range between 70 and 78° F., and 40 to 80 per cent is satisfactory. Strong light and high

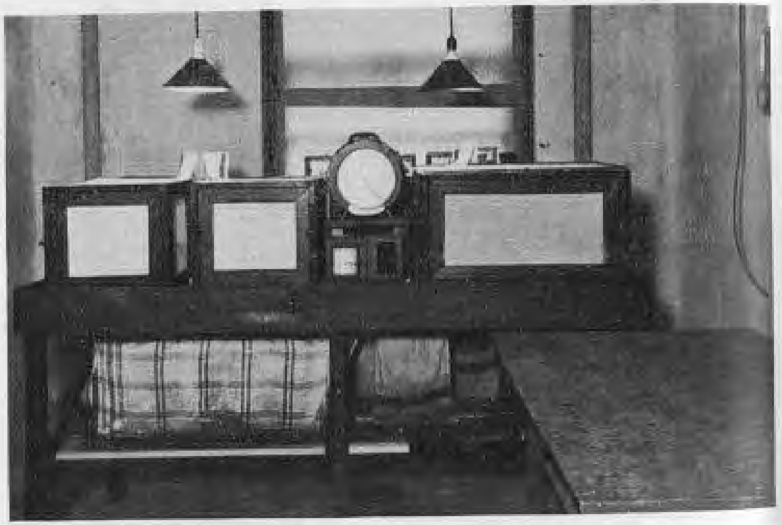

FIGURE 10. Macrocentrus breeding room showing method of lighting cages and the type of cages used. The cages are set in a bed of sand.

humidity should be avoided. Oviposition is continuous in weak daylight or with a 25 W blue daylight bulb placed about one foot from the top of the cage (Figure 10).

2. *Food.* Second and third instar fruit moth larvae may be used. Larvae kept at 80° four days after hatching, will be found to be largely in these stages. After five days all, or nearly all, will be in the third instar. We regard the third instar as the most desirable. Lump sugar or honey may be used to feed the adults.

3. *Successful hibernation.* Parasites hibernate largely as first stage larvae. If too old they will die, and if the eggs have not hatched when placed in hibernation, they will be killed by the host. Parasitized larvae should therefore be removed from the pans or containers as soon as they have spun, and placed in a cool place for hibernation. Use of the 60° room as mentioned for fruit moth larvae is helpful.

BREEDING SCHEDULE[1] FOR REARING MACROCENTRUS EMPLOYED AT THE CONNECTICUT EXPERIMENT STATION FROM 1931 TO 1933

1. Place green apple thinnings 1 to 1½ inches in diameter in cold storage, (July).

2. Obtain Oriental fruit moth eggs from greenhouse incubators (Figure 7). Eggs may be held in refrigerator not more than two weeks.

3. Place eggs on apples cut in slices (Figure 9) one-fourth inch thick. So that the slices will stay in place, the apples are not cut all the way through. Put 2,000 to 5,000 eggs (up to 8,000 have been used) on a pan of 50 to 60 apples. Slices are separated slightly, which allows the larvae to enter easily.

4. Remove apples after four to five days at 80° F., separate slices, and mount on rack as shown in Figure 8. The larvae are now ready to expose to parasites.

5. Place slices with larvae in parasite cage held at 70 to 78° F. and 60 to 70 per cent relative humidity. Elevate racks until slices are

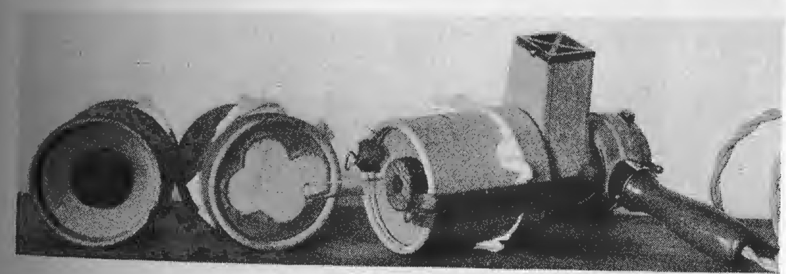

FIGURE 11. Paper boxes attached to a small hair dryer for collecting moths and parasites. The hole in the end in which the glass spout is inserted is plugged with a cork (as shown in the left hand figure), when the desired number of insects are obtained. These boxes are also used for shipping Macrocentrus adults to points within Connecticut.

about one inch from the top of the cage. For type of cages used see Figure 10.

6. Remove slices after 24 hours and place in breeding pan at 75 to 80° F. Keep humidity as low as possible (50 per cent) to prevent wet fruit rots. After several days add punctured green fruit which the larvae leaving slices can enter to complete development. Keep larvae for hibernation at 60° after they have left the slices. Those required for breeding stock need not be kept at 60°.

7. Remove larvae spun in corrugated strips as fast as they spin their cocoons, and place them in hibernation.

8. For breeding stock make use of emergence room (Figure 12). Collect adults from the light screen with suction device (Figure 11).

[1] Our method is considerably different from that employed by Daniel and others, (8) pp. 16-27, 1928.

MACROCENTRUS PARASITES OBTAINED IN NEW JERSEY IN 1930 AND 1931

Owing to the failure to secure Macrocentrus by artificial breeding in sufficient quantities for liberation in 1930, arrangements were made to send men into New Jersey to collect parasitized larvae in the field. Work was begun June 1, and both strawberry leaf roller and Oriental fruit moth larvae were obtained. Material collected in the vicinity of Moorestown during the early part of June yielded few Macrocentrus. This period was apparently not early enough and was between broods both for the peach moth and its larval parasite, Macrocentrus. Collections made later in June and early in July yielded nearly 60 per cent Macrocentrus. The yield of Macrocentrus from strawberry leaf rollers

FIGURE 12. Interior view of emergence room used for both Macrocentrus and Oriental fruit moth. The walls of the cage are of black cloth with only a light window which concentrates the insects on that side.

was poor, there being apparently a much higher parasitism by *Cremastus cookei* than by *Macrocentrus ancylivorus.* Strawberry leaf rollers obtained in the fall of 1929 were used to furnish breeding material during the winter and spring of 1929-30.

On arrival in New Haven, the fruit moth larvae in peach twigs were placed in shallow pans with moist cloths in the bottom, and the twigs were supported by one-inch chicken wire. On the wire between twigs were placed punctured green apples, to which many of the larvae transferred

on leaving the twigs. These trays with twigs and green apples were then placed in a 7 by 7 by 7 foot cage with a light screen for collection of the parasites (Figure 15).

In 1930, we secured from field collections of 20,000 folded strawberry leaves and 35,000 infested peach shoots, a total of 9,590 Macrocentrus adults. In addition we obtained from the U. S. Bureau of Entomology nearly 3,000 more. In 1931, arrangements were made with the Federal Bureau at Moorestown, N. J., to obtain a supply of strawberry leaf rollers and parasitized fruit moth larvae, which were shipped to us at New Haven. As in 1930 the material was placed in our emergence cage and the parasites collected from the light screen with a hair dryer suction device (Figure 14). They were transferred by this means from the screen to paper boxes, which were packed in moist sphagnum, and sent to growers. This year some parasites were lost through overcrowding and rapid molding of strawberry leaves, due to lack of space in the cage. A comparison of the numbers obtained in 1930 and 1931 is given in Table 32.

TABLE 32. DATA ON MACROCENTRUS OBTAINED FROM FIELD COLLECTIONS IN NEW JERSEY

Year	Peach twigs	Strawberry leaves	Number Macrocentrus	Per cent males
1930	35,000	20,000	9,590	41
1931	50,000	110,000	11,630	42

TABLE 33. STATISTICS OF MACROCENTRUS DISTRIBUTION 1930 TO 1933

Year	Total number distributed	Number growers supplied	Number colonies less than 100	Number colonies more than 100
1930	11,600	142	120	30
1931	10,736	167	141	39
1932	9,500	47	0	47
1933	4,784	22	1	21
Totals	36,620	239[1]	162	137

[illegible] include duplicates from year to year.

FIELD LIBERATIONS OF MACROCENTRUS AND OBSERVATIONS ON THEIR EFFECTIVENESS

In 1929 we began liberations of *Macrocentrus ancylivorus* in Connecticut orchards. The first liberations were made in the Rogers orchard at Southington and the Root orchard at Farmington. Owing to the rise of natural parasitism at the Rogers orchard, the results were obscured. At the Root orchard 300 Macrocentrus obtained from New Jersey were released in August, 1929. This was followed in July and August, 1930, with 125, and with 160 in 1930. The history of Macrocentrus parasitism in this orchard took the following course. In 1929 no Macrocentrus could be found in any collection. In 1930 some were found early in the season, but none later. In 1931 the parasitism was low early in the season, but increased rapidly, reaching almost complete parasitism in August. In 1933 without further introduction of this species, almost total parasitism of the second brood occurred in July.

In the Pero orchard at Manchester, 500 Macrocentrus were liberated in June, and 50 in July, 1930. Two hundred more were liberated in July and August, 1931. Larval parasitism by Macrocentrus reached a high point August, 1931, probably because of the large liberation in 1930. No Macrocentrus could be found in this orchard in 1930. In several other orchards where small liberations were made in 1930 none could be found in 1931. Our experience indicates, however, that rapid multiplication of the parasite does not always take place.

Thus in the College orchard at Storrs (Connecticut State College) no Macrocentrus were recovered at all in 1931 and 1932 and it was not until 1933, one year after liberations, that the first recovery was made. Furthermore there was not sufficient larval parasitism in 1933 to check fruit moth infestation, which appeared to be fully as severe in late peaches (Hales) as during the previous year.

In addition to the above mentioned orchards, observations have been made in several places where the fruit moth infestation was just beginning at the time of parasite liberation. In at least one other case besides the Root orchard parasitism was apparently able to keep the infestation from reaching a high figure such as occurred in the Rogers and surrounding orchards in 1929. In a few cases we have been unable to establish Macrocentrus successfully but we may be successful with continued efforts. In these orchards damage by the Oriental fruit moth continues to be serious.

From orchard inspections it seems as though Macrocentrus is now well distributed in the central portions of the state. There are still some orchards within this area where the species cannot be found and it remains to be seen whether it will be necessary or advantageous to reintroduce the species in cases of recurring infestations. It is hoped that where successfully introduced the parasite will become so thoroughly established on the fruit moth and other alternate hosts that it will return in sufficient numbers to check a rising infestation whenever it occurs. Macrocentrus liberations will then be no longer necessary or desirable.

It is quite evident from field collections that *Macrocentrus ancylivorus* will live from year to year in the same orchard in Connecticut.

The best time for liberations seems to be during those periods in which twig injury is just beginning. It is apparent from laboratory experiments that fruit moth larvae are most readily attacked in the first to third stage, or instar. Where abundant twig infestation occurs, it is desirable naturally to release them as early in the summer as possible. This occurs in favorable seasons in Connecticut about the middle of June. It is not always possible, however, to secure the desired number of parasites at the precise

time when they should be released. In such cases it appears to be better to release late than not at all. The two most favorable periods in Connecticut appear to be from June 15 to 30, and from July 15 to about August 5.

Naturally the more Macrocentrus that can be released in an infested orchard, the better the chance of establishing the colony successfully. Our results with small liberations were not encouraging during the first two years of the work and we consequently discontinued liberations of less than 100 individuals at one time.

As to the effectiveness of parasitism by this species in Connecticut it is apparent from Table 33 that considerable benefit to the orchardist occurs whenever parasitism of the second brood larvae is high. There are, of course, other factors influencing abundance of the Oriental fruit moth that may cause the infestation to vary from year to year. Some of the more prominent of these appear to be (1) the growing condition of the orchard which depends on cultivation, pruning, fertilization, and other factors; (2) the evening temperatures during the flight of the third brood moths from the middle of August to the middle of September; (3) parasitism by other species such as Trichogramma, Glypta and others. All of these points make it difficult and laborious to predict within reasonable limits what an infestation will be. However, by determination of second brood larval and egg parasitism we have been able to state whether an infestation would be large or small at picking time.

Table 34. Comparison of Parasitism by Macrocentrus and Degree of Elberta Infestation the Same Season

Orchard and location	Year	Parasitism of second brood larvae	Per cent infested Elbertas	Notes
Connecticut Agricultural Experiment Station, Mount Carmel	1933	93	7	Average of drops and picked
Bishop Farms, Cheshire	1932	89	10	Average of drops and picked
Pero Brothers, Manchester	1931	high	8	Count of drops: picked fruit less
	1932	75	8	Count of drops: picked fruit less
	1933	85	11	Count of drops: picked fruit less
L. C. Root & Son, Farmington	1933	85	16	Count of drops: picked fruit less
Connecticut State College, Storrs	1931	0	80	Average of picked and drops
	1932	0	50	Average of picked and drops
	1933	2[1]	72	Average of picked and drops

[1]Total larval parasitism (Glypta and others) 17 per cent. Macrocentrus introduced in August, 1932. First recovery August, 1933.

It appears finally that the general uncertainty of parasite control of the Oriental fruit moth is dependent in some way upon the inability of the parasites to develop in certain localities and serves only to emphasize the statement made at the beginning of this series of papers, namely, that there is great need for continued study in this line, both in field and laboratory.

ACKNOWLEDGMENTS

During the course of the work with fruit moth parasites much help has been received from others. Construction of apparatus has been in the hands of J. F. Townsend. Photographs were made by B. H. Walden. Encouragement and advice have been freely given by Director W. L. Slate and Dr. W. E. Britton. And finally, much credit is due to the Connecticut Pomological Society which has contributed financially and supported the project firmly from the beginning.

SUMMARY AND CONCLUSIONS

THE ORIENTAL FRUIT MOTH

1. The Oriental fruit moth is reared more easily on green immature apples than on ripe fruit, green peaches, or peach twigs. Apples may be obtained in considerable quantities from commercial orchards at thinning time and placed in cold storage for use during the winter.
2. More fruit moths may be reared from a given number of eggs placed on green apples than on ripe apples or green peaches.
3. The chief enemies encountered in the work were spiders, ants, and fruit rots. Of these, fruit rots appear to be the most important.
4. Fruit moth larvae reared in our insectary and greenhouse began to hibernate after the first week of August while those obtained after the first of September all hibernated. Hibernation may be prevented by placing stocks at 75° F. and breeding at this temperature.
5. Refrigeration of moths and eggs did not affect hibernation tendencies of the larvae.
6. Refrigeration of the larvae for short periods before spinning affected hibernation appreciably.
7. Maximum egg production was found to take place in greenhouse or other incubators where light is provided from above, and when the temperature is held at about 80° F., especially at sundown. A temperature drop in the greenhouse at sundown greatly reduced egg deposition.
8. Excessive moisture is not desirable for larvae hibernating in paper strips. It is believed that ability to hibernate or carry over the winter successfully is influenced by the quality of the food in which the larvae are reared.
9. One and one-half million fruit moth eggs were obtained in 1932.
10. The ratio of increase averaged 17 to 1 for 1931 tests. The sex ratio of reared moths appeared to be 1 to 1, or 50 per cent males.

THE LARVAL PARASITE, MACROCENTRUS ANCYLIVORUS

11. Three generations of Macrocentrus have been reared under insectary conditions at New Haven during the summer. Adults would be present almost continuously in the field after the first of June, according to these observations.
12. Other hosts have been reported and other species are discussed.
13. The life history of *Macrocentrus ancylivorus* and *Grapholitha molesta* are similar in many respects. In general the life cycle of the parasite is shorter than its host.
14. Oviposition continues under favorable conditions for about 12 days.
15. The ratio of increase averaged in our experiments 12 per female, but reached 50 per female in some tests. The rate of egg deposition is 10 to 15 daily for 10 to 14 days after they begin to lay. Thereafter oviposition becomes considerably less.
16. Hibernation does not affect the sex ratio or rate of increase of the generation emerging. Of the Macrocentrus obtained from exposures made August 5 to 6, 0.5 per cent hibernated. From then on in 1932 an increasing percentage passed the winter.
17. The sex ratio of field collected material was about 3 to 2, or 41 per cent males. Various methods were used to reduce the ratio to these figures in laboratory breeding. The most successful resulted from special mating experiments.
18. It required about 14 fruit moth eggs for every Macrocentrus adult reared in 1931.
19. Macrocentrus reared by artificial means from 1930–1933 totalled 112,983. We secured 12,000 for liberation in orchards during 1932 and 1933.
20. It is easier to secure a high percentage of parasitism using peach twigs infested with fruit moth larvae, than by using sliced apples.
21. The chief enemies are spiders, ants, and secondary parasites. Methods of control are discussed.
22. Sulfur dust applied to foliage shortened the life of Macrocentrus in cages.
23. Methods of breeding are given on page 109.

24. Twenty thousand Macrocentrus were obtained in two years from field collections in New Jersey. These were all liberated in peach orchards.

25. Field studies of the parasite indicate that it will live from year to year in the same orchard and that its presence is correlated with a general reduction of fruit infestation when the parasitism of the second brood fruit moth larvae is high.

26. It required three years in the Root and Bishop orchards to bring about the desired parasitism. The orchard of the Connecticut State College at Storrs seems to be following this course. In the Pero Orchard, parasitism developed more rapidly.

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Bulletin 357 January, 1934

REPORT OF THE DIRECTOR

For the Year Ending

October 31, 1933

Connecticut
Agricultural Experiment Station
New Haven

REPORT OF THE DIRECTOR

For the Year Ending October 31, 1933

To the Board of Control of the Connecticut Agricultural Station:

The Station year just ended has brought us many perplexities but also it has been a period of unusual opportunity. Farming at best is a constant struggle. Each season seems to bring new pests, new competition from other regions. In periods of low prices, such as are now prevailing, the difficulties are exaggerated. However, in spite of great discouragements, our farmers in general have carried on in much the usual manner. Personal expenditures have been curtailed as income has shrunk. It has been most interesting to observe a change in the thinking of country people, a greater interest in life and living than was evident during the period of prosperity. Perhaps this is due to a number of influences. In any case, it suggests a new opportunity for those who are charged with service to agriculture. Farming is still a way of living as well as a means of gaining a livelihood.

Each year new or special tasks arise at the Station; this was no exception. The European pine shoot moth, Stewart's bacterial wilt of sweet corn, the Dutch elm disease, a new "trouble" of peach trees—these and others of a minor character required intensive study and much time. The Entomology and Forestry departments have been called on to organize and direct the work of unemployed in the control of pests such as the blister rust, gipsy moth, mosquito, and pine shoot moth. All of these projects offer an opportunity for setting large numbers of men at work, but careful supervision is required. Coming at a time of reduced income, this extra endeavor has thrown an unusually heavy burden on the Staff and in some cases has interrupted progress on research projects.

Interest in potatoes as a cash crop has increased rapidly, especially as a substitute for tobacco. While we have learned much of tobacco fertilization on these soils, the growing of potatoes on them offers many problems. At the request of growers in the Connecticut Valley, a series of potato experiments was begun on a field adjacent to the Tobacco Farm at Windsor. In addition to fertilizer studies, demonstrations on the control of insects and diseases were included. The results were very satisfactory and the projects will be continued.

In keeping with the State's policy, every effort has been made to economize, without restricting essential services. To this policy the staff has given its whole hearted support. The budget on which we are now operating was planned without knowledge of the many new tasks that have been assigned to the Station. Just what the outcome will be is uncertain but we hope to avoid a deficit. To the peach moth parasite breeding project the Pomological Society has pledged its support.

Here follow brief reports from the several departments on matters of greatest interest at this time. In spite of many handicaps, the regular Station program has gone forward without serious interruption. No better evidence of the efficiency and patience of the staff could be asked.

Progress of the Station's Work

Analytical Chemistry

Fertilizers. The report on fertilizer inspection for the season of 1933 appeared as Bulletin 355. A summary of data for the last 11 years shows that an increasing proportion of samples of mixed fertilizers supplying nitrogen, phosphoric acid and potash substantially meet or exceed guaranties in all respects. There has been also a considerable decrease in so-called commercial deficiencies. The following table illustrates these points:

Year	No. of samples examined	Substantially meeting guaranties in N, P_2O_5 and K_2O %	Commercial deficiencies of $1.00 or more per ton %
1923	261	55	17
1924	282	60	7
1925	255	67	13
1926	247	66	11
1927	243	68	7
1928	250	71	13
1929	239	72	9
1930	236	80	3
1931	235	74	3
1932	222	76	3
1933	199	76	3

Feeds. The regular annual report of inspection of commercial feeding stuffs was issued in April, 1933. The Department is frequently called upon to examine animal tissues or stomach contents in cases of sudden and unexplained deaths of farm animals. Such examinations are laborious and often no satisfactory conclusions as to the possible cause of death can be drawn. When lead, arsenic, or strychnine is found there is reason to believe that the animals have had access to paint, spray materials, or poisoned grain. In many cases, however, no evidence of the commoner poisons can be obtained and it seems probable that deaths can be attributed to poisonous alkaloids in forage plants. Water hemlock, sheep laurel, deadly nightshade and wild tobacco are known to be poisonous to animals. Two recent cases investigated by us (C. E. Shepard) prove or strongly suggest forage plants as the probable cause.

In one of these cases several animals died. Lead arsenate was suspected because the animals had had access to foliage that had been sprayed with that arsenical. No lead or arsenic was found but an alkaloid giving the reactions of atropin was found in the stomach contents. Survey of the pasture disclosed a luxuriant growth of deadly nightshade and there was distinct evidence that its foliage had been browsed off. Atropin is a poisonous principle of that plant. In another case nicotine was isolated and identified in an examination of stomach contents of a cow. The pasture was not searched in this case but wild tobacco plants may have been the cause of death. Both of these cases are interesting from the laboratory standpoint, and the evidence in the first case was of very practical value because the circumstances strongly indicated that spray residue was the cause and the spraying company responsible.

Insecticides. Bulletin 346, a supplement to Bulletin 300, a compilation of analyses of insecticides, fungicides, bactericides and weed killers, was issued in February, 1933. Both of these bulletins have been useful for reference purposes and have been in considerable demand.

Foods and Drugs. Bulletin 354, the report on food and drug inspection for the year 1932, was issued in July, 1933. Considerable attention was given to the examination of fruits and vegetables for spray residues, chiefly arsenic and lead. Our experience to date indicates that spray residue is not a serious problem in this State. Very few instances of arsenic or lead in excess of the accepted tolerances have been found. Since the early inspections of foods and drugs sold in this State, notable improvement in their quality has been observed. For example, the survey of spices made in 1897 showed that only 65 per cent of the samples examined were of satisfactory degree of purity. Of about 300 samples examined since 1920, 90 per cent have been found to be of standard quality. The first Station Report on drugs showed that only 40 per cent met the required standards and specifications; in the five-year period ending in 1931, 72 per cent were satisfactory.

Cooperative work. A considerable volume of analytical work has been done in collaboration with other departments of the Station; and members of the department staff have collaborated with the Association of Official Agricultural Chemists in studies of analytical methods.

Biochemistry

The chemical investigations of the tobacco plant have been continued, particular attention being devoted to the chemical changes that occur during curing and during culture of tobacco leaves in distilled water. The results of this study have been published in monograph form. Perhaps the most interesting of the observations made is that a rapid increase in the nitrate content of the leaves occurs both during curing and during water culture. The nitrate formed must arise from the oxidation of some other nitrogenous substance within the leaf tissue since no extraneous source of nitrate was available.

The nature and distribution of the organic acids of tobacco leaf have been investigated throughout the period of curing. It was found that a marked simplification of the organic acid picture took place inasmuch as the proportion of organic acids of unknown nature diminished materially, their place being taken by citric acid. This acid increased at least six-fold in amount during the curing period. The results of this study are given in detail in Bulletin 352.

Much time has been devoted to the study of the methods for the determination of organic acids, in particular of the total acidity and of the three individual acids that predominate in tobacco leaf tissue, namely, oxalic acid, citric acid and malic acid. Convenient methods for the determination of all three have been developed. The method for malic acid is of especial interest inasmuch as it depends on a hitherto unknown reaction of this substance.

A new method for the determination of cystine in proteins has been developed and applied to a series of proteins. A satisfactory agreement between the results of this method and those obtained by other investigators working with other methods was obtained.

The nutrition investigations have included extensive studies on the basal metabolism of rats, and on the effects of rate of growth upon the skeletal development and the size of certain of the soft organs. In addition the comprehensive investigations of mineral metabolism and of the technic of colony management have been continued.

The laboratory has collaborated with the Association of Official Agricultural Chemists in the study of several methods useful in plant analysis.

Botany

Late blight on tomato (Phytophthora infestans). This blight appeared in the State in 1932 and was even more wide spread and destructive in 1933. Primary infections were found as early as September first. Infection took place on the leaves in contact with the soil and spread upward, eventually to the fruit. This observation was confirmed experimentally, with the use of infected soil. No evidence of infection through the seed has been obtained. Cultures were secured from the fruit but these produced conidia only, as with potato blight. A careful examination of many specimens, both living and dead, has failed to discover oöspores in any part of the plants.

Dutch elm disease. For several years a careful watch has been kept for the Dutch elm disease. Several cases of elms have been found affected by other fungi, *Cephalosporum, Verticillium* and *Sphaeropsis.* This fall, on the extreme southwestern border of the State, one tree yielded the *Graphium Ulmi* which is said to be the active fungus of the Dutch elm disease. Arrangements were made to have the tree destroyed. The federal agents have scouted the State, but no other cases have been reported.

Chestnut blight. The general survey for chestnut blight indicates that the spores are less abundant each year and the percentage of healthy seedlings and sprouts seems to be increasing. Also more reports of burrs are received. The oldest tree in the State, at Lebanon, has been fertilized and pruned in an attempt to keep it alive. The seedlings planted at four locations in the State have suffered from competition and drought, but very few have died from the blight.

The accumulated records of the *Plant Disease Survey* have been prepared for publication as Part II of the Plant Pest Handbook for Connecticut.

Stewart's bacterial disease. Stewart's bacterial wilt on sweet corn was even more serious this year. So far no control treatment has been found entirely effective. Treatment of the seed gave rather poor results. The most promising lead is the use of resistant strains. Studies involving inoculation of healthy plants were conducted in cooperation with the Genetics Department.

Apple spraying. The apple spraying experiments have been directed at the problem of spray injury resulting from the use of substitutes for lead arsenate. So far there seems to be nothing entirely satisfactory. A series of tests with fewer applications is under way.

This year the Spray Service information was broadcast daily over three radio stations, from April 10 to June 15. The results of this service are being checked in one county.

The Botany Department is cooperating in an extensive investigation of a new peach trouble widespread over the state. Description of the Station's studies is given elsewhere in this Bulletin.

Seed analyses. Seed analyses under the statute and as a service to farmers required 395 germination tests and 200 purity analyses. Even with the excellent apparatus now installed, testing for purity is long and tedious. However, the effect of this inspection is shown in the constant improvement found in the quality of seed offered for sale.

As vegetable growing becomes more intensive, the control of diseases increases in importance. In an elaborate series of field experiments, new methods of control are being tested on all of the vegetable diseases causing serious trouble in the State. Of particular interest are the results with double strength Bordeaux. On potatoes this has given far better results than the single strength. Sprays in general are more effective than dusts.

Entomology

Oriental fruit moth. Control studies on the Oriental fruit moth in 1933 consisted chiefly in applications of oils and nicotine tannate on peach and quince. Fairly good control on quince, amounting to 47 per cent sound fruit, resulted from early sprays of lead arsenate, followed by late sprays of a pyrethrumized oil. Oil and nicotine tannate did not control the fruit moth on peach trees.

Mexican bean beetle. Further observations were made on the life history of the Mexican bean beetle, on the effect of spacing of plants, dates of planting and on tests of insecticides, the details of which have been prepared for publication. In general the infestation is less severe on plants 4, 6, and 8 inches apart than on plants 2 inches apart, and although the total yield is less, the yield of marketable pods may be greater. Early planted beans (May) gave a marketable crop without the use of sprays. There was no particular difficulty in controlling the Mexican bean beetle by the applications of the recommended insecticides of magnesium arsenate and barium fluosilicate either as a spray or dust. Copper calcium arsenate dust gave good control and the non-poisonous dusts of pyrethrum and rotenone gave results only slightly inferior to those where poisons were applied.

Insect survey. This is a continuous project. Each year a few species of insects not before known to occur in Connecticut are collected, and 1933 has been no exception. A manuscript of about 150 typed pages has already been prepared for the Natural History Survey of the additions to the Check-List of Connecticut Insects (Bul. 31).

European pine shoot moth. Further records have been made on life history of the European pine shoot moth. Parasite counts in the New Haven area showed a low percentage of parasitism. Several shipments of introduced parasites were received from the Bureau of Entomology and liberated in New Haven and Fairfield Counties. Tests of sprays as a means of control were made in Middletown and North Branford and good results were obtained both with lead arsenate and fish oil, and with lead arsenate, nicotine sulfate, and penetrol. Clipping off the infested tips has been carried on as an experiment in New Haven and Meriden, and has been practiced widely in nurseries, and in forest plantations by owners or by men of the Civilian Conservation Corps Camps, all of which will give us useful data on the value of clipping as a means of control.

Potato flea beetle. Further life history notes were gathered in 1933, and control applications were made of barium fluosilicate, lead arsenate and fish oil, calcium arsenate, and Bordeaux mixture. Although results in the three field tests were not uniform all treated plots gave a larger yield than the check plots. Barium fluosilicate actually killed a good percentage of the flea beetles but most of the others killed only a small percentage and probably acted partly as repellents.

White apple leafhopper. Observations were continued and field experiments were conducted in control of the second generation. It was found that very satisfactory control of the nymphs could be obtained with nicotine sulfate, free nicotine, and anabasine sulfate—in water without the addition of soap. A number of pyrethrum preparations were also tried against the nymphs with good success.

Onion thrips. Observations have been made on onion thrips and spray tests conducted in Southington and Windsor, using nicotine sulfate, pyrethrum, and rotenone, all of which greatly reduced the thrips population in comparison with that of the checks. The sprays were only effective for a short period however, and some treatment having a more lasting effect is necessary if thrips are to be satisfactorily controlled by field sprays.

Spraying and dusting experiments. A comparison of the effects of calcium and lead arsenate in spraying and dusting is under way. One half the apple orchard at the Station farm was sprayed with one brand of calcium arsenate and the other half with lead arsenate. Then certain portions of each were treated with liquid lime-sulfur, dry lime-sulfur, lime and fish oil, flotation sulfur, and Kolofog, as fungicides. Where no extra lime was added with fungicides, severe burn resulted. With extra lime this injury was slight. The burn was less on young trees than on older ones.

Study of lead arsenate substitutes. This study occupied considerable time. Demand for information regarding them led to investigation of calcium arsenates in four different orchards in the state. It was found that calcium arsenate, even the better grades, could not be used without lime, and should not be mixed with lime-sulfur solution. In two of the orchards combination of calcium arsenate with wettable sulfurs caused little or no foliage burn. In the Mount Carmel orchard there was burn from all applications of calcium arsenate, but this was more pronounced on some varieties than others. It is concluded that calcium arsenates need further study from the standpoint of spray burn before they can be generally recommended. Insect control with calcium arsenate appeared to be very good in this year's tests. Of the non-arsenical substitutes tried this year, synthetic cryolite appears to be the most promising. With this material insects were fairly well controlled and there was no spray burn. More than 94,800 apples (about 135 barrels) were examined in the course of the work.

Some experimental work with lead arsenate and other materials on peach trees indicates that barium fluosilicate, lead arsenate with zinc sulfate and lime added, and basic lead arsenate can be used without danger of burn. Severe burn resulted from applications of magnesium arsenate and potassium fluosilicate. The best control of curculio was obtained in the plots treated with barium fluosilicate, and standard lead arsenate with zinc sulfate corrective. Applications of oil and nicotine sulfate and nicotine tannate in August did not control the Oriental fruit moth.

Fruit moth parasites. Rearing and distributing parasites of the Oriental fruit moth was continued as in 1932. Applications for the service came from 227 peach growers owning 162,780 trees. In all, 276 packages were mailed. Together with the parasites placed in orchards by members of the staff for experimental purposes, this constitutes an estimated total of 28,300,000 Trichogramma; 4,656 Macrocentrus and 2,594 larval parasites belonging to four other species. Of the latter, 1,603 were obtained from the Federal Government laboratories and came originally from Japan. In addition, a species of Trichogramma from Europe was studied, but we were not successful in breeding it in quantities even though bagworm eggs were obtained from New Jersey for the purpose. Artificial breeding of Macrocentrus was continued and we were able to rear them at a rate of 17,000 per month or an average of more than 500 daily. Breeding of this parasite, however, was not so successful during late spring partly on account of difficulties encountered in maintaining suitable temperature and moisture conditions in the breeding rooms at this time of year.

Inspection of orchards and nurseries. The usual inspections have been made. Of nurseries there are now 365 in the State. Because of the European pine shoot moth all nurseries growing pine trees have been re-inspected this fall and some of them have been visited three and four times. An attempt has been made to have this insect eliminated from all nurseries.

The gipsy moth. The control of the gipsy moth proceeded in the usual manner except that a troublesome infestation in Wolcott required much attention. It covered so much ground that it took a long time to scout the region, and also to spray it. The spraying season was short on account of rainy weather, so fewer infestations were sprayed than usual.

Altogether 54 towns were scouted, 96 infestations found, 17,719 egg-clusters creosoted, 17 colonies sprayed, 23.9 tons of lead arsenate used; 68,272 larvae and pupae were killed by hand and 1,214 miles of road-side and 13,782 acres of woodland scouted.

Just as the spraying season ended, in July, an important infestation was discovered at Groton Long Point where about 20 acres of oak and maple woodland had been defoliated. The egg-clusters will probably run into hundreds of thousands. Scouts are now cleaning up this infestation.

Under the Public Works Appropriation, Federal scouts are now at work and will cover the territory west of the Connecticut River including the Barrier Zone. Plans are now being perfected whereby the territory east of the Connecticut River will be scouted by men from the unemployed lists, paid out of the Civil Works appropriation.

Mosquito control. The usual maintenance work with a few extensions was carried on during the summer months. In October it was announced that Federal Civil Works appropriations for relief of the unemployed would be available to pay for labor to finish ditching the salt marshes, and plans are now being carried out toward that end. The authorization is for 1,200 men.

Apiary inspections. Apiaries have been inspected as usual but with a reduced appropriation. Consequently somewhat fewer apiaries were inspected in 1933, than were examined in 1932. However, the only disease found (American foul brood) occurred in a smaller percentage of the apiaries than in 1932. During 1933, 1,342 apiaries containing 10,927 colonies were inspected. Only 33 apiaries and 49 colonies were infested with American foul brood.

European corn borer. The only control work in 1933 has been the enforcement of the compulsory clean-up statute, carried out in about the same manner as in former years. On April 12, 22 inspectors checked over the entire state and issued 5,309 cards of which 970 or 14.5 per cent were not returned. The severe injury to early sweet corn in East Hartford, Glastonbury, Milford and Stratford, by the first brood larvae led us to have a survey of these localities made. In some instances this damage equalled 100 per cent, and averaged as high as 1,342 borers in 100 stalks, or 259,464 borers to an acre. A later survey of the second generation larvae was made and although the infestations did not run as high as in the first generation, there were several instances where the number of borers to an acre totaled between 75,000 and 130,000.

Asiatic beetle. Quarantine against the Asiatic beetle was revoked March 1, 1933, and no control work has since been carried on. Advice has been freely given to property owners regarding the lead arsenate treatment to protect their lawns, and 36 inspections have been made of infested lawns.

Japanese beetle. Three hundred traps were placed in various portions of the State not then known to be infested. Beetles were caught in traps at Manchester, Middletown, and Putnam, the first time that these towns were known to be infested. In Bridgeport the beetles were so abundant that grapevines, Virginia creeper and roses were considerably injured. As usual, plants for shipment were inspected when necessary.

Forestry

The establishment of 12 camps of the Civilian Conservation Corps in Connecticut has materially affected the work of this department. Two members of the staff were loaned to the supervising staff of the camps, which resulted in some curtailment of our studies on the relation of soil characters to the growth of trees. The Conservation Corps, however, made available a supply of labor for use in control of forest pests and the year has been an active one along that line.

Blister rust. The work of eradicating wild currant and gooseberry bushes (Ribes) by State crews for the protection of the white pine against blister rust was curtailed this year, due not only to the reduced appropriation, but to the necessity for using available trained men on emergency projects. A limited amount of wild Ribes eradication work was done by State crews, and in addition the annual nursery sanitation work was carried on at nine nurseries. A cultivated Ribes survey was also completed in six towns.

The emergency work consisted of wild Ribes eradication under the Emergency Conservation Work program and the National Industrial Recovery Act. Approximately 200 members of the Civilian Conservation Corps were employed on eradication work in 19 towns. Under the National Industrial Recovery Act (N. I. R. A.) 80 men were employed locally in six towns in Litchfield County on wild Ribes eradication.

Approximately 250,000 wild currant and gooseberry bushes and 1,925 cultivated plants were destroyed, affording protection to the white pines on all the state forests and to many acres of natural and planted white pines on private lands.

White pine weevil. Two projects for forest insect control by the C.C.C. have been developed under the joint supervision of the Forestry and Entomology Departments of the Station. Control of the white pine weevil in certain definite areas was undertaken during the summer of 1933. About 1,500,000 white pine trees on areas totaling 10,000 acres in the vicinity of C.C.C. camps were inspected and all weeviled tops within reach were removed. Detailed records of this work were kept and it is planned to repeat the work in 1934 on the same areas if the men are still available.

European pine shoot moth. Control included inspection of all forest plantations of red and Scotch pine in Litchfield, Tolland, Windham, Middlesex and New London counties, and the eradication of infected bud clusters where found. Enough of the inspection work was completed during the summer so that the eradication work could be undertaken by C.C.C. crews beginning October 1. This will continue during the fall and winter so far as weather conditions permit, and will be pushed vigorously in the spring.

Except for the improvement cuttings referred to in the last report, very little work has been possible at the Rainbow forest during the current year. Owing to the other projects demanding attention, it has been impossible to secure the additional data needed for a progress report on the studies at Rainbow, and this publication must be postponed for another year at least.

Preservative treatment of posts. The experiments started in 1928 are beginning to show definite results and a progress report on the subject is in preparation. The serviceable life of untreated posts of white pine, poplar (Populus sp.), red maple, and gray birch is two to three years and of pitch pine four to six years. Treatment by brushing with creosote may be expected to add two to three years of service for these species. Posts treated by both the pressure and the open tank process are found to be sound at the end of five years of service.

The cooperative experiments carried on last winter with the State Highway and State Forestry Departments resulted in a new set of specifications for posts for guard rail and property fence construction being issued by the Highway Department. Hereafter such posts will be only of native woods, properly treated to secure adequate penetration of preservative. As the Highway Department is the largest consumer of posts in the State, this is a very important step toward better utilization of native forest products.

Further experiments to increase the efficiency and improve the technique of the open tank process will be carried on in cooperation with the State Forestry Department on the Meshomasic Forest at Portland. The experimental plant will be part of a commercial plant, to be constructed and manned by the Conservation Corps as a means of utilizing material cut by the crews during the coming winter. Much additional data should be secured from this source.

Forest planting stock. The distribution of forest planting stock continues to show the effect of unfavorable economic conditions. The total of 873,000 trees sold to Connecticut land owners in 1933 is 12 per cent less than that for 1932.

Genetics (Plant Breeding)

Resistant sweet corn. Out of 80 commercial varieties of early yellow and white sweet corn tested on the Mount Carmel farm, none were found to be free from serious injury by Stewart's bacterial wilt. Spanish Gold has been found to be somewhat freer from injury in Connecticut than other varieties ripening in the same season. Several crosses of Spanish Gold with inbred strains of Golden Bantam and of Whipple's Yellow have shown no infection in preliminary trials. Although the number of plants grown was small, these preliminary trials indicate that early corn can be obtained comparatively free from damage by this disease.

Out of a large number tested, a few inbred strains of Spanish Gold, Golden Early Market, and Golden Sunshine have been found with very little or no infection when the seedlings were artificially inoculated in the greenhouse. The same strains are, for the most part, equally free from infection in the field. It is planned to use these strains in the production of varieties resistant to bacterial wilt.

Some of the first generation hybrids of inbred strains of Whipple's Yellow sweet corn that have produced well in previous trials, have been found to be quite susceptible to bacterial wilt. The tests carried out during the past season both at Mount Carmel and at Windsor have shown certain combinations to be outstanding in showing very little injury from this disease. Some of these resistant combinations were well-eared and otherwise desirable for market garden purposes.

Ensilage corn. In three years' trial of ensilage corn, late southern varieties such as Cocke's Prolific, Pamunkey, and Virginia Eureka have produced the most dry matter to the acre. All of these varieties during the past three years have reached at least the dough stage. Later varieties such as Tuxpan that produce no mature grain have less total dry matter. Earlier varieties that produce ripe ears and give good grain yields, such as Sweepstakes and Lancaster Sure Crop, yield even less total dry matter than the latest varieties obtainable. The past three seasons have been warmer and the period of growth somewhat longer than the average so that the later varieties may not be expected to make such a good showing every year. Nevertheless they are being grown and should receive even more consideration where the most food value to the acre is desired.

Genetic studies. Additional material was grown for the study of the two lethal factors causing the disturbance in the ratio of starchy and sweet kernels on ears segregating for the *Su su* gene. The two factors responsible for this disturbance are very closely linked to the *Su su* locus (about 2 to 3 per cent crossing over).

One factor, lethal ovule, causes practically all ovules carrying it to abort and this eliminates either the *Su* or *su* ovules, depending on the one with which it is linked. This gene is transmitted almost entirely through the pollen.

The other condition, small pollen, causes one-half of the pollen grains to be much smaller than normal pollen grains. The small grains cannot function in competition with normal grains and hence are lost. This results in an elimination from the pollen of practically all of the *Su su* genes, the one associated with small pollen being excluded. This condition is transmitted almost entirely through the ovules.

We now have ears in which the lethal ovule *Lo lo* and small pollen *Sp sp* are linked each with the starchy *Su* and sugary *su* genes. Entirely different ratios are produced by the *Lo lo* and *Sp sp* factors. The linkage is well established for the *Su su* gene, and this last summer material was grown for testing the linkage with other factors on the *Su su* chromosome.

Vegetables. The vegetable strain trials at Windsor show marked variation from year to year in the performance of the same varieties due to the differences in seasonal conditions. A few varieties seem to have the ability to yield well nearly every year and in other respects are desirable. Such varieties can be recommended to Connecticut growers for trial on their own farms. This is notably true for lettuce, beets, tomatoes and peppers. The results of all trials are given in Circulars 82, 87 and 94, entitled "Testing Vegetables for Connecticut", in a series for 1931, 1932 and 1933.

At Mount Carmel particular attention is being given to methods for improvement by breeding of lettuce, beets, carrots, squash, peppers, tomatoes, lima beans, and sweet corn. An especial effort is being made to produce a lettuce that will head late in the season from seed sown directly in the field. Growers want greater uniformity in root crops. The transmissable factors controlling variation in shape, color, and rapidity of growth of beets and carrots are being studied. Promising selections of squash, peppers, and tomatoes are also in process of development.

Strawberries. About 400 selected seedling strawberries from crosses of inbred strains of Howard 17, Chesapeake, Glen Mary, and Progressive are being grown in their second trial. Some of these have outstanding characters of desirable fruit and productiveness, but must be tested under a wide range of conditions to determine their adaptability and usefulness for Connecticut.

New strawberry varieties are being tested in comparison with old standards for yield, quality of fruit, and time of ripening. These include Dorsett, Fairfax and Catskill, three new varieties of unusual promise.

Raspberries. It has been found that black raspberries show very little reduction in vigor when inbred. Two inbred lines, self-fertilized for three generations, are as uniform grown from seed as the original vegetatively propagated variety, and as productive. Further trials are being made and seed is available in limited amount for testing. The seedlings must be started in flats or cold frames, but when once growing are as easy to handle as tip layers. Being produced from seed they have the advantage of starting free from virus infection.

Soils

Greenhouse fertilization trials. During 1933 a series of 11 soils from alfalfa fields of the State have been investigated for fertilizer requirements, using tobacco as a test crop for soil deficiencies, as in former years.

In spite of the previous growth of alfalfa on these soils, all of them showed significant responses to nitrogen. Yields without nitrogen ranged from 28 to 53 per cent of those on pots completely fertilized, with an average of 40 per cent.

While the soils had received some phosphatic fertilization when seeded to alfalfa, all were still seriously deficient in phosphorus. Yields without phosphorus ranged from 20 to 65 per cent, averaging 49 per cent. Four vegetable crop soils by the same scheme of evaluation ranged from 69 to 86 per cent crop in the absence of phosphorus, during the previous year's trials.

Potash deficiency was especially marked on this series of soils, with one exception. Ten of the 11 soils gave yields without potash ranging from 15 to 46 per cent, averaging 31 per cent. The four vegetable crop soils ranged from 53 to 73 per cent in the absence of potash.

It is apparent that alfalfa fields, seeded on average soils, treated with about 600 pounds of superphosphate and 200 pounds of muriate of potash to the acre at the time of seeding, are deficient in phosphorus after alfalfa has been grown for a few years, and there is evidence that alfalfa crops tend to deplete the available potash in the soil to a significant degree. Crops requiring a considerable amount of readily available nitrogen cannot depend upon the residual nitrogen left in the soil by alfalfa to supply their requirements.

Soil testing service. During the past few years, a series of simple and reasonably accurate soil tests for the active constituents concerned in plant nutrition has been developed at this Station. The technique involves the extraction of the soil with a sodium acetate-acetic acid buffer mixture, designated as the "Universal" soil extracting solution, and subsequent tests of this extract for the following: Nitrate nitrogen, ammonia nitrogen, phosphorus, potassium, calcium, magnesium, aluminum, manganese and iron. During the 1933 season more than 1000 samples of soil from fields, gardens, lawns and golf courses of the State have been tested by these methods, and recommendations of treatment have been made on the basis of these tests and on conditions of soil reaction, soil type, drainage and crop requirement. The tests are being constantly studied on soils of known nutrient deficiency, and the series of more than 100 soils upon which crop response data has been obtained by means of pot tests during the past eight years furnishes a suitable basis for the correlation of results of the chemical tests.

Lysimeter experiments. The series of lysimeter experiments to show the effect of heavy applications of various nitrogenous fertilizers upon the drainage losses of various soil constituents is now in the fifth year. Important soil changes have taken place as a result of the differences in effect of the forms applied, and these will be studied in detail at the close of the five year period.

The series of lysimeters started in 1931 to show the effects of cover crops in conservation of plant nutrients against leaching indicated an average annual saving of about 56 pounds of nitrogen, 44 pounds of calcium, 24 pounds of potassium, and 8 pounds of magnesium per acre during 1931 and 1932 when oats were grown as a cover crop between tobacco crops. The fall of 1933 has been unusually dry at Windsor, and no drainage losses have occurred under oats, as compared with the equivalent of about 0.75 acre-inch of water leached in the absence of cover crop.

Forest soil studies. A set of six shallow lysimeters were recently installed in a red pine plantation in Woodbridge for the purpose of determining what nutrient materials are leached out of the humus and upper mineral soil. Although the experiment must be carried over several seasons before conclusive results can be obtained, the lysimeters have already demonstrated the value of forest litter in absorbing rainfall. Of the total precipitation between April and November, about 65 per cent reached the ground and was absorbed by the soil covered with needle litter, while only 35 per cent was absorbed by the bare soil.

The soluble nitrogen content of the water that had leached through the soil was considerably higher in the fall, even in mid-November, than it was in June and July. This helps to explain why tree roots continue to grow so late into the fall. Growth of the tree above ground takes place in the early summer and is dependent to a considerable extent upon the food reserves taken up by the roots the previous year.

The composition of forest leaves changes rapidly after they fall and become subjected to the leaching effect of rains. In the first seven weeks about three-quarters of the potassium and from 12 to 50 per cent of the phosphorus were lost. If the full manurial value of raked leaves is to be conserved, they should be collected and put on a compost pile as soon as possible after they have fallen.

Studies on moisture distribution under trees have shown that tree roots go a long way for water if necessary. In a coarse sandy soil they may draw upon the soil two or three times as far as the branch spread. Close to the base of the tree, moisture is removed fairly uniformly to a depth of four feet or more, but the lower limit of the depleted region gradually becomes shallower with increasing distance from the tree base. Roots were encountered 30 feet from a red oak tree only 22 feet tall. The amount of rainfall that reaches the ground under a tree averages between 40 and 80 per cent of the total precipitation, varying with the intensity and duration of the rain and the direction from which it comes.

Fertilizer tests with red pine indicate that the plant food requirement of that species is quite low in comparison with that of the ordinary farm crop. Nevertheless, on poor soil growth may be increased by using fertilizers in the seed bed and transplant bed.

Seedlings grown at New Haven in a highly fertilized tobacco soil brought from Windsor were more than 50 per cent larger than those grown in coarse sand from Rainbow. Considerable care to prevent injury must be exercised in using some fertilizers such as sulfate of ammonia and nitrate of soda. Dried ground fish, blood tankage, bloodmeal, Nitrophoska and Milorganite are some of the materials used that have been beneficial with a fair degree of consistency. Some of the trees that have been fertilized in the nursery have been planted in the field and their future growth will be observed.

Fertilizers applied to red pines five to seven feet tall had not, at the end of the second growing season, caused any definite increase in growth, nor had they altered to any appreciable extent the composition of the needles.

Duration of liming effects. In the spring of 1927, a series of 48 concrete walled soil plots were filled with uniformly mixed soil and subsoil. This soil was strongly acid, with the reaction of 4.99 pH when the experiment was started.

Lime was applied to 24 of the plots at the rate of four tons of calcium carbonate to the acre, and thoroughly mixed with the soil to a depth of six or seven inches. No liming material has been used since that time.

Soil reaction (pH) has been measured at monthly intervals for more than six years. The somewhat excessive original liming raised the pH during the first year above the neutral point. Since that time there has been a general downward trend, compared with the unlimed treatments, as shown in the following table:

MEAN ANNUAL pH VALUES
(June 1 to May 31)

	Unlimed	Limed	Difference due to lime	Annual change
First year	4.96	7.53	2.57+	....
Second year	5.05	7.01	1.96+	.61—
Third year	4.75	6.44	1.69+	.27—
Fourth year	4.86	6.42	1.56+	.13—
Fifth year	4.97	6.28	1.31+	.25—
Sixth year	4.93	6.14	1.17+	.14—

It is apparent that the difference between limed and unlimed treatments is becoming less each year, and by interpretation of the past trend in the future it may be shown that in about 20 years there should be less than 0.2 pH difference between limed and unlimed soil, which represents the disappearance of significant effect by usual standards of measurement.

However, in the seventh season after liming, an excellent crop of barley, an unusually acid-sensitive cereal, was produced on completely fertilized lime plots at a reaction of 5.82 pH at harvest time. A practical failure was shown on the unlimed plots receiving complete fertilizer (Reaction — 4.76 pH).

Market garden fertilizer trials. In the past four years two acres of a light sandy loam (Merrimac series) have been intensively cropped to various market garden vegetables, in a series of fertilizer plots. Three crops are grown in two years on the same field.

Under this system of cropping it has not been possible to grow a sufficiently heavy green manure crop (rye, or rye and vetch) during the idle period from late fall to early spring to maintain productivity on the same level as attained by the use of a moderate amount of manure in conjunction with fertilizer treatments. Twenty tons of manure and 750 pounds of a commercial fertilizer supplying 45 pounds of nitrogen, 50 pounds of phosphoric acid and 60 pounds of potash to the acre, has given the maximum return for practically all crops. Forty tons of manure, without commercial fertilizer, has been inferior for early spring crops, and, except in case of a few late planted crops in dry seasons, has not produced as well as when half of this quantity of manure was replaced by the fertilizer application.

A larger application of fertilizer, supplying 90 pounds of nitrogen, 100 pounds of phosphoric acid and 120 pounds of potash, with as much green manuring as has been practicable, has failed to produce as good crops as obtained by the smaller amount of fertilizer with stable manure. However, reasonably good early and midseason crops have been consistently produced each year without stable manure. Crops seeded after July 1, following early crops, have been very unsatisfactory when no manure was used. It must be considered that unusually dry conditions have prevailed in the late summer months during all of the years of the experiment.

In comparisons between types of commercial fertilizer, there has been little or no consistent difference, for the season as a whole, when equivalent quantities of fertilizer elements were used. A highly concentrated formula made up from potassium nitrate, urea, and ammonium phosphate has given equal results with a formula containing castor pomace, superphosphate, sulfate of ammonia, nitrate, and sulfate of potash. The concentrated formula was slightly more effective on early planted crops, and was slightly less beneficial on late crops. This was also true of a formula made up of sulfate of ammonia, tankage, superphosphate, and muriate of potash.

The addition of extra nitrogen as a top dressing was beneficial in the majority of cases, particularly with early crops. There was no significant benefit from using more than 120 pounds of potash per acre on this soil.

Half-rate fertilizer applications, as compared with full treatment, both in the absence of manure, has caused a significant decrease in yield on all early and most late seeded crops, but has produced nearly equally good yields on sweet corn, peppers and squash. Tomatoes and cucumbers have done significantly better on the full fertilizer treatment.

Plots receiving no lime, as compared with all other plots that have been limed in 1930 and in 1932, have consistently failed to produce satisfactory crops of lettuce, spinach, radishes, beets, and carrots, and the differences due to lime have become more striking during the past two years. The other crops, including sweet corn, tomatoes, peppers, squash, string beans, lima beans, cucumbers and onions, have showed no significant differences due to liming. The reaction on the unlimed plots is only moderately acid, (5.2 to 5.6 pH).

Tobacco Substation

Cause of seed bed failures. The spring of 1933 was marked by an unusual number of failures of seed beds to produce enough plants for setting. Many beds were completely abandoned because not enough plants were left to pay for further care. This was not due to lack of seed germination but the plants began to disappear as soon as the first tiny leaves (cotyledons) were visible and every day the stand became thinner as more seedlings died. This condition, which appeared like an epidemic for a few weeks, was prevalent in all parts of the valley and in all three types of tobacco. It was worse in steam sterilized beds than in unsterilized. The cause was found to be a parasitic fungus (Pythium) which spreads with extreme rapidity, especially in previously sterilized soil, and kills the plants within a few hours. The fungus has been isolated and thoroughly investigated in the laboratory. Application of formaldehyde dust to the soil has given fair control in greenhouse tests, but its application to field conditions has yet to be determined.

Nitrogen fertilizer experiments. The major part of the land available for fertilizer experiments on the Station farm is now devoted to nitrogen test plots. These are divided into four series:

1. Optimum total quantity of nitrogen. Five increments from 100 to 300 pounds per acre are under comparison.
2. Comparison of single sources of nitrogen. Cottonseed meal, castor pomace, corn gluten meal, linseed meal, dry ground fish, urea, sulfate of ammonia, nitrate of soda and cal-nitro are each used year after year on the same plots as the only source of nitrogen on their respective plots. The effects on yield, grading and leaf characters are determined. Most interesting is the effect of sulfate of ammonia when used for seven successive years on the same soil. This soil is now excessively acid (3.91 pH) and the tobacco was a total failure in 1933. Nitrate of soda in recent years has been applied in four or five successive applications during the growth of the plants and under these conditions has given good results. Urea at the end of seven years is beginning to show adverse effects similar to those of sulfate of ammonia. Differences resulting from the several organic materials are insignificant.
3. Value of nitrates in the mixture to serve as a "starter". Various combinations of organic nitrogen materials with and without such a starter are under comparison on Broadleaf and on Havana seed tobacco.
4. Value of combinations of materials as compared with single sources of nitrogen. Various combinations of nitrogenous materials are compared with single sources in the mixtures.

Rates of transformation of the nitrogenous materials to available compounds in the soil are determined by weekly soil tests. Rates of intake and assimilation in the plant are determined also by frequent chemical analyses of the green plants.

Placement of fertilizer in the row. It is the common practice of tobacco growers to broadcast the fertilizer evenly over the soil before setting. It has been shown with crops other than tobacco that equally good results can be obtained by using less fertilizer if it is applied in the row instead of being spread over all the surface of the soil. In order to learn whether the same saving of fertilizer can be made in growing shade tobacco the quantity was reduced on successive plots to 7/8, 6/8, 5/8 and 4/8 of the usual broadcast application. No differences in growth were observed in any of these plots in the field. The sorting results however are not yet available and conclusions cannot be drawn until the grading shows what effect, if any, such reductions have had on the percentage of grades and quality of the leaves.

Improvement of Havana seed strains. This work, in cooperation with the United States Department of Agriculture, began in an attempt to find strains of Havana seed tobacco that are resistant to black rootrot. To that extent the project was successful and we now have a number of strains that show satisfactory resistance. The next important problem was to learn which strains are the most satisfactory in quality from the manufacturer's standpoint and in yield from the farmer's viewpoint. As far as yield is concerned, repeated tests have shown that they will produce more than the ordinary strains. The judgment of the manufacturers has also been favorable on a number of them.

Soil nitrification studies. Studies of the effect of various nitrogenous fertilizers on nitrate production and soil reaction were continued on the single source of nitrogen plots. The general level of nitrate production was low during the entire season, because of inadequate rainfall. Irrigation failed to stimulate nitrification, in contrast to a natural rainfall in early July, which was followed by a moderate increase in nitrates. Soil nitrates had practically disappeared by the middle of October.

Soil reaction was determined concurrently. The acidity increased during the summer, reaching a low point of pH 3.39 on the sulfate of ammonia plot. Readings of pH 6.21 and pH 6.25 were found on the nitrate of soda plots in early spring and late fall.

Diagnosis of nutrient deficiencies in tobacco soil. The tobacco plant is a heavy feeder on nutrients in the soil, and although relatively large quantities are applied annually to the Connecticut Valley tobacco fields in the form of fertilizers, frequently the grower observes that parts of his fields produce unsatisfactory growth in one way or another. We are often called upon to advise the grower as to possible remedies for the troubles. Sometimes a simple determination of the reaction will show whether the soil is too acid or not acid enough and it is then a matter of lime or no lime. Such soil testing service the Tobacco Station has rendered the growers for a number of years.

However, in cases where the reaction is satisfactory and the soil still produces unsatisfactory growth, other causes must be sought. Through the work of the soils laboratory at New Haven we now have microchemical soil tests for rapid diagnosis of soil deficiencies. Considerable work has also been done on nutrient deficiency symptoms of plants. Work is now under way at this Station to adapt microchemical tests to our special problems and to correlate the chemical tests with the growth and appearance of tobacco plants.

Conservation of plant nutrients by cover crops. Field tests for five years have shown that the use of winter cover crops has improved both the yield and quality of tobacco. It is reasonable to suppose that this improvement may be partly explained by the quantity of plant nutrients which are retained by the cover crop and thus prevented from leaching away during the fall, winter and spring rains. In order to measure the extent of such conservation, cover crops were sowed in lysimeter tanks and the water that naturally leached through the cropped soil was analyzed for nutrients and compared with the leachate from uncropped tanks. In this way it was found that a cover crop of oats saves annually

56 pounds of nitrogen, 62 pounds of lime, 28 pounds of potash and 13 pounds of magnesia to the acre.

Tobacco insects. Barium fluosilicate dust was used commercially this season on several hundred acres of shade grown tobacco and proved quite satisfactory as a control measure for the potato flea beetle on tobacco. Diluted 1 to 5 (by volume) with tobacco dust and applied at a rate of five pounds of barium fluosilicate to the acre, excellent results may be obtained. Other dusting materials are also being tried.

The use of calcium cyanide against wire worms again demonstrated the efficiency of this material when drilled into infested soil at a rate of 100 pounds to the acre.

Observations of the life cycle of wire worms are being continued.

Studies on the control of tobacco thrips indicate that sprays are more effective than dusts.

Special Investigations

A New Peach Trouble

A special investigation was begun in August of a seemingly new peach trouble which at that time was known to occur in several orchards in the State and was severe enough to cause some alarm among the owners.

The trouble is characterized by a premature yellowing and ripening of the foliage on a part of the branches at midseason or later, and is usually accompanied by a falling of the injured leaves and of the fruit on these particular branches. The fruit that remains on the tree appears normal but perhaps ripens a little earlier. There is also in the wood of the injured branches a characteristic dark brown streaking, extending longitudinally through the branch, these streaks frequently arising from a cut end of a branch or a cut-off side branch. The twig growth and bud formation on the branches from which the leaves have fallen appear normal and in the winter it is very difficult, if not impossible, from the external appearance, to distinguish between healthy and injured trees.

A careful survey was made of sixty-three orchards scattered throughout the State, and as complete records as possible were obtained of the past history of each orchard, as to source of trees, varieties, age, spraying, cultivation and any other particulars that could be learned. Maps of the whole or a part of several of these orchards were made, so that in 1934 the spread of the trouble, if any, can be determined. In 62 of the 63 orchards visited the trouble was found to be present in varying amounts, affecting from one per cent to 100 per cent of the trees, mostly ranging around five per cent.

Temperature and rainfall records for a period of years have been plotted and studied with the thought that weather conditions might be a contributing factor. The last five years have been decidedly abnormal. It is very evident that drought has caused a decided decrease in annual ring growth but what other part weather conditions play is still uncertain, although it is possible that the metabolism of the trees has been unbalanced to such an extent as to render them susceptible to the invasion of fungi or to injury from other causes which would have no effect on normal trees.

A quantity of seedlings were budded with buds from injured trees to determine the possible presence of a virus disease. The results of this experiment will not be known for at least a year. Healthy trees were injected with expressed juice from healthy and injured trees to determine if there was any toxic principle in the sap of the injured trees. The results were negative. The water conductivity of the wood from healthy and abnormal trees was tested and it was found that the healthy wood conducted more water than the wood from the injured trees, but what bearing this has on the problem was not determined. Some chemical analyses of wood and bark from the abnormal trees showed an appreciable amount of arsenic. However, these data were not sufficient to warrant any conclusions.

Much material has been examined for fungi and in all cases a fungus or fungi have been found in the streaks in the wood. Cultures from all the material have been saved and inoculations of healthy trees in the greenhouse were made. No results have as yet been obtained from these inoculations so it is not yet known what part the fungi may have in causing the injury.

Increment borings were taken from healthy and injured trees and these show that all the trees had made approximately the same normal annual ring growth until 1930, which was a year of severe drought. In 1930 all the trees showed the same decided decrease in annual ring growth. In subsequent years the data at hand show a tendency for the healthy trees to put on increased growth, while the injured trees still show a static or decreasing rate of growth. Considerable material from these trees has been sectioned in an attempt to discover deformations of the wood caused by freezing or any other adverse climatic condition, but so far with negative results.

Soil samples were taken from all the orchards examined and to date the soil type or the condition of the soil as indicated by chemical analyses, have shown no correlation with the presence of the injury. Greenhouse pot experiments with soils from a number of orchards are now in progress.

In the late fall observations and reports indicated a seeming recovery in some of the orchards most seriously affected, at least if development of buds on the injured branches may be so interpreted. Later still, the low temperatures of Christmas week caused great injury to the fruit buds which may introduce a disturbing factor in this investigation.

Potato Experiments at Windsor

On a two-acre field adjacent to the Tobacco Station, a series of potato experiments was begun, involving fertilizer practice and the control of insects and disease.

Fertilizer experiment. Many fields formerly in tobacco for years, and heavily fertilized, are being planted to potatoes. In order to ascertain

the fertilizer requirements of potatoes under these conditions, a series of 70 one-fortieth acre plots was established in the spring of 1933 on a field which had been under tobacco fertilization for a long period.

Preliminary soil tests on this field showed a high content of active phosphorus and a moderate content of active potassium, which is characteristic of old tobacco land. A low magnesium test was obtained.

Varying rates of application of phosphorus, potassium, magnesium, and nitrogen were included. The standard treatment supplied 100 pounds of nitrogen, 120 pounds of phosphoric acid, 120 pounds of potash, 60 pounds of lime, and 40 pounds of magnesia, with all of the nitrogen as sulfate of ammonia. Green Mountains were used and on this standard treatment yielded 376.6 bushels of marketable size, and 12.2 bushels of culls, per acre.

Varying applications of phosphoric acid and potash gave no significant differences in yield. There was a slight indication that the yield was somewhat decreased by omitting magnesia, and there was a slight decrease when the nitrogen application was reduced by 50 per cent. The following data are indicative of the results obtained:

	Yield marketable potatoes (bu. per A.)	Probable error (bu. per A.)
No fertilizer	279.4	...
No magnesia	351.2	15.4
Half rate nitrogen	358.8	5.9
No potassium	369.3	7.7
Standard treatment	376.6	7.7
No phosphorus	385.8	11.5

On the basis of the results for the first year, it appears that there were sufficient amounts of residual phosphoric acid and potash remaining from previous tobacco fertilization to supply the needs of the potato crop, and it is evident that on old tobacco land there is no necessity for using as large amounts of these ingredients as are customary in potato fertilization (2000 pounds of 5–8–7 supplies 160 pounds of phosphoric acid and 140 pounds of potash).

A continuation of this experiment should reveal the duration of residual fertilizer effects. From similar studies on tobacco it is anticipated that significant increases will be obtained from potash applications in 1934 on this field.

Spraying and dusting. This report contains the results of a demonstration of the relative effectiveness of certain insecticides and fungicides used in the culture of late potatoes, carried out at Windsor in connection with the soil-fertility experiments.

The materials used in the demonstration test were: barium fluosilicate one pound, lime five pounds, applied as a dust; copperlime dust; 4–4–50 Bordeaux mixture; 8–8–50 Bordeaux mixture; and arsenate of lead three pounds, fish oil one quart, water 100 gallons, as a spray. Each treatment was applied to five rows 75 feet in length and an untreated plot of five rows was retained as a control. Six applications of all of the above materials were made on the following dates: May 29; June 8, 19, 30; July 18, 28. On August 18, the only plots showing sufficient green foliage for further treatment were the two plots which had received Bordeaux sprays and these were given the sixth and last application on that date.

During the first part of the season, early blight was present on the check, dusted, and arsenate of lead and fish oil plots. Late blight was found on a few leaflets at the time of digging, October 5, but no late-blight rot was found on the tubers in any of the plots.

The potato flea beetle was abundant during June and caused considerable damage. Later in the season it was not so destructive. Leafhoppers were moderately abundant during the late summer, and some tip burn resulted from their feeding. The Colorado potato beetle was not present.

The yields of potatoes from the various plots are given in the following table:

Treatment	Yield—Bushels per acre		Increase over checks (Firsts)	
	Firsts	Seconds	Bushels per acre	Per cent
Control	176	23	..	..
Lead arsenate—fish oil	216	13	40	23
Copper-lime Dust	225	16	49	28
Barium Fluosilicate	227	16	51	29
4-4-50 Bordeaux	376	12	200	115
8-8-50 Bordeaux	404	7	228	130

In this table the various treatments are listed in the order of their effectiveness in increasing the yield of tubers. The lead arsenate and fish oil spray and barium fluosilicate dust were used primarily for the control of flea beetles. Since the increases in yields with these materials amounted to 40 and 51 bushels per acre respectively, the usefulness of these insecticides for flea beetle control is demonstrated and these figures also show the proportional amount of damage due to this insect. The copper-lime dust treatment was found to be much less effective than Bordeaux mixture in obtaining increased yields of potatoes. The outstanding increases in yield of 200 bushels or more per acre obtained by the Bordeaux sprays are due to: prevention of flea beetle and leafhopper injury, protection against climatic conditions unfavorable to the potato plant, and stimulation of the plant resulting in increased tuber production.

A comparison of the yields from the two strengths of Bordeaux mixture shows a difference of 28 bushels per acre in favor of the 8-8-50 spray. The yield of 404 bushels of first grade potatoes from the 8-8-50 Bordeaux plot was the highest of all the yields from the various treatments used in the demonstration. This plot also produced the smallest amount of second grade tubers.

Electrically Heated Hot Beds

In connection with the market garden trials at Windsor, a series of hot beds with electrically heated cables for temperature control were installed during the fall of 1932. The beds were divided into three

sections, each controlled with a separate thermostat. Each section consisted of eight sash equipped with two heating units (120 ft. cable) for each four sash.

In connection with this work, a sand propagating bed for the establishment of cuttings was laid out in order to determine the possibilities of utilizing the hot bed space in this way during the early winter months. Excellent results were obtained, especially on certain ornamental hardwood shrubs from which cuttings are difficult to produce under ordinary greenhouse conditions. Carnations, verbenas, arbor vitae, grapes and eleven species of hardwood shrubs were successfully propagated in this manner.

During November and December, 1932, head lettuce was grown in the electrically heated beds, under three conditions:

1. Wafer type thermostat, in air space above soil, set at 40° F.
2. Soil thermostat, set at 60° F.
3. Soil thermostat, set at 70° F.

The plants matured very slowly and produced small heads at the 40° minimum air space temperature, indicating too cool conditions. Best heads and highest percentage of heads were developed at 60° F. soil temperature. At 70° F. soil temperature, growth was too rapid to produce good heads, and at the later stages the plant tissue broke down rapidly.

Beets were also grown in flats from seed, during early winter.

In late winter and early spring cauliflower, lettuce, tomatoes and pepper plants were started for later transplanting into the field. In April and May sweet potato plants were started at 80° F. minimum soil temperature.

In order to show maximum current consumption, data for December, 1932 gives an excellent representation. The average temperature for the month was 32.5° F., with an average daily minimum of 24.3°. An extreme minimum of six degrees below zero occurred on December 17. The average daily current consumption was 0.875 Kilowatt hour per sash, costing, at two cents per K.W.H., one and three-quarters cents. Maximum daily current consumption for 24 sash was 38 K.W.H., on the coldest day.

Sweet Potato Trials

In response to a demand for more specific information on sweet potatoes under Connecticut Valley conditions, this crop has been grown in a small way in variety trials at Windsor during the past three years. In 1933 this work was expanded to include fertilizer experiments, comparisons with white potatoes and curing technique.

The following are comparative yields of sweet potatoes (Yellow Jersey) and Irish potatoes (Green Mountain) in the dry season of 1933, under those treatments which showed significant results.

Treatments, per A.	Yield of marketable potatoes in bushels per A. Sweet	Irish
40 tons manure	308	377
20 tons manure and 750 pounds 6-7-8 fertilizer	278	342
1500 pounds 6-7-8 fertilizer	229	310
750 pounds 6-7-8 fertilizer	189	295

The omission of lime in this moderately acid soil did not produce a decreased yield of either crop.

Sweet potatoes showed an apparent benefit from increasing the potash application from 120 to 180 pounds per acre. No definite conclusions should be drawn from the results of a single season.

In order to store sweet potatoes for any length of time, the skins must be dried down by placing the potatoes in a warm, dry place for several days, as soon as possible after harvesting. The crop grown at Windsor was thus cured in a section of a tobacco shed which was partitioned off so as to close as tightly as possible. The potatoes were racked up in bushel baskets set on boards across the beams used for the tobacco lathes. Charcoal fires were kept up in an open space between the racks for seven days, maintaining a temperature of about 85° F. After five days, humidity records indicated that the potatoes had ceased to contribute significantly to the moisture of the air within the chamber.

This process, with chambers utilized to their full capacity, would cost approximately five cents per bushel. The potatoes thus cured have since kept without serious storage losses in a dry room at moderate temperatures, (45 to 50° F.)

The report on the several varieties grown in 1933 will be found in Circular 94, "Testing Vegetables in Connecticut".

The Library

During the year ended October 31, 1933, the Station Library has had approximately the following number of additions:

U. S. Department of Agriculture bulletins and reports	644
State Agricultural Experiment Station publications	1165
Scientific and agricultural domestic and foreign journals	3000
Single books purchased	68
Total	4877

The library subscribes to 85 sets of scientific journals. It receives in exchange for its own publications about 20 sets of domestic farm journals and 15 sets of foreign agricultural journals.

The total number of cloth and paper bound volumes on hand is now about 17,400. Most of the United States Department of Agriculture and State Experiment Station publications are received in pamphlet form and are not included in the volume count until bound.

Field Days and Exhibits

Approximately 350 farmers and their families attended the annual field day at Mount Carmel on August 16. Dr. F. J. Sievers of the Massachusetts Agricultural Experiment Station addressed the gathering in the big tent at noon on "The Sins of the Farmers".

Station people were posted at the various experimental plots to explain the projects to the visitors. Interest centered around the experiments of the plant breeding department to control the inroads of Stewart's disease by breeding resistant strains of sweet corn. The farmers were shown certain crosses resistant to the wilt in the midst of sickly plants.

Another important exhibit was the demonstration in control of the Mexican bean beetle. The Station investigators were able to show clean beans as a result of a careful spray schedule and wider spacing of the plants.

The visitors were also shown the effects of various substitutes for lead arsenate which were being tried out in an effort to avoid harmful spray residues.

On August 10, the annual twilight meet of the vegetable growers was held on Windsor field. The Hartford County Market Gardeners Association and the Hartford County Farm Bureau cooperated with the Station in holding this meet. The growers made careful inspection of the vegetable fertilizer studies, the breeding experiments and the tests of various strains.

In addition a number of smaller groups have met at the Station in New Haven, or at one of the Station farms. The usual field day at the Tobacco Substation was omitted this year.

Changes in Staff

Appointments

Mrs. Oran B. Stanley, A.B., Secretary in Soils Department, October 28, 1932.
Miss Genevieve Booth, A.B., Secretary in Plant Breeding Department, December 1, 1932.
Miss Helen A. Hulse, Secretary in Entomology Department, July 1, 1933.

Resignations

Mrs. Catherine R. Miller, M.A., Secretary in Plant Breeding Department, December 1, 1932.
Mrs. Gladys Brooke, B.A., Secretary in Entomology Department, August 1, 1933.

Projects for 1933-34

Analytical Chemistry

1. Inspection of fertilizers.
2. Inspection of feeding stuffs.
3. Inspection of foods and drugs.
4. Calibration of Babcock glassware and thermometers.
5. Analyses of insecticides and fungicides.
7. Analyses of special and miscellaneous foods.
8. Collaborative studies on analytical methods.

Biochemistry

1. Cell chemistry.
   a. A detailed examination of the nitrogenous constituents of plant cells, in particular those of leaf tissues. The further development of methods for the determination of the different forms of nitrogen in extracts of such tissues.
   b. An investigation of the constituents of the tobacco plant with special reference to the changes that occur during curing.
   c. An investigation of the composition of tobacco seed.
2. Protein chemistry.
   a. The methods for the determination of the basic amino acids yielded by proteins with the object of increasing their accuracy and convenience.
   b. The methods for the separation of other amino acids yielded by proteins.
   c. The properties of certain of the amino acids and their derivatives.
   d. Methods for the preparation of pure proteins on a large scale with the object of obtaining material for chemical and nutritional study.
3. Nutrition investigations.
   a. The relation of diet to the rate of growth with special attention to certain factors that appear to determine rapid growth.
   b. The investigation of the relation of certain constituents of the diet to the growth of skeletal tissue.
   c. The relation of rate of growth to well-being as shown by the investigation of certain organs and tissues.
   d. The relation of the rate at which growth has occurred to the basal metabolism of the rat.
   e. An investigation of the requirements of mineral nutrients.

Botany

2. The nature and cause of mosaic diseases of plants.
5. Plant disease survey of Connecticut.
8. Spraying and dusting experiments on apples and peaches. (See also Entomology, No. 3.)
15. A study of the virulence of the chestnut blight.
20. Diseases of shade trees.
24. Studies of the morphology of the willow scab fungus.
27. An investigation of an elm disease in Connecticut.
28. Studies on the identification of apple varieties by seed characters.
29. The absorption of nitrogen through the leaves of the plant.
30. Investigations on the diseases of vegetable crops and their control.
31. Investigation of a new peach "trouble."

Control and Service

12. Seed testing.
25. Spray service (with the Extension Service.)

Entomology

3. Spraying and dusting experiments on apples and peaches. (See also Botany, No. 8.)
9. Insect survey of Connecticut.
17. Studies in the control of the Oriental fruit moth.
21. Control of the spinach leaf miner.
28. Investigations on oil sprays.
29. Control of the Mexican bean beetle in Connecticut.
30. A study of insects that attack the tobacco plant. (See also Tobacco Substation, No. 20.)
31. Studies on the biology and control of the European pine shoot moth. (See also Forestry, No. 13.)
32. The biology and control of the potato flea beetle.
33. Mosquito control.
34. Clothes moths.
35. The biology and control of the white apple leafhopper.
36. The control of onion thrips.
37. Substitutes for Lead Arsenate in orchard sprays.

Control and Service

10. Inspection of orchards and nurseries.
11. Control of gipsy moth. (In cooperation with U. S. Dept. Agr.)
12. Elimination of mosquito nuisance.
13. Inspection of apiaries.
19. Control of the European corn borer. (In cooperation with U. S. Dept. Agr.)
24. Control of the Asiatic beetle.
25. Control of the Japanese beetle. (In cooperation with U. S. Dept. Agr.)
27. Rearing and distributing parasites of the Oriental fruit moth.

Forestry

1. Experimental plantations on a sandy tract at Rainbow.
   a. Comparison of many species of conifers and hardwoods, in pure stands and in combinations.
   b. Methods of management for those species that have survived.
   c. Studies on growth and habits of the several species.
2. Effect of thinning in white pine at Shaker Station.
3. Effect of thinning in hardwoods at Quassipaug Lake.
6. Studies of forest plantations throughout the state.
   a. Comparative growth of various species.
   b. Reasons for success or failure.
   c. Soil and other site factors necessary for success of each species.
10. An investigation of the distribution and growth of forest trees as influenced by soil conditions and other site factors.
11. Coniferous seed bed study to determine:
    a. The value of fertilizers in seed beds.
    b. The value of different amounts of seed.
    c. The value of dusts and sprays in preventing dampening off.
12. A study of preservative treatments of native woods used for posts.
13. Studies on the biology and control of the European pine shoot moth. (See also Entomology, No. 31.)

Control and Service

5. Distribution of forest planting stock. (Under Clarke-McNary Act.)
7. Control of white pine blister rust. (With U. S. Dept. Agr.)

Genetics (Plant Breeding)

1. A genetic study of hereditary characters in corn involving their linkage relations and variability.
2. The effects of inbreeding and crossing upon corn.
3. Methods for the improvement of naturally cross-fertilized plants by selection in self-fertilized lines, with particular attention to field corn for grain and ensilage; alfalfa; some of the more important vegetable crops, such as sweet corn for market gardening and canning, beets, carrots, cucumbers, melons, squash; and some fruits, such as bush fruits and strawberries.
4. Methods for the improvement of naturally self-fertilized plants, with particular attention to tobacco and vegetable crops such as lettuce, lima beans and tomatoes.
5. A study of variation and the effects of selection in strains of cross-fertilized and self-fertilized vegetables.

Soils

1. A descriptive inventory of Connecticut soil types in relation to their use for crops, pasture and forest.
2. The physical and chemical characteristics of important soil types in relation to the nutritive response of tobacco and other crops when these soils are variously treated in the greenhouse.
3. Nutrient requirements of vegetable crops on important soil types used for market gardening in the state.
4. A study of the physical, chemical and biological conditions of several soil types in natural mixed hardwoods and in planted coniferous forests.
5. Lysimeter studies of the drainage losses and other changes that occur in several soils under heavy fertilization as practiced for tobacco and vegetables.

Tobacco Substation

1. Fertilizer experiments—various sources and rates of nitrogen, phosphoric acid, potash, lime and magnesia.
2. Field tests with farm and "commercial" manures.
4. Tobacco nutrition studies—the role of nitrogen, sulfur, potassium, calcium, manganese, boron and magnesium.
5. Improvement of Havana seed tobacco. (With U. S. Dept. Agr.)
6. Improvement of Broadleaf tobacco.
7. Improvement of Cuban shade tobacco.
8. The effect of various winter cover crops used on tobacco land.
11. Soil reaction in relation to tobacco.
13. Preservative treatment of shade tent poles. (See Forestry, No. 12.)
17. The role of humidity and temperature in curing tobacco.
19. Diseases of tobacco—a Pythium damping-off and root-rot.
20. A study of insects that attack the tobacco plant. (See also Entomology, No. 30.)
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All of which is respectfully submitted,

WILLIAM L. SLATE,
Director

Bulletin 358 February, 1934

PLANT PEST HANDBOOK FOR CONNECTICUT

II. DISEASES AND INJURIES

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PREFACE

Some thirty years ago, the Station issued a slender bulletin describing plant pests and their control, and gave it the title "A Spray Calendar." It proved very useful and was followed by many revisions, culminating in the present, "A Plant Pest Handbook," issued for convenience in two parts. Part I, Bulletin 344, deals with Insects. Part II, presented herewith, is devoted to Diseases, chiefly those caused by fungi, and to Injuries due to various causes other than insects.

For several reasons, the treatment in this part is somewhat different from that in Part I. Herein are listed all of the troubles on plants cultivated in Connecticut that have come to the writer's notice. To that extent this constitutes a check list. Further, especially as Addenda, there are recorded certain scientific observations from a more detailed and personal point of view. Thus, in the main body of the book, the needs of the practical grower are more nearly served, and the record is completed in the Addenda for those who study plant troubles from a more critical aspect.

The arrangement is similar to that in Part I. The hosts are listed alphabetically and under each a description of the troubles found thereon is given. In case a disease occurs on several hosts, the description is given but once, and then merely mentioned under the other hosts, with reference to the first host. This reference is indicated by "q.v." or by "see host." The hosts and troubles are arranged alphabetically according to common names. For greater accuracy the scientific name, where known, is given also in each case. The usual authorities are not included after these scientific names as is done in most scientific handbooks. One of the reasons for this is that the determinations given are the author's and not those of the scientist who first described the species or later changed it to another genus. Therefore full responsibility is assumed for the names used, in case they are incorrect or involve a matter of judgment, in order not to force this responsibility on some one, possibly now dead, who might have used the same scientific name quite differently, especially in the case of fungi. It has seemed best to be conservative in the use of new names in the place of old ones and of new species, because of the bias that often lies unrecognized back of these changes.

Under each host are taken up, first, the diseases caused by bacteria and fungi, the common name of which is followed in most cases by the scientific one in italics. Following these come the common and scientific names of occasional troubles caused by nematodes. The troubles listed under the general title of Injuries follow under the common names alone. Some of these, as the viruses, may possibly be due to living organisms and so some day should possess a scientific name as well. Most of them, however, are injuries or possibly in some cases diseases (sometimes called physiological) that are due to unfavorable environments of various kinds. The illustrations are merely to indicate the general type of trouble that is caused to a host by a fungus or injury.

To the author's former teachers, the late Professors Burrill, Farlow and Thaxter, due to the high standards they set and the ambition they inspired, he largely owes what knowledge he has gained concerning fungi and plant diseases during the forty years he has been studying them.

In conclusion he wishes to thank the various assistants who have at one time or another been helpful in collecting, determining, cultivating, spraying or observing certain fungi and their injuries. These persons include E. M. Stoddard, Florence A. McCormick, A. A. Dunlap, A. D. McDonnell and Mrs. William W. Kelsey, present assistants, and W. R. Hunt, G. L. Zundel, H. B. Bender and G. E. Graham, former assistants.

G. P. C.

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PLANT PEST HANDBOOK FOR CONNECTICUT

II. DISEASES AND INJURIES

G. P. Clinton

FUNGI (DISEASES)

Nature of Fungi

Although not so well known to the casual observer and not so numerous as to species as are the insects, fungi are even more important. As parasites they are important because of the injury they cause to a great variety of plants in various ways and in varying degrees. Some true fungi, as well as the bacteria, cause diseases of animals, and some of the worst infectious diseases of man are due to them. The so-called virus diseases of plants, whose cause is undetermined, are placed by some as due to ultra-microscopic bacteria. Further, bacteria and true fungi are useful in many manufacturing processes, especially of foods and beverages. They are also a great help in the disintegration of plant and animal tissues and thereby in maintaining the fertility of the soil for future plant growth, upon which all animal life in the end depends.

In this publication slime molds and bacteria are included under the general term fungi. These are all low forms of plants that lack *chlorophyll,* the green coloring matter of the leaves of flowering and most other plants. Chlorophyll enables the plants that possess it to manufacture out of the water of the soil and the carbon dioxide of the air, in the presence of the sun, the food that they later use for growth. Lacking this ability to form food directly out of inorganic matter, all fungi must obtain it from organic matter, either from other plants or animals. They can do this from either dead or living tissues. When fungi live on dead tissues they are called *saprophytes* and when on living tissues, *parasites.* However, all fungi are not merely Dr. Jekylls or Mr. Hydes; some are both, while others may be one or the other according to the different stages in their life history.

Stages of Development

It is these different stages in the life history of a fungus that often complicate matters. Many true fungi have such distinct stages in their development that they appear to be two different kinds of fungi, until by special culture or infection methods they are found to be merely stages of the same fungus. The stages of some fungi are easily followed by their sequence on the same mycelium, but with others only careful study reveals the various stages in their development. With many, their dual nature has yet to be revealed and perhaps some have lost or have never developed this dual nature. When two distinct stages of a fungus develop, one of them is usually connected with an asexual and the other with a sexual development, as explained later. Often each of these stages has received a distinct specific name under a different genus, before its true nature has been determined.

All true fungi, however, consist of two very distinct stages—a vegetative stage that has to do with search for food, and a reproductive stage that has to do with their perpetuation as individuals, often through unfavorable periods of their existence.

Mycelium. The vegetative stage is usually simple and consists in true fungi of threads, usually branched and more or less divided by cross-partitions or *septa* into individual *cells,* that ramify through the substances from which they obtain their food. These threads are usually single though they may be more or less bunched together as tissues or bodies especially when they form their fruiting stage. The vegetative stage, however, is generally hidden from sight in the medium on which it develops. These vegetative threads are known as a *mycelium* and in a general way correspond to the roots, stems and leaves of a flowering plant. In some cases the mycelium sends special branches known as *haustoria* directly into the host cells to obtain food. It is the enzymes or toxins that the mycelium, directly or indirectly produces that cause the disease, death or disintegration of the plant tissues in which they occur.

Spores. The reproductive parts of the fungus are known as *spores* and these correspond in a general way to the seeds, tubers, runners, etc., of the flowering plants. Many fungi have several kinds of spores; developed at different times. The spores, or at least the *fruiting bodies* on which they develop, are the evident and conspicuous part of the fungi. For instance, the black, sooty mass in corn smut consists entirely of spores while the conspicuous toadstools and shelf fungi are fruiting bodies in which the spores are limited to definite areas.

Spores vary greatly in size, shape and the manner in which they originate from the mycelium. Sometimes they are simply cut off as special cells and at other times they are more elaborately formed in special protective bodies. In general there are two kinds. *Sexual* spores, often called mature or winter spores, are those that result from a more or less direct union of bodies corresponding to male and female units and are similar to seeds in this respect. *Asexual* spores, sometimes known as temporary or summer spores, are produced directly from the mycelium without this fertilizing process. These function somewhat like tubers, runners and cuttings. Each fungus has but one kind of sexual spores, if known, but may have more than one kind of asexual spores. Few spores can be seen individually except as magnified under the microscope, although in a body they may be the conspicuous part of the fungus. However, in certain parasitic fungi, especially leaf spots, it is usually the effect or disease produced on the host rather than the fungus itself that becomes most evident to the naked eye. While the mycelium and its effect on the host are taken into consideration in describing fungi, it is chiefly by the character of the spores and their production that fungi are classified.

Classification

As is the custom in classifying living organisms, fungi are classified here in various groups such as classes, orders, families, genera and species, and sometimes varieties, before we come to the individuals upon which the classification is based. To all of these groups, according to their relationships, scientific names are applied to distinguish them. In this publication, in a semi-scientific, popular way, the fungi are roughly divided into the greater groups as follows: Slime molds or *Myxomycetes,* bacteria or *Schizomycetes,* and true fungi or *Eumycetes.* The last group can be further divided, for our purpose, into Water molds or *Phycomycetes,* Sac fungi or *Ascomycetes,* Imperfect fungi or *Fungi Imperfecti* and Basidial fungi or *Basidiomycetes.* As these groupings and the terminology that goes with them are used in the special diseases discussed later, a brief statement as to each group is desirable here for clarification.

In this paper the scientific name is applied to the stage of a fungus, when distinct, that acts as a parasite, rather than to the mature stage, since the parasitic stage is the one that is really important to the grower. If however, the mature stage is known, even when saprophytic, this is indicated in the general description of the fungus. With rusts all stages are parasitic but when they occur on two different hosts, as explained later, the name is applied to the stage on each host, and the relationship to the other stage is indicated.

Myxomycetes. The slime molds are almost all saprophytes and so are of little interest or importance to the practical grower of plants. They are commonly found on decaying vegetable matter in wet places or after rainy weather. They consist of a naked, jelly-like, vegetative mass of protoplasm that can slowly creep up or on

vegetation and then under dry conditions change rather quickly into dusty spore groups of various types. The clubroot disease of crucifers and certain smothering forms on grasses in lawns are the only forms mentioned here.

Schizomycetes. This group, bacteria, not only causes serious diseases of animals but also of plants. Professor Burrill of Illinois, with whom the writer studied, was one of the very first to prove that plants were subject to bacterial diseases, as shown by his work on pear blight and other troubles. Bacteria are very simple forms of fungi consisting of minute cells that separate from one another by fission (direct division) or else adhere in temporary threads or masses. Under certain circumstances, within their own minute bodies, bacteria produce spores, which are much smaller than the spores of fungi. These bacterial spores are more resistant to unfavorable conditions than the bacteria. The enzymes or toxins produced by bacteria help to destroy the tissues of the hosts in which they develop and secure the food necessary for their existence. In this paper the term "bacterial blight" is used to indicate bacteria on their different hosts. Some thirty species on over fifty distinct hosts are listed. Most of these were originally described by Dr. E. F. Smith of the U. S. Department of Agriculture or his assistants.

Eumycetes, or true fungi. Phycomycetes. These are the lowest form of the true fungi and probably the first to develop. They usually grow best in water or under rather moist conditions. Like all true fungi, they develop from threads or a mycelium, but differ from the higher forms in that these threads are not usually divided by cross-partitions or septa except where spore formation is taking place. The asexual spores are borne singly or in numbers in a covering called a *sporangium.* The sexual spores are produced in various ways by fusion of special fertilizing threads resulting in one or more usually thick-walled permanent spores. These are known as *zygospores* when the fertilizing threads are very similar and as *oöspores* (contained in cell-like coverings called *oögonia*) when the threads are so distinct sexually as to indicate male and female bodies. With this group very often the germination of the spores results in the formation of simple, animal-like cells, *zoospores,* that swim around in water for a time before they infect their hosts or dead matter to form a mycelium. The downy mildews, including the specially destructive potato blight, belong to this group, as do certain of the fungi that occur on insects. Professor Thaxter was one of the prominent investigators of this group.

Ascomycetes. These are called *sac* fungi because their mature or sexual spores, *ascospores,* are borne in hyaline sacks known as *asci.* These in turn are produced in an open layer as in the leaf curls, are included in open cups called *apothecia* (*Discomycetes*), or are enclosed entirely in receptacles called *perithecia* (*Pyrenomycetes*). These latter fruiting bodies may be simple or compound and be free or more or less surrounded by the mycelium from which they are formed. They may be embedded in their host or more or less free on its surface. The fruiting bodies give protection and permanence to the spores borne in them. The spores usually are liberated by special openings in these bodies upon their maturity or at the season favorable for germination and infection of new hosts. Besides the ascospores the Ascomycetes may produce various kinds of temporary or asexual spores. These serve to spread the fungus to other hosts during the growing season. Many of the imperfect fungi, discussed next, will probably be found to belong here as asexual stages when their life histories have been carefully worked out. When an Ascomycete has had its life history determined, we frequently find that the imperfect spore form is a parasite while the sac form is a saprophyte, as in apple scab and many leaf fungi. Besides the leaf curls and cup fungi (usually saprophytes), this group includes among its prominent parasites, scabs of apple, pear and willow, chestnut blight, black knot of plums and cherries, and the powdery mildews.

Fungi Imperfecti. These are the imperfect stages of fungi usually belonging to the Ascomycetes or rarely to the Basidiomycetes. In other words their mycelium in certain stages produces only asexual or imperfect spores but in other stages they have finally been determined, in some cases, as producing sexual spores. The imperfect fungi having similar appearance are grouped together artificially into genera known as *form genera,* such as Fusarium, Fusicladium, etc. Many of these imperfect fungi have never been sufficiently studied to connect them to a sexual stage and so remain under their form genus. Probably many will never be connected up to a genus having sexual spores. With certain of these form genera, while one species may be connected with a certain sexual or mature genus, others may be connected with a different genus, as is illustrated by certain species of Fusarium. On the other hand species of Fusicladium all seem to be stages of the same mature genus. The connecting of the various stages of a single species of a form genus, therefore, is often an aid to connecting up the other species. Apple scab, for example, is a parasite that injures the living apple leaves and comes under the form genus Fusicladium but studies have shown that it is really merely an imperfect stage in the life history of an Ascomycete known as Venturia that appears as a saprophyte on the old dead leaves. This discovery has lead to the connecting up of other species of Fusicladium with other species of Venturia.

With the imperfect fungi, the manner in which their asexual spores are produced divides them into distinct groups. In the first group, *Moniliales,* the spores are borne externally on the host in more or less evident and modified branches of the mycelium called *conidiophores.* In another group, *Melanconiales,* the spores are formed inside the tissues of the host, usually on little differentiated threads of the mycelium, and ooze forth on the surface as viscid drops or tendrils. A third class, *Sphaeropsidales,* has the spores produced in special covered receptacles of fungous origin called *pycnia* and their so-called *pycniospores* are liberated by a special opening or pore at their top. In a fourth, *Mycelia-Sterilia,* and by far the smallest group, the mycelium fails to produce any spores but often perpetuates itself through special tuber-like bodies of mycelial cells called *sclerotia,* or root-like bodies called *rhizomorphs.*

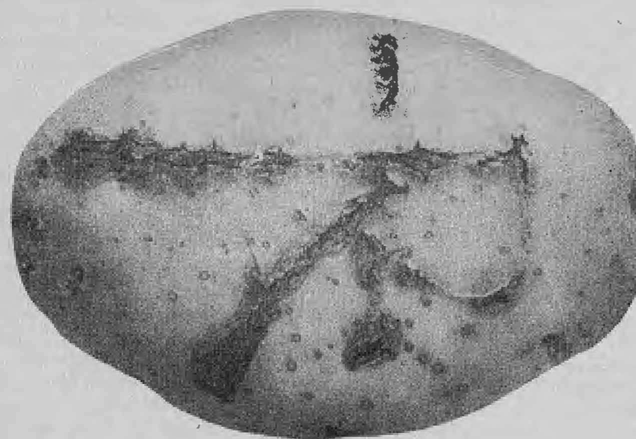
Basidiomycetes. As far as we are concerned here, the basidial fungi (which are characterized by having certain of their spores borne on pointed threads, *sterigmata,* of special cells called *basidia*) can be classified into three general groups. These are the *Ustilaginales,* the *Uredinales,* and the *Hymenomycetes.*

Ustilaginales or true smuts are all real parasites that attack the leaves, stems, fruit and occasionally the roots of a great variety of plants, chiefly the grasses, but rarely if ever occur on trees or shrubs. They are usually distinguished to the naked eye by the black, smutty outbreaks that appear when their spores are matured. A few, however, have embedded and light colored spores that are found chiefly in discolored spots in the leaves. The spores are usually single-celled but there is also quite a variety of arrangements of those that are grouped more or less permanently into compound spore bodies. They cause injury chiefly to the cereals when their spores usually take the place of the maturing seeds. They have only one kind of permanent spores which on germinating usually give rise to a short thread or *promycelium* bearing temporary, basidial spores which cause the infection of the seedlings or plants with which they come in contact. Onion smut and smuts of certain cereals like wheat, oats and barley are the injurious forms most commonly found in this state. Our losses in the cereals, however, are small compared with those in the large grain regions further west.

Uredinales. The rusts are somewhat similar to the smuts and on germination certain of their spores, like those of the smuts, produce basidial spores on a promycelium. They are much more numerous and variable on the hosts they attack and include trees and shrubs as well as herbaceous plants. Also they have a greater variety of spore forms; some species have as many as four spore forms besides the basidial spores. They are even more strictly parasitic than the smuts or any other fungi. While botanists have succeeded in growing the mycelium or certain spore stages of all the other groups of fungi in artificial cultures in test tubes, the rusts have resisted such attempts. Likewise they are the only fungi that may have alternate, or different hosts, for the growth of their distinct spore forms. They are called *heteroecious* (having stages on two different hosts, O-I on one, and II-III on the other) or *autoecious* when all the stages occur on the same host. For instance with the blister rust there are the two stages that appear on the white pine (O-I) and the two others (II-III) that develop only on species of Ribes (currants and gooseberries). On the white clover, however, all four stages appear, one after the other.

The spore stages are as follows: The O or *pycnial* stage appears first. Its function is not known certainly but it is supposed to be a spore stage or to have something to do with fertilization. The so-called spores, *spermatia,* are small bacterial-like bodies cut off from threads and usually enclosed in a special receptacle called a *pycnium* or *spermagonium.* The I or *aecial* stage (constituting the so-called form-genera of Caeoma, Aecidium, Roestelia and Peridermium) breaks out as open spore masses or *sori* or is enclosed in a special elevated white cup called a *peridium.* The II or *uredinial* stage produces groups of the *uredospores* that spread the rust to other leaves and plants during the earlier part of the growing season. These spores are often similar to those of the I stage and are of a temporary nature. Later in the season comes the III or *telial* stage whose spores are called *teleutospores.* These are quite distinct, usually thicker walled and often unlike the single-celled spores of the other stages, and may even be composed of two or more cells. They are designed to carry the fungus over unfavorable periods such as winter.

Hymenomycetes. The final class of the Basidiomycetes that we need to consider here are those that include the shelf fungi, toadstools and allied forms. These are the highest forms of the fungi as well as the most conspicuous as to size, form and variety of their fruiting bodies. They result from growth of the inconspicuous mycelia that develop in the living or decayed tissues of the hosts they inhabit or in the humus in the soil. Their spores, usually of simple structure and appearance, are formed on basidia developed on a *hymenium* or fruiting layer of united fungous threads on a definite fruiting body or *sporophore.* Varying according to different genera, this hymenium covers the fruiting bodies with a plain surface, with teeth, clavate structures, pores or gills. Most of the species occur on the ground or on dead wood as saprophytes, though some groups or species are of considerable importance as parasites. The toadstools and shelf fungi that occur on the living bark and sapwood of trees are considered true parasites. Those that cause decay of the heartwood, while not strictly parasites, are at least somewhat harmful even though they develop their fruiting bodies only as saprophytes on the dead trunks later.



Potato showing scab infection as a result of Thaxter's original inoculation. *See* page 250.

INJURIES

Troubles of plants caused by fungi, nematodes and viruses are classified in this publication as *diseases* and those caused by insects and other agents as *injuries*. We think of a disease as a more or less progressive trouble, generally caused by some parasitic organism, and an injury as a more or less local trouble that usually acts quickly rather than continuously, such as is caused by an insect chewing off the tissues of a leaf. These are somewhat arbitrary classifications, however. Some insects can cause diseases, as those that produce galls, and there are many injuries that are caused by agents other than insects. It is with these latter that this section of the bulletin deals. They are sometimes included under such terms as *physiological* troubles or *mechanical* injuries.

Under the two hundred and sixteen hosts listed by common names in the headings given below, there are described, in more or less detail, about one thousand troubles. Of these about seven hundred are caused by fungi, thirty to thirty-five are probably due to viruses and sixteen are produced by nematodes or microscopic worms that cause swellings on the roots or sometimes diseases of the leaves. All of these can be called diseases. The remaining, some two hundred troubles, are classified as injuries, in spite of the fact that in some cases they might be considered by others as diseases, though not caused by fungi, insects or other animal parasites.

Causes of Injuries

The causes of these injuries are of great variety, being agents or factors detrimental to the normal vigor or appearance of the plants or to their various organs or tissues. They may be roughly classified under the following terms: animals (including man), autos, chemicals, cold, drought, dust, electricity, excavations, fertilizers, fillings, fire, frost, fumes, gas, hail, heat, ice, lightning, oils, pruning, salt, smoke, smothering, snow, sprays, sun, water and wind. All of these at one time or another have been called to our attention as causing injuries, but it is not necessary to go into detail at this place concerning them. They are factors, however, that need to be taken into consideration when the cause of a plant trouble is not shown to be a fungous parasite or insect. Special mention of them is made under the various hosts upon which each particular injury has occurred. We can consider here only two of these causes and their resulting injuries,—cold and heat, or the extremes of temperature as they affect the health of plants. These are apparently the most common and most injurious of the troubles listed above.

Injuries Caused by Cold

Cold injures plants chiefly in two ways—by the so-called winter injuries when the plants are in a dormant or semi-dormant condition, and by early or late frosts when the plants are in active growth. Winter injuries vary greatly in the amount of damage that occurs to different species of plants but are especially severe to those grown out of their natural surroundings. Some species are severely injured in very cold winters and are usually those that are normally grown in a warmer climate. Others are less severely or not at all injured by the same degree of cold and are usually those that are natives of that region or of similar regions. Cultivated and fertilized trees, especially if fertilization and cultivation is continued late in the season so that the tissues are not properly matured before cold weather sets in, are more subject to winter injury than are the wild species.

Man is anxious to grow a great variety of plants out of their natural climatic conditions and these naturally suffer most from winter injuries. Trees and shrubs are more subject to injury in this respect than are herbaceous plants since the latter, if tender, are usually properly protected or are limited to greenhouses. Nurserymen, however, have learned largely by experience what woody species can stand winter conditions in various regions, and eventually they limit their stock to those species which escape injury in the normal winters. There are, however, always some species on the border line that are subject to injury, especially in very cold winters.

There are a great variety of ways in which trees and shrubs show these winter injuries, such as blackened sapwood, injured or killed cambium, death of twigs and branches, cankers on the limbs or at the base of the trunk, injured or dead tap or side roots, death or injury to the leaf and flower buds. The presence of water in the soil especially at the base of the trunk and the absence of snow or other mulch for protection have their influence as well as has the severity of the cold. In this state, fruit trees, especially peaches, are apt to suffer if the temperature drops below —10° F. Also the exposure as to hill sides and valleys and the varieties of fruit trees grown are important factors. All winter injuries, however, do not come from unusually cold weather. Mild, warm, winter days that tend to start sap circulation, followed by a sudden drop in temperature, though not severe, may also cause trouble. A not uncommon type of winter injury to evergreens, especially Conifers, occurs when warm, early spring days come before the frost is really out of the ground. Then there results a scorch of the leaves, sometimes called winter-scorch. The leaves lose their moisture before it can be replaced by the roots because of their inactivity in the still cold or frozen soil. As to herbaceous perennials, of course, winter injury is limited to killing or injuring their underground parts so that their growth the following season is abnormal.

On the other hand, frosts, coming late in the spring after leaves and blossoms begin to grow, may kill these or cause injury to certain of their tissues or organs such as epidermis, chlorophyll, petals, anthers or styles. Moisture on the fruit may result in local russeting in frosty weather. Early set vegetables are also often severely injured or killed by such frosts. Likewise early frosts in the fall often cause harm to crops not yet matured or harvested. When one does not know that frosts have occurred or is ignorant of their effects on certain plants, he may be confused as to the cause of the trouble.

Injuries Caused by Heat

Heat, the second serious trouble of plants, shows its effects in a variety of ways —scorches, wilt of leaves, death of plants or their tissues, baking and dropping of fruits, prematuring and abnormal blossoming of vegetables. Sometimes the trouble is the direct result of the heat, but usually it is an indirect one resulting from lack or loss of water. Scorch of leaves is often of this nature when muggy days are suddenly followed by bright hot days or when very dry weather accompanies a long period of hot days.

It has seemed to the writer that if man could control the weather he would do away with most of the troubles of his crops. It is these variations of the weather, combined with insect and fungous pests which are largely regulated by it, that help to make agriculture so interesting and at the same time so uncertain or even hazardous as a method of securing a livelihood.

PREVENTION OF DISEASES AND INJURIES

In the control of *diseases*, since they are caused largely by parasites, the methods must aim to prevent the particular parasite from getting a start on a particular plant and, if it does start, to prevent its spread to other parts of the same plant or to other plants. This is especially true of fungi, which cause three-fourths of the troubles listed here. Once a fungus, through its spores, gets inside the tissues of the host, no treatment will kill the fungus without killing the tissues of the host that surround it, although with certain spray treatments one can often prevent propagation of the external spores and so limit the spread somewhat. Therefore all treatments must be largely preventive.

On the other hand *injuries* usually come on suddenly, rather than continuously, and so are even more difficult to remedy. One must foresee the trouble as likely to occur and so ward it off by some special treatment that ordinarily the plant does not enjoy. On the whole the discussions given here relate chiefly to preventive treatments against diseases rather than against injuries.

Disease-free Seeds and Plants

Sometimes fungous diseases are carried in or on the seeds or plants when they are first planted. They may carry a fungus either by the mycelium that has already gained entrance into the tissues or by the spores merely mechanically attached to the tissues but ready to gain entrance under favorable conditions. This latter condition is especially true of seeds which upon their germination may favor infection by the attached spores. So the first step in controlling fungous diseases is to use seed and plants that are grown under conditions free from the fungi that are ordinarily troublesome to them. This is especially desirable in varieties that are known to be very susceptible to certain diseases.

In the case of grains, certain smuts gain entrance through spores that have already partially infected or are mechanically adhering to the seeds. It is much more desirable, therefore, to obtain seed from fields where smut is not present or at least not very evident, than from those where it was abundant the previous season. Likewise certain vegetables, such as celery with late blight, are known to carry disease through infected seeds. With perennial plants, it is much safer to avoid trouble by the use of bulbs, corms, tubers, etc. that come from fields or regions where there was no infection. Sometimes this infection can be discovered by a careful examination of the stock to see if rot, sclerotia or some fruiting stage shows. In some cases seeds or bulbs have been treated before distribution to guarantee a greater freedom from certain troubles. In other cases, as with mosaic on potatoes and raspberries, certified tubers or plants are sold from fields where the absence of these troubles above a specified amount has been verified by inspection.

Immune and Susceptible Varieties

On the other hand, some species and varieties, especially horticultural ones, are known to be more resistant, and some more susceptible, to certain fungous diseases than are other varieties and species used for a similar purpose. Unless one needs a particular plant for special reasons it is better to use the more resistant varieties and to avoid those that are known to be especially susceptible. It frequently occurs that the susceptible variety of a food plant is more tender and better in eating quality, or in case of a flowering plant, has more beautiful blossoms. The grower naturally prefers these qualities and therefore runs his chances of trouble as regards disease. There are, however, many susceptible plants in which these desirable qualities are not so prominent, and therefore it is better on the whole to omit them.

Plant breeders are constantly increasing the number of plants resistant to definite diseases in which they retain or build up the factors of resistance. Experience has taught the grower and further experience will add to his knowledge, so that he may know what varieties of greenhouse plants, and to a less extent of those that are grown out of doors, are strongest in their resistance to certain diseases. Orchardists already know that McIntosh is a variety of apple that is especially susceptible to scab, but since it is a very desirable variety, spray treatments have been developed for its protection against this fungus. On the other hand, spraying is much less effective on Wealthy, which is very susceptible to rust. Where rust occurs seriously it is therefore better to omit such a variety.

Special Protections

Another way in which we can help to avoid trouble from plant diseases and injuries is by special care as to when, how and where the plants are grown. The following precautions are indicated as examples.

Mulch. Mulch, either snow, leaf or earth, is often the means of protecting perennial plants, especially trees and shrubs, against winter injury. Snow in severe winters is often protective in this way. It is sometimes found that on hills where the wind has blown the snow away, the injury to orchard trees, especially at the base and roots, is more evident than in another orchard where the snow has remained as a protective layer. Likewise in severe winters, injury on certain shrubs, such as privet, merely extends down to the snow line. Other less hardy shrubs, such as box, and certain evergreens, sometimes have to have special coverings to protect them from severe winter weather. In the orchards, especially peach, the growers often protect the base of the trees by a dirt mulch to prevent an open space between the trunk and the surrounding earth in which water might accumulate and in severe weather cause a girdle type of injury.

Rotation. Another form of protection is by rotation which helps prevent the accumulation in the soil of diseases such as Fusarium, which are harmful to certain crops if grown continuously. Any crop grown continuously on the same soil tends to increase its diseases through the accumulation of spores, etc., from the dead tissues that remain on the land after the crop is harvested. Rotation to a different type or species of plant, therefore, is a way to help avoid unusual troubles of this type.

Clean culture. Special protection by clean culture is another way of lessening plant diseases. Clean culture not only keeps down the weeds, thus allowing the crop to get all of the available fertilizer and moisture, but it also helps to get rid of the insects, especially lice, which might carry the germs from the diseased to the healthy plants. It also helps to keep out those weeds that may develop special fungous diseases, which can in turn spread their diseases to the closely related cultivated crop.

For example, clubroot can develop on certain weeds and so be a menace to cultivated crucifers planted there, even if the latter did not bring in the clubroot themselves. Likewise the downy mildew of spinach is the same or so similar to the mildew common on lamb's quarters that there is a chance that the oospores commonly developed on the latter can carry the trouble over the winter and become a source of infection to the spinach when planted on the same land.

We do not know enough concerning the relationships of these weed fungi to those of similar fungi on related cultivated crops to be sure how much effect they have in starting trouble on the latter. Perhaps special strains in time may also help to start new diseases on the cultivated crops because of their relationship.

Finally, clean culture includes gathering up and destroying the infected plant tissues in the fall to lessen the chances of infection the following year from spores, sclerotia or mycelium, especially when the same perennial plants come up or annuals of the same or similar type are to be planted again.

Fertilization

Fertilizers of the chemical type are apparently safer to use, so far as discouraging disease germs for the succeeding crop on the land, than are those of organic origin, such as animal manures, fish-scrap, etc. This is especially true where the manure is not well rotted and came from animals fed on infected refuse from a diseased crop similar to one that is to be planted next on the same land.

Apparently acidity of the fertilizer may also have something to do with certain troubles. For instance, manure from animals that have been fed with scabby potatoes possibly might carry the germs of the scab as well as furnish an alkaline fertilization in the soil. Likewise such manure is very favorable for the development of the scab already there or carried in by the seed tubers. A chemical fertilizer, such as lime or wood ashes, would also be favorable for the development of scab because of the alkaline reaction. Lime, on the other hand, is used as a remedy for clubroot of crucifers because its alkalinity helps to keep down infection from the germs of this slime mold.

An acid soil or an application of an acid fertilizer is likely to invite injury to the roots of certain plants, especially seedlings, by favoring development of the Rhizoctonia fungus. A sod or a green mulch crop plowed under but not thoroughly rotted before the planting of the crop often will favor bacterial injury in certain plants, especially in a wet season.

Some persons seem to think that a well fertilized crop is less likely to develop fungous troubles than one poorly fertilized. My opinion, on the contrary, runs in the opposite direction. Good fertilization tends to develop luxuriant vegetation and this is often of soft growth in contrast to that of the slower, hard growth of the poorly fertilized plants. This soft, quick growth with favorable moisture conditions is more readily attacked, weather conditions being equal, than less luxuriant, poorly fertilized growth. For instance the author has known greater injury from brown rot on peaches stimulated to luxuriant growth by nitrate of soda than on those not so stimulated. This was partly due to the softer and larger growing fruit, but was also due to the denser foliage favoring infection because of more moisture for a longer time on the fruit in damp weather.

In a different way injury rather than disease may result from continuous or late fertilization and the manner of its application, because the fertilizer favors late growth and subsequent winter injury and if applied too near or too strong, may have direct injurious action on the seeds, leaves or roots.

A way of stimulating growth of trees that have been injured by drought, cold, or other causes is the crowbar method of fertilization that is coming more and more into use. This consists of drilling holes, at regular places around the tree, by means of a crowbar that is driven down twelve to eighteen inches, as needed. A large handful (about one-quarter pound) of a complete fertilizer is then placed in each of the holes and is washed into the soil by means of a garden hose. A 4-8-4 or a 5-8-7 fertilizer, as most available, may be used, though some seem to prefer one higher in nitrogen. From two to twenty-five pounds, according to the size of the tree (two to thirty-six inches in diameter), may be used. Some tree men use even larger amounts for very large trees. From eight to sixty holes can be made, in a zigzag way, beginning just beyond the spread of the branches and running in about two-thirds of the way to the trunk. It is preferable to use this fertilizer early in the year, before the first of July, to avoid possible winter injury from late fertilization.

Watering

Most fungous diseases develop and become bad because of moist or wet weather. This is usually beyond the control of the grower. In the greenhouse or on farms where some special irrigation system is used, or where the grower uses a hose out doors, he may be entirely responsible. Just as lack of rain may be a drawback to a good growth of plants, injudicious watering by artificial means—use of too much water or at inopportune times—may prove just as bad by favoring fungous diseases.

Greenhouse men are apt to use water too freely. This is because they have found by experience that free watering at the right time develops the most luxuriant growth and blossoms of certain plants. At the same time this optimism of the grower favors the development of fungi as well, if they happen to be present in the house and especially if susceptible varieties are used. Consequently the wise grower is the one who watches for any signs of disease and who uses water more or less moderately as needed. This is especially true of the use of water on the leaves, particularly when conditions are not favorable for its drying off fairly quickly. Early or late watering on bright days is not so likely to develop sunscorch of the leaves as watering in the heat of the day. Late watering, however, if the water does not dry off during the night, favors infection from fungi. So the season and the time of day, as well as conditions of moisture and air drainage, have to be taken into consideration in watering. In dry summer weather occasional heavy drenching of the soil is apparently better in preventing drought injuries than more frequent light watering.

Seed Treatments

We have spoken about the use of clean seed as a method of securing a crop less likely to develop serious injury by fungi. On the other hand, we do not always know the origin of the seed or its freedom from disease germs; or even if we do know that it comes from a diseased crop we still have need for its use. These conditions give rise to the use of seed treatment to kill the spores or to kill the badly infected and weakened seed.

Treated seed is not so desirable as disease-free seed since sometimes the treatment has not been sufficient or its efficiency has been so great that injury is done to the sound seed itself. The time has not come when treated seed generally is available in the market. The grower of seed rather than the buyer is the one who should know whether or not the seed needs treatment. Usually, however, it is the buyer who treats it for his own protection in growing a subsequent crop. Sometimes the buyer treats seed which does not need treatment and so is not benefited. A good rule is not to treat seed unless it looks suspicious or the grower has had trouble from similar seed that he can trace to a seed-borne disease.

Formalin, hot water, copper sulphate, corrosive sublimate have in the past been favorite types of fungicide for seed (also bulbs, tubers, etc.) treatments. More recently, organic forms of mercury, including various commercial specially-named brands, acetic acid and dusts of various types such as copper salts, mercuric compounds and formalin, are coming into use. The type of the fungicide, the length of treatment and the character of the seed have all to be taken into consideration to secure the most harm to the fungous germs and the least harm to the seed treated. Commercial preparations usually indicate in their literature the method of treatment and the kind of plants to be treated.

Soil Treatments

It is not usually advisable to treat the seed for a disease if the same disease is carried in the soil where it may later affect the seedlings or the growing plant. Hence the need in some cases for soil treatment, especially when the disease is in the soil and is not carried there by the seed. Recent experiments, however, with seed treatments for damping-off troubles, such as Pythium and Rhizoctonia, especially with dusts, seem to indicate beneficial results in preventing these troubles, even, apparently, when the fungi are in the soil rather than in the seed. Perhaps the fungicide adhering to the seed acts as a sort of soil disinfection around the germinating seed for a short distance and thus secures this effect.

The writer believes that for such troubles the best results are secured by fungicides in the soil itself to kill or limit these damping-off fungi. Steam has been used in greenhouses and seed beds, especially tobacco seed beds, for this purpose. The treatment is usually severe enough not only to kill most of the fungi and their spores but also to kill the weed seeds and so help in the matter of weeding. Pans or rakes for enclosing the steam in the soil are used. These usually require a treatment of twenty to thirty minutes and at high enough pressure, 75 to 100 pounds, to force down into the soil six or more inches heat sufficient to cook potatoes buried at that depth.

Formalin has been used to kill fungi in the soil for several different diseases in the state, such as onion smut, black root rot of tobacco, wilt diseases of lettuce and damping-off fungi. While formalin, 1 or 2% in water, is used at the rate of one gallon to half a gallon per square foot of surface of the soil treated, it is, as a rule, not quite so effective as steam. It gives fair results in killing weed seed and is usually effective as a fungicide. When the 1% formalin is used, at the rate of one gallon per square foot, the water has to be applied gradually to allow it to soak into the soil; otherwise the ground becomes waterlogged. A 2% formalin with less water is preferable, as a general rule, because it becomes more quickly absorbed. However formalin stays in the soil so long before it is dissipated that ten days should be allowed before planting seed or fourteen days before setting plants, even when the soil has been stirred later, to facilitate escape of the fumes and thus prevent injury to the plants. Recent experiments with "formaldehyde dust" gave very favorable results.

The writer has not been very successful in treating soil with commercial preparations of organic mercury compounds because of the injury that often results to the plants when the preparation used is strong enough to kill the fungi. On the other hand we have, in flats and beds for damping-off troubles, used various forms of acetic acid with as good results as those obtained by formalin or steam. (See statement under Spinach.) We have also advocated in some cases the use of Bordeaux on the soil and on the plants as they emerge from it as an extra precaution against certain troubles both of seedlings and perennial plants.

Spraying-Dusting

The most familiar practice in preventing fungous troubles is spraying or dusting. A great many fungicides have been used in one form or another as sprays or dusts. The two that stand out as the best and most frequently used are copper and sulphur in various forms. Bordeaux mixture, a combination of copper sulphate and lime in water, one of the oldest fungicides, has proved to be one of the best. On certain plants, however, such as apples and especially peaches, spotting or rusting has resulted and has limited or prevented its use, while on potatoes, cucurbits, grapes, etc., it has not been supplanted by any other spray.

Sulphur as a dust, especially in greenhouses, and later as a spray, and potassium sulphide as a spray are also among the early fungicides. More recently lime-sulphur has been used in orchards especially, and still more recently various forms of very finely divided sulphur, under various commercial names, are gaining prominence both as sprays and dusts.

With any of these fungicides the difficulty is to obtain one that will kill fungous spores and not cause injury to the host. Usage only can determine what will eventually prove the most successful in these respects with different plants.

The third factor of success, besides its fungicidal value and its harmlessness to the hosts, is the ability of the fungicide to stick to the plant tissue to which it is applied. As a rule Bordeaux mixture has been better than either sulphur sprays or dusts in this respect, though with the finer and more recent sulphur products better results are being obtained than formerly. However, it has often been found necessary to use some additional substance to act as a spreader and sticker for the fungicide. This has been especially true with the fungicides that are applied to smooth or glaucous surfaces. Resin-Bordeaux, molasses, oils, various soaps, casein and other substances have been used for this purpose. For small garden and greenhouse work we have found nothing better than a commercial preparation known as potassium-oleate used in paste or liquid form and added in small amounts to the fungicide, especially to Bordeaux.

So far as the chemical factor of a fungicide is concerned, a special one is not necessary for each different disease as seems to be the case with animals. This is apparently due to the fact that a fungicide is valuable only to prevent the germination of spores and their gaining entrance into the plant tissues. The reason some spores are more easily killed than others is due to the greater protection of the walls of some types rather than to any particular difference in the action of the fungicides.

Other factors in successful treatment of plants against fungous attacks relate to the time, frequence and method of application of the fungicides on the tissues of the plants through which infection takes place. The treatments, of course, should start just before and during the time when the fungous spores are active in their germination. This means in some cases spraying or dusting during a limited period; in other cases more continuous treatments; in still others, later treatments. For instance, a dormant spraying just before the buds open is usually sufficient to control peach leaf curl. Dormant and several leaf sprays are necessary to control apple scab on susceptible varieties, while for those not very susceptible to scab less frequent sprayings or dustings usually suffice. To combat apple rust on susceptible varieties, a continuous coating of spray during the period of susceptibility for several weeks on both the emerging and the older leaves and even on the fruit may be required.

The spray should be used on the new growth that is put out during the period of susceptibility and should be renewed as well on the older growth when it has been washed off. Likewise the manner of spraying, that is, how thoroughly it is done, has much to do with success. Successful spraying usually requires good nozzles to thoroughly coat the tissues of the plants and pressure high enough to give a fine mist to settle on all the susceptible surfaces. A drenching that allows the spray to run off is not good.

At the back of this bulletin are given directions for making fungicides. For anyone who wishes general direction for treatment of commercial orchards, both for fungi and for insects, the use of the Station's and the Extension Service's literature on the subject is suggested. In the Station's botanical department, E. M. Stoddard, who has long been interested in the control of fruit diseases and injuries, is always willing to give advice on special and general problems of this nature. In a similar manner, Dr. A. A. Dunlap will give advice on treatments against troubles of vegetables.

DISEASES AND INJURIES OF CULTIVATED PLANTS

ALPHABETICALLY ARRANGED ACCORDING TO HOSTS

Alfalfa

Black mold, *Macrosporium sarcinaeforme.* Apparently this imperfect fungus is uncommon and does not cause much havoc in Connecticut, though in one young field where it was found the seedlings were doing poorly. It is probably the same species as reported here on clover, *q.v.*, although Alfalfa is said to be the host for two other Macrosporiums found in the United States. This one has recently been placed under the genus *Thyrospora.*

Downy mildew, *Peronospora trifoliorum.* This fungus forms a grayish-purple growth on the young shoots and under side of the leaves of *Medicago sativa,* causing the tissues to turn yellow and then brown or purplish before dying. It develops in wet seasons when the plants make a rank growth. As yet it is too rare in this state to be serious.

Leaf spot, *Pseudopeziza medicaginis.* A fungous disease that becomes common on the leaves, first showing as small, brownish-purple spots, is this Ascomycete which forms eventually a minute, disk-like, fruiting pustule on the upper surface of each spot. The leaves turn yellow and often drop off.

In wet seasons it is often serious but there is no very efficient remedy. Cutting fields early rather than late and planting new fields as old ones run out may help.

Rust, *Uromyces medicaginis.* This rust has been found here only twice in alfalfa fields and then it was so scarce that it caused no evident harm. It has been reported on this and other species of Medicago usually further west. Arthur reports the O-I stages as uncertain, though some writers claim the rust is heteroecious with the preceding stages (O-I) on *Euphorbia Cyparissias.* We have found only the II-III stages as small, dusty outbreaks on the leaves, the former light-red and the latter dark-red in color. The rust appears to the writer to be closely related to the red clover rust with which it was associated in one of the fields.

White spot. This shows as numerous white, oval to longer, irregular spots chiefly at upper end of the leaves. It is usually scattered in spots throughout the field. The cause is doubtful but may be due to thrips.

Yellow top. This is usually due to drought conditions or to hot, dry weather of limited duration. It may be furthered by root injury or by type of soil in the field.

Almond (Flowering and Nut)

Brown rot, *Monilia cinerea.* The flowering almond, *Prunus glandulosa,* in late spring may show dead leaves and branches killed by this fungus, often with little evidence of the fruiting stage. Where serious, two or three sprayings with L. & S. or Bordeaux, used in time, should control the trouble. *See* Cherry.

Scab, *Cladosporium carpophilum.* This occurs on the fruit and young stems of the nut-bearing almond, *Amygdalus communis,* rarely grown here. *See* Peach.

Amaryllis

Undetermined trouble. Our only recorded trouble on the plant known as Giant American Hybrid Amaryllis (Hippeastrum sp.) occurred in a greenhouse where complaint was made that a disease injured the flower peduncles so they became one-sided. Purplish-red spots appeared, particularly on the leaves when they reached a considerable size, and especially at the sides and tips, with a yellowish discoloration extending into the normal green tissues. Similar small, discolored spots also showed on the bulbs and the disease may have started from these. While it seemed to be caused by a fungus, we were never able to find a mature fruiting stage to establish its identity. We should like to receive further specimens of this trouble.

Apple

Bitter rot, *Gloeosporium rufomaculans* (*G. fructigenum.*) This trouble of *Pyrus Malus* is not so important here as it is farther south where it is often very destructive. With us it causes occasional rotting of the ripening or stored fruit but has not been seen in cankers on the limbs. The rotted tissues show the characteristic, sticky or dried, pinkish, concentric spore masses. The Gloeosporium stage is formed in a somewhat similar manner on a variety of other hosts; those noted here are apple, currant (red and yellow), grape, horsechestnut, Palm, pepper, privet. The mature stage, a sac-fungus known as *Glomerella cingulata,* on certain of its other hosts sometimes appears later than this conidial stage.

Ordinary spraying takes care of the trouble here.

Black rot, *Sphaeropsis malorum.* Black rot causes the maturing fruit to turn brown, then black with more or less evident spore pustules. On the leaves it forms small, brown spots and on the branches, dead areas or cankers. It also occurs on a great variety of hosts, chiefly on the branches, often as the result of winter or other injury. Besides on the apple, we list the fungus here on oaks, pear, pine and quince. Its asco stage, found on the dead tissues, has been determined as *Physalospora Cydoniae.* We have not yet found this stage.

Besides the hosts on which this fungus has been definitely listed here, we have collections of Sphaeropsis on the following hosts: *Amygdalus Persica, Crataegus Oxyacantha, Hedera helix* (determined by Thaxter as *Sphaeropsis hedericola*), *Morus alba* (called *S. Mori* by some), *Ulmus americana,* (also called *S. Ulmii* or *S. ulmicola*) and *U. pumila,* on the branches of all except Hedera on the leaves. On these specimens, the fungi seemed to have been acting as saprophytes rather than as parasites, but further study as to their nature and identity is needed. *See* also Walnut.

With fruit trees, we recommend spraying as for scab and with these and other trees the removal of all injured and dead branches.

FIGURE 13. Apple European Canker

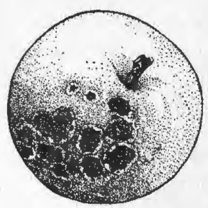


FIGURE 14. Apple Scab.

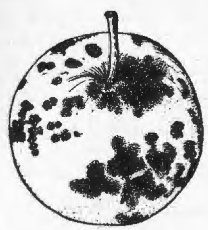


FIGURE 15. Apple Sooty Blotch

Blister canker, *Nummularia discreta.* This trouble was first called to the attention of orchardists by Hasselbring in Illinois in 1902 while the writer was working with him on apple diseases. We have never certainly run across it in Connecticut. Thaxter in March, 1889, collected specimens at Greens Farms, although he did not mention it in his Reports. This fungus is said to be rather serious in some orchards, especially in the Mississippi valley, and to cause somewhat sunken, reddish-brown cankers in the bark from which in time there may break through the evident, saucer-shaped, fruiting bodies, about a quarter of an inch in diameter, of this Ascomycete.

Brown rot, *Monilia cinerea.* This occurs occasionally on ripened fruit. *See* Cherry.

Crown gall, *Bacterium tumefaciens.* It is seen on nursery stock; apparently it does little damage in the orchards. *See* Rose.

European canker, *Nectria galligena.* *See* Birch. (Fig. 13).

Fire blight, *Bacillus amylovorus.* Apparently this bacterial disease is not so bad here as in some regions. It confines itself chiefly to killing young twigs in late spring and early summer. In a few cases it has been seen on the ripening fruit. *See* Pear.

Fruit spot, *Phoma pomi,* makes small, dark-colored spots in the skin of the fruit and in light skinned varieties often shows a reddish border. In wet seasons it may be bad and extra later sprayings be required, as for scab, for its control.

Heartwood rots, *Fomes igniarius, Hydnum septentrionale, Pleurotus ulmarius, Polyporus admirabilis, P. galactinus, P. spumens.* In the well tended orchards, heartwood rots are not serious, but in neglected orchards often the whole interior of the tree is destroyed by one or another of the above, large Basidiomycetes. The fruiting stage, however, is not always found.

Where necessary, the owner should clean out the decayed wood and allow proper drainage and ventilation, or if desired, seal tight with some recognized cavity filler.

Powdery mildew, *Podosphaera leucotricha.* This mildew is apt to be present in nursery and young or neglected orchard trees. It coats the leaves and twigs with a more or less evident, white felt of mycelium and summer spores in which eventually the asco stage may appear as small, embedded, blackish bodies. Where necessary, give several sprayings, beginning on the dormant trees in the spring.

Rusts, leaf, *Roestelia pyrata, R. globosa.* The former is by far the most common leaf rust here; the latter is described under Hawthorne, *q. v.* The common rust forms more or less conspicuous, orange-yellow spots on the leaves on the under side of which, from July on, the fruiting stage shows as clustered cups containing the powdery, brownish spores. These cups split open with reflexed, fringed hairs at the edges. The fruit occasionally shows yellow-green infection spots that may or may not produce fruiting cups. Certain varieties of apples, as Wealthy, are very susceptible to this rust, while others, as Baldwin, are nearly exempt. The mature stage is found on the cedar, *q. v.,* known as "cedar apples" and is called *Gymnosporangium Juniperi-virginianae.*

If necessary cut down the infected cedars around the orchard; the spores from these are, however, carried long distances. Spraying is not entirely effective but if deemed necessary the leaves should be thoroughly and continuously coated from their first appearance until the very last of June.

Rust, stem, *Roestelia aurantiaca.* This is found rarely on young twigs. *See* Quince.

Scab, *Fusicladium dendriticum.* On the fruit this fungus shows as olive-black, scabby spots rupturing the skin and causing the fruit to be stunted or misshapen. On the leaves the scab shows as spore-bearing, olive threads radiating from a central point and eventually producing brown, dead spots that may cause defoliation. On very susceptible varieties, it can carry over on the twigs as more or less inconspicuous pustules and infect the new leaves. The mature stage, *Venturia inaequalis,* develops on the dead leaves in the spring and causes primary leaf and blossom infections. It is worst here on McIntosh, Fall Pippin, is often bad on Greening, and is least injurious on Baldwin and Russet.

On susceptible varieties, spraying may be necessary on the dormant trees and repeated as pre-pink, pink and calyx stages with one to three subsequent leaf and fruit sprays as required according to weather conditions. (Fig. 14).

Sooty blotch, *Gloeodes pomigena (Phyllachora pomigena).* This is a superficial fungus that is produced usually late in the season on the fruit, showing as blackish, round blotches that can be more or less removed by wiping well with a cloth dampened with vinegar. It is most evident and common on light skin varieties and is also found on the pear. Except in a wet season orchards well sprayed suffer little, especially if late spraying is carried on. (Fig. 15.)

Sooty mold, *Fumago vagans.* Under this name we classify the black, superficial, saprophytic fungus that appears on apple leaves when honey-dew from aphids is present. It is also found under similar conditions on the leaves of other trees, shrubs and herbs. Complaints have been made of its marring appearance on linden, maple, pear and greenhouse tomatoes especially. It is probably connected as an imperfect mycelial and conidial stage *(Cladosporium, Macrosporium)* of the Capnodium fungi, reported here also as following honey-dew, on Tulip tree and White Pine, *q. v.*

Storage and Drop rots, *Alternaria* sp., *Botrytis cinerea, Cephalothecium roseum, Fusarium* sp., *Penicillium expansum, Phytophthora cactorum* (*See* Pear), *Rhizopus nigricans, Volutella fructi.* These troubles occur on drops under the trees and in apples in storage in addition to the fruit rots already described. They mostly occur on apples in storage not properly sprayed or stored under poor conditions, although all the fruit as it reaches over-maturity may develop a rot, especially out of cold storage. Penicillium is perhaps one of the most common causes in the latter case.

Baldwin spot (Bitter pit). This trouble occurs on different apples but here it is most common on the Baldwin. It shows in the flesh of the apple as small, dry, brownish spots of more or less collapsed cells and occurs most frequently near the surface and blossom end but in bad cases reaches deeply inward and upward. At first these spots may not be evident on the surface but are revealed on cutting the apple open. If abundant, they give a somewhat bitter taste when the apple is eaten. Eventually the trouble may show as discolored, somewhat sunken spots in the skin. Individual trees under certain conditions develop the trouble more than others. Drought is said to be a factor by some. Possibly injury by insects, such as the rosy aphid, when the fruit is growing, may cause this or similar injury. In certain varieties very similar injury by the railroad worm needs to be distinguished. (Fig. 16.)

Fasciation. We have seen these flattened growths only once on this host, but in this case with very short and recurved tips of a young branch. We thought it to be due to winter injury of the buds. *See* Asparagus.

Frost injury. There are several kinds of late frost injuries found here. The twigs and leaves may be injured more or less severely, or the latter may be crinkled and thickened and the skin be separated from the tissues beneath. The blossoms may be killed, moderately or generally according to the stages of development, or just the pistils or stamen may suffer. If the fruit is set, it later may develop scabby bands where the water settled and froze on it.

Hail injury. Severe hail storms late in the summer occasionally cause serious injury to fruit orchards especially on the more tender varieties. The hail stones often produce deep, sunken spots where they hit the fruit, causing it to become unsightly or even knocking it off the branches. They also open the way for rot later on. On the stems the stones bruise or break the bark and later on the healing-over gives the effect of small cankers. These may be mistaken for other injuries if one is not aware that the storm occurred over the orchard.

Mice girdle. In winter when snow covers the ground rather deeply or continuously, girdling by field mice is not uncommon. The tender bark at the base of trees and shrubs of various kinds is eaten. Where nests are made in the refuse around apple trees, the girdling sometimes extends all around the tree and up to the top of the snow line, as high as two feet. Complete girdling eventually will kill the tree by starvation.

Bridge grafting with twigs long enough to extend from the lower to the upper bark cambium, if done in time, usually will save the tree.

Mosaic and Chlorosis. The former usually shows as lighter and darker streaks between the side veins of the leaves, especially at the tips. It has been described as a trouble caused by leaf hoppers but does not seem to be perennial here on affected trees, so its nature as a true mosaic rather than as an insect injury is in doubt. A more definite trouble, which we call chlorosis, showing as irregular, whitish spots in the normal green leaves, is seen occasionally on isolated branches. Rarely we have found this abundant on single trees, especially evident on the lower branches. The cause of this trouble has not been determined and although certain trees seem to be more subject to it, they do not show it yearly to the same marked degree. Some deficiency of definite chemical elements in the soil, or of the power of the tree to obtain them, seems to be the most probable explanation, although late frosts may be the cause.

Scald. This is a term applied to injured apples (and other fruits) that have been held in cold storage under conditions of temperature, moisture, etc., unfavorable for their best preservation. Also its appearance may have been favored by other conditions before the apples were placed in storage. It becomes evident in the market soon after the apples are removed from storage through the brownish discoloration of the skin. Under ordinary farm-storage it also sometimes appears.

The U. S. Department of Agriculture has made a special study of this subject and has literature on its cause and prevention.

Spray injury. We have yet to find the perfect fungicide, as regards killing fungous spores before their germination and at the same time preventing injury to the sprayed or dusted host. Injuries to the host vary with different fungicides and in different climates, different seasons and times of applications. Too high pressure pumps or certain nozzles and guns may increase the trouble. The apple is not so sensitive as the peach either to injury to its leaves or twigs but varies according to varieties as regards leaf and fruit injury. So orchardists get burning and spotting of the foliage with more or less defoliation and varied misshapening and especially russeting of the fruit. Many fungicides have been rejected as unsafe or useless, while others after long usage, as Bordeaux, have largely disappeared except for certain treatments or in restricted localities. Even L. & S. has met with objections from some growers under certain weather conditions. Addition of lead arsenate and other ingredients have complicated or increased the injury. Occasionally spray injury is greater than the good accomplished by killing fungi or insects. Gradually through experience the grower finds what will best suit his needs with the least average injury of this kind. (Fig. 17.)

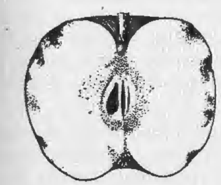


Figure 16. Apple Baldwin spot.

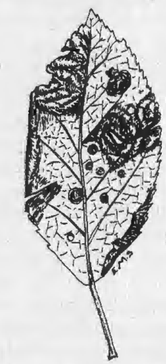


Figure 17. Apple Spray injury.

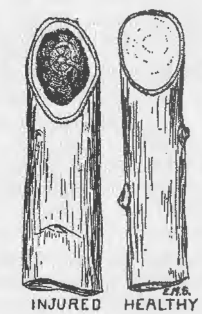


Figure 18. Apple Winter injury.

Sun scorch. Exceptional hot weather produces wilt and death of the leaves and scorch on the exposed side of fruit and bakes apples on the ground. Injury often follows showers or spraying on hot days, especially in the middle of the day. Similar injury we have seen on gooseberries, tomatoes, eggplants and peppers.

Water core. This shows usually only in certain varieties, as King and Pound Sweet, and is worse in wet seasons with a variable growth of the fruit. The apple shows a watery condition of the tissues beginning at the core and reaching outwards for a variable distance.

Winter injury. Severe winters, especially when the temperature falls below zero for a few days and when there is lack of snow mulch, produce various injuries to trees. Warm winter weather followed by sudden cold, a late growing fall with a sudden severe drop in temperature, too early a start of growth in the spring, all result in certain types of injury. Wet spots in the soil give rise to root injuries, as do lack of snow or other mulch in wind swept areas. Too late fertilization of nursery and orchard trees, putting them into winter in an unripened condition, is also responsible for wood, twig and bud injuries. Severe injury to the sap wood may show by its blackened condition changing it prematurely into heartwood.

Injury to branches and twigs may result in their sudden or premature death. Bark may be killed at the base of the tree and a girdle or cankers, of various sizes and shapes on different sides of branches, may result. These are sharply marked off by cracks from the living bark but later are sometimes mistaken for a fungous injury when saprophytes or weak parasites in fruiting stages appear on them. (Fig. 18.)

Apple Mint

Rust, *Puccinia Menthae.* This rust is reported here as new to the host, *Mentha rotundifolia,* in the State as well as in the United States. *See* Beebalm.

Ash

Anthracnose, *Gloeosporium aridum.* Anthracnose is an occasional trouble of *Fraxinus americana* but it may in wet seasons become locally prominent. It causes a wilting and death of the foliage or a light-brown discoloration of certain areas of the leaves. *See* Anthracnose of Sycamore for treatment.

Leaf spot, *Piggotia Fraxini.* This shows as small, purplish specks on the upper surface of the leaves with the fruiting stage scattered all over the lower side as minute, black bodies. It is not so important or common as usually to require treatment.

Rust, *Aecidium Fraxini.* The rust not only attacks the leaf blades, petioles and young twigs but also occasionally the winged fruit. The cluster cups project above the more or less swollen tissues as small, aggregated receptacles, toothed at the edge and filled with orange-colored spores. Early wet weather favors its development, as it comes from a mature stage known as *Puccinia fraxinata* on marsh grass. As it is annual on the ash and varies greatly with different seasons, spray treatment is hardly advisable. It usually seems to be worse along the sea shore.

Cankers, etc. *See* Addenda for details.

Asparagus

Anthracnose, *Colletotrichum* sp. We have seen this rarely on the mature stalks of *Asparagus officinalis* showing as irregular, often elongated, areas of a gray color in the normally green tissues and producing numerous, small, black fruiting pustules.

Rust, *Puccinia Asparagi.* Rust was formerly a very bad parasite on the leaves and stems of asparagus. It begins as semi-dusty, reddish-brown pustules of the summer spores and later these develop the black, firmer pustules of the winter stage. The cluster-cup stage has rarely been found here at the base on the recently cut stems in the spring. With the introduction of the resistant or semi-resistant strains of the Washington types about twenty years ago, rust became much less common. Recently, however, it apparently has become more common on some of the semi-resistant strains. The best of the resistant varieties only should be planted and, if they or the susceptible ones gradually become infected, late in the fall the tops should be cut and burned to prevent general spring infection from the mature or winter spores. (Fig. 19.)

Fasciation. *See* Addenda for information in detail.

Frost injury. Occasionally late frosts, occurring after the asparagus shoots begin to show above ground, kill the earliest ones, as shown by whitish, soft tips that finally rot through saprophytic fungi. Below the ground, the tissues may be firm and uninjured. A loss of 10% has been noticed in small plots.

Smoke injury. We have heard of a few cases of injury from brick kilns where law suits have resulted. *See* Grape.

Aster

Gray mold, *Botrytis cinerea.* Under moist conditions this semi-parasitic fungus causes more or less rot of the leaves, flowers and young stems. *See* Geranium.

Powdery mildew, *Erysiphe cichoracearum.* This mildew has been found rather common on various species of wild asters and occasionally on some of these when cultivated. *See* Phlox.

Rust, *Coleosporium Solidaginis.* While this rust is very common on wild goldenrods and asters and occasionally on these in cultivation, it has been seen here on the China Aster, *Callistephus chinensis,* and recently on the rock aster, *Aster alpinus.* The summer stage shows as small, dusty, orange outbreaks of spores and the mature stage in late summer and fall as firm, larger, orange blisters. The spores of the latter soon germinate in position and infect the needles of certain pines, *q. v.,* which in the spring produce the cluster cup stage known as *Peridermium acicolum.* While the rust on the pines is annual, on certain of the perennial herbaceous plants it may appear each year by late fall infection, through its II spores, of the roseate leaves on the ground that carry over the winter. The III spores apparently are only for infecting the pine needles and the I spores on the pine needles only for infection of the alternate (Asters, etc.) hosts.

Stem rot, *Fusarium* sp. So many species of Fusarium are now described, often occurring on the same host, that one is in doubt what to call the species when found. Anyway we find a Fusarium rotting the stems and main roots here of various herbaceous plants and cuttings as well as on asters. Too much water or injury at the base is frequently the cause of the fungus getting a start in the young, unhardened tissues.

Stirring the soil to obtain a dry mulch, aided by some lime or sulphur dusted at the base, may help to keep infection from starting. The destruction of infected plants as soon as they appear and rotation each year to a new plot of ground may help to lessen this trouble. Also the grower must be careful in the use of manure. Obtain resistant strains of the aster if possible.

Nematode rootknot, *Heterodera radicicola.* *See* Cucumber.

Yellows. This host was the first on which "yellows" was found. Sturgis of this Station was one of the first to mention the trouble. It is now known on a large number of plants; here we have listed it only on aster, calendula, dahlia, and strawflower, but it is also found on certain weeds, as ragweed. The symptoms in general are the yellowed foliage with frequently distorted or one-sided blossoms. True yellows should not be confused, however, with the yellowing of leaves caused by dry weather. It has been shown by Kunkel that a leaf hopper carries the "virus" from diseased to healthy plants, thus spreading the disease. The nature of the virus, like that of mosaic, is unknown.

One should remove and destroy all "yellows" plants as soon as they appear, also rotate yearly and prevent, where possible, the presence of leaf hoppers. Some experimenters claim good results in keeping out leaf hoppers by growing asters under cheesecloth tents (22 x 22 threads per inch) and rogueing out any suspicious plants as they appear.

Azalea

Leaf curl, *Exobasidium Vaccinii.* This fungus is common on members of the Heath family, especially in nature on blueberries, etc. Occasionally it forms more or less cup-shaped thickenings in the leaves. Usually it infects a cluster of leaves as well as the young shoots, that when young are pinkish tinted but become covered with a white bloom when spore formation takes place. On certain hosts, as Lyonia, it forms large green galls, formerly considered as a distinct species, known as "swamp or honeysuckle apples". These at first, are rather solid and sour but later become larger and less compact. The fungus is one of the simplest forms of the Basidiomycetes or the toadstool group.

Apparently no treatment for control has been given by experimenters but a late dormant spray might prove of benefit if needed.

Powdery mildew, *Microsphaera Alni.* *See* Lilac.

Rust, *Pucciniastrum Myrtilli.* Like the leaf curl this fungus has a large number of wild hosts in the Heath family in its II and III stages. On cultivated Azaleas it has been found here on *A. nudiflora* and *A. viscosa.* The II or summer spore stage occurs as small pustules on the under side of the leaves which discharge orange-colored spores, while the later III stage is more permanently embedded in the leaf tissues and easily overlooked. The I or cluster cup stage occurs on the needles of the hemlock, *q. v.*, and is known as *Peridermium Peckii.*

Keep the azaleas away from the hemlocks to prevent infection, which takes place in the spring and early summer.

Barberry

Anthracnose, *Gloeosporium Berberidis.* In midsummer of wet seasons the leaves show a brownish, dead area at the tips and margins, separated from the normal green tissues by a purplish border, but sometimes the entire leaf is involved. The inconspicuous fruiting area occurs beneath. No permanent damage is done except to the leaves of the season involved.

Rust, *Aecidium Berberidis.* This is the common I or cluster cup stage of the rust that the farmers of England pointed out (and later deBary proved) was connected with the II and III stages of wheat rust, *q. v.*, then known as a distinct species, *Puccinia graminis.* The leaves of *Berberis vulgaris* in the spring show yellow spots in which above are minute, black dots that ooze out spore-like bodies of uncertain function. Later on the underside of the leaves appear the clustered, toothed cups in which yellowish spores spread the rust to various grasses and grains thus proving that this rust, like many others since reported, is parasitic on two distinct types of hosts (heteroecious).

In the west, government and state control aim to lessen the spread of the black stem rust in grains by the destruction of the barberry (except resistant Japanese) in that region. *See* Timothy.

Seedling rot, *Rhizoctonia Solani.* This was prominent one year in a nursery where acid peat moss was used as a fertilizer on the seedlings. *See* Spinach.

Wilt, *Verticillium alboatrum?* Nurserymen have complained to the inspectors of a trouble in certain fields of Japanese barberries, *Berberis Thunbergii,* that often killed the plants prematurely, usually showing a wilting of the leaves or a turning yellow and falling off. We have occasionally seen such a trouble in hedge rows in the city but with no evident signs of a definite fungus acting as the cause; so we have thought of it as the probable result of winter injury. Recently Dr. McCormick investigated the stems of certain sick specimens and found evidence of a Verticillium. This seemed to be the cause in this and probably in some other cases, since obscure root and stem troubles of various plants are being laid more and more to species of Verticillium. Whether or not any species or strain other than the one named here questioningly is involved for the different hosts, further study should finally determine. So far we have listed black raspberries, maples, potatoes and snapdragons as other plants having wilts caused by Verticillium. The species *V. alboatrum* has been definitely named as a cause of wilt of Japanese barberry in New York.

Leaf scorch. Scorch appears in dry or hot seasons causing leaf damage much like that of anthracnose from which it can only be distinguished by the absence of the fungus.

Barley

Powdery mildew, *Erysiphe graminis.* This is common in wet seasons on *Hordeum vulgare. See* Rye.

Rust, leaf, *Puccinia anomala.* The II stage occurs as small, orange, dusty outbreaks on the leaves (chiefly), while the III stage is lead colored and more permanently embedded in the tissues. Its cluster cup stage has never been found here, though it occurs in Europe on Ornithogalum; so the rust apparently carries over through its II stage here or further south. Its damage is chiefly to barley grown for green fodder and no control is attempted.

Rust, stem, *Puccinia graminis.* The stem rust is not frequently found here. *See* Wheat.

Smut, covered, *Ustilago Hordei.* This smut forms more permanent, blacker outbreaks filling the heads of the grain than the next smut. It responds to dusted and wet seed treatment but the injury here is so little that no control is attempted.

Smut, loose, *Ustilago nuda.* The loose smut also shows in the heads but as a more dusty, olive-black spore mass that is sooner disseminated, leaving behind the naked, hard plant tissues. The two smuts are sometimes seen together in the field in about the same amount. This smut seems to require more thorough or modified seed treatment for control since the smut infects the tissues of the young grain in the field in the same way as does the loose smut of wheat. (Fig. 20.)

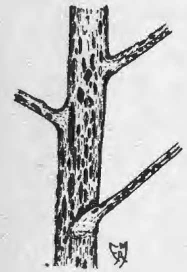


FIGURE 19. Asparagus rust

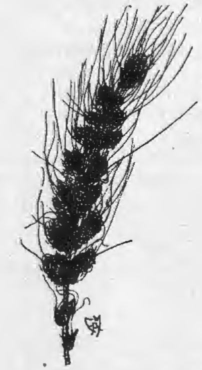


FIGURE 20. Barley smut.

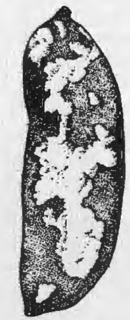


FIGURE 21. Bean (Lima) Downy Mildew.

Stripe, *Helminthosporium gramineum.* We have collected this fungus twice, both times in July, 1926. It is apparently not serious in this state. Both specimens show elongated streaks of dead tissues chiefly along the midribs of the leaves. Other species of this genus have also been reported on this host but this is the name we have selected for our specimens. *See* Black mold under Timothy.

Beans, Lima

Bacterial spot, *Bacterium Vignae.* This is usually a smaller and a more definite spot disease than the blight of string beans. It occurs on the leaves first as small, reddish spots that later may run together as a larger spot with a brownish center (which may eventually crack away) and a purplish-red border. Sometimes a yellow halo surrounds the spots. The infections develop also on the pods and the bacteria may occur on the seed and so carry the disease to new fields. It varies according to seasons, being worse in wet ones. This disease has also been found once on cowpeas at the Station farm. If necessary, one should treat the seed, or use the best seed only, and rotate the fields.

Downy mildew, *Phytophthora Phaseoli.* The very characteristic downy, white felt of mycelium and summer spores is best seen on the older, infected pods of *Phaseolus lunatus.* While the leaves and young blossoming stems may be infected and killed, the growth is not so conspicuous on them. The mycelium enters the pods and seeds and produces under certain conditions the characteristic, round spores that carry the fungus over the winter. It requires a moist season in July and August to get a start and so it is quite variable in its appearance. Most years there is little or no damage but occasionally it is severe. *See* Rept. **1905**:278–303. (Fig. 21.)

For control the grower should rotate the crop, use drier rather than moist soils and, if the disease gets an early start, should begin at once to spray with Bordeaux and continue as long as needed.

Leaf-Pod spot, *Phoma subcircinata.* We have seen this rarely and then only on the leaves. It produced large, semicircular to irregular, brownish spots often with a reddish border and more or less evident rings of growth. In these spots the fruiting stage is embedded as small, black bodies. In time the tissues cracked and wore away. So far there is no need for treatment.

Powdery mildew. *Erysiphe Polygoni.* It has been found only in the conidial stage and usually not very prominent. *See* Clover.

Arsenical burn. We have seen cases, in the past when Paris green was more in evidence and was used on the soil to kill chewing insects, of burn resulting where care was not used in keeping it away from the leaves and base of the plants. The remedy is evident.

Mosaic. This is similar to the mosaic of other vegetables. *See* Cucumber.

Beans, String

Anthracnose, *Colletotrichum lindemuthianum.* Anthracnose shows on the leaves and especially on the pods of *Phaseolus vulgaris* as usually round, brown spots with a reddish border. It may be mistaken in some cases for the bacterial blight but the presence of the more or less evident, pink spore-masses helps to identify it to the naked eye. Here it is quite variable in different seasons as well as on different varieties. As it is carried over in the seed, as well as on the refuse, it gains entrance to the new crop in this way. The young seedlings are often killed or badly injured. Shear made artificial cultures of this imperfect stage and in them were produced the asco stage which he calls *Glomerella lindemuthianum.* We have never found this stage in nature. (Fig. 22.)

Seed treatment and spraying have not proved entirely satisfactory where the crop is grown on a large scale. Rotation and selection of good seed, especially of resistant varieties, probably in the long run prove the most practical methods of control.

Bacterial blight, *Bacterium Phaseoli.* This is somewhat like the bacterial spot of the Lima bean but the spots are more likely to run together and merge into extended areas involving the whole or a large part of the leaf. When wet, the thin, infected tissues have a semi-pellucid, water-soaked condition. Apparently some of our herbarium specimens identified under this name also include *B. medicaginis* var. *phaseolicola* since yellow-halo spots show on some of them. From the number of species of bacteria that have been listed on this host, we are inclined to believe that plant bacteriologists have overdone the matter.

Treatment is the same as for the bacterial spot of the Lima bean. As this trouble is much more injurious than on that host, care in weeding out the young plants in the field early in the season might prove helpful, as well as the selection of the most resistant varieties to start with.

Bacterial wilt. *Bacterium flaccumfaciens.* This wilt has appeared here occasionally and might be mistaken for sun scorch. It has been recognized only on the young plants and especially when they were exposed to strong sunlight and apparently when planted in a favorable time and location for the disease. The leaves wilt down and sometimes the whole plant dies without any very evident external sign of the cause. Cutting across the stem or main veins, however, frequently reveals a milky exudation which shows that bacteria have clogged or injured the vascular system and thereby cut off the water supply to the healthy tissues above, thus resulting in their wilting and death.

Damping-off, *Pythium debaryanum, Rhizoctonia Solani.* The second fungus has also been found injuring the roots and base of young field plants as well as seedlings. *See* Spinach.

Leaf blotch, *Isariopsis griseola.* This is a saprophyte or weak parasite that appears on plants grown under rather unfavorable conditions of crowding, dampness, etc. The leaves develop irregular, brown spots in areas on the under side on which appears a more or less even growth of erect, black fruiting threads, bearing at their summit a grayish, bushy group of spores.

Leaf spot, *Phyllosticta phaseolina.* The spots caused by this fungus are darker, circular, with more or less evident concentric marking of growth and show embedded, small, black fruiting pustules. It is even less common than blotch.

Powdery mildew, *Erysiphe Polygoni.* Usually this forms a somewhat scanty growth, of the conidial stage only, on the leaves. *See* Clover.

Rust, *Uromyces appendiculatus.* The bean usually injured here by this rust is the Kentucky Wonder. The II stage shows on the leaves and pods, usually abundant, as small, dusty, reddish-brown outbreaks; later the III stage is similar but of a dark-brown color. The I stage has been seen here rarely, and then on young plants, earlier in the season, as white cluster cups and spores, the former usually few in number.

Where troublesome, restrict the planting to the more resistant varieties or select seed only from plants known to be free from the rust the previous season and plant in new soil.

Mosaic. This trouble occurs fairly frequently but usually is not serious as it is generally confined to a few plants. *See* Cucumber.

Sun Scorch. In certain years when hot sunshine follows a shower, we have seen a sudden and severe scorch of plants that otherwise gave no clue as to the cause of the trouble.

Beebalm

Rust, *Puccinia Menthae.* The common rust of mints in nature has been found here on cultivated species of *Monarda didyma, M. fistulosa, M. Kalmii, M. Ramaleyi* as well as on species of Mentha. The infections show the II and III stages chiefly on the under side of the leaves as small, light or dark-brown, dusty pustules usually very abundantly. They cause a more or less definite spotting of the upper surface. We have found the I stage that sometimes occurs earlier on the same hosts only twice, once each on peppermint and spearmint, *q.v.*

In the fall after the plants die above the ground, cut off and carefully clean up all remains of the same to destroy the spores. If this fails, also spray the plants and ground a few times with Bordeaux as the plants start to develop in the spring.

Beech

Anthracnose, *Gloeosporium Fagi* var. *americana.* Occasionally in favorable wet seasons, this trouble has been seen on the leaves of cultivated beech trees, especially the copper beech, as irregular, light-brown areas reaching inward from the edges or as isolated spots within the normal green tissues, upon which the embedded fruiting stage is more or less evident.

Gas injury. We have seen one case where this injury was evident on all of the leaves, showing as more or less extended dead areas inward from the margins and causing partial defoliation. Similar trouble has been found on Maple.

Leaf scorch. This trouble is more variable but very similar to the preceding. *See* Maple.

Lightning injury. A Copper beech was badly injured by lightning, but continued to live despite the bark at the base being entirely girdled except a small connection at one side with a large healthy root. Proper pruning of the dead and dying branches eventually produced an equilibrium for water supply above and food to the roots at the base.

Beet

Damping-off, *Pythium debaryanum, Rhizoctonia Solani.* *See* Spinach.

Drop rot, *Sclerotinia sclerotiorum.* We have seen this on young plants in seed beds. *See* Lettuce.

Leaf-Root rot, *Phoma Betae.* As compared with the leaf spot below we have seen this only rarely, on the leaves of *Beta vulgaris.* It shows as conspicuous, round to irregular, at first yellowish, spots with rather faint, concentric growth-markings. The embedded, black fruiting bodies are most evident on the upper surface. We have also had seed that dampened off in the germinators rather badly, thus showing how the fungus carries over on them to infect new crops. We have received no complaint, as yet, of the dry rot of the matured roots. Select the best seed and if necessary treat it to kill that which is badly infected.

Leaf spot, *Cercospora beticola.* On this host the leaf spot is quite common; *see* Chard.

Root rot, *Rhizoctonia Solani.* This occurs very often in greenhouses as a damping-off trouble similar to Pythium but sometimes it also causes injury to more mature roots. *See* Potato.

Scab, *Actinomyces scabies.* This trouble is not uncommon but usually less injurious than the same scab on potatoes, *q.v.*

Prematuring. In some years, as in 1924, seedling beets premature and some go to seed the first year. *See* Lettuce.

Begonia

Nematode leaf blight, *Aphelenchus olesistus.* This trouble is due to minute worms, known as eel-worms, related to the rootknot species that is common on roots of various hosts. This leaf species is slender enough, especially when young, to enter the leaf through the small openings or water pores of the epidermis. In the large chambers beneath these, they live and reproduce and the young spread the injury through connecting openings or again through the water pores to better locations. Of course they gain food from and cause injury to the invaded plant tissues. (Fig. 23.) The infected spots change color and enlarge so that eventually considerable portions of the leaf are involved. The main veins lessen the rapid spread of the injury and mark it off from the healthy tissues. *See* Rept. **1915**:455.

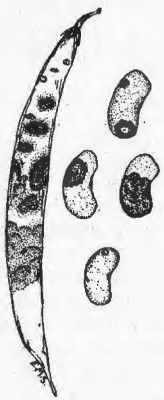


FIGURE 22. Bean (string) Anthracnose.

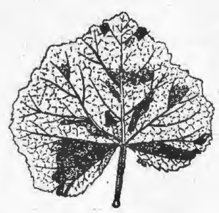


FIGURE 23. Begonia Nematode leaf blight.

FIGURE 24. Blackberry Orange rust.

Water should be kept off the leaves to limit the spread of the trouble and old badly infected leaves should be destroyed. Infected plants should be given plenty of space and kept from contact with the healthy. In Europe growers claim to help the plants by dipping them in hot water for two to several minutes.

Nematode rootknot, *Heterodera radicicola.* This other nematode trouble has also been found here on the roots of greenhouse plants. *See* Cucumber.

Bellflower

Rust, *Coleosporium Campanulae.* This is very closely related to the pine-goldenrod leaf rust. The orange outbreaks of the II and III stages have been found here only on leaves of cultivated *Campanula rapunculoides.* The I stage on pine needles is also similar to the species just mentioned but has not been found here.

There is no question, however, that the rust can carry over through the II stage on the bellflower, so the parts of all infected plants above ground should be destroyed in the fall. *See* Aster and Pine.

Birch

European canker, *Nectria galligena.* This fungus produces a conspicuous, central deep canker with concentric, shallower rings of growth that are gradually killed back at the edges. It occurs on the apple and some other trees but is especially bad on the wild sweet birch, *Betula lenta* and less so on the paper birch, *B. papyrifera* and grey birch, *B. populifolia.* The fruiting stage shows more or less abundantly (sometimes it is even missing) as scattered or grouped, red bodies like insect eggs that produce the winter spores. It is listed here also in apple, hornbeam and oaks.

Cut off and burn the infected branches of badly injured trees.

Rust, *Melampsoridium betulinum.* This rust so far has been found only on the various wild species of birch, chiefly on *Betula populifolia.* It forms yellowish, more or less dusty, pustules of the II stage on the leaves and is rather common, especially in the northern part of the state. The III stage is not so common and is difficult to detect, apparently occurring on the leaves very late in the season. The I stage, with inconspicuous cups, probably occurs on the leaves of the larch in our swamps but so far we are not certain whether those collected belong to this rust or to the rusts on willow and poplar. There is some evidence to indicate that the rust sometimes carries over through the II stage.

Bittersweet

Crown gall, *Bacterium tumefaciens.* This is seen occasionally in the nurseries on *Celastrus orbiculatus. See* Rose.

Chlorosis. The yellow and white spotting, or the more common yellowing, found on the leaves of native plants of *C. scandens* may be due to insects or late frosts.

Blackberry

Crown gall, *Bacterium tumefaciens.* This is not uncommon on roots of individual plants in a patch of Rubus sp. but does not seem to be serious. *See* Rose.

Leaf spot, *Septoria Rubi.* This spot is common on various species of blackberry, dewberry and raspberry, both cultivated and wild. It shows as small, round, white to brown spots with an evident purplish border not only on the leaves but also on the young stems. The summer spore stage is parasitic on these showing as embedded black spots; the winter stage is said to develop later as a saprophyte and is an ascomycete, known as *Mycosphaerella Rubi,* which as yet we have not found. The trouble is usually not serious enough to warrant spraying.

Powdery mildew, *Sphaerotheca Humuli.* So far this mildew has been found only sparsely in its conidial stage. *See* Rose.

Rust, *Kuehneola albida.* This autoecious rust, in its II stage with much smaller pustules than the next rust, occasionally becomes conspicuous on the leaves of the cultivated blackberry. The characteristic white pustules of the III stage are not so abundant as on the wild dewberry, *R. hispidus,* which may be the source of infection. However, raking up and burning the leaves in the fall may serve to lessen the trouble.

Rust, orange, *Caeoma nitens.* On the cultivated blackberry we apparently find only this short-cycled form causing the injury. The large, dusty, orange outbreak of the aecia on the underside of the leaves is the only stage. Their spores combine the functions of both the summer and winter spores. As the fungus is perennial in the underground parts of the plant, the only remedy is to pull up and destroy the infected plants as they appear. (Fig. 24.)

Mosaic. This disease is less evident and injurious than on the raspberry, *q.v.*

Winter injury. There have been some complaints but this trouble is less likely to occur than on the raspberry.

Blueberry

Leaf curl, *Exobasidium Vaccinii.* This is much more common on the wild blueberries, huckleberries, Vaccinium species, etc., than on the cultivated Azalea, *q. v.*

Rust (Hemlock-Blueberry), *Pucciniastrum Myrtilli.* This is common on various wild species of the heath family but also has been found once on the cultivated black blueberry. *See* Azalea.

Rust (Witch's Broom), *Calyptospora columnaris.* Both the wild, common, low and high blueberries occasionally develop this perennial rust in the northern part of the state. The III stage only is present and it forms chestnut-brown swellings on the young shoots which are often clustered together into a witch's broom effect. The embedded spores germinate in position and infect the leaves of the balsam-fir which is very rarely found in our northern woods, but grows still farther north.

Box

Canker-Wilt, *Volutella Buxi.* While this trouble of *Buxus sempervirens* occurs here, I think that sometimes winter injury is mistaken for it. It causes cankers on the stems and a wilting of the leaves. The latter may be directly attacked also. The fruiting stage is more or less evident as pinkish exudations on the injured parts. When it is bad the stems are killed. In any case where trouble of this nature occurs, the badly injured and dead branches should be cut out and burned and the surrounding branches sprayed with oleate Bordeaux.

In the early summer of 1932 there was called to the writer's attention certain box plants in a New Haven yard that were losing their leaves and many of whose branches were dying. They were in two rows bordering a walk and the previous fall certain of them had been replaced by larger, vigorous plants from Maryland. All of the plants were said to have been protected over the winter and apparently appeared in good shape in the early spring, but later these Maryland plants acted as described above. On certain of the leaves were found rather commonly spores of a Macrophoma said by some also to cause injury. On the leaves and stems much more prominently, however, were developed the fruiting stages of the fungus described here, a lax growth of pinkish spores on the leaves of the Verticillium type and the pink pustules and spores on the stems of the Volutella type.

Just whether the winter protective treatment in a fairly warm winter, the transfer of the plants from a southern climate to a more northern one, or the presence of these unusual parasites on these new plants or all three of these factors had to do with the trouble is still not clear to the writer. Certainly this Volutella (or Verticillium when on the leaves) fungus needs further study in this state, and probably elsewhere, to determine its real parasitic character. We have never run across a *Nectria (Nectriella) rousseliana* on *Buxus sempervirens,* said to be associated with this fungus as its asco-stage.

Leaf blight, *Macrophoma Candollei.* This fungus, mentioned in the preceding paragraph as having also been found on box, is claimed by some as a parasite of the leaves. We are not sure whether it is a true parasite or merely a weak one following other injury. In this case it was on the green leaves that were attached to the dying branches. We have seen it also on the yellowed and dead leaves when we were not sure what was causing their death. It shows in its fruiting stage as small, black pustules with a white mouth, on either side of the leaves, and produces elongated, white, apparently single-celled spores of considerable size distinct from the ordinary Sphaeropsis.

Sun scorch. From nurseries we occasionally receive specimens that show in summer time injured or dead leaves, usually white in color, or even whole branches, with no definite parasitic fungus present to account for the injury. We usually attribute such injuries to sun scorch if the weather has been favorable for such a trouble.

Winter injuries. Severe or even variable winters not so cold may injure box hedges much as just mentioned, when they are not protected by snow or artificial covering. We have seen cases where the injury was limited to the upper, unprotected parts of the plants when the protection was given to only the lower parts. Death may result directly or the injured plants may lag along during the growing season and attract attention as a possible fungous injury.

Broccoli

Black leaf spot, *Alternaria Brassicae.* *See* Cabbage.

Black leg, *Phoma lingam.* Both the leaves and the stem of *Brassica oleracea botrytis* are infected but the injury is started in the latter often from the infected seed. The plants while young are injured with a foot rot, known as black leg, in which the tissues turn black and finally rot away leaving only the interior hard parts. The plant above slowly turns yellow and dies or fails to mature the head. On the leaves the occasional, at first yellow and then grayer, spots grow to about half an inch in diameter, but can be distinguished from other leaf spots on the same hosts by the small, black, embedded fruiting bodies.

Watch the seed bed to avoid using infected plants and if necessary change it. If desirable treat the seed. Rotate the fields to other distinct crops and keep the infected refuse out of the manure pile. Cabbage is also infected in this state occasionally.

Clubroot, *Plasmodiophora Brassicae.* The characteristic feature of this trouble is the greatly enlarged, white swellings on the roots in a variety of cultivated plants and weeds of the Mustard family. In time the infected roots rot and disappear through bacterial invasion. Where bad the plants turn yellow and often die prematurely or fail to properly develop the edible parts for which they are grown. Clubroot here is especially bad at times not only on Broccoli but also on Brussels sprouts, cabbage, cauliflower, kohlrabi, mustard, radish, rutabaga and turnip.

The grower should start with plants free from the disease and practice rotation with other dissimilar crops. If the field becomes badly infected and a further crop is still desired, treat it in the fall with about two tons of lime to render it less acid. However, the farmer, if the soil becomes alkaline, needs to keep potatoes and beets off the land for sometime afterwards. Watch the seed beds that the trouble does not start there.

Downy mildew, *Peronospora parasitica.* *See* Turnip.

Brussels Sprouts

Clubroot, *Plasmodiophora Brassicae.* So far this is the only disease noticed in the state although elsewhere other diseases have been reported. *See* Broccoli.

Bryophyllum

Crown gall, *Bacterium tumefaciens.* While we have never found this gall in nature on this host, Dr. McCormick has easily produced it artificially in our greenhouse by inoculations with germs grown in test-tube cultures. *See* Rose.

Buckwheat

Leaf spot, *Ramularia rufomaculans.* This host, *Fagopyrum esculentum,* apparently has few fungous troubles here. So far the only two seen are leaf spots of which this is the most common but still causes little injury. It shows chiefly on the under side of the leaves as a white, mealy growth in more or less numerous spots.

Poor growth. The chief trouble of buckwheat, as we have seen it in scattered fields over the state, is poor growth apparently due in some cases to insufficient fertilization. In hot dry seasons, however, this may be due to lack of sufficient moisture, the plants becoming prematurely dwarfed and yellowed.

Bugloss (Italian)

Undetermined spot. The only trouble we have found on this plant *Anchusa italica* (vars. Opal and Dropmore) was seen in nurseries at Bristol and Centerville in late October. The leaves, besides being killed more or less at the margins and tips, showed definite, large, reddish-brown spots in the interior of the normal green tissues. The death of the sides and tips suggest frost or scorch injury. No fruiting stage of a fungus was found though the injury looked like a trouble of that kind. Study of further specimens is desired.

Bush Clover (Pea Shrub)

Fasciation. The only trouble we have recorded on this plant, *Lespedeza formosa* (*L. Sieboldi*), was described in Bull. 222: 453. The flattened stems of the two specimens seen were about one to two and a half inches wide. One specimen had two recurved, very similar tips but the other had a smaller, flattened, side-stem further down but each with a recurved tip. Both specimens were provided with numerous small, normal branches from the flattened stems and with immature, aggregated blossoms at the curved tips.

Butterflybush

False mosaic. This mosaic-like mottling of the leaves of a species of Buddleia was called to our attention as occurring on plants in Bridgeport early in May, 1932. It was evidently due to a late frost since the later leaves showed no further trouble. *See* Japanese knotweed.

Butternut

Anthracnose, *Marssonia Juglandis. See* Walnut.

Canker, *Melanconium oblongum.* This trouble has been reported by Graves as a weak parasite injuring the trees of *Juglans cinerea* here by developing cankers that eventually cause the death of the infected branches. It has been found in the woods on this slowly disappearing tree. Its mature stage is said to belong to the Ascomycete, Melanconis.

Heartwood rot, *Fomes igniarius.* This has been found here once on a living roadside tree in Hartland. *See* Oak.

White mold, *Microstroma Juglandis.* Occasionally this is seen on the leaves as a continuous, short, white growth on the under side of the leaves of forest trees. It has also been reported once on a cultivated foreign variety of walnut. On the Hickory it is also said to cause a witch's broom effect on the young branches. Apparently the mycelium invades the young stems to produce this abnormal condition. The fungus is considered as one of the low parasitic forms of the toadstool groups known as Basidiomycetes.

Cabbage

Bacterial black rot, *Bacterium campestre. See* Rutabaga. (Fig. 25.)

Bacterial leaf spot, *Bacterium maculicolum. See* Cauliflower.

Bacterial soft rot, *Bacillus carotovorus. See* Iris.

Black leaf spot, *Alternaria Brassicae.* The spots on the leaves of *Brassica oleracea capitata* caused by this fungus are much like those formed by the black leg disease when it occurs on the leaves. However, they can be distinguished from the latter by the fungus developing, instead of embedded fruiting pustules, a more or less evident growth of erect fruiting threads that have a blackened appearance. The spots also usually show concentric rings of development. The trouble is never serious and occurs chiefly on the lower older leaves. It has also been found on several of the related host plants mentioned here, as follows: broccoli, cauliflower, Chinese cabbage, horseradish, radish and rutabaga. This imperfect fungus causing the disease is distinguished from a saprophytic Alternaria, also occurring on the languishing leaves, by the long slender pedicels of its narrow spores which we have previously distinguished as var. *macrospora.*

Black leg, *Phoma lingam. See* Broccoli.

Clubfoot, *Plasmodiophora Brassicae. See* Broccoli. (Fig. 26.)

Downy mildew, *Peronospora parasitica. See* Turnip.

Drop rot, *Sclerotinia sclerotiorum.* This is occasionally seen in heads of stored cabbage. *See* Lettuce.

Gray mold, *Botrytis cinerea.* This also develops sometimes in heads under poor storage conditions. *See* Geranium.

Seedling rots, *Pythium debaryanum, Rhizoctonia Solani.* Both of these fungi have been found killing seedlings in the seed beds as described elsewhere for a variety of other seedlings. For treatment *see* Spinach.

Growth cracks. With variable weather conditions as to moisture and heat, the cabbage heads may crack open more or less and cause damage if this extends too far inward. *See* Snapdragon.

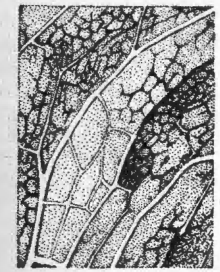


FIGURE 25. Cabbage black rot.

FIGURE 26. Cabbage clubroot.

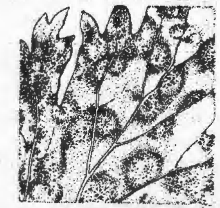


FIGURE 27. Celery late blight.

Lightning injury. We have seen a case where injury to the plants was largely confined to the edges of the leaves, apparently attracted by their wet condition when the lightning occurred. Ordinarily the injury is much more severe, the plants being killed in a circular space.

Oedema. On seedling and mature cabbages we have seen these intumescences looking like insect punctures. The greenish, swollen, small punctures eventually turn brownish and die, resembling somewhat the corky growth of lenticels. *See* Glorybush.

Premature. In variable seasons, we have seen fairly young plants start to blossom the first year and occasionally considerable damage is caused to the expected crop. *See* Lettuce.

Storage injury. In the early winter of 1933, we saw a case of injury to cabbages sold from a New Haven grocery store where the heads, stripped of green leaves, showed the blanched leaves free from trouble. However, on cutting open the cabbages beyond the normal outside layers the inner ones showed a grayish-white, water-soaked appearance with greyish to black areas in the same. A microscopic examination of these tissues failed to show the presence of any mycelium of a fungus or of bacteria. We came to the conclusion that the heads had been injured by unusual cold conditions during storage since there was no injury to the base of the stem above where it was cut off. These cabbages came from outside the state by railroad and either the natural or cold storage conditions had been too severe and so had injured the inner, younger and more moist tissues without harm to the outer, dryer and more mature layers.

Calendula

Mosaic. While not common we have seen mosaic on *Calendula officinalis* and certain other ornamental, herbaceous plants. It shows the rather typical lighter and darker green mottling patterns on the leaves. *See* Cucumber.

Yellows. This is also rather unusual here on this host. *See* Aster.

Calla Lily

Bacterial soft rot, *Bacillus carotovorus.* While this trouble of *Richardia Africana* has been described as caused by *B. Aroideae,* we doubt if that organism is distinct from the common soft rot organism occurring in soil rich in organic nitrogen and causing decay in various herbaceous plants. On this host it has been seen only occasionally in greenhouses but one complaint was of rather serious injury.

Care should be taken in the use of organic matter, especially if not well rotted, and in watering the plants. Destruction of the infected tissues of the host should also help. Do not crowd the plants and look to proper ventilation when needed.

Canna

Bacterial bud rot, *Bacterium Cannae.* This is the only trouble we have found on *Canna indica* so far. It has been seen several times in the same city park, becoming most prominent in the wet seasons. The trouble seems to start, after the plants attain some size, in the stem bearing the upper leaves and blossom buds, injuring or killing them. The leaves when infected at a more advanced stage show dead, blackish areas when dry, or when wet they may have a semi-pellucid appearance. Evidently the remedy here is to get rootstocks free from this disease, plant them in new soil and be careful not to overwater the plants.

Carnation

Black leaf spot, *Alternaria Dianthi.* This is one of the worst of the several leaf spots of this plant, *Dianthus caryophyllus.* The spots are whitish with the fruiting stage as a more or less conspicuous, black growth on both the leaves and stems. Some varieties are more subject to it than others and often it becomes established in plants that were grown outside for a time in wet weather. Occasionally the whole plant is killed but usually the injury is confined to the top from a girdled spot in the stem below, or the injury may be confined to the defoliation of the leaves or injury to their tips. *See* Pansy for treatment.

Gray mold, *Botrytis cinerea.* *See* Geranium.

Leaf spot, *Heterosporium echinulatum.* This is similar to but less common than the first carnation disease mentioned here. The spots are perhaps more definite and often have a purplish border. Like the other, it is an imperfect fungus but the spores of the two, borne on the exposed fruiting threads, are readily distinguished under the microscope.

Leaf spot, *Septoria Dianthi.* While this is similar to the last, it can be distinguished by the minute, embedded, fruiting pustules. The treatment is the same for all three leaf spots.

Root rot, *Rhizoctonia Solani.* We have rarely found the fungus rotting the roots of this plant. *See* Potato.

Rust, *Uromyces caryophyllinus.* Rust is the common trouble in our green houses on this host, especially on certain varieties. The reddish-brown, semi-dusty spores break out as small, oval pustules or sori, usually partly covered by the epidermis, and are somewhat clustered or more frequently scattered over the leaves and stems. The II and III stages look much alike to the naked eye. The I stage, occurring on Euphorbia, has not been found in this country.

The grower should start with plants free from the rust and try to keep it out by selecting only free stock. If in spite of this it does appear, at the very start he should pick off the infected leaves and spray with Bordeaux, with potassium oleate as a sticker, to keep the plants continuously coated until the danger is past. If the trouble gets a good start, spraying will probably be of little value.

Stem rot, *Fusarium* sp. This trouble is found occasionally on this host, chiefly in the greenhouse. *See* Aster.

White tip. This trouble shows as white spots usually at the tip of the leaves, or in the calyx of the blossoms, where drops of water were present when treated with some insecticide or fungicide. It results from fumigation, or spraying in some cases, usually with some form of tobacco as an insecticide or, less likely, sulphur for mildew. Watch these treatments carefully and fumigate only when the plants are dried of adhering moisture.

Carrot

Bacterial soft rot, *Bacillus carotovorus.* *See* Iris.

Blight, early, *Cercospora Apii* var. *Carotae.* We have seen this on *Daucus Carota* once recently. It was sent from a garden in the northwestern part of the state where it was associated with the leaf blight mentioned below. It apparently is less serious than the latter, but makes a more definite spot. *See* Celery.

Drop rot, *Sclerotinia sclerotiorum.* *See* Lettuce.

Leaf blight, *Macrosporium Carotae.* During the last ten years, especially in wet seasons, we have had some complaint of this trouble by growers. We have also seen several cases in gardens where some damage occurred. The finely divided leaves, or their infected segments, dry up and the black spores of the fungus show on the same. When bad, especially in wet years, all of the leaves of the plant may be killed or become badly injured and the root crop diminished as a result. Recently we have seen what seems to be this same trouble on parsley.

While spraying with Bordeaux will control the trouble, it does not seem to be a very practical remedy especially when the injury is so infrequent in its severity. Rotation, less close crowding and planting on higher, better drained land should ordinarily limit the injury.

Nematode rootknot, *Heterodera radicicola.* *See* Cucumber.

Catalpa

Leaf spot, *Macrosporium Catalpae.* The fungus said to cause this disease needs to be investigated more thoroughly. The Macrosporium, really an Alternaria, that appears on the spots is not very abundant and frequently is absent in the spore stage. The spots are round, reddish-brown, conspicuous and injurious when abundant on the leaves. They are often found on trees in the nurseries and occasionally on shade trees around dwellings. This spot has been found here on *Catalpa bignonioides, C. Kaempferi* and *C. speciosa.* Insects sometimes produce somewhat similar spots but show indications of their presence as injury between the epidermal layers.

Although we have no records of treatments by spraying, we believe that if Bordeaux is applied early in the season, it might control the trouble.

Powdery mildew, *Microsphaera elevata.* This is considered by some as a variety of *M. Alni.* The white coating of mycelium and conidia on the leaves is not very heavy and gives a gray appearance. The rather few perithecia embedded in the same differ in the length of their appendices (that hold them fast to the mycelium) from those of *M. Alni.*

Rarely it merits spraying for control except in nurseries where it might sometimes be done to advantage.

Cauliflower

Bacterial black rot, *Bacterium campestre.* *See* Rutabaga.

Bacterial leaf spot, *Bacterium maculicolum.* This is a trouble that has been noticed here particularly since cauliflower, *Brassica oleracea botrytis,* has been more commonly cultivated in larger quantities. It was first found in the state, before it was described elsewhere, as a new disease on turnip and kale and later on cauliflower, where it seems to cause the most damage, and on cabbage. The bacteria produce small, blackish specks or spots in the leaves, and, if abundant, these run together and yellow the leaves. It is usually troublesome only in wet years. Rotate and try seed treatment if necessary.

Bacterial soft rot, *Bacillus carotovorus.* *See* Iris.

Black leaf spot, *Alternaria Brassicae.* *See* Cabbage.

Clubroot, *Plasmodiophora Brassicae.* *See* Broccoli.

Cedar

Nursery blight, *Phomopsis juniperovora.* While apparently we have found this fungus present on the mature trees, it is only in the nurseries on young plants, especially on the variety of red cedar called *Cannarti* and on *Juniperus scopulorum*, that it has proved serious here to our knowledge. The leaves and stems turn a light brown color and die and the embedded, black, fruiting pustules can be found more or less abundantly in them. No other stage is known.

While certain spraying tests have not, apparently, proved very satisfactory, we believe, if the trouble is taken in its early stage, repeated treatments with Bordeaux will control it in most seasons.

Rust, Bird's nest, *Gymnosporangium Nidus-avis.* As its name suggests this perennial rust, found so far only on our wild cedars in the parks and woods, causes a bunching of the smaller branches into a sort of nest-like affair. On the main trunk and the larger branches, however, we have seen it without this effect, the yellow, gelatinous sori issuing from the cracks in the wood without evident swelling or distortion of the same. This rust was originally described from this state by the Station's first botanist, Dr. Thaxter. It has its I stage on the wild Amelanchier and is said also to infect the quince. The host in Connecticut for this and the succeeding rusts is *Juniperus virginiana.*

Rust (Cedar-Apple), *Gymnosporangium Juniperi-virginianae.* This is the rust that acts as the III stage for the common apple rust, *q. v.* As with other cedar and juniper rusts, this stage develops in the wet weather of April to late June jelly-like horns containing the spores that carry infection to the alternate hosts and later produce the I stage. There is no II stage for any of these rusts here. With this particular rust, the jelly-like horns issue from round galls on the branches that were formed the previous season from infections on the leaves from the apple-rust spores. In these horns are produced the III spores which germinate in position and bear smaller, temporary spores that are carried by the wind to the apple leaves and produce there the apple-rust stage.

Here in Connecticut the owners of ornamental cedars are often as much interested in them as in the apples, so common destruction of cedars to prevent apple rust is not generally advocated. However, cedars should not be planted near apple orchards or the cultivated very susceptible Betchel's Flowering Crab. Destruction of the galls before fruiting might be helpful to both hosts. Spraying the cedars in July just before the apple-rust spores are produced and repeating before or after rains until the end of the season probably would require too many treatments to be profitable.

Rust (Cedar-Hawthorn), *Gymnosporangium globosum.* This is very similar to the cedar-apple rust in that it produces small, round galls on the red cedar known as "cedar apples". The galls in this case are said to be perennial, producing the jelly-like horns containing the III spores each year in the spring. The horns are tongue-shaped, shorter and flatter than those of the more common cedar-apple rust. Its I stage develops commonly on the hawthorn, *q. v.*, or occasionally on one or two related hosts.

Rust (Cedar-Quince), *Gymnosporangium germinale.* This fourth rust develops its small, jelly-like III stage in the wood of slightly swollen branches of both the cedar and juniper. The I stage occurs on the fruit and bark of certain pomaceous hosts like the quince, hawthorn, shadbush and apple.

Celery

Bacterial soft rot, *Bacillus carotovorus.* *See* Iris.

Blight, early, *Cercospora Apii.* This leaf trouble of *Apium graveolens* appears in the celery fields usually in August, becoming evident then or later, and is called the early blight, as it precedes the disease next discussed. The light to reddish-brown spots are larger and more irregular than the late blight and the fruiting stage usually shows as short, grayish threads bearing the spores. This same species is found here on celeriac, while on carrot and parsnip distinct varieties have been named. The injury is usually less severe than that caused by the late blight but both are controlled by the same treatment.

Blight, late, *Septoria Apii.* Late blight appears soon after the early blight gets a fair start and the two are often seen on the same leaves. The late blight has smaller, more numerous spots and produces embedded, black, fruiting pustules, called pycnia, from which the spores ooze out following wet weather and spread the disease. Both diseases are caused by imperfect fungi of which the asco stages are unknown. The late blight is commonly the more injurious, especially on the petioles, and is a source of subsequent injury to the plants stored under conditions favorable for its later development and for that caused by other fungi. (Fig. 27.)

Some investigators advocate dusting as giving good results. In this state, however, we prefer thorough spraying with Bordeaux, beginning in July as soon as the celery starts to grow in the field and repeating every 10–14 days, according to the weather, until the last of October if necessary. Whether a grower needs to spray depends on the location of his field, the variety grown (self-blanching varieties are often more susceptible) and his previous experience of injury from these troubles. At any rate it is best for him to start with plants that are free from the diseases and were sprayed in the seed bed as a precautionary measure.

Gray mold, *Botrytis cinerea.* This is rarely seen in storage. *See* Geranium.

Rots, *Pythium debaryanum, Rhizoctonia Solani.* These two fungi have been seen both on seedlings and also as causing injury to more mature plants. *See* Potato and Spinach.

Brown root rot. This trouble has been seen several times in which the bunched, shortened, reddish-brown roots failed to develop properly and so hindered the proper growth of the tops. It looked like a soil-fertilizer trouble of some kind, similar to that of tobacco and onions mentioned here.

Crinkle. Occasionally we have found a trouble of this sort where the leaves were puckered and sometimes slightly mottled. It does not appear to be a true mosaic type of injury but rather one due to a variable season for growth, perhaps when a dry, slow growing period is followed by a wet one causing sudden, vigorous growth.

Celeriac

Blight, early, *Cercospora Apii.* As this plant, *Apium graveolens rapaceum,* is not so commonly grown here as formerly neither this nor the next fungus is so commonly found on it as on Celery, *q. v.*

Blight, late, *Septoria Apii.* *See* Celery.

Chard

Leaf spot, *Cercospora beticola.* This is the common leaf spot of beet, chard *(Beta vulgaris cicle)*, mangel and ornamental beets, on all of which it has been found here. The spots are round, light colored, with a definite, purplish and often slightly raised border and are frequently abundant on the leaves. The fruiting stage is more or less evident according to season and weather conditions and consists of short, erect, tinted threads bearing the more conspicuous, lighter-colored spores. It is an imperfect fungus whose asco stage apparently is not yet known.

It is sometimes quite bad in sugar-beet fields but in Connecticut it rarely merits special preventive treatment other than care in selection of good seed and rotation. If necessary it can be controlled by proper spraying.

Cherry

Anthracnose, *Cylindrosporium Padi* (called by some *C. hiemalis*). The disease is sometimes very bad on cherry, when the early season is moist, so that considerable defoliation results. It occurs on both *Prunus avium* (sweet) and *P. Cerasus* (sour) but is worse on the latter. While it occurs on other related species it seems to be bad chiefly on the wild black and choke cherries. The fungus is called by some *C. lutescens* on these other hosts. It produces numerous, small purplish spots on the leaves on the under side of which the ooze of the spores may show as a yellow-pinkish globule. On some hosts shot-hole in the leaves may result. The asco stage occurs on the old leaves in the spring and is known as *Coccomyces hiemalis.* It seems probable also that the conidial stage may be carried over on the young twigs of some of the hosts.

Spraying should be started before the middle of May on the young immature leaves and repeated several times until the leaves are fully grown in July. *See* also Plum, where it is sometimes called *C. prunophorae*.

Black knot, *Plowrightia morbosa.* This has been found most commonly on the sour cherry. *See* Plum. (Fig. 28.)

Brown rot, *Monilia cinerea. See* Addenda for detailed treatment of this trouble.

Leaf curl, (Witch's broom), *Exoascus Cerasi.* This witch's broom species is occasionally found here perennial in the branches of the cherry. One or more of the branches prematurely develop the leaves so that when the rest of the tree is in full bloom their green leaves stand out in evident contrast to the white blossoms. For treatment *see* Peach.

Powdery mildew, *Podosphaera Oxyacanthae.* This is only occasionally troublesome, producing the most injury to seedlings in the nursery or on the tips of the twigs of the older trees. On the younger tissues it forms a felt of the white mycelium which becomes less evident on the surfaces of the mature leaves. In time the small, reddish-black perithecia of the asco stage appear embedded in or on this mycelial and conidial growth. Besides being found on cultivated cherries and plums, this mildew has been collected here on wild species of *Prunus serotina* and *P. virginiana*.

Spraying should begin on the opening buds with Bordeaux or some less injurious spray, as dry mix, and continue as needed for three or four treatments.

Winter injury. This usually shows on the older trees by the sudden or gradual death of the larger branches, in the latter case the leaves turning yellow and dying prematurely with no evident cause of the trouble. These dead and weakened branches should be cut off and in the spring a fertilizer be given to stimulate new vigor to both roots and branches.

Chestnut

Blight, *Endothia parasitica.* Since this trouble was first noticed in this state about twenty-five years ago, it has carried off all of the old trees and most of the sprouts and seedlings of younger growth. Today because of the scarcity of the host, *Castanea dentata,* the fungus is not nearly as abundant and so the chance of infection of the remaining sprouts and seedlings is lessened. The fungus is a typical Ascomycete, producing cankers killing the bark and cambium. When the girdling is completed, the parts of the host above are killed, with the dead leaves often adhering for some time. The conidial stage shows as yellowish, sticky exudations of spores produced from internal fruiting chambers and is followed by the asco stage in the same reddish, grouped tubercules in which are embedded the minute, black necks for the discharge of the ascospores.

In the late fall of 1932, we saw at Lebanon what apparently was the last living old tree in our forests. Although it was badly diseased, efforts were made to keep it alive. We have seen several moderately large trees of the Japanese chestnut, *Castanea crenata,* that have remained nearly free from the disease. Certain other Asiatic species are said to be fairly immune.

Those who have wood lots where the chestnut still survives should annually go over the woods and cut out and burn all of the infected sprouts, thus lessening further spread to the sprouts still free. The Station has started five small plantings of seedlings in the state from nuts grown in the south, in the hope that these and the natural seedlings here may eventually escape the destroyer and help bring back this valuable tree in our forests. We are basing our hope on the less favorable conditions for the spread of this disease, together with the possibility that the fungus may gradually lose its virulence as a parasite.

Leaf spot, *Marssonia ochroleuca.* Once fairly common, the leaf spot, caused by this imperfect fungus whose asco stage is unknown, is now rarely seen. It forms small, round, light-brown spots with a reddish border and in the center are the inconspicuous, embedded, fruiting pustules.

Powdery mildew, *Microsphaera Alni.* This fungus coats the leaves in late summer and fall and is not uncommon on the sprouts and seedlings. *See* Lilac.

Wood rots, *Polyporus Spraguei, P. sulphureus.* While a large number of species of the Basidiomycete have been found on the bark and wood of dead chestnuts and while the heartwood of the living trees is sometimes rotted, we have not generally found their fruiting bodies on living trees to identify the cause of their decay. The fungi listed above are two that have been seen and commonly ascribed to heartwood rots.

Fasciation. We have one specimen from Ansonia, collected in May, 1910, of a young sprout showing a moderately flattened stem with a smaller, flattened side branch but the main one with a further bifurcation ending in slightly flattened and curved tips. *See* Asparagus.

Chinese Cabbage

Bacterial soft rot, *Bacillus carotovorus.* The rot has been found rarely in wet seasons when this infrequent plant, *Brassica pekinensis,* is grown. *See* Iris.

Black leaf spot, *Alternaria Brassicae.* It was found first at the Station's Mount Carmel farm. *See* Cabbage.

Clubroot, *Plasmodiophora Brassicae.* So far this has been seen only on inoculated experimental plants. *See* Broccoli for description and Turnip (White) for further statements.

Leaf spot, *Cercosporella albomaculans.* This unusual fungus forms a more or less evident growth of short, dark threads bearing white spores on small, grayish spots in the infected leaves. It has not yet been connected with a perfect stage. The white turnip is another of its hosts in the State. Because it rarely becomes of economic importance, no attempts for control have been made.

Chinese Lantern

Leaf spot, *Phyllosticta Physaleos.* On *Physalis Francheti,* now being grown occasionally in our gardens, this leaf spot has been seen once. It shows as circular, gray to brown spots with a darker border and bears the embedded, black, imperfect fruiting stage of the fungus usually in the center. Apparently the fungus has never been reported on this particular host and little is known concerning it.

White smut, *Entyloma australe.* This also was found here only once. *See* Groundcherry.

Chives

Rust, *Puccinia Porri.* This rust occurs on *Allium Schoenoprasum* in all three stages, though so far we have not seen the I stage and the II has been found more often than the III stage. It has been collected here not only on chives but also on the Egyptian perennial onion. The sori appear as little blisters that open with a central slit in the epidermis which, wearing away, discloses the reddish-brown spores. The thicker epidermis of the onion allows it to protect the spores for a longer time than on the chives where also the outbreaks often appear more numerous, probably due to the more ready dispersal of the II spores.

Once the rust gets a start on these perennial plants, it is apt to appear year after year and in favorable seasons it causes considerable damage. The grower, if the trouble appears, should again start with plants free from the rust and plant in a new place.

Chrysanthemum

Crown gall, *Bacterium tumefaciens.* This trouble has recently been collected on roots of greenhouse chrysanthemums where it was quite conspicuous. *See* Rose.

Leaf spot, *Cylindrosporium Chrysanthemi.* We have found both a Cylindrosporium and a Septoria on this host and there is some question whether or not they are really distinct, though the latter forms a definite pycnium or fruiting body enclosing the spores in the leaves while the former merely oozes out its similar spores without a very definite enclosing layer of sterile threads. Both produce conspicuous, blackish spots or areas in the leaves and cause them to turn yellow and drop off, defoliation taking place from the base of the stem upward. When very severe this prevents cutting stems long enough to have proper foliage for the blossoms even if the latter are in prime condition, which very often they are not due to improper nutrition from this lack of foliage.

The grower should watch the young plants for this trouble, avoid excessive use of water, especially on the leaves, and use care in ventilation to dry off excessive moisture. If the trouble appears and it is necessary to prevent spread, spray before the blossoming period with Bordeaux. Potassium oleate used as a spreader certainly will stick the Bordeaux so that it will not easily wash off.

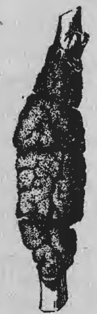


FIGURE 28. Cherry black knot.

FIGURE 29. Chrysanthemum rust.

FIGURE 30. Corn smut.

Powdery mildew, *Erysiphe cichoracearum.* So far only the conidial stage has been found on this host. *See* Rose.

Rot of Cuttings, *Rhizoctonia Solani, Botrytis cinerea.* We have found both of these fungi rotting the cuttings of certain susceptible varieties, like Bonnaffon, when starting the roots in sand. The former acts as a soil parasite, the mycelium spreading in the sand and rotting all the cuttings in the area, and the latter develops spores on the languishing leaves and through them spreads the disease to the stems.

Sterilization of the sand, use of hardened rather than tender growth for cuttings, care in the use of heat and water, spraying the cuttings and soil with potassium sulphide (1 oz. to 10 qts. water), may all be essential to success with the very susceptible varieties.

Rust, *Puccinia Chrysanthemi.* The rust shows as rather conspicuous, round, dusty, reddish-brown pustules either grouped or scattered, usually on the lower side of the leaves. Only the II stage has been found here. (Fig. 29.)

The grower should watch to keep the rust out of the greenhouse by using only healthy cuttings and plants. He must avoid the most susceptible varieties, pick off the first leaves if rust appears and start spraying to prevent further spread.

Leaf drop. This trouble sometimes appears in greenhouses on certain varieties where the leaves become black-spotted or merely turn yellow and drop off, very much like the leaf spot disease but with no sign of infection by that or any other fungus. Sometimes too close planting may have something to do with root competition but to the writer it seems to be due to unfavorable soil condition (due to unbalanced fertilizing elements) the exact nature of which has not yet been disclosed.

Clematis

Leaf spot, *Cylindrosporium Clematidis.* This usually shows as small, numerous, angular spots on the leaves with the imperfect fruiting spores (asco stage unknown) oozing out sometimes in a whitish exudation. It is found chiefly on the wild species, *Clematis virginiana,* or on the same in cultivation. Investigators, so far, seem to have disregarded it in control treatments.

Rust, *Aecidium Clematidis.* The I stage of this rust occurs on the leaves, especially of wild species, in rather small, closely clustered, white cups. The II and III stages go under the same specific name as a Puccinia and occur on certain grasses, being especially common on quack grass. The infection of the cultivated Clematis depends on its species and the proximity of the infected grasses and so is not common.

Clover

Black mold, *Macrosporium sarcinaeforme.* This leaf trouble shows as reddish-brown spots usually with indications of concentric rings of growth. It can easily be told from other clover fungi by the microscopic appearance of its spores which are borne on the short exposed threads on the surface of the leaves. It is, as yet, not connected with an Ascomycete as a mature stage. It occurs here on red clover, *Trifolium pratense,* causing moderate damage at most. Since clovers are very rarely grown in pure stands in Connecticut, the damage resulting from the different diseases are not sufficient to merit control. *See* Alfalfa.

Leaf spot, *Pseudopeziza Trifolii.* Like the similar fungus on alfalfa, this trouble shows as reddish-brown spots on the leaves where at the center can usually be seen the small, saucer-shaped, fruiting-cup of the Ascomycete causing it. Apparently it is less common than the preceding disease and so far has been found here only on the red clover.

Powdery mildew, *Erysiphe Polygoni.* A few years ago this mildew became prominent on the leaves of red clover over Eastern United States. It seems never to occur except in its conidial stage and varies in prominence according to the weather of each year though always present somewhat. It has rarely been found here on alsike, *T. hybridum,* and never on white clover, *T. repens.* Besides the clovers, this mildew has a wide distribution of hosts mostly of the Pulse family. However, in many of these hosts it is limited to its conidial stage and this and its late appearance usually diminishes the damage it causes, so little is done to control it. Like all powdery mildews, it is largely an external parasite and so subject to rather direct control by spraying and dusting. The other hosts listed here are: cowpeas, larkspur, Lima and string beans, lupine, peas (garden and sweet), rutabaga and turnip.

Rusts, *Uromyces hybridi, U. Trifolii, U. Trifolii repentis.* Formerly considered as one species of rust on all clovers, botanists now distinguish the preceding rusts as limited, in the order named, to alsike, red and white clovers. These rusts are all autoecious, that is, have the I, II, III stages on the same host. The cluster cup stages, however, are rarely seen and then only in the spring and are missing so far here with the red clover rust which is the most common of the three.

Sooty spot, *Polythrincium Trifolii.* The fungus in this stage shows as small, black, fruiting threads on the leaves and later as more permanent, black pustules in its asco stage, known as *Phyllachora Trifolii.* It is common here on the white and alsike clovers and less so on the red and crimson clovers.

Mosaic. This disease is occasionally seen on single plants, or a few adjacent ones, and evidently is carried by lice and becomes perennial. *See* Cucumber.

Columbine

Gray mold, *Botrytis streptothrix.* Recently Dr. McCormick obtained a Botrytis from the rotting tissues of a cultivated species of Aquilegia. So far as we have found, no species of this genus has been reported on this host. Artificial cultures gave a scanty mycelial and spore growth of the Botrytis and numerous, small, black sclerotia very similar to those obtained from the Tulip, *q. v.,* rather than to the more luxuriant mycelial growth we have obtained from the Peony, a more nearly related host, though it differed from both in the nodulose conidiophores.

Powdery mildew, *Erysiphe Polygoni.* The only other diseases found on species of Columbine is the powdery mildew, seen only in its conidial stage, and an undetermined leaf spot. For powdery mildew, *see* Clover.

Corn

Anthracnose, *Colletotrichum graminicolum.* One of the minor leaf diseases of *Zea Mays* is this one, since it causes small damage and is infrequent in occurrence. It starts as small, brownish, oval spots that may run together into elongated areas lengthwise of the leaf bearing the embedded fruiting pustules with exposed, black spines. It has been found here so far on sweet corn and on sorghum. On the latter the disease causes a reddish color. Control measures are unnecessary.

Bacterial leaf spot, *Bacterium Holci.* As early as in 1916 at a seed farm in Orange we found a bacterial leaf spot disease on sweet corn, and in 1921 in Hamden, and again in 1928 at a different farm there, and also in Hazardville. Although not determined until recently, all four specimens seem to agree best with the description and specimens of the above disease on corn which has also been reported elsewhere on several other hosts. In no case did we find it a very common or serious injury and as most of the injured leaves were on the lower part of the plant and the chief injury was on their outer halves that could reach down to the ground, we believed that the trouble came originally from germs in the soil.

The injury showed usually as small, elliptical to more elongated spots. At first when matured, these were a reddish-brown, especially when water soaked, but when dry they were either reddish-brown or at length a lighter brown in the center with the margins darker. When the spots were abundant, they often killed the intervening tissues which also turned a light brown and so more or less obscured the spots in the dried specimens.

Bacterial sheath blight, *Bacterium Andropogoni.* This disease shows especially on the inner, enveloping sheaths of the leaves as a reddish to purplish-brown discoloration, usually involving most of the inner tissues in a wet to dry rot according to the moisture present. I think that Burrill included it under his *Bacillus Zeae* which he also associated with other injuries of corn in various stages of its growth. At least the writer, then associated with him, collected such specimens in Illinois and so named them. We have frequently seen this same sheath injury here in Connecticut but have made no special bacterial study of the same. For further statement *see* Sorghum.

Bacterial (Stewart's) wilt, *Aplanobacter Stewarti.* In 1932 and 1933 this disease proved unusually serious in this state. *See* Addenda for detailed statement.

Ear rots, etc., *Diplodia Zeae, Fusarium moniliforme, Basisporium gallarum, Cladosporium Zeae.* In late, wet or short growing seasons, growers sometimes have trouble with ear rots both in the field and storage. However, they do not have nearly as much as those who grow corn in the states farther west. The first two of the fungi mentioned here, possibly also the Fusarium stage of the root rot, are the chief causes of ear rot. The Diplodia can be told by its pure-white mycelium, when protected, and the small, black, fruiting bodies of its imperfect stage, so far the only known stage. The Fusarium species are also told by the white, external mycelium, with finally a pinkish coloring especially upon spore formation.

Concerning the third fungus mentioned, we have rarely found it and then on the mature or nearly mature ears of sweet corn where its white mycelium has invaded the cob and the base of the kernels in the chaff, blackening the same by the production of its dark spores produced externally. It seems to be a semi-parasite that invades the injured or improperly matured tissues, especially in seasons poor for their natural maturity.

The so-called *Cladosporium Zeae* is a saprophyte that is occasionally found (Rept. **1906**:314) on the cobs of storage corn, showing as a black growth on certain of the immature kernels.

The grower should start with good seed, practice rotation, properly cure his seed and he need fear little trouble, except in very unfavorable seasons, from these fungi.

Leaf blight, *Helminthosporium turcicum.* This trouble shows late in summer or early fall, following moist weather, as a rather sudden scorch of the leaves as if hit by an early frost. The fruiting threads, bearing the dark spores of the imperfect stage, show as a more or less evident, black growth on the injured tissues.

Late planting, preventing proper maturity, and poor fertilization are two contributing causes, so the poor growers are those who suffer the most. The trouble is so uncertain that other precautions are not profitable.

Root rot, *Gibberella Saubinetii.* It is generally believed that this fungus, especially in the Fusarium stage, is largely responsible for the common root rot of corn as it comes to semi-maturity in the field. The roots are rotted off and the base of the stalk is invaded. If the main or holding roots are gone, the stalk is often blown over. A reddish discoloration may even show at the internodes above when the stalk is split open. Sometimes the Fusarium stage can be found in the diseased roots or stalks and frequently it shows in the ear as one of the ear rots previously described. The mature or asco stage is also found here but, less evident, on mature parts of the stalk.

The character of the soil as to its chemical constituents and the growing of small grain crops subject to the disease on the same land are factors in its serious development in the west. Here in Connecticut these unfavorable factors are largely lacking, so we do not suffer as much from this trouble. Good seed and rotation help us still further.

Rust, *Puccinia Sorghi.* This rust shows as reddish, dusty outbreaks on the leaves in its II stage; later the III stage develops lead-colored pustules more firmly covered by the epidermis. The I stage occurs on Oxalis, woodsorrel, and has not been found in this state. The rust is fairly general here but sometimes becomes abundant in certain fields or on certain varieties, the reason for which is not evident. Remedial measures apparently have rarely been tried.

Smut, *Ustilago Zeae.* As this is our most common fungus and as it attacks all parts of the plant, especially the tassels and ears, we consider it as our most serious disease of corn, especially of sweet corn. The fruiting pustules, varying from small on the leaves to large in the ears, are at first covered by a white envelope but when mature show as black, dusty masses and are familiar to every one who has grown corn. This black mass is the chief spore stage but these spores on germination, especially in manure, give rise to temporary, secondary spores that, blown by the wind to any exposed young tissues of the corn, produce local infection there. (Fig. 30.)

Seed treatment is of no use as it is with some other grains. It has been claimed by some that if the immature smut balls are carefully gathered and destroyed several times a year, the succeeding crops, if sufficiently isolated and fresh manure avoided, will show less infection.

Albinism. This trouble sometimes appears in seedlings, especially when recently crossed. These fail to mature if all of the leaves are white. Occasionally one finds mature plants with some indication of the lack of chlorophyll in certain of the leaves.

Hail injury. This injury sometimes occurs. *See* Onion.

Poor seed. Here our growing season is so short that care has to be taken to grow for seed only varieties that will mature before frost. With wet, cold weather and early fall frosts, as elsewhere, even this precaution sometimes fails. Care, too, has to be given to the proper curing and storing of the seed after harvesting it. Seedmen and growers who save their seed are aware of these difficulties. Yet there occasionally come years when seed is generally poor over the country. Then it is especially true that the grower needs to test his seed for germination before planting in order that he may use only the best available.

Cornflower

Crown rot, *Sclerotium Delphinii.* We found this once in 1932 on the base of the cornflower, *Centaurea cyanus,* in a flower garden where this fungus was common and serious on a variety of herbaceous plants. *See* Larkspur.

Rust, *Puccinia Cyani.* This rust is occasionally found on this host, also called Bachelor's Button, producing numerous, circular, dusty, reddish-brown outbreaks occasionally on the stems but chiefly on the leaves especially on the lower sides. These pustules consist of the spores of the II and III stages, the latter being a little later in appearing and darker in color. Apparently it has no cluster cup stage.

As the host is practically an annual here, the rust need not become troublesome, since one can get seed from a different source and plant it in a new place another year.

Cosmos

Stem canker, *Phomopsis Stewartii.* This trouble shows as evident spots, at first purplish, on the lower nodes of the stems of *Cosmos bipinnatus* causing, when bad, serious decay. The fruiting stage in these spots shows as little, black, embedded bodies bearing the imperfect spores but its asco stage is unknown. Circular, brown spots on the leaves have also been seen by us that may have been caused by this same fungus.

The most satisfactory treatment probably consists in pulling up and destroying the infected plants and spraying the lower parts of the remaining ones to prevent further spread of the trouble.

Cotoneaster

Red canker, *Tubercularia vulgaris.* The only trouble we have seen on these shrubs, *Cotoneaster horizontalis,* has been in a nursery where this imperfect stage of *Nectria cinnabarina* showed as reddish tubercules on the dead bark. The trouble to this host resulted probably from winter injury in the first place rather than from this fungus which at best seems to be a weak parasite following other injuries.

Pruning off the injured branches and protection against winter and drought injuries are the remedial measures suggested.

Cowpea

Bacterial spot. *Bacterium Vignae.* None of the diseases listed on *Vigna sinensis* are so common or important here as to require preventive treatments as yet, so we merely give short descriptive characters to distinguish them. This spot has been found here once, at the Station's Mount Carmel farm, and is the same species that occurs commonly on the Lima bean, *q. v.*, and produces similar spots.

Leaf blight, *Cercospora Dolichi.* This leaf blight is caused by an imperfect fungus whose asco stage is as yet unknown. The fungus causes evident, reddish discolorations that usually assume a circular shape, become about a quarter of an inch in diameter and develop a grayish center. On this the fruiting stage may be seen as a scattered, often inconspicuous, grayish growth of fertile threads and spores.

Leaf spot, *Amerosporium oeconomicum.* This fungus produces spots very similar to the preceding but can be told by its imperfect stage, likewise unconnected as yet with an asco stage, showing as a few, black bodies embedded in these spots.

Powdery mildew, *Erysiphe Polygoni.* So far we have found the conidial stage only. *See* Clover.

Cucumber

Anthracnose, *Colletotrichum lagenarium.* This is occasionally serious, and is found chiefly on the leaves of *Cucumis sativus.* *See* Watermelon.

Bacterial angular spot, *Bacterium lachrymans.* We have found this bacterium on cucumber, muskmelon and squash but it causes serious damage only to the first host where, if present in wet years, the injury may be considerable. The germs cause small, angular spots on the leaves, rarely here on the cucumber fruit, which are reddish-brown and in wet weather show as thin, water-soaked areas, especially when the infections run together. Sometimes the bacteria ooze out on the surface in tear-like drops, hence the specific name.

As the germs can be carried by the seed, sterilization of the same if suspicious (soak seed 5 minutes in 3½ gallons of water containing ½ oz. corrosive sublimate) may be given and rotation practiced, especially when there has been trouble with a previous crop. If the disease appears, spraying with Bordeaux may prove helpful if done in time.

Bacterial soft rot, *Bacillus carotovorus.* This may appear in the fruit in wet weather, often following the preceding trouble, as a general rot. *See* Iris.

Bacterial wilt, *Bacillus tracheiphilus.* Wilt is not uncommon in favorable seasons, wilting and killing the vines. *See* Squash.

Damping-off, *Pythium debaryanum.* This is found occasionally in seedlings. *See* Spinach.

Downy mildew, *Peronoplasmopara cubensis.* In past seasons this was one of our worst diseases appearing on this host before it developed on muskmelons, *q. v.*

Powdery mildew, *Erysiphe cichoracearum.* Powdery mildew usually appears late in the season, in the conidial stage only, and does not cause much harm. *See* Phlox.

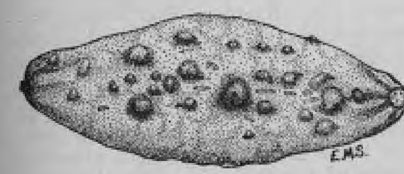


FIGURE 31. Cucumber white pickle.

FIGURE 32. Currant anthracnose.

FIGURE 33. Gooseberry mildew.

Scab, *Cladosporium cucumerinum.* This occurs here on cucumber and muskmelon on the leaves and stem but chiefly on the fruit where the damage is most serious. It shows in the latter as small, sunken areas which under moist conditions are covered with a copious growth of the olive, fruiting threads of the immature stage, so far the only known stage. Sprayed vines do not usually suffer.

Nematode rootknot, *Heterodera radicicola* (*H. Marioni*). We have seen this trouble worse on greenhouse cucumbers than on any of the numerous hosts. Those included here are: aster, begonia, carrot, cyclamen, cucumber, gardenia, ginseng, parsnip, primrose, rose, snapdragon, tobacco, tomato. Others are probably just as susceptible if grown under favorable conditions for infection. The disease is caused by small worms, called eel-worms or nematodes, which infect the young internal tissues of the roots gathering their food from them and reproducing their young from eggs deposited there. These invasions cause the roots to develop fusiform swellings which frequently become large and numerous but in the end quickly decay. Finally the plants suffer from lack of sufficient food and moisture for growth of the parts above the ground.

This species of nematode cannot usually live over winter out of doors, so field crops are not usually bothered here as they are in the south where the land sometimes becomes badly infected. In greenhouses and protected seed beds, however, the soil often becomes so badly infected that it is desirable to prevent further trouble in succeeding crops. In such cases careful removal of the infested soil or subjecting it to complete winter conditions or to its sterilization in place with high pressure steam is the remedial treatment.

Mosaic. This trouble is similar to or the same as the tobacco mosaic. The cause of the yellow-green mottling of the normally green leaves has not been determined but it is a so-called virus disease which is infectious. The *white pickle* (Fig. 31.) of the fruit, due to a similar mottling but one which produces irregularities in growth, is to our mind merely another manifestation of the same trouble. Other cucurbitous crops such as squash, pumpkins and muskmelons are similarly infected. Some believe that the trouble can be carried at times in the seed. At one time it was the most serious trouble of cucumbers but it has not been so bad recently. Lice are the common carriers of the disease from the infected to the healthy plants in most cases.

Care in selection of good seed, rotation, destruction of the mosaic weeds around the fields including their lice, all are necessary to success in seasons that favor mosaic production. *See* Tobacco.

Currant

Anthracnose, *Gloeosporium Ribis.* While both currants and gooseberries are subject to this trouble, the common red and white currants, *Ribes vulgare,* suffer most, especially in the years when it is abundant. The leaves are the chief point of attack and show purplish to reddish-brown spots, usually small in size and numerous, with a pinkish globule of spores oozing out on the under surface when fruiting. When infection is abundant defoliation is severe. The asco stage, as yet not found by us, develops on the old and dead leaves in the spring and is known as *Pseudopeziza Ribis.* (Fig. 32.)

Early spraying with Bordeaux, preferably begun before the leaves start to develop and repeated as needed, is necessary for control in the seasons favorable for the disease.

Bitter rot, *Gloeosporium rufomaculans.* This rot has rarely been seen on the fruit. *See* Apple.

Cane blight, *Botryosphaeria Ribis.* The cane-blight fungus has been reported by others as causing trouble here. The canes are killed and the fruiting stage of the Ascomycete causing it shows as small, black, rough cushions on the dead stem. While we have had no complaints, it is said to cause serious trouble elsewhere in currant plantations. It is well, therefore, to destroy by burning any infected canes, or whole bushes if bad, to hinder further spread.

At the same time we have seen similar trouble, due to winter injury, on the weakened and dead branches on which appears another fungus which might tend to confuse these two troubles. In this latter case the fungus (*Nectria cinnabarina,* sometimes called *N. Ribis*) appears as smooth, yellowish tubercules in its conidial stage (with age blackish) and as reddish, roughened ones in its asco stage and develops as a weak parasite or saprophyte following the injury.

Leaf spot, *Septoria Ribis.* This is usually not abundant enough to cause conspicuous damage. *See* Gooseberry.

Powdery mildew, *Sphaerotheca Mors-uvae.* This mildew is infrequent but capable of injury. *See* Gooseberry.

Rust, blister, *Cronartium ribicola.* This rust has its conspicuous, cluster-cup stage on the stems of white pine where it is so destructive. Spores from these are carried long distances to currants and gooseberries and produce infections there in late spring and early summer. These develop small, yellow spots on the leaves on the under side of which appear the II stage as minute, clustered pustules that ooze out the yellowish, dusty spores that spread the disease through the summer. In late summer or early fall in these same spots appear short, reddish, hair-like growths of the III stage. These are composed of united spores that germinate in position immediately in moist weather and develop numerous, smaller spores that blown by the wind carry the disease for short distances and infect the pine needles. *See* Bull. 214.

Of all the hosts, the black currant seems the most susceptible and so its cultivation here is prevented by law. The ordinary red and white currant at times are abundantly attacked, as well as the yellow currant, *R. odoratum,* while cultivated gooseberries seem to be much less injured than some of the wild species. The currants can be sprayed with Bordeaux to lessen this trouble but in most regions of the state this is not necessary. *See* White Pine.

Rust (Cluster cup), *Aecidium Grossulariae.* In this case the I stage of this entirely different rust appears on currants and gooseberries, while the II and III stages, as *Puccinia Grossulariae,* infest wild species of the sedges of the genus Carex. The I stage is evident as more or less numerous, small, white, toothed cups, containing the orange spores, situated generally on the under side of the leaves. Rarely any very evident damage results to the invaded host and so no preventive treatment is necessary.

Chlorosis. This trouble occasionally shows on individual leaves or those of a branch as a yellow-white mottling in the normal green color. Rarely this may be due to insects but usually it seems to be caused by some unfavorable but obscure weather or soil conditions.

Winter injury. Such injury occasionally occurs in severe winters or exposed places; *see* trouble mentioned here under Cane Blight.

Cyclamen

Gray mold, *Botrytis cinerea.* It has been found occasionally on plants kept too wet. *See* Geranium.

Nematode rootknot, *Heterodera radicicola. See* Cucumber.

Leaf spotting. While certain varieties normally develop a purplish color on the under side of the leaves, we have had complaints of a green variety where certain plants become abnormally so spotted beneath. This abnormal appearance hindered their sale and apparently also affected somewhat their general vigor. The cause could not be exactly determined in this case though variable conditions in heat and moisture during their growth may have been responsible. The grower did not think it came from fumigation or spraying with tobacco since all plants were equally exposed.

Daffodil

Bulb injury. Recently we received injured bulbs of Daffodil sent us by a seed house in Hartford which had received them from the Pacific coast. There was a question whether the bulbs had been injured by fumigation, improper storage or other conditions. Dr. McCormick found considerable of the fruiting stage of a Penicillium on the dried coats as the only fungus present but we had no proof that this fungus was primarily responsible for any injury. Some of the bulbs when planted later did fairly well and with no fungous injury, so any injury that occurred seemed to be due to the other unfavorable conditions rather than to a parasite.

Running-out. Aside from the preceding complaint, we often find that these and similar bulbous plants do poorly after establishing themselves in the ground a few years. In such cases, while the foliage may be good, the plants fail to bloom freely or not at all. Transplanting the divided bulbs, when necessary, in new soil with more room often proves helpful but sometimes it is desirable to secure new, vigorous bulbs grown in a different region.

In this connection it may be said that better fertilization, while it may affect the vegetative growth, will not, usually, increase the number of blossoms of that year though it may increase their vigor. This is because the blossom buds of certain bulbs are laid down in them the previous year and their number at that time is decided by the favorable or unfavorable condition for the vigor of these bulbs.

Dahlia

Powdery mildew, *Erysiphe cichoracearum.* The mildew is usually not very abundant and is seen chiefly in its conidial stage, but in late October the asco stage has been found here rarely. *See* Phlox.

Mosaic. Only occasionally is the trouble seen on this host. *See* Cucumber and Tobacco.

Yellows. We have sometimes seen what we considered yellows of the virus type but have never proven its infectious nature. *See* Aster.

Drought injury. In very dry years after very hot weather, the leaves of this plant frequently turn yellow at the margins and sometimes die inward for a shorter or longer distance. This injury might be mistaken for the true "yellows" which is a more serious, infectious disease. However, with this drought injury there is no danger of recurring injuries from planting the bulbs from the injured plants.

Dandelion

Leaf spot, *Ramularia Taraxaci.* The three diseases mentioned here on fields of *Taraxacum officinale* cultivated for greens are all found on the same host as a weed in nature. Apparently in the cultivated fields, they do not bother greatly since the fields are usually renewed before they become too conspicuous. The leaf spot trouble shows as round, moderate-size, brownish spots with concentric rings of development and purplish borders, having a more or less evident whitish growth of spore-bearing threads on the under surface. No asco stage is yet known.

Powdery mildew, *Sphaerotheca Castagnei.* This powdery mildew is more or less conspicuous on the leaves in its mycelial and the powdery conidial spore stage. Later the reddish to dark-colored, small perithecia (mature fruiting bodies of the asco stage) are more or less abundantly embedded in the external mycelium. While the mildew has a variety of other hosts, chiefly Compositae, this is the main one reported here. Powdery mildews show their specific characters largely through the microscopic examination of their perithecia. *See* Speedwell.

Rust, *Puccinia Hieracii.* The II and III stages of this rust appear here on the dandelion and endive, and certain related wild species, as the usual, roundish, lighter and darker, reddish-brown, powdery pustules chiefly over the leaves. It is said to possess no I stage.

Dewberry

Leaf spot, *Septoria Rubi.* We have found the trouble on this and related hosts of raspberry and blackberry, both cultivated and wild, in varying degrees of prominence. Generally at least a moderate number of spots can be found on the leaves and less commonly on the young stems. The spots are whitish or light-colored with a decided purplish border and in the center the embedded, black, fruiting bodies of the imperfect spore stage are more or less evident. The mature asco-stage appears on the old dead leaves and is known as *Mycosphaerella Rubi* but as yet we have not found it here.

It rarely pays to spray to prevent this trouble but if desired use Bordeaux, with potassium oleate as a sticker, and start in the early season.

Rust, orange, *Caeoma nitens.* This is occasional on the cultivated and common on the wild plants and on practically all the rust is the short-cycled form. *See* Blackberry.

Dill

Black spot, *Phoma Anethi.* This is the only fungus that we have observed on this host and we are not sure that it was more a parasite than a saprophyte. *See* Addenda for further details.

Dogwood

Leaf spot, *Septoria cornicola.* While a number of diseases have been reported elsewhere on different species of Cornus, chiefly of the leaf spot type, so far this is the only one we have determined on cultivated species here. It has been found on two species, *C. paniculata* and *C. sanguinea,* producing more or less abundant spots, light to dark brown at the center and with evident, purplish borders. The embedded fruiting stage in the center is usually not very evident.

The asco stage has apparently never been reported; however, if the disease is prominent, it might pay in late fall to rake up and burn the fallen leaves.

Dutchman's Pipe

Gray mold, *Botrytis cinerea.* We have found this fungus occasionally in wet weather on the leaves of *Aristolochia sipho.* *See* Geranium.

Eggplant

Early blight, *Alternaria Solani.* This blight is seen occasionally on the leaves of *Solanum melongena* but does little damage. *See* Potato.

Fruit rot, *Phomopsis vexans.* When started in a field during wet weather, this proves a most destructive disease. We reported it years ago as *Phyllosticta hortorum.* It forms occasional, light colored spots on the leaves with an embedded, black fruiting stage but is chiefly injurious and prominent on the fruit usually as it ripens. Here the fungus rots it into a light-brown, gradually increasing zonated area in which finally appear the small, black, imperfect fruiting bodies that when abundant give it a blacker color. No asco stage has been reported.

Practice frequent rotation; keep refuse out of manure pile; use only best seed but if suspicious treat with corrosive sublimate 1 to 1000 for five minutes. Here spraying seems hardly advisable though Bordeaux has elsewhere given good results when used weekly for five treatments.

Gray mold, *Botrytis cinerea.* It is sometimes responsible for rotting the ripe fruit when an evident, grayish growth develops. *See* Geranium.

Seedling rot, *Rhizoctonia Solani.* It is found occasionally in seedlings. *See* Spinach.

Wilt, *Verticillium alboatrum?* We have seen a wilt very troublesome in certain fields but we have never isolated the fungus to be sure that it was this species or a similar Fusarium. In other nearby states, however, this seems to have been done and, as we have found this fungus on potato, it seems to be the reasonable one. There is little on the outside of the infected plants to show the cause of the injury but when the stem is cut open one can see a darkening of the fibro-vascular bundles and usually under the microscope get evidence of mycelial growth and internal production of spores. The first sign of the trouble shows as a somewhat stunting of the maturing plants, wilting and yellowing of the leaves and the gradual death by defoliation of the same from below upwards. The infected plants may be adjacent or scattered over the field and, if bad, little or no crop is harvested. As there seems to be no evident external means of spreading the disease by spores, it always has seemed to us that it did not spread from plant to plant but became general all over the field at the same time. Evidently infection is through the fungus in the soil of the field or it is brought in by infected plants from the seed bed. So far as we know the seed is not the source of infection.

The seed bed should receive the first attention to be certain that it is not the source. Next, frequent rotation should be practiced, avoiding land recently in potatoes and care should be given in the use of manure that might carry or increase the trouble.

Mosaic. This disease is usually not so evident as on other plants and is apparently not serious here. *See* Tobacco.

Scald. We have seen this occasionally on the fruit following very hot weather. *See* Apple.

Elm

Anthracnose, *Gloeosporium ulmicolum.* This new leaf disease is scarcely to be distinguished from the older one described as Black spot, *q.v.* However, only the imperfect stage is known and it is distinguished from the imperfect spores of the other by their larger size. It has been found here during the last few years on *Ulmus americana* and certain of the introduced species and varieties, such as the Chinese or Siberian elm. Early in June, 1933, we received specimens of the Siberian elm where the fungus was fruiting prominently on that year's twigs and advancing into the leaves at their bases through the midribs. Later we received the same fungus on the twigs of the American elm. Evidently the fungus must carry over the winter in the small twigs and thus secure early infection in this way.

Beetle fungus, *Sporotrichum globuliferum.* This fungus, in wet seasons and when elm beetles are abundant, is responsible for causing their death in considerable numbers, thus helping to keep them in check the next season. It can be distinguished by the evident, white growth that covers the dead insects found in the cracks of the bark.

Black spot, *Gnomonia ulmea.* The black spot has been common on the leaves of the American elm for years and has recently been noticed on some of the foreign species. It causes little, black, clustered pimples, evident on the upper surface of the leaves but less evident and often concave beneath. In these are produced the minute spores that spread the disease during the early season. The trouble is always present in a small way each season but if abundant it causes the leaves to turn yellow and drop prematurely; sometimes the trees are practically defoliated in mid-summer. The infected leaves begin to develop the asco stage while still living, but it never matures until the following spring.

When bad, the old leaves should be gathered and burned in the late fall. If the trees are small or their foliage is highly valued, it may pay to spray them with Bordeaux the next spring, beginning with the developing leaves. Under ordinary conditions and with the variability of its appearance, most people are not likely to give large trees the two or three sprayings necessary.

Canker, *Nectria cinnabarina,* etc. This saprophyte or weak parasite has recently been found on the Mongolian elm, *Ulmus pumila,* in several nurseries of the state in both its asco and conidial stages (*Tubercularia vulgaris*). Where seen by us it appears to be merely a saprophyte on the lower, suppressed and dead branches without injury to the main stem. However, some nurserymen claim it causes death of the living trees, which might really be due to drought or winter injury rather than to the fungus. In some cases, also, the dead tissues show the fruiting stage of *Sphaeropsis malorum,* another saprophyte or weak parasite. *See* Horsechestnut.

Dutch elm disease, *Graphium Ulmi.* One tree badly injured with this disease was found in Connecticut in the fall of 1933. It was destroyed in January, 1934. Whether others will be found in 1934 remains to be seen, but the finding of a second tree in February indicates they will be. *See* Addenda for further statement.

Heart and sapwood rots, *Pleurotus ulmarius,* etc. Wood rots are not very evident in this tree but the above in the sapwood and undoubtedly other fungi, such as *Fomes applanatus* in the heartwood, are responsible for the same.

The Fomes species we find in fruit apparently only after the trees have been cut into logs. This is described under Maple.

The Pleurotus is a large, toadstool-like type with a buff-colored top, often cracked at center and with white gills beneath usually notched to the conspicuous, central but often recurved stem. Often it occurs singly.

Another fungus, *Polystictus conchifer* is a small, papery body, often conch-shaped or cupped, with a grayish upper-surface usually coated with dark lines and a white, porous under-surface. While it is probably not responsible for the death of the twigs and branches, it does cause decay in them afterward so that in storms they are usually broken off and become a menace to people travelling beneath the trees.

Leaf spot, *Septogloeum Ulmi.* This fungus was found once on seedlings of Ulmus sp. in Hamden. It produces minute, yellowish to finally reddish brown spots in the leaves on the under surface of which oozes out a conspicuous, yellow globule containing the spores. Some claim it is the imperfect stage of *Dothidella Ulmi.*

Twig wilt, *Cephalosporium* sp. While we have found only two specimens of the Dutch elm disease, *Graphium Ulmi,* which has proved so destructive in Europe, there have been called to the attention of the Station several large American elms in the state that developed a wilt of the smaller twigs and branches somewhat approximate to it in appearance but not in severity. The above name of the fungus causing it has recently been applied to it by another worker.

The trees show a curling, wilting, yellowing and final death of the leaves followed often by the slower death of the twigs and smaller branches. No external sign of a fungus is seen but, on cutting across the smaller branches, one often can find blackish spots in the newer wood. Sections of these, under the microscope, reveal the presence of the mycelium of a fungus, and cultures of it have been obtained. Inoculations on elm seedlings with these cultures made by Dr. McCormick, who is carrying on this investigation, have not as yet revealed this fungus as a very vigorous parasite.

Aerial roots. We have seen large elms, also willows, when the bark had been injured from various causes, that started small, root-like growths from the cambium and in a few cases, running down beneath the dead but finally decorticated bark for a considerable distance, reached the ground, taking hold there as true roots.

We have also seen somewhat similar growths on forest trees that were apparently injured by lightning.

Bleeding and Slimy flux. When elm trees, also some other trees as maples, etc., are injured in various ways in the bark or by cutting off branches, they often start bleeding at these places, especially in the spring in wet weather. It is frequently very difficult to stop this water or crude sap. If it continues the surrounding bark rots as a result. If sufficiently rich in elaborated food material, this sap sometimes develops a mixture of fungi, bacteria and yeasts that thicken the same into the so-called slimy flux. Once a tree starts this bleeding trouble, especially in wet weather, one cannot be sure when it will stop.

So far the chief remedy, if the trouble occurs on the main trunk, is to cut away the injured bark back to the healthy to start a new cambium growth and to insert, a short distance below the injured place, a small pipe to help stop the bleeding and carry away the drip from the bark directly to the ground.

Mechanical injuries. One need not elaborate on the various types of these injuries due to transplanting, removing of needed dirt or filling in to greater depths, unnecessary pruning of limbs and roots, paving of streets, etc. These troubles apply to all street trees to a greater or less extent. One of the most frequent and conspicuous injuries in the past has been due to horses gnawing the bark, but now this can largely be charged to man and his automobile. Many of these bark injuries, through neglect or by repetition, now show large, deep, concentric cankers where the original injury has increased yearly by the dying back of the bark at the edges of the injury.

Endive

Rot, *Rhizoctonia Solani.* We have found the fungus rotting the seedlings and roots of this plant. *See* Spinach.

Rust, *Puccinia Hieracii.* This rust has been seen only rarely on *Cichorium endivia.* *See* Dandelion.

Euonymus

Crown gall, *Bacterium tumefaciens.* This is occasionally reported in nurseries. Apparently *Euonymus radicans* is a very susceptible species. In 1932 we saw specimens in a nursery labeled variety *variegata* that showed a great number of these galls of considerable size growing on the running stems but the injury did not seem as great as one would expect. However, these gall-like growths die much more readily and earlier than the normal tissues. *See* Rose.

Eupatorium

Crown rot, *Sclerotium Delphinii.* The mist flower, *Eupatorium coelestinum,* is another herbaceous plant that recently has been sent to the Station for information because of injury by this sclerotial fungus. *See* Larkspur.

False Dragon Head

Crown rot, *Sclerotium Delphinii.* This fungus, with its evident but small, reddish-brown sclerotia, has recently been found rotting off the base of plants of this western plant, *Physostegia virginiana,* now coming into cultivation in some of our flower gardens. *See* Larkspur.

Ferns

Nematode leaf blight, *Aphelenchus olesistus.* This trouble has been found occasionally on a variety of ferns in greenhouses causing more or less damage. *See* Begonia.

Leaf scorch. The death of the leaves, or parts of the same, shown by the red discoloration in contrast to the normal green color, has occasionally been seen in greenhouses on the delicate ferns of the Maidenhair type. The injury is similar to that caused by the preceding disease but without any evidence of nematodes. It is evidently due to lack of proper shading or watering at certain times during hot or dry weather.

Fir

Gray mold, *Botrytis cinerea.* We have occasionally seen this trouble on the very young leaves and twigs of large trees of Douglas Fir, *Pseudotsuga Douglasii,* that have been killed in the wet weather of spring. It does not seem to be progressive after the leaves mature. We see no reason for considering it as a species distinct from the common gray mold found on a variety of cultivated plants under similar conditions, though some call it *B. Douglassii.* *See* Geranium.

Firethorn (Scarlet)

Scab, *Fusicladium pyrinum* var. *Pyracanthae.* This fungus was sent to Dr. Marshall by Dr. Felt of the Bartlett Tree Expert Co., and turned over to the writer for determination. It is the first time the fungus has been listed from the state and apparently for the United States on this host, *Pyracantha coccinea* (*Crataegus Pyracantha*). This fungus was evidently objected to by the grower because it spoils the scarlet color of the berries in the fall. It has been listed previously at least in France and Germany under the same name, and our specimen agrees with exsiccati specimens from those countries. A Fusicladium also is listed by Saccardo under *F. dendriticum* (the apple scab) as var. *orbiculatum* on this host as well as on two other hosts. Cladosporium and Venturia, however, have been reported in the United States as occurring on species of Crataegus. The fungus is unquestionably related to the pear, apple and peach scabs but needs special study to determine its exact relationship. It forms evident, circular, olive-black spots on the fruit but is apparently not so abundant or conspicuous on the leaves, at least in our specimens.

While it would seem that late summer and fall sprays would control the trouble, it might be necessary to also make these in the spring as for apple scab.

Flax

Crown rot, *Sclerotium Delphinii.* Complaint was made of this trouble rotting off the plants of an ornamental flax in a nursery in the late spring of 1933. While we did not collect the fungus on this plant, on account of the dry condition when we visited the nursery, we did find it there on monkshood.

Rust, *Melampsora Lini.* This rust was found sparingly in its II stage on experimental plants of *Linum usitatissimum* in October, 1924, at the Station farm. It has been found causing more or less damage of this cultivated flax in North Dakota.

Flowering Crab

Rust, *Roestelia pyrata.* On flowering crab, especially that known as Bechtel's, *Pyrus ioensis,* this rust becomes very abundant even when a considerable distance from the infected cedars. *See* Apple.

Flowering Currant

Bitter rot, *Gloeosporium rufomaculans.* This has been seen once on the fruit of the yellow, flowering currant. *See* Apple for details.

Blister rust, *Cronartium ribicola.* It is not uncommon in its II and III stages on the yellow currant, known as *Ribes odoratum.* *See* Currant.

Foxglove

Anthracnose, *Colletotrichum* sp. We have a single collection of this fungous disease made in July, 1916, on *Digitalis purpurea* at Norfolk. The very small, circular spots are brownish with an evident, reddish border and are most apparent on the upper side of the leaves. We have found no description of this disease attached to a specific name although a Colletotrichum has been reported by the U. S. Disease Survey from Massachusetts. Species of Ramularia and Gloeosporium on this host have been reported from Europe with somewhat similar spores but the spots they cause and the lack of setae, very evident on our specimens, seem to indicate their difference.

Stem-Leaf nematode, *Tylenchus Dipsaci.* Here we have a trouble, collected in 1916 by the writer on the variety of foxglove known as *alba* as a possible fungous disease, that recent examination shows, as determined by Dr. Steiner, to be due to the nematode given above. The spots in this case are reddish-brown, small (2-3mm), angular and abundant on the leaves, fusing more or less in the region of the midrib. According to Steiner foxglove is a new host for this species. He also states that specimens of this nematode have been revived up to four years after drying out. While our specimens seemed to be in fair shape and swelled out and uncoiled after infected pieces of the leaves were kept in water for a few days, we did not succeed in reviving any of them. *See* Phlox.

Fuchsia

Mosaic. Besides an undetermined leaf spot, this is the only disease we have seen on this plant which apparently has few fungous enemies elsewhere. Even the mosaic, similar to the ordinary yellow-green and normal green mottling of other infected plants, has rarely been seen here. *See* Cucumber for this trouble.

Gardenia

Nematode rootknot, *Heterodera radicicola.* In 1915 this trouble was reported on *Gardenia florida* from a greenhouse in Ridgefield. *See* Cucumber.

Undetermined trouble. Recently there was brought to our laboratory injured specimens of Gardenia from a greenhouse in Massachusetts but the person who brought them said a similar trouble had been seen in Connecticut. The stems were cut off above the ground and showed some injury but whether this occurred on the roots we could not tell. The most evident injury was to the leaves which turned brown and then finally black, usually starting at their base while the upper part was still green. We could find no sign of bacteria or fungi in the plant tissues but the fibrovascular bundles seemed to be the parts first affected as shown by their discoloration. It looked to us, so far as we could tell from the specimens, like a soil trouble of some kind. The man who brought in the specimens later wrote concerning the firm that had a similar trouble in Connecticut, as follows:

"This firm had occasional, isolated plants that showed this condition. It did not, however, spread in their case and when they discovered a plant in this condition they pulled it up. I learned from them that at one time this trouble was more or less prevalent with certain greenhouses on Long Island and it was, apparently, traced to the use of German peat moss which was spread on the surface of the bed. When the moss came in contact with the stem of the plant and became watersoaked through frequent watering, it seemed to kill the stem at that point."

Geranium

Bacterial leaf spot, *Bacterium Erodii.* Considering its frequent cultivation and the great variety of forms, there are comparatively few troubles reported here or elsewhere on the various species of Pelargonium. This bacterial disease of the leaves is one of two reported so similar that we are doubtful to which it belongs, providing they are really distinct. We are using the name which was given the first one. The trouble shows chiefly on the leaves as small but numerous, round or angular, reddish spots, pellucid and thin when wet but in time puckered and blackish. It often causes the leaves to turn yellow and drop off. It has been seen in different years in outdoor beds at various places, sometimes spoiling their entire appearance. Usually it has looked as if the trouble came from infected stock grown in the greenhouse before transplanting into the beds.

Growers should be careful to propagate only from entirely healthy plants and the purchaser should plant in a new situation if he has had trouble recently. If one sees the trouble at its very start, it might pay to pull off and destroy the few infected leaves and give the plants one or two sprayings with Bordeaux.

Gray mold, *Botrytis cinerea.* Besides on this host, the gray mold (also sometimes called scientifically *B. vulgaris*) is listed on about twenty-five other hosts given here and under the right conditions it might be found on many others. These conditions are abundant moisture and heat in the presence of tender foliage and stems or matured fleshy parts.

While not a serious parasite under most conditions, the above conditions and its tendency to fruit as a saprophyte on decaying vegetation make its appearance readily available for injury to the tissues of many plants. There may be some difference of opinion as to its being just one species on all of these hosts, since it is somewhat variable in artificial cultures and other species have been recognized by some on certain hosts.

The fungus has the habit of producing scattered or abundant, dark, fruiting threads, with a cluster of lighter colored spores at the top, over the surface of the infected host. Occasionally on the host and especially in artificial cultures of certain strains, one finds developed small, flattened, black sclerotia that are adapted for carrying the fungus over unfavorable conditions.

In the past certain European botanists, as deBary, believed that this fungus was connected with the Ascomycete known as *Sclerotinia Fuckeliana* and then later botanists, failing to get this fungus from the sclerotia but only the Botrytis, decided that it was not. Brooks, in his Plant Diseases, who has given us one of the best discussions of these two genera, seems to indicate that some of the strains, under certain conditions, may show this relationship.

Control measures are largely sanitary, such as: preventing in leaky greenhouses drops of water falling on the plants; removal of plant rubbish to prevent propagation of spores; avoidance of excess moisture in watering the plants, especially in damp cloudy weather; proper ventilation.

Oedema. We have seen pimply swellings on the leaves of geraniums that we thought might be due to a lack of proper water transpiration and so a trouble of this sort, but possibly they were caused by something else. *See* Oedema under Glorybush.

Ginseng

Blight, *Alternaria Panacis.* While we have never collected this fungus, one of the growers stated some years ago that he had been troubled with it in his seed beds where he grew *Panax quinquefolium.* So little ginseng is grown in the state, and apparently still less than formerly, that we know little of the numerous troubles that have been reported elsewhere where it is grown more commonly.

Downy mildew rot, *Phytophthora cactorum.* We saw this once on the roots of cultivated ginseng in the northern part of the state many years ago. *See* Pear.

Nematode rootknot, *Heterodera radicicola.* This nematode trouble was reported in 1916 as causing considerable trouble in the seed beds of a grower of ginseng at Hamden.

Gladiolus

Bacterial spot (Stem rot), *Bacterium marginatum.* This gladiolus trouble was first collected by us in a private garden in Fairfield in 1925 where it was rather bad. It was not seen again until 1932 which seemed to have been a very favorable year for its development as well as of injury caused by thrips. The corms grown in 1932 also showed the trouble when planted in 1933. The bacteria produces small, reddish-brown, subcircular spots, or more elongated as limited by the veins, on various parts of the leaf and stem but especially numerous below. On the sheathing bases these spots may run together as a general, reddish discoloration and cause a rotting of the softer tissues in wet weather. The disease is carried on the corms by isolated, reddish-brown, circular spots of variable size that finally become sunken in the dried, healthy tissues and are very similar to the hard rot fungus except there is no sign of any fruiting stage.

Treatment of the bulbs with mercuric compounds or formalin is said to have given some beneficial results in preventing the trouble. Badly diseased corms should never be planted. Rotation should be practiced especially where the disease has proved troublesome.

Dry (Sclerotial) rot, *Penicillium Gladioli.* This is a storage rot of the corms. *See* Addenda for further data.

Hard rot, *Septoria Gladioli.* The hard rot fungus is also carried by the corms and its presence is indicated by the reddish rather than blackish, hard rot-spots. On these the embedded, small, black, fruiting pustules are not usually very conspicuous.

Plants from the infected corms under favorable conditions often produce dwarf, yellowish plants with poor foliage and blossoms. On the discolored spots of the leaves, the pustules of this imperfect fungus also may appear in its only known stage. Premature death, before or at blossoming time, may occur to plants most seriously injured.

One should purchase or save only good, sound corms and, if the disease has appeared in the field, plant in a new locality. Treating the corms does not seem to have yielded very encouraging results.

Stem rot, *Fusarium* sp. We have had one case of stems of this plant rotting at the base, evidently caused by a Fusarium. *See* Aster.

Glorybush

Oedema. This, sometimes called intumescence, is usually an excrescense on the leaves or stems induced by too great turgor in the tissues. The development of enlarged and rapidly growing cells often ends in their rupture and then the excrescences may act something like stomates or lenticels. The turgor is induced by too rapid absorption of water, with their fertilizing elements from the soil, without proper loss from the leaves. This occurs especially in cloudy or muggy weather or when trimming of the foliage is made at an unfavorable time especially with strong root pressure. We have seen this trouble only once on the leaves of this host, *Tibouchina semidecandra* var. *floribunda* (*Pleroma splendens,* see Bull. 222: 460). It appeared as evident, ruptured, whitish pustules on the upper side of the new leaves of a house plant that was severely cut back. Somewhat similar ruptures have been reported on the stems of yews similarly treated. Growth cracks are perhaps somewhat similar phenomena especially in the case listed here under snapdragon.

We know, as yet, too little about such troubles and especially the environmental conditions that favor them because the injury is often not evident until the causes have disappeared. Somewhat similar troubles are mentioned here under cabbage, geranium, honeysuckle and yew.

Goldenglow

Drop rot, *Sclerotinia sclerotiorum.* This is seen rarely on the cultivated form of *Rudbeckia laciniata* but when present causes serious injury to the infected stalks. *See* Lettuce.

Powdery mildew, *Erysiphe cichoracearum.* Powdery mildew is found occasionally in its conidial stage on the leaves. *See* Phlox.

Goldenseal

Gray mold, *Botrytis streptothrix?* Over a dozen years ago we had complaint of a fungous trouble in a seed bed where the grower was raising *Hydrastis canadensis.* The leaves and base of the stem were injured by a severe rot of the soft tissues. Our remembrance is that the Botrytis fungus causing the injury made very little, evident, external growth of the fruiting stage except possibly when the leaves were kept moist. The sporophores were peculiar because their terminal branches were wavy or nodose in character. On the rotting or watersoaked tissues of the leaves one could sometimes find the small, black sclerotia that also readily appeared in artificial cultures. This trouble seems to be fairly common where these plants are cultivated. We use the scientific name questionably since Whetzel writes to us that he thinks the fungus on this host deserves specific distinction.

Care in keeping the plants rather dry, removal of the rotting rubbish and spraying in time with Bordeaux should lessen this trouble.

Mosaic. At the same time and place, Mt. Carmel, a few of the plants in the beds mentioned above showed light and dark green mottling of the leaves typical of mosaic. While no inoculation experiments were conducted, it seemed to be of the infectious type.

Gooseberry

Anthracnose, *Gloeosporium Ribis.* Anthracnose on cultivated gooseberries, Ribes sps., is not common or serious. *See* Currant.

Leaf spot, *Septaria Ribis.* The leaf spots on cultivated and wild red and black currants and gooseberries all probably are due to the same species, though on the latter it is sometimes called *S. Grossulariae.* On both types of hosts it forms on the leaves small, grayish to brown spots, with a purplish border, which vary somewhat in size. On these spots is formed, more or less abundantly, the imperfect stage which shows as small, black, embedded bodies.

Usually no spray treatment is necessary because of the small injury involved. Raking and burning the old leaves may pay since on these the asco stage, known as *Mycosphaerella Grossulariae,* is found in the early spring.

Powdery mildew, *Sphaerotheca Mors-uvae.* This mildew is not frequently found here though years ago it was evidently more common and caused serious loss especially on English varieties of gooseberries. It has been found a few times by the writer on gooseberries and once on both cultivated red currants and the wild skunk currant. Usually the mycelium forms a dirty-white felt, rather than a powdery growth, of the mycelium and summer spores and this is apt to cover the young stems and leaves but on the gooseberry it is sometimes largely limited to dense patches on the fruit. Embedded in this growth are the perithecia containing the winter spores of this Ascomycete (Fig. 33).

Spraying as for anthracnose of currants, *q. v.,* should take care of this trouble when necessary.

Scald. In very hot weather we have seen the fruit so badly injured that it looked as if baked and most of the berries fell off. *See* Apple.

Gourds

Anthracnose, *Colletotrichum lagenarium.* The anthracnose is seen only occasionally on the fruit of various gourds (Luffa, etc.) *See* Watermelon.

Downy mildew, *Peronoplasmopara cubensis.* It was seen once on bottle gourd, *Lagenaria leucantha.* *See* Muskmelon.

Powdery mildew, *Erysiphe cichoracearum.* The mildew occurs occasionally and is found so far only in its conidial form. *See* Phlox.

Grape

Bitter rot, *Gloeosporium rufomaculans.* It has rarely been found here on the fruit of Vitis sps. *See* Apple.

Black rot, *Phyllosticta Labruscae.* This trouble is so-called because on the fruit it produces a rot that results in the berries becoming shriveled into black mummies adhering more or less firmly on the bunches, which may be entirely or only partly infected. The fungus also invades the young, tender, woody tissues to a less degree. On the leaves the disease shows as distinct, reddish-brown spots in which the small, black, fruiting bodies of the imperfect stage are embedded showing even more evidently than on the fruit and twigs. The next year the infected tissues, at least in the mummied fruit, mature the saprophytic asco stage known as *Guignardia Bidwellii* and now commonly applied to both stages. We have never looked carefully for this mature stage but it is probably the chief cause of the new spring infections. The same imperfect fungus occurs here on the Boston ivy and Virginia creeper, where it is conspicuous chiefly on the leaves. (Fig. 34).

Bordeaux mixture has proved the best fungicide in the control of this fungus but should be started with the beginning of leaf development and be applied every seven to fourteen days up to the middle of July, when further sediment on the fruit may hinder its sale.

FIGURE 34. Grape black rot.

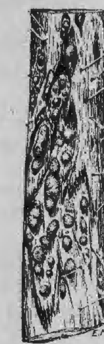


FIGURE 35. Hollyhock rust.

FIGURE 36. Ivy black rot.

Blue mold, *Penicillium expansum.* This is found common in storage on fruit of grapes, apples and pears and is considered different from the similar appearing blue mold on citrus fruits called *P. digitatum,* also common here. It is an imperfect fungus that rots the fruits and breaks through the ruptured skin as tufted, fruiting threads that bear a multitude of small spores, blue-green to olive-green according to age. Apparently the asco stage of this particular fungus has not been discovered although other species are known to have such a stage.

The fruit should be stored in a cool, dry place and subject to inspection for removal of the rotted ones. Sprayed fruit apparently is less likely to rot from this fungus.

Crown gall, *Bacterium tumefaciens.* This has been seen here only rarely on grape and then on tropical, greenhouse grapes where the base of the vines developed numerous, rather prominent galls, rather than simple hard ones, that early rotted away. We originally thought it was a winter injury. *See* Rose.

Downy mildew, *Plasmopara viticola.* We have found the downy mildew as early as the last of June but usually it becomes most conspicuous after the middle of August. It is common on the wild as well as on cultivated varieties of grapes. It forms reddish spots on the upper surface of the leaves varying in shape, size and grouping according to the outgrowths of the immature or summer fruiting-stage beneath. This consists of minute, white, tree-like threads issuing through the stomates or pores of the leaves and having bunches of temporary spores at their tips. These threads may be scattered or grouped in a dense growth that stands out prominently if the white hairs of the leaves of certain varieties do not obscure it. This conidial growth may also appear on the young tender tissues of the twigs, tendrils, pedicels of the fruit and even on the green grapes. After the grapes begin to ripen, especially white varieties that seem more susceptible, the mycelium of the fungus may develop a brown rot without external appearance of the fruiting stage.

The winter stage produces larger, thick-walled, spherical spores borne singly in a sack and embedded in the plant tissues. These spores are usually difficult to locate but serve to renew the fungus the next year. Next to the black rot, this mildew causes the most serious fungous injury to our grapes and is even more frequently present causing minor injury.

Spraying for the black rot should ordinarily control this trouble as well. However, in this state, it rarely pays to spray for this trouble alone.

Gray mold, *Botrytis cinerea.* We have found this chiefly on greenhouse grapes where it forms a rather dense matted growth on the fruit. *See* Geranium.

Powdery mildew, *Uncinula necator.* Usually this *powdery* mildew, as contrasted with the *downy* mildew, becomes common in the late summer, appearing on the leaves and less frequently on the pedicels and fruit of the grapes. *See* Virginia Creeper.

Lightning injury. We have seen injury due to lightning which apparently hit the wires on which the grapes were trained and passing down the stems into the ground killed the roots directly. Later the vines slowly died indirectly as a result of the root killing. See similar injury reported elsewhere on trees and shrubs.

Shelling. The green and ripening grapes in certain seasons fall off the bunches, sometimes without evident indication of insect or fungous injury. The downy mildew, causing the brown rot of white grapes, is sometimes the cause of this trouble but it can be identified as the cause. Other less easily identified causes may be due to variable weather, affecting growth of the vines, or to the condition of the soil regarding the availability of certain mineral constituents. *See* Rept. **1896**:278 and **1906:315.**

Smoke injury. We have had several complaints where injury resulted from smoke from brick yards when certain weather conditions prevailed. These conditions include the presence of coal in burning the bricks and a good volume of smoke which instead of going up into the air is driven along the ground in the direction of the grapes, the leaves of which are wet with dew or rain, when a more or less extended, reddish-brown scorch results. Similar scorch to the leaves of other plants may result under like conditions, complaint having been made for various trees (especially conifers, maples and fruit trees) and a few vegetables such as asparagus. The injury results from the sulphur dioxide of the smoke uniting with the water on the leaves to form sulphurous or sulphuric acid that produces the burn.

Winter injury. This trouble usually results from killing the roots in too wet soil or, in severe winters, when a snow or other mulch is lacking to protect the roots. The vines may not show the injury until they leaf out or even later when the leaves begin to die as a result of this severe or fatal injury to the roots.

Groundcherry

White smut, *Entyloma australe.* We have occasionally found this smut on the leaves of cultivated species of *Physalis pubescens* and on various wild species of the same genus. It has also been found here once on the Chinese lantern. The smut produces yellow, discolored spots on the upper surface of the leaves with finally a white conidial growth on the lower surface. The light-colored, permanent spores are embedded within the tissues. It usually is not injurious enough to need any treatment.

Mosaic. This has been found on wild species of Physalis. As this perennial weed can carry the mosaic over the winter, it is no doubt the source of infection to some of our cultivated crops by means of lice carriers. *See* Cucumber.

Hawthorn

Fire blight, *Bacillus amylovorus.* This has been seen chiefly on the English hawthorn, *Crataegus Oxyacantha,* and on trees whose blossoms when abundant favored visitation by bees. *See* Pear.

Leaf-fruit blight, *Entomosporium maculatum.* On this host the blight has been seen so far only on the leaves of the English hawthorn and it does not usually cause severe injury. *See* Quince.

Rust (leaf), *Roestelia globosa.* The rust occurs here chiefly on the leaves of the various wild hawthorns but is also found occasionally on the apple and mountain ash and rarely on the pear. It develops the O-I stage on these hosts. The cluster cups are more elongated than with the common apple rust and split into elongated threads that wear away gradually rather than the recurved ones fringing the edges of the cups of *R. pyrata.* The III stage occurs on the cedar and is called here a cedar-hawthorn rust, *q. v.*

Rust (stem), *Roestelia aurantiaca.* We find this rust rather common on the fruit and small twigs. *See* fruit rust of Quince.

Hazelnut

Knot, *Cryptosporella anomala.* So far this trouble has been found only occasionally in nurseries on the European hazelnut or filbert, *Corylus avellana.* It is distinct in its appearance since it develops, in its final form, one or more rows of small, oval galls on the branches. These break through the bark enclosing them at the base and on their tops show the numerous black, embedded pustules of the asco stage.

One should cut off and burn the infected branches a considerable distance below the outbreaks. The trouble is so infrequent that spraying does not seem to be necessary.

Hemlock

Rust (cone-stem), *Melampsora Farlowii.* Of the three rusts described here, this is the only one that has its III stage on the hemlock, *Tsuga canadensis,* and so far it is the only known stage. It develops on the scales of the cones and the small twigs, rarely running up into the leaves, and produces small, embedded, reddish blisters composed of a layer of permanently united spores. It has very rarely been found here and does no particular damage. The rust was originally made the basis of a new genus, Necium, and differs from our species of Melampsora in that it lacks the II stage that accompanies the III stage on the same host.

Rust (Hemlock-Blueberry), *Peridermium Peckii.* This rust in the I stage occurs in early summer only on the leaves of this year's growth. It is evident through the very definite, white peridia that stand up in a row on either side of the midrib. Often only a single leaf on the small twig is infected. The peridia split open irregularly from the top disclosing the dusty, orange spores which are carried to the blueberries and related hosts and there develop the II and III stages of the rust which is then called *Pucciniastrum Myrtilli.* *See* this name under Azalea.

Rust (Hemlock-Poplar), *Caeoma Abietis-canadensis.* The I stage of this rust occurs in June and July on the leaves, cones and tips of the very young twigs of this host. The outbreaks usually develop sparingly on the leaves, are most evident on the cones and may cause slight distortion of the twigs. They show slight evidence of the cups or peridia, being small blisters beneath the skin that rupture and disclose the orange mass of spores. Little damage is caused the host. The II and III stages, known as *Melampsora Abietis-canadensis,* occur on the poplar, *q. v.*

Abnormalities. We saw some years ago a native hemlock that a farmer had transplanted in his yard because of the peculiar, somewhat curled tip of the young twigs. He wished to know what caused this peculiarity. While we examined these twigs for signs of a fungus, we could not be sure that it was the result of injury of that type.

More recently we had sent to us specimens of hemlocks that instead of a main stem made a great number of smaller stems giving a bushy effect. The man wished to know if the same could be propagated by cuttings or grafts.

These cases led us to consult a nursery firm where abnormalities of this type are saved. They have found that in the culture of their seedlings a few of them vary from the normal type. So they save these by themselves when transplanting and if they continue to maintain their abnormality they sell them as such at special prices. In this way they have accumulated quite a variety of forms, usually of the more dwarfed and bushy types. They were not very successful in perpetuating these types by cuttings and as yet were not sure of the results of grafting. Some of such variations are sold by other nurseries under special names describing some type of their variation. These, possibly, have become so fixed that they can be propagated true to type.

Hickory

Anthracnose, *Gloeosporium Caryae.* This fungus causes conspicuous, purplish or reddish-brown spots showing on both surfaces of the leaves of Hicoria sps. and on the lower side develops the minute, more or less evident, fruiting bodies that ooze out the spores of this imperfect stage. The perfect asco stage, known as *Gnomonia Caryae,* is found on the old fallen leaves. The disease is not uncommon on the trees in the woods.

Witch's broom, *Microstroma Juglandis.* The white mold, as it is more commonly called on the leaves, is said to cause this type of trouble on the branches of hickory; for description *see* same under Butternut.

Wood rot, *Fomes connatus.* This fungus is found on the living hickory and some other trees, as maple and poplar, and is variable in size from two to several inches across, according to age. It consists of one to several, overlapping shelves grown more or less together to form this, at first soft but finally corky, or even woody, Basidiomycete. These fruiting bodies, especially at the edge, are colored light-brown but with age may become blackish, while the lower, porous fruiting surface is a flesh color. When cut across, the superimposed layers of the annual spore-tubes can be made out.

Hollyhock

Leaf spot, *Cercospora althaeina.* Occasionally this fungus produces numerous spots on the leaves of *Althaea rosea* causing serious injury. These spots are small, chiefly an eighth or less of an inch across, angular and light to reddish-brown in color. On the under surface, some indication of the imperfect stage can be seen by the growth of the dark-colored, fruiting threads and spores. The asco stage is apparently unknown. The treatment is the same as for next disease.

Rust, *Puccinia malvacearum.* This is our most common disease of the hollyhock and is frequently sent to the Station for identification. The rust forms its only stage (III) as pustules on the leaves, chiefly beneath, and on the pedicels and stems. They are firm, roundish cushions of spores of a reddish-brown color. These spores usually germinate as soon as formed in the pustules and then they have a whitish or gray color. The rust may appear early in the spring and extend into the early winter on protected plants. (Fig. 35.)

The old stems and leaves should be gathered up carefully and burned. Then in the spring, as soon as the plants begin to appear above the ground, they and the ground about them should be thoroughly sprayed with Bordeaux and the treatment repeated a few times at intervals of 7–14 days.

Honeysuckle

Crown gall, *Bacterium tumefaciens.* On species of Lonicera the crown gall has been found occasionally in nurseries. *See* Rose.

Gray mold, *Botrytis cinerea.* This common mold has been collected occasionally on outdoor plants in wet years. *See* Geranium.

Leaf curl, *Glomerularia Lonicerae.* This imperfect fungus we call a leaf curl on this host because of its similarity to the effect produced by Exobasidium on its hosts. The former shows a short, white growth of its conidial spores and conidiophores more or less general on the under side of the leaves. We collected it once, and it was also sent in for examination in 1932 on cultivated shrubs of *Lonicera canadensis.* It has been reported only a few times on cultivated Lonicera, but a similar species has been found on *Cornus canadensis* in the woods. Formerly both were considered the same species, known as *G. Corni,* but the one on Lonicera later was separated as a distinct species, as given above. Little is known about its life history.

When the disease is not abundant, cutting off the infected twigs should take care of it. If it becomes general on the shrubs, it may be necessary to spray beginning in the spring before the leaves show its presence.

Powdery mildew, *Microsphaera Alni.* Both conidia and perithecia have been found on undetermined species of this host. *See* Lilac.

Oedema. In 1927 specimens of cultivated honeysuckle were sent to us where, the old stems having been winter killed, the new stems showed loose, gall-like swellings with ruptured cells. Evidently the winter injury had not extended to the roots so that they supplied water too freely to the new stem growth. *See* Glorybush.

Hornbean (Blue Beach)

European canker, *Nectria galligena.* We have found this fungus rarely on *Carpinus caroliniana* causing cankers on forest trees. *See* Birch.

Horsechestnut

Bitter rot, *Glomerella cingulata.* Both the imperfect stage and the asco stage of this fungus were found once in Meriden on the living leaves of this host. *See* Apple.

Canker, *Nectria cinnabarina.* This stage and its imperfect stage, *Tubercularia vulgaris,* have been found on dying trees, primarily injured by severe winter weather, at Norfolk and elsewhere. *See* note under cane blight of currant.

Leaf blotch, *Phyllosticta Paviae.* The European horsechestnut, *Aesculus Hippocastanum,* is very susceptible to this disease which usually appears here each season but in favorable ones becomes serious. However, we have never seen a tree die as a result of repeated injury. The injury is chiefly to the foliage and when severe premature defoliation may take place long before the usual time. The affected leaves develop conspicuous, reddish-brown spots or areas of greater or lesser extent that eventually may kill them. On these can be seen the small, black, embedded fruiting bodies of the imperfect stage named here. The small spores ooze out on the leaf surface and spread the disease to other leaves. If the season turns very dry after infection, as in 1931, these fruiting pustules often fail to appear on some of the leaves and then it is difficult to tell the trouble from an ordinary sun scorch.

It is from the old dead leaves in the spring that reinfection apparently takes place through the maturing of the asco stage, called *Guignardia Aesculi.* In the fall these old leaves should be raked together and be burned. Spraying the next year should begin on the young developing leaves and should be repeated two or three times until the first of July.

Powdery mildew, *Uncinula flexuosa.* Like all the powdery mildews, this species develops its mycelium and conidial stage as a white, superficial growth over the leaves, in this case chiefly on the upper surface. The perithecia of the asco stage are small, blackish, superficial bodies and are not usually very abundant. The characteristics of the genus *Uncinula* are the hooked, slender appendages that hold the perithecia to the mycelium. With this species, *flexuosa,* these appendages are wavy at their outer half. Both of these terms are indicated in the scientific name *Uncinula flexuosa.* Normally this is not a trouble that needs attention by spraying in Connecticut.

Winter injury. Occasionally species, not adapted to the climate this far north especially when the winters are severe, have been killed or show injury to the buds or by cankered areas on the limbs. Certain semi-parasitic or saprophytic fungi may later develop on these and thus obscure the real cause of the trouble.

Removal of the badly injured trees, cutting off the injured branches and, where needed, spring fertilization to secure new growth are the only treatments required.

Horseradish

Bacterial leaf spot, *Bacterium campestre* var. *Armoraciae.* This was first seen on *Radicula Armoracia* at Silver Lane in 1928 about the time the disease was found and described elsewhere. It occurred only on a few plants in a large field but was conspicuous on these. The bacteria produced numerous, small, reddish-brown spots that often ran together into larger ones. At first the spots were most conspicuous on the under side of the leaves. They were often bounded by a darker line along the border. Seen by transmitted light, the spots showed as hyaline areas, as if all the tissues between the epidermal layers had been destroyed. The disease is caused by a special variety of the bacterium of black rot of crucifers mentioned here. Little apparently has been done concerning treatment anywhere.

Black leaf spot, *Alternaria Brassicae.* While this has been called by several others *Alternaria herculea,* it is doubtful if it is distinct from the Alternaria common on crucifers as given here. *See* Cabbage.

Leaf spots, *Cercospora Armoraciae, Ramularia Armoraciae.* These are two other leaf spots that can usually be told from the preceding by their lighter-colored, smaller spots usually without evident rings of growth. They are very similar to each other and produce whitish to grayish, fruiting threads on the surface of the leaves that need to be examined microscopically to distinguish them. Sometimes these infected spots fall out giving a shot-hole effect to the leaves. As yet no asco stage has been reported for either fungus, although the Ramularia is said to produce sclerotia on the leaves that carry it over the winter.

Little has been done to control the three leaf spots but if necessary destruction of the foliage in the fall and spraying in the spring or early summer should help.

White rust, *Albugo candida.* This fungus produces white, roundish, irregular blisters on the leaves and frequently on the stems of certain of its hosts. These blisters are the conidial stage of the rust which, despite its looks, is a close relative of the downy mildews rather than a true rust. The growth of the pustules ruptures the epidermis of the leaf and the white, powdery spores are scattered and on germinating spread the disease. The winter stage is composed of colored, thick-walled spores, similar to those of the downy mildews, that are embedded in the tissues of the host. Besides the horseradish, the radish is the only other of the cultivated crucifers upon which we have found this fungus, though it is common on certain of the weeds. So far, little injury has been observed to either of these plants.

Mosaic. This has been seen rarely in cultivated fields but as the host is perennial the disease will probably appear each year on the same plants and so be a menace to other plants. *See* Cucumber.

Hydrangea

Chlorosis. The only trouble we have seen on this host, besides an unidentified leaf spot, has been a chlorosis of the same. The whitish mottling of the leaves was of varied designs and of unknown origin. It did not seem to be merely a variegated variety and apparently was not a true mosaic.

Iris

Bacterial soft rot, *Bacillus carotovorus.* The bacterial soft rot was first observed and mentioned in Connecticut on *Iris germanica.* The rootstocks rotted in the ground and caused the leaves and flowers to turn yellow and die. Sometimes the rot extends to the bases of the leaves. With most of the hosts, this bacterium usually attacks the fleshy parts under or in contact with the soil; such as roots, rootstocks, tubers and sometimes the leaves and fruit. It may follow injuries by animals or other bacterial injuries, when soft rot follows black rot of cabbage, or even fungi, when soft rot of potatoes follows late blight in the tubers. Abundance of humus in the soil and wet weather favor infections since they increase the development of this saprophytic bacterium in the soil.

The hosts injured here, so far as noticed, are as follows: cabbage, calla lily, carrot, cauliflower, celery, Chinese cabbage, cucumber, lettuce, muskmelon, pepper, potato, radish, salsify, squash, tobacco, turnip.

Poor storage conditions at unfavorable temperatures (too high or too low), especially winter storage in too deep piles without proper ventilation or storage in trenches out of doors, are contributing factors for infection of harvested crops. All of these contributing factors should be looked after carefully. If ornamental plants are in too wet soil, the healthy ones should be removed to higher ground.

Bacterial spot, *Undetermined bacteria.* In 1922 specimens of a bacterial disease of cultivated iris (apparently *I. germanica*) were gathered by Stoddard at Bantam.

It was rather prominent on the leaves. They had a watersoaked appearance with elliptical to elongated, somewhat irregular areas lengthwise between the veins especially at the margins. The spots when dry were light brown with some indications of purplish borders. We have never seen a trouble quite like this since (and so far as we know it was not associated with a rot of the rootstocks) unless it was on *Iris pumila* where bacteria, as well as a little of the leaf spot reported below, were present. In July, 1933, we found the same or a very similar bacterial leaf spot in a nursery at Greens Farms on *Iris cristata* where it was especially bad. The infected areas were very variable in size and shape, having at first a watersoaked, lighter green appearance then running more or less together and turning a light to dark brown. Bacteria were very abundant in the tissues and where the whole leaves were invaded they soon dried up and died.

Crown rot, *Sclerotium Delphinii.* Occasionally this fungus has been found rotting these plants, including *Iris cristata, I. germanica,* and some of the Japanese species. *See* Larkspur.

Leaf spot, *Heterosporium gracile.* This imperfect fungus causes small, oval, yellowish, watersoaked and then grayish to brownish spots with purplish borders on the leaves. If abundant, it causes the leaves to turn yellow and die prematurely. The fruiting stage shows as small, blackish, fruiting threads erect on the infected spots. The asco stage is claimed by Tisdale to mature on the old dead leaves and stalks as the fungus known as *Didymellina Iridis,* but later Klebahn claimed it as a new species, called by him *D. macrospora.* The disease has been found on the German Iris the most commonly of any of the species. It has been found also on *Iris pumila.*

All the old leaves should be gathered in the fall and burned. If desired Bordeaux, with the potassium-oleate sticker, can be applied to the new growth in the spring and early summer as needed.

Root rot, *Rhizoctonia Solani.* We have found the fungus rotting the roots of this plant. *See* Potato.

Rust, *Puccinia Iridis.* This rust is common on our wild species of Iris and has been found here on the occasionally cultivated *Iris versicolor* and on *Iris hexagona.* So far, only the II stage has been found, showing as very small, oval or elliptical pustules chiefly on the leaves. These frequently cover the surface of the leaves and, on rupturing the epidermis, show as reddish-brown, dusty masses of spores. The III stage is said to occur only in the far west and the I stage is unknown.

Its rare appearance on cultivated species makes unnecessary any preventive treatments other than the removal and destruction of the old dead leaves and rubbish in the late fall.

Ivy, Boston

Black rot, *Phyllosticta Labruscae.* The imperfect stage as given here is seen not uncommonly as the reddish-brown spots on the leaves. *See* Grape. (Fig. 36.)

Seedling root rot, *Rhizoctonia Solani.* This trouble was seen in a nursery where peat was used on the seed bed and the acid reaction favored the development of this fungus. *See* Spinach.

Winter injury. This host, *Ampelopsis tricuspidata,* is much less subject to winter injury than the English ivy. However, we have seen injury on the north side of a brick building when a severe winter injured or killed the vines. With some of the horizontal branches, the injury was confined to the uppper side, the lower being still alive. When the injury was not too severe, the leaves showed the trouble only after the beginning of the hot summer weather.

Ivy, English

Leaf spot, *Phyllosticta* sp. This trouble on *Hedera helix* has been reported several times by the nursery inspectors but specimens are not available at present for study. Two species of this genus have been reported elsewhere. Apparently it is not a very severe disease as seen so far.

Winter injury. While occasionally this plant escapes the winter in protected places, our experience has been that it easily winter kills. This is especially true of plants that run over the ground without a protective mulch. As there are many varieties some are perhaps more hardy than others, as is claimed for *H. helix* var. *baltica*.

Japanese Knotweed

False mosaic. Early in May, 1933, we saw this trouble, on the leaves of certain of the stems of *Polygonum cuspidatum* (*P. Sieboldi*), that appeared suddenly in a neighbor's yard where we had never seen it before. Some of the stems showed the injury while others did not and it was evident on the leaves that came out at a certain time and not on those of later development. The trouble was so similar in appearance to the yellow-green mottling of the true or infectious mosaic of certain plants that we have called it false mosaic. The angular spots were scattered rather abundantly on the leaves with their chlorophyll of a lighter green color than that of the normal tissues of the same leaf blades. There was a slight folding of the tissues, as was indicated by white lines usually above the veins. These white lines were evident where the epidermis had separated in folds from the adhering parenchymatous cells beneath. Evidently the trouble occurred when the young leaves were growing rapidly and the injury was confined to the rupturing of the epidermis and the slight injury to the young chlorophyll grains. Possibly later further injury to the tissues might result from these primary injuries.

The trouble was so similar to frost injury that we have seen on apple leaves that we have little doubt that this was the primary cause. Whether the injured spots had moisture on their surface or the water in the vessels was the secondary factor of the localized spots being injured by the cold we are not sure. There was no sign of insect injury and the trouble was certainly not due to an infectious virus since we were unable later to produce it on the young healthy leaves when the juice from the injured ones was applied to them. A similar trouble was seen on the leaves at the same time of the year on a butterflybush at Bridgeport in 1932.

Juniper

Leaf spot and Needle cast, *Cercospora Sequoiae Juniperi, Lophodermium juniperinum.* In June, 1927, at the golf course at Norfolk, the writer collected specimens of *Juniperus communis,* whose leaves were dying apparently from two fungi, showing prominently on them, that turned out to be the above species. The first one, an imperfect fungus whose fruiting bodies showed as small, black dots on the leaves, looked more like a Phyllosticta than a Cercospora because the conidiophores were clustered in small, sclerotia-like masses. The second fungus, an Ascomycete, showed larger, black, elongated and raised fruiting bodies, split down the center, and was characteristic of the Lophodermium type. Both of these fungi have been associated more or less with injuries to the leaves of this host but which was the chief offender in the case and whether they had any relationship was not determined.

Nursery blight, *Phomopsis juniperovora.* Nursery blight has been discussed under Cedar, *q.v.*

Rust (stem), *Gymnosporangium clavariaeforme.* This is the perennial rust most commonly found on the wild juniper, *Juniperus communis,* that is sometimes used for ornamental planting in the state. The infected branches usually show a somewhat fusiform thickening and on this in the spring the yellow, jelly-like telia develop as evident, elongated columns that bear the III spores. The cluster cups of the I stage appear chiefly on the shadbush as the alternate host.

Rusts (foreign), *Gymnosporangium japonicum* (*G. Photiniae,*) *G. haraeanum* (*G. koreaense*). Both of these rusts were found originally on varieties of *Juniperus chinensis* imported from Japan. They occurred only in the III stage, the first species on the stems as conspicuous, flattened telia and the second as small, roundish telia on the leaves. Neither of them escaped here, for their original infected hosts were largely destroyed before they were set out. There was little chance of the one or two infected specimens, later found in the nursery, escaping to the alternate hosts of the rose family on none of which was the I stage ever found. *See* Repts. 1912, 350 and 1914:15.

Kale

Bacterial black rot, *Bacterium campestre.* This host, *Brassica oleracea acephala,* is apparently not so commonly grown as formerly when this and the other diseases listed here were reported.

Bacterial leaf spot, *Bacterium maculicolum.* The bacterial leaf spot was found early (1902) on this host.

Clubroot, *Plasmodiophora Brassicae.* While not so commonly found here on kale, this host is probably just as susceptible to the clubroot. *See* Broccoli.

Kerria

Leaf-twig blight, *Cylindrosporium Kerriae.* This trouble of *Kerria japonica* was first called to our attention in a nursery in 1920 and we have since seen it there and in private plantings. The leaves show small, roundish to angular, light to reddish-brown spots with a distinct, darker border. If abundant they cause the leaves to turn yellow and die prematurely. Similar but more distinct spots show on the young stems and these may sometimes run together into extended cankers. In such cases the twigs are gradually killed and the leaves wither and dry up. In these twig-infected spots, the bark at the center in time may slit or crack away revealing the blackish, fruiting bodies at the center. From these ooze out the long, usually curved, white spores with or without evidence of a septum or two. This imperfect fruiting stage also appears in the leaf spots. Stewart, who described the fungus, found the asco stage, *Coccomyces Kerriae,* matured on the old dead leaves in the spring.

This is another disease where it will pay to cut out the diseased sprouts, rake up the dead leaves and, if necessary, spray the plants the next spring and early summer with Bordeaux.

Kohlrabi

Clubroot, *Plasmodiophora Brassicae.* Clubroot has been reported only once on this host; known technically as *Brassica oleracea caulo-rapa. See* Broccoli.

Kudzu Bean

Bacterial spot, *Bacterium medicaginis* var. *phaseolicola* (*B. Puerariae*). This is another bacterial disease that we collected before it was described on this host, *Pueraria thunbergiana.* The writer found it in 1924 in a flower garden at Fairfield where the vine was used as a covering on a trellis and although the disease was collected several times that year between the last of August and the first of October it has not been seen since there or elsewhere on this host. Our specimens all show small, reddish-brown, angular spots on the leaves that are more or less abundant. Usually there is a large, very distinct yellow halo around the invaded tissues, such as is shown in the wildfire of tobacco. As these vines were near some string beans which had apparently the same disease on them, the trouble evidently spread from the bean to the Kudzu vine.

Laceflower

Stem rot, *Fusarium* sp. We found the blue laceflower, *Trachymene* (*Didiscus*) *coerulea,* injured by this common basal rot both in a greenhouse and a private garden in 1932. *See* Aster.

Larch

Rust (leaf), *Caeoma* sp. The rust has been found here on the leaves of the native tree of *Larix laricina,* but not yet on it in cultivation. We have occasionally found, in the early season, a few sori of the rust showing as small, round, dusty, orange outbreaks of spores of the I stage but without evident peridia or cups. This stage without doubt connects with a Melampsora-like stage on some alternate host of which there are several in the same general region in the northwestern part of the state where it has been found.

Twig saprophyte, *Dasyscypha calycina.* This saprophyte, scarcely distinguished from the parasitic form, *D. Willkommii,* found formerly in New England causing cankers on the larch, has been seen in this state merely on dead twigs. It shows as small, saucer-like, white, fruiting bodies with a pinkish, smooth fruiting surface above. These fruiting bodies open widely in wet weather but close together in the dry. The parasitic, canker-producing form should be looked for and notice given the Station botanist if found, although it has been exterminated where originally found in Massachusetts.

Larkspur

Bacterial leaf spot, *Bacterium Delphinii.* The angular, purple-black spots showing through on both sides, reach a diameter of about one-quarter of an inch and are few or numerous on the leaves of certain species of Delphinium. Some varieties or plants seem to be seriously injured while others near by may be practically free. This trouble should not be mistaken for the one, caused by mites, which produces curled, swollen, purplish distortions on various parts of the plant.

If one finds the bacterial disease on the plants, he should gather and burn all the leaves and stems in the fall hoping to escape the trouble the next year. It proves most troublesome in wet years and in moist, shady places.

Crown rot, *Sclerotium Delphinii.* This fungus rots off the plants at their base just above and below the ground. Frequently the white mycelium can be seen running over the ground from the rotted base and in this are developed, more or less abundantly, round, reddish tubercules (sclerotia) about the diameter of a large pin head. These are merely solid masses of mycelium that are white within the thin, reddish coat and serve to carry the fungus over unfavorable periods.

This fungus was first found by the writer in 1907 in a local nursery causing damage to several herbaceous plants. Later it was described elsewhere on one of these hosts, Delphinium, and given the specific name from this host. However, the fungus attacks a great variety of plants besides this one, including cornflower, Eupatorium, Funkia, Iris, Monkshood, Madonna lily, Penstemon, Physostegia, Tulip, Valerian, Veronica and perhaps others. It is closely related to another species that has similar but smaller sclerotia, that attacks a variety of plants chiefly in the south, but which we have not yet seen here.

As the sclerotia are difficult to kill by any treatment, the gardener should gather up all of the decayed trash around the plants, removing any dead or injured stocks and also the dirt around the base of the plants so as to include all of these sclerotia. New dirt from outside can be used to replace that removed. The bed should be opened up where planted too thickly, so that the air and light can get in around the base of the plants to favor drying out in wet weather. It might pay also to spray the soil and base of the plants with Bordeaux several times in the spring and early summer. Once the trouble gets a start it may play havoc with a variety of plants but especially with the Delphinium in the wet seasons.

Leaf spot, *Ascochyta (Phyllosticta) Aquilegiae.* The only apparently fungous leaf spot we have found on this host was seen in August, 1932, in a private flower garden in Orange where the lower leaves showed numerous, purplish-brown spots that apparently were caused by the imperfect fungus known as Ascochyta. While such a fungus seems not to have been reported before on this host, we feel that its spores are similar to *Ascochyta Aquilegiae* found in Europe and the United States on the related species of Aquilegia. This fungus was originally described as a Phyllosticta, apparently because the septum is not always evident on certain of the spores on either host. The slight difference in the spots on the two hosts may be due to the much thicker leaves of the Delphinium.

Powdery mildew, *Erysiphe Polygoni.* This has been seen often only in its conidial stage and is not usually troublesome. In 1932, however, we received specimens in July where the perithecia developed rather abundantly on both the stems and leaves, possibly after the specimens were kept in the laboratory for some time. *See* Clover.

Root rot, *Rhizoctonia Solani.* We have found the fungus rotting the roots of this plant. *See* Potato.

Fasciation. These curious, greatly flattened branches have been seen occasionally on this host. A specimen, collected in July, 1914, at Whitneyville, shows the flattening of a mature seed stalk. One of the best specimens we have ever seen on this or any other plant was sent us from Sharon in July, 1931. This shows the flattened flower stem at least four inches wide but of normal thickness before it divided near the top to produce the two flattened stems bearing the aggregate masses of blossoms. *See* Asparagus.

Frost injury. In May, 1932, we were called to see specimens of Larkspurs certain of which showed swollen, crinkled spots on the leaves or on the buds. The entomologists stated that the trouble was not due to mites which later cause somewhat similar spots on the flower parts. So the trouble was diagnosed as a frost injury, since frosts had occurred in that vicinity when the young plants were appearing.

Lawn Grasses

Brown spot, *Rhizoctonia Solani.* This is an old trouble caused by the soil fungus that causes injury to a great variety of hosts, especially seedlings and the fleshy parts of more mature plants. Many complaints have been made of it in yards, especially in newly seeded ones in damp weather, and in golf greens where heavy fertilization and frequent waterings have developed a luxuriant growth. Often it can be told by the white, mold-like growth of the mycelium that develops on the ground and rots the base of the grass stems into a definite, roundish, brown spot in the lawn.

It seems to develop in the more acid soils. Spraying with Bordeaux or commercial forms of organic mercury compounds are said to prevent or lessen injury if started in time. *See* Spinach.

Lawn rot, *Helminthosporium-Pleospora* sp. Another trouble has recently appeared, apparently caused by an entirely distinct fungus. This has an imperfect stage, known as Helminthosporium, that appears to be the parasitic form and a Pleospora or asco stage that seems to be the saprophyte since it becomes abundant on the old, dead grass. According to Stoddard, unlike the brown spot, it usually kills the grass in less definite spots but in a more widespread, general decay of the water-soaked tissues, often blackish when wet and grayish when dried out. This trouble seems to be most common in lawns and golf courses where the newer species of bent grasses, or mixtures of these with other species, are used. It is thought by Stoddard to be even worse than the preceding one but needs to be further studied as to its exact nature. The control treatment is the same as for the preceding.

Slime molds, *Physarum cinereum, Fuligo ovata.* These are two slime molds belonging to the Myxomycetes, or animal-like plants just below the fungi and bacteria, that appear on lawns suddenly after wet weather. By means of their motile, protoplasmic, microscopic cells they aggregate in masses over the tops of the grass to form a colored, jelly-like substance that soon changes in dry weather to their dusty, fruiting stage. In the former and more frequently observed species, this consists of numerous, small, grayish, separate pustules on the individual leaves that rupture slowly to disclose the colored spores. In the second species it is a large, conspicuous mass over the grass that is covered with a whitish, powdery coating that readily wears away revealing the dark-colored spores beneath. Neither of these slime molds are parasites on the living grass but only cause injury, if any, by smothering the leaves by these coatings.

Toadstools and Shelf fungi. *See* Addenda for a very general treatment of some of these fungi found in lawns.

Drought, etc. Continued dry weather is likely to turn the grass brown. If very severe it may kill out the grass more or less completely but usually the grass, where well established, revives after sufficient rains have fallen. The injury may be general or in spots where the soil is poorer for one reason or another. These poorer spots showing first may give the impression that it is the brown spot. Sometimes the lawns show a sun scorch type of injury, especially those recently made. Injury also can occur, when the grass is mowed long and not removed, from smothering the grass in wet weather beneath the thick masses of cut leaves. Too early cutting of young grass just starting, especially in dry or hot weather, may also cause injury. Watering of lawns in dry times to be effective should be continued during the dry period and preferably in not too bright sunshine.

Leek

Black molds, *Macrosporium parasiticum, M. Porri.* Leeks, *Allium porrum,* are occasionally grown here but the only troubles we have seen on them are the above two fungi. The first is not very serious being seen usually on occasional plants. This shows a white streak, usually along the midrib, on which is situated the black, fruiting stage of the fungus which at most seems to be a weak parasite. By some this imperfect fungus is said to be connected with the Ascomycete *Pleospora herbarum.*

The second is apparently a true parasite and is found on more definite, elliptical, light-colored spots with less of the black, conidial growth on the same. Thaxter called it the larger Macrosporium because of its larger spores with an elongated projection, which to our mind indicates it as an Alternaria.

Neither of these molds have caused much damage in recent years to this host, so nothing is done for their control. *See* Onion.

Lettuce

Bacterial soft rot, *Bacillus carotovorus.* This soft rot of *Latuca sativa* has been seen in fields rather rich in humus following moist weather and sometimes it causes serious loss. The bacteria on the ground develop in the lower leaves, often at their edges, and may work up into the interior as a head rot at first hidden. *See* Iris.

Downy mildew, *Bremia Lactucae.* We have seen this trouble usually in the fields in the fall when little damage occurs. In greenhouses, if it gets a good start, serious trouble may occur to that and succeeding crops. So far there has been little complaint of it here in this respect, however. The conidial stage may show as a scattered or dense, white to grayish growth of the fruiting threads on the leaves. These fruiting threads are easily told from the other downy mildews by their hand-shaped endings with short, pointed tips bearing the spores. The mature spores for carrying the fungus over the winter are as usual produced in the interior of the tissues. If this disease gets a good start in a greenhouse used only for lettuce, it may prove so troublesome that special precautions have to be taken.

Drop rot, *Sclerotinia sclerotiorum.* The "drop rot" was so named on lettuce because the sterile, white mycelium of the fungus, creeping over the ground around the plants, would after entrance gradually rot off the lower leaves and cause them to drop over on the ground. The trouble sometimes becomes so bad in greenhouses where lettuce is continuously grown that it cannot be raised profitably. While never so bad as in some other states, we have seen it causing serious loss to lettuce and parsley under such conditions. Not only these two hosts are injured but we have found it also on cabbage and carrot in storage and on tobacco, goldenglow and Zinnia in seedbeds and gardens. The mycelium, especially in connection with the rotting tissues, develops small, flattened, but variable as to shape, black sclerotia that carry the fungus over long periods in the ground. On these after winter freezing, the asco stage may develop as elongated, funnel to cup-shaped at the top, fruiting bodies that discharge their spores from their upper surface when touched. There is apparently no known imperfect spore stage. (Fig. 37.)

It is hard to control this fungus when it gets a good start because of the difficulty in killing these sclerotial bodies. If bad in the seedbeds these should be changed if this is easily done. In flower gardens the healthy plants of the susceptible host may be changed to a new locality, taking no dirt with them. In greenhouses or hot beds, if desired, the soil can be sterilized by high pressure steam or formaldehyde. The latter requires at least a 2% (1 to 50) solution and it is applied at the rate of at least two quarts to each square foot of surface. Before sterilization all

of the old plant-rubbish should be removed and after the sterilization the soil should be covered for one or two days to keep in the fumes. Crops should not be planted on the same before two weeks.

Gray mold, *Botrytis cinerea.* Gray mold is seen occasionally, especially in greenhouses, but is not serious. *See* Geranium.

Leaf spot, *Septoria Lactucae.* This has been found occasionally both in greenhouses and out of doors. It has never proved serious here. The injury shows in the leaves as more or less irregular, grayish to reddish-brown spots or areas with the rather evident, imperfect fruiting stage as black, embedded dots in the same. There is no asco stage as yet reported but the fungus is said to carry over in the seed. In the greenhouse it may pay to pick and destroy the infected and dead leaves and use care in watering.

Rot, *Rhizoctonia Solani.* We have seen this in the fields, with similar conditions to those which caused the bacterial soft rot but probably with a more acid soil, where the lower leaves in contact with the ground were rotted and allowed the fungus to enter the head causing a more or less hidden, reddish rot of the interior. *See* Potato. It also causes damping off of seedlings. *See* Spinach.

Seedling rots, *Pythium debaryanum,* etc. This is the common cause of seedling rot in beds and flats although the spiny species of Pythium has also been found on dying seedlings. *See* Spinach.

Mosaic. This has been found occasionally on the Cos or Romaine lettuce but never very abundant. *See* Cucumber.

Prematuring, etc. It is difficult to grow lettuce even of the best varieties in the fields in summer because of its tendency to go to seed prematurely. With ordinary or wet weather followed by very dry periods, this is especially true. In our opinion lack of moisture is the primary influence and because of this the diminished supply of available nitrogen going into the plant for continued growth may more directly bring about the prematuring. If this is true then watering and nitrogen fertilization, where necessary, should prove helpful if carried out in time. Somewhat similar troubles, but usually not so common, are reported here on beets, cabbage, onions and potatoes.

Another effect of sudden, hot weather may show as a brownish searing of the leaves for a short distance inward, known as leaf scorch.

White heart. This is an obscure but apparently a physiological trouble complained of by growers of Big Boston and perhaps other varieties of head lettuce. The heads do not fill up solidly, the interior being composed of loosely rolled, hard, white, irregular leaves. Whether it is the result of irregularities of heat, moisture or due to certain soil conditions has not been determined.

Lilac

Anthracnose, *Glocosporium Syringae.* This fungous disease was sent to the Station in June, 1933, from Westport by a lady who wrote: "The twig is from a lilac shoot. Whatever it is that is attacking, it goes only for the young tender end of the shoots." We determined the trouble as the above fungus. This was the first time we had seen it and, so far as we know, it has not been reported before from the United States. The specimen sent was confined to the edge of the leaves which were curled and showed the small pustules of the fruiting stage. Later, on visiting the place we found the trouble chiefly on the young shoots at the base of the plants. The younger, upper leaves of these wilted, blackened and then dried up. The young shoots also were sometimes killed for a short distance and developed fruiting bodies. The spores resembled very much those of the bitter rot fungus.

The only reference to a trouble of this kind we have found is that describing the species from South Bavaria by Allescher and published in 1895 (Hedw. **34:** 276). His description fits our specimen well though the spores we saw were chiefly of the larger size, 12–18μ by 4–6μ. They were mostly rounded at the tips and were borne on compacted conidiophores embedded in the tissues. The fruiting stage shows as more or less evident, flesh-colored, embedded pustules. Allescher & Schnable also issued specimens in Fungi bavarici no. *478* but our specimens in their exsiccati, while showing the dead and recurved edges of the leaves, do not show definite fruiting pustules and the spores seem to be the small size, around 6μ as described by the author, rather than the large spores that reach 18μ as also mentioned by him.

Apparently this fungus is not usually very serious, attacking the younger growth and often confined to the edges of the leaves. If, however, it does become harmful it would be well to spray the developing leaves, until full-size, two or three times with Bordeaux mixture.

Bacterial blight, *Bacterium Syringae?* This truble, somewhat questionable as to cause, is described in the Addenda.

Binder fungus, *Hymenochaete agglutinans.* The leathery growth of this Basidiomycete is occasionally seen binding together living or dead twigs in the woods. Specimens were once sent to us where it had bound together living twigs of the lilac, causing the death of the parts above through strangulation.

Gray mold, *Botrytis cinerea.* The gray mold occurs occasionally in wet weather of the spring on young leaves and stems. *See* Geranium.

Powdery mildew, *Microsphaera Alni.* This is one of our common powdery mildews occurring on a variety of plants but chiefly on shrubs and trees. The conidia and mycelium show in the summer on the leaves as an evident, more or less abundant, white growth. Usually the mature fruiting stage, known as perithecia, become apparent toward the end of the season as small, reddish and then blackish, spherical bodies embedded in this mycelium. It is the common fungous trouble of the lilac, chiefly on *Syringa vulgaris,* showing each season though the amount varies according to the favorable or unfavorable weather. Other hosts given here are: azalea, honeysuckle, oaks and sycamore.

Spraying, if thought advisable, and if taken in time, should control the trouble.

Graft blight. Recently there has come to the attention of the nursery inspectors, a common trouble of the lilac due to the grafting of the scions on uncongenial root stocks, chiefly privet. Some plants develop a more or less sickly, yellowish growth of canes and leaves as compared with those grafted on their own kind of roots. Such plants are often sold while in fair condition but gradually go back without evidence as to the real cause of the trouble.

Lily

Crown rot, *Sclerotium Delphinii.* Crown rot has been found on the Plantain lily (Hosta) and the Madonna lily (*Lilium candidum*). *See* Larkspur.

Drop rot, *Sclerotinia sclerotiorum.* This was reported once on the Bermuda Easter lily, *L. longiflorum* var. *eximium.* *See* Lettuce.

Gray molds, *Botrytis* sps. *See* Addenda.

Rhizoctonia rot, *Rhizoctonia Solani.* The Rhizoctonia rot was seen once on the goldband lily (*L. auratum*) and the Madonna lily, rotting the roots badly. *See* Potato.

Mosaic? One of the common troubles of Easter lilies seems to be mosaic, showing in a mottling of the leaves and resulting in a poor growth of the plants and their blossoms. It was first noticed years ago on the Bermuda Easter lilies shipped to this country. While we have not had much experience with this particular mosaic trouble, we have recently seen a case where it was bad on certain Japanese Easter lilies. One grower complained that a very large percentage of the plants he grew from these bulbs. (*L. longiflorum* variety *Erabu*) were so poor that he could not offer them for sale. While lice were very evident on these when seen by us, he claimed that they came on chiefly after he neglected the plants because of their poor condition. So far as we could find, the mosaic mottling of the leaves, showing as somewhat elongated, lighter green areas in the normal green, was the apparent cause of the poor condition of the plants. We did not determine if the trouble was contagious, either by the lice or the use of needle punctures, but it appeared to us to be a possible virus mosaic.

In this case it was probably carried by the bulbs but the presence of the lice on the plants was a possible means of spreading it further. The use of perfectly

healthy bulbs and the control of the lice would be the means of combatting the trouble.

Split blossoms. A trouble of easter lilies recently complained of to the writer was the splitting apart of the petals of the flowers when they came into full bloom, thus giving them an abnormal and poor appearance. This was caused by the petals at one or more places separating, giving the scraggly appearance. Normally these petals, though they are divided down to the top of the ovary, still adhere together by their edges into a united blossom. Such split blossoms are of little value for sale.

We are not sure of the cause of this trouble but it may have resulted from the manner in which they were forced to appear at just the right time for Easter.

Lily of the Valley

Leaf spot, *Undetermined.* The only trouble we have found on *Convallaria majalis* is a leaf spot, apparently caused by some fungus, though as yet we have never found its fruiting stage on the spots and so cannot be sure of its nature or identity. Several troubles have been found elsewhere and some of them are on the leaves but we have been unable to identify them with the purplish, elliptical spots, whose centers sometimes become brownish, that we have seen more or less abundantly on this plant especially in the late summer and the fall. We have a suspicion that the fruiting stage does not begin to mature until the following spring on the old, dead leaves.

Linden

Anthracnose, *Gloeosporium Tiliae.* While this has not yet been reported on Tilia from this state but was sent for determination from Long Island, it should be looked for here. It forms small, round, light-brown spots with darker borders but, where running together or at the edges of the leaves, it may become more irregular in shape. In transmitted light the embedded, reddish, fruiting pustules can be seen when matured. No other stage has yet come to light. Small cankers at the base of the petioles sometimes cause defoliation and the smaller branches are also infected and so carry the fungus over the winter.

One or two sprayings on the growing leaves with perhaps one later should control the trouble. If feasible cut off the infected twigs.

Black mold, *Fumago vagans.* This trouble has been seen a number of times and was reported from a city park as prominent on the trees there. The imperfect fungus shows as a black growth of mycelium covering the surface of the leaves and evidently gets its start following lice injury as it is not a parasite but develops in the honey dew of the latter. Between the lice injury and the shading of the leaves by the fungous coating, the leaves may drop prematurely but even if they do not their appearance is greatly marred. Control the lice.

Locust

Leaf spots and wood rots. Both the black and honey locust are found here, but as yet no parasitic fungi have been reported on them. These fungi, elsewhere, are chiefly leaf spots and parasitic or saprophytic wood-rots of various kinds and no doubt some of them occur here. We have seen one or two of the latter on dead limbs of *Robinia Pseudo-acacia.*

Lupine

Powdery mildew, *Erysiphe Polygoni.* We found this mildew once very abundant on wild specimens of *Lupinus perennis* and since this is occasionally grown in flower gardens it may appear there. The leaves were abundantly coated with the white mycelium and conidia and the perithecia were also numerous and conspicuous. *See* Clover.

Rhizoctonia rot, *Rhizoctonia Solani.* The only trouble we have seen on cultivated Lupinus was a root rot sent us by a nursery company in 1932. The sole fungus we could find on the roots of the plants was the above species. This may not have been entirely responsible, since Dr. McCormick found some signs of insect work, and there has been another soil fungus that has been reported elsewhere causing damage. *See* Potato.

Mangel

Crown gall, *Bacterium tumefaciens.* Mangel is merely a variety of beet called *Beta vulgaris macrorhiza* and so has practically the same troubles. The crown gall has been seen once as a conspicuous gall at the top of the roots. *See* Rose.

Leaf spot, *Cercospora beticola.* The leaf spot is commonly found on this host and occasionally is rather prominent. *See* Chard. (Fig. 38.)

Root rot, *Pythium debaryanum?* This has been seen by the writer but once in a mangel field after the roots were dug but the injury was noticed earlier by the grower through the wilting and yellowing of the leaves. The injury came because of a serious rot of the tap roots, apparently starting in small, side roots in the ground and working into the tap root, always below and rarely reaching into the crown. The rot was favored by the wet summer and low ground of most of the field. While the mycelium seen in the edge of the infected tissues was of the type of the above fungus no spores were found in the infected plants, so there was the possibility that it may have been a related fungus that has been reported elsewhere on this host.

Once a field shows this trouble, it should not be planted with a similar root crop for some years.

Scab, *Actinomyces scabies.* Sturgis in 1896 reported as high as 40 per cent of scab on mangels planted in infected soil. *See* Potato.

FIGURE 37. Lettuce drop rot.

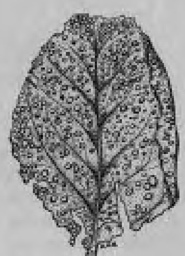


FIGURE 38. Mangel leaf spot.

FIGURE 39. Maple leaf scorch.

Maple

Anthracnose, *Gloeosporium saccharinum.* We have collected specimens of injuries caused by Gloeosporium on the leaves of Sugar (*Acer saccharum*), Norway (*A. platanoides*), and Japanese (*A. japonicum*) maples. The general appearance of the spores is about the same, though the type of injury to the leaves may vary somewhat with the different hosts. A number of species of Gloeosporium have been described on the various maple hosts, but until we have reason to believe they are distinct we shall consider them as one, as indicated by the above name.

The common type, most often found in the hard maple, is the irregular, greenish-brown but finally reddish-brown, dead area reaching from the leaf margins inward, often following the ribs, and isolated smaller spots within the green tissues. On the Norway maple we have seen specimens where the injury was confined to long, narrow lines on either side of the midrib or larger veins. On Japanese maples the injury is often in smaller spots or irregular specks scattered in the leaf tissues. Frequently it is difficult to find the small, embedded, fruiting bodies of this imperfect fungus. When this is the case and the injury is largely confined to the margins of the leaves, it is hard to distinguish anthracnose from sun scorch.

Apparently the asco stage has not been found on the old infected maple leaves, but it is just as well to burn these in the fall. While not usually serious, except in wet springs or early summers, spraying as for the similar sycamore anthracnose should prove effective.

Canker, *Tubercularia vulgaris.* This imperfect stage of *Nectria cinnabarina* has been found on the dead twigs of the Japanese maple, *Acer palmatum,* probably following other injury. *See* Elm.

Heartwood rots, *Fomes applanatus,* etc. Our impression is that the Fomes fungus is the chief heartwood rot of our maple shade trees. However, the fruiting stage, of this our largest woody, poroid, shelf fungus belonging to the Basidiomycetes, is not always present to identify it as the cause. Other fruiting fungi that have been found on living maples and which may be responsible at times for this or sapwood rots, are *Fomes connatus, Hydnum septentrionalis, Pleurotus ostreatus, P. sapidus* and *Polyporus squamosus.*

For treatment at least clean out all the dead wood, allow complete water drainage and cut back the bark properly to facilitate new cambium on all the sides.

Leaf spot, *Phyllosticta minima.* Leaf spot of maples, while usually less serious than the anthracnose, is more common especially on nursery and forest trees. As with the former fungus more than one species has been reported on the same and different hosts but those found here are included under one species until more definite information concerning their difference is shown. The spots are small, usually about one quarter of an inch in diameter, light to reddish-brown, often when mature with a lighter center and a darker border. They show the small, black, fruiting pustules most prominently, when present, on the upper surface. No other than this imperfect fruiting stage is known. The fungus has been found on the box elder (*Acer Negundo*), red (*A. rubrum*), soft (*A. dasycarpum*), hard, sycamore (*A. pseudoplatanus*) and Norway maples.

No spray treatment is usually necessary; it can do no harm to rake and burn the old leaves.

Powdery mildew, *Uncinula circinata.* The conidial and mycelial development on the surfaces of the leaves may show as a scattered or a more dense, white growth. The perithecia are more conspicuous and larger than others of these "hooked" species and are found chiefly on the under side of the leaves, often without much evidence of the mycelium.

No special treatment is necessary, though it may help to burn the old leaves.

Tar spot, *Rhytisma acerinum.* This Ascomycete is easily distinguished on the leaves where it produces one to several, tar-black blisters, like finger prints, on the upper surface but which beneath are cupped and less marked in color. It is abundant on soft, especially the cut-leaf variety, and red maples. It is found also in the woods where another similar species with less evident spots likewise occurs. The fungus produces an inconspicuous but questionable spore stage on these blisters but it is only after the leaves fall and pass the winter that the true asco spores mature.

The usual preventive treatment is to rake and burn the leaves in the fall.

White mold wilt, *Cristulariella depraedans.* So far this newly discovered trouble has been confined to the woods where small shaded trees, under variable moist and hot weather conditions, have developed it. The leaves first develop grayish areas or spots as if from a scorch but later may change color and drop off. The inconspicuous, fruiting stage of this imperfect fungus may show as a few, white heads, the size of a small pin head, on the under side of the leaves especially on the veins.

Wilt, *Verticillium alboatrum?* There seems to be some doubt as to just what species causes the wilt of the maple. In this country it is referred to as Verticillium sp., while in Europe it is designated specifically as given here. We have found the injury here chiefly on Norway maples. These show the trouble by dropping the withered, green leaves and then the branch bearing them may die and this may be followed by the gradual death of the whole tree. No fruiting stage shows on these since the trouble comes from a fungus whose mycelium and spores are borne internally in the woody tissues. The injury there cuts off the water supply with resulting dropping of leaves and death of the branches. Some believe, however, it is the toxins, developed by the action of the fungus, that is the cause of the death of the leaves when they reach them, rather than the cutting off of the water supply. It can be detected by cutting across the small stems, when its presence is indicated by the dark-green areas in the sap wood. *See* Barberry and Raspberry.

We have seen several adjacent trees where the trouble seemed to spread from the first affected though unfavorable soil or other conditions may have had their influence. We have also known of trees where a single branch only became affected. In any case it is well to prune off all infected branches and cut down severely injured trees and burn all the rubbish.

Fasciation. In 1932 a tree man showed us a specimen of red maple where the one year's growth showed a flattening about two feet long which was an inch wide but only a quarter of an inch thick, with the divided, elongated flattened ends somewhat curved. *See* Asparagus.

Knots and Bunched sprouts. These are not uncommon on street trees that in some way have been injured, often probably by local winter injury in the bark chiefly on the main trunks. The injury has stimulated unusual growth in abnormal ways, usually inducing bud formation, that continues year after year so that there remain these large gall-like growths or closely clustered, small twigs that may increase in number but where none gain ascendance over the others.

Leaf scorch. This trouble particularly on hard maples may suddenly occur when moist or wet weather, especially in the spring, is quickly followed by bright sunshine or it may result from severe dry weather, certainly where there is root injury to the trees. Whipping winds when the leaves are young may add to the injury. The leaves turn reddish-brown in irregular areas from the margins inward. Such injury is often difficult to tell from spray, smoke or gas injury and even in some cases from the anthracnose trouble, unless the investigator knows of the probable cause. In occasional years the trouble is so general that some people have become alarmed for fear some new disease is at work. On the injured leaves which usually adhere to the trees, certain saprophytic fungi in wet weather may appear which to those uninformed might be considered the real cause. It is usually difficult to determine in old shade trees why one or more show the trouble when others nearby remain normal, but perhaps the secret lies buried in the roots or soil. (Fig. 39.)

Transplanted trees should have good fertilization and plenty of water under a mulch covering to insure rapid new growth to supplant the mutilated roots. In very dry periods occasional heavy night watering of valuable trees might be advisable. Fertilization in some cases might also help.

Oil injury. This is apt to occur when certain miscible oils are used without care on dormant hard maples to kill definite insect pests. The oil may penetrate the bark and kill the cambium in such cases.

Staghead. This is a general term we apply, chiefly to hard maples, where the large, central branches gradually die, often from causes not readily made out on careful examination. Girdling borers are sometimes the rather inconspicuous cause.

Decay of the wood of these dead branches always results, caused by fungi often with no evident, woody, fruiting bodies. Such branches should usually be removed before or after death and the cuts properly treated, but their removal is apt to result in a poorly shaped tree. Fertilization should stimulate new growth more quickly.

Steam roller burn. A common injury seen along the highways that are lined with trees, especially in cities, are the burned leaves due to the steam rollers used in fixing the pavements, etc. This injury is especially common on the maples whose branches just reach above the smoke stacks of these rollers. The heat from these kills the leaves, particularly where the rollers are under them for some time. Possibly also there is some injury from the coal smoke when the leaves are wet. Usually the injury is a temporary one limited to the death of the leaves but sometimes the branches are also injured or killed.

There should be more care used by the owners and attendants of these rollers that this injury be limited to the least possible amount.

Mignonette

Leaf spot, *Cercospora Resedae.* In greenhouses and gardens this trouble of *Reseda odorata* occasionally appears on the leaves as numerous, small, light-brown spots, sometimes with a slightly darker border. When in fruiting condition these spots are often covered with a dense growth of the fruiting threads and their lighter-colored spores. No asco stage of this imperfect fungus has yet been reported.

If suspicious of the trouble, start spraying the plants, when young, with Bordeaux.

Rhizoctonia rot, *Rhizoctonia Solani.* This fungus is rarely found in greenhouses, rotting the roots. *See* Potato.

Millet

Smuts, *Ustilago Crameri,* etc. While this smut sometimes causes considerable injury where Hungarian millet, *Setaria italica,* is commonly grown, we have seen it here only a few times and then in only small amounts. The spikes are changed into black, smutty masses by individual infection of the interior of the separate spikelets.

This smut can be controlled by seed treatment if desired.

On the Japanese millet, *Echinochloa frumentacea* (*E. Crus-galli edulis*), two entirely different smuts (*Ustilago Crus-galli* and *Tolyposporium bullatum*) are also found here but these are of even less importance.

Mockorange

Crown gall, *Bacterium tumefaciens.* Crown gall has been reported once on Philadelphus sps. in a nursery. *See* Rose.

Gray mold, *Botrytis cinerea.* On this host the gray mold has been seen rarely on young leaves and twigs in wet weather of spring. *See* Geranium.

Monkshood

Crown rot, *Sclerotium Delphinii.* Crown rot is not uncommon on Aconitum species under conditions described under Larkspur, *q.v.*

Rhizoctonia rot, *Rhizoctonia Solani.* The rot was found once on the roots of this plant. *See* Potato.

Mountain Ash

Crown gall, *Bacterium tumefaciens.* This trouble has been seen only rarely in nursery inspection on the above host. *See* Rose.

Fire blight, *Bacillus amylovorus.* While this is a known host and has been reported here once or twice, a more critical examination of specimens as to the cause is needed. *See* Pear.

Rust (leaf), *Roestelia globosa.* This rust has been found rarely in the northwestern part of the state; however, it may become prominent there on individual trees. It is claimed by some that the leaf rust on Mountain Ash, *Sorbus americana,* in northern New England and Canada is a different species, *Roestelia cornuta,* from that found in southern New England, hence we have placed our specimens with the latter species, known as *R. globosa.*

Looking at specimens collected in both regions the chief differences we note are that the northern ones have shorter, stouter, more pointed and permanent peridia on larger, thicker spots. In these respects our few specimens from Connecticut show peridia more like those on Crataegus, the common host here for *R. globosa.* The available host of the III stage of *R. cornuta* in the north is only the juniper while here both juniper and red cedar are available but the III stages on these are usually quite distinct. Further infection work with these III stages on mountain ash is needed. *See* Hawthorn.

Mountain Laurel

Leaf spots, *Cercospora Kalmiae, Phyllosticta kalmicola, Septoria kalmicola, Mycosphaerella colorata.* All three of these imperfect fungi and the last or sac fungus have been found on the leaves of the mountain laurel, *Kalmia latifolia,* both wild and cultivated, but, since the spots they produce are apparently so similar and often lack a fruiting stage, we merely give here a general description covering all of them. The spots are small, about one-quarter of an inch in diameter, round, at first purplish, but finally white, gray or brown in the center but always with an evident purplish border of variable width. Sometimes these spots are so abundant that they kill the tissues between them and at the same time greatly mar the appearance of the infected plants.

As the leaves carry over the winter on the bushes, the spots show at all times of the year. It may be that one of these imperfect fungi may be connected with some asco stage, as the one already found on the leaves, but detailed study is needed to bring out all the facts.

In the late spring and early summer of 1932 we found the Ascomycete given here had matured and was common. Many complaints had been received the previous six months of this spot disease. It seems to us that this Ascomycete is largely responsible for most of these leaf spots. The badly infected leaves were often shed in the early summer but new infections on the young leaves apparently take place from these and those still remaining on the shrubs, under favorable weather conditions.

As this is the state flower and is frequently grown in cultivation, information is sometimes asked for control of these leaf spots. While no very definite experiments have been tried by us, our judgment would be that spraying with Bordeaux with a potassium-oleate sticker would prove helpful but might require time to get rid of the badly infected leaves that act as sources of infection. We would suggest three sprayings beginning on the young leaves in the spring and continuing up to the blossom period, with perhaps one afterward. These treatments should be repeated each year until the trouble becomes inconspicuous. The potassium-oleate Bordeaux stuck to the leaves a long time for us where we used it on these plants. One should also rake up and burn the old leaves after they fall in the spring.

Scorch. This trouble shows a reddish-brown, dead area reaching from the edges of the leaf inward. Sometimes the trouble is due to winter injury since the leaves adhere to the bushes throughout the year or longer. At other times it may come as a sun scorch on plants in the open or those subjected to hot sunshine from one direction, while protected on the other sides by buildings.

We believe in a soil mulch to hold water in the ground in summer and to protect the roots in winter. This also should favor an acid condition of the soil that these plants seem to need. If necessary water the plants through the mulch in summer, and in winter give extra protection to the parts above ground.

Mulberry

Bacterial spot, *Bacterium Mori.* This is the only disease we have found on this host, *Morus alba* or *rubra,* and then just once in a nursery. It makes small, irregular, reddish-brown spots on the leaves which have a pellucid appearance when wet. On the young twigs it shows as small cankers that may run together and gradually girdle the same, producing a stunted growth of the twigs and sickly, yellowish leaves, or it may gradually heal over showing as a rough swelling on the bark.

The trouble in this state is so unusual that merely cutting out the infected twigs, raking together the leaves and burning both, should ordinarily take care of the trouble without spraying.

Muskmelon

Anthracnose, *Colletotrichum lagenarium.* Anthracnose appears occasionally on both leaves and melons of *Cucumis melo* but not as bad as on watermelons, *q.v.*

Bacterial angular spot, *Bacterium lachrymans.* This bacterial spot has rarely been seen on the leaves. *See* Cucumber.

Bacterial soft rot, *Bacillus carotovorus.* We have seen this only occasionally as troublesome on melons. While a similar disease of the fruit has been described elsewhere as *B. melonis,* it does not seem that the trouble is distinct from the ordinary soft rot. *See* Iris.

Bacterial wilt, *Bacillus tracheiphilus.* This bacterial wilt in certain seasons is troublesome but not so bad as on squash, *q.v.*

Black mold blight, *Macrosporium cucumerinum.* Years ago this trouble was called to the attention of the public by Sturgis of this Station and identified as *Alternaria Brassicae* var. *nigrescens.* It is an Alternaria rather than a Macrosporium and the spores approach those of *A. Brassicae.* We have found it occasionally during the past thirty years but more frequently earlier than recently. It can cause considerable damage but usually not so great or as often as does the downy mildew on this same host. The spots on the leaves, where the damage is done, are quite similar for the two. With this one conspicuous, round, reddish-brown spots may show some indications of concentric rings of growth and a very limited amount of the black fruiting threads and spores. No other stage is known. It also occurs less frequently on the watermelon.

The treatment should be the same as for the downy mildew.

Downy mildew, *Peronoplasmopara cubensis.* This is the disease that fifteen to thirty years ago nearly ruined the muskmelon industry in the state. While not so common in recent years, it still is the chief pest with which melon growers have to deal in spraying. It attacks all of the varieties grown and is about as bad on the cucumber, both garden and greenhouse varieties, on which it usually gets an earlier start. It also occurs less prominently and plentifully here on squash, pumpkin, bottlegourd and watermelons. This fungus has been found only on the leaves where it produces usually conspicuous, round or somewhat angular spots, varying from light to reddish-brown according to their age and the host infected. When the disease is abundant, these leaves wither up and the vines often die before they mature their melons. Even melons that do mature on such vines are usually of very poor quality as to taste.

The fungus develops a rather scanty growth, on the under side of the spots, of its tree-like, white conidiophores bearing the large conidial spores at their tips. These spores are purplish in color and give this tint to the infected spots, especially at the edges when wet weather favors their abundant production. Just how the fungus passes the winter here is not surely known as search has failed to reveal the oospores of the mature stage. Of course, in some cases, it might hold over in greenhouses in its conidial stage but its presence there is infrequent. Presumably it advances here gradually from infected plants grown in the south, which may account for its variable appearance. However, the oospores have been found recently more or less abundantly in the leaves, especially the upper leaves, in Japan by Hiura and Kawada (Jap. Journ. Bot. 6:507–513, *Illust.* 20 D. 1933). This means that a further search should be made for them in Connecticut. (Fig. 40.)

The mildew, on both the melon and cucumber, is usually controlled by spraying with Bordeaux; but the treatments should start on the vines when they first begin to run and be continued up to the end of the season. This requires treatments from one to two weeks according to the weather conditions.

Powdery mildew, *Erysiphe cichoracearum.* This other but very different mildew is occasionally seen in its conidial stage on the leaves in late summer and causes no particular harm. *See* Phlox.

Scab, *Cladosporium cucumerinum.* The scab trouble is conspicuous only on the fruit where it shows in wet weather as small, sunken areas with the dense, olive-green, fruiting threads. *See* Cucumber.

Seedling rot, *Pythium debaryanum.* It is found rarely. *See* Spinach.

Bordeaux injury. Sometimes in bright, hot weather the leaves of this plant will show a whitish or yellowish area at their margins merging into the normal green color. Similar but more pronounced injury frequently shows on vines sprayed with Bordeaux and may hinder the vigorous growth of the same. When this is likely to occur we suggest that the spraying be confined to the cooler and less bright days or made only in the late afternoon. Some try to reduce this trouble, without much success, by the use of a weaker Bordeaux or a reduced amount of copper sulphate.

Growth cracks. The melons sometimes show this trouble when dry weather is followed by a favorable, wet period developing a rapid growth of the melons with a resulting cracking in the rinds especially at the blossom end. Different varieties vary considerably. *See* Snapdragon.

Mosaic. This virus disease is seen occasionally but is not nearly as bad as on the cucumber, *q.v.*

Mustard

Clubroot, *Plasmodiophora Brassicae.* Apparently little mustard (Brassica sps.) is grown in the state. Occasionally it is grown for seed purposes and sometimes the Italian farmers plant it for greens. So far we have seen only two troubles on mustard, the species of which we have not determined, the first and chief one being this trouble on the roots as described under Broccoli, *q.v.*

Downy mildew, *Peronospora parasitica.* This is the second trouble, seen here in 1932, in a vegetable garden of greens where it was doing no especial harm. We have seen it more abundant, however, on wild mustard and charlock. *See* Turnip.

Narcissus

Bud blight. We have had complaints, especially of certain double varieties, that after they produce the blossom buds these fail to develop further, remaining enclosed in the spathes and finally dying. Our entomologists have found no insect responsible for this trouble. Competent observers claim it is not a frost injury. Our examination of the injured tissues has so far failed to reveal the mycelium of a fungus as a possible cause. In at least two cases that came to our attention, the plants showed this trouble only after they had been transplanted to another place. We have no explanation of the cause.

Running out. The failure of certain Narcissus species to blossom after growing a number of years in the same place is not an uncommon trouble. See Daffodil.

Oak

Anthracnose, *Gloeosporium canadense.* This disease is considered by some as identical with the sycamore anthracnose and it has a similar effect on the oak hosts, although these belong to quite a distinct family from the former. The fungus carries over winter in its imperfect stage on the small twigs, but it is the young leaves in the opening buds or as they grow to maturity that suffer the greatest injury. We have not yet seen the asco stage. The oak most frequently and seriously injured here is the white *(Quercus alba)* but the fungus has been reported on the scarlet (*Q. coccinea*), swamp (*Q. palustris*), chestnut (*Q. Prinus*) and black (*Q. velutina*) oaks. *See* Sycamore.

Chestnut blight, *Endothia parasitica.* This fungus rarely occurs here as a weak parasite causing no harm on the white (*Q. alba*) and red (*Q. rubra*) oaks. A similar but entirely saprophytic species, *E. radicalis,* has been found on the red oak.

European canker, *Nectria galligena.* This has been collected on *Q. rubra* and *Q. velutina* in this State. *See* Birch.

Leaf curl, *Taphrina caerulescens.* This fungus forms large, somewhat thickened, whitish to brownish, eventually dead spots on the leaves. When fruiting there is a purplish tinge or bloom on the lower surface where the fungus is confined. In time the spots become cupped and wrinkled below. The trouble becomes noticeable in late spring or early summer and has been found here on *Quercus alba, Q. Prinus, Q. rubra* and *Q. velutina.* The last named is the most frequent host.

Spraying the trees just before the buds open and perhaps again on the new young leaves apparently should control the disease, since it is related to the peach curl where this treatment is effective.

Leaf spot, *Marssonina (Marssonia) Martini.* In 1914 this was reported once on *Quercus alba* from Pomfret. Probably it is not uncommon in the woods on this and other species of oaks. It forms a definite, circular, brownish spot with a narrow, purplish border and is one-eighth to one-quarter of an inch in diameter according to the species of oak on which it occurs. On the under side is the fruiting stage of this imperfect fungus which oozes a yellow globule containing the elongated, somewhat curved spores usually showing a septum at their center. This genus is closely related to Septogloeum under which it is placed by some authorities.

Powdery mildew, *Microsphaera Alni.* The mildew is not uncommon on the leaves, especially of sprout growth. *See* Lilac.

Rust (Pine-Oak), *Cronartium Quercus.* This fungus has been found here but once on the trees of an estate along the sea-shore. It was not serious in this case as only the III stage developed for some unexplained reason. The leaves had few to numerous infections but showed only inconspicuous yellow spots above while below were the reddish-brown, hair-like, telial columns of the III spores. The II stage when it does appear, shows before the III stage as more or less numerous, small, yellowish outbreaks on the under side of the leaves also. The disease was limited to the general vicinity of the small, infected, wild pines of *Pinus rigida* that earlier produced the I stage. Only leaves of the *Quercus velutina* and *Q. coccinea* were infected though *Q. alba* and *Q. Prinus* were equally exposed. *See* Pine.

Stem canker, *Strumella coryneoidea.* This trouble so far has been found only in the woods but according to some observers is a somewhat prominent one in certain situations. It shows as a large canker eating out the bark and outer layers of the wood. Usually only a single canker is found on a tree, generally above reach on the main trunk. The rotting wood at this spot so weakens the tree that it is often broken off there in severe storms. The fruiting stage that is said to cause this trouble is not very evident and sometimes cannot be found on the canker. It forms conspicuous, fruiting pustules of the above imperfect fungus which to the writer seem hardly likely to cause a serious wood rot. At times it almost appears as if the trouble might be started as a winter or other injury opening the way for entrance of spores of some wood-rotting Basidiomycete. Wet locations favor the trouble apparently. So far it has been found here by the writer on *Quercus alba, Q. rubra, and Q. palustris,* with the last the most frequent host. An infected tree should be cut and used for fire wood.

Wood rots, *Polyporus sulphureus, Fomes igniarius.* These are the only two poroid fungi that we have found on the living oaks, though perhaps others, as *Fomes applanatus,* may be responsible for rot of the old wood as they have been found on the dead oaks or on their logs. The Polyporus is a conspicuous, at first fleshy and then corky or harder, fungus, usually with adhering and overlapping shelves that are orange-red above and sulphur-yellow on the porous, lower surface. We have found it apparently on injured trees where it may act only as a heart-wood rot.

The Fomes seems to be a sapwood as well as a heartwood rot and is sometimes seen at a definitely injured spot on the trunk, showing as an evident, roundish, hard, blackish-brown, gall-like growth that may not develop a fruiting surface for some years. It has been found here also on apple, butternut and a few forest trees.

Remove the fruiting bodies when found, and protect the bark of infected branches but use judgment in cutting when the disease occurs on the main trunk.

Drought injury. *See* Addenda.

Woody galls. By this trouble we do not mean the small insect galls that sometimes occur abundantly on the oak trees, but the conspicuous, hard, woody galls on the larger branches, usually showing on a single tree in the neighborhood. These spherical galls usually vary in size from that of a fist to that of a large head and have thick, rough bark and a solid, permanent, swollen growth of woody tissues that is abnormal in arrangement as compared with the rest of the branch. Similar but smaller and smoother bark galls occur on the hickory.

The galls result from some injury at these places but the cause is not definitely known since they are not supposed to be caused by the bacterial crown-gall organism to which they bear the most striking resemblance. They occur on shade and forest trees but do not seem to spread, at least not easily, on the infected tree and apparently not at all to adjacent trees.

If desired the limbs showing these galls can be removed, cutting them some distance below for safety, but the galls do not usually seem greatly to injure the infected branches.

Oats

Leaf spot, *Helminthosporium Avenae.* Oats, *Avena sativa,* are our chief, small, grain crop but the fungi on oats, or any of the similar crops, do not cause as much injury as they do in the larger grain-districts further west. Therefore our farmers do not generally find it necessary or advisable to take advantage of certain treatments used elsewhere. This particular disease has never been bothersome here and is merely found in a minor way on the leaves as small spots with a more or less evident development of this imperfect fungus as a blackish growth on the surface. The asco stage is said to be *Pleospora Avenae.* No treatment is required here.

Rust, crown, *Puccinia coronata.* This is the common rust of oats and is also found on a few wild grasses in the state. The I, or cluster cup, stage has been found here only once on wild specimens of Buckthorn, *Rhamnus cathartica.* The II stage is conspicuous in midsummer on the leaf blades of the oats, forming small, oval to linear, dusty, orange outbreaks usually numerous between the veins. The III stage appears later as similar pustules but with the black spores more permanently covered by the epidermis and so lead colored. This rust is considered less injurious than the next though much more frequent here.

Rust, stem, *Puccinia graminis.* This rust occurs on the leaf sheaths and stems causing the grain to lodge when abundant. *See* Wheat. (Fig. 41).

Smuts, *Ustilago Avenae, U. levis.* These two smuts are about equally common in our grain fields. They are similar in that both change the panicles of grain into black, dusty outbreaks. The former, however, completely changes the individual spikelets into olive-black masses that gradually wear away entirely, while the latter does not so completely destroy the spikelets but only their inner and basal parts where the dusty masses are more of a purple-black color. These dusty outbreaks are composed entirely of one-celled spores which in the first species are slightly roughened but in the second are smooth.

Seed treatment by sprinkling or dusting with chemicals, usually formalin or copper carbonate, will prevent infection in the succeeding crop. Here, however, as the loss rarely runs to five percent of the grain and usually is only one or two percent or less, seed treatment is rarely given.

Yellow leaf. In dry years growing fields sometimes show a large number of yellowed leaves. This is without doubt due to lack of sufficient moisture since there is never any evidence of bacteria or fungi on them or their roots.

Okra

Bacterial spot, *Undetermined species.* This trouble has been seen only once in August, 1922, at a seed farm in Milford. We have been unable to identify it with any described bacterial disease on this host. Its appearance on the leaves was very striking often causing evident, angular spots in the tissues but more commonly showing as lines following the veins and their branches. It produced a reddish-black discoloration of the infected tissues with a more or less evident yellowing surrounding the same.

Powdery mildew, *Erysiphe cichoracearum.* On Okra, *Hibiscus esculentus,* this mildew is found occasionally as a mealy, white growth of the conidial stage only. *See* Phlox.

Wilt, *Fusarium vasinfectum.* We have occasionally seen this disease in garden plants as they reach maturity. The leaves become irregularly yellowed and then dry up and drop off from the stems. This takes place from the bottom of the plant upward. A cross section of the stems shows discoloration of the bundles and microscopic examination reveals the presence of the mycelium of this fungus. The water supply to the leaves is gradually cut off and this results in their death.

Care in selecting seedlings from uninfected seedbeds and planting in garden soil not previously infected are the chief precautionary measures.

Onion

Black molds, *Macrosporium parasiticum, M. Porri.* Two different species of Macrosporium have been found on the stems and leaves of onions, *Allium cepa,* in this state that differ much in the microscopic appearance of their spores. These were both described by Thaxter years ago. The first one (called by him *M. sarcinula* var. *parasiticum*) he found on onions, especially seed ones, often following injuries by the downy mildew as a semi-parasite. It made a dense, black growth of the roughish, small spores on short pedicels. *See* Leek.

The second one with longer, more elongated, smooth spores, evidently an Alternaria similar to those found on potato and cabbage, he considered more of a true parasite. Further study is needed on these two imperfect fungi and the possible injury they may cause; both are also found on the leek. *See* Rept. **1889**:158.

Bulb rots, *Bacillus carotovorus, Fusarium* sp., etc. We have seen bulbs in storage rot from both of these causes, the former as an ill-smelling, wet rot and the latter less so but with evidence of mycelium in the tissues that allowed the successive layers to slip apart easily. While no doubt some of the onions are

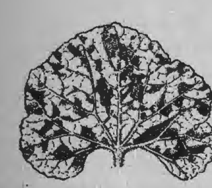


FIGURE 40. Melon downy mildew.

FIGURE 41. Oat stem rust.

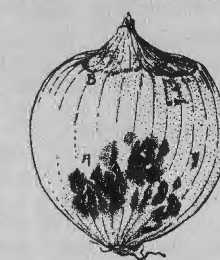


FIGURE 42. Onion smudge.

infected in the field and carry the disease into storage, lack of care in the manner of storing, as to depth in piles or crates and ventilation for heat and moisture, increases the trouble.

Rots of occasional plants by similar organism in the field, especially of seed onions, have also been seen. Such plants we have called yellow leg because of the premature yellowing of the stems due to the rotting of the bulbs and roots. Such plants are easily pulled from the ground because they lack firm roots to hold them in it and reveal the presence of the Fusarium or bacteria or both in the rotted tissues.

These troubles in the main result from an unfavorable season as regards excess of moisture, use of poor seed-bulbs or infrequency of rotation, two of these factors being under control of the grower.

Downy mildew, *Peronospora Schleideni.* While this may prove destructive it has rarely been found in this state, since we have seen it only twice in the last thirty years, and before that it was reported once by Thaxter. It forms whitish or yellowish spots on the infected tissues with usually a scant, white growth of the conidial stage that may become blackish because of the Macrosporium previously mentioned.

Sometimes it comes late in the fall with very wet weather, since in 1933 we found it causing considerable damage of plants in one field at Wilson, the leaves of which drooped down and died prematurely. The oospores are as usual hidden in the infected tissues but neither Thaxter nor the writer saw them in the specimens gathered.

Preventive measures are so doubtful and the fungus so rare that we have no practical suggestions to make here.

Gray mold, *Botrytis Allii. See* Addenda.

Rust, *Puccinia Porri.* We have never found the rust on the common onion but have seen it occasionally on the perennial Egyptian onion and on chives, *q. v.*

Smudge (Black spot), *Colletotrichum (Vermicularia) circinans.* This appears as more or less numerous, somewhat circular, black coatings, often with concentric rings of growth on the outer coats of the onion bulbs, being especially serious and conspicuous on the white varieties. It is an imperfect fungus whose mature stage is not known. It forms a black outer mycelium with erect, pointed, hairs covering a swollen base in which are produced the light-colored spores. It causes little or no rot but is objectionable on account of the black discoloration. (Fig. 42).

Part of the fungus can be removed by rubbing off the dry outer coats of onion. Some growers advocate dusting the onions in storage with dry lime. Storage should be under the best conditions to prevent development of the fungus by heat or moisture. Rotation is said to be helpful since the fungus can be carried over in the field.

Smut, *Urocystis Cepulae. See* Addenda. (Fig. 43).

Yellow leg mold, *Macrosporium parasiticum.* This has been seen as yellow or whitish spots on leaves and stems of seed onions which later become covered with the black fruiting stage of the fungus. *See* statement above under Black mold.

Abnormalities. Producing seed-onions, which are grown from large bulbs to produce seed from the flowers at the end of season, used to be quite a prominent industry in the Milford district of the state some years ago. Comparatively few fields, however, are now grown for that purpose. Under favorable conditions these large onions, often over two and a half feet tall, were a pretty sight when in full bloom in the fields but occasionally they produced scattered freak plants, especially in their blossoming stage, that are indicated by the following names with brief descriptions: *Bastard blossoms* indicate that instead of the normally, full, stiff-heads there was produced a flopping, weak head with more elongated pedicels bearing fewer flowers and little seed. *Bulblet heads* are those that instead of producing normal, flowering heads form bulblets in their place, as often occur with wild onions. *Double flower heads* produced two heads a short distance above one another. *Elongated spathe,* which at first normally encloses the young head and then withers up and dies, is one that continues to grow in abnormal size and pushes aside the head. *Goose neck* is where the stem turns down and then curves upward again, often making several crooks before it decides where to grow. *Growth cracks (white ring)* show one or more parallel white cracks across the stem so that it is easily broken at these places; *see* Snapdragon.

All of these troubles are due either to poor bulbs or abnormal weather conditions and are usually so infrequent that they cause little damage.

Blasted heads and Prematuring. In the past seed-onions in the state occasionally failed to produce a normal or even a paying crop. The trouble seemed to be tied up with the character of the season. These unfavorable seasons were not always wet ones or due to wet weather at unfavorable times. Sometimes the trouble was due to prematuring of the onions before they properly set their seed following hot weather. Sometimes wet or foggy weather caused a growth of the Botrytis fungus mentioned under Addenda. Under either condition the heads developed a minimum amount of seed at maturity.

We were never able to lay the trouble entirely to the fungus. However, we did conduct for several years tests with Bordeaux mixture and got some increase of seed yield. The onions were sprayed several times, especially on the heads, both before and after the seed was set. On the whole, however, it did not seem to be a practice that would prove of much benefit considering the difficulties of spraying a large field.

Brittle (Brown root rot). Years ago we investigated a trouble of seedling onions that we called "brittle" because of the brittleness of the young leaves which were also often curled or even spirally coiled. The trouble seemed to start in the roots and affected the seedlings so seriously that their later growth was also interfered with. The trouble appeared in spots in the fields and seemed to spread especially in those fields continuously used in growing onions.

While a small amount of the mycelium of a fungus, apparently a Fusarium, was found in some of the infected roots, this was never definitely determined as the real cause. The trouble was not due to a lack of fertility since extra complete fertilization failed to improve the growth of the seedlings in the infected land. Considerable improvement, however, was seen by the use of formalin, lime and sulphur, especially the former, when applied to the soil before planting the seed. On the whole it now seems to the writer after his experience with a somewhat similar trouble of young tobacco plants, known as brown root rot, which also responded to formalin soil treatment, that it was one of those obscure soil conditions where response of the roots to securing the proper chemical elements for their normal growth was interfered with, resulting in their premature death, rather than that the trouble was due to any direct attack by a definite fungus. Although our reports do not state that the roots were reddish-brown in color it is our impression that such was the case as with the tobacco seedlings in their early stage.

Hail injury. As with other vegetables we have seen severe injury to onions, especially seed-onions, due to hail storms in midseason. The hail stones hit the large stems producing injuries that soon showed as white spots. Usually the direction from which the storm came could be told by the side of the stems on which the spots were evident. *See* Tobacco.

Orchard Grass

Ergot, *Claviceps microcephala.* This smaller ergot has been seen rarely in the heads of this host. *See* Timothy.

Rust, *Puccinia graminis.* Besides the above this is the only other fungus so far reported on orchard grass although it is quite likely that smut, *Ustilago striaeformis,* occurs here. *See* Timothy.

Pachysandra

Anthracnose, *Volutella* sp. The only disease we have seen on *Pachysandra terminalis* was brought in from one of the yards at Yale University where it was causing some trouble, mostly on recently transplanted plants. The disease was most conspicuous on the stems which had been cut back, the fungus working down on these as a dark-colored, dry rot and in time showing the fruiting stage as evident, flesh-colored pustules with an abundance of spores and occasional setae.

Evidently the disease came from the lower, old, yellowing leaves on which the fungus generally worked down from their tips causing a dark to light-brown spotting. Some of the leaves had apparently been injured at the tips by sun scorch. The fungus eventually produced on their under side the flesh-colored pustules of the spores, especially if kept in a moist place a short time.

The spores were hyaline, elongated, guttulate and chiefly 14–18μ in length by 2–3.5μ in width. They were more or less pointed and were borne on the exposed conidiophores which were about the same length or a little larger. We were unable to find any definite mention or description of this disease in literature, except we did learn of an article in Mycologia **21**:137, published by Hutchinson of a new species described by him as *Volutella Pachysandrae.* This agrees somewhat with the symptoms of our disease but his statement that the spores are 2.3–6.1μ by .9–2.4μ seems to indicate that he had a different species unless in culture he got a much smaller development of the spores than we did on the leaves and stems of the living plants.

The fungus acts as does a weak parasite but if it should become troublesome the diseased stems and leaves should be cut off and destroyed and a Bordeaux spray applied beginning fairly early in the spring and following with one or two further treatments.

Palms

Bitter rot, *Gloeosporium rufomaculans.* This stage has rarely been seen on Kentia palms in greenhouses, attacking the leaves usually at their base and causing the tip to turn yellowish and gradually die. The fungus produces small, black, circular, fruiting bodies which ooze out the pinkish spores.

Cut off the outer leaf or two, if badly infected, spray with Bordeaux and stimulate new growth by fertilization. *See* Apple.

False smut, *Graphiola Phoenicis.* This has been seen in greenhouses and especially on imported plants of date (*Phoenix dactylifera*) and other palms. It shows on the leaves as small, cup-shaped, black elevations with a whitish top from which the spores are later liberated.

On the whole the fungus acts here as a weak, inconspicuous parasite but if it should become troublesome the diseased stems and leaves should be cut off and destroyed.

Pansy

Anthracnose and Leaf spot, *Colletotrichum Violae-tricoloris* and *Cercospora Violae.* These are two leaf troubles on *Viola tricolor,* very similar in appearance, producing discolored spots, finally usually whitish and often with somewhat colored borders, on which the fruiting threads may show as a more or less evident, blackish growth. The spots may be variable in number and even appear sometimes on the petioles and stems. It usually takes the microscope to distinguish the species, the first producing sterile, black setae or spines among the conidiophores and spores. They are prominent on greenhouse and garden plants, especially on the latter in wet seasons.

Their treatment is the same, spraying with Bordeaux mixture, best with potassium oleate as a sticker and spreader. If the plants are grown out of doors to be later taken in the greenhouse, it may pay as a precautionary measure to spray them even if no disease shows. If it does appear there or later in the greenhouse, pick off the worst infected leaves, be careful of watering and spray once every week or ten days to protect the new growth until danger is past.

Black root rot, *Thielaviopsis basicola.* This has been reported a few times on the roots, which may become badly infected, of pansies in gardens and probably also occurs in greenhouses. *See* Tobacco.

Damping-off, *Pythium debaryanum.* So far damping-off has been found on this host caused only by the above fungus but it has not usually been bad. *See* Spinach.

Parsley

Drop rot, *Sclerotinia sclerotiorum.* We found this trouble once on this host, *Petroselinum hortense,* in a greenhouse where the soil had become contaminated from drop rot on lettuce. It also became prominent on this host, the mycelium showing as an evident growth on the dead leaves at the base of the plants and also around them in the ground. *See* Lettuce.

Leaf blight, *Macrosporium Carotae.* We have recently seen one doubtful case of this trouble on parsley. *See* Carrot.

Leaf spot, *Septoria Petroselini.* This in appearance is very similar to the late blight of celery to which it is also closely related, the latter being once considered a variety of it, but on this host it has never proven as serious as that disease on celery. No perfect or asco stage is known. *See* Celery.

Parsnip

Bacterial soft rot, *Bacillus carotovorus.* We have seen this only in stored roots of *Pastinaca sativa* and then rarely. *See* Iris.

Leaf spot. *Cercospora Apii* var. *Pastinacae.* This is another case, similar to that cited under parsley, where a host and its fungus are related to celery and one of its fungi, this time to the early blight of the latter plant. This relationship is indicated by the scientific names of the fungous species and variety, as given here, which are derived from the scientific generic names of celery and parsnip. In this case, however, the injury to the parsnip often is almost as great as that shown on celery. In the last ten years the fungus has been reported at least three years as prominent.

No treatments have been tried by the writer. Spraying as for the blights of celery, however, should prove helpful if thought necessary and if given in time.

Nematode rootknot, *Heterodera radicicola.* This eel-worm trouble has been found occasionally in market-garden crops out of doors. Usually not much harm is caused because of the severity of the winter climate which largely prevents overwintering of the nematodes. The appearance of the infected roots, however, is marred as well as being objectionable if the nature of the injury is known.

Infected fields when they do occur should be planted the next year with a crop whose roots are not used for food, such as cereals or grasses. *See* Cucumber.

Pea

Anthracnose, *Colletotrichum Pisi.* This trouble of *Pisum sativum* has been found in the state only during the past two years. It is undoubtedly closely related to the anthracnose of bean. While in one collection we saw the characteristic setae of Colletotrichum, in another these seemed to be lacking, thus placing the fungus under Gloeosporium. This is a situation sometimes seen with the bean anthracnose and apparently some writers have considered the two as the same disease. The trouble is most serious on the pea in early wet weather before the pods are ripened. It produces irregular or roundish spots on the leaves and lesions on the stems running down even to the roots. We have not found the fungus as yet on the pods where it is said to occur. The plants are sickly and fail to grow to full size and produce, when bad, a very poor crop. The injury apparently opens the way for other stem and soil fungi to increase the damage. No perfect stage is known and the fungus has not yet been found carrying over on the seed.

In the case specially examined by us, the seed used appeared to be excellent and was planted on new land and the grower had not had previous trouble of this sort. This year, however, most of the peas on his old and new soil did not come up to standard, so the season, possibly the variety Laxtonian also, was a prominent factor in the failure. Attempts by us to lessen the trouble after it got a fair start by spraying with Bordeaux were not successful.

Black root rot, *Thielaviopsis basicola.* While we have found this fungus twice on the roots of garden peas, in both cases the Pythium fungus was also present. We believe that either of these fungi could have caused the rot and have no doubt that the former sometimes occurs here on the pea roots without the latter. *See* Tobacco.

Blight, *Ascochyta Pisi.* In contrast with the anthracnose of pea this is one of the old troubles of this host but it acts almost as seriously in some regions. With this fungus the chief injury occurs to the pods. While the usually whitish, circular spots with the embedded black, fruiting pustules appear more or less prominently on the leaves and stems, they become more evident, numerous and consequently injurious as sunken spots in the pods. In contrast with the preceding fungus the asco stage of this imperfect fungus has been found on the old, dead stems and is known as *Mycosphaerella pinodes,* though as yet we have not found it here. The fungus also carries over on the seed and the old stubble reproducing the conidial stage in the spring.

There have been so few complaints against the fungus in this state that we have never tried to prevent it by spraying. Writers state this is usually not very successful. On the other hand rotation and the use of clean seed give the best results.

Powdery mildew, *Erysiphe Polygoni.* So far we have seen this fungus only in its conidial stage as a white, more or less conspicuous coating on various parts of this plant but usually causing little serious injury. *See* Clover.

Root rot, *Aphanomyces euteiches.* Apparently from Jones and Drechler's investigations, this is the chief fungus of market garden peas which here in wet seasons rots the roots and produces sickly, spindling plants. The oospores that occur in the tissues of the rotted roots are so similar to those of *Phytophthora cactorum,* also found here, that the latter may be mistaken as the cause although it has a somewhat different life history.

Rotation, good seed, the use of the least susceptible varieties, as Horal, and frequent cultivation to dry out the wet top soil seem to be the best preventive measures.

Root rots, *Pythium debaryanum, Rhizoctonia Solani* and *Fusarium.* sp. All three of these fungi act much as does the preceding one in rotting the roots and stems just at and beneath the soil. The infected plants are generally stunted, turn yellow and usually die before they have produced the pods. Wet weather and too deep covering of the seed aid these fungi, commonly present in the soil, to take advantage of these conditions. Usually a microscopic examination of the rotted tissues is necessary to determine the particular fungus that causes the trouble and sometimes two are found to be present.

These root rot troubles have been seen chiefly in small garden plots and treatment may be given there as described under similar troubles of Sweet peas.

Fertilizer burn. We have had a few complaints of cases where the roots and base of the peas turn reddish-brown and die as if from one of the preceding fungi but with no indication of their presence either through mycelium or spores. In such cases it usually happens that the chemical fertilizer, applied either in drills or broadcast in the furrows, has come into too close contact with the germinating seed as it pushes up through the soil with resulting injury to the tender tissues. Usually the grower blames the character of the fertilizer rather than the manner of its application as the real cause of the trouble. Sometimes the seed fails to germinate under such condition. We have experimentally produced similar trouble with a chemical fertilizer scattered over the seed in the furrow.

FIGURE 43. Onion smut.

FIGURE 44. Peach brown rot.

FIGURE 45. Peach curl.

Peach

Bacterial leaf spot, *Bacterium Pruni.* This trouble of *Amygdalus Persica* was first found in this state on the peach leaves about the time that the late Dr. Smith first described it on the green fruit of plums elsewhere. The damage here is chiefly to the leaves showing as small, reddish-brown spots that when wet are semi-pellucid and often fall out later, giving the shot-hole effect. When abundant the leaves often turn yellow and fall off the trees. While the germs carry over on the twigs and sometimes cause small, sunken spots in the fruit, on neither of these are the injuries conspicuous. *See* Plum.

Brown rot, *Monilia cinerea.* The brown rot is the worst trouble of peaches in this state being bad on early varieties and especially so in wet seasons when the fruit ripens. It also forms its asco stage on the old mummies half buried in the ground. For details *see* Cherry. (Fig. 44.)

In May, 1933, it was very bad at the blossom time, killing the flowers and invading the young branches. It also developed its conidial spores abundantly on the infected leaf-curl leaves that occurred commonly that year. This was unusual.

Crown gall, *Bacterium tumefaciens.* This is found here chiefly on nursery stock but does not seem to cause much damage in the orchards. *See* Rose.

Die back and Dead limb fungus, *Valsa leucostoma* and *Cytospora Persicae.* We have seen one or two cases in exposed orchards where evident cankers, on the small and large limbs often at the base, were not due to the brown rot fungus but showed the above Ascomycete or its probable conidial stage Cytospora. However, we have had the suspicion that these cankers may have had connection with winter injury, especially since the Cytospora is not uncommon on dead limbs or trees where it was not the cause of death and was evidently a saprophyte.

Frosty mildew, *Cercosporella Persicae.* While Thaxter years ago once reported this trouble so prominent on an orchard tree that defoliation took place, the writer has seen it only very rarely and then never prominent. The infected leaves show yellowish or even sometimes reddish discoloration on their upper surface with a short, white, powdery growth of the imperfect fruiting stage on the under surface. Apparently nothing has been found out concerning its asco stage and little concerning its life history. In recent years it has never needed attention here for its prevention.

Fruit rots, *Botrytis cinerea, Rhizopus nigricans.* Both of these fungi have been found on ripening peaches usually those that have fallen on the ground, though rarely have we seen the former on fruit on the trees or the latter on fruit shipped here in car lots from the south. For description of the former *see* Geranium and of latter *see* Sweet Potato.

Leaf curl, *Exoascus deformans.* Here is another peach fungus that years ago was much more prominent than it is today. Apparently spraying with lime-sulphur for scale has considerably lessened its appearance. The fungus is chiefly a leaf inhabiting species infecting the leaves just as the buds begin to open or soon afterwards. When fully grown, the infected leaves show thickened, curled or wrinkled tissues and are pinkish or whitish when fruiting. The naked asci with the ascospores are produced on the upper leaf surface, at first just beneath the cuticle but soon entirely exposed. The leaves may be entirely or only partially invaded and in the latter case the infected tissues are in strong contrast with the normal, thin, green tissues. If the infection is bad the tree may be partially or entirely defoliated and a new crop of leaves developed later that is almost entirely free from the disease. The fungus carries over in a rather obscure way on the young, swollen twigs. The blossom and the fruit may be injured, the fruit often dropping off when very young or on maturing showing a more or less distorted growth with the infected surface free of hairs. (Fig. 45.)

The treatment for San José scale, spraying with liquid lime-sulphur about 1 to 10 just before the buds begin to swell in the spring, also usually takes care of the trouble.

Powdery mildew, *Sphaerotheca pannosa.* This may show in the early season as an evident, whitish, conidial and mycelial growth, with possibly a few embedded perithecia of the mature fruiting stage, on the young twigs and leaves of nursery and orchard trees. We have had one complaint where the owner had trouble controlling it in a peach orchard by the ordinary spray treatment but usually the dormant spraying with lime-sulphur and the later summer strength of the same should control it. *See* Rose.

Scab, *Cladosporium carpophilum.* The round black spots, about a quarter of an inch in diameter, are familiar to every one who buys peaches. Sometimes these are isolated spots but when bad they may run together giving an extended black coating usually at the upper side of the peach next to the stem end. This is because this imperfect fungus is carried over on the young twigs and the first infections on the fruit come from these. The fungus appears rarely on the leaves in an inconspicuous, fruiting stage. The spots on the fruit usually do not become conspicuous until it is half grown but infection takes place even earlier. The fungus does not rot the fruit but may stunt or distort it when abundant and when very bad causes it to crack and thus opens the way for rot by the Monilia fungus. Even when full sized the black discolorations affect the sale of the fruit. The asco stage of the fungus has never been determined though it is most likely to come under the Venturia genus if found. The conidial stage consists of short, black hyphae on the surface of the host bearing spores of about the same color. (Fig. 46).

Control by spraying or dusting should start soon after the young fruit begins to show and should be continued to include the brown rot that appears prominently as the fruit begins to ripen. This means three or more treatments according to weather conditions.

Stem canker, *Phoma Persicae.* This trouble has been seen only in nurseries or on young orchard trees. A sunken canker of darkened tissue is formed on the stem, usually at the nodes, which if it encircles will kill the parts above. The embedded, black, fruiting dots are not usually very conspicuous though the spores may be produced abundantly in them. The trouble may be prominent on the infected trees but these usually are not common.

The infected branches should be cut off or the badly injured seedlings be pulled up and these infected parts be burned.

Wood rots, *Fomes applanatus,* etc. The Fomes and other less conspicuous Basidiomycetes have been found on the bark and wood of dying or dead orchard trees. So far as noticed none of these fungi are the direct cause of the death of the trees, coming on them after winter or other injuries and developing only as saprophytes. *See* Maple for the specific fungus mentioned.

Crown rot. This is a trouble, scarcely a true rot, that appeared in a few orchards a number of years ago showing where the stock had made a large, somewhat irregular growth greater than the scion above. Such trees in time often broke off at these weakened places. Some signs of the presence of the mycelium of a fungus was seen in some of the specimens but no evidence was obtained that this was of a parasitic type. Apparently the trouble was due to uncongenial growth and union of the stock and scion of such trees, as has been seen in cherry, lilac and some other woody plants. The trouble has not been called to our attention in recent years.

Growth cracks. In certain wet seasons these become more or less common on the ripening fruit but vary considerably on different varieties being especially common on the earlier ones. *See* Snapdragon.

Gummosis. To the writer's mind this trouble is usually the result of winter injury in this state. The bark becomes more or less roughened and injured. The wood sometimes shows indications of winter blackening and spots on the branches develop gummy exudations with no definite indications in them of a cause of the trouble. Any local injury to the bark or sapwood is likely to develop such exudations and they are specially evident on the main stem below the ground as the result of peach borers.

Hail injury. This has been seen several times in local orchards developing bruised or sunken spots on the fruit and especially in young orchards showing evident injury to the young tender growth of the trees on the side of the branches from which the storm came.

Leaf fall. In dry summers, especially when there has been a fairly full development of foliage, the lack of moisture is shown by the yellowing and sometimes by the severe dropping of the foliage to cut down loss of water through the leaves.

Little peach. This is a trouble very similar to Yellows, but not so common here, the main difference as we have seen it being in the smaller size of the peaches and in delayed rather than premature ripening. The effect on the foliage is much the same. In fact we do not always distinguish between the two troubles here. Of course little peach must not be mistaken in the orchard for trees where the scion has died and a seedling growth developed below the grafted bud, since such trees usually produce small, late peaches but do not necessarily show evidence of foliage injury. *See* Yellows in Addenda.

Spray injury. The peach tree is much more liable to injury from spraying than the apple, or even than some varieties of cherries and plums, so care has to be used as to the kinds and strength of spray materials used on it. This is true when lead arsenate is used in fungicides even with lime-sulphur. Injury may result to the young twigs, showing later as reddish-brown spots especially at the base of the leaves, thus often confusing the grower as to the cause. When in foliage discolored spots on the leaves, with after development of shot-holes, leaf yellowing and defoliation, may also be caused. The leaf injury may easily be confused with the bacterial leaf spot without a microscopic examination. Of course there are certain sprays, as Bordeaux mixture and certain commercial products, that should never be used when the trees are in foliage. Lime-sulphur has to be used in a very weak summer strength, avoiding the lead arsenate if possible, and even lime-sulphur dust has sometimes caused injury where this arsenate is added. Atomic-sulphur and self-boiled lime-sulphur have in the past given fair results as fungicides with the least injury but these are now rarely used, the latter chiefly because of its inconvenience. Dry-mixed sprays seem to be the most satisfactory forms for use.

Winter injuries. Winter injury of peach trees that have not received proper cultivation and fertilization is perhaps even more common and severe than those that have received good attention. Of course late fertilization, where the wood goes into the late fall in a soft condition, is even worse than no fertilization at all in this respect. Likewise the location of the trees as to certain exposures, elevations or even depressions, direction of wind and sun, amount of water in the soil, the character of the mulch (vegetable, soil or snow), the low temperatures of certain winters or sudden changes of cold and warm spells, all have much to do with the kind and severity of winter injuries in Connecticut. This state is near the northern limit of successful peach growing and so care must be given as to the districts in which orchards should be located.

Collar girdle at the base of the trees is one of the common troubles in severe winters, especially when water gathers around the base without proper mulching or banking. We have also seen young seedling trees stripped of their buds where ice and snow freezing around the trunks and limbs have carried down these buds with their attached bark when the snow beneath melted before the frozen crust. *See* Apple for further details.

Yellows. *See* Addenda.

Pear

Bitter rot, *Gloeosporium rufomaculans.* We have seen this only rarely in the picked fruit of *Pyrus communis* and then not causing much damage. It seemed to be chiefly a saprophyte.

Black rot, *Sphaeropsis malorum.* Here again is a trouble that is less common on the pear than on the apple, *q.v.*

Brown rot, *Monilia cinerea.* As with the apple this is not a very common or serious trouble, showing chiefly on the matured fruit. *See* Cherry.

Crown gall, *Bacterium tumefaciens.* Crown gall has been seen here only once on pear and then on nursery stock recently imported from France. *See* Rose.

Downy mildew rot, *Phytophthora cactorum.* This trouble was first seen here in 1919 on stored fruit sent to the Station to determine the cause of rotting. In this case the rot seemed to start at the core and extend outward to the apparently healthy skin. The rot was later found on fallen pears on the ground under the Station's trees and seemed to be fairly common under these conditions though contamination by other fungi soon occurred. The trouble shows on the outside merely as an ordinary brown rot with no evident growth unless the fruit is protected to allow an external, whitish development of the mycelium. So far we have not seen the oospores in these rotted pears although they were readily produced in artificial cultures made from the mycelium of the infected tissues. There is little doubt, however, that they finally develop in the infected tissues. The same trouble was later also seen on the apple and in this case it was even seen on the fruit still attached to the lower part of the tree. We have also reported it on corn, ginseng, pea, sweetpea, strawberry and the same or a very similar species on peony.

Fire blight, *Bacillus amylovorus. See* Addenda.

Fruit rots, *Botrytis cinerea, Cephalothecium roseum, Penicillium expansum.* All three of these are semi-parasitic fungi that occur on other hosts but on this one chiefly as rots of the stored fruit, especially if it has been previously injured and is stored under unfavorable conditions. They are all imperfect fungi whose asco stages have never been discovered. Their exposed fruiting stages when present can be told by the appearance of the spores, in the first having a grayish, in the second a pinkish and in the last a greenish color.

Leaf-fruit blight, *Entomosporium maculatum.* This fungus occurs here on both the leaves and fruit of the pear but is less common and injurious than on the quince, *q.v.*

Leaf spot, *Septoria pyricola.* This has been seen occasionally, usually causing little injury, as small, grayish, sub-circular or angular spots with purplish borders on the leaves. The imperfect stage develops as embedded fruiting dots on these, and later on the dead leaves the asco stage, known as *Mycosphaerella sentina,* is said to appear. Burning the old leaves, therefore, should help to take care of the trouble where necessary.

Powdery mildew, *Sphaerotheca pannosa?* This was found once on a nursery inspection, invading the tips of a single tree, with the conidial stage only developing. We are, therefore, in doubt as to its exact identity but class it with the same mildew occasionally found here on the peach, though it might have been one of the two species of Podosphaeria that have been reported on this host elsewhere.

Rust, *Roestelia globosa.* Both Thaxter and Hunt have reported this rust on the leaves of pear and the writer has seen it rarely as well as have occasional nursery inspectors. All of our specimens, however, except Thaxter's, show only the pycnial stage and even this sparingly. Thaxter in 1890 wrote of it as follows: "The several varieties of pears of the Japanese strain (Kieffer, etc.) have shown themselves very susceptible to injury by one of the rusts derived from the red cedar, . . . the finger-like Roestelia stage developing from the under side of these spots during August and September." *See* Hawthorn.

Scab, *Fusicladium pyrinum.* Here is a troublesome fungus of the pear, especially on certain varieties, of which the Flemish Beauty is most severely injured. This imperfect fungus occurs on the leaves and fruit doing the greatest damage to the latter, much as does the related scab on apple. However on the young twigs, at least on the Flemish Beauty, the small fruiting pustules it produces are much more evident to the naked eye. Recently we have seen these pustules just split open that were producing new, mature conidia on April 15, some days before the flower or leaf buds started to open. As shown by Aderhold years ago the asco stage also develops on the old leaves in the spring, much as does the apple scab, being known in this case as *Venturia pyrina.* We have rarely collected this stage, apparently chiefly because we have not looked for it carefully. (Fig. 47.)

Spraying, as for the scab of apple, should also control this trouble but only the very susceptible varieties need to be treated.

Sooty blotch, *Gloeodes pomigena.* This occasionally shows in late, wet seasons in its blackish mycelial growth on the fruit. *See* Apple.

Spray injury. Spray injury has occasionally shown on pears especially those that have been sprayed with Bordeaux mixture and even with lime-sulphur. However, as pears are not so commonly sprayed here, much less injury has been reported than on apple or peach.

Winter injury. We have not seen or heard of as much winter injury to pears as to apples, partly because they are not so commonly grown, but apparently also because with less cultivation and fertilization and with fewer varieties grown, they go into the winter in a much harder condition.

Sturgis as early as 1895 described bands or blotches occurring on the fruit as due to late spring frosts. *See* Rept. **1895**: p. 190.

Pea Shrub

Fasciation. On *Lespedeza formosa* (*L. Sieboldi*) in a nursery in 1917 specimens were found showing stems that were greatly flattened and at least eighteen inches long but they were broken off at the lower end of the flattening and so may have been longer. The leaves were scattered along this abnormal stem and its tip was divided into two tips each with a double coil to the same side.

Peony

Downy mildew rot, *Phytophthora* sp. We first found this trouble in 1923 and have seen it several times since on the petioles of *Paeonia officinalis.* We have not studied the fungus sufficiently to determine whether or not it is distinct from *P. cactorum.* It appears on the young peonies in the spring as they push up through the soil. The upper parts only may be killed or the infection may be limited to the basal parts in which the upper free parts may later die as a result of this basal infection. The mycelium can be found in the invaded tissues but as yet we have not recorded the presence of the oospores there though they later were obtained in the artificial cultures made from the mycelium. We have seen this trouble in wet places or during wet, early weather on certain varieties such as Prince of Wales and Queen Victoria but do not know if these are more susceptible than other varieties. Sometimes on the rotted petioles Botrytis also appeared, in which case it is somewhat doubtful as to which was the primary cause.

Keep the plants and earth as dry as possible as the former push up through the soil in the spring and do not select wet or too shady spots for their planting. Destroy any injured or dead tissues. If rot starts select only healthy stock that is free from dirt to transplant to a new and drier location. It might be well where the trouble has occurred to spray such plants and the soil with Bordeaux mixture as the plants push through the earth the next spring.

Leaf blight, *Botrytis ?Paeoniae.* There is some question in the writer's mind, not having studied this trouble especially with pure cultures, whether this fungus really is distinct here on this host or is merely another form of *B. cinerea* to which it bears close relationship. Both species are recorded on this host from the United States. Some of the writers claim that the conidiophores and spores are somewhat different and the sclerotia are smaller and more regular. The few sclerotia we find on the stems of the specimens we have saved are about 1 mm. in length but the conidiophores and spores are either not abundant or not well preserved.

The disease may appear on the young growing stems in the early season rotting them at the base when the parts above also die with or without infection. It is on or within these rotted stems that the sclerotia are found. More commonly we find the disease, especially on plants in shaded places, causing evident but variable sized spots, showing on both sides of the leaf and varying from light brown to dark purple especially on the upper side. At times no fruiting stage may show or it may develop under favorable conditions, especially on the under side of the leaves or even on the stems, as the erect, fruiting threads characteristic of the gray mold, though often less dense, as seen on the geranium, *q. v.,* and other hosts.

Leaf mold, *Cladosporium Paeoniae.* This trouble shows on the leaves in spots quite similar to those caused by the preceding fungus. Sometimes the spots do not show the olive-brown, fruiting stage at all, which leaves one more in doubt as to the cause. Like Cooke of England, who also records the presence of the fungus there, we are in doubt of its true parasitic nature since it might come on through Botrytis injured spots as a common saprophytic Cladosporium to which a new name has been applied when found on this host.

Fasciation. The only specimen we have of this trouble on the peony was collected in June, 1917, at Whitneyville and merely shows a slight flattening of the stem bearing an apparently normal blossom. *See* Asparagus.

Mosaic-like mottling. We have seen this trouble on individual leaves of plants where there was a very definite pattern of narrow mottling giving an effect as if caused by some insect traveling over and injuring the tissues when they were very young. Yet there was no certain evidence of any insect or its remains to show that it was the primary cause.

Winter injury. Occasionally in the spring we have seen the roots of peonies that failed to grow or made a sickly growth of plants. Such roots show that their tissues have been partly or largely killed as indicated by their reddish-brown or rotted condition. In some of these we have seen the dark mycelium of some fungus present and in others nothing at all. As this trouble is most evident after severe winters, we judge that winter injury is the usual cause, especially as we have never seen any fruiting stage on the infected roots.

Pepper

Anthracnose, *Gloeosporium rufomaculans* (*G. piperatum, Colletotrichum nigrum*). Sturgis first reported this trouble here on peppers, *Capsicum annuum,* in 1899 as causing 25% rot of the fruit in certain fields. He called the fungus *Colletotrichum nigrum* since the fruiting pustules produced black setae, around the base of which the pinkish spores oozed out from the tissues beneath. Later the writer reported it as *Gloeosporium piperatum* since the specimens seen by us did not have the setae and the pinkish spore masses were even more evident. Botanists have since decided that these are not distinct species but variations of the same one (as given here in the heading) which also has a great variety of hosts. On this particular host it has been found only on the fruit, causing brown or blackish spots according to its fruiting condition.

Spraying is not very satisfactory; pick off and cart away the infected fruit. *See* further statements under Apple.

Bacterial soft rot, *Bacillus carotovorus.* The soft rot is rarely reported on the green fruit. *See* Iris.

Black spot, *Alternaria* sp. We have had one case of small, black, rotten spots appearing on the red fruit that developed Alternaria spores only after being kept a few days under a bell-jar. Apparently this trouble has been reported elsewhere.

Gray mold rot, *Botrytis cinerea.* On the green and ripening fruit in wet seasons, this has been seen causing a brown rot often with evident growth of the fruiting threads. *See* Geranium.

Seedling rots, *Pythium debaryanum, Rhizoctonia Solani, Sclerotinia sclerotiorum.* All three have been isolated as causing the death of young plants in seed beds and flats in the spring. *See* Damping-off under Spinach.

Mosaic. Occasionally we have seen mosaic in the fields and gardens where it caused considerable injury although the mottling effect is not so evident as on some other plants. We have produced the disease on healthy plants of tobacco with the juice from both the leaves and the fruit of the diseased peppers. *See* Cucumber and Tobacco.

Scald. We have occasionally seen this on one side of the fruit following very hot weather. *See* Apple.

Peppermint

Rust, *Puccinia Menthae.* While we have found this rust common on the wild species of the mint family, it has been less common on those cultivated, especially on the peppermint. Yet it was on cultivated plants of this species, *Mentha piperita,* that the I stage occurred the first time it was found in the state. This was May 23, 1933, at Westville. The stems of the plants were somewhat swollen for a considerable distance, as if the fungus was perennial on them. On this swollen part were seen numerous outbreaks of the cluster cups, filled with orange spores, and showing the small teeth at their edges. The I stage is also said to occur on the petioles and on the under side of the leaves. This is the earliest stage of this rust and no other stage occurred at this time on these specimens. *See* Beebalm for other stages.

Periwinkle (Myrtle)

Black wilt, *Undetermined fungus. See* Addenda.

Persimmon

Scab, *Fusicladium Levieri. See* Addenda.

Petunia

Mosaic. We have found this trouble several times on *Petunia hybrida* and frequently have produced it from juice from mosaic tobacco plants, *q.v.* However, this is the only disease we have recorded for this host and those reported elsewhere do not seem to be serious or numerous.

Phlox

Anthracnose, *Vermicularia phlogina.* We are not sure that this fungus was the cause of the death of plants sent us in 1932 from a garden in Washington, Conn., but it was the only fungus we could find in the stems which had apparently died from a rot at their base. Two species of Vermicularia have been reported for Phlox, *V. Dematium* a species on a variety of hosts and apparently a saprophyte and *V. phlogina* described originally as found on the leaves. Our specimen agrees with this latter as issued in Fungi Coll. no. *4800* where it occurs on the stems as well as on the leaves. The fruiting stage of this fungus shows as small, often numerous, black tubercles with setae, beneath which are found the spores. In 1924 at Westport and in 1926 at Wallingford there were also collected on dying stems of *Phlox paniculata* specimens of Vermicularia that seemed to have some connection with their premature death.

Crown rot, *Sclerotium Delphinii.* This was reported once as rotting off the base of the plants. *See* Larkspur.

Leaf spots, *Cercospora omphakodes, Septoria divaricata, S. Drummondii. See* Addenda.

Powdery mildew, *Erysiphe cichoracearum.* While we have reported several different species of powdery mildews in this bulletin, each usually with several economic hosts, this one seems to have more than any of the others and it certainly has as many more on our wild plants. Most of these hosts, both cultivated and wild, belong to the Composite and Gourd families, as is shown by the following which are listed here: chrysanthemum, cucumber, dahlia, goldenglow, muskmelon, pumpkin, rosinweed, salsify, squash, sunflower, verbena and zinnia. On many of these hosts only the conidial stage has been found and often in such cases the white coating of mycelium and conidial spores is not so evident or thick. On the phlox, however, the coating of the mildew is evident, often as a heavy coating, especially on the stem, and the asco stage is usually present as small, black perithecia embedded in or on this growth. Two large ascospores in each ascus are characteristic of this species. We have often wondered if the absence of the asco stage indicates that the host in such cases is one of recent origin so far as infection by the mildew is concerned; however, we know in some cases it is due to the very late appearance of perithecia in October after frost has largely killed the leaves.

We suggest the same preventive treatment as given for the leaf spots though the number of sprayings required may be greater and for a longer period to meet with success.

Stem-leaf nematode, *Tylenchus Dipsaci.* This is distinct from the common root nematode already mentioned here on the roots of a variety of hosts. It was sent to the Station once in 1928 from Darien showing infections on the stem and petioles and causing a decided malformation of the leaves with elongated petioles and in some cases almost no blades. Specimens were sent to Dr. Steiner, of the U. S. Department of Agriculture, who determined the species of the nematode as given here. He wrote as follows:

"This pest has lately been mentioned several times on phlox in Europe but, as far as we know, this is the first time that it has been observed on the plant in this country. We do not know a sure way to get rid of this pest on these plants; perhaps the best is to cut the infested tops of all the stems off and destroy them, but some forms of the nema might stay in the soil and the crowns of the plants and make trouble the next season. It would, therefore, be well to watch the plant and, if the trouble should come up again, take out the entire plant and destroy it. This is the same nema that is commonly called the 'stem nema' or the 'bulb nema.' It is found in a number of host plants like narcissus, hyacinths, onions, alfalfa, clover, strawberries, etc."

Drought injury. As already indicated under Leaf spots we have had specimens of phlox sent in for examination when the fungus present or the direct evidence of insect injury were not sufficient to account for the poor condition of the plants. Usually these complaints have been in dry years or dry periods when the yellowish, sickly or dried-up leaves might be due to the unfavorable amount of moisture in the soil. We shall continue to give such a designation until we have some proof that the trouble, which sometimes shows under more favorable moisture conditions, is not due to some obscure early injury by sucking insect or to a virus carried by them.

Mosaic? We have occasionally seen mottled leaves on certain sickly plants when we were not sure whether they were the result of direct insect attack, probably lice, or were of the nature of a true mosaic injury.

Pines (other than White)

Black rot, *Sphaeropsis malorum.* To those to whom a new host-genus means a new species for the fungus found on it, this fungus might be called by some other specific name. The few times we have found it on pine has been on *Pinus austriaca* and then under such conditions that we believed the injury to the buds and stem had been caused primarily by winter injury, *q.v. See* also Apple.

Needle blight, *Hypoderma Desmazierii.* We have seen this fungus a number of times on the leaves of *Pinus rigida,* where their free ends had apparently been injured by winter or drought, showing a reddish-brown discoloration. The fungus develops as evident, slightly elevated, oblong to linear, black lines through the center of which, with age, dehiscence occurs for the discharge of the ascospores. We question how much the fungus is responsible for the injury to the leaves since some leaves show the presence of its fruiting stage and others do not. It seems to us to be a weak parasite, or possibly even a saprophyte, that attacks the leaves only when injured from some other cause. Apparently little work has been done on this Ascomycete to determine its real nature as a parasite.

Needle cast, *Lophodermium Pinastri.* This trouble is so near to the preceding in external appearance that it takes a microscopic examination to distinguish them. They can be determined through their ascospores, the former being one-septate and broader than the thread-like single cells of this one. Even this examination may be insufficient since with both of them the maturity of the spores may not take place until they have been shed from the trees. This is true especially of the Lophodermium, known as Needle cast.

We found this Lophodermium on drought injured trees of *Pinus resinosa* in a forest plantation recently. A very dry year, which was preceded by a very wet one, had caused an unusual dropping of the older, lower and closely shaded leaves in this plantation of young trees about fifteen feet high. Many of the lower branches were dead but often, too, higher ones, presumably from shading, competition and the unusual drought conditions, and many of them still had the dead leaves attached. Not many of these leaves, however, showed the fruiting stage of this fungus present though those on the ground showed it commonly and often with mature ascospores. Mycelium of some fungus was found in the dead branches and somewhat in the base of the attached leaves. If this fungus was the cause of the leaf fall, it was more as an after effect of the dry season than as a direct parasite since there was no evidence of its spreading to the younger, living leaves. The same fungus apparently was also seen in winter-injured nursery trees of *P. austriaca,* though in this case the leaves were still on the young trees and had not fully developed their ascospores.

Rusts (Pine-Goldenrod), *Peridermium acicolum, P. delicatulum.* By far the most common of these two leaf rusts is the first mentioned which occurs on a great variety of wild goldenrods and asters (or rarely on cultivated asters, *q. v.*) in its II and III stages where it is known as *Coleosporium Solidaginis.* In the fall, infection of the needles of the pines, as shown by our infection experiments, takes place from the germinating telial (III) spores from one of these alternate hosts. These spores produce secondary spores or sporidia that are blown to the pines where evident infection of the needles does not show until the next spring or early summer as the white, cluster-cups of the I stage. These show more or less abundantly, in an irregular row along the length of the needles. These fragile cups are somewhat flattened, about one-eighth of an inch high and slightly less wide and break open irregularly from their tips, disclosing the orange-yellow spores of the I stage that carry the rust back to the goldenrods, etc., at this time. Originally found here only on the native species of *Pinus rigida,* the rust has recently appeared even more abundantly on the needles in plantations of the red pine, *P. resinosa,* and in 1932 it was collected once on *P. Banksiana.*

The second needle rust of pines given here also has as its hosts a few species of goldenrods (chiefly section of Euthamia) with II and III stages only to be distinguished from the preceding rust by microscopical examination. It also produces the I stage on the pine needles, so far only seen here on *P. rigida,* but in this case the smaller cups scarcely show above the infected tissues.

Neither rust is perennial on the pines but requires new infection of the needles each year from the alternate hosts. The control of them on the pines, therefore, is confined to getting rid of all goldenrod and asters, especially infected ones, in the plantations. After the pines reach some size, this means chiefly destroying these herbs at their edges since the shade within will usually crowd them out there.

Rust (Pine-Oak), *Peridermium cerebrum.* In this case, the rust is one inhabiting the stems and limbs of the pines, especially young plants; while it is found there only in its I stage, this is perennial on its hosts. It shows usually as round galls surrounding the stems and reaching from one to three inches in diameter. In time these galls may cause the death of the parts above, as one frequently sees them further south on young dead seedlings. Sometimes more than one gall is found on these seedlings. Early in the year these galls, when mature, show the compound peridium as a white coating (often in separated blisters as individual peridia) surrounding these woody swellings, and beneath this coating are developed the yellowish spores. These spread the disease to the oak leaves where the II and III stages develop much less conspicuously. While this trouble seems to be common in the pine barrens farther south, in Connecticut it has rarely been found on either host. It was seen first in the Station's plantation at Rainbow on *Pinus Banksiana* and native *P. rigida,* again on this latter host as mentioned under oak, *q. v.,* and still later in a water company's plantation on *P. ponderosa.*

So far all that needs to be done for control here is to destroy the occasionally infected pine seedlings.

Rust (Pine-Sweetfern), *Peridermium Comptoniae.* This is another perennial rust on pine stems and is easily distinguished from the preceding by the fusiform swellings on the stems and branches and by the very definite, tongue-shaped, temporary peridia that break out individually on the infected tissues. These peridia of the I stage stand up as white, fragile elevations, a quarter of an inch in height, and when they break open at the top they often show a definitely toothed edge from which the orange-yellow spores escape.

The host species of the pines is rather extended, as indicated so far by the following found in Connecticut: *Pinus austriaca, P. Banksiana, P. Pinaster* (*P. maritima*), *P. montana* var. *Mughus, P. Murrayana, P. ponderosa, P. rigida, P. sylvestris.* These have been found either in the natural woods, forest plantations or nurseries.

With this species the writer and Dr. McCormick, as with the white pine blister rust, have proved that the spores from the III or Cronartium stage infect the pine needles, producing the yellow spots and the sclerotial masses from which the mycelium gradually works down the bundles into the stems to become perennial there. In this case the alternate hosts are limited to the wild sweetfern and its close relatives (Myrica formerly Comptonia).

In this state, the chief preventive measures are to destroy the sweetfern, especially if infected, in the vicinity of the pines and certainly to do this in the vicinity of the seed beds and nurseries; the occasional infected tree or its branch in forest plantations or in cultivation should also be destroyed.

Seedling rots, *Rhizoctonia Solani, Pythium debaryanum.* Damping-off of pine seedlings occurs frequently in the nursery and forest seedbeds and according to our experience in this state the Rhizoctonia fungus is by far the chief agent. Some pine seedlings seem to dampen-off more frequently and abundantly than others though this may be merely due to their surroundings or the frequency with which they are grown. We have recorded injury in the seed beds from the Rhizoctonia to *Pinus resinosa, P. Strobus* and *P. sylvestris.* In our crock experiments with pine seedlings grown for other purposes, we have used about forty different species and we have lost many of the individuals of these by damping-off. Besides those already mentioned here, those definitely recorded as killed by Rhizoctonia are *P. austriaca (P. nigra), P. densiflora, P. excelsa, P. palustris, P. pinaster* and *P. ponderosa.*

A different type of injury was called to our attention by one of the nursery inspectors who found imported seedlings of the umbrella pine where some trouble had been caused by the Rhizoctonia creeping over the seedlings, due to conditions favoring its development because of the manner of shipping by boat.

We have little data of injury to pine seedlings through the Pythium though this has been reported elsewhere as sometimes serious.

Sterilization of the soil of the seedbeds before planting, care in the use of water and shading, keeping the top soil dried out by frequent cultivation and spraying the seedbeds as the seedlings come through the soil and for the necessary time afterward, have all been suggested as possible means of controlling these two troubles. *See* Potato and Spinach.

Mice girdle. As with apple and other trees in nurseries and orchards and even wild trees along stone walls, mice sometimes girdle the base and roots of the young pine trees in plantations especially when well covered with snow. A few cases have been called to our attention, one particularly of young Scotch pines in a plantation at Union in the northeastern part of the state. *See* Apple.

Sun scorch. We have seen a few cases in seedbeds where seedlings, not properly protected by shade, were injured, showing the trouble on the needles and sometimes the tips of the seedlings when the roots seemed to be sound. Somewhat similar injury may be caused when beds are not watered in drought times though the injury there is more likely to show death of the whole plants. We have also seen occasional cases of leaf injury to certain large trees, especially native *Pinus rigida,* similar to the so-called white pine blight, that was apparently due to drought conditions.

Another type of sun-scorch was seen in a plantation of large trees of *P. sylvestris* in the late summer of 1931 where the trees, except those on the north side, showed evident injury to this year's needles especially exposed to the sun and particularly those at the top of the trees. This injury was evidently caused by two unusually hot days late in June exaggerated on the trees in one place where a large stone pile was close to them and reflected the heat. This sudden and severe heat killed, by drying out, the tender growing bases of the young needles so that with their collapse the harder tissues above died while still green but short of their normal length. Many of these new needles of the shoots had fallen off, leaving them bare except for the normal leaves below produced in previous years. We have seen a somewhat similar injury to white pines that seemed to be due to late frost injury.

Winter injuries. Cases have been seen of young trees, sometimes apparently not entirely hardy, as *Pinus excelsa,* that following the winter have died suddenly without evidence of fungus or insect injury. Cultivated and fertilized trees in the nurseries most frequently show such injuries.

We have also seen cases of *P. austriaca,* especially on sea-shore estates, where the leaves and buds of the new shoots were severely injured (often killed or followed by weak spring growth), the injury being aided perhaps by ice from storms off the water. In 1932 we received especial complaints of injury to this same species from New York state, particularly on Long Island, and from Connecticut. In these cases the drought of the preceding years may also have aided the injury. On the various specimens seen during different years, we have occasionally found on some of the leaves or dead stems the fruiting stage of Sphaeropsis (*q.v.* here under Black rot) but we believe that this came on as the result rather than the cause of the injury.

Likewise we have seen late frost injury to the young leaves and winter injury to the old leaves producing the so-called white pine blight type of injury, *q.v.*

Another type of winter injury arises, especially in winters with alternate thawing and freezing periods, through the heaving of the seedlings, especially of

recent transplants that have not been protected by a proper mulch, out of the soil. We have seen cases of certain conifers where erect plants a foot high have had their bases and roots pushed up several inches above the soil so that they dropped over on the ground. Such plants are apt to be stunted or weakened even when not directly winter injured or killed.

Witches' brooms. These are occasionally seen on young trees that have been injured from some unknown cause other than fungi and have developed abnormal shortened shoots or bunched branches. Specimens of these have been called to our attention on red, white and Scotch pines usually from plantations.

Plums

Anthracnose, *Cylindrosporium Padi* (called by some *C. prunophorae*). While we list this under the same name as that of the imperfect stage on the cultivated cherry, as it was formerly so considered, more recent investigations seem to separate it as a distinct species, called *C. prunophorae,* with a separate asco stage known as *Coccomyces prunophorae.* Our experience with it on *Prunus* sps., however, has been much less than on the cherry and, while common shot-hole injury on the plum may be in part due to it, we do not ordinarily see the fruiting condition on such leaves. Our only herbarium specimen on the plum is one collected by Thaxter years ago with similar specimens on cultivated cherry and wild black cherry leaves. The spores from these three hosts show some differences in the size of the spores, those on the last host especially by their larger size. There are certain other differences claimed for the mature stages on these three hosts that are said to distinguish them as three species. Of course the really important factor is whether these fungi can pass from one host to the others, which is unlikely if they are distinct species. *See* Cherry for further information.

Bacterial spot, *Bacterium Pruni.* While this produces injuries on the leaves, the effect seems to be about the same as on the peach except that injured tissues fall out more readily, thus producing a pronounced shot-hole. It is on the fruit, however, that the chief difference shows. As on the peach, the bacteria develop on the young growing tissues producing a dry rot that seems to stop with their maturity. On the plums these spots are much larger than on the peach and show purplish-black, sunken, dry spots or areas that are very conspicuous on the green fruit. There is considerable difference in the susceptibility of different varieties to infection. Our complaints have all been on Japanese plums, especially on the Abundance. Because of the damage to the fruit this trouble seems to be more serious on the plum than on the peach.

As in this state there are no plum orchards of any size, we suggest the picking off and destruction of the infected green fruit. Where the infection is bad, however, the use of a late dormant spray with lime-sulphur and dry mix after blossoming might be tried.

Black knot, *Plowrightia morbosa.* This trouble occurs on both the cultivated plums and cherries as well as on several wild species in this state. The knots are swollen places on the stems that break through the bark and on maturity show as thickened, elongated, black galls with close, pimple-like marking indicating the imbedded fruiting receptacles of the asco stage of the fungus. These galls are in strong contrast to the smaller, healthy part of the branch on which they occur. With age the outer infected parts die after maturity of the ascospores and the fruiting tissues gradually crumble away though a new crop of galls may start later farther on or even at the edge of the old gall. In time, due to the girdling of the branch, the parts beyond may finally die. On forest trees we have seen old galls, often with imperfect fruiting receptacles, that have reached a size several inches in diameter and over two feet in length but ordinarily on the cultivated trees they rarely exceed an inch in diameter and one to several inches in length. When first breaking through the bark before the black covering develops, there can frequently be found, on the infected rough tissues of the host, a dark-olive growth of the imperfect stage of the Cladosporium type. While other stages have been described, this and the ascostage are the only ones we have recognized.

Years ago we conducted certain spray treatments in a badly infected orchard of sour cherries, which seem to be the ones generally infected, and on these the treatments largely prevented the development of the fruiting stage on the immature knots. The chief remedy, however, was the removal of the infected twigs and branches if the latter were not too large and did not interfere with the shape of the trees. These should be cut *off* some distance below the knots and beyond any indication of evident discoloration of the interior tissues. Cutting *out* the knots from the branches was not usually successful since this often involved the almost complete girdling of the branch and then, if not cut back far enough, there was a subsequent development of a new gall from the mycelium in the infected tissues remaining.

Brown rot, *Monilia cinerea.* On certain varieties this rot is just as bad as on the most susceptible sweet cherries, *q.v.*

Crown gall, *Bacterium tumefaciens.* This has been seen chiefly in nursery stock and more frequently in the past than recently. *See* Rose.

Fire blight, *Bacillus amylovorus.* While this disease has never been recognized by us on this host, it was once reported years ago by Sturgis as very unusual. *See* Pear.

Leaf curl, *Exoascus mirabilis.* This is somewhat similar to the peach leaf curl but seems to involve more extended, general and apparently perennial infection of the young leaves and the terminal shoot rather than the commonly isolated, annual, leaf infections of the peach. It was reported on a variety of Japanese plum in 1895 from New London by Sturgis but has never been found in the state by the writer and has never been reported to him, so it cannot be common here.

Plum pocket, *Exoascus Pruni.* Here is another fungus closely related to the above that apparently confines its infection to the young fruit. This becomes swollen and puffed out as a sort of bladder, since the ovule does not mature into the hard seed, and changes in color from yellow or pinkish to whitish when the fungus matures its ascospores. While it has been reported in various states and was sent to us from Massachusetts, we have no specimen or record of it in this state, although no doubt it has been seen here especially formerly when plums were more commonly grown than now. It apparently is a perennial fungus since it often confines its attack to a single tree that becomes badly infected. These pockets or bladders appear soon after blossoming and at first are round but finally become elongated and sometimes curled and reach one or two inches in length by half an inch in width. They finally turn blackish and fall off the tree in early summer. No treatment so far has been needed here.

Powdery mildew, *Podosphaera Oxyacanthae.* A single specimen and very few records indicate that this is not a common or serious trouble in this state. *See* Cherry.

Shot hole. This injury is common on the leaves, especially of the thinner-leaf varieties. The trouble shows as small, discolored spots in which the tissues separate and then fall out from the surrounding healthy tissues. There are various causes that can produce these shot-like effects, such as sprays, bacteria as in bacterial spot, the anthracnose fungus and apparently other less easily determined ones. In case of the bacterial spot and anthracnose a careful examination of the tissues before they fall out should disclose the cause. When any spray has been used, especially if it has previously shown injury, this is certain to be the cause. Unfavorable environment, producing injuries to the roots, wood or even directly to the leaves, although hard to determine, is likely to result in some shot hole injury. Such may be winter, water, heat or fertilizer injury. Perhaps there are also other fungous or even insect injuries not so well understood that may result in this trouble.

Find the cause and then treat accordingly.

Winter injury. We have had little experience with winter injury on plums. Undoubtedly there has been trouble of this kind in the past, especially when various varieties of Japanese plums were grown in the State. These did not do well for one reason or another and have now largely dropped out of culture. *See* Apple and Peach.

Yellows. Though we have no records and have seen no infected trees in private grounds, we did succeed in producing this disease on a couple of young plum trees in the Station grounds by grafting on them the buds from yellows peach trees. The trouble has been reported elsewhere but apparently the symptoms do not seem to be so definite or the injury so serious or common as on the peach.

Polemonium

Leaf spot, *Septoria Polemonii.* This is an uncommon fungus on cultivated *Polemonium reptans* causing whitish spots, with black fruiting dots, surrounded with a purplish border. Ellis and Martin's *S. polemoniicola* is not distinct from it. Spraying in time should control this trouble where necessary.

Poplar

Anthracnose, *Marssonia Populi* (*M. Castagnei*). There have been several species of this genus reported on various poplars in the United States but whether they are all distinct needs further investigation. The one we report here is the one most commonly seen on the white poplar, *Populus alba,* although we have found it on at least two other poplars, *P. deltoides* and *P. nigra* var. *italica.* This species shows as small, circular, reddish-brown spots from which the embedded fruiting pustules ooze out the hyaline, one-septate spores, somewhat curved and somewhat pointed at one end and rounded at the other. On the white poplar, on account of its hairy lower surface, the spots are most evident on the upper surface from which the spores exude, but on the other species the spots show on both sides with exudation of the spores chiefly on the lower surface. When abundant the fungus may cause some defoliation but apparently no asco stage has been reported on these old fallen leaves.

Ordinarily no spray treatment is necessary but if deemed desirable it should be started on the young leaves.

Crown gall, *Bacterium tumefaciens.* This has been seen as occasional galls on young forest trees and in one case on a yard tree of *Populus alba* where it caused considerable damage to the base of the tree. *See* Rose.

European poplar canker, *Dothichiza populea.* Apparently imported from Europe this disease has been known in the state since 1917 and has been frequently reported by inspectors from various nurseries where infected trees are condemned. The Lombardy Poplar, *Populus nigra* var. *italica,* is the host usually attacked both in the nurseries and in private plantings though we have had one report of it on *P. deltoides* and others on undetermined species. The fungus produces injuries at the base of the trees or their branches especially at the nodes. On young trees or those of smooth bark, these injuries may take the form of definite cankers with evident fruiting bodies of this imperfect fungus, but often these injured areas are not so definite though the branches of the trees may be dead or dying. On some of these we have been able to find some signs of the spores of this fungus and on others not. In such cases it is difficult to determine whether the fungus, winter injury or even insects are the primary cause of the trouble. The fungus gains entrance through wounds or possibly dead branches and, according to Hedgecock, the one who first reported the disease in this country in 1916, infection can apparently also take place through the leaves. The identity of its asco stage, if it has one, is apparently in doubt.

We know of no definite experiments to prevent this trouble by spraying. While thorough pruning may prove helpful when there is little disease present in a tree, if there is much of it we suggest cutting the tree down and burning it.

Leaf curl, *Taphrina aurea.* This disease was not found here until 1931 when it was seen in two of the nurseries on the Lombardy poplar by the inspectors. It shows as round, whitish, thickened spots on the upper surface of the leaf but below develops a yellowish fruiting-surface that is cupped upward. Usually these cups are separated but sometimes they run together; rarely the yellow, cupped surface shows on the upper side of the leaf. The normal size of the cupped spots is about a quarter of an inch in diameter. With age the yellow surface becomes blackish.

The disease is said to carry over on the outer surface of the buds so spraying, as for peach leaf curl, should care for this trouble if needed.

Rusts, *Melampsora Medusae, M. Abietis-canadensis.* These two rusts are not uncommon on the leaves of poplars in this state. They both have their II and III stages on them, the II showing as dusty, yellow outbreaks in the summer and the III in the fall as reddish blisters permanently embedded. The dusty spots of the II stage spread the disease to other poplar leaves. The embedded spores of the III stage germinate on the leaves in the spring and their secondary spores are carried by the wind to the alternate host for their infection. In the first rust, this is the young leaves of the larch; for the second, the young leaves, twigs and cones of the hemlock. *See* these alternate hosts for the I stage described there. Little serious damage is caused to the poplar hosts by these two rusts; the first rust is found chiefly on *Populus deltoides* and the second commonly on *P. tremuloides* and *P. grandidentata.*

It is not likely that spraying will prove profitable in controlling the rusts. One, however, might rake up and burn the old leaves, especially if the alternate hosts are planted near by.

Scab, *Fusicladium radiosum* (*F. tremulae*). No doubt this fungus has long been in the state but we first identified it in 1928 and since then have found it in 1929 and 1931. It occurs here both on the small and large toothed aspens, *Populus tremuloides* and *P. grandidentata.* The leaves are in part or entirely blackened and sometimes even the entire young shoot with its attached immature leaves. At times no growth shows on the dead tissues but, under proper moisture conditions, there appears an evident, sometimes dense, dark, olive-green development of the conidiophores and the one to three septate conidia. We once sent a specimen by mail from Canada that when gathered looked like a bacterial blight but when it arrived in New Haven it showed the evident, conidial growth. We have seen clumps of young aspens seeding in waste places where the disease was very striking in wet seasons and have heard of it as the possible cause of severe damage in Canada at one time. The asco stage belongs, as described by Aderhold, to a *Venturia, V. tremulae,* and has been found here on the dead leaves in the early spring. The fungus is very closely related to the willow scab, *q.v.*

Winter injury. As indicated here under European canker, we have often seen winter injury of Lombardy poplars when planted in yards and streets, especially in the northern part of the state. We believe that between the two troubles the owner will in time lose his trees, so we do not advise planting this species. Even if the trees survive for some time they generally will have plenty of dead branches to spoil their looks.

Poppy

Bacterial leaf spot, *Bacterium papavericola.* This bacterial disease was first found in 1908 in the writer's yard on *Papaver* (probably *P. rhoeas*), and has been seen once since in 1928 in a neighbor's yard, and more recently on *P. orientale* at Newtown. It has only recently been described by others as a species new to science. We found the disease especially prominent on the poppy leaves producing eventually very small, blackish spots scattered over their surface. When wet these spots may become semi-pellucid and at times show exudations of the germs. It is said to occur on the stems and floral parts as well.

Destroy the infected plants of the annual species and plant the new ones next season in a different place. With the perennial species gather up all the rubbish in the fall and spray the ground and the emerging plants in the early spring with Bordeaux.

Potato

Bacterial black leg, *Bacillus phytophthorus.* This disease of potato, *Solanum tuberosum,* was first mentioned from this state in our 1904 Report where it was called questioningly *Bacillus solanacearum.* It was about that time that the black leg was described in Germany and later in the United States under the title given here. It shows as a rot, with the tissues often blackened, at the base of the vines; above these rotted tissues it runs up the vascular bundles and discolors them, as seen in cross sections. The plants are often stunted, the lower leaves yellow and

the upper curled upward; where it is severe the plants die. Often it develops on the young tubers and may show as a blackish discoloration, especially at the edge, under the skin which is easily peeled off. In time, apparently, the soft rot organism may gain entrance. By means of the slightly infected tubers the germ may be introduced in the new fields. Usually in this state the disease in most years merely infects occasional plants scattered through the fields. However, in years very favorable for its development, it may cause noticeable injury.

One should use care in obtaining disease-free tubers or, if suspicious, those treated with formalin or corrosive sublimate. Care in the use of clean knives in cutting the tubers is also desirable so that the germs are not spread from diseased to healthy seed pieces.

Bacterial soft rot, *Bacillus carotovorus.* Almost every potato grower has at times been troubled with the soft, ill smelling rot due to this bacterium. The trouble usually occurs in wet soil or wet years and is often associated with land having considerable humus in it, especially if a green crop has been plowed under late before planting the potatoes. Too large pieces of the tubers used in planting may help develop these bacteria especially if they are not used up in producing the new growth. The trouble, however, is most frequent and serious in the years when the late blight opens the way in the tubers through its dry rot thus allowing this organism to gain entrance and, outstripping the dry rot, to cause the ill-smelling, soft rot. *See* Iris.

Blight, early, *Alternaria Solani.* This disease is so called because it appears before the next disease, usually sometime in June or later. If it were the only fungous disease of the potato we would not need to worry in this state about the crop so far as it was concerned. However, in some years it does a moderate amount of damage. The trouble shows as small, reddish-brown spots on the leaves that usually can be told by the concentric lines of development. The imperfect fungus develops its microscopically conspicuous spores in an inconspicuous way on the surface of these leaf spots. No other stage is yet known. The same fungus has been found here on other solanaceous plants such as egg plant, tomatoes and certain of the wild species.

When necessary spraying with Bordeaux will take care of it if started in time. Where potatoes are regularly sprayed for the late blight this trouble is taken care of at the same time.

Blight, late, *Phytophthora infestans. See* Addenda. (Fig. 48.)

Dry rot, *Fusarium* sp. Every time we look in Seymour's Host Index of The Fungi of North America and see the seventy or more species of Fusarium that have been listed on the potato alone, we hesitate to give a name to any species of this genus. Therefore we fail to give a specific name to the fungus or fungi in this case.

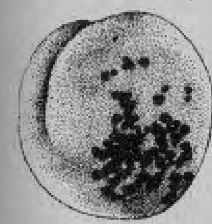


FIGURE 46. Peach scab.

FIGURE 47. Pear scab.

FIGURE 48. Potato late blight.

One of the species of Fusarium is said to cause a wilt of potato vines in the east and also to infect the tubers through blackened invasions of their bundles. This fungus has received the name *Fusarium oxysporum.* We have seen an occasional field where we suspected a wilt of this nature as partly responsible for the trouble. Likewise we have seen tubers with blackened bundles in which there was the presence of mycelium of a Fusarium and have frequently seen stored tubers whose ends were rotting from the evident, whitish growth of the fungus. We suggest to the growers that all such individual tubers should be rejected for seed. Fusarium or other fungi also usually follow the late blight fungus as well as the bacterial soft rot organism in the infected tubers.

Pythium rot (Leak), *Pythium debaryanum.* The first time we saw this trouble on potatoes, commonly called leak because of its soft wet rot, was in a small way in a field of Irish Cobblers in Milford in 1922. It did not form so ill-smelling or mushy a rot as does the bacterial soft rot. Potatoes grown in the same field the next year showed a greatly increased amount of this trouble, those dug for temporary storage as well as those placed directly on the market soon after digging. We did not see the trouble again until the late fall of 1932 when it was brought to us on Green Mountains that evidently at the end of the season had suffered a slight touch of the late blight. After storage these had developed some rot but after sorting and drying this had stopped and the trouble when seen by us showed on only a few tubers that had a dry, sunken, internal rot without much indication of it on the outside. However, certain reddish-brown sunken places in the skin indicated that it had gained entrance through injuries by the late blight and was responible for a further but different type of rot.

With this trouble spraying as for late blight should prove helpful. If it develops after digging, the tubers should be placed in a cool but dry storage in piles not too deep and sorted over as necessary, especially before sale. Dry liming possibly may help. The sooner the tubers dry out the safer they will be from further rotting.

Rhizoctonia rot, *Rhizoctonia Solani* (*Corticium vagum*). This fungus can easily be recognized by the housewife, when she washes the potatoes for cooking, through the small, black, flattened bodies that adhere closely to the skin despite her efforts to remove them. These are the sclerotia that when the tubers are planted send out the eventually colored mycelium to crawl over the growing plant and gain entrance at some tender place usually at the base of the stem. The reddish-brown cankered areas produced there cause the plants to become dwarfed or develop a sickly growth with yellowed foliage or a terminal rosette of leaves and the tubers are apt to be limited, often directly on the stem just below or even above the ground. Such plants usually occur here scattered through the fields but where seed has not been carefully selected and the season is favorable may cause more severe damage. Occasionally at the base of the stems just above the ground one can find a grayish felt surrounding them. This is the only known fruiting stage, *Corticium vagum,* and belongs to a low form of the Basidiomycetes of which the ordinary toadstools are samples.

Besides injuring the potato this fungus, in its different strains, causes rot here on various parts of a variety of plants as follows: beets, carnation, celery, chrysanthemum, endive, iris, larkspur, lettuce, lily, mignonette, monkshood, pea, radish, rhubard, rutabaga, strawberry, sweet pea, sweet william, tulip; also it causes damping off of a great variety of seedlings, for which *see* spinach in Addenda.

For prevention the grower should secure the best seed potatoes showing little or none of these sclerotia if they have not been treated. Seed treatment is effective but since certified seed potatoes have been introduced this treatment is not so commonly carried on in this state as formerly. If such treatment is desired soak the potatoes for one hour in a barrel of water using four ounces of corrosive sublimate to each thirty gallons.

Scab, *Actinomyces scabies.* This is another of the famous old timers of the potato about which there was confusion as to the cause until Thaxter, the first botanist of this Station, isolated the obscure fungus responsible and produced the disease on tubers through inoculation with cultures, in one case using the germs to trace his initials. We still have on hand, preserved in liquid, one of these cultures and also the inoculated tuber showing the monogram. This low form of fungus is not evident on the infected tubers but its effect is commonly shown through the corky spots etched rather imperfectly on and just beneath the skin and known as scab. Its effect on the tuber itself seems to be usually of little importance but to the growers its presence there is of importance since scabby tubers always sell to a disadvantage. *See* page 157. (Fig. 49.)

The same conditions for control hold as with the preceding fungus except that formalin is also frequently used as a fungicide on the tubers at the same rates. Rotation is also desirable and the use of fresh manure, lime and wood ashes are ordinarily to be avoided since the fungus thrives best in a nearly neutral rather than in an acid soil.

Scurf, *Spondylocladium atrovirens.* This fungus also attacks the tubers but only causes slightly sunken, darker areas on the skin that may cause the tubers to wither somewhat in drying out. The imperfect fungus fruits in an inconspicuous manner on the surface of these injured areas through erect threads bearing whorls of characteristic, multiseptate spores. The fungus was first reported in this country by the writer in 1907 on potatoes grown from a variety of sources on the Station grounds. It has been seen rarely since and never prominently, so it seems to be of little commercial importance here.

Wilt, *Verticillium alboatrum?* We have seen this trouble only rarely and then only on a variety more commonly grown in Maine than here, called Spaulding Rose. One field some years ago in July showed a number of plants somewhat wilted and with rolled foliage but the chief evidence was the canker-like injury on the main roots with a white fungous growth on the same. A second field in August showed at least 10% vines dead or dying prematurely. An examination of the roots showed similar canker and the white growth of the fungus on the main roots. This fungus in both cases also had invaded the fibrovascular system shown by its blackening. Evidently the fungus was carried into the field through infected tubers and the season favored its unusual development. The fungus developed spores of the Verticillium type but no cultures were obtained. This wilt is very similar to the Fusarium wilt already mentioned under dry rot. *See* also Barberry and Maple.

Black heart. This is a trouble that shows in the center usually of large potatoes and sometimes around a central cavity. It seems to result from unfavorable storage conditions as to heat and ventilation. The trouble shows in potatoes shipped into the state, rather than in those raised here, and the manner of heating the cars and the storage barn or the deep piling in storage, cutting off the supply of oxygen, seem to be the unfavorable factors.

Curly dwarf. As applied here curly dwarf of the potato is the occasional plant that remains stunted with short internodes and petioles and curled, rugose, small leaves. It is said to be a virus disease perhaps of the extreme mosaic type since there is some indication of mottling. It is most likely to appear in fields of continuously home-grown seed or those of cheap northern grown seed. It does not seem to be much of a factor in fields grown under the best modern conditions.

Frozen tubers. These may occur with native potatoes stored in pits or cellars not well provided against freezing weather but usually the owner knows the danger of such conditions and realizes the trouble when it appears. It is when potatoes are shipped by cars in freezing weather without proper protection against cold that most of the trouble occurs and complaints are made. Only part of the potatoes may be injured and the purchaser may be in doubt as to the nature and cause of the injury. Such potatoes take on a softer condition when thawed. They often become blackened and the skin may slip off more easily. Of course if the injury is too severe, rot from fungi or bacteria occurs. A sweetish taste usually indicates a frozen potato. Slow thawing rather than quick, lessens the injury if not too severe.

Along this same line is the occasional injury to early potatoes in the fields when late frosts hit the emerging vines. Growers usually want to know what is going to happen to such fields. As a rule the fields seem to pull through in fair shape, especially if the sprouts were not exposed too much and new shoots develop later, which generally happens. However, in the spring of 1932 we saw a few fields in the Ellington potato region where the growers said that the vines had been severely hurt by one of these very late frosts (June 8-9). Apparently the Irish Cobblers were injured more than the Green Mountains possibly because they were more advanced. So far as the freezing of potato vines in the fall is concerned this rarely happens in this state since the vines are usually dead long before killing frosts appear. Likewise the tubers are dug before cold weather injures them.

organism, by isolating bacterial cultures from the infected sweetpeas and re-inoculating them into very young healthy ones.

Rotate, change or sterilize the soil where this trouble occurs.

Powdery mildew, *Erysiphe Polygoni.* This has been reported, in its conidial stage only, a few times on this host as more or less conspicuous. The scientific name employed is that usually given by others but, because of the presence only of the conidia, the mildew might belong to the genus Microsphaera which also has been reported on this host.

Root-seedling rots, *Fusarium* sp., *Phytophthora caetorum, Pythium debaryanum, Rhizoctonia Solani.* On sweetpeas showing yellowing of the foliage and stunting of the vines as a result of rotting of the basal parts and roots, we have found at one time or another all of the above fungi, occasionally two together. While we hold each separately responsible for such rots, it is quite possible that one or two are more directly responsible for the start of the trouble.

If manure is used, place it deep in the soil and cover with a shallow layer of earth. Trench the seed and plant shallow at first and gradually cover with the soil as it comes through. Cultivate the top soil around the plants frequently to maintain a dry mulch and if necessary scatter a little mixture of sulphur and lime around them. Change the planting location each year and if trouble still bothers sterilize the soil as indicated under damping-off of Spinach.

Mosaic. The light-green mottling, interspersed with the natural green of the leaves, has been found occasionally on greenhouse and garden sweetpeas. It causes some damage and is evidently a true virus mosaic. So far as we can judge it is not distinct from the mosaic disease of tobacco, *q.v.* It can be carried by aphids.

Sweet Potato

Black rot, *Sphaeronema fimbriatum.* The sweet potato, *Ipomoea batatas,* is rarely grown here, apparently because we are too far north and not because we lack sandy soils. Recently, however, there has been some interest in growing this crop among the tobacco farmers. The only time we have seen a disease on plants grown in the state was in the fall of 1933 when Dr. Jones brought in specimens from the Station's Vegetable Garden at Windsor, showing the black rot on the variety Long Stem Jersey where it proved serious. This showed as sunken, dark-brown to black spots of somewhat variable size on the roots, some of which produced the fruiting stage of this imperfect fungus. The bases of the pycnia were embedded in the skin, but showed above as free necks in a black, hair-like growth. At the fringed tips sometimes could be seen the pinkish mass of oozing spores. The disease is said to be troublesome in storage as well as in the field and is general in the sweet potato sections of the United States.

We have had no experience in controlling this trouble but others advise the selection only of healthy sprouts from disease-free seedbeds or tuber treatment with corrosive sublimate, rotation in the fields and extra care in storage.

Soft rot, *Rhizopus nigricans.* This trouble is the chief one with which storekeepers and housewives have to contend. The non-septate mycelium of the fungus is hidden in the rotting tissues but under suitable conditions there is often evidence of the fruiting stage as a growth of black, stalked sporangia. This fungus causes a wet rot of certain other plants as well as being a saprophyte on dead substances. It is listed here only on apple, peach, squash and strawberry besides on sweet potato. A very similar rot of the sweet potato is sometimes caused by the bacterial soft rot organism, *Bacillus carotovorus.*

Fasciation. We have seen this malformation several times recently where the ends of the vines were flattened out an inch or so wide and ran out for a distance of two or three feet, bearing numerous leaves on the flattened surface. *See* Asparagus.

Sweet William

Crown rot, *Sclerotium Delphinii.* This serious rot of a great variety of herbaceous plants was found once on this host at Wallingford in 1932. *See* Larkspur.

Rhizoctonia rot, *Rhizoctonia Solani.* This has been reported a couple of times as causing rotting at the base of these plants, *Dianthus barbatus. See* Spinach and Potato.

Rust, *Puccinia Arenariae.* The rust has been found a few times on this plant in private yards. It has only the III stage which is evident on the leaves, chiefly the lower surface, as roundish groups of lead-colored blisters that are reddish-brown after the epidermis ruptures and discloses the embedded spores. These apparently germinate in position and spread the rust or carry it over the winter before germination.

Sweet Vernal Grass

Smut, *Tilletia Anthoxanthi.* The smut confined to this host, *Anthoxanthum odoratum,* occurs inconspicuously in the seeds, being revealed only by their slightly larger size and their smutty appearance when broken open. It has been found in North America only in Connecticut, Pennsylvania and Nova Scotia and there only rarely.

It has never been conspicuous enough to require preventive treatment in Connecticut but probably could be controlled by the various seed treatments.

Sycamore

Anthracnose, *Gloeosporium nervisequum.* This is the prominent disease of our sycamore trees, *Platanus occidentalis,* killing the young leaves as they come out in the spring and causing reddish-brown areas on the leaves that escape the earliest infection. Often these areas or streaks spread along the ribs, as indicated by the specific name. Some scientists consider the trouble on the oaks the same species as this on the sycamore. An imperfect stage carries over on the young twigs and produces infection of the leaves. The fungus has also been connected with a saprophytic Ascomycete, on the old leaves in the spring, known as *Gnomonia veneta* but which has not yet been found by us.

Sometimes the leaves are so badly injured in the early season that a new crop has to be put out to carry the tree along. Continued infection of the leaves year after year causes the trees to produce weakened limbs that may finally die, giving them the appearance as if on the last lap to destruction but they usually pull through. Here the European sycamore, *P. orientalis,* one of our street trees, seems to be less subject to the disease or at least escapes it while young.

We advocate at least two sprayings with Bordeaux—one a dormant spray just before the buds begin to break and the second on the very young leaves after the buds have opened, with a third treatment in some cases when the leaves are half grown. It can do no harm to rake up and burn the leaves after defoliation in the fall and possibly it may do some good, especially if much infection comes from the asco stage.

Powdery mildew, *Microsphaera Alni.* This mildew has been reported chiefly by nursery inspectors, apparently not being very common or injurious. *See* Lilac.

Electric injury. We have seen this trouble from feed wires along the trolley tracks. When the insulation had been worn off and the exposed wire came in contact with the wet leaves, the injury was evident by their premature death. Occasionally where direct contact was had on large limbs we have seen a local burn that resulted in their death as well.

Frost injury. Certain years, when late frosts occur after the leaf buds begin to emerge, we find similar, fatal injury to the leaves all over the tree that very closely resembles the anthracnose trouble.

Teosinte

Smut, *Ustilago Zeae.* This Mexican relative of corn, known as *Euchlaena mexicana,* is grown here rarely as a curiosity. Only at the Station farm have we found the smut on it but we consider it to be the same species as the one attacking corn, *q.v.*

Timothy

Black mold, *Helminthosporium* sp. In July, 1926, and again in 1928, we found at the Mt. Carmel Station farm roadside timothy, *Phleum pratense,* showing a little spotting but more evidently a premature yellowing and then a browning of the leaves. These leaves showed spores of the above fungus as a probable cause, as well as those of Cladosporium and Macrosporium which were more evidently saprophytes. There was, however, the possibility that drought rather than the Helminthosporium was really the primary cause of the trouble. We have determined the fungus under the generic name only since it may be only a weak parasite occurring on a variety of grasses (possibly *H. gramineum*) rather than a specific one limited to a single host genus as is indicated by the work of recent authors in classifying the species of this genus. *See* stripe under Barley.

Ergot, *Claviceps microcephala.* The ergot on this plant is much smaller than the one found on rye, *q.v.,* as it is rarely over a quarter of an inch long and relatively thinner. One or few of these sclerotia may be seen on the spikes of timothy extending out a short distance beyond the floral parts. The same species has also been found here on *Dactylis glomerata* and possibly on *Phalaris arundinacea.* This latter host has the narrow sclerotia but often reaching a length of half an inch.

Leaf spot, *Heterosporium Phlei.* Quite distinct from the Black mold in its effect on the leaves is this fungus which was sent in by County Agent Wing from Pomfret in June, 1933. It produces definite, small, oval to oblong spots, more or less abundantly, in the green tissues. These spots are chiefly 1–2 millimeters in length and have a straw-colored center and usually a very definite purplish border. While our specimens had few spores, these were obtained abundantly by placing the leaves in a damp chamber for a few days, but the olive-green growth of the conidiophores and spores was not entirely confined to these spots. The spores were not so prominently echinulate as figured by Gregory, who originally described this species (Phytoph. **9**:576) in 1919 from New York state.

Rust, *Puccinia graminis.* Both the II and III stages of this rust have been found to be common on this host. There are more than eighty specimens in the herbarium from various localities in the state. However, we have not found it very serious in hay fields. It is usually seen on roadside plants. The II stage shows as reddish-brown, elongated pustules while the III pustules are black and more permanently embedded, both occurring chiefly on the stems and sheathing base of the leaves. These sori are surrounded by the evident, ruptured epidermis. The I stage occurs as cluster-cups in the leaves of the barberry, *q. v.,* in the spring and early summer. Besides occurring on timothy, this rust is reported here on barley, oats, orchard grass, redtop, rye, wheat. It also occurs on a few wild grasses.

While common on certain of its hosts, it is not injurious enough to warrant any special treatment. In the west where it is more serious in the grain fields, laws have been passed for eradicating both wild and cultivated barberries. Many years ago this same method was tried in New England. The late Dr. Jenkins, Director of this Station for years and interested in the early history of Agriculture in Connecticut, in 1921 handed the writer a memorandum on this subject, part of which is given here:

"In 1784 the laws of Connecticut provide that anyone, with the advice and consent of the civil authorities and selectmen of the town, may during March, April, October and November enter any lands where barberry bushes are growing and dig up and destroy them without being liable to any action, suit or damage. . . . . . In 1796 the town of New Haven granted $200 for the purpose of destroying barberry bushes within its limits and they were 'principally destroyed. The method adopted to destroy them was to eradicate them.' I'll bet a student of the classics wrote that last sentence. E. H. J."

Smut, *Ustilago striaeformis.* This occasionally occurs on the leaves. *See* Redtop.

Proliferation. In the spikes we have sometimes found one or more larger, elongated, leaf-like bodies instead of the normal spikelet. *See* Rose.

Toadflax (Butter and Eggs)

White smut, *Entyloma Linariae.* The only fungus we have found on this plant, *Linaria vulgaris,* which occurs here chiefly as a weed escaped from cultivation, is this smut which is inconspicuous and shows as small, light-yellow spots on the leaves.

Tobacco

Diseases and Injuries. We have listed in this state on *Nicotiana tabacum* nearly fifty of these troubles, distributed as follows: Fungi, 8; Bacterial, 3; Virus, 2; Nutritional, 5; Mechanical and Environmental, 15; Undetermined, 15. We can give here only a brief condensed statement of these.

Bacterial angular spot, *Bacterium angulatum.* We first noticed this trouble in July, 1922, when we were making a survey of the tobacco troubles during the years from 1920 to 1922. We found it first in the general region of New Milford and have seen it since, more or less common in wet years in the Housatonic river tobacco region but less so in the Connecticut river tobacco section to the east. It forms small, reddish-brown, angular spots that are more or less grouped and become semi-pellucid when wet. On the whole it is not usually very serious, especially when compared with the bacterial wild fire with which it occasionally occurs on the same plants in wet seasons. While we have made no attempts to isolate the organism causing the trouble or any serious attempts to reproduce it by inoculations, we have no doubt of its bacterial nature since we have compared it with similar specimens from the south where the disease has been more thoroughly studied.

FIGURE 58. Tobacco black root rot.

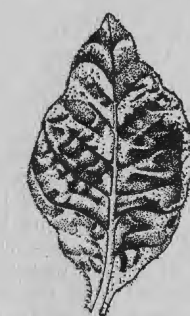


FIGURE 59. Tobacco mosaic.

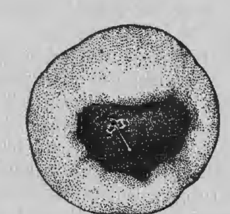


FIGURE 60. Tomato point rot.

Bacterial soft rot, *Bacillus carotovorus.* This is likely to show in wet seasons especially on land where nitrogen is used in organic form, such as fish scraps, manure or cover crops plowed in late. Usually only an occasional plant shows the trouble by the interior of the stems developing a wet rot of the tissues and becoming hollow, when it is known locally as hollow stalk. Sometimes the plants rot off at the base and the disease is more general in low spots of the fields. *See* Iris.

Care in the use of such nitrogenous fertilizers, especially in low or wet fields, is necessary.

Bacterial wild fire, *Bacterium tabacum.* In 1920 this disease was definitely recognized in the Connecticut valley although it had probably been present one or two years previously and in July, 1922, it was first found in the Housatonic valley. During the first few years after its discovery it became very general in the tobacco fields of both of these regions. It was chiefly due to the alarm caused by this disease and the interest brought about by the tobacco surveys of 1920 and 1921 that the tobacco substation at Windsor was established in 1921. In recent years the trouble has not caused so great damage probably largely because of knowledge gained concerning its nature and methods of control.

The disease is characterized by a sort of wet rot of the very young plants in the seed bed and later by the yellow, roundish spots on the leaves of the older seedlings. In the field these yellow spots, under favorable moist conditions, become more abundant as the plants begin to grow and in time turn to white or brown dead spots with a yellow halo surrounding them. With increasing age of the plants the spotting may become very abundant and more or less run together into irregular shapes of dead tissue and this may be torn or dropped out. In fields where the trouble has been favored throughout the season by moist conditions, the injury may be so great that the entire crop is lost or not worth the cost of harvesting and curing. *See* Bull. 239.

The trouble comes about entirely from the seed bed and does not spread readily from field to field or from a diseased crop previously on the same land. Therefore it is now largely controlled by careful attention to the seed bed, chiefly by spraying with Bordeaux mixture. It does not pay to plant a field from a seed bed in which the seedlings have shown signs of the disease. Even if apparently healthy plants only are used, when the season later is wet, trouble is likely to follow.

Black root rot, *Thielaviopsis basicola.* This is common in the seed beds where alkaline fertilizers, such as wood ashes or lime, have been used or where the soil is more nearly alkaline than that in normal seed beds. When it is bad young plants make a slow growth with the leaves often forming a rosette close to the soil without much change until new roots are developed. Examination shows a black discoloration of them due to this fungus rotting the tissues, hence the name of black root rot. In the fields the trouble is also found when plants are used from infected seed beds or the fertilizers and climatic conditions favor its development. Such infected plants, sometimes in spots or generally over the field, make a less favorable growth due to the preliminary stunting. Later field infections, due to favorable, cool, wet weather of the early season, favor the growth of the fungus. On this latter account later planted tobacco, during the warmer weather, is said by some to be less injured. The type of fertilization in the field also has some effect on the development of the fungus as has already been indicated for the seed beds. (Fig. 58.)

In the past a good deal of poor tobacco has been laid to this trouble even when the roots did not always show its presence in sufficient amount to indicate it as the primary cause. Round Tip, at one time in favor here after its first introduction, seemed to have more resistance to this fungus than the other varieties grown here commonly or at least it had a more vigorous root system that was helpful. On the other hand a certain type of Burley was especially susceptible to injury by the fungus and was used as an indicator of its presence. So far the other hosts on which this rot has been found here are pansy, pea, sweetpea and violets.

Attention to the seed bed, especially as to alkaline fertilizers and sterilization, and proper field fertilization are helpful in preventing this trouble. Recent attempts to develop resistant strains of Havana, Round Tip and Cuban tobacco may eventually largely solve this problem.

Canker, *Sterigmatocystis niger;* **Must,** *undet. organisms.* Both of these warehouse troubles develop in the cases after the tobacco is packed for fermentation. The canker is due to the saprophytic, imperfect fungus named here which forms a black growth of conidiophores and spores on definite spots of the overlapping leaves of the hands and the mycelium of which works through them. It develops a wet rot that eventually when dry causes these large infected spots to become brittle and easily broken as well as discolored.

Favorable conditions of heat and moisture as well as the presence of the spores, rather commonly present in nature, favor the development of this trouble so care has to be used to prevent these optimum conditions.

Must is a somewhat similar trouble due to about the same causes and is so named because of the musty smell given to the tobacco. However, from the few specimens we examined years ago, we were not able to identify the specific cause. These specimens showed a whitish growth of bacteria and fungi along the midribs but no definite specific organism that seemed to be primarily the cause.

In the past, dealers who had this trouble sometimes renovated the musty tobacco by washing it with rum.

Frost fungus, *Botryosporium pulchrum.* The fungus receives its common name because of its frost-like appearance. The white, branched conidiophores with their adhering spores are a pretty sight when seen growing on the refuse tobacco on the floors of the tobacco barns. It also occasionally occurs as a semi-parasite on the curing leaves there. Sturgis speaks of it in this latter case as follows: "Stems affected with this disease are covered with pure white patches having the appearance of a long pile velvet. The patches spread rapidly, encroaching upon the veins of the leaf and destroying the tissue and in the end inducing a more or less widespread decay, especially in the neighborhood of the midrib and veins." The same fungus is also sometimes found on other languishing plants in the greenhouses.

The tobacco rubbish on the floors of the barns should be cleaned out to prevent the spores being blown to the tobacco hung there for curing and care should be paid to the heating and ventilation.

Fusarium spot, *Fusarium affine.* This apparently weak parasite has been found as the cause of roundish spots, usually less than half an inch in diameter, on the leaves. These spots may be distinct or more or less run together. They stand out best on yellow leaves as a brown or bronzed color but with a purplish tint on the green leaves. They have been found on the old languishing leaves in greenhouse plants but more commonly in the Broadleaf fields on the old basal leaves on the ground from which infection may come. The fungus is apparently never conspicuous on these spots but can be obtained in cultures from them.

We do not consider it, so far, a serious trouble that needs any special treatment for control.

Seedling rots, *Pythium debaryanum, Rhizoctonia Solani, Sclerotinia minor, S. sclerotiorum.* Beside the black root rot of seedlings in the beds, the above four fungi have also been found causing trouble. The Pythium fungus usually attacks the roots and forms a reddish rather than a black rot of them. The fungus is ordinarily rather indefinite on the outside as whitish threads but is evident by the roundish oospores found within the tissues. It is the same species found on a great variety of seedlings as discussed here under Spinach. In our tobacco disease-survey of seed beds in 1920 and 1921, we found this Pythium more common than any other of the damping-off fungi.

The Rhizoctonia, as already described under lawn grass and spinach, was also common and while it rots the roots it may send mycelium above the ground to rot off the parts above as well. It is said to favor an acid soil. *See* also Potato.

Of the two Sclerotinia, the *S. minor* has only been found once on tobacco while the larger sclerotial form, *S. sclerotiorum,* was seen a number of times but both act alike. Like the Rhizoctonia the seedlings may be rotted down in bunches and often a thick, white mycelial growth may show on these parts above the ground. Both fungi develop rather characteristic, black sclerotia in artificial cultures. *See* Lettuce.

Care in the watering and ventilation of the seed beds is the prime factor in controlling all these troubles. Of course sterilization of the beds is even more effective. Both steam and chemical sterilization have been used. In the latter case both formalin and acetic acid, the latter the more recently tried, treatments have been used. Steam sterilization, if done properly, is generally more successful and keeps down the weeds better. In certain cases, however, the chemical treatment is the only method at hand for the grower. *See* statement under soil treatment.

Stem canker (Foot rot, Sore shin), *Pythium debaryanum, Sclerotinia sclerotiorum.* In the field one occasionally finds plants weakened by cankers at their base so that they are easily broken off there. These are usually plants that were infected in the seed beds by these fungi but whose tissues have become so hardened that the rot at these places has stopped or has progressed slowly, especially in the case of the Pythium, to form a dark, foot rot. Possibly other fungi at times may be responsible for these troubles but as yet we have not found them.

Nematode rootknot, *Heterodera radicicola.* So far this trouble has been seen only rarely on greenhouse plants grown at the Station in New Haven. *See* Cucumber.

Abnormalities. These are not frequent and so do not constitute any menace to tobacco growing here. They are, however, interesting because of their different types and causes. They may be briefly mentioned as follows: *Albinism* shows as whole plants or certain leaves or parts of a leaf in which the normal green color gives place to a whitish-yellow or pure white color. It is quite distinct from mosaic and does not seem to be contagious but possibly it is an inherited character as is often shown by crossing of plants. *Crinkled leaf* is rarely shown by the crinkling and puckering of certain leaves of plants and in some cases seems to disappear later. *Curley dwarf* is much like the similar trouble in potato plants but whether due to a "virus" is not known. Unusual *mottling* or *golden marbling* is rarely seen on the leaves of certain plants that suggest abnormal fertilization. *Strap leaves* are shown by very narrow leaves, often largely limited to the midrib; they are apt to occur on badly mosaic plants or on whole plants that have been stunted in some way by unfavorable soil and weather conditions. *Twin plants* and *twin leaves* are apparently due to early injury to the bud or young tissues that produce them. They are seen so far only in seed beds because they would not be set out in the fields. We have never seen a case of *fasciation* on this plant.

Brown root rot. This is a trouble that rots the roots causing them to turn a brown color. There is usually no indication on the roots as to the cause. The trouble is complained of chiefly in the fields because the rotting of the tap and side roots delays the vigorous development of the plants until new roots are formed above these. Even then the plants never fully recover. They are likely to wilt more easily in hot weather than normal plants and fail to produce a satisfactory crop. Certain fungi, as Fusarium, and adverse fertilization, such as calcium deficiency, have been claimed as the cause but the latter seems to be more likely as shown by recent investigations. The infected fields or spots often progress in severity.

The Station in experiments has found that certain types of fertilization and cover and rotation crops seem to lessen this trouble. The use of stable manure and an annual application of lime were helpful. Resting the land to weeds also was favorable to its decrease. Sterilization, by steam and to a less extent by formalin while beneficial, is not practical for wholesale treatments. Rotation of tobacco with forage crops (timothy, corn, rye, alfalfa and clovers) and the use of timothy as a cover crop were apparently detrimental rather than beneficial.

Fertilizer injuries. *See* Addenda.

Fire injury. Injury of this type occurs only on tent tobacco when fire from lightning, smoking, etc., causes burning of the cloth covering, with resulting injury from the burning cloth dropping on the tobacco beneath. During the war owners were especially suspicious of fire that they thought might be set intentionally, so a more careful watch of the tents was made at that time.

Frost spot and mottling. We have seen white specks or spots, in seed beds covered with cloth or those with glass that were not covered at night or had broken glass, appear as the result of freezing weather. These spots, at times, are difficult to distinguish from fertilizer burn and sun scorch spots.

In the fields in June, after the tobacco has been set out, there occasionally occurs freezing temperature in certain exposed fields in which a more evident type of injury develops. The injury comes on suddenly and does not progress to other parts of the plant, although some stunting may result. This injury shows as irregular, white specks, spots or areas in the leaves, rarely on the stems, with a more or less deformity of the tissues when severe. The chlorophyll is killed leaving white spotting without very evident injury to the cells. Sometimes the grower finds the injury only on certain plants; it is quite likely those injured had moisture on the injured parts at the time of the frost.

Hail injury. Such injury has long been known as serious in local regions in the Connecticut valley. Sometimes the injury has been so local that one grower has had his tobacco seriously injured while a neighbor entirely escaped injury from this cause. The hail stones tear out or rend the leaves in such shape that they are of no use for wrappers or binders. We have seen leaves that had numerous holes like a large sieve and the stalks showed injury by discolored dents. The trouble occurs on both field and tent tobacco, in the latter case causing damage to the cloth as well. Sometimes the hail stones accumulate on the cloth until their weight tears it apart and drops them in large piles on the ground where they sometimes last until the next day despite the high temperature. Some years are worse than others

but we have clippings from local papers for various years estimating the damage by hail and wind that run from thousands up to hundreds of thousands of dollars.

Leaf spots. There are a number of different leaf spots concerning the cause of which we are still in the dark. It may be that some are due to a lack or an excess of certain elements in fertilization. Some may be due to obscure bacteria, others to "virus" types of injury and still others to unfavorable weather conditions. We group these spots, unknown as to cause, here together. *White speck* or *spot*, often seen moderately on Havana tobacco scattered on the leaves, is indicated by small white spots or specks that when they occur in circles we call *ring spots, q. v.,* which are said to be due to a virus. Similar *brown spots*, usually circular in shape, occur on various types of tobacco but are classified here as one. No definite organism has been associated with them here although in some sections somewhat similar spots have been laid to bacteria. Some of the spots, known as *Broadleaf spot* and *John William spot*, usually white in color but sometimes brown or dark and then changing to white, come on the lower leaves exposed to the dirt and under certain weather conditions seem to act much like wild fire. So possibly they are due to bacteria or a "virus," though we have never spread them by using infected tissues on healthy plants.

Lacking the data as to the cause of all of these troubles, we have as yet no means for control when they become serious in certain seasons.

Lightning injury. This trouble is seen occasionally as in potato fields. The lightning strikes a definite place in the ground and kills or injures the plants in a somewhat circular spot around the place that was hit. On the edge of the spot the plants may be alive and continue to grow but show cankers at their base and wilted or curled leaves, especially near their midrib.

Mosaic (Calico). *See* Addenda. (Fig. 59.)

Pole burn (Sweat). Personally we have not had much experience with this trouble though Sturgis was an early investigator here and Anderson, of the Tobacco Station, has been interested in it in recent years. The trouble occurs in the barns after the green leaves or stalks have been hung there and the temperature and moisture are favorable for the development of bacteria and molds and a wet decay results before the tissues are thoroughly dried out. Sturgis dealt largely with the type of barns that favored the drying of the tobacco in the best possible way and he and others also considered artificial heat as a preventive.

Anderson advocates the use of charcoal, in certain containers for the regulation of moisture, as a means for avoiding the trouble. In one of the Tobacco Substation bulletins he says. "A conservative estimate of the loss to Connecticut growers this year (1928) is over a million dollars. . . . . Firing to wilt, *i.e.*, within a few days after filling the shed and while the leaves are still green is a good practice but is not always necessary for prevention of sweat. Pole sweat never attacks leaves when they are in the green stage. The late yellow and early brown stages are the danger stages. . . . . If the tobacco is in those stages and wet weather sets in, with high humidity preventing evaporation from the leaves, it is time to start firing. Don't wait until the leaves begin to 'puff' and the midribs 'strut'." For details of treatment consult the Tobacco Substation at Windsor. *See* Rept. **1891**:168; **1899**:265; Bull. **299**:195.

Rain spot. This occurs in rain storms, where the plants are of some size, on the lower leaves especially of Broadleaf. The drops hit the upturned under surface and there result soon afterward roundish spots, usually not showing at all on the upper surface, of a dark, copper color or more rarely a silver gray on certain plants. Generally no permanent injury is produced. Apparently the leaves absorb this water, giving at first a water-soaked appearance in these spots. Sometimes extended areas of the leaves on the ground develop a purplish or grayish color on their under surface. It is doubtful if there is much bruising injury where the rain drops hit the leaves.

Ring spots. One finds on the leaves of scattered plants of tobacco, usually on Havana here, small white spots generally arranged in a circular manner and often more than one circle to a leaf. The chief difference between these and the ordinary white spots found more frequently on the leaves is their circular distribution. Their cause may be the same but certain investigators have shown by experiments that these ring spots are due to a "virus" that can be transmitted from infected leaves to the healthy. We have never tried carefully to produce these spots in this way from local diseased specimens, but believe the trouble here is the same as that described by these investigators. The regular distribution of the spots, however, gives one the impression that they might be due to the puncture of some insect, though there is no proof of such an agent as a possible contributing cause.

While we have not tried to produce this trouble from the ring spots on leaves grown in this state, we have produced similar injury by the pricking method, from another trouble sent here from elsewhere. Recently, too, we have produced similar spots on the lower, mature leaves of young plants when they were inoculated by the hand-rubbing method, from what seemed to be straight mosaic leaves kept sometime in the herbarium. The young upper leaves of these infected plants, however, produced the normally mosaic leaves without these white spots. Yet when we tried again to reproduce these ring spots by infecting other young tobacco plants, using only the ring-spot lower leaves showing no visible mosaic appearance, the leaves of the newly infected plants all produced typical mosaic plants with no white spots even on their lower apparently normal leaves.

Rust. We limit this term to those plants that show an irregular and often an extended, reddish-brown killing of the leaf tissues. In our experience this is usually limited to the killing of mosaic-infected leaves especially when suddenly exposed to bright sunlight or to extremes of dry, hot weather. While normal leaves possibly may be subject to similar injury, they are certainly less likely to develop it while mosaic leaves, even in somewhat normal conditions, may occasionally show such dead spots. We have in mind a case where mosaic plants were topped during a hot period and an unusual case of rust developed. A grower once complained to us that he always had this trouble on a certain piece of land. In the hot, dry air of the greenhouse, mosaic plants often show this trouble conspicuously.

Sand blast. Most tobacco here is grown in rather sandy soils. During wind and rain storms, the sand may be blown against the wet leaves or the leaves are dashed against the soil and the slight injury caused is known as *sand blast.* This is shown by small, white, specks on both surfaces of the leaves and is found most commonly on the leaves near the ground.

Spray, Poison and Fume injuries. Spraying with Bordeaux, preferably home made, is apparently more desirable than dusting, and in general little injury results, chiefly a yellowing of the leaves. Years ago we saw some injury from a commercial form of Bordeaux containing a poison, that was know as *purple speck.* Injury results when Paris green is used to kill insects and accidentally gets on the leaves or next the stems.

Fumes from boards recently treated with creosote may cause injury to the plants in the seed beds. Injury has also been observed on field plants next to state roads sprayed with hot preparations of tarvia or road tar to keep down the weeds. In these cases the lower leaves of the few rows of tobacco near the road may show the characteristic injury from the fumes by the varnish-like glaze on their upper surface with a slight upturning of the edges. In some cases dead spots appear when the injury is severe.

Water injuries. This is sometimes seen after severe rain storms in low, wet fields from which the water is not easily drained off. As a result the tobacco roots in this water covered or soaked soil are smothered for lack of air and a sickly yellow color of the foliage results, much as in nitrogen starvation. Abundant but well distributed moisture, on the other hand, coupled with favorable fertilization, in certain seasons may make a luxuriant growth of leaf but with less favorable texture and color when the leaves are cured.

Wind injuries. Torn leaves, following hail and rain storms, are in part caused by heavy winds. The plants in the wet soil may be blown down by heavy wind and have to be straightened afterward. If this is not done these plants try to straighten themselves, sometimes making permanent bends in the stalks in their effort to go toward the sun and away from the earth.

Tomato

Anthracnose, *Colletotrichum phomoides.* This is a trouble occasionally prominent on the ripening fruit of *Lycopersicum esculentum,* the scientific name of the tomato. It starts as small translucent and then black specks that eventually enlarge into circular, sunken spots which may run together with evidence of the fruiting stage shown by the orange ooze of the spores of this imperfect fungus. The black setae that accompany these spores may be more or less abundant; when not so evident the fungus then takes the type of a Gloeosporium. It is most abundant in wet seasons at the ripening time.

Frequently nothing need be done for its control beyond picking and destroying the infected fruit and care in not leaving the sound ones to over ripen.

Bacterial blight, *?Bacillus solanacearum.* This trouble acts much like the black leg as described here on potato, *q. v.* Both were found on these two hosts about the same time in 1903 and were noted under the above Bacillus. The Southern brown rot, as it is commonly known, however, rarely occurs this far north. Later the black leg was described from New England on potatoes, and the trouble on our potatoes was identified as that. We are now inclined to believe that the trouble on the tomato, which we have not recently seen, may have been the same thing. Later the Michigan bacterial canker, described below, was found here and this earlier trouble possibly could have been it though apparently it was somewhat different, being more particularly confined to the vascular rather than to the epidermal systems.

Bacterial canker, *Aplanobacter michiganense.* While this disease, also known as Michigan canker, is said to be a vascular wilt and progresses from the lower leaves upward, we have noticed it at first merely as a wilting of the leaves which, losing their color, dry up on the stems. Eventually a brownish streak appears under the epidermis on the petioles and stems, running lengthwise of them and often showing only on one side. The epidermis may soften or rot away from the tissues beneath and eventually there may be a general rotting of these soft tissues. But to the writer the trouble seems to progress downward rather than upward and may finally reach the base of the plant and cause its death. It does not seem to be a vascular invasion, as with black leg where there is a general rotting of tissues below and in the hard tissue above a browning of the vascular system which is seen only when cut across.

This bacterial canker was first definitely recognized in this state in July, 1924; it was more common in 1925 and 1927, though since then it has been reported only occasionally. It is said to be carried by the seed. In some cases we have found it very destructive in the fields but we have never been quite sure that it spreads there to any great extent, apparently having come from plants infected in the seed beds and then showing up gradually or suddenly on those in the field.

Care in the selection of clean seed or its sterilization, if doubtful, and similar care of the seed bed should be used. Just what good could be accomplished in the field by spraying, especially if the spread there is limited, we are in doubt. Rotation, especially after the trouble appears in the field, however, should be followed the next year for safety.

Blight, early, *Alternaria Solani.* This appears chiefly on the leaves though we have seen a little on the fruit. It varies in different years but is usually not very serious. *See* Potato for further details.

Blight, late, *Phytophthora infestans. See* Addenda.

Fruit rots, *Macrosporium Tomato, Fusarium* sp. Both of these fungi were noticed by Thaxter on ripe tomatoes in the early days of the Station. They are the chief ones observed so far by the writer in the fields, where he considers them primarily as saprophytes. The first one occurs on the green as well as on the ripe fruit, chiefly as a dry rot, and often shows as a secondary effect following Blossom-end rot or other troubles. It is evident as an olive-black, external growth of the conidiophores and conidia. The fungus is probably an Alternaria, possibly *Alternaria fasciculata,* as given by some authorities. A recent trouble in the south known as nailhead spot, which is especially bad when the tomatoes are shipped north, may be caused by the same or a similar fungus.

The Fusarium fungus is most prominent on the ripening and over ripe tomatoes and is likely to cause a wet rot. This fungus frequently shows as an evident, white or salmon, external growth. There are, no doubt, other fungi than these two that cause trouble as distinct or associated fungi on the ripened fruit in the fields as well as on fruit shipped here from outside the state.

The chief helpful measures against these saprophytes or semi-parasites is to pick and destroy the infected fruit and to gather the ripening sound ones regularly.

Leaf mold, *Cladosporium fulvum.* We have seen and had complaints of this trouble chiefly in the greenhouses. It produces most of its injury directly on the leaves and indirectly later to the whole plant. The leaves are invaded by the fungus and later are covered by an evident, olive-brown growth of the conidiophores and spores on their under surface with discoloration of the upper. The leaves finally turn yellow and dry up chiefly from the base of the plant upward. Apparently no other stage has been found. This trouble was first mentioned by Thaxter in 1889, about six years after its first discovery, and again in 1890, both reports apparently being on out of doors tomatoes. It was also mentioned by Sturgis in 1893.

In the greenhouses care should be used in watering, especially on the leaves when this trouble is present. The temperature of the house also should be kept down as low as is consistent with good growth. Spraying with Bordeaux, if used, should start early and be repeated as necessary. The ripening fruit should be picked before spraying if any treatments are needed at that time.

Leaf spot, *Septoria Lycopersici.* This is our most common and so our most serious leaf disease of tomatoes. It occurs also on the stems and fruit but not seriously. If it occurs early and abundantly it may cut down the yield considerably but in this state this does not usually happen, so that the vines of late varieties are rarely killed before a frost. This makes it doubtful if spraying as a yearly operation pays here. The fungus is known only in its conidial stage. It produces at first discolored but finally small, whitish spots with a darker border in which usually the spore receptacles can be seen as black, embedded specks. The elongated, septate spores ooze out from these and spread the disease. Very similar spots are also found on the stems and to a limited extent on the fruit.

We have been fairly successful in controlling this trouble by spraying small patches with Bordeaux mixture, keeping the vines fairly free until killed by frost; however, spraying is likely to delay the ripening of the fruit somewhat and the late pickings are rarely so profitable as the early ones. Where desirable, as in the case of serious injury that we have heard of on tomatoes grown occasionally for canneries, the spraying should begin before the fungus becomes prominent and be continued every ten to fourteen days according to the weather conditions. The fruit should be picked just before spraying and if necessary washed. Rotation of the fields should help since the fungus apparently can carry over in the infected rubbish.

Seedling rots, *Pythium debaryanum, Rhizoctonia Solani.* These fungous troubles are found occasionally, causing damping-off of seedlings in cold frames, hot beds and flats in greenhouses. *See* description of damping-off under Spinach and of the Rhizoctonia fungus under Lawn grasses and Spinach.

Sooty mold, *Fumago vagans.* We have seen this commonly on the leaves of greenhouse tomatoes (Rept. **1906**:329) when the white fly or aphids were evident. *See* Apple.

Wilt, *Fusarium Lycopersici.* While at least thirteen species of Fusarium are said to occur on tomatoes, this is the one we use to designate the wilt trouble that is found in this state on both our fields and greenhouse crops. It causes a wilting, yellowing and dying of the leaves from the lower part of the plants upward. Cutting across the apparently healthy stems of the infected plants, one can see the fibrovascular bundles discolored reddish-brown and a microscopic examination reveals the presence of the mycelium and occasionally the spores of the fungus. Its presence gradually cuts off the water supply to the parts above, with their resultant death. Usually no external appearance of the fungus shows until the stems or portions of them begin to die or the fruit to ripen. Then a whitish growth of the mycelium, turning to a pinkish color with spore production, may appear.

We have found the mycelium in the fruit attached to the seeds and in this way, or internally in the seeds, the fungus carries over as well as in the refuse of the soil. No mature stage is known. Selection of healthy seed, the use of seed beds free from the fungus and rotation are the preventive measures for control of this trouble.

Nematode rootknot, *Heterodera radicicola.* This is occasionally found on the roots of greenhouse plants where it may cause considerable trouble. *See* statements under Cucumbers.

Growth cracks. This trouble shows around the stem end of the fruit rather than on the blossom end, as with the Point rot, and is more common on irregularly shaped than on roundish varieties. Cracks appear radiating outward from the point of stem attachment and if prominent are likely to hinder the sale of the fruit. Sometimes these cracks scar over but if they remain open certain fungi may gain entrance and start rots. The type of the weather, the variety grown and perhaps the fertilization, all apparently have to do with the trouble which, therefore, varies from year to year. Large and ill-shaped specimens are apparently most likely to show the trouble. Complaints have been made of such varieties as Bonny Best, Earliana, etc. *See* Snapdragon.

Leaf rolls. As with the related potato, the tomato shows trouble of this nature due to weather conditions, lice and "virus" infection. The first type seems to be the most common and least serious. *See* Potato for further information.

Lightning injury. So far the botanical department has examined injury of this nature to tomato vines only once, in 1931 at Branford. The injury was similar to that caused to the fields of potato. *See* also Tobacco for further statements.

Mosaic. As with tobacco, the tomato is subject to injury by this virus disease. On the whole, however, it is not so commonly and usually not so seriously injured by it. We consider the cause the same in each case, since the writer was able, years ago and apparently for the first time, to transfer the disease from mosaic tobacco to healthy tomatoes and back again to tobacco. In some of our experiments with the mosaic on tomatoes in the greenhouse, we noticed a trouble similar to that described by "streak" which seemed to be of a bacterial nature thought by some to be caused by *Bacillus Lathyri* and by others to be connected with unbalanced fertilization. *See* Tobacco for further statements concerning mosaic.

Point rot (Blossom-end rot). This trouble has long been known on the fruit of tomatoes, beginning at the blossom end when the style falls off and leaves more or less small cracks. It may finally extend to half of the green fruit as a brown-black, somewhat sunken, dry rot. It has been laid to bacteria, *Macrosporium Tomato* described here and to dry weather, especially sudden, hot spells. Apparently lack of water is the chief cause since we were never able to isolate any suspicious germ as the cause. The trouble varies greatly in different years and some varieties are more subject to it than are others. It apparently can be lessened in the greenhouse by sub-irrigation and possibly in the garden by judicious watering and mulching. (Fig. 60.)

Scald. As a result of hot, dry weather, especially if it comes on suddenly, this trouble may develop on the more exposed surface of the fruit as a light-brown discoloration, often with withering of the skin and even with injury to the tissue beneath. It may also open the way for further trouble by fungi. *See* Apple.

Trumpet Creeper

Leaf blight, *Cercospora sordida.* This is the only fungus on *Tecoma radicans* that has been found here and then only once, at Storrs in 1907. It is evident on the under surface of the leaves as small, angular patches, of a sordid-brown color, that often run together. The upper surface of the infected leaves is discolored more or less yellowish to reddish-brown according to the age of the infection. No other stage is known and not much has been written concerning it outside of the original description and its distribution. It has been found more or less common, chiefly east of the Mississippi but especially in the south. Apparently, so far, no treatment for control has been necessary.

Tulip

Botrytis blight (White spot), *Botrytis Tulipae.* *See* Addenda.

Crown rot, *Sclerotium Delphinii.* This fungus was found once on tulips causing a rot of their bulbs. However that year, 1933, the tulips blossomed in good shape since they had only recently been transplanted in the soil, where this fungus had caused injury the year before. *See* Larkspur.

Rhizoctonia (Gray bulb) rot, *Rhizoctonia tuliparum.* In the spring of 1932, the writer received, from a seed firm in the state, certain tulip bulbs that had been planted the fall before but had failed to come up in some cases and generally did poorly. These bulbs were more or less badly rotted and showed the presence of bacteria, yeasts and fungi in the rotted tissues; the one suspicious thing, however, was the sterile mycelium of one of the latter. This was evidently a Rhizoctonia which at the time we thought might be *R. Solani,* so common on the roots of a variety of plants. Later, reading Whetzel and Arthur's bulletin on the Gray Bulb rot of Tulips (Cornell Agr. Expt. Sta. Mem. 89) we decided the trouble essentially agreed with what they described as due to *R. tuliparum.* This, according to them, seems to have certain differences in the black sclerotia (as to their shape and microscopic structure) that form on the bulbs. No other stage is as yet known.

This trouble is apparently common to countries where tulips are grown for sale. Care should be used in purchasing good bulbs, especially avoiding those that show any signs of the black sclerotia on the exposed tissues. If trouble occurs plant in new ground with only healthy bulbs.

Tuliptree

Powdery mildew, *Erysiphe Liriodendri.* This is the only true fungous parasite, so far determined, on *Liriodendron tulipifera* in Connecticut. It has been found occasionally on seedlings in nature and on nursery trees. Only the conidial stage has been seen, though elsewhere its asco stage is occasionally reported. The mycelium and conidial spores are evident as an externanl, white growth on the leaves and according to some also on the young stems. We follow Burrill as to the specific name rather than Salmon who apparently places the fungus under *E. Polygoni.*

As yet this mildew has never been serious here and so needs no treatment.

Sooty molds, *Fumago vagans, Capnodium elongatum.* These black, saprophytic fungi, which perhaps are merely different stages of the same thing, have been found on the leaves and stems of this host growing on the honey dew of aphids. The first has been found chiefly on the leaves and is a conidial stage. The second has occurred on the stems and is the asco stage but so far as we have seen the evident, elongated perithecia are without asci or spores. Besides being unsightly, by cutting off the light, etc., on the infested parts of the plants, it does some secondary damage. *Look* for similar troubles here under Linden, White Pine and Apple.

Wood and bark rots. While this host is a rather common tree in our forests and is occasionally grown as a shade tree in the yards, we have received no complaints of any serious injury to its wood or bark of a fungous nature. We have listed half a dozen woody and fleshy fungi on it but these have all been found on the dead trees or branches as saprophytes. Perhaps some have caused rotting of the heartwood before the trees have died but if so we have no definite information as to their identity. Those found so far as saprophytes are as follows: *Daedalea confragosa, Fomes applanatus, Irpex tulipifera, Merulius tremellosus, Pleurotus sapidus* and *Polystictus versicolor.*

Turnip, White

Bacterial leaf spot, *Bacterium maculicolum.* This has been found rarely on this host, *Brassica rapa.* *See* Cauliflower.

Bacterial soft rot, *Bacillus carotovorus.* The bacterial soft rot has been found on the roots of turnips, rarely out of doors as well as on the stored roots. *See* Iris.

Black leaf spot, *Alternaria Brassicae.* This fungus has been occasionally found on the leaves of the white turnip as well as on other cultivated crucifers. Little damage is caused. *See* Cabbage for description.

Clubroot, *Plasmodiophora Brassicae.* We have seen clubroot more frequently on the white than on the yellow turnip but not so frequently on either as on some of the other related plants. In 1932 Dr. Dunlap, at the Station greenhouse and at our farm, mixed soil from fields infected with clubroot in the healthy soil and then planted seeds of the following crucifers: Broccoli, Brussels Sprouts, Cabbage, Cauliflower, Chinese Cabbage, Collards, Kale, Kohlrabi, Mustard, Radish, Rape, Rutabaga and White Turnip. All of these developed clubroot except the last two but the real reason for failure in these was not determined. *See* Broccoli for description and control of clubroot.

Downy mildew, *Peronospora parasitica.* This mildew causes a downy or scanty, slightly elevated, white growth of conidiophores and spores in patches, usually on the under side of the leaves. Its larger, thickwalled winter spores, oospores, are developed hidden within the tissues and so are usually difficult to find. While this mildew is not uncommon on certain of its hosts, it does not generally cause much damage. So far it has been found here only on the following cultivated plants: Broccoli, Cabbage, Mustard, Radish and White Turnip. Besides these it has also been collected on an even greater number of wild ones belonging to the Mustard family.

So far the trouble has not merited preventive treatment here on any of the hosts.

Powdery mildew, *Erysiphe Polygoni.* The powdery mildew, seen only in its conidial stage, has been found a few times on the upper surface of the leaves causing little injury. *See* Clover for further statements.

Scab, *Actinomyces scabies.* Sturgis reported this trouble as on both white and yellow turnips, especially on land previously infected with scabby potatoes, *q. v.*

White leaf spot, *Cercosporella albomaculans.* We have found this trouble once here on white turnip but not on the yellow though we collected it on the latter host in Massachusetts where is seemed to be more common. *See* Chinese Cabbage for description.

Aphid mold, *Empusa Aphidis.* In certain years aphids become very prominent on the under side of the leaves of turnips, as well as on some other plants, and cause much injury. With the advent of moist weather, the above fungus often gets started and kills great numbers of the aphids and thus, by their destruction, acts as a beneficial agent to the plant. This fungus develops its mycelium internally in the aphids and about the time of their death comes to the surface and produces spores that are shot off and on falling on other aphids cause their infection. A similar fungus is seen on house flies attached to windows by a white powder of spores. Besides the help from this fungus, it is sometimes desirable to kill the aphids by use of nicotine compounds, though it is difficult to get these insecticides to hit them on the lower leaves just above the ground.

Growth cracks. These sometimes appear at the top or sides of the roots. *See* Snapdragon.

Umbrella Tree

Chlorosis. The only trouble we have recorded on this tree, *Magnolia tripetala,* was described in Bull. 222, when in May, 1916, we received leaves from Southport showing a yellow-green mottling much like a mosaic trouble. However, this trouble of the leaves evidently came from injury to the trunk, possibly winter injury, which showed on the bark as dead places.

Valerian

Crown rot, *Sclerotium Delphinii.* We have found this fungus at least twice on specimens of *Valeriana officinalis* causing trouble; for description *look* under Larkspur.

Verbena

Powdery mildew, *Erysiphe cichoracearum.* Occasionally on the leaves of these garden plants we find a slight development, of the conidial stage only, of this fungus. Usually no harm is done though on some of the wild species of Verbena the fungus is more common and luxuriant and the asco stage frequently is present. *See* Phlox.

Vetch

Leaf spot, *Ascochyta Viciae.* This fungus has been found several times spotting leaves of *Vicia villosa.* The fruiting receptacles are visible as minute, black bodies embedded in these spots. If abundant the leaves die prematurely and even the pods are said to become infected. So far the trouble has not been bad as the vetch is only occasionally grown, chiefly as a cover crop. Apparently no mature stage has been found unless it is really the same species as that on the pea, as some believe, in which case it is connected with *Mycosphaerella pinodes.*

Rust, *Uromyces Fabae.* So far this rust has been found here only on wild species of *Vicia Cracca,* though in England we collected it on *V. Faba,* so it is likely to appear where that species is occasionally grown here.

Violet

Anthracnose, *Colletotrichum Violae-tricoloris.* While we mentioned this in our 1903 report as occurring occasionally on the leaves of *Viola odorata,* we saved no specimens and have not collected it in recent years. It has been found more frequently on the Pansy, *q. v.,* where it sometimes causes rather severe injury.

Black root rot, *Thielaviopsis basicola.* Thaxter in the **1891** Rept., page 166, was one of the first, if not the first, to report this trouble on violets grown in greenhouses and outdoors. It has been found occasionally since by others here. It attacks the roots and causes a sickly, yellow growth of the foliage and if severe may also stunt the growth of the plants.

The soil becomes infected so that this should be changed, sterilized, or new ground selected when other plants are again grown. *See* Tobacco.

Leaf spots, *Alternaria Violae, Cercospora Violae,* and *Phyllosticta Violae.* These three very similar leaf spots attack chiefly sweet violets, *V. odorata,* though some of them as well as *Septoria Violae,* have been found on the wild species. For treatment *look* under Pansy.

The first species has been by far the most serious and, during moist or foggy weather, has caused serious trouble in certain greenhouses, especially those along the Sound. It produces very definite, white, round spots, usually one-eighth to one quarter of an inch in diameter with a darker border. The first two of these imperfect fungi produce conidiophores and spores, the first dark and the second light colored, on the surface of the infected spots. The last fungus has its spores embedded in small, black receptacles within the invaded tissues and so far has been only rarely reported here, being first seen by Thaxter.

Rusts, *Puccinia ellisiana, P. Violae.* Both of these rusts have been collected only on wild species of violets in this state. The first rust is a heteroecious form having its aecial or cluster cup stage only on the violet. The second is much more common, is autoecious (all four stages on the violet) and occurs on a number of different species. Since these wild violets are being more commonly cultivated, it is quite likely that the second rust may eventually be found in our gardens. In fact since the above was written, we found it common on *Viola odorata* in a famous garden in Fairfield.

Speck anthracnose, *Marssonia Violae.* This trouble has been seen only once, having been sent from Niantic in 1906 on wild species of violet cultivated in a garden. In this case it could easily be distinguished from the preceding leaf spots by the small, speck-like, invaded tissues as well as by its spores. Where abundant in the leaves it causes a yellowing of the same.

Virginia Creeper

Black rot (Leaf spot), *Phyllosticta Labruscae.* This imperfect fungus is often found causing round, brown spots more or less abundantly on the leaves of *Ampelopsis quinquefolia.* It also occurs on the Boston Ivy and Grape. *See* these for further details.

Powdery mildew, *Uncinula necator.* This mildew is not uncommon on both this host and the grape, usually causing more injury to the latter. The white mycelium and powdery, conidial spores develop externally on the surface of the leaves and to some extent on the young stems and fruit. If the plants are attacked early and vigorously, then some damage may occur by the death of the invaded tissues but ordinarily the injury occurs so late in the season that the injury is of minor importance here. The small, reddish to black perithecia can be seen developing in the fall attached to the mycelium. They are very interesting, as seen under the microscope, because of their hooked appendages from which the genus takes its name.

Where necessary spraying should control the trouble if started in time.

Walnut

Anthracnose, *Marssonia Juglandis.* This has been found here on *Juglans nigra,* on which it is our most common leaf trouble, and rarely on *J. regia.* It also is found on the butternut, *J. cinerea,* where that occasionally occurs. The injury is evident on the leaves as medium to large spots or blotches of reddish-brown, dead tissues. The fruiting stage can usually be seen as flattened, black, embedded bodies especially on the upper surface of the leaves. It is an imperfect fungus.

No spraying experiments, so far as we know, have been tried but such treatment has been suggested. The asco stage is said to be *Gnomonia leptostyla,* found on the old dead leaves, so this should be gotten rid of in the fall by raking up the leaves.

Black rot, *Sphaeropsis* sp. We found this fungus once on the branches of an English walnut, *J. regia,* at a private estate at North Stamford in 1924. It seemed to be acting as a parasite or possibly was merely following winter injury to the branches. Dr. McCormick obtained cultures and in the successive renewals made it produced spores easily which seems to distinguish it from the ordinary cultures of *S. malorum* from apple. Its sori on the branches also seemed to be larger and more elevated than with that species.

White mold, *Microstroma Juglandis.* While we have listed this fungus on the above host, we lack a specimen. However, it has been reported from a number of other states and no doubt occurs here. *See* Butternut and Hickory for description.

Watercress

Leaf spot, *Cercospora Nasturtii.* Watercress, now known as *Radicula Nasturtium-aquaticum,* is gathered for sale as a garnish for food. It is not really cultivated but is sometimes transplanted in slow streams to be gathered as needed. The above fungus is the only one so far found here on the plant. It forms rather distinct, whitish spots with usually a scanty development of the conidial stage as an external growth. The chief objection to it is that it may spoil the looks of the foliage for decorative purposes.

Watermelon

Anthracnose, *Colletotrichum lagenarium.* Watermelons, *Citrullus vulgaris,* are not grown here so commonly as formerly. Certain of our sandy soils seem adapted to their growth but their lateness in ripening and competition with those grown farther south have discouraged their production. When grown here their chief trouble, as far as we have seen, is this anthracnose. It develops as small, angular spots on the leaves but is most evident on the fruit as sunken places of varying size that when abundant may spoil them for sale. Generally the evident ooze of the pinkish spores can be found on these rotted spots. This same trouble has also been found on cucumbers, gourds, muskmelons, pumpkins and squash. In 1932 it was very injurious to Michigan squash where its appearance was somewhat different on the fruit. (Fig. 61.)

These crops should be rotated with others to lessen the trouble and, if necessary, spraying with Bordeaux should start before the appearance of the anthracnose. In the early treatment, attention should be paid to coating the fruit, using potassium oleate as a sticker and spreader where necessary.

Black mold blight, *Macrosporium cucumerinum.* We have found this fungus occasionally on the leaves of watermelon, but never causing as much injury as on the muskmelon, *q. v.*

Downy mildew, *Peronoplasmopara cubensis.* This fungus was found here once or twice in the past but it did not cause much harm to this host; however, it has been found frequently and causing much damage to muskmelon, *q. v.*

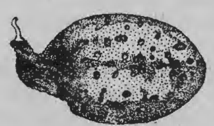


FIGURE 61. Watermelon anthracnose.

FIGURE 62. Wheat loose smut.

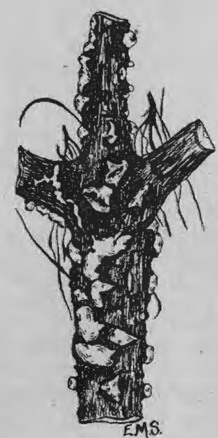


FIGURE 63. White pine blister rust.

Fruit rot, *Pythium* sp. A Pythium has been found only once on watermelon, grown at the Station's Mt. Carmel farm in 1931. There in August were seen a few melons before maturity that were rotting from a fungus of the *Pythium artotrogus* type with spiny oogonia. The same or a similar fungus has been found once or twice on rotting seedling lettuce.

Wilt, *Fusarium* sp. We have never collected specimens of watermelon vines that had died from a Fusarium wilt, though we have occasionally seen such a trouble on muskmelons, but have heard once or twice of its probable occurrence here on watermelons. Since watermelons are so rarely grown in the state today and since the growers usually practice rotation, little trouble may be expected here. However in the Mississippi Valley, a Fusarium wilt has proved very serious in many fields. In 1931 and 1932 we obtained seed of three varieties of melons from Iowa that were said to be resistant to this trouble and they were grown in several places in the state but neither they, nor other varieties reported, showed any signs of a wilt due to a Fusarium. If melons were grown here year after year with little or no rotation, there is no reason to doubt that this trouble would develop and become serious once it got established in the soil. In such cases a wilt resistant variety would be valuable.

Wheat

Glume-leaf blotch, *Septoria* sps. Only rarely, when especially sought, have we seen a fungus of this genus on the glumes and leaves of wheat, *Triticum aestivum,* and then it has been so inconspicuous as to cause little injury. The discolored spots show the fruiting stage as small, black, embedded bodies. There have been several species of Septoria listed on wheat and often those on the glumes and leaves are considered as distinct but we have made no special studies of those found here.

Wheat, while it has been grown here more or less extensively in the past, with a slight revival during the world war, is now very rarely found on our farms. For this reason none of the troubles, often very serious in the fields in the west, prove very harmful in Connecticut.

Powdery mildew, *Erysiphe graminis.* This fungus has been found occasionally on this host but never so prominently as on Rye, *q. v.*

Rust, leaf, *Puccinia triticina.* When wheat is grown this rust has been found more or less conspicuous on the leaves and sheaths in its II and III stages. The dusty, uredo sori break open as small, oval, orange blisters in the early summer and are succeeded later by the lead-colored, embedded, telial sori, long covered by the epidermis. Our specimens, however, are confined chiefly to the II stage. The I stage, said to occur on Ranunculaceae, has not definitely been associated here with the rust on wheat but, by some, our wheat rust is not considered distinct from *P. Clematidis,* which has a wide range of hosts for both its O-I and II-III stages and is found here in all stages on several of its wild hosts.

Rust, stem, *Puccinia graminis.* While this rust has been found here very frequently on wild or escaped plants of timothy and redtop, it has rarely been found in recent years on wheat though in the west it is one of the chief threats to this crop. However, it apparently was abundant here on this crop during the latter part of the eighteenth century, as shown by the quotation given under Timothy.

Scab, *Fusarium culmorum.* This fungus has occasionally been seen as a pinkish growth on the heads of wheat but causes little damage. *See* Rye.

Smut, loose, *Ustilago Tritici.* This is one of the most common troubles in wheat growing districts since it directly destroys the seeds and glumes, changing them into dark, dusty masses of spores held together temporarily by the remains of the flower tissues on the spikes. Often the grain destroyed reaches a high percentage but in Connecticut this rarely reaches over one or two per cent. (Fig. 62.)

Seed treatment in its modified form, therefore, has never been advantageous here.

Smuts, stinking, *Tilletia laevis* and *T. Tritici.* Both of these smuts have been found a few times in our occasional wheat fields, the first more commonly, but neither has caused any serious injury so far as we have seen. They develop in the modified, slightly swollen seeds which are hidden in the glumes of the head. When broken open these infected seeds show a brownish mass of spores having a fetid odor. The two species differ in their spores, the first having smooth and the second reticulate walls.

One of our chief complaints has been with the sale of ground foods for animals, sent in from other states, where badly smutted wheat has been used. In some cases sickness of the animals has been laid to this food but we have never been able definitely to blame it on the smut spores.

These smuts when present can usually be controlled by various seed treatments, though in some regions the spores seem to pass the winter in the ground and so help to infect a new crop grown there. Copper sulphate, hot water, formalin and dust treatments have been used at various times as the fungicides to kill the spores on the seed before planting.

White Pine

Blister rust, *Peridermium Strobi.* *See* Addenda. (Fig. 63.)

Butt rot, *Polyporus Schweinitzii.* This semi-fleshy to corky, large Basidiomycete has been found a number of times at the base of dead trees or on logs of conifers, especially those of white pine. We have never been sure, however, that it was responsible for their death though it is classified as a root parasite by some authorities. In fruiting it forms chestnut-brown (lighter colored when young and darker in old specimens) sporophores with a spreading cap (sometimes with more than one overlapping or irregularly placed cap) on a short, central or eccentric stem. The under side of the caps show large, thin-walled, honeycomb-like pores. The mycelium is said to produce a red-brown rot of the heartwood of the roots and base of the trees.

Needle cast, *Lophodermium lineare.* We have several times collected specimens of a fungus on the needles of white pine that seemed to be responsible for their death and which we have identified as the above species. At times part or the whole of one or more needles of the whorl turn reddish-brown while the remainder show the normal green color. On these dead areas frequently appear the oblong to linear (often fusing and running the length of the needle), elevated, black, fruiting receptacles of an Ascomycete which eventually open by elongated slits. The spores when seen are linear, rather than oblong, and so are more like a Lophodermium than a Hypoderma as this one was originally called. The fungi of this general type on various conifers, however, need further study as to their exact identity and possible parasitism.

Root rot, *Fomes annosus.* In our report for 1906, page 320, we mentioned a trouble of white pine in a plantation at Windsor where some of the trees in the low ground blew over, sometimes before they had died, in different years. This was evidently due to their weakened and rotted roots. While we could find the mycelium on the roots of the fallen and usually dead trees, we were not sure whether their death came from it or was the result of winter injury to the roots, as there was no sign of the fruiting stage of the fungus. More recent examinations disclosed this on the roots, usually hidden by the soil, and it turned out to be the fungus given here. So far this is the only place where it has been found in the state. However, elsewhere in this country and in Europe, the fungus has been reported on various conifers and it is regarded as a true root parasite. We do not know whether any experiments with mycelium inoculated into the roots of healthy trees have proved its parasitism, and what, if anything, weather conditions unfavorable to the roots have to do with its development and destruction of the root. The mycelium develops conspicuously beneath the outer root covering and penetrates deeply into the woody tissues causing evident and characteristic rotting.

The fungus usually develops rather thin, or sometimes thicker, leathery to woody fruiting-bodies on the hidden roots, with their upper surface dusty to reddish-brown and somewhat velvety, and the lower with rather even, white pores. These sporophores are usually irregular and often develop with the upper surface attached directly to the surface of the roots, giving an inverted appearance. This Basidiomycete is perennial and with the thick specimens one can see indications of the pores in layers on cutting across. So we have placed the fungus under the genus Fomes rather than Polyporus, where it was originally described, or *Trametes radiciperda* which is considered a synonym.

Seedling rot, *Rhizoctonia Solani.* So far as we have seen, this has been the chief cause of the damping-off of seedlings of this and other conifers in the state. *See* statements under Pines, Potatoes and Spinach. In one unusual case (Report **1915**, p. 450) after the seedlings had passed the damping-off stage, we found this fungus by its mycelial strands creeping up on the outside of the stems to the needles which it killed by penetrating their tender tissues at their sheathed base.

Sooty mold, *Capnodium Pini.* This fungus has been collected by us and also sent in for identification a number of times when it was causing injury to the needles of the white pine. Sometimes only the mycelial or conidial stage was showing as an evident, superficial, black growth on these and the young stems. Occasionally this growth had developed to form a very luxuriant covering with the numerous, elongated and pointed fruiting bodies reaching out to about 2 mm. in length on the leaves and even 4 mm. on the stems which are characteristic of the Capnodium fungi. So far, however, we have not seen mature asci or asco spores developed in these bodies. While the fungus is a saprophyte, developing

in the honey-dew secreted by aphids on the trees, there is little doubt that this growth, by its black color and luxuriant coating, cuts off the light to the chlorophyll of the leaves and thus causes injury.

The remedy is to prevent its development by killing the aphids, an entomological treatment. *See* Pine, Bull. **344**, p. 144.

Doubtful parasitic fungi. Besides the above fungi we have listed on stumps, logs and branches of white pine various fungi which while they may cause decay of the dead bark and wood we have never or rarely seen on the living trees. Certain of these, however, have been listed by some writers either as parasites or heartwood destroying fungi. Of these we mention here but three:—

Trametes Pini is a very variable Basidiomycete. It is sometimes thick and hoof-shaped with a variously rimosed, cracked, blackened upper surface and sometimes a comparatively thin, resupinate form with at first a reddish-brown, hairy surface. But always it has a cinnamon-brown interior and a similarly colored, poroid, fruiting surface with fairly thick partitions between the pores. We have found it here rarely on dead tissues and only once on a living tree. It is said to cause a rot of the heartwood.

The second Basidiomycete is a lower form, called *Septobasidium pinicola,* that is occasionally sent in for determination as a possible parasite. Usually we have found it on the smooth, green bark where a branch has been cut off. It seems to be merely a saprophyte developing on the exuded material or, in some cases, on the dead insect scales but in no case have we seen any evident indication of injury to the living bark. It forms a loose, felt-like, reddish-brown, somewhat roughened or pitted sporophore adhering directly to the bark.

Scoleconectria scolecospora is an Ascomycete that develops on twigs or on larger branches as cankers, and forms clustered, dark-red, small, egg-like perithecia similar and related to those of Nectria. We have sometimes associated it with possible blister-rust cankers but usually we have seen it on dead twigs or branches where it seems to be a saprophyte rather than a parasite. However, by some it has been classed as the latter under the name of *Nectria* (*Chilonectria*) *Cucurbitula.*

Ant cankers. Since pine plantations have been set out in our sandy soils, one can find spots where the young seedlings up to a fair size are missing or dead and in the center of these circles, twenty to fifty feet in diameter, can be seen a large hill or nest formed by red ants. Occasionally on the bark of these dead pines could be found the fruiting stage of a Phoma (Rept. **1912**, p. 354) and it was a question at first whether or not the trees had been killed by a parasitic fungus since at least two species of this genus are reported from Europe as injuring conifers through canker-like growths. Later investigation, however, has shown that the trees were killed by the ants, possibly in some cases through chewing, but more certainly by injection of formic acid into the young tissues of the bark. These ants usually build their nests in more open places and the shade from the pines, as they developed, apparently proved objectionable.

Blight. Needle-blight is a general term applied to pines, particularly white pines, in which certain or all of the last or this year's needles on a tree show a reddish-brown discoloration from the tips inward to a greater or less extent. If the injury came early in the season of their growth, then the needles are stunted and more or less bunched on the branches. Efforts were made at first by some to show that this injury was the result of parasitic fungi, since growths of these sometimes showed somewhat on the dead tissues. Our experience in this state, however, has been that we have never found any fungus consistently on the leaves as a possible cause and usually they are devoid of any such growths. Loss of water from the needles and failure to be supplied sufficiently from their roots or direct injury to the leaf tissues or their roots are the immediate causes of the trouble.

The writer was one of the first in this country to call attention to this trouble in the Report for **1907**, p. 353, and again in **1909–1910**, p. 720. The summer of 1907 was dry and hot and the needles were apparently injured chiefly from these conditions. At other times we have seen injury due to severe winters, late frosts, summer-like weather in late winter when the ground was frozen, sudden hot spells in early spring following wet or muggy weather, drying out of the roots on improperly transplanted trees and rarely to direct injury through fumes from brick-yards. All of these are so-called physiological or environmental types of injury. If severe the trees may show the trouble year after year and become dwarfed or even die. If the injury is slight and non-recurrent, then the trees usually regain a healthy appearance upon the production of new leaves and the loss of the injured ones.

Care in planting, watering in dry weather and possibly some fertilization are the only partially preventive or remedial measures for troubles of this sort.

Drought injury. *See* preceding article. We have also seen trouble in the seed beds in dry years after very hot periods especially if the seedlings were not watered or protected by a proper screen.

Fertilizer burn. While fertilizers are not used extensively on these seed beds, we have seen one case where the fertilizer (said to have been ground bone?) was sprinkled on one-year old seedlings wet with dew with the result that the leaves were burned, though the same treatment later in the day on seedlings with dry leaves produced no harm. Ordinarily where a fertilizer is applied to any seed bed, the sediment should be washed off the leaves at once.

Leaf and Stem yellow spots. The first of these appear as small, yellow spots on the leaves, often on several in the bunch at the same height, thus suggesting a common cause. As we have found insect scales on the leaves that later disappeared, we believe that these spots are often caused by their punctures. However, these spots are occasionally so similar to the yellow spots caused by blister-rust infections that sections of the needle-spots should, in such cases, be made in order to be sure of their real cause.

The second mentioned yellow spot, on the one or two year old stems, is much more evident as to color and size, often centering from the base of a needle bundle which also may be yellowed at its base. When studying blister rust infection some years ago, we at first thought that this might be one way in which the fungus gained entrance directly to the stems but sections always failed to show any signs of mycelium in them. On young stems of the pines in certain years, we often find spittle bugs and these seem to be the most probable cause of these spots but, if so, the injury does not appear until some time after their disappearance.

Lightning. We mentioned and showed a photograph in Bull. 263, p. 177, of a white pine at Cornwall that was struck by lightning in 1917. It showed no evil effects afterwards other than the natural stripping off of a few limbs and an evident, torn streak down the trunk to the ground. We have seen other trees apparently similarly injured. On the other hand we have known of certain trees where the results of lightning injury have been fatal and this probably also occurs with conifers under similar conditions. Just what these conditions are, we are not sure as yet, though some writers have offered explanations, but evidently the cambium is killed in such cases.

Mice girdle. This sometimes occurs in plantations when snow long covers the ground. *See* Pine.

Snow bend. In young plantations especially when heavy snow falls on the trees and sticks there for some time it makes a more or less permanent bend of the young trunk which later assumes gradually a natural, upright growth from the bend.

Winter injury. Winter injury or death sometimes occurs to trees, especially in low wet spots, and also to seedlings when not properly protected. Later in the season it may be hard to determine the cause of the injury if the trees are dead.

A different type of injury is frequently shown in the green bark of the trees which turns prematurely reddish-brown in spots like that of the older bark. Often this does not reach the cambium so that the trouble may be outgrown but its presence in the green bark may suggest to some a fungous type of injury but without evidence of a definite fruiting stage.

Witch's broom. We have seen at least one case in a plantation where the branch or terminal trunk made a condensed growth of aborted branches closely pressed together and covered with leaves. In this case the broom was not due to fungi but we have no good explanation for it unless slight winter or insect injury may have been responsible.

Willow

Anthracnose, *Physalospora Miyabeana.* In recent years this fungus has been found on willow twigs and leaves and with the scab has been partly responsible for great injury to cultivated willow trees both here and in northeastern United States and Canada. While we believe most of the killing of the very young leaves in early spring, resulting after several years in the death of shade trees of *Salix alba* var. *vitellina,* can be more directly attributed to the scab, we find the anthracnose fungus also kills the young leaves when infected artificially and is not uncommon later in nature on the older, living leaves and twigs.

Dr. McCormick has grown cultures of the anthracnose from this state, Canada and Japan (where the fungus was originally found) and we are not sure that it is really distinct from bitter rot, *Glomerella cingulata,* found on various hosts, though we keep it separate here since there seem to be some slight differences. In cultures the Physalospora is variable, especially in the color of the mycelium. It forms pink exudations of its conidial spores chiefly on the lighter-colored, young mycelium but when more of a dark growth appears one is likely to find perithecia with ascospore development. Cultures from single spores, as well as general cultures from here and Japan, have eventually developed the asco stage.

On the whole the writer believes this fungus, while possibly more of a strict parasite than the scab, causes most of its injury later in the season. We find it on the older, mature leaves, but especially on the twigs in the fall, both in its conidial or Gloeosporium stage and its asco or Physalospora stage. In the spring both before and after the beginning of leaf development, we have found the conidial stage of the scab on the dead and injured twigs as the apparent chief cause and source of infection and death of the young developing leaves. *See* later statements under Scab in the Addenda.

Crown gall, *Bacterium tumefaciens.* This bacterial disease has been found a number of times, chiefly by nursery inspectors on the roots or base of young trees, but it does not seem to cause much damage. Usually the species of the willow is not known but *Salix babylonica* and *S. nigra* are two that have been reported definitely. *See* Rose.

Heartwood rots, *Fomes applanatus, Trametes suaveolens.* The fruiting stages of these two Basidiomycetes have been found on living trees of *Salix alba* var. *vitellina* causing rot of the heartwood. *Fomes applanatus* is a common, heartwood rot of trees (especially maple, *q.v.*) but it is not commonly found fruiting on them as it is on their stumps and logs. It is our largest and most common of the woody fungi. It develops a rather flat, hard, evident sporophore light to dark brown in color on its upper surface and minutely poroid and usually white on the lower. It is attached to the host on one side and the mycelium from which it develops is found causing a white rot of the heartwood. The fruiting bodies may vary from a few inches to two feet across the attached side. If old it shows concentric rings of development on the upper surface and annual, superimposed rings of growth when cut across its fruiting surface. The white, lower surface is easily marred and so is made use of for etching.

Trametes suaveolens is another poroid fungus but in this case the fruiting body is more corky and often develops overlapping or irregular fruiting bodies also attached at one side directly to the host. Their surface is smooth and somewhat velvety to the touch and rather evenly colored all over from a light yellow-brown to a dusty-brown according to age. The poroid surface when young has rather thick dissepiments but with age these are thin with rather large pores between. One of the chief characteristics of the fruiting bodies, however, is the rather sweetish or anise-like odor.

Powdery mildew, *Uncinula Salicis.* Like the other powdery mildews this one forms a more or less evident, white coating, often in spots, on the leaves usually on their upper surface. The small, black perithecia, maturing later in the season, have numerous hooked appendages as seen under the microscope. On certain wild specimens collected by Thaxter, the perithecia show by the thousands scattered, or more or less grouped, over the leaves. However, this mildew is not usually bad enough on cultivated trees or shrubs to need much attention.

Radiating fungus, *Asteroma Capreae.* This fungus is apparently only a weak parasite appearing on the old and often languishing leaves of the willow in the fall. It produces evident, discolored blotches on them that at first are brownish but later become black through the evident, radiating, dark mycelium growing on their upper surface. This mycelium is something like that of apple scab in that it is evidently produced just beneath the cuticle. It is said that the fruiting stage has not been observed but some of our specimens show immature fruiting bodies at the center of the spots, especially on the older leaves that were shed on the ground. It is quite possible that the fruiting stage matures on these later and is an Ascomycete. We saw a few hyaline, oblong spores much like Physalospora that possibly were connected with its fruiting stage, but we were not sure how they were borne. Asteroma is placed with the imperfect fungi.

We have made only two collections of this fungus though it is probably not rare. One was on cultivated basket willows, labeled Lemley at the Mt. Carmel Station farm, and the other was on wild specimens of *S. cordata* obtained the same year, 1928, at Morris. Seymour does not list this fungus from North America although he does list *Asteroma Salicis* on Salix sp.

Rusts, *Melampsora Humboldtiana* (*M. americana*), *M. Bigelowii.* These rusts are not uncommon on native trees and shrubs but are not so frequently seen on the cultivated ones. They need little attention other than care in avoiding planting too close to alternate hosts that harbor other stages of the rusts and in raking and burning their leaves in the fall when these have become infected.

The alternate hosts for the I spores are *Abies balsamea* for the first, so far never seen rusted here, and *Larix laricina,* presumably rusted here in the northern part of the state but yet to have its identity and relationship proved. These two alternate hosts produce the I stages as rather inconspicuous, Caeoma-like outbreaks on the leaves. Their spores carry the rust to the various willows on which soon appear the II stage.

The II sori show as small, yellowish, dusty pustules chiefly on the lower sides of the leaves. These are the repeating stages. Late in the season the III stages develop as larger, dark-red blisters embedded permanently in the leaves and their spores, on germinating, carry the rusts early in the spring back to the alternate hosts. These two rusts on the willows are so similar that they usually need microscopic examination to distinguish them. While *Salix cordata, S. nigra* and *S. sericea* have been identified as hosts for the first species mentioned, most of our collections have been determined merely as on Salix. These species are closely related to similar rusts mentioned here on poplar.

Scab, *Fusicladium saliciperdum. See* Addenda.

Stem canker, *Septomyxa exultata.* This is a trouble worked on by Dr. McCormick. It was first sent to our laboratory by Metcalf of the U. S. Department of Agriculture from Iowa specimens and has since been received from a tree surgeon from New York state and has been found once or twice in Connecticut. It does not seem usually to be a very vigorous parasite on most of the willows. On a variety of golden weeping-willow, however, Dr. McCormick's inoculations were successful, producing red-brown injuries on the bark with fruiting bodies in a short time but on the other species there was only a slight infection or failure. *See* Bull. **337,** p. 462.

Aerial roots. This abnormality was seen at Old Lyme Shores in the fall of 1930 on young willow trees that apparently had been severely injured by the preceding winter so that the bark was killed in areas of varying size. The cambium in some cases, however, had formed new bark at the edges of the cankers. It was beneath the dead but still adhering bark that the trees were forming these short

clustered roots in certain places in an effort to overcome the injury. None of them had succeeded in reaching the ground at this time. *See* Elm.

Wisteria

Canker, *Tubercularia vulgaris.* This conidial stage of the questionable parasite *Nectria cinnabarina* has been found on injured parts of this host. *See* Horse-chestnut.

Crown gall, *Bacterium tumefaciens.* While we have seen the above and certain unidentified spots on the leaves, the crown-gall is the only definite parasite we have listed on the stems of this climbing plant, *Wisteria chinensis.* Apparently even this latter is rare, since it was found only twice, first by a nursery inspector in 1912 on plants imported from Japan. *See* Rept. **1912,** p. 388; also Rose in this publication.

Yew

Damping-off, *Rhizoctonia Solani.* In certain of our nurseries in the past it was claimed that, because of the damping-off caused by this fungus, it was very difficult to grow seedlings of *Taxus cuspidata* in their beds. *See* Potato, Pines, and Spinach.

Oedema. We have had one or two complaints from a nursery of trouble on the young stems of Taxus showing small ruptures of the tissues without any evidence of a fungus or insect causing the same. Recently another observer has reported to us a case of similar trouble on plants in a cemetery where they had been cut back but the next year, when they were not so cut back, the trouble did not appear on the new growth. It seems to the writer that this reveals the explanation, since the normal transfer of the water from the roots to the leaves could not be properly regulated by transpiration when the foliage was largely removed, with the result that intumescence or oedema cracks appeared. *See* Glorybush.

Yucca

Leaf spot, *Cercospora concentrica.* This was reported twice in 1929 by one of the nursery inspectors but, as apparently no specimens were collected, we mention it here only as a possible trouble. There is no doubt that this or some other fungous leaf-spot was observed. Though it is the only fungus yet reported on this host here, elsewhere in the United States a total of over a dozen species have been reported as either saprophytes or parasites on *Yucca filamentosa* alone.

Frost-Growth cracks? In June, 1933, Mr. Zappe of the Station brought for examination the flower stalk of a yucca which he obtained from a nursery at Rockville. The injuries showed something like linear insect punctures but no evidence of the insect was evident and our entomologists knew of no similar injury caused by insects. The best guess we could give was that when very young the flower stalk had been hit by a frost, with some moisture present on the stems, and this slight injury had been accelerated soon afterward by unusual fast growth stimulated by favorable hot weather. Both of these conditions prevailed that spring. The evident, elongated, roughened tissues showed a callus-like, corky growth with cross splits of the epidermis reaching from the base of the secondary flower stalks and running downward, often to a point, one or two inches below on the main flower stalk. The scales at the base of the flower branches were dead apparently from the frost and a few of the stems of the lower branches showed this streaking effect. Apparently all the rest of the side branches had not been developed far enough to be exposed to the injury from the frost.

Zinnia

Drop rot, *Sclerotinia sclerotiorum.* This fungus was isolated once in 1930 from plants of *Zinnia elegans* where injury was being caused. *See* Lettuce.

Powdery mildew, *Erysiphe cichoracearum.* This has been seen frequently in late summer and fall forming a white, usually scanty growth of the conidial stage on the leaves, especially on their upper surfaces. It was only once, in October, 1932, that it was found producing mature perithecia and the asco stage. *See* Phlox.

Leaf spots. There have been two leaf spots caused by Cercospora reported in the United States on this plant. We have occasionally seen roundish, discolored spots on the leaves in gardens in this state but so far we have been unable to find a fruiting stage of a fungus that we could definitely associate with them as the probable cause.

Mosaic. Only twice have we seen mottled leaves on this plant, and, while no experiments were conducted to prove their infectious character, the trouble looked like a true mosaic. *See* Tobacco.

Field of Potato Plants Killed in Less than a Week by the Late Blight in July, 1902

ADDENDA

Under this heading are included some of the larger articles originally placed under their proper hosts in the main body of the paper. Most of these include special work that the writer has done on these diseases or injuries, while a few relate to those new or unusual to him or of special importance because of recent outbreaks in the state. They are referred to in the main paper, therefore, merely by title.

Ash

Canker, etc. This trouble is included here because of complaint of certain tree men who seem to think that a definite fungus is responsible for cankers on the limbs and a general unhealthy condition of white ash trees. Personally we have not studied the problem other than to see some of the cankers and trees complained of in this state. Outside of the cankers, which may have come from injury by a fungus or insect, we are inclined to believe that the trouble, which has been reported as evident and often serious in the eastern part of the United States and Canada, may also be connected with recent unfavorable drought and perhaps winter conditions, resulting in poor growth of the leaves and a general premature killing of the twigs. The cankers start as small, swollen places in the bark of the twigs but eventually rupture and become prominent, empty, sunken cavities down to the wood. Rarely fruiting pustules, probably of different kinds, are seen on the cankered tissues.

Marshall in 1930 Proceedings of the National Shade Tree Conference gives a more detailed account of this trouble and the possible fungus that is thought to be its cause, and from him we have furnished Dr. McCormick with Connecticut specimens for a preliminary study. She, like Marshall, was able to isolate from around the cankers a fungus of the Macrophoma type (spores elongated, hyaline and single celled) but Marshall apparently got more variable or varied growths in cultures including Sphaeropsis and Diplodia as well. Seymour lists a large number of synonyms including all of these genera for presumably the same fungus. So far, apparently, no one has selected out a definite fungus and proved its parasitic nature on the ash by inoculations. This trouble, therefore, needs more definite study to show its nature. We have seen rarely isolated spots on leaves of ash trees where a true species of Sphaeropsis, similar to *S. malorum,* was fruiting.

Asparagus

Fasciation. The abnormal, flattened and thin stem of the main stalk, with divided and recurved tips, is usually characteristic of the type of trouble known as fasciation. This has been seen here occasionally in different years. One of the best specimens we have is several feet long, makes a complete turn on itself, bears numerous small, normal branches and its flattened sides are about three inches wide compared with a thickness of about a quarter of an inch. Such troubles have been associated by some with injury by insects, fungi, winter or by pressure on the growing tip of the plant. Our efforts some years ago to produce a similar trouble by pressure of stones against the growing tip of asparagus as it emerged from the ground were not successful but were too limited. In the examples we have seen on this or other hosts we were never able to trace the injury definitely to a fungus or insect. Failure of the leaf scales to properly open and so cause pressure or winter injury to the growing tips may be possible causes in some of the cases we have seen. Besides on asparagus we have seen very similar injuries on apple, bush-clover, chestnut, larkspur, peony, red maple, rose, spirea, sumac and a few wild plants.

In the spring of 1933 the writer tried various methods of injury to the growing tips of asparagus sprouts (2 to 12 inches high) as they grew in the Station's bed to see what effects resulted in the subsequent growth of the stems. The sprouts were treated, chiefly at the extreme tips, in the following ways: (1) tips bound permanently by flattened sticks or spring clothes-pins; (2) tips cut lengthwise by a sharp knife; (3) tips punctured vertically by a needle three or four times; (4)

same as (3) but punctured horizontally; (5) tips both cut and punctured; (6) tips pinched by the fingers; (7) tips just emerging from the ground stepped on; (8) stems below tip bound by a wire.

Thirty such treated sprouts were then left for growth for two to four weeks before they were cut and examined for injuries. Two of the sprouts were dead and a few made a slight but abnormal growth. Most of them, however, grew fairly well from two to six feet tall. We had hoped to produce at least one typical, fasciated stem but none showed such a result though we did find one such in the bed which had received no special treatment. We did, however, get a variety of abnormalities in practically all of the treated plants, most of them including more than one of the following: (1) zigzag growth of the main stem, seven cases; (2) coiled tip, four cases; (3) divided in two coiled tips, two cases; (4) coiled tip and then with straightened upward growth, one case; (5) curved and then straightened growth, six cases; (6) openings in the stem which grew together again, five cases; (7) creasing of the stem on one or both sides, five cases; (8) flattening of the main stem or branches, mostly moderate to slight, eleven cases; (9) slight bend of main stem, two cases; (10) slight deformity or swelling, two cases.

Most of the injuries of the thirty treated sprouts were made by pinching the growing tips with the fingers (fourteen cases) either moderately or severely. It seems to the writer that injury by stepping on the young sprouts, just before or after emerging from the ground, might account for fasciation or other deformities of this plant, though we did not reproduce greatly flattened stems in this experiment. In the two cases where the emerging sprouts, one or two inches above the ground, were stepped on, they showed only a slight growth but with a complete coil at the tip.

Cherry

Brown rot, *Monilia cinerea.* Of all the fungous diseases, this ranks among the ten most injurious here, being specially bad on the sweet cherry. It is serious largely because of its varied hosts (given here as half a dozen—almond, apple, cherry, peach, pear, plum, quince—and perhaps including another fungus, *M. fructigena,* according to some authorities) but more particularly because of the very considerable injury that it causes to the fruits for which these plants are grown. However, because it attacks these chiefly only when they ripen, it cannot be considered as a very aggressive parasite. Wet weather at the time of ripening the fruit is largely the controlling factor in its development and injury. It is one of those imperfect fungi that bear their spores exposed on the infected parts. In this case they are thin, oval bodies produced in chains on short, grouped threads together forming powdery, gray *pustules* evident on the fruit but less conspicuous on the blossoms and young twigs. These spores are also produced on the infected twigs and mummied fruit adhering to the trees in the spring thus causing new infections. On the fallen peach mummies half buried in the soil are developed small, black sclerotia. On these latter there is rarely found here in the spring the asco stage, known as *Sclerotinia fructicola,* showing as evident, cup-shaped bodies on elongated pedicels. These cups produce spores which when shot into the air are carried by the wind to the young parts of the tree and cause early infections.

Because of the abundance of spores, their easy infection of the ripening fruit and their general rot-production with repeated new sets of spores, the control of this fungus, especially in wet weather, is difficult. Spraying must be repeated several times on the young fruit up to its ripening period. It must be harmless to the host, stick fairly well and especially coat the fruit, which is difficult on cherries and plums. This coating often proves an objection if it is fairly evident when the fruit is sold. In the past spraying, according to different hosts, with Bordeaux, Atomic Sulphur, Self-boiled L. & S. and dusting with fine sulphur, especially on the hairy fruit of the peach that favors sticking, have given more or less success.

Corn

Bacterial (Stewart's) Wilt, *Aplanobacter Stewarti.* This trouble was first described by Stewart of the New York Geneva Station (Bull. **130**:423-430) in 1897, hence the common name used to designate it but he gave no scientific name. This was supplied in the scientific description by Smith the next year in his publication (Proc. Amer. Assc. Adv. Sci. **47**: 422-426) though he called it a Pseudomonas at that time. We have had complaints in the past of obscure corn troubles in this state but we were unable to link them up with this one either by specimens or descriptions sent in without specimens. Nevertheless Rand and Cash of the U. S. Dept. of Agr. (Jour. Agr. Res. **21**: 263) in 1921, listed Connecticut as one of the seventeen states where it had been found.

In 1919 there was complaint of a trouble of sweet corn and in our examination of Golden Bantam at Woodmont and Milford, after the stalks had attained large size, we noticed a fairly large amount of root rot that we laid at that time to a Fusarium. We are now convinced that it was chiefly due to Stewart's wilt since we also noticed the presence in the injured tissues of a considerable amount of bacteria as well as the Fusarium. An earlier examination, no doubt, would have shown bacteria as the primary cause. The Plant Breeders of our Station also report the presence of this trouble in their variety tests in 1931 in a minor way. So the trouble is not entirely new to the state and presumably has caused more or less serious injury in certain past years. This leads us to hope that it will again fade out under less favorable conditions for its development.

Early in June in 1932, however, there was called to the attention of the writer a trouble of early sweet corn that definitely proved to be this disease, showing first by the lower leaves wilting and then drying up, usually a greenish color somewhat like that caused by a late frost or drought. The earliest planted corn at this time was about two feet high, while the latest planted fields were about six inches high. The trouble appeared first and most prominently in the former, though the latter fields in time showed the injury less prominently. Examination of the wilted plants whose roots and stalks seemed to be normal when pulled from the ground showed, when cut lengthwise, that there was a badly injured, reddish-brown spot at the very base of the stem from which the first roots develop. When the stem was cut crosswise at this diseased spot, and examined with a lens, one could see a yellowish, or occasionally at first a whitish, sticky ooze proceeding from the cut ends of the bundles scattered through the stem. These exudations contained countless numbers of microscopic bacteria that clogged the bundles thus cutting off the water supply to the leaves with their resulting wilt and death, especially with the advent of the hot, dry weather that came later in June and July. Other plants made a poor growth with no maturity of ears. In some cases the rot invaded the whole base of the plants and even the roots, so that the stalks were finally easily pulled from the ground. Where the invasion of bacteria was late or slight, the corn suffered correspondingly little.

It is claimed by some that this disease is carried only by the seed and so they have advocated purchasing seed from the north where the disease in the past has seemed to be less prevalent. During the past two years, several states have reported the disease on the increase. In 1932, however, the disease was unusually serious in various regions. We had the greatest outbreak that had been seen in Connecticut up until then and we heard of even more severe losses in Pennsylvania, certain midwestern states and Ontario, Canada. So the trouble was rather bad and widespread. We had much less injury to the late planted sweet corn and practically no complaint of the normally late planted field corn. While Golden Bantam and some of its crosses suffered most, we found injury almost as bad on early planted other varieties. The varieties seen were Atkin (local), Early Yellow Sensation, Golden Bantam, Golden Early Market, Golden Gem, Golden Sunshine, Long Island Beauty, Spanish Gold, Surprise and Whipple's Yellow. The varieties came from various sources and it seems to the writer that the season, as well as the variety and the source of the seed, had something to do with the presence and severity of the attack so far as Connecticut was concerned.

In 1933, the trouble was even worse here than in 1932, and it seemed to be generally worse over the country where sweet corn is commonly cultivated. We tried various forms of prevention by seed treatment, but these were not entirely satisfactory. There was, however, considerable difference in the different varieties grown on the same land and planted at the same time. At present we can merely suggest the following measures as more or less satisfactory:

The Seed. Use the best seed possible and, if known, from fields that had the least trouble. Plant varieties the least susceptible to the disease, especially of the golden varieties, and preferably use the white ones. So far the early or medium early varieties that have shown the least injury from this disease here have been Golden Cross Bantam, Whipple's Yellow and Spanish Gold. Treat the seed with corrosive sublimate tablets for further protection, using at the rate of 1–1000 for 20 minutes. Some growers plant the seed abundantly in the rows and hoe out the suspicious plants as soon as seen, hoping to get a good stand of healthy plants finally.

The Land. Plant in land not in corn recently; we have seen fields, however, where the trouble ran as high as 30% that had not been in corn for several years. Preferably plant on land where manure has not been used in the past few years, especially hog or cattle manure where corn stalks have been fed to the animals.

The Fertilizers. Use only a complete chemical fertilizer. We saw one field which ran only 5% of injury where a complete chemical fertilizer was used, while the same seed from the same source ran as high as 30 to 50% on the same farm in fields fertilized with hog manure.

Practice if possible all of the above precautions.

Dill

Black spot, *Phoma Anethi.* The only fungus we have found on dill, *Anethum graveolens,* was seen at a vegetable farm at Wethersfield in September, 1926. On a dying but still green plant we found on the leaves, but especially on the stems, somewhat numerous, small, oval to linear, black pustules running between the parallel veins and when abundant merging into long striae. These pustules were papillate with merged fruiting bodies but they were so immature that we could not definitely identify them. While a few, small, Phoma-like spores were seen, the receptacles mostly looked like immature perithecia.

The only fungi reported on this host in America are a Phoma and a Cercosporella (later described by Saccardo as Cercosporina). Our specimen does not agree with the latter, as it has no external Cercosporella spores though otherwise it could be it. We have one specimen of the so-called Phoma from Iowa and it agrees fairly well with the general description given by European writers. Fuckel, who listed this fungus under Sphaeropsis, mentioned finding larger stylospores (apparently the Cercosporella spores) later in the development of the fungus.

We have examined stained sections of the infected stems of three American specimens (ours from Connecticut; one from Iowa, U. S. D. Agr. Herb., labeled Phoma; and Brenckle's Cercosporella, Fungi Dak. *353,* from North Dakota) and three exsiccati specimens labeled Phoma from Europe, and we have come to the conclusion that they are all merely different stages of the same fungus. They show one or more of three different stages as follows.

First, the Cercosporella stage develops just beneath the epidermis and comes from a localized, colored, sclerotial mass of cells. When the colored, scarcely septate cells of the conidiophores begin to elongate from the upper end of this sclerotial mass they break through the epidermis and develop their elongated, lighter-colored spores at and near their nodose tips. The Dakota specimens seem to show this stage alone and so give a grayish, fuzzy appearance to the outbreaks different from most of the other specimens.

Secondly, we find a pycnial stage with small bacteria-like spores or spermatia which gives rise evidently to the generic name of Phoma usually applied to the specimens. Lastly we find in similar enclosures an immature stage of colorless cells that seem to be the beginning of an asco stage. One or both of these two stages are shown in the other five specimens examined. Both the pycnial and the immature asco stages are enclosed with similarly colored cells like those found in the sclerotial stage. The Iowa specimen and one or two of the European specimens, to a less extent, show all three of these stages thus indicating their relationship.

When the mature Ascomycete is found then we can really know what to call the fungus which so far has been known chiefly as *Phoma Anethi* and under which name we place it provisionally here. The fungus is interesting chiefly because of its obscure life history rather than because of any harm it causes as a possible parasite.

Elm

Dutch elm disease, *Graphium Ulmi.* This disease was first noticed in the Netherlands in 1919, and has since spread to a number of other countries in Europe, being especially serious in Holland, Belgium and certain parts of France and Germany. Apparently little effort has been made in Europe to prevent the spread by cutting down the infected trees. It occurs there on a number of different species of the elm but is worse on some than on others. Some effort is being made in Holland to secure resistant trees by selection, since certain seedlings of the same species are said to be more resistant than others. Apparently *Ulmus pumila* is one of the most resistant of the species. *Graphium Ulmi* is the immature stage of an Ascomycete that recently has been found in its mature stage, known as *Ceratostomella Ulmi.*

This disease was first reported in this country from Ohio during the summer of 1930 and has been found there on about a dozen trees though only one was reported in 1933. In the fall of 1932 it was also found in New Jersey and in 1933 in New York State. By the end of February, 1934, more than 1000 trees had been found in the general vicinity of New York city, most of them, however, in New Jersey. One tree was also found in Baltimore, Maryland.

There are said to be two types of injury, one which kills the trees very quickly and the other more slowly. The infected trees show a wilting or yellowing of the leaves, sometimes limited to certain branches, and often a premature dropping of the foliage as the first evident sign of the trouble. Sections of the twigs an inch or less in diameter may disclose a dark-brown streaking in the wood, usually as small spots in cross sections, extending in the rings of those of one to four years old. However, the evidence may be limited to the death of the cambium layer in certain serious cases. It is necessary to obtain artificial cultures from the injured tissues for exact determination since other fungi may cause them. Certain species of European beetles spread the disease to healthy trees by carrying the spores to the young twigs. These beetles and the imported diseased logs are said to have been the source of infection in the United States. A quarantine has been put on the importation of infected logs. So far the only remedial measure practiced here is the destruction of the infected trees.

During the past six years the botanical department of this Station has been on the lookout for this trouble in Connecticut but more especially in 1933 when it was found in the nearby states of New York and New Jersey. By the end of 1933 only one infected tree had been found in our state—that discovered by Mr. Dunbar at Glenville in Fairfield County not far from where the disease was earlier found on trees in Rye and White Plains in New York State. Cultures of Graphium were obtained from this tree both by the U. S. Department of Agriculture and our Station.

A second infected tree was found by the Government, and confirmed by its and the Station's laboratories, in Greenwich in February, 1934. This tree apparently became infected as early as the spring of 1931, as shown by spots in the wood of certain of its main branches. Some of the larger limbs were already dead when found and on these lower down near the still living tissues, between the inner bark and the outer wood, were the channels produced by the European bark beetle, *Scolytus multistriatus.* In the youngest of these main channels the dead female beetles that produced them were often present and in the side channels, running out from each side and filled with frass, could be seen some of the living larvae ready for this year's further development.

In some of these main channels were also found numerous, fully developed fruiting bodies of the Dutch Elm fungus. These bodies, called coremia, visible to the naked eye but much more evident with a hand-lens, are clusters of dark-colored threads bound together into definite, erect, bundles bearing at their tips a viscid mass of minute, hyaline spores. In the side channels nearly sessile and less mature fruiting bodies were seen under the frass, and also, in one case, on and under a dead larva. When the bark was placed in a damp chamber for a day or two a white bloom appeared all over the bark adjacent to the channels. Under a lens it was shown to be chiefly the very young coremia producing countless numbers of the spores at their tips.

It is evident that when the living larvae emerge as beetles and fly to the healthy trees, which they injure somewhat by chewing the bark at the base of young twigs, that they may carry with them some of these spores which, gaining entrance through the injured places, can become the source of further injury.

Both of the infected trees in Connecticut have been cut down and burned. In the vicinity of the tree at Glenville no other suspicious trees were found. In the neighborhood of the Greenwich tree, several miles from that at Glenville, however, several suspicious, smaller trees have been seen and from the spots in the wood of the small branches cultures are now being made for positive identification. These trees, too, will be cut down if found infected.

The botanical department also has made a number of cultures from suspicious branches from other trees but all these have turned out to be caused by other fungi. These have been species of *Cephalosporium, Verticillium, Sphaeropsis* and *Fusarium* which usually do not cause serious trouble. However, the elms in certain parts of the state have also suffered from insects, drought and winter injury and it is certain that these injuries as well as the Dutch Elm disease have had something to do with the death or decline of the elm. It will take at least another season of scouting to determine how widespread this latter trouble has become.

The writer is not in favor of creating a popular scare concerning this trouble, with large state expenditures, which might result from a concerted attempt to cut down all suspicious elms in New England. Rather he is in favor of the destruction of infected elms only when the trouble appears in a new locality and then in a limited way. He believes that the better campaign is the spraying of the elms against insect troubles, the fertilization of languishing trees, together with the destruction of badly injured trees in an effort to limit the spread of the carrying insects and the fungus, rather than an attempt to exterminate the disease.

Gladiolus

Dry (Sclerotial) rot, *Penicillium Gladioli.* We have seen this storage trouble only occasionally on corms of gladiolus. It was first shown us by Mr. Hopson, Superintendent of the Station Farm at Mt. Carmel, in the spring of 1933 but others reported similar trouble soon afterward. The infected corms reveal a somewhat sunken, reddish-brown, dry rot of varying size and depth. The skin at first covers these areas but shows on its surface, especially after being kept in a moist chamber, a growth of whitish, yellowish or greenish fungi, chiefly Penicillium. When the injured spots are cut across one is surprised to see the tissues more or less crowded with small, flesh-colored sclerotia about .5 mm. in diameter. They are more evident on the exposed, broken diseased tissues. They resemble somewhat those of *Sclerotium Delphinii* but are more of a flesh than a reddish-brown color and are smaller. Mites also may be evident in the diseased tissues, especially if these have been kept moist for a short time. The appearance of the trouble agrees so closely with the description and figures given by McCulloch and Thom (Jour. Agr. Res. **36**:217-24, F. 1928) that we attribute it to the new fungus described by them.

We suspect that injury by the mites or mechanical injuries when the corms were stored, perhaps not thoroughly dried out, aided the trouble. How it affects the plants grown from these corms the writers of the article do not say. They state, as we would expect, that treatment of the corms with fungicides showed these sclerotia as rather resistant.

Some of the diseased corms, both treated and untreated, were planted by us in the spring of 1933 and the trouble was confined to the injury in the corms since the leaves that developed from them showed no special disease but merely a weakening from the badly injured corms. Badly diseased corms, especially when the injury is near the eyes, will not develop strong plants even if the fungus does not attack the leaves produced. They therefore should not be planted.

Lawn Grasses

Toadstools and Shelf fungi. On lawns a great variety of toadstools appear at different seasons of the year but especially in the spring and fall. Some of these produce fairy rings. Where certain chemical fertilizers are used sometimes the mycelium of molds appear. Where manure is used unusual toadstools, especially of the deliquescent type, also appear. None of these fungi usually cause any harm to the grass and most of them are not poisonous. Some people have been afraid lest their small children eat them when left on the lawns but we have never heard of any trouble of this sort.

The meadow mushrooms, Agaricus species, with the pink and then dark-colored gills and a ring around the stem, are often eaten. The Coprinus species, with deliquescent gills that go down to an inky liquid, are also edible. Very often *Coprinus micaceus* can be found in the spring in large clusters in the parking grass on the streets or on lawns where trees have been cut down and can be told by the minute glistening scales on the caps as well as the deliquescent, black gills. All such fungi should be gathered in their younger stages for food.

However, when the lawn is on the edge of woods some of the poisonous Amanitas are likely to be found in the fall. It is these that are often eaten by foreigners from southern Europe. They are made deathly ill or frequently are killed by them. Usually they gather them from the edge of woods rather than from lawns. The two common species are the deadly agaric, *Amanita phalloides,* and the fly agaric, *A. muscaria.* Both of these have *white gills, a ring on the stem and a volva (a swollen or cup-like enlargement) at their base.* The deadly agaric has caps varying from white to brownish in different varieties and the fly agaric has white, fluffy scales on a more or less evident, orange cap. Avoid any toadstools of these general types.

Where roots or stumps are buried in the soil we have even found fleshy forms of woody fungi appearing on lawns. One householder recently brought in fruiting bodies of *Polyporus frondosus* over eighteen inches in diameter that showed up in his lawn, apparently from buried roots of trees. We have seen the same fungus around the privet hedge fences in other lawns. This fungus has a white, poroid, fruiting, lower surface and a somewhat darker, smooth, upper surface. It is at first fleshy but with age becomes somewhat corky and the overlapping segments are free at their circumference but united to a common central or one-sided base.

Lilac

Bacterial blight, *Bacterium Syringae?* During the past few years the writer has occasionally found, early in the spring, young shoots and leaves of lilac that looked as if they had been killed by a late frost. Sometimes isolated, reddish-brown spots occurred on the more mature leaves, showing in strong contrast to the normally green, healthy tissues. While we could occasionally find bacteria in these dead areas, we were inclined to believe that they were the results of late frosts, since they did not seem to spread afterward. In late May, 1932, however, we were called to a nursery in Simsbury where this trouble was so conspicuous that it looked as if great damage would be caused if it was a bacterial disease and continued to spread further. Here, as before, the injury was confined to the new shoots killing them and the young leaves but spreading more extensively and conspicuously than we had seen it before, even to the spotting of the mature leaves. Also, we could find bacteria in isolated places in the leaves and stems which often became blackish in color.

The question then arose: Was the trouble due to frost or bacteria? In this case the lilacs were large and had been transplanted the year before, apparently in the fall, and were cut back some to induce new growth. This was what was chiefly injured, especially the suckers at the base. The grower did not think that frost was responsible and while the land was somewhat low we were not sure that other plants in the nursery had been injured by frost. The injury was largely confined to the common lilac rather than to hybrids or other species, not recently transplanted, that were in the same nursery. On the other hand the injury agreed with Elliott's description of *B. Syringae* which has been reported on a great variety of woody plants under different names. We tried to infect young lilac leaves and stems with crushed extracts from infected leaves and stems but without very evident results. On the other hand we were equally unsuccessful in trying to produce similar injury by subjecting the young stems and leaves to freezing temperatures in a refrigerator for definite periods. In August we again visited the nursery but the trouble had failed to progress further.

If this trouble was due to the bacteria, it seems to us that it is primarily one that develops on young tender tissues and fails to progress further on the mature tissues, much like the bacterial rots of stone fruits, and that it was favored by the recent transplanting of the old bushes, since where we have seen it elsewhere it has not seemed to progress later that year or become more prominent the next year. In this particular nursery, also, the trouble was quite inconspicuous the next spring.

Of course where not too evident the trimming off of the infected branches helps to improve the plants and lessen danger of spreading the next year if the disease is primarily due to bacteria. In this nursery we gave certain of the shrubs a very good coating with potassium-oleate Bordeaux, some evidence of which remained on them until the first of August, but as the trouble had not progressed we do not know that it had any particular value.

Lily

Gray molds, *Botrytis* sps. In 1932 we had complaints from several sources of the spotting or wilting and premature death of Madonna and Regal (*Lilium regale*) lilies. On the definite, light spots, often with a purplish border on the leaves of some of the plants, no fruiting stage was evident but when these leaves or the wilted plants were placed in a moist chamber there appeared a white mycelial growth from which Dr. McCormick isolated cultures that uniformly proved to be a Botrytis. This species made a luxuriant, white growth on the media with usually a few, large, black sclerotia. The conidial stage when seen was of the Eu-botrytis or Sporotrichum type with small, globose spores rather than the Polyactis type with larger, spherical to oval spores as with *B. cinerea*. However, in the early summer of 1933 we had sent us a Madonna lily that showed similar spots on the dying leaves but on the rotting blossoms there was an abundance of the large-spored Polyactus type, possibly *B. elliptica*. It looks as if there may be two species of Botrytis that work on the lilies here; in Europe several have been listed.

An herbarium specimen of Madonna lily collected in New Haven in 1908, shows very definite, conspicuous, elliptical spots. The contents of these spots have so completely disappeared that when they are placed in water and examined under the microscope the branched threads of the mycelium are very evident in the tissues as seen by the transmitted light. That the fungus does fruit under certain conditions in the infected tissues was shown by a more careful examination of the specimens collected in 1932 and kept under moist conditions for a time. A microscopic surface examination of boiled pieces of the leaves showed, in some places, tufted conidiophores issuing from the stomates and bearing clustered groups of spores at their upper ends.

Control measures are doubtful but one, at least in securing new bulbs or plants, should select only the best and plant in a new location. Keep water off the leaves and blossoms. When the bulbs are left in the ground, the old leaves and stems as soon as dead, as well as any suspicious bulbs, should be removed. In the spring when the plants appear spray them and the bulbs with Bordeaux.

Oak

Drought injury. In 1930 and 1931, following the drought years of 1929 and 1930, there were several complaints after midsummer of oak trees dying in the woods of certain sections of the state. Even 1931, while it had more frequent rains generally over the state, should be considered a dry year in certain sections so far as the roots of forest trees were concerned, since the temporary streams, springs and wells still showed a lack of water. An examination of the trunks of these injured trees, chiefly oaks, showed that they sometimes began to die at the bottom but more frequently from the top downward. Some of them were already dead or past help. Sometimes the leaves dropped off or withered on the branches and then the limbs died but usually with no positive evidence then or afterward of suspicious fungous growths or insect injuries. While occasionally we did find fungi on the injured or dead bark (as Nectria, etc.), and again on the dead or dying twigs (as Sphaeropsis) we were unable commonly to associate any of these as the direct cause of injury but rather as weak parasites or saprophytes following it. Usually the trees that suffered the most were in low, rocky soil but in one case they were on a high, rocky hill.

Our explanation is that the trees gradually died from lack of water, the injury first killing the root hairs and then the other parts of the tree, usually those above the ground first. The succeeding winter, as always, made the trouble prominent the following spring and summer. The trees that suffered first and most severely were those that were accustomed to abundant water as in the low, moist lands or the high rocky hills near temporary water holes and small streams. Trees that were more accustomed to dry conditions were able to pull through in better shape. The trees that showed the injury chiefly were *Quercus prinus* and *Q. rubra*.

The only treatment was to cut down the trees and make use of them before any heartwood rot or insect injury started. We expect that forest and shade trees may continue to show obscure injuries from this drought period.

Another trouble, seen occasionally in 1931 on individual trees in yards on *Q. alba*, etc., was where the small twigs with their leaves dropped off in midsummer. Sometimes the green leaves, apparently pinched at the base of the petioles, were shed separately. No signs of insect or fungus injury was seen either on the leaves or twigs and we were inclined to lay the trouble to drought entirely. The injury, however, had some resemblance to the Verticillium trouble of trees, though Dr. McCormick found nothing suspicious in the twigs she examined.

Onion

Gray mold, *Botrytis Allii*. A great variety of common and scientific names have been applied to this disease of onion bulbs. Personally, as the trouble is common in the onion districts of the country and is only a semi-parasite and agrees fairly well with the common gray mold mentioned here under a variety of hosts, we doubt if it is really distinct from *Botrytis cinerea*. It becomes conspicuous after the onions are stored, showing the gray mold more or less abundantly on the bulbs especially at the neck end. This imperfect fungus, with the blackish conidiophores bearing the bunches of gray spores at their upper ends, is also accompanied by the evident, black, flattish, sclerotial bodies embedded in the outer tissues that carry the fungus over in unfavorable periods. Sometimes these sclerotial masses are more abundant and conspicuous than this same conidial stage which they may reproduce under favorable conditions for germination. So far the asco stage has not been reported.

A conidial stage of apparently this same fungus may also appear on the living leaves and especially on the blossoms of seed onions where in wet years it may cause more or less damage especially to the latter. However, it is chiefly to the bulbs in storage that the greatest damage occurs. This is apparently due to infection before the bulbs go into storage and is favored there by poor storage conditions. These latter include unfavorable conditions of ventilation and heat which are often increased by placing the onions too deeply in the containers or not allowing enough air space between the racks or crates used. One of the chief causes, however, is pulling the onions and leaving them in piles on the ground so the green leaves will dry out. In wet or cloudy weather this may occur so slowly that the fungus gets a good start in the bulbs before they go into storage.

We have seen cases, years ago, where a large part of the harvested crop was finally lost and have heard of others where the shipment of onions by boat, said to be in good condition when sent, had been received by the dealer in New York in a worthless condition. The white onion, especially the Southport white variety, suffered here by far the most and this is one of the reasons onion growing in that part of the state has largely disappeared. At present onion growing all over the state has so greatly declined that complaints are now rarely received concerning this trouble.

Some years ago we tried spraying the white onions once or twice with Bordeaux mixture shortly before they were pulled and again after they were loosely piled on the ground, turning them over to get the spray on all sides. These onions when dried out were then placed under more favorable storage conditions with the result that these precautions somewhat lessened the rot. The experiment was for one or two seasons only but we believe this is one of the proper ways to go about the trouble. If spraying is tried potassium-oleate should be used as a sticker on the living plants on account of the glaucous conditions of the leaves. Other writers have advocated cutting the top close to the bulbs at harvest time and artificially drying the bulbs at 90 to 120° F. for two or three days and then storing them at 32° F. with as low humidity as possible.

Smut, *Urocystis Cepulae.* Years ago this was a prominent trouble in seedling onions grown in this state. Where onions were grown in the same soil for some years the smut finally became so bad that large acreages had to be abandoned or at least limited to sets which were not infected. During the past thirty years, however, the writer has only occasionally met with this trouble. Even after a smutted soil had not been in onions for five years it was said to be unsafe to plant onion seed in it. We knew of one case where the field had become so smutted that it was given up for this purpose and then ten years later was tried again when a moderate number of seedlings became smutted and the second year this was, of course, considerably increased.

The smut shows on the seedlings soon after they appear above ground as evident pustules, at first covered by the epidermis of the leaves, that soon rupture disclosing the black, dusty spore mass. Often these leaves are twisted and the first ones are soon killed. If abundant many of the young plants also die so that those that come to maturity are greatly reduced in number and the resulting crop correspondingly limited in amount. Where infection is less or later in developing, the onions may develop to maturity but show the black, smutty masses on their external layers and the bulbs are more or less reduced in size. As stated before the spores may retain their virulence in the soil for a long time. (Fig. 43.)

Thaxter (Repts. **1889**:129; **1890**:103.) of this Station was apparently the first botanist to give a careful account of this smut both as regards its life history and its preventive treatment, though Farlow had previously considered it from the former point of view. Thaxter tried a number of chemicals in the infected soil at the time of planting as preventive measures, and at harvest time he narrowed these down to two of the most successful ones—sulphur (with lime) and sulphide of sodium. He advocated the former because of its cheapness and availability. Sturgis later carried on experiments with sets on infected soil and advocated this as a method of relief. *See* Rept. **1895**: 176.

Some years ago the writer made a few experiments for controlling onion smut, based on experiments at Ohio and New York, with formalin as a more modern method as well as lime and sulphur. We did not have so great an amount of smut in the land treated and so apparently did not get as evident results from the formalin treatment as some others have reported but this was the more successful method. It seemed also to be better than the lime and sulphur. We had trouble with the latter in wet soil forming a crust when dry and interfering with the young seedlings in pushing through it.

The method now commonly advocated is to have an onion planter with an attached reservoir for holding a supply of formalin that allows, by a special drip attachment, wetting soil and seed before the latter is covered by the shovels. The formalin is a 1 to 2% dilution (1 pt. formalin to 6 to 12 gals. of water) and the amount required varies with the strength of the solution and the wetness of the land. This will probably take one to two hundred gallons per acre for the treatment.

Peach

Yellows. Yellows is one of our old troubles of the peach caused by that mysterious agent which we commonly call a "virus" and the nature of which on any plant has not yet been entirely explained. It is apparently related to the yellows of raspberries and of asters, less so to the mosaic of tobacco and other hosts, in

many of which insects are the common carriers of the virus from the infected to the healthy plants. As yet a carrier* of this sort on the peach has not been determined, though lice or leaf-hoppers seem to be the most plausible.

The symptoms of yellows as seen on the fruit, are its premature ripening a few days to more than a week before that on the normal branch or tree, also often a higher color, especially with reddish spots on the skin or in the interior tissues, particularly near the stone, and the peaches affected have an insipid or poor flavor. The foliage at first becomes prematurely yellowed and is apt to be somewhat curled at the edges and finally scanty and smaller. Water sprouts may appear on the stems with similar, sickly foliage that in the final stages show as small, witch's-broom effects. The larger branches with their foliage gradually die followed finally by the death of the whole tree.

The writer has long been interested in this subject and has conducted various experiments to determine the cause of the same both in private orchards and at one time in a Station's "Yellows" orchard. As first demonstrated by Smith of the U. S. Department of Agriculture, it is easy to infect seedlings or even bearing trees by setting buds from yellows trees into the healthy trees. We were even successful by merely using a small, oblong strip of infected bark with no bud on it. In either of these cases in time the whole tree becomes infected. We were not successful in securing infection from infected leaves and stems when placed in the ground around the roots or from liquid material placed in holes in the stems and then plugged up. We did not, however, use special means to force the liquid into the sap circulation of the tree. Neither did we succeed by using pruning shears on healthy trees after constantly moistening them with tissue from infected trees. Likewise we were also unsuccessful in inoculating a tree or its fruit by using pollen from yellows trees to fertilize the blossoms of a healthy one, though in most cases the fertilization was not completed.

The few attempts by us with the species of lice common to both raspberries and peaches that developed on mosaic plants of the former and were placed on trees of the latter in closed outdoor cases, were without positive results. It is quite possible, however, that eventually an insect carrier may be found. In our orchard investigations we have never surely traced spreading from naturally or artificially infected trees to the healthy adjacent ones. Neither have we seen a case of spreading by dragging infected trees through the orchard or replacing a diseased tree by a healthy, though some have claimed such results. Spreading by this process might be expected if insects are carriers of the virus.

We came too late into the state to observe the results of the legalized tree destruction in the orchards where yellows was thought to exist. Fundamentally we are opposed to such measures or to quarantines unless evidence is first shown that they are necessary or likely to prove financially profitable to the grower and not too burdensome to the state. Apparently in this case the growers as well as the state did not desire to continue the legalized destruction of infected and suspicious trees. To our mind the comparative infrequence of the trouble here during recent years seems to result chiefly from the greater care the nurserymen use in selecting peach pits and buds from sources where there is less danger of producing the disease in their nursery stock offered for sale. Whether winter injury and the type of fertilization, as using potassium nitrate, have had their influence we cannot say. One needs to be very careful to distinguish yellows from winter, drought or peach borer injuries.

Pear

Fire blight, *Bacillus amylovorus.* Pears are rarely grown in this state in large orchards so their troubles are perhaps less common and conspicuous than elsewhere. With the fire blight, often called pear blight, we have a trouble that has proven troublesome especially on certain varieties and in some years, though it rarely seems as bad here as in certain other regions. As is indicated by the common name, it is a bacterial disease and is largely spread in the spring by bees and certain other insects. The bees mechanically carry the germs from

*Since this was written Kunkel has proved that a leaf-hopper, *Macropsis trimaculata* can transmit this disease from yellows peaches to the healthy.

blossom to blossom and some of them are left behind in the nectar. Developing there they soon work down into the young tissues killing the blossoms or later the immature fruit and even the tender twigs with the blackened attached leaves. This seems to be our chief type of trouble. Once the disease gets started on the main branches or trunk, however, large cankers may finally result with serious injury or death of the tree. The infected tissues, under certain conditions, ooze out drops of liquid containing multitudes of the germs and these through insects and other means are distributed and thus spread the disease.

The trouble here on pears is most conspicuous on Bartlett especially where cultivation and fertilization has stimulated quick new growth. Quince bushes also seem to be as commonly injured as the pear. Apples, except sometimes in the nurseries, are not usually so seriously injured as in New York or Pennsylvania, perhaps due to the varieties grown or to the more moist spring weather in those states. With us the chief injury to apples in the orchard is shown by the killing back of the young twigs, after blossoming, in the favorable seasons for the development of blight. The English Hawthorn is apparently another susceptible host though the blight is not very common on it here. The only other hosts reported here have been rarely Mountain Ash and once years ago, by Sturgis, plum.

Little can be done to prevent infection by insects unless it be by spraying to help kill the particular insects that carry the germs, though protection by spraying at blossoming time in orchards may lessen the set of the fruit. Large cankers are taken care of by cutting off the badly infected limbs some distance below the canker. Other less serious cankers can be cut out, using tools kept clean by wiping them with a cloth wet with a disinfecting solution, described below, using especial care that the tools are absolutely clean when cutting in the healthy bark or wood. With shallow bark cankers, the infected bark may be removed merely by scarifying it but with a deep seated canker one may need to go into the wood.

In cutting the bark and in trimming infected but unimportant branches, the poisonous solution (1 part mercuric chloride, 1 part mercuric cyanide, 300 parts glycerine and 100 parts water, all by weights) should be used in cleaning the tools. On the cut out cankers, a coating of Bordeaux paste is also recommended by some. All diseased bark, twigs and wood removed should be burned. This treatment can probably be best done in winter when there is less danger of spreading the disease. Where the trouble is confined merely to killing the young twigs early in the summer after blossom infection, it is doubtful if one need to go to the trouble of trying any remedy.

Periwinkle (Myrtle)

Black wilt, *Undetermined fungus.* Early in the spring of 1932 we received injured specimens of *Vinca minor* sent from Long Island and later in the season came complaint from Stamford in this state where the trouble had been noticed for two or three years. At first we thought it was due to winter injury since there was no evidence of a fruiting fungus on the leaves and in many of them no mycelium. In August after examining specimens from several places at Stamford and later in a Bristol nursery, we came to the conclusion that it was an obscure fungous trouble. Some of the leaves and the younger stems died prematurely. They turned a blackish color in contrast to their normal green. Where the leaves were killed by a girdling of the stem they evidently were not invaded by the fungus and merely turned a light-brown color. The leaves on the stems in some cases died from the base upward while the other leaves showed no sign of infection at that time.

The only fungus we could find at first was a Phoma-like one with very small pycnial spores on some of the old dead stems. After leaving the injured leaves and stems in a bell-jar for some time, however, a fruiting stage of a Phyllosticta (*P. minor*) with larger, hyaline, ovoid to sub-globose spores, 7–10μ by 6–7.5μ in size was seen on some of the leaves and this also was found in October on the old dead leaves at Bristol. At the latter place we also found on some of the leaves dark-colored spores of *Sphaeropsis Vincae* in somewhat similar but larger pycnia. Both of these fungi are under suspicion but further work needs to be done to determine whether either of them was the cause of the trouble.

We believe that several sprayings with potassium-oleate Bordeaux, beginning in the spring, should be helpful in controlling this trouble. It might, likewise, be advisable to remove all the dead refuse in the fall and cut off any new infected growth that appears the next season even if the plants are sprayed.

Persimmon

Scab, *Fusicladium Levieri.* While a few apparently native specimens of *Diospyros virginiana* are in existence at Lighthouse Point, we have never collected any disease on them. However, this species and the Japanese persimmon, *D. Kaki,* are also occasionally cultivated on estates and in nurseries. On the Japanese persimmon and on some of its crosses with the native species, we have received from Dr. Morris of Stamford, in two different years, specimens of a leaf disease that we have placed under the genus Fusicladium. This fungus is similar to the apple scab since it shows as an evident superficial mycelium, just below the cuticle of the epidermis, radiating out from a central point. The spots on the leaves as seen by us were from 2 mm. to 10 mm. in diameter, chiefly circular in shape and of a dark or purplish color. The mycelium was largely confined to the upper surface of the leaves and the exposed spores were lanceolate, rarely slightly curved, one-septate, chiefly 20 by 4–5μ in size and about the length of the clustered sporophores.

Two species of Fusicladium on Diospyros have been reported from Japan, *F. Kaki* and *F. Diospyrae,* but we have seen no specimens of these and Saccardo has given no description of them, so we cannot say whether they are distinct or whether our specimens agree with them. Another species was described by Magnus in 1900 on *D. Lotus* from the Caucasus and named *F. Levieri* and our specimens seem to agree fairly well with his description though we have no specimen from that region. On the other hand Berkeley and Curtis named a specimen, *Dendrina Diospyri,* collected by Ravenel from Aiken, South Carolina, on *D. virginiana,* but apparently gave no description of the same. This was issued by Ravenel in his exsiccati Amer. Fungi no. *588* and later sent by him to three other individuals who also issued it in exsiccati (de Thuemen, Myc. Uni. no. *1282*; Roumeguère, Fungi Gall. no. *4595,* Ellis, N. A. Fungi no. *854*). The radiating mycelium on the upper surface of these specimens resembles that of ours but it is longer and the spots are much larger and there were no spores that we could find. Saccardo does not recognize this genus and apparently gave no description of this particular species. With the data at hand we, therefore, place our fungus, provisionally, as given above, with the assumption that it is also a new species to the United States.

Dr. Morris thought that this fungus might have been responsible for the leaves being partly shed early in 1932 but this does not seem probable because of the apparently slight injury caused. If necessary the fungus should be controlled by spraying as for apple scab.

Phlox

Leaf spots, *Cercospora omphakodes, Septoria divaricata, S. Drummondii.* We have found the first fungus not uncommon on the leaves, apparently rarely also on the stems, of species of phlox of the type of *Phlox paniculata* or its crosses, often when they were not doing very well. Yet in most cases the fungus was not so abundant as to account for much of the injury, so we have laid most of it to obscure insect or drought injury in such cases. The spots are of moderate size, somewhat subcircular, usually with a whitish center and a purplish border. However, the color of the central part may vary with its age or condition since in herbarium specimens it often shows darker. While these spots may be common on the plants, we have often failed to find the fruiting stage but when present it shows the conidiophores and septate, slender spores as a more or less evident growth chiefly on the under side of the leaves. This imperfect fungus apparently has not been connected up with any Ascomycete and also needs further attention concerning its life history.

The second fungus, *Septoria divaricata*, also seen here on *Phlox paniculata* and probably also on *P. divaricata*, produces somewhat similar but often more irregular, whitish spots in which its imperfect stage shows as small, black dots embedded in the tissues. It was originally reported in this country by botanists, including the writer, as *Septoria Phlogis* of Europe, but Ellis and Everhart, who also reported it as that, later described it as a new species having smaller and less evident septate spores. Its asco stage apparently has not been discovered though that of *S. Phlogis* is said to be *Leptosphaeria Phlogis*.

Ellis, who with Everhart named both of the Septoria given here, evidently thought that the one on *P. Drummondii*, called *S. Drummondii*, was distinct from *S. divaricata* by its somewhat larger spores which according to him are still smaller than the true European *S. Phlogis*. We have not studied these three species carefully enough to decide whether or not they are really distinct though we do list the two species here on these two hosts and there seem to be some differences in the size of their spores and of the spots they make on their hosts.

The treatment of these three fungi would be the same. Even if the mature stages have not been found on the old dead leaves, the infected plants and their rubbish should be destroyed in late fall after their death. We also suggest spraying with Bordeaux, starting on the young plants in the spring and repeating if necessary up to about blooming time.

Potato

Blight, late, *Phytophthora infestans*. Not only is this the most serious but it is the most noted of all the potato troubles, since it once caused a famine in Ireland. In the past many individuals and even governments have carried on investigations to determine its cause and control. Fortunately in many places it occurs lightly or not at all in the normally dry seasons though in wet regions, especially in the north, it may become very destructive. It is now definitely known that the trouble is due to a downy mildew belonging to the Phycomycetes though at one time there was great dispute as to the cause. In this state it has never appeared in the fields before the first of July and then only in seasons very favorable for its development. If the season is dry or wet weather comes late in the summer, it may not show until late in August or even not at all. The fungus usually gets a fair start in the fields before it is commonly noticed and then, with cloudy damp weather or continued rains, it seems suddenly to spring into prominence throughout the field.

The imperfect or conidial stage is developed chiefly in the leaves and its mycelium spreads through the tissues causing a blackish rot, when wet, but shriveled and brown when dry; it may invade the whole tip of the young stems or just a leaflet or part of it according to the weather conditions. The mycelium in wet weather quickly forms its external conidial spores by developing fruiting threads through the stomates in the epidermis of the leaves. These can usually be seen as a whitish or frost-like growth on the under sides especially at the juncture of the diseased and healthy tissues. The mature stage, like similar fungi, should develop conspicuous, round, resting spores within the infected tissues but these have never been found in America and apparently it is doubtful if they have been elsewhere. However, that such a stage may exist was proven by the writer in his early cultures of this fungus in artificial media years ago. (Fig. 48.)

The manner by which the fungus carries over the winter and infects succeeding crops is through the perennial mycelium in the tubers which reproduces the conidial stage when the seed pieces are planted in the field. According to the writer's opinion these conidia are washed from the tubers into the soil, germinate to form the usual motile bodies (or similar ones are produced from a still undiscovered oogonial stage) which eventually infect the leaves when they come in contact with the wet ground. Rarely one finds plants in which the fungus has grown up the sides of the young shoots and fruited there but this does not seem to be the usual method of field infection. From the primary infected plants the conidia produced on them are blown or carried to other plants and gradually infect the whole field. There seems to be a certain age before the plants become generally infected since we have seen older, badly infected plants adjacent to younger plants that failed to become badly infected until they reached about the same stage of development. The chief injury to the potato is not only the premature death of the vines, before they have produced a full crop of tubers, but often also the loss of the tubers after their production through rot. The fungus in this case is merely instrumental in opening the way through killing the outer tissues and thereby admitting the soft rot bacterial organism for their general decay. *See* page 300.

There seem to be no very desirable varieties that are resistant to this disease. The first step in control of the disease is to secure seed tubers free from the disease. The disease on the tubers is shown as a dry, reddish-brown rot, often somewhat sunken or pitted. All such tubers should be rejected in the seed cutting. However, merely selecting absolutely free seed will not suffice, since if the season is favorable the disease can be carried into the field from diseased plants even from some distance. Spraying, therefore, is the commonly accepted treatment for blight years, especially with late potatoes. With early potatoes in this state, since the blight does not cause serious injury more often than once in three or four years on the average and since these potatoes are commonly dead before it appears, it is not the general practice to spray for this trouble.

With the late potatoes the spraying with Bordeaux mixture should begin the last of June to control, with an insecticide, the potato bugs and to cover the lower parts of the plants that will not be so easily reached later on. The sprayings should be thorough and applied often enough to give a good, continuous coating on all parts of the vines. This can be done with a 4–4–50 mixture or better and less frequently with an 8–8–50. Hand spraying can be done most efficiently in small fields or gardens but the use of a power sprayer is now considered necessary in the larger ones. Dusting with Bordeaux is advocated by some but so far we have not had as good results with this or any other dust or spray as with the home-made Bordeaux spray.

Raspberry

Leaf curl. This is one of the virus types of disease that have recently been investigated on raspberries, showing chiefly on the red varieties. It has been proven by different investigators to be caused by a virus that can be carried by certain aphids from the diseased to the healthy plants. We found it abundant in our Experiment Station patch of Cuthberts during the last three years. The trouble is somewhat similar in nature to the mosaic disease on the same plants and the two were at one time confused under the general term of yellows. The leaf curl can be told by the more stunted, stiffer plants, being most evident on the leaves. The leaves especially are stiff, and curl downward and inward from the tip and margins, and thus cause more or less puckering at the veins. There is also a tendency for the leaves, petioles and upper internodes to be shortened. The leaves often are of a deeper green color though along the veins they may have lighter streaks but there is no distinct yellow-green mottling as in the normal mosaic.

Our somewhat isolated experimental field, in cooperation with the U. S. Department of Agriculture, was started in 1926 with inspected plants said to be free from mosaic. Unfortunately one lot, which was received in the best shape and made by far the best growth when planted, before the end of the first year began to show some mosaic. Twice each year leaf curl and mosaic plants in the patch have been removed to see if this was a practical method of control. No leaf curl was seen the first year and it has only been during the last three years that it has been prominent, gaining each year until in 1931 two hundred twenty-one leaf-curl plants as compared with two hundred fifty-three mosaic plants were removed. Whether this is an indication that leaf curl is merely a more advanced stage of mosaic, somewhat as curly dwarf is to potato mosaic, we are not prepared to say. We can state, however, that from its insignificant beginning in this case the leaf curl became a more serious trouble than the mosaic. The experiment was ended at the conclusion of the 1932 season. *See* further statement under Mosaic.

Mosaic. Like the leaf curl, mosaic is most serious on the red varieties and is especially common here on the Cuthberts. It, too, is a virus disease carried by aphids from the diseased to the healthy plants. Its chief characteristic is the yellow-green areas in the normal green leaves, thus giving them a mottled or mosaic effect. Sometimes this mottling is more evident than at other times and when faint one needs to shade the vines from the strong sunshine to see it best. It is usually more evident on the younger leaves than on the old ones. At times the old leaves are normal while those above are mottled, thus indicating their recent infection. In time the virus spreads through the plant and even the young sprouts from the underground runners may eventually develop the trouble. This makes it difficult to eradicate the disease since these rootstocks are rarely entirely removed in pulling up the infected plants. One needs also to distinguish it from yellowing of the leaves, especially the older ones on the old canes, that is due to drought or insufficient fertilization.

In our experimental field already mentioned, we had in general an increasing number of mosaic plants each year up to 1928, but after then a usually decreasing number, despite our efforts to lessen the trouble by removing the diseased canes and sprouts twice each year. The following data indicate the number of diseased (both mosaic and leaf curl) plants, including both mature canes and sprouts, removed each year:—in 1926 there were removed 180; in 1927, 290; in 1928, 1211; in 1929, 644; in 1930, 720; in 1931, 474; in 1932, 241 (removed only once in 1931 and 1932). As stated under leaf curl one of the four lots from different sources began shortly after planting to show some mosaic plants. The other three lots, planted a week or two later in dry weather did not do so well and many of the plants died from these adverse conditions so they did not fill out the rows especially at the higher end of the land. At the end of the first year at least one hundred and seventy-two mosaic plants were pulled out of the poorly inspected lot while in the other three well inspected lots only eight plants were removed. The wet year of 1927 was very favorable for aphids so that the next year infection showed up very prominently. At the end of 1931, while there were about the same number of plants that survived the first year (about two thousand plants), there had been pulled out during the six years practically thirty-five hundred plants and sprouts. The practice had been, however, to encourage new sprouts free from the disease to come in where the old diseased canes and sprouts had been removed. At the end of the experiment in 1932, there were 1411 healthy plants, 147 dead ones and of the diseased ones only 89 showed mosaic as compared with 152 with leaf curl.

On the whole this experiment does not indicate a practical solution for control of mosaic and leaf curl by removing the infected plants. However, it does indicate to the writer that the grower should strive to obtain inspected plants as free as possible from these troubles and that they should be planted in an isolated field. The grower should then watch carefully for the first signs of these troubles and destroy infected plants as soon as they appear. This should be kept up until the number removed gains considerably when it can be discontinued and the patch be allowed to remain as long as it is profitable financially. When it becomes unprofitable, the owner should start again with other inspected plants in another isolated field.

Rose

Crown gall, *Bacterium tumefaciens.* This bacterial disease on most of its hosts shows as evident, swollen growths usually at the bottom of the stems or on the roots below the soil. These swellings are generally semiglobose and vary from about one half an inch to three inches in diameter. There may be only one gall at a place or several may be close together. At first they are fairly soft and usually on herbaceous plants they remain somewhat soft but on woody plants they become hard through the infection of the woody tissues. Cross sections of the galls shows a mixed arrangement of the different tissues as contrasted with the normal regular arrangement. In the different hosts on which crown gall has appeared in this state most have been on woody plants. In one case we found it on the tap root of the mangel and in another forming curious distortions on the base of aborted or stunted stems of greenhouse sweetpeas. Artificially, however, we or Dr. McCormick have produced it on seedling Norway maple and several herbaceous plants, such as Bryophyllum, geranium, string bean, tobacco and tomato. The following is the list upon which the crown gall has been found naturally in the state, mostly in the nurseries: apple, bittersweet, blackberry, chrysanthemum, Euonymus, grape, honeysuckle, mangel, mockorange, mountain ash, peach, pear, plum, poplar, privet, raspberry, rose, sweetpea, willow and Wisteria. (Fig. 50.)

It is a question just how much harm this trouble causes to the infected plants. Nursery inspectors usually throw out any infected plants, chiefly because of the damage the crown gall has caused in the south. Here in Connecticut, we have seen no orchards that have suffered from this trouble. We have on two occasions examined apple trees that had crown gall when they were set out but, so far as we could tell on later examination, they had suffered little injury. It is possible that this trouble becomes more injurious in blackberry and raspberry plantations but we have had no complaints. On herbaceous plants and the less woody plants like the grape, the galls die prematurely and gradually disintegrate and so show at least local injury. The most prominent of all the infections that we have seen have been on certain varieties of roses (Rosa sps.) in greenhouses. In most cases we believe some injury occurs to the vigor of the stems and the general production of blossoms. In this host the galls break out any place on the stems but often occur at the cut ends. Some believe that the growth at these cut places is due to embedded crown gall strands that reappear at the new callus growth, and others that these surfaces are reinoculated by the germs on the shears used in cutting the stems.

We recently tried an experiment to test these two theories. On one bench we dipped the shears, each time before cutting, in a receptacle containing a saturated solution of corrosive sublimate and then wiped them off with a towel. On the next bench we let the men trim the roses after the normal fashion. This was done with both benches at the end of the blooming season. From the experimental bench we removed 570 galls from 306 plants and, as at least 40 more were removed a short time before, the plants averaged two galls to each plant and one had even eight removed. These varied from a very small size up to two inches in diameter. The check bench had 408 plants but we did not count the galls the men removed from there but presume it had fully as many per plant. Six months after removing the galls from the benches we counted 65 galls (or 21 to each 100 plants) on the experimental bench and 164 galls (or 40 to each 100 plants) on the check bench or about twice as many per hundred plants. Eleven months after removal there were counted 170 galls (or 56 to each 100 plants) on the plants on the experimental bench as compared with 280 galls (or 69 to each 100 plants) on the check bench. On the whole these unusual precautionary measures did not yield extra good results on these badly infected plants.

Leaf blotch, *Actinonema Rosae.* This is a serious trouble with certain varieties, especially of greenhouse roses. It shows as purplish, circular, evident spots on the leaves usually a quarter to half an inch in diameter when mature. If abundant the leaves turn yellow and drop off prematurely. The radiating mycelial threads give rise to rather inconspicuous fruiting pustules on the upper surface of the leaves. On the old dead leaves an Ascomycete, *Diplocarpon Rosae,* is said to mature in the spring but we have never collected this stage. In the greenhouses some growers report this as the chief obstacle for successful production of certain varieties. One grower reported Premier Supreme as the variety he had the most trouble with while Templar was next and Briar Cliff was the least injured.

We recently tried spraying Johanna Hill in a greenhouse during the off season just after the plants were started again for new growth. We used Bordeaux on some plants and on others potassium sulphide, both with a sticker of potassium oleate. On these plants twelve sprayings were made between June 10th and September 10th. When the blossoms began to be picked abundantly about this latter date the spraying was discontinued. During this time the watering was kept down and the disease did not spread much even on the checks. With the start of blooming the subsequent frequent watering, or dusting as it is called, not only started the vigorous blooming but also the spread of the blotch. The frequent watering of the susceptible varieties, while it may be necessary as the grower believes for successful production of blossoms, is the chief cause of the spread and serious injury by the blotch. This was shown by growing this and other susceptible varieties in the Station's drier greenhouse where the blotch failed to bother though the bloom was not as great.

We believe that in between these extremes of watering the careful grower will find the best results in the end. It might also pay to spray once in two weeks in the off season, as we did, provided that the whole house is treated, since in our case we used only a few of the bays in a large house. For roses out of doors, we recommend, as in the greenhouse, the removal and burning of the old leaves, in this case in the late fall, and then in the spring and early summer several sprayings with Bordeaux before blooming time.

Rutabaga

Bacterial black rot, *Bacterium campestre.* This is the host, *Brassica campestris,* upon which Pammel first described the disease in 1895 although it is now known on a number of cruciferous plants. We have found it in this state on cabbage, cauliflower, kale and rutabaga. On each of these we have seen it several times, though rarely causing serious injury. The most serious case was in 1929 on cauliflower, where the grower had planted about fifty acres and did not get a fifth of a crop, chiefly due to this trouble. As in other years the trouble was due to an unusually wet season, in this case late in the summer. The trouble often starts as a wedge-shaped yellowing and then a wilt at the edge of the leaves but the chief characteristic is the blackened bundles that carry the water and food and along which the invasion of the bacteria proceeds. The infections usually start at the edge of the leaf in the little drops of water that adhere there in damp and dark days and the bacteria work through these into the intercellular spaces and bundles within discoloring the latter. In time a soft rot may occur in the thickened tissues, as in the heads of cabbage and cauliflower and in the roots of the turnip. This is due to the invasion through the injured tissues of the soft rot organism which follows this more parasitic species.

As the trouble occurs so infrequently, it is difficult to control. One should be afraid of it in wet years but after its appearance it is too late to do much good. We have an idea that insects are instrumental in carrying the germs, especially thrips in the special case we mentioned. Care in selecting purchased plants or of their growth in seed beds should be exercised. The grower should practice rotation with the related crops on which the disease may occur and never use land for them on which the disease appeared the year before. If doubtful about the seed, this should be treated since the germs can be carried in this way. We treated cauliflower seed two years for a grower who experienced this trouble the year previous to our first treatment. He had no trouble the two years the seed was treated but he rotated his crop chiefly to new land and these two years were dry rather than wet ones. We soaked the seed in these cases for fifteen minutes, using corrosive sublimate 1 to 1000 on half the seed and for the other half in formalin 1 to 250. The seed was dried immediately after treatment. There was no ill effect on the germination of the seed in either case as compared with the untreated seed.

Mosaic. We had recent complaint from a Meriden farmer of a trouble to his rutabagas that became worse in succeeding seasons, since he saved certain of his roots for seed plants. Dr. Dunlap, who investigated this trouble, found lice abundant on the plants in the field but also a more or less definite mosaic mottling of the leaves. By greenhouse experiments he was able to prove that it was a true mosaic trouble, rather than merely lice injury, by transferring the disease through injections with infected juice from the diseased plants to both healthy tobacco and rutabaga leaves. *See* Tobacco.

Spinach

Damping-off, *Pythium debaryanum, Rhizoctonia Solani.* We have placed these two fungi here for general discussion since they are the fungi that are usually responsible for damping-off of a great variety of plants in cold frames, hot beds, greenhouses and gardens. They act in much the same way, rotting the seedling

near its base, causing it to fall over, wither and soon dry up and disappear. If a lot of seedlings are killed in one place, their destruction is more evident especially when they are grouped together. These fungi also cause injury to mature plants, especially in the case of the Rhizoctonia.

For seedlings grown outdoors for general farm crops, we have tried dusting and soaking the seed, treating the soil in various ways and spraying the young seedlings and we are not yet satisfied to recommend any general preventive treatment along these lines. The best we can do so far is to state that the seed should be good and not planted too early or deeply in the soil and then leave it to the grower and the Lord that the rain is just right for rapid germination of the seedlings and not especially favorable for the development of either of these damping-off fungi. We treat each fungus separately and then give the method of limited sterilization of soil in seed beds and greenhouses for their prevention:—

Pythium, on the whole, we have seen more frequently on its hosts in hot beds and gardens than in the greenhouses, this being especially true of spinach. This phycomycetous fungus is usually found in its white, non-septate, mycelial stage running on and in the tissues near or under the ground, usually rather inconspicuously. Later it develops in these diseased tissues its round, single, oospores (usually less than 25μ in diameter) with a free oogonial wall, in greater or less abundance to perpetuate the fungus. Very similar to these oogonia are thinner walled, temporary sporangia producing zoospores that spread the disease temporarily but which we have seen much less frequently. As a damping-off fungus, we have listed it here on the following seedling plants: beets, cabbage, cucumber, lettuce, muskmelon, pansy, pepper, pines, spinach, stringbean, sweetpea, tobacco, tomato; and as a rot of the roots and other parts of the more mature plants, on celery, pea, sweetpeas and tobacco.

Rhizoctonia, as with Pythium, likes dampness for its vigorous development but it often causes more harm when developing in an acid soil, where we have found it causing abnormal injury to unusual plants. It develops a larger and more vigorous mycelium that creeps over the exposed tissues so that it is often evident to the naked eye. At first this mycelium is colorless, at which time it seems to cause most of the damage, but in time it becomes more or less deeply colored reddish-brown. Often the threads are bunched together into strands which seem to aid in pulling the invaded plants together as in grasses. Another characteristic is the position of the septum that separates the side branch from the main branch, this being situated just above the base of the side branch. In the damping-off plants no spore stage is found. Not only does this fungus cause a damping-off of seedlings but it also frequently causes a rot of the mature parts of the plants; for a list of these and a further statement concerning its life-history, *see* Potato. We have found it causing damping-off on the following seedlings: barberry, beets, cabbage, egg-plant, Boston ivy, lawn grass, lettuce, pepper, pines, radish, spinach, sweetpea, tobacco, tomato, white pine, yew. No doubt there are many other seedlings to add to this list.

Treatment to prevent damping-off, as given here, is for a limited area of soil, as in seed beds, flats in greenhouses, etc. In the first place, one should be careful in watering; use just enough water to germinate the seed and aid hardening of the seedlings, for after a certain age there is little danger of trouble from these fungi. For that reason many growers plant their seed in soil not very rich in humus, using a sandy soil and even a coating of pure sand on top in some cases. After certain plants have passed the damping-off stage, they can be transplanted to a richer soil to stimulate further growth before they are set out permanently. If one has trouble even with this method he can try sterilization of the soil. However, even with this treatment, he needs to be careful of his watering of the seedlings. We have tried a great variety of methods of sterilizing the soil and spraying the emerging seedlings, chiefly with beets and spinach, and we find the best method to date to be as follows: Use at the rate of one pint, or 16 ounces, of glacial acetic acid in 10 gallons of water, or one pint, or pound, of formalin in 6¼ gallons of water and gradually sprinkle either of these liquids over the soil at the rate of two quarts to each square foot; cover with boards or cloth to keep in the fumes for a day and then expose to allow their escape; do not plant the seed for 14 days after treatment.

Downy mildew, *Peronospora Spinaciae.* For a number of years we looked for this fungus on spinach without success and then accidentally ran across it in 1915. Since then we have seen it many times, especially from 1923 to 1926 when it became epidemic in fields around Westport and Stratford and to a less extent at Wethersfield, Hartford and New Haven. It forms definite, yellow spots on the leaves on the under side of which in time appears the conidial stage as a grayish to purplish-tinted growth. The conidiophores produce the evident woolly growth while the spores formed on their ends give the violet or purplish tint. We have not seen the oospores that should appear in the embedded tissues but possibly these may develop in the old dead leaves.

While we give the downy mildew here under the specific name (*P. Spinaciae*) derived from its host's genus (Spinacia) and to which it is said to be limited by some authorities, we are doubtful if it is really distinct from the species *P. effusa,* found here commonly on the related weed known as Lamb's Quarters, which readily produces both the conidial and oogonial stages. We tried in 1925 and 1926 to infect these two hosts with the conidia from their own and the other host but were not successful with them when the conidia came from the opposite host. However, we are not certain that this never occurs and we need further work to see if this also holds true with the germinating oospores before we can decide whether or not they are really distinct.

While a good deal of damage was claimed from the fungus at the time of its epidemic, we found that in reality the glut in the market with imported spinach, thus cutting down the price, was partly responsible for the failure of the growers to market some of their own product, thus at the same time increasing the amount of damage the mildew caused.

We tried during these years various experiments to determine which was the best way to avoid damage from this disease. We grew many varieties from a number of sources to see if any were exempt from the trouble, and while we found considerable variation in the amount of mildew that appeared on them this seemed to be due to accidental infection rather than to any varietal resistance to the disease. We also treated the seed and soil and tried various dusting and spraying experiments on the young plants but none of these were effective enough to recommend them as a method to be put in practice. In one experiment mulch paper was used just after the seedlings appeared above the ground to prevent their leaves from coming in contact with the soil in their later growth. This was done with the idea that primary infection might come from germinating oospores in the ground and that this would be a good way for its prevention. This, too, was not entirely satisfactory.

As a result of all of our experiments, the only suggestions that we can make are: 1st, yearly rotation; 2nd, continued early destruction of the Lamb's Quarters, on the possibility that the oospores produced in the infected plants carry the fungus over the winter and may be a source of spinach infection the next spring.

Tobacco

Fertilizer injuries. These may be due to two general causes; namely, when the fertilizer comes in direct contact with the tissues and burns them; secondly, when there is a certain element needed by the plant the absence or scarcity of which causes a more obscure trouble. In the first case we frequently in our survey found injury in the seed beds due to the careless use of fertilizers on the young plants. This came from scattering the fertilizer on the leaves, especially when moist, and then failing to wash it off thoroughly at once into the soil. As a result a burn of the foliage, a white spot or a more general irregular injury, appeared. There was a term, yellow-chit, applied by certain growers to an obscure trouble which showed as a decided yellowing of the very young leaves and bud but which was usually later outgrown. We could never really decide if this was due to slight injury by the fertilizer sown over the plants or to cold bordering on freezing. In the fields, where fertilizers were used too strong or too close to the roots of young plants, injury sometimes resulted that was difficult to distinguish from the brown root rot described previously.

The other type of injury, due to the scarcity of a certain element that is essential to the normal growth of the plants, was seen chiefly in field tobacco. For instance, lack of nitrogen shows in a less vigorous growth and yellowed foliage of the leaves. During the war when potash was difficult to obtain, tobacco growers complained of poor tobacco, especially where no manure was used and fertilizers with very little potash in them or none at all. The tobacco was less vigorous, the leaves yellowed at the tips, and between the veins spotted and puckered. More recently the soils department of this Station has shown this deficiency of potash in experimental plants by their smaller size with lower, thicker, puckered, white-spotted leaves with downward curved tips. The trouble gradually progresses upward to the later leaves as they mature. Deficiency due to lack of magnesium, known as *sand drown* but more common further south than in this state, is shown by similar poorer growth with white or yellow areas between the veins of the leaves but without the puckering and curling. In this case the trouble is apt to occur here when only certain artificial fertilizers, without magnesium, are used, and the deficiency of the magnesium is shown by the stealing of this element from the lower leaves to supply it to the growing leaves above resulting in the spotting. In time the leaves above may show similar spotting.

Mosaic (Calico). This trouble on tobacco was first called to attention in this country by Sturgis in 1898. He did not determine its method of spreading and did not believe it was contagious or caused by fungi, insects, nematodes or apparently by bacteria. He favored the belief that it was a physiological trouble due to certain weather and soil conditions. The writer in 1906 first began experiments to prove that its spread was due to handling diseased and then healthy tobacco as indicated by certain experiments of European investigators. It is now known that the juice of mosaic tobacco plants contains a virus so that the disease can be communicated to healthy tobacco by handling, or by lice through punctures. What this "virus" is no one as yet knows; evidence is accumulating, however, that it is of a proteid nature.

The general appearance of the trouble is the same as with mosaic of other plants already described, namely, a distinct yellow-green mottling distributed in mosaic fashion in the normal green of the leaves. When it is bad the plants are reduced correspondingly in size and weight. The mosaic plants make poor wrappers on account of brittleness and other undesirable qualities and so the price received for crops is less when this trouble is evident. The top of growing plants showing this trouble is called "mottled top" and this condition is due to late infections. The trouble sometimes shows a little in the flowers also. The new sprouts from harvested tobacco are often mosaic because of increased infections through harvesting. The trouble is not carried by the seed. The disease is not visible in the leaves matured before infection although the virus may be present in them later. (Fig. 59.)

At first a good many different plants, when found to have mosaic, were considered to be caused by the virus of tobacco mosaic. More recently the tendency seems to be to consider these as distinct troubles. We showed in 1908 that the mosaic on tomato could be caused by the virus from tobacco. We have also produced mosaic on various solonaceous plants from mosaic tobacco juice and have had indications that it will produce mosaic in the Cucurbitaceae, though infection of these hosts is not easily produced by handling or artificial injections of the virus from either tobacco or members of the Gourd family. The mosaics reported here which are similar to or identical with that of tobacco are on the following plants: bean (Lima and string), blackberry, clover, cucumber, dahlia, eggplant, fuchsia, horseradish, lettuce, muskmelon, pepper, petunia, potato, raspberry, rose, rutabaga, soybean, squash, sweetpea, tomato, zinnia.

For control, the tobacco seed beds should be watched and if mosaic is found common on any, plants from other beds only should be selected. If necessary the beds should be changed to soil not in tobacco before. If a few plants show the trouble destroy them and the surrounding ones and wash the hands before handling other plants. Never pull or set plants with juice on hands from mosaic plants. Never use old tobacco stems or tobacco refuse on seed beds or spit tobacco juice on them, and clean out the remaining plants after the setting is over. In suckering and topping, clean the hands and tools occasionally so as not to spread the trouble to healthy growing plants. In suckering and topping plants, leave the mosaic ones to the last and then take care of them alone.

Tomato

Blight, late, *Phytophthora infestans.* Late blight on tomatoes was first found in the state by Thaxter in 1890. He reported it here as well as in Maine, as causing damage to both the fruit and leaves, at least in Maine late in the season. Sturgis also in 1893 mentions this trouble as "frequently attacking tomatoes also", though his statement may have been based on Thaxter's report. Since 1902 the writer has especially looked for it on this host but failed to find it until recently. The first specimens that came to hand were sent by Extension Agent Wilkinson from a farm in Ellington in September, 1928, and on the first of October, 1931, we found a considerable amount at Wethersfield.

In 1932 this disease was again found and this time about the middle of September and from that time on it became quite evident in the general region of New Haven and Bridgeport, where we were able to find it in over twenty fields that we visited. A peculiarity of the disease is that it seems to become prominent in the late fall, apparently later than on the potato from which we might expect it to spread. It appears unlikely, however, that the fungus does spread from the potato to the tomato since, while it was general this year on the tomato, we had scarcely any reports of blight on the potatoes in the same localities.

In 1933, when a careful watch was made for its very first appearance, the primary infections were found on September first and by the middle of the month the disease was widespread and finally became more serious than we had seen it before. The trouble started this year with primary infections of leaves *in contact with the moist earth* and the spores developed on these spread the fungus to the upper leaves and finally to the fruit. We were able after the first outbreaks to obtain infections of healthy plants (kept indoors) by placing their leaves in contact with the wet infected earth in crocks for a few days. These observations suggest to us that primary infections come from the ground through the fungus in some way being carried over the winter in it.

The fungus appears in its conidial stage on both the leaves and fruit but in the latter case the spores usually develop only when the skin is cracked or the fruit is kept covered or in a damp place. We have, however, occasionally found the conidiophores and spores entirely within the tissues of the fruit. The fungus kills the foliage as it does on the potato but the chief damage so far has been to the fruit. Here it produces a conspicuous, reddish-brown, dry rot of the tissues chiefly of the green fruit. The infected tissues do not change to the normal red on ripening as do the adjacent healthy tissues. If the rot reaches some size, it may show concentric rings of growth occasionally. This rot extends more or less deeply into the interior and may finally become general, involving the whole fruit in a wet rot when other fungi and bacteria become associated with it. So far, as with the potato, we have been unable to find any mature or oogonial stage though we have looked carefully on the infected parts, especially on the fruit and seeds, at different times of the year and as late as the middle of November. Artificial cultures, too, have failed to develop anything except the mycelium and the conidial stage.

The mycelium is very evident in the tissues of the fruit and can be found mixed with the hairs on the outside of the seed. This indicates to us that it may be carried over *in* rather than *on* the seed. As yet, however, we have not been able after numerous trials to get the fungus to develop on the germinating seeds from infected tomatoes. The Marglobe, so far as we have seen, is the most seriously and commonly infected variety, possibly because of its being a late variety. At a certain seed farm we found crosses of this with other varieties that were also especially attacked. We have found it, however, on several other late varieties and on some causing very considerable injury to the fruit.

Early tomatoes seem, so far, to escape the trouble even when grown in the vicinity where the later ones become infected. Where desired, spraying with Bordeaux if done thoroughly, will control the fungus but in this case there may be slight trouble from the spray attached to the fruit if not washed off when it is sold. As the Marglobe seems to have been the guilty party for bringing in the trouble, we suggest avoidance of that variety for possible safety in lessening it.

Tulip

Botrytis blight (White spot) *Botrytis Tulipae (B. parasitica).* Hopkins, in his work on this disease at Cornell (Agr. Expt. Sta. Mem. 45) considers it apparently confined to tulips since, while he was able to infect species of Tulipa, he was unable to get satisfactory results with other plants except in a few cases where he injured their tissues before placing the spores or mycelium on them. In Connecticut we have noticed this trouble chiefly on Darwin tulips and it was reported in Bull. 222, p. 480, under the name of White Spot. At that time, we thought the trouble, first seen in May, 1919, was due to frost or smoke since no sign of a visible fungus on the injured petals of the Darwin flowers was found. Since then we have seen this same trouble at various times in the spring, especially when wet and cool, and with the light shed by Hopkins's article, we have been able to secure, through artificial cultures, a Botrytis from the infected tissues.

As seen by us the trouble shows principally on the dark-colored petals as small, slightly elongated specks or small spots that more or less fleck their surface. Similar ones also show to a less extent on the leaves. They are at first discolored or water-soaked but usually when dry show white with a more or less definite dark border. As remarked before, usually no growth shows on these spots. In time, however, a more general invasion of the tissues may result with evidence of the conidial stage appearing on the dead areas. On the dry, outer skin of the bulbs, it is said, small, black sclerotia, about 1–2 mm., often develop and beneath these on the more tender white coats often can be seen small lesions which may develop further under certain conditions. Apparently this Botrytis differs from the common *B. cinerea,* which has also been reported on the tulip, in its smaller sclerotia.

It is difficult to advise treatment for this disease since we have had no practical experience. Of course all the rubbish from the old plants, including the soil on which they fall, should be cleaned off the beds as soon as the plants die back. Then in the spring, as the plants come forth, it might be helpful to spray them and the ground with potassium-oleate Bordeaux before blossoming time. Plants in the spring that show weakened growth or produce poor flowers should, with their bulbs, be pulled up and destroyed.

White Pine

Blister rust, *Peridermium Strobi.* Since the wholesale destruction of the chestnut by the blight white pine, *Pinus Strobus,* has become our most valuable timber tree both in the forests and in the plantations. Consequently we have obtained data on all of the fungi that have been found on it in this state. Of the sixteen species so far determined, we have listed only half a dozen as apparently parasites. But besides these parasites we have also noticed an even greater number of injuries due to other causes.

Of all of these troubles, the Blister rust is the most injurious one although evidently not so serious here as in certain regions where the conditions favoring its spread are much more favorable. The scientific name given here is that applied only to the O-I stages that occur on the white pine. The II-III stages, occurring on various species of Ribes, are known as *Cronartium ribicola* which by some writers is also applied to the stages on the white pine. Our chief concern in this state, however, is the injury caused to the white pine rather than to the currants and gooseberries. These latter are species of Ribes of which we have listed nine, both cultivated and wild, as found infected here. The white is the only pine in nature that becomes infected in this state. With Dr. McCormick we have been able to infect a number of seedlings of other species, most of which are not normally grown here. These seedlings take the disease in varying degrees but in a few cases as readily as does the white pine. The most susceptible of these were two and three needle pines and included *Pinus canariensis, P. Pinea, P. Coulteri,* and *P. edulis.*

In general the rust develops a life history in about the following manner: Spores from the III or telial stage on the leaves of Ribes germinate *in situ* in the fall and develop a promycelium on which delicate spores, called sporidia, are borne. These sporidia are blown onto the needles of the pine and, under favorable conditions of moisture and temperature, develop threads that push their way between the guard cells of the stomates into the interior of the needles. Once within the tissues they form a mycelium and become evident, usually the next spring, by a yellow spot on the leaves due to the bunching of the mycelium into a sclerotial mass. In time during this second year, the mycelium works down through the apparently healthy, green tissues by small strands into the base of the infected needles; then it begins to develop in the stems much more luxuriantly, causing a more or less evident swelling of the invaded bark. By the third year the fungus may cause dead, brown spots on the yellow, invaded bark from which ooze small, yellowish drops containing very small bodies known as pycnial spores. By the spring of the fourth year, the bark may show a more or less cracked or cankered area on which develop conspicuous, white blisters that on rupture disclose a dusty, yellowish mass of uredospores or the I stage. Once established on the pine, the rust may develop year after year these O and I stages until the canker surrounding the stem eventually kills the parts above. (Fig. 63.)

The function of the O stage is still not quite evident though recent discoveries of similar stages of other rusts have advanced our knowledge of its usefulness. The spores of the I stage, however, spread the rust to the various Ribes where on germination they infect the leaves through the stomates and give rise within to a limited mycelium that in a short time produces quite similar spores in very small pustules on the lower side of the leaves. These spores of the II stage may on germinating go on repeating the same stage on other Ribes leaves for several generations but eventually their mycelia give rise to the spores of the III stage. These spores are quite different and are united into compound, short, hair-like bodies developing generally on the under side of the leaves. Under moist conditions these spores germinate in position to produce a promycelium that becomes divided into four cells each of which forms at its tip a short process bearing the single sporidium mentioned at the beginning of this life history.

While this in general is the life history of the rust, it is known that sometimes the rust lives for several years on the pine before breaking out in the blister rust stage. On the other hand we have cut down the period to about one year from telia produced on the Ribes to the O stage on the pine seedling by artificial infection of pines kept over winter in the greenhouse. From the completed life history it has been determined that the rust is perennial on the white pine but is annual on the Ribes. Also the I stage on the pines does not infect, so far as yet known, the pines but the Ribes only; that the II stage is a repeating stage on the Ribes and that the III stage does not infect the Ribes but the pines only.

When efforts were first made in this state to control the rust, it was through the destruction of the infected pines, since it was by these that the rust was first brought here from Europe. This method was soon given up as impractical and attention was limited to the destruction of all wild and cultivated Ribes within 600 to 900 feet of the white pines since the sporidia produced on the Ribes are effective in spreading the rust to pines chiefly within that distance. Another matter of importance is the planting of white pines for seedlings in beds away from any danger of infection by Ribes, as infected seedlings are a very common method for dispersal of this rust. Where this care is impossible, the seedlings should be sprayed throughout the season of infection with Bordeaux mixture. Experience has shown that certain Ribes are more susceptible to the rust or at least are more frequent carriers than others. For this reason the cultivation of the black currant, *Ribes nigrum,* is prohibited by law in this state. *See* Currant, also Bull. 214:428–460.

Willow

Scab, *Fusicladium saliciperdum.* This has proved the worst trouble of the willow that we have ever seen in the state and it has been even more serious in some parts of New England and especially so in the Maritime Provinces of Canada where trees of *Salix alba* var. *vitellina* have been the chief street and shade species of certain regions. The trouble was first noticed by the writer in 1927 (*See* Bull. **302**, p. 443) but it had undoubtedly been present here and elsewhere in North America at least some years previously. We have since collected it in several of the New England states, in many places in Canada and once in England. The continued death of the young leaves and twigs on the infected trees during the few subsequent years so starved them that many died. When first seen by us in August, we thought that the trouble might have been due to late frosts, since the fruiting stage of a fungus was not seen on many of the dead leaves. Subsequent investigations, however, revealed the fungus listed here as the cause, and cultures and infection experiments proved that this was true. However, the anthracnose fungus, also described here, has at times been found as an additional cause.

The scab fungus in its conidial stage shows when fully developed a dense, greenish, swollen growth on the lower side of the leaves, particularly on the midrib and veins. It is somewhat similar to the closely related Cladosporium fungus which is also often evident but scattered on the dead leaves as a saprophyte. The scab fungus becomes especially serious by carrying over on the injured and dead twigs and thereby infecting the young leaves as they appear the next year. Many of these leaves it kills directly and on others, older when infected, it kills portions or produces spots. It seems to produce infection chiefly in the spring and, with moist weather at that time, may cause wholesale destruction of the developing leaves. Later in the season mature leaves, especially on healthy trees, seem to escape the infection to a great extent.

This fungus has been associated with an Ascomycete, *Venturia chlorospora,* found as a saprophyte on the old, dead, willow leaves by Aderhold and other European investigators. It seems from our investigations that the mature stage is a Venturia and recently Kochman in Poland is said to have obtained the scab stage from its ascospores developed on infected twigs cut off and wintered over under natural conditions. However, he did not obtain the asco stage from the scab stage in artificial cultures. The writer has made attempts to find this asco stage in America on the dead twigs and leaves at all times of the year but so far without success. He did find a certain Venturia on the dead leaves and Dr. McCormick succeeded from one of the collections in obtaining cultures from their ascospores which developed not a Fusicladium but a Cladosporium stage! However through the efforts of both of us we did succeed finally with cultures of the scab stage under certain treatments in producing, though rarely, true perithecia with mature asci and ascospores of a Venturia. The efforts to repeat these results under apparently similar conditions so far have been unsuccessful. The ascospores in these cultures were not the same as those connected with the saprophytic Cladosporium-Venturia and apparently not like those figured by Aderhold on Salix, but more like those figured by him and found by us on leaves of Populus.

Through the efforts of this Station treatments of the infected willows at Norfolk were carried on for three years. Considering the fact that the treated trees were badly infected and many of the large limbs were partly or entirely dead before any of the sprayings were given, the results were as satisfactory as could be expected. After the 1930 treatments, the spraying was discontinued and these trees went backward and were finally cut down, but check and other trees in the village proper had all been dead for several years. It appears from this that the spraying must be continued yearly until danger from infection on the sprayed or surrounding trees is entirely past. This is quite a bothersome and expensive matter that can be followed only when the trees are highly valued for either their artistic or historical importance, as in the case of the willow trees in the Evangeline Memorial Park in Nova Scotia.

The sprayings given by us consisted of four or five treatments with either Bordeaux mixture (4–4–50) or dry Lime-Sulphur (3–50). The first treatment should be on the dormant trees just before the buds break open, the second on the young unfolding buds, the third on them when one-half to two-thirds grown and the fourth on them when nearly or fully grown. The fifth spraying, if necessary, can be given later or an extra treatment crowded in earlier if wet weather makes it desirable. In this state the treatments would normally run from the last half of April to the first part of June.

FORMULAS FOR FUNGICIDES

SPRAYS

Bordeaux Mixtures

Ordinary Bordeaux

Lime 4 lbs. Copper sulphate 4 lbs. Water 50 gals.

This is the strength that has been used for the greatest length of time and on a great variety of plants. It is what is advocated for most vegetables (beans, cucurbits, potatoes, etc.) and grapes, strawberries, most shade trees and shrubs, and herbaceous plants where sediment is not especially objectionable. Formerly the lime used was fresh quick-lime that had been slaked before use, but now much of the Bordeaux is made from hydrated lime that seems to act just as efficiently and is easier to handle and keep. Only high quality spray lime should be used.

Weak Bordeaux

Lime 1 lb. Copper sulphate 1 lb. Water 50 gals.

This, or a 2–2–50 strength, can be used where it is desirable to have less sediment near blossoming and fruiting periods of certain plants, especially of those in yards and greenhouses. It is not so effective as a fungicide.

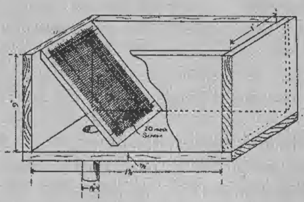
Strong Bordeaux

Lime 8 lbs. Copper sulphate 8 lbs. Water 50 gals

Some potato growers prefer this stronger mixture and it apparently covers the foliage for a longer period.

Making Bordeaux Mixture

Make stock solutions of copper sulphate and lime as follows: Dissolve 50 pounds of copper sulphate in 50 gallons of water, by suspending in a bran sack. One gallon of stock solution thus contains one pound of copper sulphate. Slake 50–60 pounds of lime, strain into a barrel and make up to 50 gallons. A gallon of this solution contains at least one pound of lime. The excess takes care of waste in slaking. Put two 50-gallon dilution barrels on a platform so that the sprayer can be backed under them. For a 100-gallon sprayer put 10 gallons of stock lime mixture into the lime barrel and 10 gallons of stock copper sulphate solution into the copper sulphate barrel. Dilute each to 50 gallons. By using a molasses spigot for each barrel, the two streams may be run together through a trough into the sprayer. A large, fine wire strainer should be set in the sprayer opening. The above amounts would make a 5–5–50 mixture. Lead arsenate or nicotine solution may be added if needed.



TYPE OF STRAINER RECOMMENDED FOR SPRAY MATERIALS

Some growers get good results with the following method: Start filling the sprayer with water, washing in at same time 10 gallons of the stock lime solution through the strainer. When half full, add the 10 gallons of stock copper sulphate solution with the remaining water, stirring meanwhile. When short handed, this method saves time. Half these amounts are used for a 50-gallon sprayer.

Quick Bordeaux

Copper sulphate can now be had so finely ground that the required amount can be put into the strainer of the spray tank and washed through with the water without previous dissolving. By washing through the strainer the required amount of hydrated lime, filling the tank half full, and then washing in the finely ground copper sulphate with the remainder of the water required, a very satisfactory Bordeaux mixture can be made directly for use.

Commercial Bordeaux

Commercial Bordeaux in a dust form can be purchased from dealers for spraying, with and without poisons. The former should not be used to spray parts of the plants to be eaten later. Commercial Bordeauxs are more costly than the homemade mixtures and often are not as effective. They should be used in the amount of water indicated by the manufacturer.

Lime-Sulphurs

Liquid lime-sulphur

Summer spray:

Lime-sulphur 1 to 1½ gals. Water 50 gals.

This spray gradually supplanted Bordeaux on fruit trees because of russeting and leaf spotting by the latter. It is now being largely supplanted by the dry lime-sulphur for summer spraying because of greater ease in shipping and handling and less injury to the foliage.

Winter spray:

Lime-sulphur 5½ gals. (12 lbs. dry). Water 50 gals.

This is used on dormant trees to kill scales, etc., but is also useful in controlling leaf curls, especially on peach trees, and also lessens infection of apple scab where this is carried over on the twigs of susceptible varieties.

Dry lime-sulphur

Lime-sulphur 3 lbs. Water 50 gals.

There are now on the market several brands of dry lime-sulphur which, because of less danger of spray injury and convenience in shipping and handling, are replacing liquid lime-sulphur as a summer spray, though the latter, because of its lesser cost, is still largely used as a dormant or winter spray.

Dry mixture

Lime 4 lbs. Sulphur (fine) 8 lbs. Calcium caseinate ½ lb.
Water 50 gals.

Mix thoroughly the lime, sulphur and calcium caseinate, and then add the water when needed. This fungicide is used in this state as a peach spray and to some extent as a summer spray for apple. It can be bought ready-mixed under several trade names.

Wettable sulphur, etc.

There are now on the market various forms of wettable sulphur, colloidal sulphurs, flotation sulphurs, much like atomic sulphur no longer on the market which had good sticking and fair spreading qualities on smooth surfaces. These newer fungicides are used as summer sprays to avoid injuries and it is hoped that eventually there will be found one that will have good fungicidal value, stick well to smooth surfaces and be generally applicable to a variety of hosts as has generally been the case with Bordeaux. Use according to directions given by the manufacturers.

Potassium sulphide

Potassium sulphide 3 oz. Water 10 gals.

This is used occasionally in greenhouses where spray is objectionable on flowers for the market. It was first used chiefly against powdery mildews as were the sulphur dusts and sulphur paint on the heating pipes.

Spray Spreaders and Stickers

Where the spray does not spread over smooth surfaces or stick well, various substances have been used with the fungicides to overcome these difficulties, such as fish oils, soaps, molasses and resin-Bordeaux. More recently certain forms of casein have been used. Commercial brands of calcium caseinate are on the market for this purpose. The value of this, because of increased cost and slightly increased spreading quality, is questioned by some, especially on peaches and apples.

On the other hand, with such plants as the leaves of cabbage and carnation, the stems of asparagus and raspberries and the fruit of cherries and plums, the ordinary sprays do not stick or spread enough to insure protection. Some special spray or spreader is needed for such plants. There is hope that some of the wettable sulphurs will solve the problem.

We have found potassium oleate the best spreader and sticker for Bordeaux that we have tried on both hairy and smooth plants. It is especially valuable around gardens and greenhouses, where its increased cost means little, if one does not object to the evident spray-coating on the plants and where one wishes it to last a long time with few applications.

Dusts

Bordeaux dust

This dust can be purchased from dealers under various trade names, with or without poison. Like other dusts it should be used early in the morning when dew is on the plants and when it is not too windy, to make it stick best.

Copper sulphate-lime

Copper sulphate dust (monohydrated) 25 lbs.
Lime (extra fine) 75 lbs.

This dust can be purchased but is cheaper when homemade. The two ingredients should be thoroughly mixed by some mechanical device. It is used chiefly as a dust on potatoes and celery by large growers. The water when present on the leaves changes it into a Bordeaux mixture.

Lime-sulphur

Sulphur 80–90 lbs. Lime dust 10–20 lbs.

If desired, add 10 lbs. of dry lead arsenate in place of part of the lime. The finer the sulphur the better are its sticking and fungicidal values. Lime-sulphur dusts can be purchased under different trade names.

Seed and Soil Fungicides

Steam and Hot Water

Seed. Steam and hot water have been used at various times for treating soils and the latter for seeds. Hot water treatment of seeds depends on the kind of seed to be treated as well as the temperature and time of treatment. It has been used at 125° to 135° F. for 10 to 15 minutes on certain grain seeds for smut. Other seeds, according to their protection, can stand higher or lower temperatures and for a longer or shorter length of time without injury.

Soil. Treatment of soils by hot water has not been very effective in most cases. For greenhouses and hot beds it is desirable to use steam from a boiler developing 75 to 125 lbs. pressure and inject this into the protected soil for 20 to 30 minutes. This will kill most of the fungi or their spores, nematodes and weed seeds, unless specially protected.

Chemical liquids

Seed. These treatments also vary with the seed and the time it is immersed. Seed should not be treated unless for some definite reason. We have used Formalin (one to 250 of water) on certain seeds like cauliflower and tobacco, soaking them for 10 to 15 minutes. We have also soaked the same seeds with corrosive sublimate one to 1000 for a similar time, both without injury to the seed.

For uncut potato tubers, we have used one pint of Formalin or four ounces of corrosive sublimate (the latter used in wooden containers) in 30 gallons of water for one hour. Gladiolus corms should be soaked in water containing corrosive sublimate, one to 1000 for three hours.

For organic mercury under various trade names, use as indicated by their manufacturers.

Soils. We have used two forms of fungicide on soils with more success than with any other chemicals. These have been Formalin (one pint, one lb., to 6¼ gallons of water, or two per cent.) and glacial acetic-acid (one pint, 16 oz., to 10 gallons water), either used at rate of two quarts per square foot of soil treated. This is then covered to keep in the fumes for a day or so after which the soil can be stirred to permit their escape, but plants should not be set for two weeks after the treatment.

Chemical dusts

Various forms of chemicals, such as organic mercury, copper carbonate, Formalin dust, etc., are used on seeds and occasionally on soils for treatment, chiefly against seed-carried spores (like smuts, etc.), slightly infected seeds, and damping-off fungi (normally in the soil). The seed is shaken with a small amount of these chemicals so that they adhere mechanically to the seed when planted. They aid in killing the spores or mycelium of the fungi, and thus prevent infection of the germinating seed.

Formalin dust, made by using 15 parts by weight of commercial formaldehyde with 85 parts of finely powdered charcoal or other absorbants has been used by Anderson with good results in the Station's tobacco seedbeds. He used 1½ ounces of the dust to each square foot of soil treated, working the dust into the soil about two inches. The seed was sowed immediately. Others had tried the same dust for prevention of damping-off of vegetable seedlings.

Recently some experimenters have claimed good results from the use of red copper oxide or zinc oxide dusted on the seed before planting, and others from the use also of copper carbonate or zinc oxide in water sprinkled around the seedlings after they came up, to prevent damping-off troubles.

Bulletin 359 February, 1934

TOBACCO SUBSTATION AT WINDSOR

REPORT FOR 1933

P. J. ANDERSON, T. R. SWANBACK
AND O. E. STREET

**Connecticut
Agricultural Experiment Station
New Haven**

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TOBACCO SUBSTATION AT WINDSOR

REPORT FOR 1933

P. J. Anderson, T. R. Swanback and O. E. Street

Most of the experiments conducted at the tobacco substation at Windsor are parts of long time projects continued over a number of years. This report includes a discussion of progress during the 1933 season on some of the projects but reports on others are reserved until they are more nearly complete. More time has been devoted this year to investigations of tobacco diseases than heretofore. Therefore more space in this bulletin is given to these and rather less than usual to fertilizer experiments. Although there still are, and always will be, fertilizer problems, and the work on them will be continued, it is felt that many of the most urgent ones have been answered by previous experiments.

The most pertinent results obtained from intensive work on one disease, begun by the senior author in 1933, are reported here. This will be followed by the investigations of other diseases as quickly as time and resources will permit.

Another new project in 1933 was in the initiation of experiments in growing potatoes on old tobacco land. These have to do with fertilizers primarily, but also include spraying for control of insects and diseases. This work has been undertaken because many tobacco growers, during the years of depression and contraction of tobacco acreage, have turned a considerable part of their tobacco land over to potatoes. Years of heavy fertilization for tobacco have accumulated large reserves of some food elements, phosphorous, for example, and have made other changes in the soil, so that the fertilization of potatoes on tobacco land is a different problem from that on other types of land in the state. The potato experiments are being carried on in cooperation with the departments of Botany, Entomology and Soils of this Station and the department of Agronomy at the Storrs station. The results for 1933 are published in the Director's Report, Bulletin 357.

The season at Windsor in general was too dry for best growth of the tobacco crop, especially during the later half of June and all of July and August. It was necessary to irrigate several of the fields twice during this period. Rainfall records for the season of 1932 and 1933 are given in Table 1. The crop, however, was above the average in weight and of good quality. There was no damage by hail or wind.

TABLE 1. DISTRIBUTION OF RAINFALL IN INCHES AT THE TOBACCO SUBSTATION, WINDSOR, 1932–1933.

By 10-day periods

Year	May 1–10	May 11–20	May 21–31	June 1–10	June 11–20	June 21–30	July 1–10	July 11–20	July 21–31	August 1–10	August 11–20
1932	.87	.02	.76	.26	2.38	.22	1.08	.73	2.18	1.39	2.34
1933	.58		1.00	1.49	.39	.08	.33	1.34	.76	.89	.58

By months

Year	May	June	July	August (total)
1932	1.65	2.86	3.99	5.72
1933	1.58	1.96	2.43	3.42
Mean*	3.60	3.08	4.37	4.29

*Average from the Hartford Weather Bureau records for the past 74 years.

PYTHIUM DAMPING-OFF AND ROOTROT IN THE SEED BED

P. J. ANDERSON

A damping-off and rootrot disease of seedlings became so prevalent and widespread in the early seed-bed period of 1933 that it appeared to be an epidemic and gave rise to apprehension that a new disease had invaded the state. Closer investigation, however, showed that it was not a new but an old disease that is present to some extent every year. Ordinarily it is not considered of serious importance. The reason for its destructive increase and epidemic prevalence in 1933 is not apparent. Since it became a source of considerable expense to growers who lost a part or all of their beds and were obliged to purchase plants elsewhere, an investigation was undertaken with the object of discovering some method of controlling its ravages.

This section presents in a preliminary way some of the practical findings. More technical phases are reserved for publication elsewhere.

Symptoms

It will first be necessary to describe the symptoms or "ear marks" by which one may distinguish this from various other seed-bed troubles.

The symptom that the grower usually notices first shows shortly after the germinating seedlings become visible. At this time the plants have developed the first pair of tiny green leaves (cotyledons). The plants begin to disappear. Every day when the grower examines the beds he finds that there are not so many plants as he thought were there the previous day. The "stand" becomes thinner and thinner. In many cases this continues until there are not enough plants left to pay for further care and the beds are abandoned, or until the stand is so reduced that there are not enough plants to set the intended acreage.

The cause of such continuous disappearance of plants can be determined by a close examination of the beds at this early stage. Looking carefully, one finds that many of the little seedlings are unable to stand upright and have fallen over to lie prostrate on the soil surface, (Fig. 64 and Fig. 65, A). It will be observed that the stems (hypocotyls) of such prostrate plants are withered and lifeless. This dead part of the hypocotyl may be only a short portion just at the surface of the ground or the shrivelling may extend well up, even to the base of the cotyledons, in which case it gives the appearance of a white or straw-colored string connecting the first leaves with the soil. Depending on the moisture conditions, the cotyledons may remain green for several days or may rot and disappear very quickly.

Another symptom that is characteristic is the presence of small plants

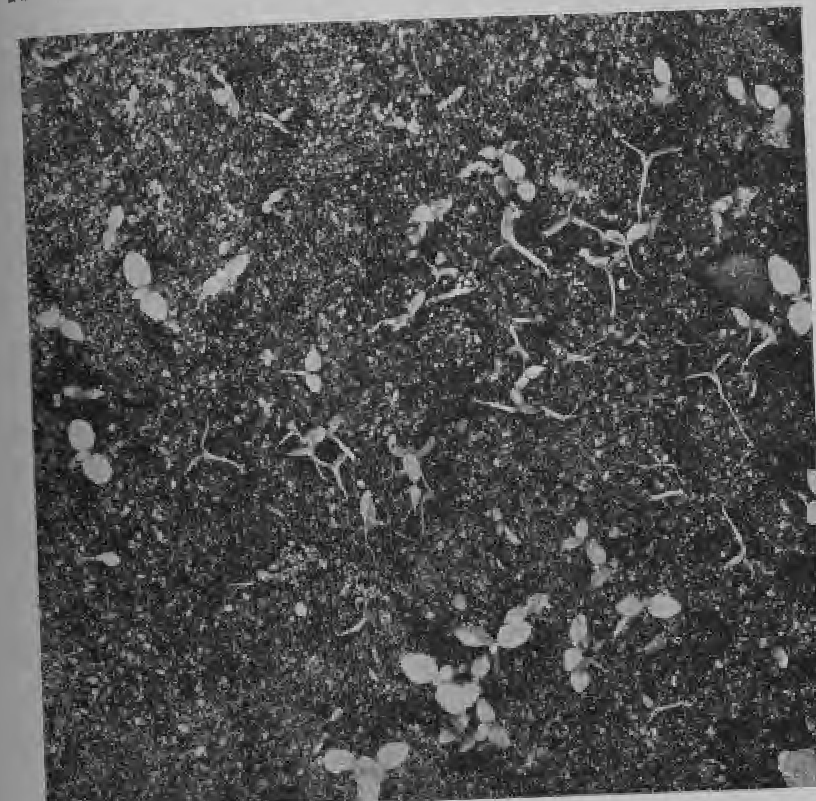

FIGURE 64. Damping-off of young seedlings. Note shrivelled hypocotyl of prostrate plants. Enlarged 3 diameters.

with sound stems but not attached to the soil at all. They are either lying prostrate or entirely inverted, with the naked blunt stubs, where the roots should have been, standing upright. In this case, the hypocotyls are still sound but the roots have been completely rotted away. The little plants, therefore, have no anchorage and when splashed by water from sprinkler, hose, or rain, they topple over and either recline on their sides or are completely upside down with the root stubs standing up in the air. The disease is the same as the damping-off described above but in this latter case the roots only are affected while in the former, it is the stem which dies first—although microscopic examination shows that also in damping-off the roots are diseased.

Another symptom of the same disease may appear at a somewhat later stage. After the plants have developed 4 to 6 leaves, one notices patches in the bed where the plants stop growing and the leaves fade out to a pale yellow. Then, beginning with the lower, the leaves turn almost white and finally die. This causes the death of many of the smaller plants. The above-ground appearance of such affected plants is not different from that of plants affected with the black rootrot. No amount of watering or fertilizing will start the plants in these spots growing. Examination of the roots under a hand-lens or dissecting microscope shows that some or all of the rootlets are withered. Unlike the other rootrots of tobacco, this disease does not cause the roots to turn brown or black. They remain white or very light in color as long as they are beneath the soil. If the plants are pulled the flimsy rotted roots remain below and are not noticed, but if the soil is carefully removed by gentle washing in water, they may be found readily. Their collapsed condition can be determined by teasing them apart under a dissecting microscope when it will be found that they have no turgor or coherence and the rotted outer cortex slips easily from the central strand.

Microscopic examination of the tissues characterized by any of the above symptoms shows abundant oospores and mycelium of the fungus described below.

The condition of the older plants described above could not properly be called damping-off. The term "damping-off" is applied to a disease characterized by collapse of infected tissue at the base or ground level of the stem — although it is now generally recognized that when damping-off occurs the roots are also affected. When, however, *only* the roots are affected while the stem remains healthy, we can properly refer to the disease only as a rootrot. For the sake of clarity it seems advisable to call this disease the *Pythium damping-off and rootrot.*

This disease should not be confused with "bed-rot," a wet, brown, slimy rotting of the stalks at a later stage — usually when the plants are about large enough for transplanting. Bed-rot in all cases observed here is caused by other fungi and its control is a problem quite different from that of the disease under discussion here.

Cause

Damping-off is not caused by too much water or too little ventilation or overcrowding, although these conditions may favor it. The primary cause is invasion and destruction of the hypocotyl or roots by a parasitic fungus (*Pythium debaryanum* Hesse)*. This fungus is not usually visible to the naked eye except that sometimes under very damp conditions it may be seen as a white felt of fine threads like spider webs or cotton fibres

*Dr. Charles Drechsler of the U. S. Department of Agriculture has kindly confirmed the writer's identification of this fungus.

spreading over the surface of the wet soil around the dying plants. These fine threads are continuous but branching tubes which in the young growing condition are filled with living protoplasm. This weft of tubes, called the mycelium, makes up the body of the fungus. The mycelium continues to branch and grow for an indefinite period beneath the soil and is probably present in all of our soils. It is not necessary that the tobacco plants be present; it may live for an indefinitely long time on the organic materials in the soil or in water and grows very rapidly. The writer has found that on artificial media, in pure culture, the mycelium will spread as much as ¾ of an inch in one day. It produces several kinds of spores (Fig. 65, D to J) which serve the same purpose as the seeds of higher plants. Some of these spores have heavy walls (Fig. 65, F19 and H) and serve to keep the fungus alive under adverse conditions of drying out or freezing; others are thin-walled and short-lived (Fig. 65, D, E) and probably serve more for rapid distribution. Such spores may be carried about by wind* or by water. Its rapid growth, omnipresence and many methods of rapid dissemination explain why the disease is so difficult to control.

In germination, the tobacco seed swells and then bursts open at one end from which emerges a white, rapidly elongating "shoot," the tip of which is the primary root and the upper end of which is the hypocotyl. The cotyledons (Fig. 65, A) or first leaves, above the hypocotyl come out of the seed coat last. Just as soon as the tip of the primary root emerges, it is susceptible to attack by any branch of the mycelium which may come in contact with it. No part of the root or hypocotyl is resistant at this stage, but the point of attack is usually close to the point of union between root and hypocotyl, therefore near the surface of the soil. When a hypha (branch of the mycelium) comes in contact with the epidermis of the plant, it swells into a knob at the tip, from which it passes as a narrowed much constricted tube, through the wall and into the interior of the cell (Fig. 65, C). Once inside the cells of the host plant, it lives upon and destroys the living cell contents, branches freely and spreads between and through the cells of all the parts of the hypocotyl or roots (Fig. 65, B). This causes the cells to fall apart and collapse, and soon the little plant topples over and dies. All this happens with extreme rapidity. In inoculation experiments in pure culture, the tissues were found to be thoroughly permeated with the threads of the parasite in less than 24 hours after the fungus came in contact with the plants. After killing the tissues, the fungus produces spores inside the plant and at the same time some of the hyphae grow out into the surrounding air or soil, passing through the outer wall of the epidermis as a much constricted neck with enlargements of the hypha on either side.

It is doubtful whether any seedling attacked in the hypocotyl at this stage ever recovers. Later, at about the stage when the true leaves (above the cotyledons) develop, the stalk becomes resistant and there is little danger of further loss from hypocotyl infection. If infection is in the roots, however, the attack is not so sure to be fatal. On the other hand resistance does not seem to develop at such an early stage. When some

*Hoffman (17) found the spores in air currents 30 feet above the ground.

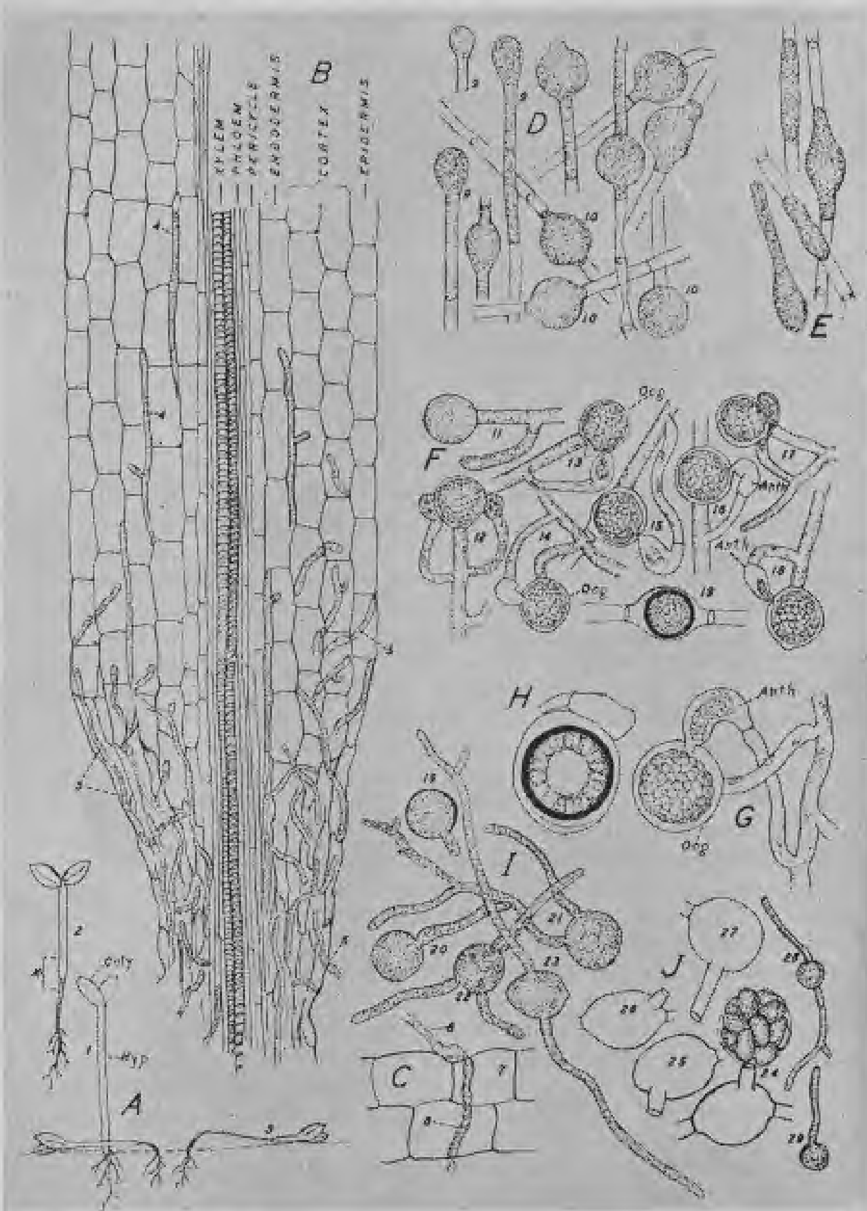

FIGURE 65. Stages in the development of the damping-off fungus, *Pythium debaryanum.*

EXPLANATION OF FIGURE 65.

A Tobacco seedlings 10 days old (x 4)
  1. Healthy seedling. *Hyp.*, hypocotyl. *Coty.*, cotyledon
  2, 3. Diseased seedlings with shrivelled hypocotyls.

B Highly magnified (x 160) longisection of hypocotyl at point marked X in A, 2. Shows cellular structure and invasion of the cells by the fungus mycelium.
  4. Intercellular mycelium
  5. Intracellular mycelium
  6. Point of entrance of mycelium into the epidermis.

C Entrance and penetration of cells (x 320)
  7. Epidermal cell of hypocotyl
  8. Mycelium, constricted at the cell walls.

D Conidia (Asexual spores) (x 300)
  9. Young stages of development
  10. Mature conidia

E Chlamydospores (x 300)

F Oospores (Sexual). Stages of development (x 300). *Anth.*, antheridum. *Oog.*, oogonium.
  11. Youngest stage
  12 - 18. Later stages
  19. Mature oospore.

G Antheridium and oogonium (x 500)

H Cross section of mature oospore (x 560) showing empty antheridium above, oogonial wall, heavy oospore wall and central drop of reserve substance.

I Stages in germination of conidia (x 300) with 1, 2, or 3 germ tubes.

J Zoosporangia (x 330)
  24. Cluster of zoospores at mouth of exit tube.
  25, 26, 27. Empty zoosporangia after contents have passed out through exit tubes to form zoospores.
  28, 29. Germinating zoospores.

of the rootlets are killed, others are developed from the root or hypocotyl above. These may be attacked in turn and there results a struggle between the host and the parasite which causes dwarfing and etiolation but not always death of the plant.

This later infection resulting in dwarfing of older plants was not so common or serious in 1933 as the infection in earlier stages. Rootrot of younger seedlings resulting in complete loss of the root system before four leaves were developed was very prevalent this year.

Distribution of the Disease

Damping-off diseases of seedlings produced by species of Pythium have been described from most countries and on a great variety of cultivated plants, including beets, tomatoes, cress, celery, peppers, cabbage, corn, sugar cane, coniferous seedlings and others too numerous to mention here specifically. Some of these diseases are caused by the same species of Pythium described here, others by different species of this genus, but the symptoms and course of the diseases are quite similar. Also many damping-off diseases are caused by other genera of fungi.

On tobacco, this disease, or a similar one caused by species of Pythium, has been found in widely separated regions. Descriptions given in published articles or notes are for the most part not in sufficient detail for one to be sure that the writer had under observation the same disease, caused by the same organism, that we have here.

In 1900 Raciborski (24)* found *Pythium vexans*** attacking overcrowded or weak tobacco plants in Java.

In 1912 Serbinov (26) found a damping-off disease of tobacco seedlings very destructive to tobacco beds in southern Russia (Crimea). He described and figured the disease and the causal organism in considerable detail giving to the organism a new name, *Pythium perniciosum*. The disease as described by him has all the symptoms that we have observed here and one might judge the two to be identical. However, the causal fungus he found has somewhat different morphological characters.

In 1919 Subramanium (28) in India described what appears to be the same disease on tobacco and gave to the fungus the new name *Pythium butleri*.

Drechsler (9) has recently found *P. aphanidermatum* in diseased tobacco seedlings from Sumatra.

Pythium debaryanum as a cause of damping-off of tobacco seedlings has been reported by Johnson (19) in Wisconsin in 1914, Reinking (25) in the Philippines in 1919, Doran (8) in Massachusetts in 1928, and Nolla (22) in Porto Rico in 1932.

In local lists of parasitic fungi, *Pythium debaryanum* has also been reported on tobacco in Germany, Turkey, Rhodesia, and Sumatra (21).

In Connecticut, Clinton (7) first reported a damping-off of tobacco (in greenhouse in 1906) caused by a species of Pythium. In recent correspondence Clinton states, "In 1920-21, when we made a disease survey on tobacco in this state, we found *Pythium debaryanum* as a common trouble in seed beds. I have a list of from 15 to 20 seed beds where we found it each of those years and I have known it occurring before and after those years."

The writer has at various times during the last 10 years found a Pythium in diseased seedlings which he has referred to *P. debaryanum*. He reported successful treatment for its control with acetic acid in 1928 (3).

Probably tobacco in most or all of the tobacco growing regions of the world suffers from Pythium damping-off and rootrot to a greater or less degree but it appears that the disease is not always produced by the same species of Pythium. The observations of Clinton, Doran and the writer, previously mentioned, show that it is a wide-spread disease of long standing in the Connecticut Valley. It is probably responsible for a larger proportion of poor stands and failures in seed beds than has been suspected.

Influence of Environmental Conditions

It is well known that certain conditions of the environment may modify considerably the severity of damping-off diseases caused by Pythium. Most important of these are temperature of the surrounding air and soil, humidity of the air or percentage of moisture in the soil, percentage of

*Numbers in parenthesis refer to Literature Cited on p. 353.

**Butler (6) later presented reasons for doubt as to the correct identity of this species since *P. vexans* is not known to be parasitic.

organic matter, and degree of acidity of the soil. Atkinson (4) says "The trouble is favored by damp soil, comparatively high temperatures, and humid atmosphere."

Temperature. In the literature of *Pythium debaryanum* and of closely related species of Pythium one finds numerous references to the effect of different temperatures on the growth of the fungus and on incidence of the disease. Some are based only on observation, others supported by controlled experiments.

Johnson (19) found 33° C. to be the optimum temperature for growth of *Pythium debaryanum* and its growth very slow below 16° C. He, therefore, recommended keeping the temperature of the seed bed low as a means of checking the disease.

Flor (10) found the rate of growth of the cane rootrot Pythium, as tested in pure culture, increased regularly with rise in temperature up to 30° C. but diminished above that point. When, however, he investigated the influence of soil temperatures (ranging from 15° to 35° C.) on infection and injury to roots he found that the amount of injury increased as the temperature decreased, being most severe at 15° C.

Johann et-al (18) also found the Pythium causing rootrot of corn more injurious at low temperatures.

Hawkins (15), working with *Pythium debaryanum* which causes "leak" of potatoes, found the minimum temperature for growth of the fungus to be 5° C., the optimum 30° to 35 ° C., and the maximum 35° to 40 ° C.

Harter and Zaumeyer (11) found the wilt disease of beans (caused by *P. butleri*) was dependent on a high temperature (30° C. or above) and that it caused no damage at low temperatures. They considered temperature a more important factor than humidity in the incidence of this disease.

Alexander, Young and Kiger (1) found the Pythium disease of tomato seedlings most destructive at 18° to 24° C (65 ° to 75° F).

The most exact and complete experiments on the relation of temperature to *Pythium debaryanum* were conducted by Hemmi (16) in soil tanks with thermostatically controlled temperatures. He found the damping-off of cress seedlings most severe between 22° and 27° C. However, even with a temperature as low as 15° C. he considered the fungus still a dangerous parasite. When, in other experiments, he controlled the temperature of both soil and air, 80 per cent of the plants were diseased at temperatures between 20° and 30°, decreasing below 20°, but even at 10° there was an infection of 24 per cent of the plants. At temperatures higher than 30°, seed germination was inhibited, therefore there was no chance of control by keeping the temperatures high.

All the investigators agree that these fungi grow best at a relatively high temperature, around 30° C. (86° F.), but some have found infection of the plants more severe at lower temperatures. The range of greatest infection found by Hemmi, 68° to 86° F., corresponds fairly well with the temperatures for best germination of tobacco seed. Even at 10° C. (which is below the point where tobacco seed will germinate) infection was severe. It is obvious then that the disease cannot be controlled by regulation of temperature. It is possible that it might be less severe at low temperatures but this matter requires further experimentation before any recommendations for tobacco beds can be made.

Moisture. The name "damping-off" was applied to the disease because it was usually found to be most severe in damp places. DeBary (5) considered moisture the most important environmental condition favoring the disease.

Johann et al (18) found the Pythium causing rootrot of corn more pathogenic in wet than in dry soils.

Flor (10) also found that the injury caused by the Pythiums parasitic on corn increased with the increase in moisture content of the soil, and was severe only in those soils which contained over 50 per cent of their moisture-holding capacity.

Harter and Zaumeyer (11) emphasized the importance of the air moisture as contrasted with soil moisture. The bean wilt caused by *P. butleri* was severe even in an extremely dry soil when the relative humidity of the air was high.

Johnson (19) found both high air moisture and high soil moisture favorable to damping-off, pointing out that air humidity permits aerial spread of the fungus from plant to plant. Growth through the air is more rapid than through the soil. He attributes the greater prevalence of damping-off in thick sowings to increased humidity thus produced.

As a means of combatting damping-off it is often recommended that the moisture of soil and air be kept at a low level. Such advice for germinating tobacco seed (the stage of infection) is of little practical benefit. Tobacco seed are sowed very close to the surface of the soil; in fact many of them lie on top of the soil. If the soil becomes dry during the germination stage, the seedlings die. Since constant moisture at this time is essential, the conditions favorable to infection cannot be avoided.

Composition of the soil. Several writers have stated that the disease is favored by increased organic matter in the soil. This conclusion is apparently based only on observations. No published experiments to substantiate it have come to the notice of the writer. The fact that the saprophytic existence of Pythium in the soil is dependent on the presence of dead organic matter supports such a conclusion. Tobacco growers find, however, that a soil with considerable organic matter is more favorable for the production of good plants than one without much vegetable matter, as, for example, pure sand. It is quite unlikely that they would wish to forego this advantage for the sake of any benefit that might come from a possible reduction in damping-off.

Reaction of the soil. Like other fungi, Pythium requires for its best development that the medium in which it grows be within a certain range of acidity. At more acid reactions its growth is inhibited and finally stops. There is also a degree of alkalinity at which it will not grow.

Flor (10) found that the sugar cane Pythiums grow best in a neutral or somewhat alkaline medium. The optimum growth was at 8.3 pH. At the other extreme, growth was inhibited by increasing acidity until it ceased entirely at 4.6.

The writer found that when the tobacco Pythium was grown in pure culture media ranging from 7.0 down to 3.0 pH, growth was not inhibited

by acidity until 5.0 pH was reached. Below this point, growth became progressively less until it stopped completely at about 4.0 pH.

In soil tests to determine the effect of different degrees of acidity on germination of tobacco seed, it was found that in soils testing 4.0 pH or lower the germinating seedlings failed to establish themselves. Apparently these very acid soils contain some soluble substance which is toxic to the roots. If, therefore, a degree of acidity can be found which permits the plants to grow normally but at the same time checks the development of the fungus it must be in the range between 4.0 and 5.0 pH. Soils above 5.0 showed considerable damping-off; from 4.85 downward there was decreasing severity of infection. The range of safety, however, is so narrow that it seems doubtful whether a method of control based on adjustment of the soil reaction could be practical for the average grower.

In the present state of our knowledge of the influence of environmental conditions, it seems doubtful whether any changes the grower can effect in natural conditions in the seed bed at this early stage of development can be depended on to control damping-off.

Control

Since the causal fungus lives in the soil and infection occurs for the most part below or just at the surface of the ground, it is obvious that any contemplated method of control, to be successful, must be aimed at elimination or checking of the fungus in the soil. Covering the above ground parts of the plants with a protective spray is of no benefit. Johnson (19) found that spraying with Bordeaux mixture after the plants were started gave negative results. The writer also, during the course of the experiments described below, sprayed infected flats at intervals of two or three days with Bordeaux mixture. This treatment was started just as soon as the first seeds began to crack. The plants damped off badly, however, and at the end of the experiment there were just as many living plants in the unsprayed as in the sprayed flats.

In the experiments discussed below, the soil used was a sandy black loam taken from the seed beds of a grower in Hockanum where the disease was so serious in 1933 that the beds were a total failure. Flats measuring 18 by 10 by 4 inches were filled with this naturally infested soil and kept in the greenhouse at temperatures of 60° F. at night and about 70° during the day with occasional bright days when the temperature rose during the middle of the day to 80° F. The experiments were made during October, November and December of 1933 and January of 1934. The Cuban Shade Variety of seed was used throughout. A measured equal quantity of seed was sowed in each flat. In order to keep an optimum humidity of the air and surface of the soil for germination, the flats were started under a hot bed sash which was hinged to the side of the greenhouse bench, thus approximating the conditions of an ordinary seed bed. After the seed had germinated and most of the cotyledons had spread — about 10 days — the flats were removed to the open benches of the greenhouse. Observations on the amount of damping-off in each flat were recorded at frequent intervals. When the plants had developed about six leaves and were judged to be beyond the susceptible stage, all were pulled and counted. The "check" or control flats contained untreated soil and were seeded at the same time as the treated flats and kept under the same conditions.

Sterilizing the Soil with Steam. The object of this method is to raise the temperature of the top soil sufficiently to kill the mycelium and spores of the causal fungus; then to grow the seedlings before the fungus threads grow back to the surface. This is the method in common practice here and in other cigar leaf sections of the country. The inverted pan system is used almost universally for this purpose. It kills not only this fungus but also other pathogenic fungi and bacteria, insects and weed seeds. Yet most of the serious cases of damping-off found in 1933 were in beds which had been steamed. It is apparent that steaming has not controlled this disease. The fault, however, lies not in failure of the treatment to kill the fungus, but in the ability of the fungus to rapidly reinfect the soil after sterilization. Steaming sterilizes only the top four to six inches of soil. The fungus remains alive in the soil below that depth and starts growing back up just as soon as the soil begins to cool off. We have previously mentioned the extreme rapidity of growth of Pythium — three-fourths of an inch in a day. The rate of growth is also favored by lack of competition in a sterile soil. By the time the seeds are germinating, the fungus is again in position to infect, or the fungus may be introduced by water, air currents, tools, or by other means.

In order to see whether infection is prevented by steaming, one flat was steamed for 20 minutes at 100 pounds pressure under the pan and as soon as cooled was immediately seeded along with an unsteamed flat. Both were kept in the greenhouse under conditions which would offer little opportunity for reinfection.

Soon after germination, damping-off appeared on the check flat but not on the steamed flat. Germination, however, was not good on the steamed flat and many of the plants remained yellow and stunted with poorly developed roots. This condition often develops in beds which have been seeded too soon after steaming and is probably due to accumulation of ammonia in a freshly steamed soil. Analyses showed more than twice as much ammonia in the steamed soil as in the check soil. The stand on the check flat became thinner throughout the experiment due to damping-off. At the end of 5 weeks there were 1087 plants alive on the steamed soil and only 184 on the check flat.

This experiment shows that the disease can be controlled by steaming if one guards sufficiently against reinfection. As a practical method of control in the seed beds, however, it cannot be depended on because reinfection is too difficult to prevent. This fact is not an argument against the general practice of steaming the soil, but it indicates that in places where damping-off and early rootrot is a serious factor some other method of control must be used.

Drenching the Soil with Formaldehyde. Drenching the soil with formaldehyde, and thus killing damping-off fungi before seeding, is a method used for many years, not only in tobacco beds but for many other seedlings and cuttings. As commonly practiced, formaldehyde is diluted with water at a ratio of 1 to 50 and sprinkled on the soil at the rate of one-half gallon to the square foot. This completely saturates the soil and reduces it to mud. As soon as it is somewhat dried out, the soil must be stirred several times until the fumes of formaldehyde have gone off. If seeded too soon, many of the plants will die. This method involves a delay of about 10 days or even longer in rainy weather, and therein lies a serious objection.

Johnson (19) conducted extensive experiments with the formaldehyde drench method and found it effective in controlling damping-off.

The present writer made a test in which one flat was treated at the above mentioned rate. After stirring the soil at intervals several times, the seed was sowed a week after treatment of the soil. This interval was found to be too short since it resulted in delayed germination and some injury. Damping-off, however, did not develop in this flat at any time. Although the plants in the untreated check flat were more numerous at first, damping-off began as soon as they germinated and continued until, at the end of 4 weeks, there were 285 plants alive as compared with 755 in the treated flat.

It is apparent that the disease can be controlled by this method, but in order to avoid chemical injury it is best to wait longer than a week to allow the fumes to escape. No attempt was made to determine how long the sterilizing effect of formaldehyde continues. Thus the question of how soon the fungus may reinfect remains to be answered.

Formaldehyde Dust as a Soil Disinfectant. The previously mentioned objection to the formaldehyde drench method may be eliminated by substituting formaldehyde dust. This method was recently developed by Alexander, Young and Kiger (1) in Ohio for controlling damping-off of tomato seedlings. Commercial 40 per cent formaldehyde is sprayed or sprinkled on some absorptive dust at the rate of 15 parts by weight of formaldehyde to 85 parts of the dust. This treated dust is then distributed over the surface of the soil and thoroughly mixed into the upper 2 or 3 inches of soil with a rake. The seed is sowed immediately, thus eliminating the delay which the drench method requires. The gas passes out into the soil at a rate which produces a concentration sufficient to inhibit growth of the fungus but not strong enough to injure the germinating seedlings. Various absorptive materials such as finely ground charcoal, diatomaceous earth, kaolin, swamp soil or other soils containing a high percentage of organic matter have been used.

Since no tests of this material against damping-off of tobacco have been published, the writer ran three series of experiments in flats in the greenhouse with the infested soil previously mentioned.

In the first experiment, finely ground charcoal was used as a carrier. Since it was feared that tobacco seedlings, on account of their very small size, might be injured by seeding immediately after treating the soil, flats were treated one and two days previous to sowing the seed and compared with those in which the seed was sowed just after treating. The rate of application was one and a half ounces of dust to the square foot of soil. To a fourth flat no dust was applied. All were watered heavily at the time of sowing. Just as soon as the cotyledons appeared, damping-off became

FIGURE 66. Control of damping-off and rootrot by treating seedbed soil with formaldehyde dust. Plants 4 weeks old. Bed shown above treated at rate of 1½ oz. to square foot. Bed below, not treated.

prevalent in the untreated flat and caused great damage thereafter. A small number damped-off on the treated flats but the disease never became serious. After 35 days all plants were pulled and counted. The results presented in Table 2 show that the control was good in all of the flats but best in the flat that was seeded the same day as treated (Fig. 66). No injury from the formaldehyde appeared. Therefore, in all subsequent experiments the seed was sowed just as soon as the soil was treated.

The second experiment was to test different rates of application of the dust. Four flats were treated respectively with 0, ¾, 1½, and 2½ ounces of dust to the square foot. As in the previous test, damping-off appeared early and caused serious loss in the untreated flat. None whatever appeared in any of the treated flats. The results presented in Table 2 show that any of these rates are satisfactory.

The object of the third experiment was to see whether a swamp soil (mostly decayed vegetable matter) would give as good results as the char-

TABLE 2. FORMALDEHYDE DUST EXPERIMENTS

Time of application	Amount to square foot	Severity of disease	No. of live plants at end of test
a. Testing effectiveness of charcoal dust used at different times			
Two days before sowing	1½ oz.	Trace	1086
One day before sowing	1½ oz.	Trace	1112
At time of sowing	1½ oz.	Trace	1416
Check	No treatment	Severe	178
b. Testing effectiveness of different amounts of charcoal dust			
At time of sowing	¾ oz.	None	1434
At time of sowing	1½ oz.	None	1830
At time of sowing	2½ oz.	None	1908
Check	No treatment	Severe	553
c. Testing effectiveness of different amounts of humus dust			
At time of sowing	1½ oz.	None	2071
At time of sowing	2½ oz.	One small spot	2056
Check	No treatment	Very bad	369

coal dust. The soil was dried thoroughly, sifted and then mixed with the formaldehyde at the same rate as in the previous experiment. Two flats were treated and one left untreated. No damping-off appeared in the treated flat except on one small spot an inch in diameter. The check flat damped-off badly. The results, as indicated in Table 2, were just as good as where charcoal dust was used.

Considering the formaldehyde dust experiments as a whole, it is apparent that this method gave the best control of any of the various methods tried. Under the conditions of these experiments it was entirely satisfactory. Experiments on a larger scale in seed beds, however, are necessary before a recommendation for its general use can be made.

Formaldehyde dust is now offered for sale by several commercial concerns and distributed by farmers' supply houses. In this form, however, the cost is considerably higher than for the home-made material. Because the escaping fumes of formaldehyde irritate the nose and eyes it is best to make the mixture of formaldehyde and dust in a closed container such as a tight barrel or iron drum. After the ingredients are put together the barrel may be rolled about until the mixture is uniform. If the mixture is still "lumpy" it may be necessary to pass it through a sieve. After preparation, it should be stored in air-tight containers until used.

Sterilizing the Soil with Acetic Acid. This method is the same as the formaldehyde drench except that a 1 per cent solution of acetic acid is substituted for the 1 to 50 formaldehyde solution. Doran (8) found this method effective against damping-off of tobacco. The writer also published experiments (3) which corroborated Doran's results.

During the present investigation another test was made in which one flat was treated with 1 per cent acetic acid solution at the rate of 2 quarts to the square foot of soil while a second flat was left untreated as a control. The seed was sowed 1 week after the soil was treated. Damping-off developed early on the control flat. When the number of living plants was counted at the end of 6 weeks there were 302 plants in the control flat and 1013 in the treated. No damping-off was observed at any time in the treated flat.

Experiments to determine the minimum time between treatment and seeding showed injury on all flats sowed within a week after treatment. Some injury was evident even when sowed seven days after treatment. The delay in sowing the beds constitutes an objection to the acetic acid method.

This treatment, however, prevented completely the appearance of damping-off under the conditions of the experiment. There appears to be no reason why it should not be satisfactory in the beds if the grower does not object to the delay.

Soil Treatment with Sulfuric Acid. This method has been used successfully in preventing damping-off of coniferous seedlings in forest nurseries (12, 13, 14, 27, 29).

One flat was treated with 1 per cent solution of sulfuric acid at the rate of 1 quart to a square foot of soil. The seed was sowed 1 week later. The seed started to germinate but the plants were never able to develop roots and establish themselves. At the end of 4 weeks, not a single plant was alive. The soil before treatment tested 5.15 pH. Three weeks after treatment it was 3.30. Since in other tests it was found that the plants would not start in a soil as acid as 4.0 pH it is assumed that the injury was due to the extreme acidity.

No weaker solutions were tested because this preliminary test indicated that this method under any conditions would probably not be safe to recommend. It also involves considerable delay between time of treating and sowing and thus presents the same disadvantage as drenching with formaldehyde or acetic acid.

Treating the Soil with Copper Carbonate. Nolla (22) was able to control damping-off in tobacco beds in Puerto Rico by application of copper carbonate to the soil at the rate of 4 grams to the square foot mixed thoroughly with the soil before sowing the seed. Another application at the same rate was made a week after germination by dusting the material over the surface and watering heavily. Under some conditions; however, he found that this treatment injured the plants.

In our own experiments at Windsor, two flats were treated at the same rate and in the same way as recommended by Nolla. One flat was seeded at the same time without treatment. It was planned to repeat the application a week after germination in one of the treated flats, but so much injury resulted from the first treatment that no second application was tried. The seed in all the flats germinated but those in the treated flats much more slowly than the check. Most of the seedlings failed to establish any root system. Our observations confirm in every particular the statement of Nolla that "the injury in the copper carbonate treated beds was manifested in much delayed germination and the few seedlings that developed were stunted and yellow."

This experiment shows that, at least in this soil, copper carbonate is quite toxic. Copper salts are known to be toxic to green plants when present even in weak concentration in the soil solution. No further experiments were tried with this or other copper salts because it seemed doubtful whether it could ever be safe to recommend generally the mixing of a copper salt in the soil even though it was found to be safe in some cases.

Treating the Soil with Bayer Dust. Bayer dust was selected as an example of the organic mercury compounds which have been widely recommended for seed and soil disinfection. Nolla (22) tried Bayer Dust at rates of 1 to 4 grams to the square foot and found that none of the applications caused injury to the tobacco seedlings, but that, on the other hand, they did not control damping-off. Major (20), experimenting on control of black rootrot of tobacco in Canada, found that when he treated the soil with 12 or more grams to the square foot the plants were stunted.

In the one experiment which was made at Windsor the soil was treated with three grams of Bayer Dust to the square foot and thoroughly mixed with the top inch of soil. After heavy watering, the seed was sowed, covered with a very thin layer of soil and then watered again. Although there was some germination, the seedlings died and at the end of four weeks there was not a plant left. Even at this weak concentration this material appears to be very toxic to the plants.

Treating the Seed with Bayer Dust. The seed was shaken with a small quantity of Bayer Dust in a flask until all the seeds appeared covered with dust. One flat was seeded in the usual way. Germination appeared normal but most of the plants failed to establish a root system and fell over flat on the surface of the ground when watered. Many of the hypocotyls shrivelled with infection. In other cases where the roots were lacking it was not always possible to tell whether the roots had been killed by Pythium or were prevented from growing on account of the toxic salt.

In either case, the treatment was a failure and cannot be recommended against damping-off.

Seed Treatment with Cuprous Oxide. Treatment with cuprous oxide which was used successfully by Pirone (23) in 1932 to combat damping-off of spinach on Long Island, has recently been adopted and widely recommended for the control of damping-off of a variety of crops. It has not been tried previously for tobacco. The aim of the treatment is to cover the seed with a fungicidal substance which will prevent entrance of any infecting fungus before germination. Also it is assumed the fungicide will sterilize a narrow zone of soil immediately surrounding the seed.

In our experiments, seed was mixed with the red copper oxide at the rate of one part of fungicide to 15 parts of seed and thoroughly shaken in a flask until all seeds were covered with a uniform dust layer. The flats were then sowed with the treated seed in the usual way. The treatment apparently stimulated germination since the treated flats were up two days before the checks. During the first week after cotyledons appeared there was no damping-off in the treated flats but considerable in the control flats. After that, however, damping-off, and more especially the Pythium rootrot type, became prevalent in the treated flats. At the end of five weeks there were 838 plants in a treated flat as compared with 542 in the check. In a second experiment the corresponding figures were 1161 and 655. It appears from these experiments that cuprous oxide gives some control in the early stages of damping-off but that as soon as the growing shoot or root has left the seed a little way, it is beyond the protecting influence of the dust and infection occurs as usual. Treated in this way, the "stand" is somewhat better than in the check flats, but control is not as complete as by other methods such as disinfecting the soil with formaldehyde dust. The cuprous oxide treatment involves the least amount of labor or expense of any of the methods tried. No injury to the seedlings was observed.

Summary

A damping-off and rootrot disease caused by the parasitic fungus *Pythium debaryanum* Hesse, is often responsible for complete or partial failure of seed beds.

The damage is most severe when the seeds are just germinating and shortly afterward. This is not the same as "bed rot," a disease which affects the plants in the bed when they are older.

It is not practical to control the disease by regulation of such environmental conditions as moisture, temperature and soil reaction, because the same conditions which are most favorable for its spread are also the best for germination of the seed and early growth of the seedlings.

Steaming the soil has not controlled it because the fungus grows so rapidly and reinfects so easily. Neither can it be controlled by spraying with Bordeaux Mixture.

Seed treatment with red oxide of copper or with Bayer Dust has not given satisfactory control.

Drenching the soil with formaldehyde solution or acetic acid is subject to the objection of too long a delay before the seed may be sowed.

Excellent control in greenhouse tests has been obtained by mixing formaldehyde dust at the rate of 1½ ounces to the square foot with the top soil just before seeding.

This formaldehyde dust may be made at home by mixing 15 parts by weight of formaldehyde with 85 parts of ground charcoal or dry swamp soil or other soil containing a high percentage of organic matter.

The cost of the formaldehyde is about two cents for each pound of dust. Since one pound will treat 10 square feet, the actual cash outlay is less than four cents a sash (three by six feet). The computation assumes that the grower mixes his own dust.

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HOW TO PREVENT "GREEN MOLD" OR "MOSS" IN THE SEED BEDS

P. J. Anderson

In the early seed bed period while the soil must be kept constantly moist to insure good germination, many growers are troubled with a surface growth of a bright green scum which has received the popular name of "moss" or "green mold." Both of these names are unfortunate because this is neither a moss nor a mold but consists of a surface growth of one or more species of green algae. None of these algae are parasitic on tobacco seedlings but their dense growth may smother the sprouting seeds. There is considerable difference of opinion as to the extent of the damage, but at least such a condition is not desirable.

It is a common practice to sprinkle a thin coat of sharp dry sand over the ground to check the green growth. The benefit derived, however, is probably more imagined than real. Applications of Bordeaux Mixture at intervals of two or three days give much better control, but there may be some injury to the germinating seeds if this treatment is started before the cotyledons appear.

A completely satisfactory method of control for "green mold" was discovered during the course of the experiments on Pythium damping-off and rootrot previously described. When the soil at time of seeding was mixed with the formaldehyde dust (as described on p. 347), not a trace of "green mold" appeared at any time on these beds. On the untreated flats sowed at the same time, the surface became completely covered with green growth of algae. Apparently formaldehyde is quite toxic to these organisms.

THE USE OF SULFATE OF AMMONIA IN TOBACCO FERTILIZER MIXTURES

T. R. Swanback and P. J. Anderson

Sulfate of ammonia, containing about 20 to 21 per cent of nitrogen, has for many years been one of the cheapest sources of nitrogen and is widely used on many crops. Naturally it has found its way into many commercial fertilizer mixtures for use on tobacco fields.

It is well known that different nitrogen-furnishing materials may have different effects on the yield and quality of the tobacco crop. Such differences arise from variation in rates of availability of the nitrogen, presence of other beneficial or detrimental elements in the material, or physical and chemical changes induced in the soil. The suitability of sulfate of ammonia for tobacco mixtures depends, therefore, not so much on its cost as on its effect on yield and quality of leaf as compared with the effect of other nitrogenous materials.

The first field plots laid out after the establishment of the tobacco substation at Windsor were devoted to a comparison of different nitrogen sources, of which sulfate of ammonia was one. During the following 12 years this was supplemented by two other long-time field experiments and by laboratory analyses. Progress reports on these various tests have been included at times in our annual reports. Since we have now reached some quite definite conclusions, it seems proper to summarize all the experiments dealing with sulfate of ammonia and to present the conclusions.

In the first field tests, which were concluded in 1926, there were included (1) plots on which the mixture contained one-fifth of the nitrogen of the formula from sulfate of ammonia and (2) plots on which one-half of the nitrogen was in sulfate of ammonia. After careful analysis of the results obtained from the crops of 1925 and 1926, the following statements were published in our report for 1926, page 32, concerning the plots on which one-fifth of the nitrogen was from sulfate of ammonia: "The grade index was lower, indicating that the quality was not quite so good. Notes taken at the time of sorting and burn tests also confirm this statement." Concerning the plots where one-half of the nitrogen was from sulfate of ammonia: "It will be noticed that the grade index for the sulfate of ammonia was the next lowest of all the plots. The percentage of dark leaves was higher on these plots than for any other treatment. The quality at time of sorting was rated as low as any. There was considerable white and prominent vein. When burn tests were made, these plots rated the lowest of any in fire holding capacity and color of ash. Sulfate of ammonia keeps up the yield (for two years) but produces tobacco of poor quality and poor burn."

In order to study more accurately the effect of this and other nitrogenous materials, another set of four plots was laid out in 1926 in which there was only a *single* source of nitrogen in each plot. Sulfate of ammonia alone was applied to one plot year after year, nitrate of soda to another, cottonseed meal to a third and urea to the fourth. The other fertilizer elements, potash, phosphorus, lime and magnesia, were applied in optimal quantities and in equal amounts to all plots. This has now been continued for eight years. The yields and grade index for these plots are presented in Tables 3 and 4.

During the first six years, the growth of tobacco on the sulfate of ammonia plot was luxuriant. The leaves were dark green and never showed any signs of nitrogen starvation such as was apparent during most of the time on the nitrate of soda plots and, during some years, on the cottonseed meal plots. During wet years, however, there was some magnesia-hunger chlorosis which always appeared first and most severely on the sulfate of ammonia plots. During later years, however, this was corrected by increasing the magnesia applications on all

TABLE 3. SINGLE SOURCES OF NITROGEN. SUMMARY OF YIELDS 1926–1933

Source of nitrogen	Acre yield by years							
	1926	1927	1928	1930	1931	1932	1933	Ave.
Sulfate of ammonia	1482	1386	933	1436	1678	1731	736	1340
Nitrate of soda	1440	688	585	802	728	1682	1762	1098
Cottonseed meal	1228	1131	696	1374	1582	1703	1812	1361
Urea	1350	1166	876	1510	1761	1734	1813	1460

TABLE 4. SINGLE SOURCES OF NITROGEN. SUMMARY OF GRADE INDICES 1926–1933

Sources of nitrogen	Grade index by years							
	1926	1927	1928	1930	1931	1932	1933	Ave.
Sulfate of ammonia	.370	.333	.357	.366	.352	.334	.100	.316
Nitrate of soda	.353	.130	.158	.186	.100	.412	.459	.257
Cottonseed meal	.288	.297	.299	.411	.380	.377	.436	.355
Urea	.375	.350	.443	.415	.449	.375	.424	.404

plots. By 1932 the growth was becoming uneven; patches appeared on which the plants were short and the leaves very dark. The next year, this condition had spread over the entire plot. Many of the plants died in the field, the others were stunted and very dark green. When some of the plants were dug and the roots examined, a considerable part of the root system was found to be dead and brown, symptoms much like those of brown rootrot. The plot as a whole was so poor that it was not worth harvesting. Appearance of this plot in the field is shown in Fig. 67.

With respect to the quality of the tobacco grown on the sulfate of ammonia plot during the years of this experiment the following undesirable features were noted: (1) The cured leaves are always darker in color than those from the other plots. The percentage put into the grade "darks" is invariably highest on this plot. (2) It has been noted at time of sorting each year that the veins tend to be more prominent. (3) The leaves are thicker and coarser. These observations are in accord with those of the first experiment and with those of the third field test mentioned below. (4) Also the combustion characters were the same as in the first experiment, i.e., the fire holding capacity was low, the color of ash dark, coal

band broad, the taste and aroma inferior to that of tobacco from the other plots.

This whole combination of undesirable characters of the crop has so consistently followed the use of sulfate of ammonia on different fields

FIGURE 67. Sulfate of ammonia plot—between the two sign boards—July 1933. Note uneven stand and stunted growth.

through a long series of years, that we are fully warranted in concluding that they are direct effects of the use of this material.

An adequate explanation of each of these effects is not yet at hand. Some of the links in the complicated chain of cause and effect have been revealed, however, by laboratory tests and analyses. One naturally turns first to the changes induced in a soil through application of sulfate of ammonia. That this treatment makes the soil constantly more acid is a known fact fully established by many investigators. Soil reaction tests on these plots made at monthly intervals during the experiments have shown that the soil on the sulfate of ammonia plot has become very acid. At the start of the experiment in May, 1926, it tested 5.2 pH; May, 1927, 5.0; July, 1928, 4.66; July, 1929, 4.41; July, 1930, 4.0; July, 1931, 4.20; July, 1932, 3.91; July, 1933, 3.61. There are seasonal and monthly fluctuations but always this plot is more acid than any of the others and the general trend is constantly toward greater acidity. At reactions as low as 4.0 or lower, tobacco does not grow normally and this factor alone is sufficient to account for the stunted and unhealthy condition of the plants in the last years of the experiment.

The effect of the treatment on the supply of some nutrient elements in the soil was determined by M. F. Morgan of the Soils Department. His analyses, presented in Table 5, show that in June, 1933, seven years after starting the experiment, the amount of nitrate nitrogen was less than in

TABLE 5. ANALYSES OF SOIL FROM THE SINGLE SOURCE OF NITROGEN PLOTS JUNE 15, 1933. POUNDS PER ACRE

	Source of fertilizer nitrogen			
	C. S. meal	Nitr. Soda	Sulf. ammonia	Urea
Nitrate nitrogen	50	100	50	80
Ammonia nitrogen (Available)	20	8	40	12
Phosphorus (Available)	120	80	60	140
Potassium (Replaceable)	320	320	160	240
Calcium "	600	600	150	200
Magnesium "	80	160	30	40
Aluminum "	8	2	10	12
Manganese "	20	10	30	40

the soil of other plots but the ammonia nitrogen was higher; the phosphorous was lower; the three bases, calcium, magnesium and potassium, were much lower; and the manganese was high.

Previous investigations here have shown the injurious effect of increased manganese on tobacco. Manganese toxicity may be expected in any soil when it becomes sufficiently acid.

Sulfate of ammonia exhausts the mineral bases of the soil more rapidly than the other nitrogenous materials considered here, because, (1) it contains in itself no mineral base; (2) its ammonium base is changed in the soil to nitric acid; and (3) thus it introduces two acid radicals (sulfate and nitrate) which must combine with bases in the soil. The bases are thus either leached away or, in the first crops of the series, may be taken into the plant in larger amounts. Ultimately, however, the soil supply is exhausted and the plants show a shortage. Chemical analyses of the leaves have shown that this actually happens; particularly is the percentage of magnesium reduced. Here is apparently one explanation of the darker ash. Our previous studies on magnesia have shown that a good supply

of this element in the leaf is necessary to insure a white ash. With a dark ash is also associated poor aroma and taste. Analyses have also shown that the use of sulfate of ammonia increases the sulfur content of the leaf, a condition which is known to reduce the fire holding capacity. There is thus at hand an explanation of the effect of sulfate of ammonia on the combustion properties of the leaf.

Why sulfate of ammonia should cause the leaves to be so much darker, heavier, and prominently veined is not so readily explained. These characters are like those produced in tobacco by an over supply of nitrogen and one might suspect that in some way this material increased the total nitrogen, or supplied it to the plant at an unfavorable time or in an unfavorable form. However, chemical analyses thus far made, fail to show an appreciably increased quantity of total nitrogen in the leaves.

Since some of the unfavorable effects on tobacco are a result of acidity of the soil induced by sulfate of ammonia, a possible remedy was suggested in application of sufficient lime to neutralize the acidifying effect. In order to test this, a third series of plots was laid out in 1932. On four of the plots, sulfate of ammonia was the only source of nitrogen. On three other plots, a standard formula with nitrogen from cottonseed meal, linseed meal and dry ground fish was used. Two of the sulfate of ammonia

TABLE 6. SULFATE OF AMMONIA TESTS OF 1933. WITH AND WITHOUT LIME

Fertilizer treatment	Plot No.	Acre yield		Percentage of grades								Grade index	
		Plot	Ave.	L	M	LS	SS	LD	DS	F	B	Plot	Ave.
Sulf. of Am. with lime	N13–1	1912		5	6	35	3	40	1	10	0	.435	
	N13–3	1994	1953	4	7	27	4	47	1	10	0	.409	.422
Sulf. of Am. without lime	N13–2	1896		4	5	32	4	41	2	11	1	.413	
	N13–4	1659	1778	2	4	28	4	45	4	13	0	.380	.397
No sulf. of Am. and no lime	N59	1940		14	11	24	4	33	1	13	0	.476	
	N59–1	2050	2008	16	12	27	2	31	1	10	1	.506	.492
	N59–2	2036		15	11	27	3	32	0	11	1	.495	

plots were limed with high calcic limestone at the rate of 1,000 pounds to the acre in the spring of 1932. Since this did not sufficiently neutralize the acidity, another application (this time, 1200 pounds of magnesian lime) was made in the spring of 1933.

Despite the lime application, there was no difference in growth. All the sulfate of ammonia plots, limed and not limed, were somewhat less luxuriant in growth and of a darker green color than the check plots. At time of sorting, the leaves as compared with the check plot tobacco, were darker, heavier and more "veiny." The sorting records of the seven plots for the 1933 crop are presented in Table 6, and the summary of the two years in Table 7. Particularly striking in Table 6 is the difference of about 10 per cent in the percentage of "darks" between the sulfate plots and the checks. This tendency is the same as found in the other two experiments. The figures in Table 7 indicate that there has been some increase in yield from the use of lime on sulfate of ammonia plots but the grade index is not raised.

This set of plots will be continued for some years and final conclusions must await further results. Results already at hand do not indicate that the bad effects of sulfate of ammonia can be overcome by liming.

In this third series, no tests have been made to determine the effects of the treatment on the burn characters. In a previous set of experiments on this same field, however, it was fully demonstrated that sulfate of ammonia reduced the fire holding capacity of the tobacco and that the addition of lime did not sufficiently correct it (Tob. Sta. Bul. 10: 27. Rept. for 1927).

TABLE 7. SULFATE OF AMMONIA TESTS, WITH AND WITHOUT LIME. SUMMARY OF 1932 AND 1933

Fertilizer treatment	Plot No.	Acre yield 1932	Acre yield 1933	Acre yield Ave.	Grade index 1932	Grade index 1933	Grade index Ave.
Sulfate of Ammonia with lime	N13–1	1845	1912		.379	.435	
	N13–3	1996	1994	1937	.404	.409	.407
Sulfate of Ammonia without lime	N13–2	1895	1896		.436	.413	
	N13–4	1861	1659	1828	.457	.380	.422
No sulfate of Ammonia and no lime	N59	2035	1940		.404	.476	
	N59–1	2051	2050	2024	.420	.506	.455
	N59–2	2031	2036		.429	.495	

Conclusions

In all experiments of this 12 year period, there are certain effects constantly associated with the use of sulfate of ammonia:

1. It makes the soil more acid and, if used in sufficient quantity through a sufficiently long period, acidity increases until tobacco will no longer grow.

2. Other soil changes include depletion of the mineral bases, increase in the ammonia nitrogen with decrease in percentage of nitrate nitrogen, decrease in available phosphorus and increase in soluble aluminum and manganese.

3. Sulfate of ammonia makes the cured leaves darker, thicker, and more prominently veined.

4. With respect to combustion characteristics: The fire holding capacity is reduced, the ash is darker, coal band wider, taste and aroma inferior.

NITROPHOSKA FERTILIZER TESTS

T. R. SWANBACK

Nitrophoska (No. 3) is a commercial fertilizer mixture containing 16.3 per cent nitrogen, 16.3 per cent phosphoric acid, and 20 per cent potash. It is claimed to be a chemical mixture rather than a mechanical one, containing no chlorine, since the potash is present in the form of sulfate. If such a fertilizer, containing the three important elements in a very concentrated form, were found to be suitable for tobacco, it is obvious that it would mean considerable economy in cost of the material and of handling.

It is a common belief among growers in the Connecticut Valley, however, that the bulk of a good fertilizer should be made up from organic material, from which Nitrophoska is practically free.

In order to give this material a thorough trial and at the same time test it in comparison with a fertilizer containing considerable organic material, a field experiment was begun in 1929. A set of 6 plots was laid out on Field I at the station farm. This field has always produced good (Havana Seed) tobacco with yields probably above the average of this district. Two plots were used as controls and were fertilized according to the following formula:

Cottonseed meal	1765	pounds per acre
Castor pomace	740	" " "
Nitrate of lime	260	" " "
Sulfate of potash	164	" " "
Carbonate of potash	123	" " "
Precipitated bone	222	" " "
Magnesium carbonate	36	" " "
	3310	" " "

These materials furnished 200 pounds of nitrogen, 160 pounds of phosphoric acid and 200 pounds of potash to the acre and in addition some 200 pounds of lime and 40 pounds of magnesia.

Two other plots received a fertilizer where Nitrophoska as nearly as possible substituted for one-half of the nutrients in the formula above. Finally the remaining two plots were fertilized with Nitrophoska and some magnesian lime with urea added to bring the nitrogen up to 200 pounds per acre. All the plots with their respective treatments remained in the same location throughout the five years during which the experiments have been carried on. Progress reports on these tests have been published in Connecticut Agricultural Experiment Station Bulletins 326: 377-379; 335: 252; and 350: 478-479. Final conclusions from the five year trial are presented herewith.

All through the growing seasons practically no difference in growth could be observed in the field between the tobacco on the control plots and on those fertilized with Nitrophoska. Observations on the tobacco at time of sorting have shown that the check plots in most cases produced tobacco satisfactory in quality, while the half and all Nitrophoska produced dark and veiny tobacco.

From the records of yield and grading for 1933 (Table 8) it appears that a decrease in yield and grading is produced through the use of Nitrophoska. That this tendency is consistent is shown in Table 9 where a summary of four years' results is given.

In view of the rather unfavorable results obtained with Nitrophoska under the conditions of the experiment it should hardly prove worth while to use this material as a fertilizer for tobacco in the Connecticut Valley.

TABLE 8. YIELD AND SORTING RECORDS OF NITROPHOSKA PLOTS. CROP OF 1933

Proportion of Nitrophoska	Plot No.	Acre yield		Percentage of grades								Grade index	
		Plot	Ave.	L	M	LS	SS	LD	DS	F	B	Plot	Ave.
None	N28	2039		11	11	32	2	32	1	10	1	.483	
	N28–1	1926	1892	8	10	30	2	34	1	13	2	.445	.464
Half Nitrophoska	N29	1918		4	9	39	2	33	1	11	1	.447	
	N29–1	1839	1879	8	5	38	3	30	3	12	1	.456	.451
All Nitrophoska	N30	1936		5	7	37	2	35	1	12	1	.440	
	N30–1	1683	1810	6	6	35	5	31	3	13	1	.434	.437

TABLE 9. NITROPHOSKA SERIES. SUMMARY OF FOUR YEARS'* RESULTS, 1930, 1931, 1932 AND 1933

Proportion of Nitrophoska	Plot No.	Acre yield by years					Grade index				
		1930	1931	1932	1933	Ave.	1930	1931	1932	1933	Ave.
None	N28	1884	1793	2070	2039		.491	.493	.439	.483	
	N28–1	1829	1764	1974	1926	1910	.464	.481	.482	.445	.470
Half Nitrophoska	N29	1810	1813	2016	1918		.457	.451	.455	.447	
	N29–1	1934	1856	1866	1839	1886	.453	.478	.386	.456	.448
All Nitrophoska	N30	1915	1813	1957	1936		.435	.440	.437	.440	
	N30–1	1875	1820	1839	1683	1857	.473	.446	.381	.434	.436

*No sorting records are available for 1929 since a hail storm destroyed the tobacco on August 1.

COMPARATIVE STUDIES OF FUELS FOR CURING

O. E. STREET

The experiments conducted in 1932 to determine the relative merits of processed charcoals (Eastman Charkets and Ford Briquets) as compared to lump charcoal were continued in 1933. The equipment and technique as described in Bulletin 350 were employed with only a few changes.

Chamber No. 1, which proved to be inefficient due to location, was not used in the present tests. The fuels were rotated in the other three compartments, and accurate records obtained of temperature and fuel consumption.

It was found that the processed fuels could be used more efficiently if the pits were shallow, as the volume of fuel required was not as great as with lump charcoal. The use of a small box-like sheet iron container, 9 by 11 inches and 5 inches deep, fitted with a perforated bottom for ventilation, was successful. The bottom ventilation, however, was unnecessary, as the fuel burned freely with the ventilators closed. A still simpler container, and one that was more efficient was observed in connection with other experiments. This was a granite-ware hand wash basin of about 12 inches diameter and not over 4 inches deep. Used with Eastman Charkets, these containers were very convenient in many respects. Shallow depressions were scooped out of the shed floor in which to place the basins, and the fires started by moistening a few lumps of the fuel with kerosene. The loss of fuel which occurs in pits in the soil was eliminated entirely. At the end of the firing period, the basins were turned upside down and the fires thus smothered without dust. The heat produced by the fires did not damage the basins.

In the present experiments, tests were made on the second, third and fourth pickings of shade tobacco grown on the station field. Two sample hands to a pole, taken from the general tobacco, were marked for studies of the effect on grading.

The fuel and temperature records for the experimentst are shown in Table 10.

TABLE 10. SHADE TOBACCO FIRING EXPERIMENTS. FUEL AND TEMPERATURE RECORDS

Run	Chamber	Fuel	Fuel consumed pounds	Average chamber temp. °F.	Average outside temp. °F.	Gain °F.	Fuel consumed in pounds per degree gain	Length of run
1	3	Lump charcoal	147.5	91.35	82.32	9.03	16.33	48 hrs.
	2	Ford Briquets	117.5	91.40		9.08	12.94	
	4	Eastman Charkets	118.5	91.54		9.22	12.85	
2	4	Lump charcoal	172.0	88.46	73.76	14.70	11.70	48 hrs.
	3	Ford Briquets	181.5	85.72		11.96	15.17	
	2	Eastman Charkets	160.0	88.73		14.97	10.69	
3	2	Lump charcoal	170.75	86.10	67.83	18.27	9.35	48 hrs.
	4	Ford Briquets	178.5	85.59		17.76	10.05	
	3	Eastman Charkets	159.5	87.69		19.68	8.03	

Summary

	Fuel	Fuel consumed pounds	Weighted averages—144 hours			
			Chamber temp. °F.	Outside temp. °F.	Gain °F.	Fuel consumed in pounds per degree gain
	Lump charcoal	490.25	88.64	74.64	14.00	35.02
	Ford Briquets	477.5	87.57		12.93	36.93
	Eastman Charkets	438.0	89.32		14.68	29.83

This table differs from Table 19 in Bulletin 350 in that one column "Fuel consumed in pounds per degree of temperature gain" is added. The figures in this column are valuable in showing the relative efficiency of the fuels in a single unit of measurement.

It will be observed that the three runs were made under widely different outdoor temperatures. The first run was made during rather hot weather, the second with normal seasonal temperatures, and the last in a period of cold weather. While the total fuel consumption in the first run was low, the efficiency as measured by the consumption in pounds per degree gain was also rather low. This efficiency increased as the outdoor temperature decreased, at least for the conditions of these experiments.

With the exception of the first test, Ford Briquets was the highest in fuel consumption, and the lowest in average temperature maintained and gain over outdoor temperature. This was due to the nature of the fuel, which possesses a low porosity due to the use of a starch binder. Hence the burning of this fuel is more nearly a surface reaction. In consequence of this difference, a larger mass of fuel was needed to maintain a comparable temperature and the fuel consumed in pounds per degree gain was high, especially when the outdoor temperature was low.

The most efficient fuel in each case was Eastman Charkets, with lump charcoal second in two out of three cases. This difference over the entire period is indicated in the summary which shows lump charcoal 5.5 per cent and Eastman Charkets 24 per cent more efficient than Ford Briquets. A similar trend may be noted for 1932, where Ford Briquets had the lowest temperature gain, but was 3.9 per cent more efficient than lump charcoal and only 5.6 per cent less efficient than Eastman Charkets.

The grading of the samples cured in the various chambers is shown in Table 11.

Table 11. Distribution of grades of shade tobacco cured by various fuels. Percentage of grades

Second Picking

Fuel	LC	LC_2	YL	LV	LV_2	V	VL	VL_2	AL_2	ML	XL	XL_2	S_2	WV	XX	Grade Index
Charcoal	.9	10.6	11.5	.3	32.8	18.8	.3	9.1	.3	1.8	8.5	3.6	.9		.6	1.425
Briquets	.3	5.2	2.3	5.5	37.7	27.5	.6	6.1	.1	2.9	6.1	3.2	.6	.6	1.3	1.499
Charkets	1.6	5.8	7.3	1.0	29.6	19.9	1.0	17.3	.3	2.1	6.5	5.0	1.0		1.6	1.372

Third Picking

Fuel	LC	LC_2	YL	K	LV_2	V	VL	VL_2	AL_2	ML	XL	XL_2	TOPS	XX	Grade Index
Charcoal	0.6	0.8	2.8	2.5	3.1	15.9	1.1	27.1	0.3	19.5	4.8	16.7	2.0	2.8	.973
Briquets		3.4	2.0	3.1	5.4	11.8	2.3	27.0	.6	11.3	19.8	2.3	1.4	9.6	1.035
Charkets		1.5	1.2	1.2	.4	6.2		47.1		15.2	6.2	17.1	.4	3.5	.936

Fourth Picking

Fuel	K	LV_2	VL_2	AL_2	ML	XL	TOPS	XX	Grade Index
Charcoal	.2	4.3	3.2		17.3	3.9	69.0	2.1	.369
Briquets	1.5	1.9	2.3		13.6	2.3	76.9	1.5	.327
Charkets	1.4	1.8	4.5	.7	16.9	2.0	71.3	1.4	.356

The tobacco used for these samples was obtained from a single row in the middle of each bent, this being the only tobacco available. Soil differences related to position in the field almost entirely account for the grade index differences. Comparative grade indexes in the first run show no difference between the grading of tobacco cured with Charkets or Briquets and their corresponding checks, while charcoal was comparatively higher. In the second run, there were no real differences between the samples here reported and their checks, while in the last run, all lots had very low values.

A supplementary test on Havana Seed tobacco was conducted in compartments 16 by 32 feet, with 12 fires to a compartment. The results are shown in Table 12.

Table 12. Havana Seed firing experiments, 1933. Fuel and temperature records

Run	Chamber	Fuel	Fuel consumed pounds	Average chamber temp. °F.	Average outside temp. °F.	Gain °F.	Fuel consumed in pounds per degree gain	Length of run
1	5	Ford Briquets	349	76.30		9.20	37.93	
	6	Lump charcoal	352	78.98	67.10	11.88	29.63	24 hrs.
2	5	Lump charcoal	244.5	79.73		10.04	24.35	
	6	Ford Briquets	167	79.40	69.69	9.71	17.20	24 hrs.
3	5	Lump charcoal	518.5	76.46		10.64	48.73	
	6	Eastman Charkets	366	78.14	65.82	12.32	29.71	24 hrs.

Summary of Runs 1 and 2

		Fuel	Fuel consumed pounds	Chamber temp. °F.	Outside temp. °F.	Gain °F.	Fuel consumed in pounds per degree gain	
		Ford Briquets	516	77.85		9.46	54.54	
		Lump charcoal	596.5	79.36	68.39	10.97	54.33	

In this test, compartment No. 5 was at the end of the shed and compartment No. 6 adjacent to it. Consequently compartment No. 5 was more difficult to heat. In the first run, in which Ford Briquets were used in this compartment, the gross consumption of fuel was not greatly different from charcoal in compartment No. 6, but the net temperature gain was much lower. When the fuels were interchanged, the charcoal still maintained the higher temperature, but a considerably larger amount was used. If the two runs are summarized it will be seen that their average fuel consumption per degree gain was almost identical. The difference in porosity is again a contributing factor in the lower temperature gain of the Briquets.

No opportunity was available to make a check test for comparison with the third run. However, it can be compared with the second run. This last test was made under conditions of low outdoor temperature, and the fuel consumption under poorly insulated shed conditions was high for both fuels.

TABLE 13. DISTRIBUTION OF GRADES OF HAVANA SEED TOBACCO

Fuel	Percentage of grades								Grade Index
	L	M	LS	SS	LD	DS	F	B	
Charcoal	4	2	24	1	46	3	20		.363
Briquets	8	4	28	1	36	4	18	1	.410

In the second run, the consumption of charcoal per degree gain was 41.6 per cent higher than the consumption of Briquets, while in the third run it was 64.0 per cent higher than the Charkets. As it is apparent from other data that charcoal and Briquets are about equally efficient, the greater efficiency of Charkets is quite evident.

Sorting records of samples for the comparison between charcoal and Briquets are shown in Table 13. Here again the higher grade index of tobacco fired with Briquets is apparent.

Discussion

The results of tests conducted for two years to determine the merits of processed charcoals as compared with lump charcoal have indicated that Ford Briquets are not greatly different in efficiency from the unprocessed material, while Eastman Charkets have some advantage.

Measured in fuel consumed per degree gain over the entire period of 264 hours, lump charcoal was 0.4 per cent more efficient than Ford Briquets, and Eastman Charkets 12.1 per cent more efficient than charcoal. The Ford Briquets, due to their low porosity, could not be forced and consequently low temperature readings were more commonly found with this fuel than either of the others. Charcoal burned the most freely of the three fuels, to the extent that care had to be taken to avoid too high temperatures during the day. The temperature fluctuations with charcoal sometimes were as much as 5 degrees in an hour. Hence the average temperature maintained by charcoal tended to be made up of readings which deviated more widely from the mean than was the case with the other fuels.

The Eastman Charkets, possessing a greater density than charcoal, and yet sufficiently porous to permit free burning, usually maintained the most uniform temperature. It was also possible to keep the temperature more nearly at the desired level since a smaller volume of fuel was added at any one time, and the fires were not smothered by the large bulk of fresh material as was usually the case with charcoal. Regulation of the total volume of burning fuel in the pit was an effective means of regulating the temperature level.

Conclusive evidence was not obtained that any of the fuels had a consistent effect on the grading of the tobacco, if due weight was given to other factors.

The relative cost of the lump charcoal remains as its greatest attraction. In 1933, charcoal could be obtained for approximately $14 a ton in loose carload lots, freight paid, as compared with $28 for the processed fuels under like conditions. Such factors as reduced handling and haulage charges, lower loss by breakage and pulverization, and greater cleanliness, are in favor of the processed fuels. It is quite likely that the use of such fuels will be confined to the curing of shade tobacco, in which case the higher initial cost is not a prohibitive factor.

SHADE CURING EXPERIMENTS IN 1933

O. E. STREET

The experiments on curing initiated in 1932 in the Gershel-Kaffenburgh Tobacco Company sheds were continued in 1933 on first picking tobacco. The object of these experiments was to determine the effect produced on tobacco by differences in:

a. Position of leaves in the curing shed
b. Time of picking in relation to rains
c. Type of soil
d. Humidification

Experimental procedure

The studies were conducted on first picking tobacco gathered from the field during a period from July 10 to July 14. In order to obtain a complete record, one sample lath, strung with colored string and tagged, was placed on every pole in 2 sheds. The tobacco for these samples was selected at random from the entire lot of tobacco being used to fill the shed. Each sample tag was marked with the tier, bent and pole, and record kept of the source of the tobacco and the time of picking. Both the shed fitted with humidifying equipment and a check shed were sampled in this fashion, and records of temperature and humidity obtained by means of hygrothermographs.

Filling of the humidified shed was commenced on July 10, and about one-third filled before night. A heavy rain during that night halted operations and filling was resumed and completed on July 12. Firing was started the same night and continued for 54 hours at an average temperature of 85° F. A very damp period of 40 hours necessitated a refiring of 37 hours at an average temperature of 86° F. The weather was very favorable for curing and the humidifying apparatus was not turned on until July 24, a period of 12 days from the start of the curing. During the balance of the curing period, 17 days, the equipment was in operation a total of 62 hours in 9 days. A relative humidity of above 80 per cent was maintained during most of the 62 hour total period by the use of the upper humidifying line alone.

The check shed was filled immediately after the humidified shed, on July 13 and 14. Firing was commenced the same evening and continued for 48 hours at an average temperature of 88° F. The tobacco cured quite rapidly, and as dry weather followed the firing period, a second firing was not needed.

The tobacco from both sheds was taken down August 22, placed in the bulk August 24 and remained in the bulk until October 14. The tobacco from the humidified shed reached a maximum temperature of 110° F., from the check shed a maximum of 112° F., with a final temperature of 107° F. in both bulks. The sample hands were sweated with their respective bulks, and separated out when the bulks were taken down.

All sample hands were examined and notes taken on colors and texture before sorting. The samples were grouped according to the factors to be studied, namely, vertical and horizontal position, time of picking and location by fields, and sorted into commercial grades.

Vertical position in shed

The effect of vertical position was studied in the tobacco from both sheds. The results in the humidified shed are shown in Table 14.

TABLE 14. SORTING RECORDS OF SHADE TOBACCO CURED IN A HUMIDIFIED SHED
a. EFFECT OF VERTICAL POSITION

Description	Percentage of Grades													Grade I[illegible]
	L	LL	LC	LC_2	YL	LV	LV_2	V	XL	XL_2	S1	S2	XX	
Picked before a rain														
Tier 9	0.7	18.6		29.1	12.6	8.6	4.0	8.6	2.6	2.0	10.6	1.3	1.3	2.056
8	4.7	6.1	23.5	19.7	9.4	1.4	8.4	11.3	2.3	2.3	9.4	0.5	1.0	2.106
7		7.6	13.8	15.8	11.8	2.1	10.3	18.6	6.2	4.1	4.8	2.8	2.1	1.796
6	0.8	7.3	22.8	16.7	13.1	6.5	10.2	10.5	2.0	3.2	4.1	2.4	0.4	2.083
5	3.5	6.9	27.1	16.8	10.3	4.2	6.4	6.9	3.1	0.4	11.8	1.5	1.1	2.1[illegible]
4	3.3	14.9	15.3	18.2	12.7	3.6	4.4	13.8	4.7	0.7	6.9	0.4	1.1	2.20[illegible]
3	3.5	9.2	17.1	20.2	14.0	5.3	7.9	10.1	1.8	2.2	4.8	3.5	0.4	2.0[illegible]
2	5.4	6.3	18.3	12.9	12.5	9.6	12.5	14.2	1.7	2.1	3.7	0.4	0.4	2.2[illegible]
Picked two days after a heavy rain														
Tier 8		10.1	11.6	11.6	4.4	5.8	10.1	31.9	2.9	1.4	2.9	4.4	2.9	1.867
7		3.2	22.5	5.7	3.5	12.4	15.2	27.6	4.4	1.3	1.9		2.2	2.019
6		4.4	7.9	6.4	3.0	10.8	25.6	36.0	2.2	2.2	0.3	0.5	0.7	1.844
5	0.7	4.0	9.4	8.0	4.5	14.9	18.4	32.1	2.9	2.1	1.2	0.2	1.6	1.917
4	0.2	3.2	8.9	6.7	2.7	10.1	20.9	37.3	2.4	2.0	1.7	1.7	2.2	1.7[illegible]
3	2.6	11.5	8.9	16.1	6.1	13.1	14.0	17.4	2.6	1.3	4.8	0.9	0.7	1.9[illegible]
2	4.0	13.3	11.5	11.2	4.7	13.8	19.1	12.4	2.0	2.4	3.3	1.8	0.5	2.3[illegible]
1	1.8	4.5	6.3	6.0	3.6	19.9	25.9	25.4	3.6	1.2	0.9	0.9	0.5	2.0[illegible]

b. EFFECT OF HORIZONTAL POSITION IN THE BOTTOM TIER

Description	L	LL	LC	LC_2	YL	LV	LV_2	V	XL	XL_2	S1	S2	XX	Grade Index
Outside poles	1.2	2.4	12.8	12.1	5.4	15.8	19.4	23.7	4.8	0.6	0.6	0.6	0.6	2.00[illegible]
Next to outside poles	0.6	6.9	4.0	4.0	1.7	23.2	30.7	21.4	2.8	1.7	1.2	1.7	0.6	2.09[illegible]
Inside poles	2.0	4.1	3.7	3.3	3.7	20.4	26.9	29.4	3.7	1.2	0.8	0.4	0.4	1.97[illegible]

*See Bull. 334, p. 178, for explanation of grade index. The comparative values for the different grades of shade tobacco in 1933 were as follows:

L	5.00	LV	3.00	ML	.50
LL	4.25	LV_2	1.75	S1	.70
LC	3.00	V	1.25	S2	.30
LC_2	1.75	XL	1.25	XX	.15
YL	1.25	XL_2	.75		

It will be seen that the results varied between the tobacco picked before and after a heavy rain. In the first case the poorest tobacco was found

in the seventh tier, immediately above the plate line. This tobacco was directly underneath the upper line of atomizers and was considerably darker than any other comparable lot, as indicated by the high percentage of V's. The best grade index was found on the second tier. It may be noted that the percentage of light tobacco of high quality, LL's and LC's, tended to increase up to the sixth tier. The percentage of olive leaves of high quality, LV's and LV_2's, did not vary regularly with position. Spotted leaves of light color, LC_2's, and YL's, were most abundant in the peak tier, and stained leaves were also common here. The colors were generally very light, however, sometimes to the point of being pale yellow.

An entirely different picture is presented by the tobacco picked after the rain. In this case, the seventh tier was among the best in grade index, being exceeded only by the second and first tiers. The percentage of LL's and LC's in the seventh tier, and of L's, LL's, and LC's in the second tier, was the highest in the lot. It is apparent that these tiers had a balance between temperature and relative humidity that somewhat retarded the rapid cure of the thin nitrogen-loaded leaves picked after a rain, and this retardation tended to produce lighter colors. The high grade index of the bottom tier is due to the large percentage of leaves in the LV grade, exceeding any other tier by one-third, with the light grades of the LC type very low. In this lot the fourth and sixth tiers had the highest percentage of V's and the lowest grade indices.

The effect of vertical position in the check shed is indicated in Table 15. (p. 370). Here the tobacco is divided according to fields, with field I picked on Thursday and field 7 on Friday, both after the rain. In the tobacco from field I, the better grade indices are found on the fifth tier and below. The eighth tier is superior to both the seventh and sixth, and slightly better than the fourth, although this last difference is not significant. The second tier is again the best, and it is apparent that the moisture relations were more favorable below the plate line, which in this shed nearly coincided with fifth tier. Above this point, all the lots had more than 30 per cent of V's; below it less than 30 per cent of V's, with corresponding increases in the thinner and more valuable LV_2 and LV grades. This agrees rather well with the results on the comparable lot, (picked after the rain), in the humidified shed, where better grade indices were found in the positions having the greatest moisture supply. The percentage of LV's on the second tier, 27.1, is significant.

The effect of vertical position on the tobacco from field 7 is not apparent, as the entire lot of tobacco was rather poor.

Horizontal position

A further study on the tobacco in the humidified shed was the effect of the horizontal position in the bottom tier (Table 14). It is to be noted that the poles next to the outside wall of the shed presented radically different curing conditions from those nearer the center. This is evidenced by the higher percentages of LC's and LC_2's and the lower percentages of LV's and LV_2's. The agents in this difference were undoubtedly the lower temperature near the walls during firing periods, and perhaps the more

TABLE 15. SORTING RECORDS OF SHADE TOBACCO CURED IN A CHECK SHED
a. EFFECT OF VERTICAL POSITION

Treatment	Percentage of grades													Grade Index
	L	LL	LC_1	LC_2	YL	LV	LV_2	V	XL	XL_2	S1	S2	XX	
Field 1.														
Tier 8	4.3	7.3	2.0	2.3	1.5	13.9	20.5	35.3	3.1	1.2	3.5	3.1	2.0	1.939
7	0.8	1.6	3.9	5.5	0.8	15.7	26.4	32.6	1.8	3.6	4.9	0.8	1.6	1.760
6	0.4	1.4	6.0	3.5	2.1	14.1	25.4	34.5	1.4	5.6	3.2	1.4	1.0	1.733
5	2.9	5.3	6.0	7.4	0.7	19.3	27.8	21.4	2.9	0.7	3.2	2.1	0.3	2.092
4	3.2	2.2	5.0	6.9	2.6	14.1	28.5	29.6	1.1	2.9	2.5	1.4		1.906
3	2.0	4.1	8.2	6.2	2.0	20.5	24.6	21.5	4.1	0.7	2.7	2.0	1.4	2.051
2	4.5	3.1	3.8	5.6	1.4	27.1	21.2	21.5	3.1	2.1	3.1	2.8	0.7	2.125
Field 7.														
Tier 6		0.9	3.6	10.7	4.5	5.3	39.3	*20.5	4.5	5.3	4.5		0.9	1.560
5			5.2	2.6	3.5	13.0	44.4	*20.0	2.6	6.1	1.7		0.9	1.694
4		0.8	8.2	15.6	4.1	9.8	32.0	*21.3	3.3	1.7	2.4		0.8	1.437
3	0.9	1.4	1.8	0.9	0.5	14.8	34.1	*38.3	1.8	3.2	1.4		0.9	1.640
2		0.5	0.9	0.9		22.2	32.9	*33.3	3.5	3.5	0.5	0.5	1.3	1.684
1		1.9	4.6	7.0	6.5	12.5	17.9	*41.2	2.2	4.1	0.6	0.6	0.9	1.568
b. EFFECT OF TYPE OF SOIL														
Field 1	2.6	3.0	5.8	5.9	1.8	19.1	25.5	25.7	2.5	2.4	3.0	2.0	0.7	1.995
2	1.6	3.3	4.3	6.9	5.3	11.2	22.2	23.1	2.8	3.7	12.2	2.5	0.9	1.706
7	0.2	0.7	3.2	4.7	1.9	14.6	35.8	*29.1	3.0	3.8	1.8	0.1	1.0	1.663
c. EFFECT OF HUMIDIFICATION														
Humidified	2.2	7.4	13.5	12.8	7.1	10.3	15.1	20.8	2.8	1.8	4.0	1.2	1.0	2.057
Check	1.6	2.7	4.7	5.8	2.9	16.0	24.8	29.3	2.8	3.1	3.8	1.4	1.1	1.744
Humidified—Monday	3.2	8.4	20.0	17.2	12.0	4.9	8.4	11.8	3.0	2.0	6.7	1.5	0.9	2.115
Humidified—Wednesday	1.4	7.1	11.0	9.4	4.2	12.4	18.6	26.9	2.7	1.9	2.2	1.0	1.3	2.018
Check—Thursday	2.6	3.0	5.8	5.9	1.8	19.1	25.5	25.7	2.5	2.4	3.0	2.0	0.7	1.995
Check—Friday	0.2	0.7	3.2	4.7	1.9	14.6	35.8	*29.1	3.0	3.8	1.8	0.1	1.0	1.663

*40% of V's very dark, properly belong in ML's.

rapid moistening by natural means at other times. From the notes taken before sorting, similar conditions, but to a less marked degree, were found to prevail up to the sixth tier. It was noted that the tobacco on the poles next to the center of the shed was almost always more olive in color than that nearer the walls of the shed. It seems evident that the open space up through the center of the shed, varying from one to three feet in width, serves as a flue during the firing periods, while the walls are relatively cool.

Picking in relation to rains

The effect of picking before and after a rain may be seen from the summarized data in the last part of Table 15, under the entries "Humidified-Monday" and "Humidified-Wednesday." The entire humidified shed was filled with tobacco from a uniform field rather above the average in the quality of tobacco produced, the only variable between the two lots being a rain of about 1.25 inches which intervened between the pickings.

The tobacco picked before the rain had from 80 per cent to 180 per cent more of the light brown grades, except LL's, than that picked after the rain, and averaged 89 per cent more of all grades from L's to YL's. With respect to the olive grades LV's to V's, the tobacco picked after the rain averaged 130 per cent more. These lots varied in one other respect, the percentage of stained tobacco being greater in the tobacco picked before the rain. The difference in grade index was not great as the light olive grades are as valuable as the light brown grades. The most significant difference beside the marked one of darkness of color, was the more uniform color distribution on the tobacco picked after the rain and the relative absence of stained leaves.

Type of soil

A summary of the effect of soil and other environmental factors on the grade distribution is also shown in Table 15. The tobacco from these 3 lots was all cured in the check shed, with no one lot favored by position. Field I was characterized by favorable topography and good drainage, the soil being a sandy loam. Field 2 included some sandy knolls, and tended to be too light. The area of field 7 included in this comparison was characterized by a heavy soil with poor drainage, on which the growth was slow. The fields were picked in the order mentioned, only field 7 being picked on the second day of filling the shed.

Despite the fact that it was picked only three days after a rain, field 2 illustrates the characteristics of shade tobacco grown on light sand knolls. While light grades of high value are not abundant, the YL grade is nearly three times as abundant as in field 1, and the S1 grade over four times. The YL grade consists of leaves that have light spots or mottlings, while the S1's are leaves of light yellow color with reddish staining from the midrib and secondary veins. These symptoms are the same as is found in tobacco that has been underfertilized.

The tobacco from the low area in field 7, although it had one more day to recover from the effects of the rain, was still the darkest of all the lots studied. Included in the V's was a grade known as ML, a thin leaf but one almost or completely black. The prevalence of a grade as dark as ML's in the first picking indicates poor growth and an oversupply of unassimilated nitrogen in the leaf.

Humidification

The effect of humidification, summarized in Table 15, cannot be evaluated by comparing the entire sheds and disregarding the component factors that influenced the behavior of the tobacco. Neither can the tobacco picked Monday and placed in the humidified shed be used in the comparison, as it was dry-weather tobacco and all the other lots were picked after a rain, or the tobacco picked Friday from field 7 and placed in the check shed, as it was an inferior lot.

If the comparison is narrowed down to the tobacco picked on consecutive days, and placed in the two sheds, it will be seen that almost no difference in grade index is to be found between the humidified and the check lot. The curing season was naturally quite favorable, periods of high humidity being rather common during the first two weeks the tobacco was in the sheds. The fact that the tobacco below the plate line in the check shed was better than that above would indicate that moisture conditions were quite favorable for the main body of the shed. Considering the multiplicity of factors that enter into the final product, the graded tobacco, it does not seem possible to attribute any particular benefit to the humidifying system under the conditions of these experiments.

Summary

With references to vertical position, the better tobacco was usually found below the plate line of the shed. This was particularly true with tobacco picked after a heavy rain and was correlated with a more adequate moisture supply, which retarded the curing of the thin leaves and thus produced lighter leaves. The second tier from the bottom had the highest grade index in all cases. With dry-weather tobacco the same general trend was present but was less marked. Tobacco in the peak tier was often too yellow and mottled.

Horizontal position was significant in the bottom tier, and produced some difference up to the sixth tier. The tobacco nearest to the outside walls of the shed had a greater percentage of light brown grades, while that in the interior of the shed showed more olive leaves. This effect was due to the temperature differences during firing, the center of the shed acting as a flue.

The effect of time of picking in relation to rains was very clearly shown. Tobacco picked during a dry period was predominantly light brown in color, with some mottling and staining. Tobacco picked after a heavy rain was characterized by olive shades, but the distribution of color on the leaves was more uniform.

Soil type was shown to be very important. Tobacco from light sandy knolls had a "starved" appearance and was rather badly stained and mottled. Tobacco from heavy, water-logged soils was very dark and inferior.

Additional humidification by mechanical means failed to show any advantage during the past season.

THE PRESERVATIVE TREATMENT OF SHADE TENT POLES

HENRY W. HICOCK *

A considerable part of the cost of shade tents is for poles to support the wire and cloth. These poles should be light, reasonably strong, should hold staples well, be durable in contact with the soil and inexpensive. In the past, poles of native chestnut have admirably fulfilled all these requirements. Some poles of this formerly valuable species can still be obtained but most of them were killed by blight and have been dead many years and give poor results in service. Moreover, it will be only a few years before no native chestnut poles can be obtained. Of other native species, the heartwood of red cedar, black locust and white oak only are equal to chestnut in natural durability in contact with the soil. Red cedar and locust are not sufficiently abundant to satisfy all demands for posts and poles while white oak is satisfactory only if sawed to exclude sapwood.

In anticipation of the need in the near future of a substitute for chestnut, the Connecticut Agricultural Experiment Station, in 1928, began a series of experiments with the wood of several native species to determine whether any of them could be satisfactorily used in place of chestnut if given preservative treatment.

The Experiments

In June, 1928, forty seasoned poles(1) each of white pine, pitch pine, gray birch, red maple and popple were treated(2) as follows:

(1) Fifty poles (10 of each species) were given a full pressure treatment for their entire length by the American Creosoting Company in the same manner as for railroad cross ties(3). A heavy impregnation of the sapwood throughout the post was secured by pressure treatment.

(2) The butts of 50 poles were given an Open Tank treatment with creosote(4). In this process, the butts of the poles to a height 6 to 12 inches above the ground level are immersed in hot creosote maintained at a temperature of 220° F. for three hours. They are then kept for an equal length of time in cool creosote (not over 100° F.) and then transferred to an empty tank to drain (see Fig. 68). By this process the sapwood of the butt is wholly or partly impregnated for a distance equal to the depth of the liquid in the tanks. The tops of 25 of these poles (five of each species) were further treated by dipping for 10 minutes in hot creosote. The tops of the balance were left untreated.

(3a) Twenty-five poles (five of each species) were painted with a brush for their entire length with two coats of hot creosote(4) applied 24 hours apart.

*Assistant forester in Forestry Department.
(1) Since these poles were to be used for experimental purposes only, the tops were cut off to facilitate handling.
(2) For a detailed discussion of preservative treatments see "The Preservation of Structural Timbers" by Howard F. Weiss, McGraw-Hill Book Co., 1915.
(3) The preservative used was a mixture of 70 per cent coal tar creosote and 30 per cent coal tar.
(4) See next page.

(3b) The butts only of 25 poles (five of each species) were brushed with two coats of hot creosote(4) applied 24 hours apart. The tops were left untreated.

(4) Thirty poles (six of each species) received no treatment.

(5) Twenty poles (four of each species) were treated by inserting two rings of "Treater Dust" (a highly poisonous arsenious compound produced in copper smelting) in the hole when the poles were set. The tops received no treatment.

FIGURE 68. Simple equipment for treating poles by the open tank method. Creosote in barrel on left is heated to 220° F. by charcoal fire in pit under end of 2 inch pipe return coil. Cold creosote bath in second barrel. Third barrel is for draining excess creosote. Tops of poles cut off in this experiment.

Immediately after treatment all posts were set to the usual depth for tent poles in a moderately heavy soil at the Tobacco Sub-station in Windsor.

Condition of poles after five years

Treatments

Full Pressure Treatment. All poles treated by this process were sound throughout after 5 years service. Unquestionably, pressure treatment will give the best results as far as length of service is concerned. However, either very expensive equipment must be installed or the timber taken to some central plant with consequent heavy transportation costs. Moreover, in pressure processes the tops and butts of poles received equal

(4) Coal Tar Creosote, grade 1, A. W. P. A.

treatment. This means that the tops are more heavily and consequently more expensively treated than is justifiable for a small pole.

Open Tank (hot and cold bath) Treatment. The butts of all but two poles treated by this method were sound after five years service in the soil. The equipment for open tank treatment can be assembled quite cheaply by anyone and is therefore well suited to the small user. The operation of the plant is quite simple. Native species which, untreated, are serviceable for only two years in the soil, have an estimated life of eight years or more after receiving open tank treatment.

Brush Treatment. Brush treatment is entirely superficial and little or no impregnation of the wood results. Dipping may be classed with brushing but is probably slightly more effective because the preservative flows into season checks and other openings which are impossible to reach with a brush. Brushing is the least expensive method of applying preservative. The butts of pitch pine poles treated by brushing were sound after five years in the soil. The butts of poles of all other species showed indications of interior rot at the end of three years and had become entirely unserviceable in five years. The process is not recommended for butt treatments if an impregnation method can be used. With most native species it will probably increase the natural life in the soil one to two years.

"Treater Dust." The butts of all poles set with this material in the hole were sound after five years service in the soil. While the cost of this material is quite low and while the results compare favorably with impregnation treatments after five years, this compound cannot be recommended on account of its extremely poisonous nature.

No Treatment. With the exception of pitch pine, the butts of all poles which were set untreated had become entirely unserviceable at the end of three years. The butts of untreated pitch pine poles were sound at the end of three years but had become unserviceable in five years.

Treated versus untreated tops. With few exceptions the untreated tops of popple, gray birch and red maple poles had become unserviceable at the end of five years. The untreated tops of white and pitch pine poles showed very little indication of decay after five years. The tops of all poles which had either an impregnation treatment (full pressure) or a superficial treatment by brushing or dipping were, with very few exceptions, sound and serviceable at the end of five years.

The above results indicate that the tops of poles need some kind of preservative treatment to maintain a balance of life between top and butt. Heavy impregnation of tops such as is secured by pressure treatment probably involves an unjustified expense. Moreover, pressure treated poles are likely to "bleed" in warm weather, especially if tar is used, and this may prove injurious to tobacco. A superficial treatment of tops by dipping or brushing and an open tank treatment of butts has maintained a satisfactory balance of life between top and butt for a period of five years. Poles treated superficially do not "bleed" unduly but whether or not even a small amount of "bleeding" will injure tobacco remains to be determined. If injury does result it may be necessary to treat tops with an inorganic salt solution instead of creosote.

Species

Of the five species for which five year service records are available, pitch pine seems to satisfy best the requirements for tobacco poles. The wood is naturally quite durable, is reasonably strong and tough and can be readily treated. Moreover, it is locally abundant in the tobacco region. White pine is not recommended because its wood is low in all strength properties and does not treat readily. Of the three broadleaved species, gray birch will probably not be used to any extent because it seldom grows large enough or straight enough for a tobacco pole. Popple and red maple should both make good tobacco poles with preference going to the latter because of its greater strength and toughness, its abundance and the fact that it can be treated more effectively.

An immense amount of small pole material of red and scotch pine, especially of the latter, will become available within the next 10 years as thinnings from forest plantations. The wood of these two species is intermediate between white pine and pitch pine in strength properties and can be treated with extreme ease. It was found that the several species of oak could be treated effectively with a relatively small quantity of preservative. Objection may be raised to oak for tobacco poles on account of its hardness and weight. The hardness of oak would render stapling somewhat difficult although it is believed that this would not be a serious drawback as workmen became accustomed to stapling in a hard wood. As far as weight is concerned it is believed that oak poles could be used in considerably smaller diameters than are at present specified for chestnut and still be sufficiently strong because oak is from 30 to 100 per cent stronger than chestnut in all requisite strength properties. For comparison of strength properties of various woods see Table 16.

Seasoning. All poles which are to be treated should be peeled and thoroughly seasoned. The procedure recommended is to cut and peel the poles in the spring when the bark is "slipping" and pile them "log cabin style" in the woods where they will season slowly without severe checking, and to treat them the following winter.

Conclusions

The results of experiments covering a period of five years demonstrate that poles of several native species will, if given preservative treatment, prove satisfactory substitutes for chestnut.

At the present time, pressure treated poles are not recommended because of the high cost and because the tops "bleed" in warm weather.

An impregnation treatment of butts with creosote by the open tank (hot and cold bath) process together with a superficial treatment of tops by dipping for a few minutes in hot creosote seems to result in a reasonable balance between life of butt and life of top.

Injury to tobacco from superficial treatment of pole tops with creosote remains to be tested. Should injury result, experiments with an inorganic salt as a substitute for creosote will be needed.

From the standpoint of physical properties, abundance, adaptability to treatment and demonstrated results, pitch pine and red maple seem to best

fulfill the requirements for tobacco poles. However, from more recent experiments, for which there are at present no service records available, it would seem that the several species of oak and red and Scotch pine may also be sources of pole material.

TABLE 16. COMPARATIVE STRENGTH PROPERTIES OF WOOD

Species	Bending strength	Hardness
White or gray birch	90	108
Butternut	94	80
Aspen (popple)	97	76
Red cedar	98	162
Chestnut	100	100
Sassafras	104	120
Tulip	104	80
Pitch pine	118	112
Red pine	125	92
American elm	125	132
Red maple	137	158
Pin oak	141	222
Black oak	144	208
Red oak	146	206
White oak	150	216
Yellow birch	156	172
White ash	166	214
Scarlet oak	169	240
Black birch	172	208
Pignut hickory	212	
Black locust	232	322

These index figures are based on Table I, Technical Bulletin 158, U. S. D. A., converted on the basis of chestnut equal to 100.

TOBACCO INSECTS IN 1933

DONALD S. LACROIX

Prevalence of Various Species

The eastern field wireworm, *Pheletes ectypus* Say, was present in its usual abundance during the early part of the season.

The potato flea beetle, *Epitrix cucumeris* Harr., appeared in unusual abundance during June, but the increase in population during July was slow in reaching its peak. All types of tobacco were infested with this insect, Shade Grown and Havana Seed suffering more than Broadleaf.

A few specimens of the tobacco flea beetle, *Epitrix parvula* Fabr., were taken on Shade Grown tobacco in Windsor.

Tobacco horn worms, *Phlegethontius quinquemaculata* Haw., and *P. sexta* Johan., were more prevalent on sun grown tobacco this season than last. Injury from these was considerably greater in the Housatonic Valley district.

The tobacco thrips, *Frankliniella fusca* Hinds, caused a large amount of damage (Fig. 6) to Shade Grown and Havana Seed tobacco throughout the Connecticut Valley, but was not found on the Housatonic Valley tobacco.

Only two small infestations of the stalk borer, *Papaipema nitela* Guen., came to our attention.

The tarnished plant bug, *Lygus pratensis* Linn., caused but little trouble generally.

The tobacco budworm, *Heliothis virescens* Fabr., was found on but one plantation in Windsor.

Various species of grasshoppers were present in small numbers.

Aphids were very numerous on Havana Seed in the Housatonic Valley.

Tobacco Thrips*

Because of the unusually heavy infestation of this insect this season every effort was employed to find a satisfactory method of control.

TABLE 17. INSECTICIDES TESTED FOR TOBACCO THRIPS CONTROL

Insecticides	Number of Thrips on 10 leaves					
	July 7, 1933		July 14, 1933		July 21, 1933	
	Dead	Alive	Dead	Alive	Dead	Alive
Dusts						
Cubor dust	0	42	0	31	1	56
Nicotine (4%) dust	1	21	1	24	0	19
Activated Pyrethrum "A"	2	33	1	24	0	41
Activated Pyrethrum "C"	2	26	0	33	0	39
Rotenone dust	1	37	1	27	0	24
Check	0	59	0	42	0	67
Sprays						
Cubor spray (1–200)	29	12	13	6	21	18
Jap soap (1–100)	25	3	10	4	15	27
Nicotine sulfate and soap (1–400)	21	13	17	13	23	21
Nicotine sulfate and penetrol (1–400)	17	15	24	17	19	19
Pyrethrol (1–200)	26	11	29	14	31	11
Check	0	54	0	29	0	49

It became quite apparent that there was a correlation between moisture and thrips population. During hot dry seasons, the insect is quite serious, but during rainy seasons or even years having normal rainfall, little is seen of it. June, July and early August in 1933 were extremely dry, so that in many cases tobacco was irrigated. On the irrigated portions, thrips caused less injury than on those not irrigated.

The response of tobacco thrips to moisture was observed by spraying infested leaves (in the field) with water. The insects immediately began to run around nervously, and when one came in contact with a droplet of water, it would change its course and run in another direction. It was noticed during and after a rain, that the thrips were less numerous on tobacco foliage, and often were entirely absent.

Frankliniella fusca Hinds.

There seemed to be no correlation between temperature and thrips abundance. Several times during the summer, population counts were made on 10 marked leaves to determine this. Thrips damage as it appears on the cured leaf is shown in Fig. 69.

FIGURE 69: Thrips damage. White veins on a cured leaf due to thrips infestation during the growth of the plant.

Because many growers are equipped to apply insecticides as dusts, several dusting materials were tested. All dusts tried in 1933 were found to be ineffective, acting only mildly as repellents. This may be due to the fact that the tobacco foliage is covered with glandular hairs which catch the dust particles and hold them above the leaf surface, so that the thrips can run along depressions next to the midrib and major leaf veins without actually coming in contact with the dust. On the other hand, sprays containing pyrethrum, or nicotine sulphate gave much better results, as can be seen from Table 17. Dates of application were June 27 and July 6, 14 and 20.

The sprays and dusts were applied at weekly intervals throughout July, the latter at rates of from 8 to 12 pounds to the acre, depending upon the size of the plants.

None of the materials applied caused any injury to the leaf. However, it was observed that sprays of any kind applied when the weather was hot (and when the tobacco was badly wilted) did have a tendency to injure leaf tissue.

Flea Beetle Control

The use of barium fluosilicate dust for controlling the potato flea beetle on tobacco was continued this season. There was abundant opportunity to observe the effect of this material when used commercially. A tobacco by-product known as Richmond Filter dust proved to be a very satisfactory carrier for this insecticide, and left little or no visible residue.

Several observations on the plots dusted and sprayed for thrips showed that the pyrethrum dusts killed flea beetles, as also did the sprays, but the dusts were more effective for controlling them. This is possibly due to the fact that the sprays are of little value after they have evaporated and the dusts remain effective for some time after they are applied.

Wireworm Control

The past season's work in wireworm control, centered on three materials, namely; calcium cyanide, carbon disulfide emulsion, and chlor-picrin.

In preliminary tests, these materials were used side by side on the same plot. In later tests they were used on separate plantations. In the first mentioned, the calcium cyanide was placed in furrows 4 inches deep and immediately covered with soil, (used at a rate of 100 pounds per acre); the carbon disulfide emulsion was diluted 1 to 200 with water and applied in furrows 3 inches deep at the rate of 1 quart to 2 linear feet of furrow; the chlor-picrin was poured into holes 3 inches deep and 18 inches apart; 1 ounce of the liquid to each hole. All of these treatments were on infested tobacco soil, and each placed in infested rows of plants.

Three days later the soil was examined for a distance of three linear feet in each row. In the case of the cyanide plot, dead worms were found on both sides within six inches of the center of the row; on the carbon disulfide emulsion plot, a few living worms were found, and no dead ones; on the chlor-picrin plot many dead larvae were found within a seven inch radius of each hole treated and no living ones. The weather was hot during these tests.

On another plantation, 1 acre of infested tobacco soil was treated with 100 pounds of calcium cyanide applied with a corn planter directly to each row of young tobacco plants and at a depth of from 2½ to 3½

inches. (Seventy-five per cent of the larvae were in the top 3 inches of soil at that time). Four days later, an examination of the soil indicated approximately a 66 per cent kill. The weather during these operations was cold and there were intermittent rains. Had the soil been warmer, the percentage of kill undoubtedly would have been greater.

Thus far, calcium cyanide drilled into the infested rows, has proved to be the most economical method of wireworm control. This is substantiated further by tests conducted by Anderson and Britton in 1925.

Many experiments with chlor-picrin were carried on during the summer of 1933. This material is a heavy, clear liquid, very volatile, non-explosive and terribly pungent. It is extremely toxic to insects, but not so toxic to man, as the fumes drive persons to search for fresh air.

After many trials, it was found that this material could be emulsified with fish-oil soap, diluted with water and applied to the soil in any desired quantity.

In actual tests for toxicity, five wireworms were placed in containers (the latter being salve-boxes covered with 50 mesh screen). These were buried (on edge) at 3-, 6-, 9-, 12-inch levels in the field*, 1 row being treated and the other left for a check. The chlor-picrin emulsion was poured into a 3-inch furrow and covered with soil. Examinations were made 48 hours after application. Treatments started with 100 milliliters of the emulsion to 5 liters of water down to 12 milliliters to 5 liters of water with the material applied at the rate of 1 liter per linear foot of row. One hundred per cent kill was observed in every case except the last (12 milliliters chlor-picrin emulsion to 5 liters of water). It did not penetrate to the 12-inch level, as the larvae were alive there.

Several tests on tolerance of tobacco plants to chlor-picrin showed that the material is extremely toxic to young plants even at the greatest dilutions mentioned above. Plants may be set in the field seven days after the chlor-picrin has been applied full strength, and about five days after it has been used at the weaker dilutions, but do not seem to grow as fast as tobacco planted in untreated soil.

Since the fumes from chlor-picrin are so irritating to the eyes and nose, it is absolutely necessary to use a gas mask when handling it.

Distribution of Wireworm Larvae in Tobacco Soil

During the season of 1932, soil on an infested plantation was examined at intervals, to determine the distribution of wireworm larvae at different times of the year and to observe any other activities of this pest.

Similar observations were made during 1933 and the results are included in Table 18. As was true in 1932, the larvae were concentrated in greater number in the tobacco rows. Continued feeding throughout the summer was noticed also this year. Most of the larvae remain below the 3-inch level except during a short period at about the end of May, when a large percentage of them are near the surface.

*Merrimac coarse sandy loam.

TABLE 18. DISTRIBUTION OF WIREWORM LARVAE IN SOIL OF TOBACCO PLANTATION, WINDSOR, CONN. SEASON OF 1933

		Number of larvae in soil						Soil Temperature	
Date	Depth	In row		Between rows		Total	Per cent	°F	Remarks
May 29	0"– 3"	7		4		11	64.7	77	
	3"– 6"	4		1		5	29.4	70	
	6"– 9"	1		0		1	5.8	66	
	9"–12"	0		0		0	0.0	66	
	12"–24"	0		0		0	0.0	66	
		12	70.5%	5	29.5%	17			
June 27	0"– 3"	0		2		2	4.4	78	
	3"– 6"	4		3		7	16.2	72	
	6"– 9"	15		8		23	53.4	71	
	9"–12"	5		3		8	18.3	68	
	12"–24"	3		0		3	6.9	68	
		27	62.7%	16	37.3%	43			
July 10	0"– 3"	0		1		1	5.0	64	
	3"– 6"	5		1		6	30.0	68	Plantation irrigated 24 hrs. previous to these investigations
	6"– 9"	7		3		10	50.0	68	
	9"–12"	2		1		3	15.0	68	
	12"–24"	0		0		0	0.0	68	
		14	70%	6	30%	20			
July 29	0"– 3"	0		0		0	0.0	68	
	3"– 6"	1		0		1	4.0	68	First 4 inches soil extremely dry
	6"– 9"	7 (1 Pupa)		1		8	32.0	68	
	9"–12"	7		1 (Pupa)		8	32.0	68	
	12"–24"	8		0		8	32.0	68	
		23	92%	2	8%	25			
Aug. 25	0"– 3"	1		0		1	3.2	70	
	3"– 6"	1		1		2	6.4	69	
	6"– 9"	9 (1 Pupa)		1		10	32.2	69	
	9"–12"	5		6		11	35.4	69	
	12"–24"	4		3		7	22.5	69	
		20	64.5%	11	35.5%	31			
Sept. 30	0"– 3"	1		0		1	4.0	54	
	3"– 6"	2		2		4	16.0	58	
	6"– 9"	2		3		5	20.0	60	
	9"–12"	7 (1 Adult)		3		10	40.0	66	
	12"–24"	5		0		5	20.0	66	
		17	68%	8	32%	25			
Oct. 28	0"– 3"	0		0		0	0.0	48	
	3"– 6"	0		2		2	11.1	46	Cold rain for 12 hrs. just previous to these investigations
	6"– 9"	3 (1 Adult)		0		3	16.6	46	
	9"–12"	6		2		8	44.4	46	
	12"–24"	3		2		5	27.7	46	
		12	66%	6	33%	18			

Bulletin 360 March, 1934

CONNECTICUT STATE ENTOMOLOGIST

THIRTY-THIRD REPORT

1933

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State Entomologist

Connecticut Agricultural Experiment Station
New Haven

CONNECTICUT AGRICULTURAL EXPERIMENT STATION

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CONNECTICUT STATE ENTOMOLOGIST

THIRTY-THIRD REPORT

1933

W. E. BRITTON

ENTOMOLOGICAL FEATURES OF 1933

The winter of 1932-33 like the preceding winter was not severe and temperatures were not very low. Snowfall was neither heavy nor frequent. Warm weather came on gradually in the spring and plants started into growth at about the normal time. The precipitation was considerably below normal for the months of May, June and July, and was much above normal for August and September.

There was more than the usual amount of injury by cutworms; and climbing cutworms, particularly the variegated cutworm, *Lycophotia margaritosa saucia* Hubn., caused severe injury to pepper and other vegetable and flowering plants. There was the usual injury by the striped cucumber beetle, *Diabrotica vittata* Fabr., the cabbage maggot, *Hylemyia brassicae* Bouché, the cabbage looper, *Autographa brassicae* Riley and the potato flea beetle, *Epitrix cucumeris* Harr.

Severe damage to early sweet corn by the European corn borer, *Pyrausta nubilalis* Hubn., occurred in the region around Hartford, and by the Mexican bean beetle, *Epilachna corrupta* Muls., throughout the state. In certain localities, defoliation of apple and grape was caused by the rose chafer, *Macrodactylus subspinosus* Fabr., and of grape by the light-loving grapevine beetle, *Pachystethus lucicola* Fabr. There was moderate damage throughout the state by the corn ear worm, *Heliothis obsoleta* Fabr. Rose leaves and pear fruit were injured by the rose leaf beetle, *Nodonota puncticollis* Say, and in Sharon, rose was partially defoliated by the green gold beetle, *Chrysochus auratus* Fabr. The Japanese weevil, *Pseudocneorrhinus setosus* Roelofs, reported last year, continued to injure hemlock and ornamental shrubs in West Haven and has caused similar damage in Westville.

The Japanese beetle, *Popillia japonica* Newm., has continued to increase and spread, and was found for the first time in Manchester, Middletown and Putnam. In Bridgeport the beetles were so abundant that grapevines, Virginia creeper, and roses were considerably injured. Injury by the Asiatic beetle, *Anomala orientalis* Waterh., to untreated lawns has continued in the Westville region and has occurred at several other points in New Haven and West Haven. For the first time definite injury by the Asiatic or Japanese garden beetle, *Autoserica castanea* Arr., has been called to our attention, where the adults devoured the leaves of hardy chrysanthemum, heliotrope, lemon verbena and zinnia in a garden in New Haven.

The Oriental fruit moth, *Grapholitha molesta* Busck, was prevalent in about the same degree as last year, there being an increase in some orchards and a decrease in others. Peach orchards in the northern central portion of the state were the most heavily infested. The eastern tent caterpillar, *Malacosoma americana* Fabr., has increased enormously during the last four or five years. The elm leaf beetle, *Galerucella luteola* Mull., caused less damage than in 1932, but unsprayed trees were brown by August 1, in many localities. The European lesser elm bark beetle, *Scolytus multistriatus* Marsh., is now present in Connecticut at Darien, Greenwich and Stamford, and Federal scouts have recently discovered it in Fairfield, Meriden, Naugatuck and New Milford. In New Jersey this insect has been associated with the Dutch elm disease.

Severe damage has been caused to red, Scotch and Austrian pines by the European pine shoot moth, *Rhyacionia buoliana* Schiff., in Fairfield, Middlesex and New Haven counties. Attempts to control it have been made by cutting and burning severely injured trees, clipping off and burning the infested tips, and by spraying.

A large and scattered infestation of the gipsy moth, *Porthetria dispar* Linn., in woodland in Wolcott, required much time and attention in scouting and spraying. In July, just after the spraying season had ended, a large infestation was discovered near Groton Long Point where nearly 30 acres of oak and maple woodland were stripped. Here the number of egg-clusters will run into hundreds of thousands and the place is now being cleaned.

One of the most outstanding entomological events of the season has been the opportunity to take advantage of help from the United States Government in forest insect control by appropriations to furnish work for the unemployed through the Civilian Conservation Corps Camps, the Public Works Administration, and the Civil Works Administration. Weeviled white pine tips over large areas in state forests were cut and burned between June 25 and August 15. Considerable scouting has been done for gipsy moth, and red and Scotch pine tips infested with European pine shoot moth have been clipped off and burned. More of this work will be done during the next few months.

An insect pest survey of the season is given on the following pages, arranged in brief form to save space and expense in printing. Some of the more important items are treated in greater detail in the separate articles and notes printed elsewhere in this report.

INSECT RECORD FOR 1933

Fruit Insects

Name — Locality, host, date and remarks.

Aegeria exitiosa, peach borer. Usual amount of damage to peach trees throughout the state.

Agrilus ruficollis, red-necked cane borer. Injured raspberry, Middletown, Aug. 16.

Alsophila pometaria, fall canker worm. Apple trees at Montowese had been defoliated June 8. Locally abundant and destructive, particularly in the southwestern portion of the state. Stratford, June 17.

Ampelophaga myron, myron sphinx. Caterpillar on grape, Middletown, Aug. 9.

Anuraphis roseus, rosy apple aphid. Scarce early in the season, but in June it became so abundant that severe injury occurred in several orchards particularly in New Haven County. Specimens from Bethel, May 31; Glenbrook, Oct. 7.

Aphis pomi, green apple aphid. Less prevalent throughout the season than usual.

Aspidiotus perniciosus, San José scale. Scarce for several years but now increasing. On apple, Milford, Oct. 19.

Byturus unicolor, raspberry fruit worm. Injured raspberries at New Canaan.

Cacoecia argyrospila, fruit tree leaf roller. Present in some localities, and caused considerable injury in two of the largest apple orchards in New Haven County. Also reported from Greenwich where it has caused considerable damage for several years.

Cacoecia rosaceana, oblique-banded leaf roller. Rather prevalent in apple orchards in 1933.

Carpocapsa pomonella, codling moth. Present in fully the usual numbers in all apple orchards of the state.

Conotrachelus nenuphar, plum curculio. Less abundant than usual, particularly in apple orchards. Injury on apple, Glenbrook, Mount Carmel, Oct. 7.

Eriocampoides limacina, pear slug. Skeletonized the leaves of pear and cherry throughout the state. Larvae on pear, Litchfield, Aug. 14.

Eriophyes pyri, pear leaf blister mite. On pear, New Haven, May 16; Bethany, June 20; Litchfield, Aug. 14.

Eriosoma lanigera, woolly apple aphid. On hawthorn, Ansonia, Aug. 23.

Erythroneura comes, grape leafhopper. Present in usual numbers.

Grapholitha molesta, Oriental fruit moth. Prevalent in about the same degree as in 1932; increased in some orchards and decreased in others. Peach orchards in the northern central portion of the state were the most heavily infested. About 27,000,000 Trichogramma and 4,500 Macrocentrus parasites were reared at this Station in 1933 and distributed to growers for the control of this insect.

Hemerophila pariana, apple and thorn skeletonizer. On hawthorn, Ansonia, Aug. 23.

Hyphantria cunea, fall webworm. Common locally on pear and apple but perhaps less so than in 1932.

Lasioptera vitis, tomato grapevine gall. On grape, Stratford, June 16.

Fruit Insects—(*Continued*)

Name — Locality, host, date and remarks.

Laspeyresia prunivora, lesser apple worm. Injury on apple fruit was evident at harvest time.

Macrodactylus subspinosus, rose chafer. Unusually common and injurious. Injured apples, Watertown, June 13; apple and grape, Jewett City, June 24; grape, Beacon Falls, June 29.

Malacosoma americana, eastern tent caterpillar. Increasingly abundant throughout the state on apple and wild cherry. Cocoon, Stamford, June 28.

Myzus cerasi, cherry aphid. Bethel, May 31.

Nodonota puncticollis, rose leaf beetle. Very abundant and disfigured pears in Hamden by eating into the growing fruit.

Pachystethus lucicola, light-loving grapevine beetle. Unusually abundant and defoliated vineyard of 1200 vines at Beacon Falls, June 29; Norwich, June 17; Norwalk, July 13; Bristol, July 18; Somers, July 24.

Paratetranychus pilosus, European red mite. Not as common as in some seasons, but was present on Baldwin in several localities.

Pelidnota punctata, spotted grapevine beetle. Less abundant than in 1931. Beacon Falls, June 29; Middletown, July 20; Somers, July 24.

Phyllophaga fusca, a May or June beetle. Two adults eating raspberry leaves, Orange, May 27.

Phyllophaga tristis, a small May or June beetle. Many adults feeding on raspberry leaves, Orange, May 27; Easton, June 7.

Phylloxera vitifoliae, grape phylloxera. Galls on grape leaves, Middletown, July 20.

Psyllia pyricola, pear psylla. Present but less abundant than in outbreak seasons.

Rhagoletis pomonella, apple maggot. Fully as prevalent as in 1932, and caused injury in many orchards. Infested fruit from Kensington, Jan. 7; Mount Carmel, Oct. 7.

Samia cecropia, cecropia moth. Cocoon on apple, Middletown, July 14.

Scolytus sulcatus. Adults in plum, Greenwich, July 22.

Tmetocera ocellana, bud moth. Not prevalent. Larva on apple, Woodbridge, June 1.

Typhlocyba pomaria, white apple leafhopper. Present but less injurious than in 1932.

Xylina sp., green fruit worms. Injury by green fruit worms was common in apple orchards.

Vegetable Insects

Anaphothrips striatus, grass thrips. On corn, Greenwich, June 27.

Anasa tristis, squash bug. New Haven, Aug. 1. Abundant throughout the state.

Aphis maidis. corn leaf aphid. On corn, Hamden, Aug. 9.

Vegetable Insects—(*Continued*)

Name — Locality, host, date and remarks.

Cirphis unipuncta, armyworm. Not generally prevalent. Injuring corn, Orange, June 28.

Crambus sp. (unidentified). Larva in corn, East Granby, May 27.

Cutworms, were fully as abundant as usual and troublesome throughout the state.

Deloyala clavata, clavate tortoise beetle. Adults on tomato, Essex, June 12.

Diabrotica vittata, striped cucumber beetle. Very common throughout the state.

Empoasca fabae, potato leafhopper. Some fields heavily infested resulting in severe tip burn particularly in central portion of state. On bean, New Haven, Aug. 3.

Epicauta cinerea var. *marginata,* margined blister beetle. Adults on Swiss chard and other vegetables, West Haven, July 18; New Milford, July 20.

Epicauta pennsylvanica, black blister beetle. Adults, West Haven, July 14.

Epilachna borealis, squash beetle. More abundant than usual.

Epilachna corrupta, Mexican bean beetle. Adults appeared earlier and were more prevalent than in 1932. Second generation delayed by cool wet weather, with injury somewhat less than last year. Commercial damage occurred throughout the state. New Haven, July 20.

Epitrix cucumeris, potato flea beetle. Adults appeared in large numbers May 19 and caused severe damage to potatoes in the Connecticut River Valley. Also more abundant on tobacco at East Hartford, West Granby, Windsor and Windsor Locks than in 1932.

Frankliniella fusca, tobacco thrips. Was more injurious than usual to tobacco in Windsor and East Hartford.

Glisrochilus quadriguttatus, four-spotted sap beetle. In corn injured by European corn borer, Milford, July 19, 27; Ellington, July 26.

Gryllus assimilis, field cricket. Injured tomatoes by eating into the green and ripe fruits, Windsor, Sept. 7.

Heliothis obsoleta, corn ear worm. Injured corn throughout the state. Saugatuck, Oct. 23.

Heliothis virescens, tobacco budworm. Injures tobacco by eating into the buds. Equally abundant as in 1932. Windsor, July and August.

Hylemyia brassicae, cabbage maggot. Very abundant and destructive to untreated plants throughout the state, particularly at Storrs, East Hartford, East Haven, North Haven, Milford, Orange, Cheshire, Windsor and Woodbury in June.

Hylemyia cilicrura, seed corn maggot. Spring injury to vegetable seeds about as usual. In germinating spinach, Branford, Sept. 21.

Leptinotarsa decemlineata, Colorado potato beetle. Somewhat less prevalent than usual at Mount Carmel.

Lycophotia margaritosa saucia, variegated cutworm. Injured pepper plants severely at Southington in June.

Vegetable Insects—(*Continued*)

Name — Locality, host, date and remarks.

Melanotus communis, wireworm. Larvae in corn, Middletown, June 29.

Melittia satyriniformis, squash borer. Abundant in usual numbers, Woodbridge, July 31; Greenwich, Aug. 14.

Ormenis sp., mealy flata. On bean, Middletown, July 8.

Papaipema nitela, stalk borer. In bean, Middletown, July 8; in corn, East Windsor, July 11.

Phlegethontius sp., tomato or tobacco worm. Larva on tomato, Winsted, Aug. 10; Milford, Aug. 16.

Phyllophaga tristis, a May or June beetle. Adults injured beans, New Haven, May 12.

Phytonomus rumicis, sorrel weevil. Injured sour grass or sorrel grown for seed, Milford, June 1, 20.

Pyrausta nubilalis, European corn borer. Very abundant and destructive to corn in southern and central portions of the state. In late winter larvae were abundant in cornstalks in the field in New London and Middlesex Counties. Many had been removed from the stalks by birds. Larvae injured potatoes in East Hartford in June. In corn, East Windsor, July 11; Southport, July 19; Ellington, July 26; Hartford, July 28; Saugatuck, Oct. 23.

Rhopalosiphum pseudobrassicae, turnip aphid. Southington, Aug. 2.

Sibine stimulea, saddle-back caterpillar. Feeding on corn, New Haven, Aug. 14; Norwalk, Norwich, Sept. 23.

Thrips tabaci, onion thrips. Responsible for much damage to onions grown from seed and sets in the Connecticut River Valley. On garden peas, Milford, June 14.

Shade and Forest Tree Insects

Acrobasis sp.? (unidentified). Small brown larva, crushed in the mails, on butternut, Higganum, May 8.

Acrosternum hilare, green stink bug. On cut-leaf maple, Hartford, Sept. 20.

Adelges abietis, spruce gall aphid. Common on Norway spruce, Norwalk, June 1, 30; Essex, June 20; Waterville, July 5; Greenfield Hill, July 17; Torrington, Sept. 16.

Adelges pinicorticis, pine bark aphid. Common everywhere on white pine. New Haven, May 24; Niantic, July 11; West Haven, Oct. 13.

Agrilus anxius, bronze birch borer. Injured white birch trees, Thompsonville, July 18.

Agrilus bilineatus, two-lined chestnut borer. Rather severe injury to beech branches, Greenwich, July 24, according to Dr. E. P. Felt.

Alsophila pometaria, fall canker worm. Defoliated trees locally in the southwestern portion of the state.

Shade and Forest Tree Insects—(*Continued*)

Name — Locality, host, date and remarks.

Anisota senatoria, orange-striped oak worm. Many trees wholly or partially stripped Sept. 22, in Griswold, Groton, Ledyard, Lisbon and Preston, according to J. V. Schaffner, Jr.

Aphids (unidentified). On spruce, Norwalk, June 30.

Argyresthia thuiella, arborvitae leaf miner. Severe injury, Watertown, June 23.

Aspidiotus abietis, a circular armored scale. On hemlock, Cos Cob, Mar. 3.

Aspidiotus tsugae, a circular armored scale. On *Taxus*, Greenwich, Mar. 24.

Basilona imperialis, imperial moth. Adult, East Lyme, Sept. 20.

Battaristis vittella, a pine shoot moth. Simsbury, Nov. 5, 1932; Hartland, June 17; Brookfield, June 23; Wallingford, Aug. 21.

Biorhiza forticornis, oak fig gall. On white oak, New London, July 31.

Bryobia praetiosa, clover mite. On red pine, West Haven, Feb. 28.

Buprestid beetle (unidentified). Mangled larva in oak twig, New Haven, Sept. 14.

Calaphis castaneae, a leaf aphid. On chestnut, Hamden, Sept. 27.

Callirhytis operator, a Cynipid gall. On pin oak, Bridgeport, June 17.

Cecidomyia niveipila, woolly fold gall. On pin oak, Litchfield, June 6.

Cecidomyia ocellaris, maple leaf spot gall. New Haven, June 3; South Norwalk, June 7.

Cecidomyia sp. (unidentified). A gall on pin oak, West Redding, July 7.

Chionaspis pinifoliae, pine leaf scale. Watertown, Nov. 8, 1932; East Windsor Hill, Apr. 20; Farmington, June 17; Manchester, June 20; New York, N. Y., July 31; Rockville, Aug. 1; Greenwich, Aug. 10; Devon, Aug. 14; West Hartford, Oct. 27.

Chrysobothris sp., a flat-headed borer. Larva in hemlock, Branford, Nov. 15, 1932.

Cincticornia pilulae, oak pill gall. On scarlet or red oak, Old Lyme, Sept. 20.

Citheronia regalis, hickory horned devil; regal moth. Larvae, Portland, Aug. 23; Groton, Sept. 16; Waterbury, Sept. 18.

Clastoptera sp., a spittle bug. On juniper, Devon, July 14; Guilford, July 20.

Cnidocampa flavescens, Oriental moth. Empty cocoons on Norway maple, Winthrop, Mass., July 28.

Coleophora laricella, larch case bearer. Prevalent throughout the state, and was particularly destructive in Litchfield County. Litchfield, June 5.

Coleophora limosipennella, elm case bearer. Locally abundant from Branford westward, according to Dr. E. P. Felt.

Conophthorus coniperda, pine cone beetle. In white pine cones, Keene, N. H., June 24.

Shade and Forest Tree Insects—(*Continued*)

Name Locality, host, date and remarks.

Corythucha arcuatus, oak lacebug. On white oak, Cobalt, June 14.

Corythucha ciliata, sycamore lacebug. Very abundant throughout the state. Sycamore leaves brown in late summer from injury by this insect. Wallingford, Aug. 31.

Corythucha pallida ulmi, elm lacebug. Reported by Dr. E. P. Felt as being abundant on elm in the vicinity of Kent, Aug. 24.

Cryptorhynchus lapathi, poplar and willow curculio. Manchester, June 20.

Cynip galls (unidentified). On white oak, Cobalt, June 14.

Dasyneura communis, gouty vein gall. Union, June 17; South Glastonbury, June 22.

Dasyneura corticis, a gall on willow. West Hartford, May 24.

Diapheromera femorata, walkingstick. Hamden, Oct. 13.

Diaspis carueli, juniper scale. On juniper, Bridgeport, Sept. 26.

Dilachnus sp., an aphid on beech. Greenwich, July 21.

Dilachnus sp., an aphid on pine. Rockville, Aug. 1.

Diprion simile, introduced pine sawfly. Larvae and cocoons on stone pine, Ridgefield, Sept. 8.

Dryophanta lanata, an oak leaf gall. On pin oak, New Britain, Sept. 13; West Hartford, Sept. 22; Hamden, Sept. 30.

Eriophyes modesta, a mite gall. On sugar maple, Guilford, Sept. 13.

Eriophyes sp., mite galls, probably four different species. On maple, Mass., July 17; on poplar, Mass., July 17; on linden, Greenwich, June 15, July 11; on elm, Cos Cob, May 27.

Eucosma gloriola, pine tip moth. On white pine reported by Dr. E. P. Felt, Greenwich and Stamford.

Eulia pinatubana, pine tube moth. On white pine, Norwalk, July 7, Oct. 27; Hartford, Oct. 27.

Fenusa pumila, birch sawfly. Westfield, Mass., June 14.

Fiorinia japonica ? a scale insect on hemlock. Cos Cob, Mar. 3.

Galerucella luteola, elm leaf beetle. Fairly abundant throughout the state but perhaps less so than in 1931 and 1932. Adult beetles, Stamford, Dec. 6, 1932; West Haven, Apr. 28; Norwich, May 2; Greenwich, May 4; injured leaves, Gaylordsville, July 10; Rockville, July 19; Stamford, Aug. 25.

Gall mites, on pin oak, Litchfield, June 6.

Gelechia abietisella, hemlock webworm. Branford, June 21.

Gillettea cooleyi, blue spruce gall aphid. Waterbury, Feb. 9; Bethlehem, Apr. 10; Southington, Apr. 22; West Hartford, Apr. 27; Hamden, May 12; New Haven, July 21, 28, Aug. 10; Rockville, Aug. 1; Wethersfield, Aug. 3; Middletown, Aug. 5; Windsor, Aug. 31.

Shade and Forest Tree Insects—(*Continued*)

Name Locality, host, date and remarks.

Glycobius speciosus, maple borer. Injury observed in East Haven, Sept. 21.

Haltica ulmi, green elm beetle. Occurred in great numbers at base of elm tree, Canaan, Mar. 14.

Hickory midge gall (unidentified). Cheshire, July 21.

Hormaphis hamamelidis, witch-hazel cone gall. On birch, Hamden, May 31.

Hypermallus villosum, twig pruner. Adult, Waterbury, June 16.

Itonida foliora, a marginal leaf fold gall. On black oak, Hartford, June 5.

Kermes sp. (unidentified), oak gall scale. On white oak, Hartford, June 13; on oak, New Haven, Aug. 8.

Lapara bombycoides, pine tree sphinx. Larvae, Woodbridge, Sept. 5.

Lecanium fletcheri, arborvitae scale. On arborvitae, Clinton, June 10; Darien, June 21.

Lepidopterous larvae (unidentified). On red pine, East Hampton, July 21; Austrian pine, Branford, Oct. 31.

Lepidosaphes ulmi, oyster-shell scale. On ash, Waterbury, June 28.

Leucaspis japonica, a Japanese armored scale. On Norway maple and California privet, New Haven, May 27, July 13.

Lithocolletis hamadryadella, white oak blotch leaf miner. On white oak, Cheshire, July 21.

Macrosiphum liriodendri, a leaf aphid. On tulip tree, East Haven, June 21.

Mites (unidentified). On oak, Bridgeport, Sept. 6.

Myzocallis walshi, a leaf aphid. On pin oak, Middletown, Aug. 29.

Neodiprion lecontei, red-headed pine sawfly. Larvae, New London, Aug. 19.

Neodiprion pinetum, Abbot's sawfly. Larvae, Columbia, June 19; Winsted, July 22.

Neolecanium cornuparvum, magnolia scale. Hamden, Aug. 8.

Nepticula sericopeza, Norway maple leaf-stalk borer. Litchfield, Redding Ridge, June 6.

Neuroterus batatus, oak potato gall. Bloomfield, June 2.

Paratetranychus ununguis, spruce mite. On hemlock, Cos Cob, Mar. 3; Putnam, June 29; West Hartford, July 5; New Canaan, July 13; Bridgeport, Sept. 26; on pine, New York, N. Y., July 31; on juniper and retinospora, Bridgeport, Oct. 31.

Philonix niger, a Cynipid oak gall. On pin oak, Westport, Aug. 29.

Phyllocoptes aceris-crumena, maple spindle gall. Mass., July 17.

Phyllocoptes quadripes, maple bladder gall. On silver maple, Manchester, May 22; Canaan, June 1; Darien, June 8; New Britain, June 22; Niantic, July 5.

Shade and Forest Tree Insects—(*Continued*)

Name Locality, host, date and remarks.

Phylloxera caryaecaulis, hickory stem gall aphid. Bloomfield, June 12; South Glastonbury, Aug. 19.

Phylloxera caryaefallax, a stem gall on hickory. South Glastonbury, June 22.

Pissodes approximatus, a pine weevil. Woodbridge, Sept. 5; Bridgeport, Oct. 19; also the following may prove to be this species: larvae in red pine, Hartford, June 7; pupal cells in Douglas fir, Hartford, Sept. 6.

Pissodes strobi, white pine weevil. In white pine, Brookfield, June 23; in Norway spruce, Rockville, Aug. 1.

Plagiodera versicolora, imported willow leaf beetle. Adults, West Hartford, May 26; adults, larvae, pupae, and injured leaves, Stratford, June 31; larvae and injured leaves, West Haven, Aug. 8.

Porthetria dispar, gipsy moth. A stripped area of about 30 acres of oak and maple was discovered near Groton Long Point in July, and clean-up measures are now in progress. Hundreds of thousands of egg-clusters have been found and creosoted. Adults, Preston, Aug. 4.

Prionus laticollis, broad-horned prionus. Adult, Madison, July 17.

Priophorus acericaulis, maple leaf stem borer. Thompsonville, Hartford, May 29; New Haven, June 1; Middletown, June 10.

Pseudococcus comstocki, catalpa mealybug. On umbrella catalpa, New Britain, July 17.

Pulvinaria acericola, cottony maple leaf scale. On Cornus, Bridgeport, June 17.

Pulvinaria vitis, cottony maple scale. On Norway maple, Thompsonville, July 28.

Rhyacionia buoliana, European pine shoot moth. Very prevalent in southwestern portion of the state and has severely injured red pine in many forest plantings. Larvae in red pine, Farmington, Simsbury, Nov. 15, 1932, June 17; Hartford, June 7, 17; Brookfield, June 23; in mugho pine, Norwalk, July 7; in Scotch pine, Chelmsford, Mass., Oct. 19; Hempstead, N. Y., Oct. 23.

Rhyacionia comstockiana, a pine shoot moth. Larva in red pine, Nepaug, Nov. 15, 1932.

Rhyacionia frustrana, Nantucket pine moth. In short-leaf and loblolly pine, Durham, N. C., Sept. 18.

Rhyacionia rigidana, a pine shoot moth. Pupae in red pine, Simsbury, Nov. 15, 1932; West Greenwich, R. I., Oct. 24.

Samia cecropia, cecropia moth. Larva on maple, Hamden, Aug. 4.

Sawfly larvae, injury to red pine, Middletown, Oct. 27.

Scolytid beetle (unidentified). In arborvitae, Cheshire, Aug. 17.

Scolytus multistriatus, a European elm bark beetle. Present in dead and dying elm, Darien, Fairfield, Greenwich, Meriden, Naugatuck, New Milford and Stamford, according to Dr. E. P. Felt and Federal Scouts. This insect is associated with the Dutch elm disease.

Shade and Forest Tree Insects—(*Continued*)

Name Locality, host, date and remarks.

Serica sericea, a Scarabaeid beetle. Adult, South Glastonbury, June 22.

Sesia acerni, maple sesian. Characteristic galls of this insect on maple branch, Brandon, Vt., July 24.

Stilpnotia salicis, satin moth. Adults and pupae on Carolina poplar, New Haven, June 30.

Symmerista albifrons, a Notodontid moth. Mr. J. V. Schaffner, Jr., reported the larvae as common on white oak in woodlands, Thompson and vicinity, Sept. 12 to 19.

Tetralopha robustella, a pine moth. Work on pine, Branford, Sept. 28; Hamden, Oct. 21; Danielson, Oct. 28.

Tetranychus bicolor, oak mite. On pin oak, New Britain, Sept. 13; on chestnut, Hamden, Sept. 29.

Thyridopteryx ephemeraeformis, bagworm. On arborvitae, West Point, N. Y., July 5; Greenwich, July 22; New Jersey, Aug. 4.

Toumeyella liriodendri, tulip tree scale. East Haven, June 21.

Xylotrechus quadrimaculatus, a Cerambycid borer. Reported by Dr. E. P. Felt as injuring a beech hedge, New Canaan, Apr. 24.

Zeuzera pyrina, leopard moth. Pupa in elm, Danbury, May 26; adult, New Haven, June 27; larva in sycamore, Hamden, Sept. 30.

Insects of Ornamental Shrubs and Vines

Agrilus communis ab. *rubicola,* rose stem girdler. On *Rosa hugonis,* Bolton, Dec. 9, 1932.

Aphis spiraecola, spiraea aphid. New Haven, June 23.

Archips rosana, rose leaf folder. On California privet, Hamden, May 25; Bridgeport, May 29.

Brachyrhinus ovatus, strawberry crown girdler. Adults associated with the black vine weevil from roots of injured *Taxus,* Hamden, June 14.

Brachyrhinus sulcatus, black vine weevil. Larvae on roots of injured *Taxus,* New Haven, Apr. 21; adults, Hamden, June 14.

Caliroa aethiops, rose sawfly. Injured rose leaves, West Hartford, Aug. 24.

Chionaspis euonymi, euonymus scale. On *Pachysandra terminalis,* New Haven, Dec. 7, 1932; Bridgeport, Sept. 26; on bittersweet, Hamden, July 21; on euonymus, Centerbrook, Jan. 19; New Haven, Feb. 18, July 17, Oct. 13; Middlebury, Aug. 4; Manchester, Aug. 16; Bridgeport, Sept. 26.

Chrysochus auratus, green gold beetle. Adults, Hartford, June 28; Norfolk, Aug. 14; feeding on rose, Sharon, July 24.

Corthylus punctatissimus, pitted ambrosia beetle. Injury to rhododendron, Greenwich, Oct. 23.

Insects of Ornamental Shrubs and Vines—(*Continued*)

Name — Locality, host, date and remarks.

Corythucha cydoniae, quince lacebug. On *Pyracantha* or firethorn, Greenwich, Apr. 24, according to Dr. E. P. Felt.

Crabro sp. Adults boring in cut rose stems, Bristol, Sept. 16.

Eriococcus azaleae, azalea scale. Meriden, Aug. 14; New Haven, Sept. 29.

Euphoria inda, bumble flower beetle. North Haven, May 11; Hartford, Aug. 29, 31; Putnam, Sept. 1; on boxwood, Darien, Sept. 13.

Eurycyttarus confederata, a small moth. Larva lives in a case of leaves and stems and is found hanging from the under edge of shingles and clapboards. New Haven, July 31.

Gracilaria azaleella, azalea leaf miner. Injured azalea leaves, Greenwich, Mar. 24.

Leaf roller (unidentified). On rose, Branford, June 24; West Hartford, Aug. 24.

Lecanium excrescens, a scale insect. On wistaria, Greenwich, Feb. 23. Reported by Dr. E. P. Felt, the first record of this insect for Connecticut.

Lepidosaphes newsteadi, a scale insect. Injured umbrella pine, Greenwich, Mar. 24.

Lepidosaphes ulmi, oyster-shell scale. On lilac, Keene, N. H., Sept. 18.

Liosomaphis berberidis, barberry aphid. On Japanese barberry, New Haven, May 18.

Mamestra picta, zebra caterpillar. Larva on rose, Branford, June 24.

Mite injury (unidentified). On azalea, Wethersfield, Sept. 14; on lilac, Keene, N. H., Sept. 18.

Monarthropalpus buxi, boxwood leaf miner. Injured boxwood leaves. Maggots healthy in midwinter, Southport, Feb. 21.

Nodonota puncticollis, rose leaf beetle. Injuring rose, Southport, June 9.

Pemphredon tenax, a solitary wasp. Boring in cut rose stem, Bristol, Sept. 16.

Popillia japonica, Japanese beetle. Feeding on rose, Greenwich, Aug. 7.

Pseudocneorrhinus setosus, a Japanese weevil. Adults feeding on various shrubs, New Haven, June 7; West Haven, June 16.

Pyrausta nubilalis, European corn borer. Larva tunneling in rose stem, New Haven, Oct. 20.

Rhodites radicum, rose root gall. On *Rosa rugosa*, Thompsonville, May 1.

Saperda puncticollis, woodbine borer. Adult in house, New Haven, June 10.

Sphecodina abbotii, Abbot sphinx. Larva feeding on grape and woodbine, Norwich, July 28.

Stephanitis rhododendri, rhododendron lacebug. On rhododendron, Norwalk, Feb. 18; Wilton, Apr. 25; Hamden, Apr. 27, Sept. 5, Oct. 21; Newington, May 25; New Haven, July 27.

Typhlocyba rosae, rose leafhopper. On rose, West Hartford, Aug. 24.

Insects of Ornamental Shrubs and Vines—(*Continued*)

Name — Locality, host, date and remarks.

Vespa crabro, giant hornet. Adult, June 21; girdled arborvitae twigs, Cromwell, July 13.

Insects of Flowers and Greenhouse Plants

Agriolimax agrestis, garden slug. Injured canna, Funkia and violet, New Haven, Aug. 16.

Aphis (unidentified). On begonia, New Haven, Mar. 13.

Automeris io, io caterpillar. Feeds on many different kinds of plants. Hamden, Aug. 31.

Aylax glechomae, a gall on ground ivy. Hamden, June 6.

Deloyala clavata, clavate tortoise beetle. Adults feeding on Chinese lantern plant, New Haven, Sept. 14.

Epicauta cinerea var. *marginata*, margined blister beetle. Feeding on Nicotiana, New Haven, July 26.

Epicauta pennsylvanica, black blister beetle. Feeding on various flowers, New Haven, Aug. 29.

Hemichionaspis aspidistrae, fern scale. On fern, Mystic, Sept. 26.

Lycophotia margaritosa saucia, variegated cutworm. Larva feeding on Narcissus bud, Hartford, Feb. 9.

Macrodactylus subspinosus, rose chafer. Feeding on peony flower, New Haven, June 9.

Macronoctua onusta, iris borer. Larvae in rootstocks, Oxford, July 12; New Haven, Aug. 9.

Poecilocapsus lineatus, four-lined plant bug. On Veronica, Madison, June 29; on aster, verbena, chrysanthemum, coreopsis and gaillardia, West Hartford, July 8; on spearmint, Branford, July 11.

Pseudococcus sp. (unidentified), a mealybug. On Croton, New Haven, Mar. 13; on gladiolus, Orange, May 4.

Pyrausta nubilalis, European corn borer. Pupa in zinnia stem, Old Lyme, July 31; in dahlia, New Haven, Sept.

Rhizoglyphus hyacinthi, bulb mite. In narcissus bulbs, New Haven, Feb. 28; in Bermuda lily, North Haven, Mar. 29.

Saissetia hemisphaerica, hemispherical scale. On house plant, New Haven, Aug. 3.

Sibine stimulea, saddle-back caterpillar. Larvae on wild cherry, North Branford, Sept. 5; on iris, Bridgeport, Sept. 6; on hardy aster, New Haven, Sept. 18; on corn, Norwalk, Norwich, Sept. 23.

Sminthurus hortensis, garden springtail. From gladiolus field, Orange, May 23.

Sowbug (unidentified). Feeding on pansy and violet, Greenwich, May 26.

Insects of Flowers and Greenhouse Plants—(*Continued*)

Name — Locality, host, date and remarks.

Taeniothrips gladioli, gladiolus thrips. Somers, July 24; Seymour, Sept. 29; Yalesville, Oct. 13.

Tarsonemus pallidus, cyclamen mite. On snapdragon, Montowese, Jan. 19; on larkspur, New London, May 8; Yalesville, May 16; New Haven, May 16, 27; Middletown, May 25; Hamden, June 14.

Tetranychus telarius, common red spider. On English ivy, Bridgeport, Feb. 18; on phlox, Oxford, July 12.

Thrips (unidentified). On snapdragon, Plantsville, Mar. 4.

Insects of Soil and Lawn

Agapostemon virescens, nests in lawn and hard soil. South Manchester, July 14.

Amara sp. (unidentified), a small ground beetle. Adults in soil, Norwich, May 12.

Anomala orientalis, Asiatic beetle. Larvae, Westville, Apr. 29, May 12, 17, Sept. 22, Oct. 2; New Haven, May 25, Aug. 19, Oct. 10, 11; West Haven, Sept. 25, 27; adults, Westville, June 22.

Autoserica castanea, Asiatic or Japanese garden beetle. Larvae, New Haven, Sept. 27, Oct. 7. Adults from same garden collected in July, received Oct. 2.

Blissus leucopterus, chinch bug. Killed grass in spots, Hamden, June 29; Old Greenwich, July 14; Hartford, July 25; Bridgeport, Aug. 10.

Bolboceras farctum, a Scarabaeid beetle. Adult in soil, New Haven, June 6.

Bolboceras farctum var. *tumefactum*. Adult, Hamden, May 27.

Carabus nemoralis, a large ground beetle. Adult, Southport, Apr. 19.

Chlorion ichneumonium, a large solitary wasp. Adult, Hamden, Aug. 29.

Colletes aestivalis, a sand-nesting bee. Adult, Collinsville, May 16.

Crambus caliginosellus, sod webworm. From golf greens, Woodbridge, July 13, 25.

Eutrombidium locustarum, grasshopper mite. A brilliant scarlet mite in soil, East Norwalk, Apr. 11.

Gordius lineatus, hair snake. In soil, Fairfield, June 1.

Gryllotalpa hexadactyla, mole cricket. Adult, Guilford, May 23.

Lasius interjectus, a brown ant. New Haven, May 2.

Philanthus longicornis, a solitary wasp. West Hartford, Aug. 9.

Phyllophaga tristis, a small May or June beetle. Larvae injured grass, Willimantic, Apr. 21; adult on bean, New Haven, May 12.

Phyllophaga sp. (unidentified). Larva and adult, Woodbridge, May 23; larva, New Haven, Sept. 27.

Insects of Soil and Lawn—(*Continued*)

Name — Locality, host, date and remarks.

Popillia japonica, Japanese beetle. Larva in soil, New Haven, Sept. 27.

Silpha americana, a carrion beetle. Adult, Hamden, July 18.

Sphecius speciosus, cicada killer. Nests in hard ground, Ansonia, Aug. 24.

Insects of the Household and Stored Food Products

Anthrenus scrophulariae, carpet beetle. Larvae, New Haven, Nov. 8, 1932; Watertown, June 7; White Plains, N. Y., June 28; Hartford, Oct. 30.

Apis mellifera, honey bee. Swarm colonies in chimney or porch, Hamden, Aug. 24; New Haven, Sept. 18, 22.

Attagenus piceus, black carpet beetle. Larvae, Bridgeport, Nov. 10, 1932; Waterbury, Mar. 25; Meriden, June 9; Fairfield, July 12; White Plains, N. Y., Oct. 27.

Brachyrhinus ovatus, strawberry crown girdler. Adults in houses, Cheshire, July 10; West Haven, July 14; New Canaan, July 20; New Haven, July 25, Aug. 26.

Bryobia praetiosa, clover mite. Young mites crawling on the walls of buildings, Madison, Apr. 21; Hamden, May 4.

Dermestes lardarius, larder beetle. Adult, Wilton, May 24.

Dermestes nidum, a Dermestid beetle. Adults, South Norwalk, Dec. 8, 1932; Bridgeport, Feb. 23.

Forficula auricularis, an earwig. New Bedford, Mass., June 22.

Lepisma saccharina, silverfish or bristletail. Hartford, July 28.

Mylabris quadrimaculatus, four-spotted bean weevil. Hartford, May 16.

Scutigera forceps, house centipede. Hartford, May 16.

Sitotroga cerealella, Angoumois grain moth. In popcorn, North Stonington, Jan. 23.

Thermobia domestica, fire brat. West Haven, Mar. 9.

Tinea granella, European grain moth. Adults, New Haven, Feb. 27.

Tineola biselliella, webbing clothes moth. Infesting mohair, Hamden, Mar. 2.

Insects Infesting Timbers and Wood Products

Alaus oculatus, eyed click beetle. Adult in dead stump, Hamden, Feb. 2; adults, Colchester, June 7; East Haven, June 7, 9.

Asilid larva (unidentified). In telephone pole, Sept. 11.

Camponotus pennsylvanicus, carpenter ant. Mount Carmel, July 10; New Haven, Aug. 10; Westbrook, Sept. 7.

Insects Infesting Timbers and Wood Products—(*Continued*)

Name	Locality, host, date and remarks.

Cyllene caryae, hickory borer. In houses, probably emerged from fuel wood, New Haven, Mar. 9; West Haven, Mar. 29; Danbury, Apr. 25; Hartford, May 20.

Bee (unidentified). Tunneling in decayed wood. New Haven, Oct. 31.

Diaperis maculata, a Tenebrionid beetle. In telephone pole, Sept. 11.

Dicerca divaricata, a Buprestid beetle. Adults, Hartford, July 28.

Elaterid (unidentified), a click beetle. Larva and pupa in telephone pole, Sept. 11.

Formica exsectoides, mound-building ant of the Alleghanies. In cedar cabin, Woodbridge, July 27.

Hylotrupes bajalus, a long-horned beetle. Adult in clapboard of house, Bristol, July 22.

Lyctus sp. (unidentified), a powder post beetle. Adults in hickory porch chairs, Salisbury, June 16.

Parandra brunnea, Parandra borer. Adult from telephone pole, Sept. 16.

Pelidnota punctata, spotted grapevine beetle. Larva in decaying wood, New Haven, Nov. 2, 1932; adults and larvae from telephone pole, New Haven, July 25.

Phymatodes variabilis, a long-horned beetle. Larva is a borer in dead and dying oak twigs. Adults in house, probably emerged from fuel wood, Hartford, May 16.

Reticulitermes flavipes, termites; white ants. Damaged buildings, Milford, June 6, 12, Aug. 28; Hartford, Apr. 13; New Haven, May 2; South Manchester, May 27; Clinton, June 28; in telephone pole, New Haven, July 25.

Tenebrionid beetle (unidentified). Larva in decaying telephone pole, New Haven, July 25.

Valgus sp. (unidentified), a Scarabaeid beetle. Larva in telephone pole, Sept. 11.

Xestobium rufovillosum, a Ptinid beetle. Oak timbers in an old house honeycombed by this insect, Bethany, Aug. 7.

Xylocopa virginica, carpenter bee. Tunneling in wood, Shelton, May 26.

Beneficial Insects

Adalia bipunctata, two-spotted ladybeetle. Adult, Ivoryton, May 29.

Anatis quindecimpunctata, fifteen-spotted ladybeetle. Adult, West Hartford, May 26.

Ceratomegilla fuscilabris, spotted ladybeetle. Adults, Hamden, May 18; West Haven, July 14.

Coccinella novemnotata, nine-spotted ladybeetle. Adults, Devon, June 1; Southington, Aug. 29.

Coccinella transversoguttata, five-spotted ladybeetle. Adults, Ivoryton, May 29; Southington, Aug. 29.

Beneficial Insects—(*Continued*)

Name	Locality, host, date and remarks.

Ladybeetle larvae (unidentified). On turnip, Milford, July 27.

Podisus sp. (unidentified). Nymphs on mountain ash, New Haven, May 12.

Tenodera sinensis, Chinese mantid. Adults, West Haven, Sept. 25; Bridgeport, Oct. 13.

Xanthogramma divisa, a Syrphid fly. Larva with aphids, Middletown, Aug. 29.

Miscellaneous Insects

Amphion nessus, nessus sphinx moth. Adult, New Haven, May 27.

Aphodius fimetarius, a Scarabaeid dung beetle. Adult on peach tree, New Britain, Sept. 28.

Armadillium vulgare, sowbug or pillbug. Milford, Aug. 2; Essex, Aug. 28; Madison, Oct. 12.

Balaninus caryae, hickory-nut weevil. Injured nuts, Cromwell, Nov. 25, 1932.

Bibio albipennis, march fly. Adults resting on tree foliage, New Canaan, May 25.

Ceutophilus gracilipes, a cave cricket. Adult on locust tree trunk, Norfolk, July 10.

Chauliodes pennsylvanicus, fish-fly. Adults, Middletown, Aug. 25.

Chrysops callidus, green head fly. Very abundant biting humans and livestock, along the coast, July 22.

Cingilia catenaria, chain-spotted geometer. Adults, Cape Cod, Mass., Sept. 27.

Coleophora unicolorella, a small moth. Larva on seeds of *Juncus gerardi*, on salt marsh, East Haven, June 30.

Corydalis cornuta, dobson, hellgrammite. Adult, Hartford, June 28.

Dipterous puparia in milk bottle, New Haven, Sept. 22.

Entylia bactriana, a tree hopper. Ivoryton, May 29.

Estigmene acrea, salt marsh caterpillar. Adult, Farmington, June 17.

Eumenes fraterna, potter wasp. Nest on maple twig, Thompson, July 1.

Geotrupes splendidus, a Scarabaeid beetle. Adult, Bristol, Aug. 3.

Gymnetron teter, a small weevil. Ivoryton, May 29.

Hemaris thysbe, a clear-wing sphinx moth. Adults, Plainfield, Aug. 9; Putnam, Sept. 1.

Lethocerus americanus, giant waterbug. Adult, Winchester, Apr. 27.

Lucanus capreolus, stag beetle. Adults, Middletown, July 22; New Haven, Aug. 11.

Melanotus communis, a click beetle. Adult, Waterbury, June 16.

Miscellaneous Insects—(*Continued*)

Name	Locality, host, date and remarks.

Melissodes bimaculata, a solitary bee. Adults, West Haven, July 14; Hartford, July 18.

Papilio glaucus var. *turnus,* tiger swallow-tail butterfly. Larva, Waterbury, Aug. 18.

Papilio polyxenes, black swallow-tail butterfly. Pupa, West Hartford, Aug. 3.

Papilio troilus, green swallow-tail butterfly. Adult, New Haven, Aug. 1.

Parcoblatta uhleriana, a native cockroach. South Glastonbury, June 22.

Phthirius pubis, crab louse. Woodbridge, May 8.

Pseudosphinx tetrio, a tropical sphinx moth. Probably transported from Panama or the West Indies. Adult, New Haven, Aug. 25.

Tremex columba, pigeon horntail. Adults from dead maple, Clinton, Aug. 22.

Utethisia bella, bella moth. Adults, on aster flowers, Meriden, Oct. 6.

CONFERENCE ON EUROPEAN PINE SHOOT MOTH

The damage of the European pine shoot moth, *Rhyacionia buoliana* Schiff., to red pine forest plantations in Connecticut has been so severe that the matter was brought before the Executive Committee of the Eastern Plant Board at a meeting in New York, April 7. It was voted to request the Federal Bureau of Plant Quarantine to hold a conference to discuss the whole matter, in the hope that some policy might be formulated that would aid in the solution of the problem.

At the time the request was made changes were taking place rapidly in Washington and no call was issued for the conference until later in the season. It was suggested that if possible the conference should be held within the infested region so that some of the injured trees could be seen. Consequently the Bureau of Plant Quarantine was invited to hold the conference at this Station, and in due course a notice was issued for such a meeting, September 19. About 28 were present, including representatives of Connecticut, Massachusetts, New York, Pennsylvania, Vermont, and the United States Department of Agriculture. In the afternoon there was a field trip to observe the damage to red and Scotch pine plantations caused by this insect.

CONFERENCE OF CONNECTICUT ENTOMOLOGISTS

The tenth annual conference of entomologists working in Connecticut was held in the Assembly Room at the Agricultural Experiment Station, New Haven, on Friday, October 27, 1933. Professor J. A. Manter was elected chairman and 60 were present. Luncheon was served at the Station. Director Slate, Dr. Glasgow and Mr. Worthley were unable to be present. Mr. Worthley sent a paper that was read by Mr. Johnson. In other respects the following program was carried out:

GREETING, Director William L. Slate, New Haven

ENTOMOLOGICAL FEATURES OF THE SEASON OF 1933, Dr. W. E. Britton, New Haven

RECENT TERMITE DEPREDATIONS IN CONNECTICUT, M. P. Zappe, New Haven

INSECT WORK IN CIVILIAN CONSERVATION CORPS CAMPS IN CONNECTICUT, G. H. Plumb, New Haven

RECENT DEVELOPMENTS ON THE GIPSY MOTH PROJECT, A. F. Burgess, Greenfield, Mass.

THE STATUS OF THE JAPANESE BEETLE IN THE UNITED STATES IN 1933, L. H. Worthley, Harrisburg, Pa.

THE JAPANESE BEETLE AND THE EUROPEAN CORN BORER IN CONNECTICUT IN 1933, J. P. Johnson, Shelton.

NOTES ON THE WHITE BIRCH LEAF MINER, *Phyllotoma nemorata* IN NEW YORK, Dr. R. D. Glasgow, Albany, N. Y.

INSPECTION OF SPECIAL EXHIBITS AND OF THE DEPARTMENT OF ENTOMOLOGY.

THE STRENGTH OF CATERPILLARS, Prof. J. A. Manter, Storrs.

ROUND TABLE DISCUSSION ON COLLECTING LEPIDOPTERA, John V. Schaffner, Melrose Highlands, Mass.; Otto H. Schroeter, Union, Conn.

NEW ANGLES IN RELATION TO SHADE TREE PESTS, Dr. E. P. Felt, Stamford

THE CONTROL OF FLEAS IN HOUSEHOLDS, B. H. Walden, New Haven

STUDIES ON THE POTATO FLEA BEETLE, Neely Turner, New Haven

EXPERIENCE WITH LEAD ARSENATE SUBSTITUTES, Dr. Philip Garman, New Haven

SPRAYS FOR THE CONTROL OF THE EUROPEAN PINE SHOOT MOTH, Dr. R. B. Friend, New Haven

INSPECTION OF NURSERIES, 1933

W. E. BRITTON and M. P. ZAPPE

The inspection of nurseries was commenced July 5. This work was in charge of Mr. Zappe, who was assisted by A. F. Clark, W. T. Rowe and R. J. Walker until September 2, and then in special cases by E. M. Stoddard, G. H. Plumb, Neely Turner, J. P. Johnson, R. C. Botsford and W. E. Britton. Most of the larger nurseries were inspected during July and August, and the others were completed October 11, except for one or two that registered after that date.

Number and Size of Nurseries

A constant increase in the number of nurseries each year in Connecticut is shown in Table 1 on this page. In 1933, the list contains 362 names, an increase of 11 over 1932. A classification on account of size may be indicated as follows:

Area	*Number*	*Percentage*
50 acres or more	19	5.5
10 acres to 50 acres	40	11
5 acres to 10 acres	37	10
2 acres to 5 acres	90	25
1 acre or less	176	48.5
	362	100.0

On the whole, the nurseries were in about as good condition as in 1932. There has been an increase of certain pests and a decrease of others. In 22 nurseries no pests were found. Altogether about 121 different insect pests and 69 different plant diseases were found in nurseries. These cannot all be mentioned here but some of the more important and common insect pests and plant diseases are shown in Table 1:

TABLE 1. TEN-YEAR RECORD OF CERTAIN NURSERY PESTS

Pest	1924	1925	1926	1927	1928	1929	1930	1931	1932	1933
Oyster-shell scale	44	38	39	45	57	78	86	73	68	78
San José scale	32	32	19	16	30	22	8	11	10	13
Spruce gall aphids[1]	40	27	42	82	120	147	99	124	141	231
White pine weevil	5	5	8	17	19	37	66	74	70	61
Pine leaf scale	5	4	5	6	13	13	10	20	26	46
European pine shoot moth	0	0	0	1	7	7	17	32	77	137
Poplar canker	25	34	32	39	35	37	35	23	40	34
Pine blister rust	8	7	9	9	5	7	7	13	12	11
Nurseries uninfested	33	34	46	37	18	13	18	32	24	22
Number of nurseries	116	151	162	191	228	266	302	327	351	362

Undoubtedly the apparent increase in some of these pests is due to the increase in the number of nurseries, and although the number of infested nurseries has increased the actual percentage may have decreased.

[1]Includes both *Adelges abietis* and *Gillettea cooleyi*.

An examination of the foregoing table will show that the European pine shoot moth, *Rhyacionia buoliana* Schiff., has increased rapidly during the past seven years since it was first found in a nursery in 1927.

Additional Inspection Because of European Pine Shoot Moth

On account of the life history of this insect, its presence on nursery stock cannot be detected during July and August. This is because the adults emerge in June and July and lay eggs on the twigs. By September the larvae have reached a size sufficient to cause a noticeable injury to the tips. A conference to consider the shoot moth was held at the Station September 19, and in the discussion the point was made that nurseries should be kept clean.

It was decided, therefore, to re-inspect the pines in all nurseries that had been inspected in July and August, when the insect could not be detected except by injury of the preceding season. In doing this it was thought best to check also on nurseries inspected after September 1, and make sure that the infestation had all been removed; and if not, to see that it was done.

The following information, prepared by W. E. Britton and R. B. Friend, was mimeographed as an unnumbered special bulletin, and sent under date of October 20 to all nurseries in the state that grow pine.

Control of the European Pine Shoot Moth in Nurseries

A conference on the European pine shoot moth situation was held at this Station September 19, 1933, at which several state and federal entomologists were present. The states represented were Connecticut, Massachusetts, Vermont and New York. There were also present several members of the Bureau of Entomology, and of the Bureau of Plant Quarantine, of the United States Department of Agriculture, Washington, D. C. The subject was thoroughly discussed.

Briefly, the situation is this: The European pine shoot moth, *Rhyacionia buoliana* Schiff., has caused severe injury to red pine plantations in southwestern Connecticut, and several acres have already been cut and burned, in order to protect other plantations in the vicinity which have not as yet been injured. The infestation in the eastern half of the state is very light and an attempt is being made to eradicate the insect from forest plantations in this area. It is essential that the spread of the insect be restricted as much as possible.

Danger of Spread from Nurseries

One result of the conference of September 19 is an attempt to obtain a better control of the European pine shoot moth in nurseries.

Inasmuch as this insect is a pest of young pine trees there is great danger of it being transported on infested nursery stock. In the annual inspection of Connecticut nurseries in 1933, indications of the presence of the insect were found in about 19 per cent of the 360 or more nurseries of the state. Most of the infested nurseries are in the southwestern portion of the state where the heaviest infestation and the most severe injury in forest plantings has occurred. Instructions were given the owners to clip off and burn the infested tips. To make sure that this was done an additional inspection is now being made, and the inspectors have been instructed to make certain that infestations are eradicated. Nurseries must be kept clean.

Infested Forest and Ornamental Plantings

Most of the forest plantings of red and Scotch pine in Connecticut have already been examined and the heaviest infestations are in the southwestern portion of the

state. Measures have been taken in these areas to hold the pest in check. Ornamental plantings have not yet been systematically inspected, but many are known to be infested, particularly in Fairfield, Hartford and New Haven Counties, and no doubt such is the case in other sections of the state.

Description, Habits and Life History

The adult is a moth with wing spread of about two-thirds of an inch, forewings reddish-brown with irregular cross bands of silver near the tips and silvery blotches on the basal half. The hind wings are gray. There is only one generation each year, and the moths emerge and lay eggs on the tips of the twigs the latter part of June and during July. The larvae soon hatch and burrow into the sheaths of the needle clusters near the tips of the branches. Later in the summer they tunnel into the terminal buds where they pass the winter. In the spring the larvae burrow in the young shoots distorting or killing them. The larvae are brown with black head and when full grown are about five-eighths of an inch in length. They reach maturity in May and early June and pupate in their tunnels in the shoots. The adults emerge about eighteen days later, leaving the pupal skins projecting from the shoots.

The moths rest on the foliage during the day and fly around the trees at dusk. Apparently the moths fly only a short distance, and the insect seems to spread slowly unless transported on pine trees. It is primarily a pest of young trees, as trees 15 feet or more in height are seldom severely injured.

Indications of Infestation and Injury

The larva tunnels into the tip needle clusters and terminal and lateral buds in the summer and fall, and some of the needle clusters turn brown and masses of pitch are formed on the buds. These symptoms are readily seen from the first of September until the following spring. When the new growth starts in May the developing shoots are bored. These shoots curl over and die. Where all of the buds and shoots in a terminal cluster are killed by the insect, adventitious buds develop, resulting in a bushy tip. Sometimes an injured shoot bends over horizontally but later turns upward and assumes the position of the leader, resulting in a crooked stem called "posthorn" or "bayonet growth." Heavily infested trees may be unable to make any height growth and finally exhibit only dead tips at the top. Such trees are entirely worthless in forest or ornamental plantings and should be removed and burned.

Host Pines

The following species of pines that grow in Europe and North America have been recorded as host plants for this insect:

Austrian pine,	*Pinus nigra*	Loblolly pine	*Pinus taeda*
Bull pine	" *ponderosa*	Lodgepole pine	" *contorta*
Cluster pine	" *pineaster*	Long leaf pine	" *palustris*
Corsican pine	" *nigra* var. *poiretiana*	Mugho pine	" *montana* var. *mughus*
Digger pine	" *sabiniana*	Prickle-cone pine	" *muricata*
Jack pine	" *banksiana*	Red pine	" *resinosa*
Japanese black pine	" *thunbergi*	Scotch pine	" *sylvestris*
Japanese red pine	" *densiflora*	White pine	" *strobus*

Of the pines more commonly grown, the red pine is the most severely injured and the white pine is the least injured. Their susceptibility to injury by the European pine shoot moth is in about the following order: red, Scotch, mugho, Austrian and white. Thus far the white pine although occasionally infested has not been injured by this insect in Connecticut.

Control in Nurseries

The presence of the young larvae is not readily detected in July and August but by September and until the following June the dead needles and buds, and the pitch masses and the curled tips in May are unmistakable evidence of infestation by the European pine shoot moth or one of three or four other closely related shoot moths. Particular attention should be given to red, Scotch and mugho pines, but the other kinds should also be inspected. All injured and suspicious buds should be clipped off and burned.

Infestation may be prevented in a marked degree by spraying three times about June 13, 23 and July 3 with one of the following formulas:

(1)	Lead arsenate	3 pounds
	Fish oil	1 quart
	Water	100 gallons
(2)	Nicotine sulfate (40%)	½ gallon
	Penetrol	½ gallon
	Lead arsenate	3 pounds
	Water	100 gallons

A drenching spray directed downward into the bud and needle clusters will probably prove more effective than a mist, or a horizontal spray directed against the sides of the needles.

Mr. Zappe and Mr. Turner began this additional inspection about October 15, and continued for the remainder of the year. For a few days they were assisted by J. F. Townsend and E. S. Peterson.

Many more nurseries at this later inspection were found infested than could be detected during July and August. In some of the nurseries this insect has been reported each year for several years and the owners have either done a poor job of cleaning up their pines or have done nothing. As a consequence a few of the nurseries have a heavy infestation and in some cases it was thought best to destroy the pines rather than to try to clip off the infested tips. Some of the nurseries have been visited three or four times to check on their clean-up work. In some cases the nurserymen did a fair job of cutting the infested tips and in others many infested tips were left. In the latter case the owners were told to go over their pines again and again until all infested tips were removed. When an honest effort had been made to remove infested tips and not too many had been missed, the inspectors finished the clipping. The water companies that have been in the habit of selling red pines were either refused a certificate outright or were refused certificates to sell susceptible varieties of pines. One regular nurseryman was refused a certificate to sell susceptible pines until all infested tips had been removed and the trees again inspected when dug for shipment.

Of the 362 nurseries, 7 new ones registered and were inspected before the spring shipping season and again in the fall. Two firms holding certificates in 1932 failed to register before July 1, and as provided in Section 2127 of the General Statutes, were required to pay the costs of inspection. Consequently the sum of $10 was collected from them and turned over to the Treasurer of the Station to be deposited in the State Treasury.

The area of Connecticut nurseries in 1933 is 4,645 acres, an increase of 155 acres over 1932. Altogether 30 new names have been added and 15 have discontinued business during the year. Twenty nurseries on the list for 1932 are now included under different firm names. The new

list contains 362 names, an increase of 11 over last year. The nursery firms granted certificates in 1933 are as follows:

Connecticut Nursery Firms Certified in 1933

Name of firm	Address	Acreage	Certificate date	Certificate number
Abeling, R. W.	Torrington	1	Sept. 14	2302
Adamec, George	Foxon	1	Aug. 25	2202
Aldrich, Edward	Guilford	1	Aug. 25	2203
Aldrich, Inie E.	Thomaston	2	Oct. 17	2400
Allara, Emanuel	Hamden	1	Sept. 2	2241
Allen, Henry L.	Pawcatuck	1	Aug. 21	2170
Amelunxen & DeWyn	Yalesville	4	July 17	2101
Andover Gardens	Andover	1	Aug. 21	2171
Anstett, Louis	Norfolk	1	Sept. 25	2326
Artistree Nursery	Branford	3	Dec. 2	2429
Austin, M. E.	Clinton	1	Aug. 10	2146
Barnes Bros. Nursery Co., Inc.	Yalesville	190	Aug. 5	2130
Barnes Eastern Nurseries	Wallingford	15	Aug. 5	2131
Bartolotta, S.	Cromwell	1	Aug. 5	2134
Barton Nursery	Hamden	1	Aug. 7	2135
Beattie, W. H.	New Haven	1	Sept. 30	2346
Bedford Gardens	Plainville	1	Oct. 7	2373
Beers, H. P.	Southport	1	Nov. 22	2424
Belltown Nurseries	Stamford	4	Dec. 30	2443
Benbow, Abram	Norfolk	1	Sept. 15	2312
Beran, the Florist	New London	1	Aug. 21	2168
Berkshire Gate Nursery	Danbury	1	Oct. 2	2350
Bertana, Louis	Glenbrook	2	Oct. 10	2381
Bertolf Bros., Inc.	Old Greenwich	45	Aug. 30	2221
Blue Hills Nurseries	Hartford	18	Aug. 8	2234
Boggini, Louis	South Manchester	1	July 17	2095
Bollerer, Frederick G.	West Haven	1	Sept. 30	2347
Bolton Perennial Gardens (2)	South Manchester	1	July 17	2096
Bonnie Brook Gardens	Rowayton	2	Sept. 22	2325
Booy, H. W.	Yalesville	4	July 11	2088
Brainard Nursery & Seed Co.	Thompsonville	20	July 29	2121
Brandriff's Rock & Perennial Gardens	Branford	1	Nov. 3	2416
Branford Nurseries	Branford	6	Sept. 13	2290
Breschneider, A.	Danielson	1	Aug. 28	2209
Bridgeport Hydraulic Co.	Bridgeport	15	Oct. 28	2412
Brimfield Gardens Nursery	Wethersfield	8	Aug. 19	2165
Bristol Nurseries, Inc.	Bristol	55	Aug. 9	2141
Brooklawn Conservatories, Inc.	Bridgeport	1	Aug. 24	2195
Brooklawn Nursery	Bridgeport	2	Oct. 17	2399
Brouwer's Nurseries	New London	20	Aug. 30	2220
Brouwer's Nursery, Peter	New London	2	Aug. 22	2176
Bruce Nurseries	Danielson	1	Aug. 19	2167
Bulpitt, Henry F.	Darien	4	Sept. 11	2274
Bureau of Trees	New Haven	7	Aug. 7	2136
Burke, the Florist	Rockville	1	July 17	2098
Burr & Co., Inc., C. R.	Manchester	500	July 28	2118
Burr, Morris L.	Westport	1	Sept. 15	2305

Connecticut Nursery Firms Certified in 1933—(*Continued*)

Name of firm	Address	Acreage	Certificate date	Certificate number
Burwell, E. E.	New Haven	1	Sept. 5	2247
Byram Evergreen Nursery	East Port Chester	1	Sept. 16	2313
Candee Nursery, Hollis S.	Hartford	7	Oct. 9	2376
Cant, Alexander	Springdale	1	Oct. 9	2377
Cardarelli, E. J.	Cromwell	5	Aug. 18	2163
Carey, Alice L.	Cheshire	1	Sept. 2	2242
Carlson, John B.	Newington	1	Sept. 6	2259
Case, Mrs. Louis L.	Simsbury	1	Aug. 26	2207
Cherry Hill Nursery Co.	Rockfall	50	Aug. 23	2189
Chesman, Joseph	Foxon	1	Sept. 9	2271
Chiapperini, Michele	Groton	1	Aug. 22	2182
Chippendale Nurseries, Inc.	Old Lyme	2	Dec. 23	2439
Choate School, The	Wallingford	4	Nov. 4	2417
City Line Florist	Bridgeport	1	Sept. 13	2291
Civitello & Pinatello (2)	East Hartford	4	Sept. 11	2276
Clark, Raymond H.	Milford	1	July 12	2092
Cleary, Arthur L.	Bethel	1	Sept. 27	2334
Clinton Nurseries	Clinton	90	Sept. 5	2249
Clyne Nurseries	Waterbury	6	Dec. 13	2438
Cobb, Levi S.	Fairfield	1	Sept. 12	2286
Conine Nursery Co.	Stratford	75	July 12	2126
Conn. State College Prof. S. P. Hollister	Storrs	1	Dec. 1	2426
Conn. Agr. Expt. Sta. W. O. Filley, For.	New Haven	3	Oct. 6	2368
Conn. Forestry Nurseries	Deep River	18	Sept. 2	2239
Conn. State Highway Dept.	Hartford	13	Nov. 1	2413
Conn. Valley Nurseries	Burnside	1	Sept. 6	2255
Conn. Valley Nurseries	Manchester	39	July 18	2103
Corrigan's West Haven Nurseries	West Haven	1	Sept. 1	2235
Couture, E. R.	Westport	2	Oct. 2	2351
Covey, Mrs. Arthur (2)	Harwinton	1	Oct. 7	2371
Cragholme Nurseries, Inc.	Greenwich	5	Sept. 12	2284
Cromie, G. A.	New Haven	2	Aug. 18	2162
Cronamere Alpine Nurseries, Inc.	Greens Farms	3	Sept. 22	2323
Culver, W. B.	Suffield	1	July 19	2108
Curtiss, C. F.	Plantsville	2	Oct. 26	2409
Daisy Hill Gardens	Derby	1	July 12	2091
Dallas, Inc., Alexander	Waterbury	2	Nov. 9	2418
Damen, Peter J.	Foxon	2	Sept. 5	2250
Darien Nurseries	Darien	6	Aug. 15	2155
Dawson, Wm. A.	Willimantic	2	Aug. 23	2187
Daybreak Nurseries, Inc.	Westport	6	Sept. 16	2315
Dearden Bros.	East Hartford	4	Aug. 30	2225
De Cerbo, Meyer E.	Woodmont	1	Aug. 28	2211
Deepstrom, Leon E.	Bridgeport	2	Sept. 11	2281
De Mars, F. H.	Winsted	1	Sept. 23	2324
Devany, Charles	Pawcatuck	2	Aug. 25	2201
Devon Nursery	Devon	1	July 31	2123

Connecticut Nursery Firms Certified in 1933—(*Continued*)

Name of firm	Address	Acreage	Certificate date	Certificate number
Dewey, V. E.	Groton	2	Dec. 11	2436
Dietrich & Son Nursery, B.	Greenwich	4	Sept. 13	2293
Di Giandomenico, Raffe	Middletown	1	Dec. 11	2435
Dingwall, Joseph N.	New Haven	1	Sept. 30	2348
Doane, David F.	Haddam	1	Aug. 10	2148
[illegible]eli, Charles A.	Bridgeport	1	Sept. 8	2268
[illegible]d, Inc., F. C.	Madison	1	Dec. 1	2427
[illegible]ap's Hydrangea Nursery	Cromwell	3	Aug. 29	2215
Dunn, James F.	Stamford	3	Oct. 2	2356
Eager, E. M.	Bridgeport	1	Aug. 29	2214
East Haven Nursery	East Haven	1	Sept. 5	2246
Edendale Gardens	Winsted	1	Sept. 14	2301
Edgewood Nurseries	New Haven	1	Aug. 25	2205
Eell's Sons Nursery	Manchester	1	July 17	2094
Elfgren Nurseries	East Killingly	2	Aug. 29	2216
Ellington Evergreen Nurseries	Ellington	10	July 18	2104
Elmgren, C. J.	Cromwell	1	Sept. 27	2333
Elm Grove Cemetery Association	Mystic	1	Sept. 7	2264
Emerson, C. M.	East Hartford	1	Mar. 1	2076
Evergreen Nursery Co.	Wilton	25	July 28	2120
Eyeberse Nursery	Norwich	1	Aug. 22	2179
Farmington Valley Nursery	Avon	5	Aug. 31	2226
Fletcher, Walter G.	Guilford	15	Sept. 9	2272
Flower City Rose Co.	Manchester	23	July 19	2105
Follett Nursery	Westport	10	Oct. 7	2369
Ford, George R.	Hartford	10	Sept. 18	2319
Frazer's Nurseries & Dahlia Gardens	Willimantic	3	Sept. 6	2254
Galligan, C. W.	New Haven	1	Sept. 30	2345
Gallup, Amos M.	Pawcatuck	1	Aug. 21	2169
Gardner's	Berlin	1	Sept. 15	2309
Gardner's Nurseries	Rocky Hill	250	Aug. 11	2152
Geduldig's Greenhouses	Norwich	6	Sept. 2	2240
Giant Valley Nursery	Mount Carmel	1	Aug. 18	2164
Gilbert, Henry G.	Danielson	2	Aug. 19	2166
Glastonbury Gardens	Glastonbury	3	Aug. 31	2231
Glen Terrace Nurseries	Hamden	60	Aug. 7	2138
Golden Hill Nurseries	Shelton	3	Oct. 2	2352
Goodwin Nurseries	Bloomfield	7	Aug. 30	2219
Goshen Nurseries	Goshen	5	Oct. 13	2388
Griswold, George	Old Lyme	1	Sept. 5	2245
Gunn, Mrs. Charles	Kent	1	Oct. 2	2357
Haas, Florist, E.	Milford	1	Aug. 8	2140
Hall, Henry A. L.	West Haven	1	Oct. 6	2367
Hamden Nursery	Hamden	1	Aug. 17	2159
Hammonassett Gardens	Madison	4	Nov. 3	2415
Hanford, R. G.	Norwalk	4	Dec. 4	2430
Hansen's Florist & Nursery	Fairfield	5	Aug. 30	2222

Connecticut Nursery Firms Certified in 1933—(*Continued*)

Name of firm	Address	Acreage	Certificate date	Certificate number
Happy Days Farm Nursery	Norwalk	10	Sept. 28	2336
Hearn, Thomas H.	Washington	3	Oct. 18	2402
Heath & Co.	Manchester	25	July 19	2106
Henninger, Christ.	New Britain	1	Sept. 6	2260
Hildebrand's Nursery (2)	Norwich	1	Sept. 11	2273
Hillcrest Gardens	Woodbridge	3	Aug. 29	2218
Hilliard, H. J.	Sound View	1	Sept. 13	2289
Hill Top Nursery	Orange	2	July 17	2100
Hinckley Hill Nursery	Stonington	1	Aug. 21	2173
Hiti Nurseries	Pomfret Center	11	Aug. 24	2192
Hofman, Henry	Cromwell	2	Aug. 5	2133
Holcomb, Ernest L.	Granby	1	Sept. 6	2258
Holcomb, H. Parks	Winsted	4	Sept. 30	2344
Holcomb, Irving*	Granby	1	Sept. 6	2257
Holdridge & Son, S. E.	Norwich	5	Aug. 22	2178
Hope Street Nursery	Springdale	1	May 12	2086
Horan, James F.	Hartford	2	Dec. 5	2431
Horan, Kieran W. (2)	West Hartford	1	Sept. 14	2297
Houston's Nurseries	Mansfield Depot	15	Oct. 6	2366
Hoyt, Charles E.	Danbury	25	Oct. 4	2362
Hoyt's Sons Co., Inc., Stephen	New Canaan	500	Aug. 2	2128
Intravaia & Sons, J.	Middletown	1	Sept. 30	2349
Jennings, Mrs. George S.	Southport	2	Sept. 28	2339
Joel Nursery Co., The (2)	Yalesville	10	July 11	2087
Johnson's Nursery	South Meriden	1	Sept. 6	2262
Johnson, Tom	Stratford	1	Aug. 24	2193
Judd, T. H.	Danbury	1	Dec. 31	2444
Kateley, Milton M.	East River	1	Aug. 24	2198
Kelley & Son, James J.	New Canaan	6	Sept. 12	2287
Keogh, H. W.	Norwalk	2	Oct. 16	2396
Keystone Nurseries	Danbury	1	Sept. 29	2341
Knapp's Perennial Gardens	Plainville	1	Oct. 7	2374
Kosty's Perennial Garden Nurseries	North Haven	3	Oct. 14	2391
Lanedale Farm Nursery	New Canaan	9	Sept. 28	2338
Langstroth Nurseries	Danbury	10	Dec. 28	2442
Laviola Nursery	New Haven	1	Aug. 15	2158
Lawrence Greenhouses	Branford	1	Dec. 6	2434
Leghorn's Evergreen Nurseries	Cromwell	20	Aug. 11	2151
Lewis Gardening Service	Kensington	1	Sept. 12	2288
Lewis & Valentine	Darien	9	Sept. 7	2263
Loring Nursery Co., The Robert	Yalesville	7	July 21	2111
Luckner, Jr., Wm.	Stepney	1	Sept. 11	2277
Lynch, Mrs. John H.	Ridgefield	3	Oct. 14	2394
Main, Walter G.	North Stonington	1	Aug. 22	2181
Mallett, George A.	Bridgeport	6	Sept. 29	2340

* Deceased.

Connecticut Nursery Firms Certified in 1933—(*Continued*)

Name of firm	Address	Acreage	Certificate date	Certificate number
Maplehurst Flower Gardens	Fairfield	1	Sept. 12	2285
Maplewood Nursery Co.	Norwich	2	Nov. 2	2414
Marigold Farm Nursery Co.	New Canaan	20	Sept. 8	2267
Mather Homestead	Darien	1	Sept. 14	2299
Mayapple Nursery	Stamford	1	Oct. 17	2401
McCarthy, John P.	Danbury	1	Oct. 13	2386
McConville, John	Manchester	2	July 20	2109
Meachen, Henrietta S.	Stratford	1	Aug. 24	2196
Meier, Adolf R.	West Hartford	1	Sept. 26	2332
Melville Nursery	Bridgeport	1	Sept. 14	2296
Merwin Lane Nursery	East Norwalk	3	Sept. 6	2253
Meyer, Carl H. H.	Riverside	10	Aug. 11	2153
Meyer, Ludwig	Bridgeport	4	Sept. 11	2282
Middeleer Nurseries, Inc.	Darien	28	Oct. 7	2375
Midvale Nursery	Manchester	1	Oct. 2	2355
Milford Nursery	Milford	2	July 12	2093
Millane Nurseries & Tree Experts Co.	Cromwell	35	Aug. 24	2191
Mill River Nursery	Fairfield	12	Sept. 12	2283
Millstone Garden	Terryville	1	Oct. 7	2372
Milton Flower Farm	Litchfield	1	Oct. 3	2359
Minge, G. H.	Rocky Hill	1	Aug. 11	2150
Montgomery Evergreen Nursery, Inc.	Cos Cob	5	Sept. 1	2232
Moraio Bros.	Stamford	5	Oct. 25	2408
Morgan, Wm. F.	North Stonington	2	Aug. 22	2185
Mountain Farm Nursery	West Hartford	2	Sept. 14	2300
Mountain Grove Cemetery Association	Bridgeport	1	Aug. 24	2197
Mount Airy Gardens	Stamford	1	Nov. 21	2422
Mount Carmel Nursery	Mount Carmel	1	Aug. 23	2190
[illegible]litano, Alfonso (2)	Cromwell	1	Oct. 13	2387
[illegible]ell Nurseries, The	Bloomfield	6	Sept. 15	2307
New England Nurseries	New Canaan	1	Nov. 21	2421
New Haven Park Commission	New Haven	10	Sept. 15	2308
Newington Gardens & Nurseries	Newington	1	Sept. 14	2298
New London Cemetery Association	New London	1	Aug. 26	2206
New London County Nurseries	New London	5	Sept. 16	2314
Newton, Edwin	West Granby	1	Oct. 9	2378
New York, New Haven & Hartford R. R.	Bridgeport	6	Sept. 29	2343
Niantic Bouquet Shoppe	Niantic	1	Aug. 22	2177
Nicolson & Thurston	Litchfield	1	Oct. 3	2360
North Avenue Nursery	Bridgeport	1	Aug. 30	2223
North-Eastern Forestry Co.	Cheshire	96	Aug. 10	2143
North Greenwich Nursery	Greenwich	1	Sept. 15	2310
Northville Gardens	New Milford	1	Aug. 10	2144
Norwood Nursery	Hamden	1	Oct. 13	2390
Nyveldt, Albert	New London	1	Aug. 22	2175

CONNECTICUT NURSERY FIRMS CERTIFIED IN 1933—(*Continued*)

Name of firm	Address	Acreage	Certificate date	Certificate number
Oakland Nurseries	Manchester	40	July 28	2119
Oakwood Novelty Gardens	East Hartford	1	Sept. 16	2317
Oldfield Nursery	Stratford	1	Oct. 4	2363
Old House Gardens, The	Yalesville	1	Sept. 28	2337
Ostergren, Herbert	Cromwell	2	Aug. 5	2132
Outpost Nurseries, Inc.	Ridgefield	635	Aug. 2	2129
Ouwerkerk, D. K.	Yalesville	10	July 11	2089
Ox Yoke Farm Nurseries	Bridgeport	1	Oct. 2	2354
Palmieri Nursery	New Haven	1	Sept. 26	2329
Parfitt, Mary T.	New Milford	1	July 28	2117
Park Gardens	Bridgeport	1	Dec. 13	2437
Paton, Wm. D.	Mount Carmel	2	Sept. 2	2244
Patrick, Charles	Bridgeport	2	Sept. 7	2266
Patterson, John	Old Saybrook	2	Aug. 31	2228
Peatt, Wm. T.	Ridgefield	1	Nov. 29	2425
Pedersen, Anthon	Stamford	3	Oct. 20	2406
Peschko, Robert	Danbury	1	Oct. 16	2397
Pestretto, Frank	West Hartford	1	Aug. 15	2157
Pestretto, Salvatore	West Hartford	1	Aug. 31	2229
Pflomm, Charles W.	Bridgeport	1	Sept. 11	2280
Phelps & V. T. Hammer Co., The J. W.	Branford	2	Sept. 14	2295
Piemontese, Dominick	Foxon	1	Sept. 5	2248
Pierson, Inc., A. N.	Cromwell	250	Aug. 11	2154
Pinchbeck Bros., Inc.	Ridgefield	15	Oct. 18	2405
Pinecrest Gardens	Wapping	1	Aug. 30	2224
Pine Plains Greenhouses, Inc.	Norwich	2	Sept. 16	2316
Plainville Gardens	Plainville	3	Dec. 5	2432
Polish Orphanage Farm	New Britain	1	Sept. 13	2294
Pomeroy Blue Spruce Gardens	New Milford	5	Aug. 1	2127
Powers, R. J.	Noroton	1	Aug. 29	2217
Pratt, Jr., George D.	Bridgewater	4	Sept. 28	2335
Prospect Nurseries, Inc.	Cromwell	30	Aug. 11	2149
Quinebaug Forestry Co.	Union	2	July 18	2102
Rabinak, Louis	Deep River	3	Aug. 10	2147
Race Brook Gardens, Inc.	Orange	1	July 12	2090
Reliable Nursery, The	East Hartford	2	July 20	2110
Rengerman's Garden	Granby	1	Oct. 9	2379
Reveley, Frank J.	Clinton	2	Nov. 10	2420
Reynold's Farm	South Norwalk	1	Sept. 7	2265
Richmond, Gordon L.	New Milford	8	July 31	2125
Rockfall Nursery Co.	Rockfall	30	Aug. 23	2188
Rose Hill Nursery	Gildersleeve	3	Aug. 15	2156
Rosery Rest, The	Bridgeport	5	Sept. 26	2331
Sachem Forest Landscape Service	New Haven	1	Aug. 22	2186
Sage, Hollister	North Woodbury	1	Sept. 11	2278
Sakson Nursery	Greenwich	1	Sept. 1	2237
Sandelli's Greenhouse	New Britain	1	Sept. 6	2261
Sarno, Jonah	Greens Farms	2	May 4	2084

CONNECTICUT NURSERY FIRMS CERTIFIED IN 1933—(*Continued*)

Name of firm	Address	Acreage	Certificate date	Certificate number
Sasco Hill Evergreen Nursery	Southport	1	Aug. 31	2230
Saxe & Floto	Waterbury	1	Oct. 5	2365
Scarano, Alphonso	Groton	1	Sept. 8	2269
Schaeffer Bros.	Norwich	4	Sept. 8	2270
Schleichert Nursery	Bridgeport	1	Aug. 24	2194
Schmidt, Walter A.	West Hartford	3	July 26	2115
Schneider, Godfrey	West Haven	1	Oct. 10	2382
Schulze, Edward E.	Bethel	3	Oct. 14	2392
Scott's Nurseries	Bloomfield	7	Sept. 18	2318
Selleck, Joel F.	Nichols	1	Dec. 26	2440
Seltsam's Pequonnock Gardens	Bridgeport	1	Sept. 6	2252
Seymour's Hemlock Nursery	Riverton	1	Sept. 14	2303
Sharon Valley Nursery	Sharon	1	Sept. 14	2304
Silver City Nursery	Meriden	3	Sept. 6	2256
Silver Lane Nursery Co.	Burnside	1	Aug. 8	2139
Silvermine Nurseries	Norwalk	1	Sept. 1	2236
Smith & Son, Edward A.	Mystic	1	Aug. 22	2183
Soltes Nursery, M. J.	Shelton	2	Sept. 20	2320
Southington Nursery Co.	Southington	5	Nov. 22	2423
Southport Nursery	Southport	28	Aug. 31	2227
South Wilton Nurseries	South Wilton	5	Aug. 9	2142
Spring Nursery	Bristol	3	Oct. 20	2407
Stack, Garrett M.	Guilford	1	Aug. 24	2199
Stack, Sr., Thomas M.	New Milford	1	Oct. 7	2370
Stafford Conservatories	Stafford Springs	2	July 29	2122
Stalzer & Son	Brooklyn	1	Aug. 22	2180
Stannard, E. H.	Wilton	2	Sept. 29	2342
State of Conn. Forestry Dept.	Hartford	4	Oct. 9	2380
State Street Nursery	New Haven	2	Aug. 10	2145
Steck, Jr., Charles A.	Bethel	4	Oct. 14	2393
Steck & Sons, Inc., C. A.	Newtown	12	Dec. 26	2441
Steck, Sarah B.	Bethel	1	Oct. 3	2358
Steele, Charles	Cos Cob	3	Dec. 1	2428
Stratfield Nurseries	Bridgeport	50	Oct. 28	2411
Strayer, Paul B.	Stratford	1	Sept. 11	2279
Thomas & Sons, Inc.	Hamden	1	Aug. 7	2137
Torchi, Nazareno	Woodmont	1	Aug. 28	2212
[illegible]zo, P. A.	West Hartford	5	Oct. 16	2398
[illegible]r Crispette Co.	Guilford	1	Aug. 25	2204
[illegible] Path Gardens, Inc.	Hartford	15	Sept. 1	2233
Triangle Nursery	Yalesville	1	July 25	2114
Tryon, George W.	North Stonington	1	Aug. 22	2184
Uplands Flower Gardens	Woodbury	1	Apr. 28	2083
Upson, R. E.	Marion	2	Sept. 26	2328
Valentine Greenhouses	Pomfret Centre	1	Aug. 21	2172
Valley View Nursery	Southington	1	Sept. 15	2311
Van der Bom, F.	Bethel	5	Oct. 18	2403
Vanderbrook & Son, C.L.	Manchester	50	July 22	2112
Van Wilgen Nurseries	Branford	18	Oct. 2	2353
Van Wilgen, Wm.	Branford	1	Sept. 23	2322

Connecticut Nursery Firms Certified in 1933—(*Continued*)

Name of firm	Address	Acreage	Certificate date	Certificate number
Vasileff, Nicholas	Greenwich	4	Sept. 15	2306
Verkade's Nurseries	New London	50	Sept. 6	2251
Vernick Nurseries	Bridgeport	2	Sept. 13	2292
Wallace Nursery	Wallingford	5	Sept. 2	2243
Wallingford Nurseries of the Barnes Nursery & Orchard Co.	Wallingford	75	Oct. 11	2385
Waltermire, Wm. H.	Guilford	2	Aug. 24	2200
Ward & Son, J. F.	Windsor	1	July 19	2107
Water Bureau, Metropolitan Dist. Com.	Hartford	50	Nov. 8	2419
Watertown Nurseries, Inc.	Watertown	1	Oct. 11	2384
Weinberger, Wm.	Ridgefield	2	Oct. 5	2364
Westville Nurseries, Inc.	New Haven	3	Dec. 6	2433
Westwood Nurseries	Newtown	1	Oct. 14	2395
Wethersfield Nursery	Wethersfield	2	Sept. 11	2275
Wheeler, Charles B.	Stonington	1	Aug. 21	2174
White Elm Nurseries	Talcottville	1	July 17	2097
Whittemore Co., J. H.	Naugatuck	3	Sept. 26	2330
Wild Flower Nursery, The	Brookfield	1	Oct. 18	2404
Wild's Nursery, Henry	Norwalk	30	Aug. 28	2208
Wilmaco Gardens	Manchester	5	July 17	2099
Wilridge Nurseries	Ridgefield	5	July 26	2116
Wilson & Co., C. E.	Manchester	125	Aug. 17	2160
Wilson, M. L.	Litchfield	3	Oct. 3	2361
Wood, Mrs. Pearl B.	Ridgefield	1	July 22	2113
Woodbridge Nursery Co.	New Haven	4	Aug. 28	2213
Woodcrythe	New Canaan	1	Sept. 21	2321
Woodmont Gardens	Woodmont	1	Aug. 28	2210
Woodmont Nurseries	Woodmont	83	Sept. 25	2327
Wyllie, David	Whitneyville	1	July 31	2124
Yacko, Stephen	Clinton	2	Oct. 27	2410
Yale University Forest School Nursery	New Haven	1	Oct. 10	2383
Yale University Landscape Department	New Haven	6	Aug. 18	2161
Young's Nurseries	Wilton	1	Oct. 13	2389
Zack Co., H. J.	Deep River	10	Sept. 2	2238
Total	362 nurseries	4,645 acres		

The cost of inspecting these nurseries in 1933, including additional inspection and rechecking on account of European pine shoot moth, was approximately $3,213.

Other Kinds of Certificates Issued

During 1933, 109 duplicate certificates were issued to Connecticut nurserymen to be filed in other states. Altogether 157 dealer's permits were issued to registered dealers who do not grow the stock that they sell. The number of shipper's permits issued to nurserymen in other states, who wish to ship nursery stock into Connecticut, was 245. Altogether 167 parcels of nursery stock were inspected and certified for shipment to accommodate individuals.

In order to meet the requirements of Federal Quarantine No. 62, 125,000 narcissus bulbs were inspected in the field in May, and 30,000 inspected when dug for shipment, and 40 certificates issued. There were also issued 134 miscellaneous certificates and special permits. Certain shipments of shelled corn and other seeds were examined and 161 certificates issued. Altogether 385 certificates of freedom from European corn borer, and 162 blister rust control area permits were issued.

INSPECTION OF IMPORTED NURSERY STOCK

Less nursery stock entered Connecticut in 1933 from foreign countries than in 1932. It was entirely rose stocks for propagation. It entered the United States under specifications and permits of the Federal Bureau of Plant Quarantine, and at ports of entry was released for transit to destination points, where it was examined by state inspectors.

In 1932-1933, there were 14 shipments, containing 103 cases and 764,500 plants, all of which were manetti rose stocks and were inspected by Mr. Zappe. This stock was imported by four commercial rose growers: One had five shipments containing 654,500 plants; one had five shipments containing 90,000; one had three shipments of 20,000; and one had one shipment of 10,000. Twelve shipments containing 744,500 plants came from Holland, and two shipments containing 30,000 plants came from England.

The time required to inspect this imported rose stock was equivalent to one man working approximately 14 days, and together with the cost of travel 1155 miles, and other necessary expenses, made a total cost of approximately $225.

In addition to the shipments of rose stocks mentioned above, there were eight shipments of perennial and other plants including iris, peony, dahlia and gladiolus, altogether 513 plants, of new varieties, and six shipments containing 181 pounds of tree seeds, that were examined at the Bureau of Plant Quarantine, Washington, D. C., and were not inspected in Connecticut. Reports of the 14 shipments inspected, were sent to the Federal Bureau of Plant Quarantine.

Results of Inspection

Of the 14 shipments inspected, four shipments or 28.5 per cent were found infested with insects or plant diseases as follows:

Insects

Emphytus cinctus Linn. .... 2 shipments

Plant Diseases

Crown gall .... 2 shipments

INSPECTION OF APIARIES, 1933

W. E. Britton

Instead of $2,500 annually, the appropriation for inspecting apiaries was reduced to $2,000, beginning July 1, 1933, by the General Assembly of 1933. Consequently, a somewhat smaller number of apiaries was inspected than in 1932. Altogether, 1,342 apiaries containing 10,927 colonies were inspected in 1933, as against 1,397 apiaries and 11,459 colonies in 1932. These apiaries averaged 8.1 colonies each in 1933, and 8.2 each in 1932. As in former years, the inspection work was done by H. W. Coley, of Westport, and A. W. Yates of Hartford. It required 181 man days. The total cost of inspection of apiaries in 1933 was $2,276.50.

Table 2 shows the number of apiaries and colonies inspected, the average number of colonies per apiary, and the average cost of inspecting each apiary and colony for each year since inspection began in 1910.

TABLE 2. TWENTY-FOUR YEAR RECORD OF APIARY INSPECTION IN CONNECTICUT

Year	Number apiaries	Number colonies	Average No. colonies per apiary	Average cost of inspection: Per apiary	Per colony
1910	208	1,595	7.6	$2.40	.28
1911	162	1,571	9.7	1.99	.21
1912	153	1,431	9.3	1.96	.21
1913	189	1,500	7.9	1.63	.21
1914	463	3,882	8.38	1.62	.19
1915	494	4,241	8.58	1.51	.175
1916	467	3,898	8.34	1.61	.19
1917	473	4,506	9.52	1.58	.166
1918	395	3,047	7.8	1.97	.25
1919	723	6,070	11.2	2.45	.29
1920	762	4,797	6.5	2.565	.41
1921	751	6,972	9.2	2.638	.24
1922	797	8,007	10.04	2.60	.257
1923	725	6,802	9.38	2.55	.27
1924	953	8,929	9.4	2.42	.25
1925	766	8,257	10.7	2.45	.22
1926	814	7,923	9.7	2.35	.24
1927	803	8,133	10.1	2.37	.234
1928	852	8,023	9.41	2.12	.225
1929	990	9,559	9.55	2.19	.227
1930	1,059	10,335	9.76	2.01	.206
1931	1,232	10,678	8.66	1.83	.212
1932	1,397	11,459	8.2	1.60	.195
1933	1,342	10,927	8.1	1.69	.208

In 1933, apiaries were inspected in 149 towns. Inspections were made in 1933 in the following 18 towns not visited in 1932:

Fairfield County — Weston; New Haven County — North Haven; Tolland County — Tolland, Willington; Windham County — Ashford, Brooklyn, Canterbury, Chaplin, Eastford, Hampton, Killingly, Plainfield, Pomfret, Putnam, Scotland, Sterling, Thompson, Woodstock.

On the other hand, in the following 19 towns visited in 1932, no inspections were made in 1933:

Fairfield County — Weston; New Haven County — North Haven; sonia, Beacon Falls, North Branford, Seymour; Middlesex County — Westbrook; Litchfield County — Kent, Sharon, Warren, Washington; Hartford County — East Hartford, East Windsor, Enfield, Manchester, Marlborough, South Windsor, Suffield, Windsor Locks.

There were na apiaries infested with European foul brood but there were 32 apiaries infested with American foul brood.

In 1933, American foul brood was discovered in the following 24 towns:

Fairfield County — Greenwich, New Canaan, Ridgefield; New Haven County — Cheshire, Madison, Meriden, Wallingford, Waterbury; Middlesex County — Middletown; New London County — East Lyme, Norwich; Litchfield County — Cornwall, New Milford, Thomaston, Torrington; Hartford County — Berlin, Bloomfield, Bristol, Farmington, Southington, Wethersfield, Windsor; Tolland County — Ellington, Mansfield.

Statistics of Inspection

The statistics of apiary inspection by towns and counties are given on the following pages, with summary on pages 424–5.

INSPECTION OF APIARIES, 1933

Town	Apiaries: Inspected	Apiaries: Diseased (Am. f. b.)	Colonies: Inspected	Colonies: Diseased (Am. f. b.)
Fairfield County				
Bethel	11	—	91	—
Bridgeport	2	—	23	—
Danbury	9	—	92	—
Easton	5	—	82	—
Fairfield	9	—	116	—
Greenwich[1]	36	3	288	4
Monroe	10	—	125	—
New Canaan	5	1	34	1
New Fairfield	15	—	97	—
Newtown	5	—	89	—
Norwalk	6	—	48	—
Redding	8	—	97	—
Ridgefield	5	1	51	1
Shelton	1	—	17	—
Sherman	7	—	82	—
Stamford	31	—	213	—
Stratford	4	—	19	—
Trumbull	19	—	121	—
Weston	1	—	12	—
Westport	5	—	61	—
Wilton	15	—	235	—
	209	5	1,993	6
New Haven County				
Bethany	3	—	18	—
Branford	3	—	30	—
Cheshire	7	1	79	2
Derby	1	—	7	—

[1]One apiary inspected twice.

Town	Apiaries Inspected	Apiaries Diseased (Am. f. b.)	Colonies Inspected	Colonies Diseased (Am. f. b.)
New Haven County—(*Continued*)				
East Haven	5	—	31	—
Guilford	5	—	61	—
Hamden	6	—	48	—
Madison	3	1	13	1
Meriden	17	1	187	1
Middlebury	3	—	35	—
Milford	8	—	76	—
Naugatuck	2	—	32	—
New Haven	2	—	23	—
North Haven	1	—	10	—
Orange	6	—	118	—
Oxford	2	—	28	—
Prospect[1]	3	—	15	—
Southbury	3	—	49	—
Wallingford	7	1	259	1
Waterbury	7	1	40	1
Wolcott	2	—	13	—
Woodbridge	2	—	29	—
	98	5	1,201	6
Middlesex County				
Chester	4	—	28	—
Clinton	4	—	33	—
Cromwell	10	—	64	—
Durham	9	—	59	—
East Haddam	20	—	164	—
East Hampton	14	—	98	—
Essex	6	—	28	—
Haddam	3	—	43	—
Killingworth	5	—	25	—
Middlefield	4	—	188	—
Middletown	11	1	105	1
Old Saybrook	6	—	41	—
Portland	9	—	72	—
Saybrook	1	—	3	—
	106	1	951	1
New London County				
Bozrah	1	—	12	—
Colchester	22	—	283	—
East Lyme	9	2	86	3
Franklin	2	—	23	—
Griswold	5	—	113	—
Groton	6	—	108	—
Lebanon	13	—	198	—
Ledyard	2	—	14	—
Lisbon	1	—	18	—
Lyme	2	—	90	—
Montville	2	—	50	—
New London	3	—	34	—
No. Stonington	1	—	34	—
Norwich	5	1	360	1

[1]One apiary with four colonies weak from poison spray.

Town	Apiaries Inspected	Apiaries Diseased (Am. f. b.)	Colonies Inspected	Colonies Diseased (Am. f. b.)
New London County—(*Continued*)				
Old Lyme	2	—	79	—
Preston	3	—	65	—
Salem	2	—	17	—
Sprague	6	—	52	—
Stonington	7	—	49	—
Voluntown	2	—	19	—
Waterford	9	—	96	—
	105	3	1,800	4
Litchfield County				
Barkhamsted	10	—	36	—
Bethlehem	11	—	93	—
Bridgewater	6	—	91	—
Canaan	3	—	29	—
Colebrook	6	—	30	—
Cornwall	7	1	45	4
Goshen	8	—	66	—
Harwinton	9	—	25	—
Litchfield	17	—	168	—
Morris	8	—	37	—
New Hartford	18	—	60	—
New Milford[1]	19	1	164	1
Norfolk	6	—	14	—
North Canaan	3	—	42	—
Plymouth	12	—	60	—
Roxbury	5	—	22	—
Salisbury	8	—	75	—
Thomaston	14	1	54	2
Torrington	17	2	87	4
Watertown	18	—	115	—
Winchester	14	—	52	—
Woodbury	12	—	87	—
	231	5	1,452	11
Hartford County				
Avon	11	—	38	—
Berlin[2]	19	3	78	4
Bloomfield	18	1	204	4
Bristol	21	1	108	1
Burlington	11	—	53	—
Canton	16	—	81	—
East Granby	12	—	34	—
Farmington	18	2	68	2
Glastonbury	24	1	135	1
Granby	13	—	96	—
Hartford	8	—	60	—
Hartland	5	—	84	—
New Britain	24	—	143	—
Newington	19	—	84	—
Plainville	9	—	42	—
Rocky Hill	4	—	34	—
Simsbury	13	—	54	—
Southington	20	1	182	1
West Hartford	19	—	98	—

[1]One apiary inspected twice.
[2]Two apiaries inspected twice.

Town	Apiaries Inspected	Apiaries Diseased (Am. f. b.)	Colonies Inspected	Colonies Diseased (Am. f. b.)
Hartford County—(*Continued*)				
Wethersfield	17	1	82	1
Windsor	20	1	172	1
	321	11	1,930	15
Tolland County				
Andover	3	—	5	—
Bolton	2	—	8	—
Columbia	9	—	55	—
Coventry	6	—	48	—
Ellington	10	1	68	1
Hebron	9	—	70	—
Mansfield	20	1	70	1
Somers	10	—	41	—
Stafford	12	—	53	—
Tolland	8	—	51	—
Union	2	—	8	—
Vernon	18	—	94	—
Willington	11	—	49	—
	120	2	620	2
Windham County				
Ashford	10	—	86	—
Brooklyn	10	—	137	—
Canterbury	6	—	31	—
Chaplin	3	—	18	—
Eastford	6	—	22	—
Hampton	12	—	56	—
Killingly	18	—	103	—
Plainfield	15	—	81	—
Pomfret	11	—	66	—
Putnam	4	—	62	—
Scotland	6	—	20	—
Sterling	4	—	10	—
Thompson	11	—	79	—
Windham	19	—	75	—
Woodstock	17	—	134	—
	152	0	980	0

SUMMARY

County	Number towns	Apiaries Inspected	Apiaries Diseased (Am. f. b.)	Colonies Inspected	Colonies Diseased (Am. f. b.)
Fairfield	21	209	5	1,993	6
New Haven[1]	22	98	5	1,201	6
Middlesex	14	106	1	951	1
New London	21	105	3	1,800	4
Litchfield	22	231	5	1,452	11
Hartford	21	321	11	1,930	15
Tolland	13	120	2	620	2
Windham	15	152	0	980	0
	149	1,342	32	10,927	45

[1]One apiary with four colonies weak from poison spray.

	Number apiaries	Number colonies
Inspected	1,342	10,927
Infested with American foul brood	32	45
Colonies treated		21
Colonies destroyed		24
Percentage infested	.023	.0041
Average number of colonies per apiary		8.1
Cost of inspection	$2,276.50	
Average cost per apiary	1.69	
Average cost per colony		$ .208

Financial Statement

RECEIPTS

Appropriation year ending June 30, 1933	$2,500.00
Balance on hand July 1, 1932	61.80
	$2,561.80

EXPENDITURES

Salaries	$1,194.00
Travel expense (outlying)	1,082.50
Miscellaneous supplies	36.75
Total	$2,313.25
*Balance on hand July 1, 1933	248.55
GRAND TOTAL	$2,561.80

Registration of Bees

Section 2129 of the General Statutes provides that each beekeeper shall register his bees on or before October 1, of each year, with the town clerk of the town in which the bees are kept, and that each town clerk on or before December 1, shall report to the State Entomologist whether or not any bees have been registered, and if so, to send a list of the names and number of colonies of each. In 1933, 1,342 apiaries containing 10,927 colonies were inspected. There were registered 771 apiaries and 5,376 colonies in 1933, and after checking the registrations and inspections, and deducting the duplications, the following figures show that at least this number of apiaries and colonies were kept in Connecticut in 1933:

	Apiaries	Colonies
Inspected	1,342	10,927
Registered but not inspected	392	1,946
Total	1,734	12,873

*Reverts to State Treasury.

GIPSY MOTH CONTROL IN CONNECTICUT, 1933

John T. Ashworth and W. E. Britton

This work has been continued in about the same manner as in former years, and the field organization has been in immediate charge of Mr. Ashworth. Altogether, 52 towns were covered and 115 infestations found, which is a larger number of towns and fewer infestations than in 1932. An unusual amount of work was necessary in scouting and spraying the infested woodland in Wolcott. Here 2,120 egg-clusters were found, 265 acres scouted and 7,845 pounds, or nearly 4 tons, of lead arsenate used in spraying.

In July just after the close of the spraying season a gipsy moth infestation was discovered in the town of Groton near Groton Long Point. At this infestation some 30 or more acres had been wholly or partially defoliated. The woodland trees were chiefly oak and red maple with a scattering of beech, birch and elm. The appearance of the stripped

Figure 70. View near Groton Long Point, where about 30 acres of woodland were stripped by gipsy moth caterpillars. Photographed July 10.

trees is shown in Figure 70. The trunks of some of the trees were literally plastered with pupa cases, egg-clusters and female moths laying eggs. Egg-clusters were also deposited on rocks, ledges, logs, stumps, and throughout a length of stone wall. Clean-up measures were begun soon after the moths finished laying eggs, and the eggs were creosoted and the brush cut and burned. Men are now at work at this infestation and the total number of egg-clusters has not been ascertained, but it runs into hundreds of thousands. Probably a complete report will be given next year. Since June 1, some help has been received from

men in the Civilian Conservation Corps Camps, which is gratefully acknowledged.

In November, work for the unemployed was commenced under the Civil Works Administration. The State Forester applied for a certain number of men for forest protection activities. This included a quota for gipsy moth work to be placed under the supervision of Mr. Ashworth and his gipsy moth organization. Progress is now being made and a full report will be given later. However, rather large infestations have already been discovered in Columbia, Groton, Killingly, Lebanon, Pomfret, Putnam, Stafford, Thompson and Woodstock, and extensive spraying operations next summer must be carried on if the gipsy moth is to be kept in check.

The State appropriation for gipsy moth control was reduced 20 per cent, from $50,000 to $40,000 annually, by the General Assembly of 1933.

Results of Scouting for Gipsy Moth
1932 - 1933

Windham County

27 infestations 4,675 egg-clusters

Work in Windham County this season consisted of a check-up scout around old infestations, and this work was carried on in five towns during the latter part of July and early August. In the towns of Thompson, Pomfret, Killingly, Brooklyn and Plainfield, several large colonies were found, the largest being one of 2,067 egg-clusters, on land owned by Herbert H. Robbins, just east of Quadic Reservoir, in Thompson. The largest colony discovered in Pomfret was in woodland owned by William Cheney, just north of Abington village, where 361 egg-clusters were found. One large colony of 557 egg-clusters was found on roadside trees on Mechanic Street, Danielson, in the town of Killingly, on property owned by H. A. Meyers and W. Young. In Brooklyn, two large white oaks and several smaller trees were totally defoliated and a crew of men was put to work there to clean up this infestation. They started work on July 6 and finished on July 20, altogether 45,331 larvae and pupae being found and destroyed. A similar condition was found in the town of Plainfield, near Bishop's Crossing, where 1,005 larvae and 7,611 pupae were destroyed. This work was really of a check-up nature and the results show that in some sections of the county large infestations are building up and unless money is made available for more intensive scouting work in the eastern section of the state, there will be more defoliation in the near future.

New London County

5 infestations 2,056 egg-clusters

The work done this year in New London County was similar to that done in Windham County with the exception of the town of Waterford, which was completely scouted and two colonies of gipsy moth were found. One contained 107 egg-clusters and the other 10 egg-clusters, both on white oaks, in woodland owned by C. L. Nevins, a little east of Jordan Village. Check-up scouting was done in Norwich and Voluntown. In the town of Preston one large colony was found in a dooryard, on property owned by H. L. Haynes, in the west end of the town near the Norwich town line; 1,444 egg-clusters were found on oak and apple trees and on a pile of stone in this yard. In Norwich two colonies were found; one of 292 egg-clusters on land owned by the Norwich Gas Company, the other, containing 189 egg-clusters, on land of Sam Shinigo. Both colonies were on willow trees and situated on opposite sides of the Thames River. One small colony of 14 egg-clusters was discovered in Voluntown on land owned by C. Stenberg, in the southwestern corner of the town. It is also known that there are gipsy moth infestations in the towns of Stonington, Groton and New London. As the scouting force is small, there was not time to do any work in these towns. Conditions in this county are about the same as in Windham County.

Tolland County

5 infestations 118 egg-clusters

The work in Tolland County this year was carried on along the same lines as in Windham and New London counties; namely, check-up or larval scouting around old infestations, in the towns of Somers, Ellington and Union. Several small infestations were found in Somers. One of 24 egg-clusters was the largest, found on two large white oaks in a pasture owned by George Webster, in about the center of the town. Although the infestations were all small, this examination showed that the town was more generally infested than in preceding years. In Ellington two small colonies were discovered, the largest having 20 egg-clusters, on land owned by S. J. Lapchap, near the Somers and Stafford town lines. About the first of September the office was notified of an infestation in Union. Men were sent there and discovered a colony of 41 egg-clusters on land owned by Charles A. Downs, about one mile west of the Union Postoffice. The conditions in this county are about the same as those in Windham and New London counties.

Middlesex County

3 infestations 19 egg-clusters

Work was carried on in four towns in Middlesex County this year. The towns of Clinton and Saybrook were scouted and no trace of the gipsy moth found. In Chester one single egg-cluster was found on a maple tree owned by Thomas Flaherty, in the southeastern corner of the town, near the Saybrook line. In the town of Haddam the work was confined to the territory around last year's infestation. Two small colonies, one of 3 egg-clusters and another of 15 egg-clusters, were found in adjacent woodland near the 1931 infestation.

Hartford County

27 infestations 6,652 egg-clusters

The scouting was completed in six towns in Hartford County with results as follows: Avon and Bristol, no infestations; Burlington, 4 colonies, 157 egg-clusters; Hartland, 11 colonies, 478 egg-clusters; Simsbury, 7 colonies, 820 egg-clusters; and Wethersfield, 2 colonies, 5,087 egg-clusters. In Southington about four-fifths of the town was covered and one infestation containing 49 egg-clusters was found. In West Hartford, 107 acres of woodland were scouted and 2 infestations containing 61 egg-clusters were found. A check-up or larval scout was conducted in several towns with results as follows: Suffield, no larvae found; East Granby, 12; East Windsor, 3; Glastonbury, 436; Newington, 223, and New Britain, 75. The largest colony found in Hartford County was in Wethersfield on property owned by Edward Isaacson, bordering on the Connecticut River. This colony has been re-infested for several years, and 5,086 egg-clusters were treated at this place. The next largest colony was one of 559 egg-clusters, found in woodland on property owned by J. P. McLean, in the northwest corner of Simsbury. Another large colony of 193 egg-clusters was found in woodland about a mile east of West Simsbury Postoffice. The last colony of 100 or more egg-clusters found in this county was in the Tunxis state forest in East Hartland, near the Massachusetts state line. In addition to check-up scouting and regular roadside scouting, solid scouting was carried on in about 635 acres of woodland in this county. (By solid scouting, it is meant every tree and bush as well as fallen timber was carefully examined). If the table of statistics is consulted, it will be found that a number of smaller infestations were found scattered over this county.

New Haven County

12 infestations 2,459 egg-clusters

Part of the work in New Haven County was performed by Federal men. Work was confined to woodland scouting in the towns of Middlebury and Orange, where altogether 464 acres of woodland were examined and no trace of the gipsy moth was found. The three towns in this county where scouting was completed by state men were: Wolcott, Branford, and Meriden. In Branford one colony of 40 egg-clusters, and one single egg-cluster infestation, were found, both in the village of Branford. Four colonies were discovered in Wolcott. Three of them, containing 2,120 egg-clusters, were found in woodland on property owned by the New Britain Water Department, in the eastern portion of the town. The fourth colony was in woodland, on property owned by Wilfred and John Warner, about two miles west of the preceding infestations. In all, about 265 acres of woodland were scouted at these colonies. Considerable spraying was done in this town by a state crew, and about 7,845 pounds of arsenate of lead were used in this operation. State men scouted about 25 miles of road around the old North Branford infestation and found nothing. Part of this work fell in the town of North

Haven, as the infestation is practically on the line. State men scouted the town of Meriden and discovered six infestations containing 183 egg-clusters; 160 of these were in one colony, just north of West Peak, and about 219 acres of land were scouted in this section of the town.

Litchfield County

13 infestations 3,041 egg-clusters

Scouting in four towns in Litchfield County was done by state men. Barkhamsted was completely scouted, and 20 colonies were found. Three colonies of over 200 egg-clusters each occurred in the southeast corner of the town, two of them in apple trees in a field owned by Clinton LeGeyt and the Metropolitan Water Board. All infestations found in this town were in the eastern half of the town. In the towns of Colebrook, New Hartford and Harwinton, scouting was confined to areas known to have been previously infested. In Colebrook, one new egg-cluster and 31 old or hatched egg-clusters were found in the southwestern portion of the town, on land owned by Charles Lawrence and L. F. Phelps. One small infestation containing 17 egg-clusters was found in a pasture woodland about a mile and a half south of Bakerville Postoffice, in the town of New Hartford. No trace of the gipsy moth was found in the territory scouted in the town of Harwinton. Scouting done by Federal men in Litchfield County was carried on in 10 towns, with results as follows: Canaan, 5 colonies, 1,200 egg-clusters; Cornwall, 1 colony, 116 egg-clusters; Kent, no infestations; Litchfield, no infestations; Norfolk, 1 colony, 6 egg-clusters; North Canaan, 1 colony, 32 egg-clusters; Salisbury, 1 colony, 138 egg-clusters; Sharon, 1 colony, 8 egg-clusters; Warren, 3 colonies, 84 egg-clusters; and Washington, no infestations. Seven of these 10 towns were found infested. Altogether, 12,592 acres of woodland, and 56 miles of road were scouted. Thirteen infestations were found and around 12 of them, 1,140 acres of woodland were sprayed in June. Altogether, 20 tons of lead arsenate and 1,033 gallons of fish oil were used.

Fairfield County

No scouting was done in Fairfield County.

Statistics of Infestations, 1932–1933

Towns	Infestations found	Egg-clusters creosoted	Colonies sprayed	Poison used (lbs)	Larvae and pupae killed	Roadside scouted (miles)	Woodland scouted (acres)
Windham County							
Brooklyn[1]	1	162	0	0	45,331	0	1
Killingly[1]	1	557	0	0	3,503	0	1
Plainfield[1]	0	0	0	0	8,616	0	1
Pomfret[1]	22	1,677	0	0	681	0	15
Thompson[1]	3	2,279	0	0	815	0	4
	27	4,675	0	0	58,946	0	22

[1]Scouted around old infestations

Towns	Infestations found	Egg-clusters creosoted	Colonies sprayed	Poison used (lbs)	Larvae and pupae killed	Roadside scouted (miles)	Woodland scouted (acres)
New London County							
Norwich[1]	2	481	0	0	144	0	1
Preston[1]	1	1,444	0	0	76	0	1
Voluntown[1]	1	14	0	0	52	0	2
Waterford	1	117	0	0	58	41	0
	5	2,056	0	0	330	41	4
Tolland County							
Ellington[1]	2	25	0	0	1,049	0	2
Somers[1]	2	52	0	0	1,278	0	5
Union[1]	1	41	0	0	0	0	1
	5	118	0	0	2,327	0	8
Middlesex County							
Chester	1	1	0	0	0	49	0
Clinton	0	0	0	0	0	56	0
Haddam[1]	2	18	1	6	0	12	0
Saybrook[1]	0	0	0	0	0	8	0
	3	19	1	6	0	125	0
Hartford County							
Avon	0	0	0	0	0	57	0
Bristol	0	0	0	0	0	91	0
Burlington	4	157	0	0	0	77	0
East Granby[1]	0	0	0	0	12	0	1
East Windsor[1]	0	0	0	0	3	0	1
Glastonbury[1]	0	0	0	0	436	0	2
Hartland	11	478	0	0	0	72	0
New Britain[1]	0	0	0	0	75	0	1
Newington[1]	0	0	0	0	223	0	2
Simsbury	7	820	0	0	0	84	522
Southington	1	49	0	0	0	80	0
Suffield[1]	0	0	0	0	0	0	1
West Hartford	2	61	0	0	0	0	107
Wethersfield	2	5,087	0	0	7,908	48	0
	27	6,652	0	0	8,657	509	637
New Haven County							
Branford	2	41	2	33	0	104	0
Meriden	6	183	0	0	0	81	0
Middlebury[2]	0	0	0	0	0	3	319
North Branford[1]	0	0	0	0	0	0	16
North Haven[1]	0	0	0	0	0	0	8
Orange[2]	0	0	0	0	0	3	145
Southbury[2]	0	0	0	0	0	4	691
Wolcott	4	2,235	2	7,845	0	0	265
	12	2,459	4	7,878	0	195	1,444

[1]Scouted around old infestations.
[2]Scouted by Federal men.

Towns	Infestations found	Egg-clusters creosoted	Colonies sprayed	Poison used (lbs)	Larvae and pupae killed	Road-side scouted (miles)	Wood-land scouted (acres)
Litchfield County							
Barkhamsted	20	1,408	3	30	0	91	0
Canaan[2]	5	1,200	5	23,100	0	17	3,982
Colebrook	2	32	0	0	0	15	0
Cornwall[2]	1	116	1	3,545	0	3	608
Harwinton	0	0	0	0	0	3	0
Kent[2]	0	0	0	0	0	1	270
Litchfield[2]	0	0	0	0	0	5	767
New Hartford	1	17	0	0	0	0	8
Norfolk[2]	1	6	1	150	0	3	1,022
North Canaan[2]	1	32	1	1,830	0	6	942
Salisbury[2]	1	138	1	2,020	0	2	770
Sharon[2]	1	8	1	2,880	0	2	320
Warren[2]	3	84	2	6,480	0	5	2,816
Washington[2]	0	0	0	0	0	5	405
	36	3,041	15	40,035	0	158	11,910

Fairfield County

No work was done in Fairfield County.

[2]Scouted by Federal men.

There has been no change in the Federal or State gipsy moth quarantine during the year.

Summary of Statistics

County	Towns covered	Infestations found	Egg-clusters creosoted	Colonies sprayed	Poison used (lbs.)	Larvae and pupae killed	Road-side scouted (miles)	Wood-land scouted (acres)
Windham	5	27	4,675	0	0	58,946	0	22
New London	4	5	2,056	0	0	330	41	4
Tolland	3	5	118	0	0	2,327	0	8
Middlesex	4	3	19	1	6	0	125	0
Hartford	14	27	6,652	0	0	8,657	509	637
New Haven	8	12	2,459	4	7,878	0	195	1,444
Litchfield	14	36	3,041	15	40,035	0	158	11,910
	52	115	19,020	20	47,919	70,260	1,028	14,025

Financial Statement

RECEIPTS

Appropriation year ending June 30, 1933	$50,000.00
Balance on hand July 1, 1932	290.72
	$50,290.72

EXPENDITURES

Salaries	$ 4,772.50
Labor	33,369.25
Stationery and office supplies	72.13
Scientific supplies (chemicals)	26.25
Insecticides	314.78

Small hardware	$ 1.61
Automobile oil	53.10
Medical supplies	15.40
Telephone	62.25
Travel expense (outlying)	247.99
" " (gasoline for automobiles)	853.92
Freight and express	4.37
Fuel	76.00
Electricity	17.64
Automobiles (new)	3,974.00
" (repairs)	262.44
Other equipment (new)	2,663.99
" " (repairs)	21.85
Rent of land, storehouse	454.75
Insurance	590.70
Miscellaneous contingent expenses	3.79
Total Disbursements	$47,858.71
*Balance on hand July 1, 1933	2,432.01
	$50,290.72

*Reverts to State Treasury.

THE EUROPEAN CORN BORER IN CONNECTICUT, 1933

W. E. Britton, M. P. Zappe and J. P. Johnson

This paper is a report on the compulsory clean-up, together with surveys of the degree of infestation of early and late sweet corn and injury caused by the borer.

Enforcing the Compulsory Clean-up

Pursuant to the provisions of Section 2125 of the General Statutes, Director Slate of this Station issued an order requiring that all cornstalks and stubble be satisfactorily disposed of on or before April 10, by feeding to live stock, plowing under cleanly, or burning, and that the larger weeds in and around the cornfields likewise be destroyed.

Consequently, on April 12, 22 men were sent out as inspectors to check on the clean-up work, and where it had not been done or done properly, to insist that it be done at once. In most cases where the official order had not been fulfilled, the reason was given as wet land, broken farm machinery, sick men or sick horses.

Following the system used in preceding seasons, the inspectors filled out order cards instructing each grower what to do, and obtained his signature agreeing to complete the work within a few days. Another addressed card was left for him to sign and send to the office as soon as the work had been completed. The order cards signed by the growers were brought to the Station by the inspectors, and when the report cards were received stating that the clean-up had been completed, these cards were matched up, clipped together and filed. In case the report cards were not received within a reasonable time, the inspectors visited each delinquent to learn the reason. Altogether 5,369 order cards were issued by the inspectors, and 4,399 report cards, or 82 per cent, were returned to the office. Some cards had been lost or mislaid and in many such cases the inspectors found that the work had been done. Where report cards are not returned it makes more work for the inspectors, but on the whole there was very little trouble as most of the growers have now had some injury done to their corn by this insect and are willing to cooperate in holding the pest down to such a point that it will not cause severe damage.

In 1933, there were only three prosecutions of men who refused to clean up their premises. In all cases convictions were obtained, and the courts imposed fines and ordered the fields cleaned up.

Mr. Zappe and Mr. Johnson had general supervision of this work and the inspectors used automobiles borrowed from the Bureau of Plant Quarantine of the United States Department of Agriculture. The Station paid the cost of operating the motor cars, and the wages of the inspectors. This work was completed about June 1.

The total cost to the state in conducting this work was approximately $4,279.26, while $336.39 was expended in conducting a survey during the summer and fall seasons.

Summary of the European Corn Borer Survey, Summer and Fall of 1933

Reports were received by the writers during the month of June that early sweet corn was heavily infested by the first generation corn borer in Glastonbury and Stratford. Certain fields were checked in these towns and observations made which indicated that severe injury would occur. It was decided that one man should be assigned to make observations and collect data on the resulting losses. Mr. R. E. Kimport, formerly with the Bureau of Entomology, U. S. Department of Agriculture, was employed for this purpose.

Investigations were made in Glastonbury, East Hartford, Manchester, Southington, Plainville, Middletown, Durham, Branford, North Branford, Northford, Groton, Ledyard, New London, Stratford, Hamden, Milford, Westport, Salisbury, and New Milford. It was found that moderate damage occurred in the towns of Manchester, Middletown, Southington, Plainville, Branford, North Branford, Groton, Ledyard, New London and Hamden, while severe damage occurred in Glastonbury, East Hartford, Milford and Stratford.

The most severe damage during the past season by the first generation borer occurred in sweet corn planted during April and the first ten days of May and which is usually harvested the first twenty-five days of July. This damage was primarily caused by borers entering the marketable ears rendering them unsalable, and by injury near the junction of the ear-shanks and stalks causing improper development of ears.

The first corn harvested for market was heavily infested and damaged to such an extent that consumers bought less corn through the season and were so suspicious that practically all corn was examined closely before any was purchased. This condition resulted in a decrease of the

price of at least five cents a dozen on the market. Clean uninfested corn brought little if any more than the lightly infested corn. Heavily infested corn did not sell at wholesale or retail. The average price obtained for this early corn was approximately twenty cents a dozen.

Farms were visited when reports were received that infestations of the [illegible] generation borer were present. In all, thirty-nine such farms were [illegible]ed and eleven farms were found uninfested, while others had damage as high as 100 per cent. Data were obtained from the growers concerning acreage of corn ground, and the amounts sold and left unsold. The

TABLE 3. DAMAGE TO EARLY SWEET CORN BY THE FIRST GENERATION CORN BORER

	Town	Acres	Estimated Number Doz. Ears in Field	Number Dozen Ears Sold	*Estimated Loss Due to Damage	†Loss due to Decreased Demand	Estimated Total Loss to Grower
1.	Glastonbury	15.	6,750	1,200	$ 1,170.00	$ 337.50	$ 1,507.50
2.	East Hartford	8.	3,600	1,600	600.00	180.00	780.00
3.	East Hartford	4.5	2,250	1,000	510.00	112.50	622.50
4.	Glastonbury	2.	900	0	180.00	45.00	225.00
5.	East Hartford	1.	500	200	90.00	25.00	115.00
6.	East Hartford	7.	4,000	0	800.00	200.00	1,000.00
7.	East Hartford	2.	900	100	165.00	45.00	210.00
8.	East Hartford	1.	450	100	75.00	22.50	97.50
9.	East Hartford	1.5	700	200	110.00	35.00	145.00
10.	East Hartford	1.	500	150	77.50	25.00	102.50
11.	East Hartford	2.	900	225	140.63	45.00	185.63
12.	Manchester	.5	200	20	38.00	10.00	48.00
13.	Manchester	2.	1,000	200	170.00	50.00	220.00
14.	Glastonbury	1.5	800	100	140.00	40.00	180.00
15.	Glastonbury	2.	1,100	200	190.00	55.00	245.00
16.	Southington	10.	4,500	4,200	20.00	225.00	245.00
17.	Plainville	15.	6,750	6,600	30.00	337.50	367.50
18.	Middletown	2.5	1,000	150	265.00	50.00	315.00
19.	Middletown	.7	400	50	105.00	20.00	125.00
20.	Durham	.5	200	Selling	No estimate	10.00	10.00
21.	Branford	1.5	700		No loss	35.00	35.00
22.	Branford	2.	1,000		No loss	50.00	50.00
23.	No. Branford	2.5	1,200		No loss	60.00	60.00
24.	No. Branford	2.5	1,200		No loss	60.00	60.00
25.	Northford	8.	4,000		No loss	200.00	200.00
26.	Groton	2.	900		No loss	45.00	45.00
27.	Ledyard	1.5	675	600	18.75	33.75	52.50
28.	Groton	1.	450	400	12.50	22.50	35.00
29.	New London	.5	300	250	10.00	15.00	25.00
30.	Stratford	12.	5,400	2,700	782.00	270.00	1,052.00
31.	Highwood	8.	3,600	2,200	418.00	180.00	598.00
32.	Hamden	12.	5,400	4,700	401.00	270.00	671.00
33.	Stratford	3.	1,350	700	267.50	67.50	335.00
34.	Woodmont	25.	12,500	Seed Corn	No estimate	625.00	625.00
35.	Westport	5.	2,500		No loss	125.00	125.00
36.	Westport	20.	9,000		No loss	450.00	450.00
37.	Salisbury	.3	135		No loss	6.75	6.75
38.	New Milford	2.	1,000		No loss	50.00	50.00
39.	New Milford	4.	2,000		No loss	100.00	100.00
	[illegible]	192.5	90,710	27,845	$6,785.88	$4,535.50	$11,321.38

[illegible]erage price, 20 cents per dozen. † Estimated loss at 5 cents a dozen due to decreased demand.

average yield was conservatively figured as 6,000 ears or 500 dozen to an acre. Twenty cents a dozen was used as an average price and from this basis the actual loss to thirty-nine farms was found to be $6,785.88 or an average loss of $34.73 an acre for 192.5 acres. Figuring five cents a dozen more, due to decreased demand, an additional loss of $4,535.50 occurred. By adding the actual and decreased demand losses, the total damage amounted to $11,321.38 or an average of $58.81 an acre. Additional figures will be found in Table 3.

Some growers, especially those that had roadside markets, kept records of their sales, and excellent figures were obtained. Damage was so severe

Table 4. Damage to Late Sweet Corn by the Second Generation Corn Borer

	Town	Acres	Estimated Number Doz. Ears in Field	Number Dozen Ears Sold	Estimated Loss Due to Damage
1.	Milford	19.5		Seed Corn	
2.	Orange	4.		Seed Corn	No loss
3.	Orange	1.	600		No loss
4.	Orange	.5	300		No loss
5.	Orange	1.	500		No loss
6.	Glastonbury	.5	300	200	$ 15.00
7.	East Hartford	.7	400	350	45.00
8.	Highwood	.7	400	340	13.00
9.	Hamden	2.			No loss
10.	North Haven	.5			No loss
11.	North Haven	.5	300	230	14.00
12.	Branford	1.	600	450	22.50
13.	North Branford	2.	1,200	900	45.00
14.	Middletown	.5	300	250	7.50
15.	Glastonbury	2.	1,200	750	54.00
16.	North Branford	1.	500	400	15.00
17.	North Guilford	.5	300	250	7.50
18.	Windsor	3.		Seed	No estimate
19.	East Hartford	1.	600	300	60.00
20.	Glastonbury	1.	600	0	120.00
21.	East Hartford	2.	1,200	800	80.00
22.	East Hartford	.5	300	0	60.00
23.	Stratford	.5	300	250	12.50
24.	Stratford	.5	300	200	25.00
25.	Groton	1.	600	600	30.00
26.	Ledyard	1.	500	450	10.00
27.	Groton	.5	300		No loss
28.	Groton	.3	200		No loss
29.	Stonington	.5	200		No loss
30.	East Lyme	.3	150		No loss
31.	Old Lyme	.7	300		No loss
32.	Saybrook	.3	100		No loss
33.	Killingworth	.5	200		No loss
34.	Clinton	1.	600	400	40.00
35.	North Madison	1.	450	350	20.00
36.	Southington	.5	300	300	No loss
37.	Farmington	1.	500		No loss
38.	East Hartford	1.5	800	600	24.00
39.	Manchester	1.5	800	100	70.00
40.	Glastonbury	1.	600	0	60.00
		59.	16,800	8,470	$ 850.00

on several farms that certain pieces of corn were plowed under or used for ensilage and were figured as total losses.

The second generation borer caused damage to the late sweet corn, seed corn and dahlias. Heavy infestations occurred in fields of ensilage corn but very little breakage was found. Wind damage resulting from the tropical storm was more severe than the breakage caused by the corn borer.

The sweet corn cut for the markets in late August and early September was not much injured as the borers were just hatching. However, later corn was entered by the young larvae which developed rapidly. As the season progressed the damage became more apparent causing further losses to the growers. This loss was due primarily by direct injury to the salable ears. The ears had an opportunity to develop normally before the second generation borers were large enough to injure the stalks.

A large percentage of the late corn was marketed before the damage became evident and it was difficult to obtain figures for damage on any great amount of acreage. However, after approaching the growers in a manner similar to that during the early summer, figures were obtained from 37 growers having a total of 32.5 acres. Fourteen of the 37 growers did not have any loss. The losses for the late corn were obtained by estimating the number of ears left in the field and the prices obtained by the individual grower. The prices varied from ten to twenty-five cents a dozen. The loss for 32.5 acres amounted to $850.00 or an average of $26.15 an acre. This average includes the fourteen farms where no loss occurred. Table 4 will give additional information on damage caused by the second generation borer.

The seed corn industry was dealt severe losses by the corn borer. These losses were taken as a whole and no effort was made to distinguish the damage caused individually by the first or second generation borers. Estimates by the growers ranged from five to twenty-five per cent loss, and some of these are considered very conservative by the writer. The seed corn crop is fifty per cent short this year due to dry weather, Stewart's wilt, corn ear worm and the corn borer.

The seed corn industry centers around Milford and Wethersfield, and growers having a total of 309 acres were visited. Estimates of damage in the field due to non-development and spoilage of the ears, damage and spoilage of the kernels after harvesting and in some instances extra labor costs in cleaning and preparing the seed were used to figure the losses. Actual damage by the corn borer to 309 acres of seed corn amounted to $4,333.73 while additional labor charges (those obtainable) for extra hand work in cleaning totaled $861.00. The combined figures total $5,194.73, or an average of $16.81 an acre.

During the first generation it was found that the borer population in the early sweet corn was as high as 1,342.6 borers per hundred stalks or 259,464 borers to an acre, in one field in East Hartford. The fall borer population survey was made in Glastonbury, Wethersfield, Milford, Orange, Woodbridge, Groton, Ledyard, Montville, New London, Stonington and Waterford. All the towns with the exception of Ledyard indicated an increase of approximately one hundred per cent over the

1932 survey. The infestation increased slightly in Ledyard. This survey, shown in Table 3, was primarily made on the same farms as those surveyed in 1932. Sweet, Flint, Dent and Ensilage corn were the varieties grown in the fields.

While preliminary surveys were being made during the latter part of June and first part of July, reports were received that the corn borer was infesting the stalks of Irish Cobbler potatoes in East Hartford, and upon investigation it was found that several fields had considerable

FIGURE 71. European corn borer in potato stalks in East Hartford. Natural size.

infestation. Infested stalks are shown in Figure 71. The potatoes were so far advanced that no ill effect could be noted. Green Mountain potatoes planted in adjacent fields at a later date had little or no infestation. It seemed feasible to believe that the Irish Cobblers were planted early, and corn borer eggs were deposited on the stalks, while very little if any other growth was present to serve as host plant. As the season advanced, especially during the period of the second generation, it was found that weed infestation was much more apparent than it had ever been before.

Damage to Seed Sweet Corn

In addition to the data shown in Tables 3, 4 and 5, an examination of dried sweet corn ears was made on certain farms in the seed growing regions in and around Milford and Wethersfield, by A. M. Vance and S. M. Dohanian of the Arlington, Mass., corn borer laboratory of the United States Bureau of Entomology. Some results of this seed damage survey are mentioned here by permission.

As might be expected, the degree of infestation varied with location of field and variety of sweet corn, but of 23 lots representing 15 varieties, only 4 lots showed less than 50 per cent of the ears damaged by the European corn borer. Three varieties had more than 90 per cent damaged; the highest was 99.3, and the average 58.2 per cent.

TABLE 5. COMPARATIVE CORN BORER CONDITIONS FOR THREE YEARS

FALL, 1933

Towns		Acres Surveyed	Per cent of Infestation	Average No. Borers per Inf. Plant	Maximum Borers per Plant	Borers per 100 Plants Inf. or Uninfested	Borers per Acre*
Hartford County							
Glastonbury	1933	4.59	49.8	7.8	26	388.4	75,349
	1932	6.6	42.4	5.47	13	231.93	44,994
Wethersfield	1933	25.6	83.	6.1	14	506.3	98,222
	1932	12.71	47.4	8.6	53	407.64	79,082
New Haven County							
Milford	1933	21.24	87.2	4.56	13	397.6	76,124
	1932	16.88	35.4	1.58	7	55.93	10,850
	1931	14.26	24.	3.	10	72.	13,967
Orange	1933	11.05	61.8	3.9	16	241.	46,754
	1932	14.38	20.8	2.04	8	42.43	8,231
	1931	2.33	4.88	1.74	8	8.49	1,643
Woodbridge	1933	13.39	13.6	1.82	8	24.75	4,792
	1932	9.	7.6	1.87	3	14.21	2,757
New London County							
Groton	1933	13.69	80.8	5.92	20	478.3	92,790
	1932	2.91	75.6	3.76	8	284.26	55,146
	1931	2.39	62.32	7.14	27	444.96	85,883
Ledyard	1933	2.52	39.	2.24	9	87.36	16,948
	1932	3.06	37.	2.08	6	76.96	14,930
	1931	6.	26.96	2.64	13	68.48	13,308
Montville	1933	3.83	35.6	2.44	9	86.86	16,851
	1932	2.82	24.8	1.6	4	39.68	7,698
	1931	6.5	17.52	3.58	20	62.72	12,158
New London	1933	† .15	100.	6.8	8	680.	131,920
	1932	Back Yard	60.	2.6	5	156.	30,264
	1931	1.04	69.84	7.5	17	523.8	101,738
Stonington	1933	3.37	70.6	3.3	11	232.98	45,188
	1932	4.09	46.8	2.28	12	106.7	20,700
	1931	6.57	44.08	5.48	35	241.56	46,841
Waterford	1933	7.49	89.6	4.08	8	365.5	70,907
	1932	4.85	63.	3.08	7	194.04	37,644
	1931	8.18	35.04	2.82	10	98.81	19,185

*Average based on 19,400 plants per acre. † 1 Back Yard.

This survey also took into account the damage to the tip kernels, the butt kernels and the middle kernels. The middle kernels are usually considered the most desirable for seed, and of the 27 lots representing 15 varieties, only 7 lots showed less than 50 per cent damage to the middle kernels. The greatest damage to middle kernels was 98 per cent, the least was 15.7, and the average 58.2 per cent. In estimating the financial loss per acre to sweet corn grown for seed, it is necessary to consider not only the injury to the kernels, but also the cost of separating the good from the injured kernels. In the instance of greatest damage this exceeded $51.00 an acre. The least was $3.64, and the average for the 23 lots representing 15 varieties was $15.57 an acre.

THE JAPANESE BEETLE IN CONNECTICUT, 1933

J. Peter Johnson

Scouting

In scouting, fifteen men were employed and organized into three crews of four men each and one crew of three men. With the exception of one man, all were experienced scouts. Work was begun on July 10 and completed September 2, 1933. The scouts reported at New Haven for one day of field practice. The crew foremen were furnished their assignments, supplies and automobiles. All crews were engaged in scouting classified nursery and greenhouse premises. Crews of four men each were placed in Shelton, New Haven and Hartford, and the crew of three men was stationed in Willimantic. These towns were centers from which the crews covered their respective districts. The scouting itineraries were so arranged that each classified establishment would be scouted twice, but when the establishments were in close proximity to known infestations they were scouted three times.

Altogether 116 establishments were scouted and many of these were subdivided, meaning that considerably more than 116 areas were scouted within the state. The minimum distance scouted around each firm was 1,000 feet and where necessary, this distance was extended. Scouting for the abundance and spread of the beetles was incidental to the scouting of classified nurseries and greenhouses. Beetles were found in several localities, none of which constituted new infestations.

The first beetles were found in New Haven, July 10, and the last beetles were found by an inspector in Stamford, October 5, 1933.

Trapping

Traps were placed for the first time in Manchester, Middletown, Putnam and Winsted. Beetles were caught for the first time in Manchester, Middletown and Putnam as follows:

Locality	Date	No. of beetles
Manchester	July 7 - August 28	10
Middletown	July 10 - August 1	4
Putnam	August 2 - September 2	135
	Total beetles caught in traps	149

The infestation in Bridgeport has increased to such an extent that feeding was noted on grapevines, flower gardens and shrubs in many more localities than in 1932. Telephone calls and letters were received which indicated that residents were carrying on control work. The Children's Museum, Farmington Avenue, Hartford, requested information on control measures because it had received many local calls for such information.

Inspection and Certification of Farm Products

Federal quarantine No. 48 as revised and effective January 1, 1933, was extended to include all of Massachusetts, the southern half of New Hampshire and Vermont and additional areas in New York. The extension included nearly all of the natural market areas for Connecticut farm products and very little inspection was necessary. Further, the lifting of the farm products quarantine on September 15 relieved the necessity of inspecting fruit shipments into Maine, as the peach crop was maturing at that time. The regular nursery district inspectors inspected and certified all the farm products shipments without much extra labor. Practically all shipments were made by non-commercial shippers. The quantity of each product inspected and certified is shown in Table 6:

Table 6

Product	Number of Packages
Corn	39
Beans	59
Apples	3
Peaches	19
Cut flowers	15
Total	135

The total number of plants certified for shipment into other states and foreign countries was 1,969,042. The number of certificates issued is shown in Table 7:

Table 7

Kind	Farm products	Cut flowers	Nursery and ornamental stock	Soil, sand	Total
'A'	81	12	268	1	362
'A' blks.			18,288		18,288
'B'	—	1	1,875	9	1,885
Total	81	13	20,431	10	20,535

The number of state certificates issued in 1933 for use on shipments of plant materials to the 30 states and Dominion of Canada that have placed quarantine regulations against infested states on account of the European corn borer, is shown in Table 8:

Table 8

No. of tags used	Products	Amount	Value
161	Shelled corn	120 bags)	$
6	Shelled beans	3 bags)	768.14
127	Chrysanthemums	3,606	431.87
5	Asters	19	5.20
20	Dahlias	344	544.00
319			$1,749.21

MOSQUITO CONTROL IN CONNECTICUT, 1933

R. C. Botsford

New ditching for mosquito elimination this season was limited to work done by the towns of Stratford, Fairfield, Bridgeport and Old Saybrook as a relief measure for unemployed labor. The work in Stratford and Old Saybrook was the ditching of salt marshes, and in Bridgeport and Fairfield was concerned with fresh water streams and swamps.

The following towns contain certain salt marsh areas that as yet are unditched: Bridgeport, Stratford, Milford, West Haven, New Haven, North Haven, East Haven, Clinton, Old Saybrook, East Lyme, Waterford and New London amounting to approximately 5,500 acres. Also there are brackish areas bordering the Connecticut River in the towns of Saybrook, Essex and Lyme.

Many of the tide gate structures, dikes, and culverts, serving as beach outlets which are depended upon in maintaining the areas protected, are greatly in need of repair. The tide gates on the Branford River at Montowese Street have long been a source of much annoyance on account of bad leakage under the sills. It seems almost impossible to remedy it without complete reconstruction. These gates must be removed from their hangings every autumn, brought ashore and stored, and replaced in the spring. These gates should be redesigned to overcome their present defects. The tide gate on Sybil Creek at Indian Neck has a sill that is too high to allow the necessary drainage of the marsh, back of Hotchkiss Grove. This condition should be corrected as soon as possible to eliminate mosquitoes breeding there. Tide gates near Branford Point on Harbor Street should be rebuilt. The tide gate on Stony Creek is in good condition, but the dike, which was repaired in 1923, has settled and should be completely rebuilt. The stone dike at Shell Beach, Guilford, leaks badly and should be rebuilt and raised about two feet. At Great Harbor the tide gate structure is at a point where the first severe storm may sweep it away. The old Shore Line Railroad embankment which has served as a dike there for about 15 years has weak points caused by the receding beach where a severe storm could break through, as there is no stone protection for the dirt bank.

A tide gate in the East River, Madison, should be replaced at the old site north of the Post Road. Also a tide gate is required in Clinton on the Indian River at the north end of the Post Road bridge.

An important improvement was made in an outlet in Westbrook on the Frederic P. Fisk property. An 18-inch corrugated iron pipe installed in 1924 was badly corroded and was replaced by 120 feet of 24-inch Atlas Cast Iron Lock Joint pipe, and placed on the east boundary of the Fisk property. The pipe was purchased and delivered to the job by Frederic P. Fisk. He also constructed a sea wall and a concrete manhole complete with tide gate and rubbish screen. This Station will furnish and install the same type of pipe to extend from the new sea wall through the beach to the low tide level. This job should be completed as soon as possible.

In Guilford the dike at the foot of Whitfield Street was rebuilt by a local contractor. This work was initiated by the salt meadow owners and the Experiment Station paid for half the total cost.

The pipe outlet and gate to the outlet of Oldfield Creek in West Haven installed jointly by the Town of West Haven and the Station in 1931 has proved a valuable improvement and functions satisfactorily.

Mosquito breeding places in West Haven still exist at Sandy Point, Cove River and Oyster River. These areas should be ditched.

Mosquito breeding places in West Haven still exist at Sandy Point, period since 1924. This was due to the frequent showers and generally cloudy and humid weather, which resulted in the formation of breeding spots in areas not previously requiring attention.

A large brood of mosquitoes developed and emerged in Westport at the Great Marsh where an outlet pipe became clogged and a severe storm broke through the beach and flooded the area. This produced ideal conditions for mosquito breeding.

In Guilford at Shell Beach at least two broods developed and infested the whole community. One length of corrugated iron pipe was so thoroughly rusted through that the leakage filled a grassy area of about 50 acres to a depth of 4 to 10 inches, producing ideal breeding conditions and making its discovery difficult.

The Morris Creek areas, both in New Haven and East Haven, have always been a source of mosquitoes to infest New Haven. It is impractical to ditch these areas until the tide gate sill on Morris Creek is lowered between 18 and 24 inches. Until this is done, ditching cannot be effective. The stream should also be dredged from Thompson Avenue to the beach.

The general maintenance work on ditched and accepted salt marsh areas was carried on as usual with three crews patrolling practically the entire coast line. The condition of the ditches has continued to improve and with the exception of the broods escaping in Westport and Guilford, no breeding of any importance was discovered on the salt marshes.

In New Canaan, Edwin C. Rae was again appointed State Deputy to carry on investigations and control work, and he submitted to Dr. W. E. Britton of this Station and to George T. Smith, First Selectman of New Canaan, a complete report of his work of the season.

More mosquito breeding places were found and reported in New Canaan this season than last year, and the same problems were confronted. Backyard breeding places seem to be the major problem in New Canaan, especially in the center of the town. An effective larvicide less destructive to vegetation and wild life is a necessity in this and similar towns. Much can be accomplished by ditching and draining swamps, grading streams and cleaning edges of ponds, and other permanent work.

Under the Civil Works Administration for the relief of unemployed, two mosquito control projects have been assigned for supervision by the Connecticut Agricultural Experiment Station staff. One is a Federal project that authorizes ditching of salt marshes and fresh water swamps, and the repair or construction of tide gates and dikes. The other is a State project for ditching salt marshes. With funds furnished under these two projects, it is planned to complete the ditching of the remaining unditched salt marsh areas in Connecticut, repair tide gates and dikes, and also accomplish some much-needed and permanent drainage work in many towns where malarial mosquitoes have been breeding unchecked.

TESTS OF MOSQUITO LIGHT TRAPS AND LARVICIDES, 1933

Neely Turner

Light Traps

The New Jersey light traps were used in Spring Glen, Morris Cove and New Haven for occasional collections. No effort was made to obtain a season's record, but the traps were used to collect a sample of the mosquitoes in the localities named. The number and species of mosquitoes caught are given below.

Statistics of Mosquito Trap Collections

	June				August					September	Totals
	6	16	22	28	22	25	26	27	28	8	
New Haven											
Aedes sollicitans	1										1
Aedes cantator	5	2	2								9
Aedes vexans			1	1							2
Culex pipiens			1	1							2
Totals	6	2	4	2							
Morris Cove											
Aedes sollicitans			1		3						4
Aedes vexans			7								7
Culex territans					1						1
Totals			8		4						
Spring Glen											
Aedes sollicitans					1	7	4	2	3	1	18
Aedes vexans						3	2	1	2	4	12
Aedes taeniorhynchus						2					2
Culex pipiens						1					1
Anopheles punctipennis						1				1	2
Anopheles maculipennis							1				1
Uranotaenia sapphirina									2		2
Totals					1	14	7	3	7	6	

In New Haven and Spring Glen the salt water species *Aedes sollicitans*, *A. cantator* and *A. taeniorhynchus* were more abundant than the fresh-water species. In Morris Cove few specimens were obtained, but *Aedes vexans* was more abundant than *A. sollicitans*. The number caught in a single night varied from 1 to 14. The traps were placed in locations from which complaints of mosquito abundance had been received. The number caught in no case equalled the standard of 24 female mosquitoes set as the number that should cause annoyance to residents. However, the standard of 24 females a night was obtained by placing the traps some distance from houses. In all three locations the traps were within 100 feet of a dwelling and in thickly settled portions of the city.

Other Collections

During the season many specimens of adult mosquitoes were collected in the field. A summary of these collections is as follows:

Aedes cantator. Collected larvae April 24 in East River and Madison. Adults emerged May 1.

Collected larvae and pupae May 6 in West Haven. Adults emerged May 10.

Aedes canadensis. Collected larvae April 24 in Madison (associated with *A. cantator*). Adults emerged May 9.

Collections of Adults

Aedes sollicitans. Westport, August 14.
Aedes cantator. Milford, May 22.
New Canaan, September 8.
Aedes canadensis. New Canaan, September 8 and 20.
Aedes vexans. Westport, August 9 and 14.
New Canaan, September 8 and 20.
Branford, October 18.
Aedes abserratus. North Branford, May 25.
Aedes fitchii. Westport, August 14.
Aedes excrucians. Farmington, May 16.
New Canaan, September 8.
Aedes triseriatus. New Canaan, September 8 and 20.
Culex pipiens. Westport, August 9.
New Canaan, September 8 and 20.
Culex territans. New Canaan, September 8.
Hamden, October 10.

In one case *Aedes cantator* and *A. canadensis* were reared from a swamp near a salt marsh. One specimen of *Aedes cantator* was taken in New Canaan on September 8. The nearest possible breeding place is about twelve miles from the point of collection. About 25 specimens of *Aedes*, apparently fresh-water species, have not been identified. Some of these may represent new records for the state.

Larvicides

Due to pressure of other work very little was done with mosquito larvicides during 1933. E. C. Rae of New Canaan tested a pyrethrum dust made by diluting one pound of freshly ground flowers of pyrethrum with three pounds of marc from kerosene extraction of ground pyrethrum flowers. This material killed mosquito larvae in small pools, but in large pools tended to collect in the center of the pool rather than remain near the banks where the mosquitoes were breeding. The dust was sufficiently toxic and if the physical properties can be changed may become useful as a larvicide.

CONTROL OF THE POTATO FLEA BEETLE

Epitrix cucumeris Harris

Neely Turner

The toxicity of (1) lead arsenate 3 pounds, fish oil 1 quart, water 100 gallons, (2) 5–6–50 Bordeaux mixture, and (3) barium fluosilicate 1 pound and lime 5 pounds, applied as a dust to wet foliage was compared in the laboratory. Adult flea beetles were caged on plants, treated with these materials, and a mortality count made six days later, with the results given in Table 9.

TABLE 9.

Treatment	Percentage dead
Barium fluosilicate 1 lb., lime 5 lbs.	89
Bordeaux mixture 5–6–50	26
Lead arsenate 3 lbs., fish oil 1 qt., water 100 gals.	15
No treatment	16

This test shows that barium fluosilicate was highly effective and the other materials were of little value in killing flea beetles, although they acted as excellent repellents.

On Irish Cobbler potatoes sprays were applied May 26, June 5, June 14 and July 1. The yield of potatoes is given in Table 10.

TABLE 10. IRISH COBBLER POTATOES

Treatment	Calculated acre yield bushels
Bordeaux mixture 4–4–50	260
Lead arsenate 3 lbs., fish oil 1 qt., water 100 gals.	268
Calcium arsenate 3 lbs., water 100 gals.	224
Barium fluosilicate 3 lbs., water 100 gals.	210
No treatment	226

These results show that lead arsenate and fish oil were more effective than Bordeaux mixture, and that calcium arsenate and barium fluosilicate sprays were ineffective.

On Green Mountain potatoes sprays were applied on June 5, June 14, July 19, July 29, August 7 and August 15. These sprays were 5–6–50 Bordeaux mixture, and lead arsenate 3 pounds, fish oil 1 quart, water 100 gallons. Barium fluosilicate 1 pound, with lime 3 pounds, was applied as a dust on June 5, June 14, July 22, July 31, August 8 and August 15. Tip burn was severe on all plots except the Bordeaux plots. Late blight occurred on all plots, but was less serious on the Bordeaux plots. The yields are given in Table 11.

TABLE 11. GREEN MOUNTAIN POTATOES

Treatment	Calculated acre yield bushels
Bordeaux mixture 5–6–50	650
Barium fluosilicate 1 lb., lime 3 lbs.	377
Lead arsenate 3 lbs., fish oil 1 qt., water 100 gals.	288
No treatment	294

These results show the excellent yield following use of Bordeaux mixture as compared with the other treatments. Much of this increase was due to control of the potato leafhopper, which causes tip burn. The barium fluosilicate dust did not control tip burn but decreased flea beetle injury and increased the yield. Lead arsenate was not effective on this variety.

TESTS OF VARIOUS APPLE SPRAYS

M. P. ZAPPE AND E. M. STODDARD

The testing of several spray materials for control of apple insects and fungous diseases has been in progress for several years and was continued in 1933. Owing to the legislation and general agitation against arsenical and lead residues on fruit, it was thought advisable to substitute calcium arsenate for lead arsenate in some of the plots.

The young Experiment Station orchard was used in these tests. The following varieties are represented in this orchard: Baldwin, Greening, McIntosh, Sutton, King, Northern Spy, Stark, Fall Pippin, Russet, Hurlburt, and Gravenstein. The plots were so arranged that most of these varieties were included in each plot. The orchard is divided into 16 rows. Rows 1 and 16, being on the outside of the orchard, were considered barrier rows. They were sprayed regularly but no fruit was scored at harvest time from these rows.

The rest of the orchard was sprayed with the following materials to 100 gallons of water:

Row 2	Liquid lime-sulfur	2½	gals.	lead arsenate, 3 lbs.
Row 3	Dry lime-sulfur	6	lbs.	lead arsenate, 3 lbs.
Row 4, 5	Hydrated lime	10	lbs.	lead arsenate, 3 lbs., fish oil, 1 qt.
Row 6	Flotation sulfur	6	lbs.	lead arsenate, 3 lbs., after calyx, 5 lbs.
Row 7	Kolofog	6	lbs.	lead arsenate, 3 lbs.
Row 8	No spray			
Row 9	Liquid lime-sulfur	2½	gals.	calcium arsenate, 3 lbs.
Row 10	Dry lime-sulfur	6	lbs.	calcium arsenate, 3 lbs.
Row 11, 12	Hydrated lime	10	lbs.	calcium arsenate, 3 lbs., fish oil, 1 qt.
Row 13	Flotation sulfur	6	lbs.	calcium arsenate, 3 lbs., after calyx, 5 lbs.
Row 14	Kolofog	6	lbs.	calcium arsenate, 3 lbs., after calyx-lime, 8 lbs.
Row 15	No spray			

TREATMENTS AND DATES

Prepink spray	May 2	on McIntosh only
Pink spray	May 8	on McIntosh only
Calyx spray	May 22, 23	on all varieties
10-day spray	June 2	on all varieties
17-day spray	June 9, 10	on all varieties
Last spray	July 10	on all varieties

No fungicides were used in the last spray.

All spraying was done with a quad gun and the spray directed from a tower mounted over the spray tank.

At harvest time fruit from all trees was scored. All injuries were noted even though they were slight, so that all fruit classified as good was perfect without any blemishes caused by diseases or insects.

The fruit from this orchard was exceptionally free from insect and fungous troubles in 1933. Curculios are still responsible for most of the injuries to the apples in this orchard, but the injuries were much less than for several years. The lead-lime-fish oil treatment was again the best of the materials tested. This has been true for several years. Curculio injury

TABLE 12. RESULTS OF TREATMENT

	Ars. lead-lime fish oil	Flotation sulfur lead arsenate	Flotation sulfur calcium arsenate	Kolofog calcium arsenate	Dry lime and sulfur lead arsenate	Dry lime and sulfur calcium arsenate	Calcium arsenate lime, fish oil	Kolofog Lead arsenate	Liquid lime and sulfur Calcium arsenate	Liquid lime and sulfur Lead arsenate	Check—no spray
Good	95.05	92.68	90.86	90.02	90..	89.86	88.94	88.64	85.97	83.42	33.2
Curculio	3.14	6.06	6.33	7.49	7.78	7.48	7.36	7.82	12.85	13.85	34.8
Codling moth	.08	.02	.01	.02	.02	.07	.08	.03	.2	.01	3.34
Other chewing insects	1.11	1.03	2.34	2.09	1.85	2.52	3.32	1.47	.99	2.33	21.0
Scab	.69	.33	.41	.48	.49	.07	.4	2.04	0	.55	18.3
Sooty Blotch	0	0	0	0	0	0	0	0	0	0	45.
Arsenic (As_2O_3) grains per pound	.0029	.0032	.00045	.0002	.0034	.0005	.0011	.0029	0	.0018	Tr.
Lead (Pb) grains per pound	.014	.010	.006	.0035	.014	.008	.003	.013	.003	.008	[illegible]

Legal tolerance for lead 1933—.02 grains per pound of fruit
Legal tolerance for arsenic 1933—.01 grains per pound of fruit

was about 3 per cent less than the next best treatment. The next four treatments in the table of results (Table 12) all produced good fruit and there would be little choice between them except in the cases where calcium arsenate was used. All plots where calcium arsenate was substituted for arsenate of lead showed considerable foliage injury fairly early in the season and increased as the season progressed. The old standard spray of liquid lime-sulfur and arsenate of lead was the poorest treatment of the lot, being just a little worse than liquid lime-sulfur with calcium arsenate, except that in the latter case there was considerable foliage injury. Sooty blotch was apparently controlled perfectly by all treatments even though no fungicides were used in the last spraying of July 10.

At the bottom of Table 12 are appended the amounts of arsenic and lead residue found on random samples of fruit taken from the several treatments at harvest time. The amounts are expressed in terms of grains of arsenic trioxide and lead per pound of fruit, these analyses being made by the Department of Analytical Chemistry. It will be noted in all the treatments either with lead arsenate or calcium arsenate, that the arsenic and lead are well under the legal tolerance.

Liquid lime-sulfur in combination with either insecticide showed less arsenic and lead residue than did the other treatments, which may account in part for the higher per cent of curculio damage on these plots. It is interesting to note that the fruit sprayed with either insecticide in combination with lime and fish oil did not show any excess of residue. The trace of arsenic found on the checks can be accounted for by the drift of the spray from adjacent sprayed trees.

CONTROL OF THE WHITE APPLE LEAFHOPPER[1], 1933

PHILIP GARMAN AND J. F. TOWNSEND

Trouble with the white apple leafhopper was considerably less than in 1932. It is doubtful at this time what the exact causes of the decrease were, but from orchard inspections it was apparently related in some way to the amount of rainfall occurring during periods when adult leafhoppers were emerging. Tables 14 and 15 give rainfall data for the last five years. Emergence of nymphs proceeded about as usual, both in the spring and fall of 1933, but the number of hoppers developing was not sufficient to cause trouble in most orchards. It is quite probable that insect enemies also played an important part in leafhopper reduction.

Observations were made in the MacDonald orchard, Wallingford, and in the Station orchard at Mount Carmel to determine whether delayed nymphal emergence occurred in the Wallingford locality. The emergence at that place and also at the Mount Carmel farm appeared to correspond with data secured in 1932 and reported in Bulletin 349, p. 430. Application of commercial sodium polysulfide combined with calcium arsenate was made at the MacDonald farm and counts were made to determine whether there was any advantage in this material over the standard lead arsenate-lime sulfur combination in preventing leafhopper nymphs from hatching. None was discovered.

Observations were continued during the summer and fall and spray applications for control were again made in two different orchards. An effort was made to determine just how many hopper nymphs per 100 leaves constitute a menace, with the following results. At the MacDonald orchard, trees averaging 144 per 100 leaves did not have enough to cause trouble or to warrant a spray in 1933. At the Bishop orchard 155 per 100 leaves was not enough, and at the Experiment Station farm 135 per 100 leaves was not enough. It appears that under similar conditions at least 200 per 100 leaves is necessary. The belief is, however, that a much smaller population at the time of the first generation emergence requires application of control measures; possibly 50 per 100 leaves, but this figure may be too low.

Life history work continued from 1932 indicated that the eggs of the second generation are deposited as might be expected in October, reaching a peak about the middle of the month. This data was secured from potted apple seedlings exposed to leafhoppers during the previous autumn.

The result of sprays for control are shown in Table 13. A number of pyrethrum products were tried at Mount Carmel with promising results. At the MacDonald Farm, G. L. Cass kindly applied a number of nicotine preparations (with and without soap), in comparison with anabasine sulfate containing no soap. Counts of leafhopper nymphs were made the day before and the day after the treatments and again at irregular intervals to learn if more developed after the sprays were applied. Few or no leafhoppers hatched after the spray dates in the treated plots. In the Mount Carmel farm orchard applications were made September 2 and at the Wallingford orchard, August 31. Of the pyrethrum products tried,

[1] *Typhlocyba pomaria* McAtee.

the Makepeace pyrethrum soap appeared to give the best kill, but other products are so close that the difference is doubtful in importance. In this orchard, pyrethrum products appeared to kill somewhat better than nicotine sulfate without soap.

In the MacDonald orchard there was very little difference between nicotine sulfate, and nicotine sulfate plus coconut oil soap, both giving a high percentage kill. Free nicotine without soap gave excellent results. Anabasine sulfate without soap gave as good results as nicotine sulfate without soap, and corresponded with results obtained with this material in 1932.

While no effort was made to check results of summer oils in commercial orchards, observations of the infestation in the Bishop orchard where a one per cent commercial oil was applied in midsummer lead to the belief that oils alone may be ineffective when applied during July.

TABLE 13. RESULT OF SPRAYS TO CONTROL THE WHITE APPLE LEAFHOPPER

Materials used	Nymph population per 100 leaves before application	Nymph population per 100 leaves after application	Percentage reduction
MacDonald Orchard, Wallingford			
Nicotine sulfate 1 pint Coconut oil soap 2 qts. Water 100 gals.	193	1.6	99.3
Free nicotine 1 pint Water 100 gals.	178	.4	99.8
Nicotine sulfate 1 pint Water 100 gals.	142	5.5	96.1
Anabasine sulfate 1 pint Water 100 gals.	164	2.4	98.5
Check—no treatment	145	144	.7
Experiment Station Orchard, Mount Carmel			
Pyagrol 1 pint Penetrol 2 pints Water 100 gals.	75	3.5	95.2
"Evergreen 20" 1 pint Coconut oil soap 3 qts. Water 100 gals.	85	4.0	95.3
Makepeace pyrethrum soap 6 lbs. Water 100 gals.	97	1.1	98.8
Nicotine sulfate 1 pint Water 100 gals.	68	6.7	90.1
Check—no treatment	89	135	00.0

TABLE 14. RAINFALL IN INCHES FOR NEW HAVEN COUNTY FOR THE YEARS 1928 TO 1933 INCLUSIVE

Year	May	June	July	August	September	October	Total
1928	2.26	6.09	7.86	3.51	3.85	1.38	24.95
1929	3.94	1.57	2.44	4.17	1.31	3.75	17.18
1930	5.45	2.43	1.65	1.35	1.35	2.50	14.73
1931	5.90	5.33	3.99	3.31	4.60	2.23	25.36
1932	2.00	2.12	2.79	4.40	3.65	5.51	20.47
1933	2.55	2.70	3.18	6.70	5.65	3.10	23.80

TABLE 15. SUM OF PRECIPITATION FOR JULY, AUGUST AND SEPTEMBER, AND AUGUST, SEPTEMBER AND OCTOBER

Rainfall in inches

[illegible]ember		August, September, October		Leafhopper abundance
1928	15.22	1928	8.74	moderate
1929	7.92	1929	9.13	"
1930	4.25	1930	5.10	severe
1931	11.81	1931	9.14	"
1932	10.84	1932	13.56	moderate
[illegible]	[illegible]	1933	15.45	light

Recommendations

Nicotine or anabasine sulfate with regular fungicides may be applied within two weeks after calyx or petal fall spray for the first generation. In severe infestations two applications may be necessary to clean up. No application is recommended unless there are at least 50 nymphs per 100 leaves.

For the second generation, apply nicotine or anabasine sulfate with or without soap. Nicotine alkaloid (free nicotine) or pyrethrum sprays will give good results. Apply about the first of September. No application is recommended for populations of less than 200 per 100 leaves.

Spray from the inside of the tree covering all leaves thoroughly on the underside.

ORCHARD EXPERIMENTS WITH SUBSTITUTES FOR LEAD ARSENATE

PHILIP GARMAN

Great interest on the part of fruit growers in lead arsenate substitutes and the demand for information regarding calcium arsenates in particular, resulted in a series of field experiments in various orchards. Professor S. P. Hollister of the Connecticut State College kindly coöperated with this office and his men applied a full series of calcium arsenate sprays combined with different fungicides. Plots were also sprayed in the orchards of Elijah Rogers and Son, and S. H. MacDonald, through the kindness of the owners.

The following brief description of the experiments and the results obtained is given to show the general trend of the investigation.

Apples

(1) Experiment Station orchard at Mount Carmel in charge of E. M. Stoddard; received calcium arsenate on one-half, lead arsenate on the other. Calcium arsenate used in combination with dry and liquid lime-sulfur, flotation sulfur, Kolofog, and lime-fish oil; Calcium arsenate was used at the rate of 2 pounds per 100 gallons and lime was added only in

the lime-fish oil combination where it was used at 10 pounds per 100 gallons. Five sprays were applied, the last on July 10.

Results: Lime appeared to be necessary with calcium arsenate because all plots except those sprayed with lime-fish oil and calcium arsenate were injured within two weeks of the application, and showed much yellow leaf. Lead arsenate plots showed much less injury (Figure 72) but there was considerable leaf scorch and leaf drop later in the season. Much varietal difference was noted in regard to spray burn. Gravenstein trees were apparently not affected, whereas Greening was almost completely defoliated (Figure 73) toward the end of the season. Baldwin, Spy, Pippin and King were also injured. Insect control was very good with calcium arsenate but not quite as good as lead arsenate. From the

FIGURE 72. This Greening tree, sprayed with lead arsenate and lime-sulfur, showed considerable defoliation at picking time. Photographed in September.

commercial standpoint, however, insect control appeared to be satisfactory.

(2) Experiment Station orchard at Mount Carmel a short distance from No. 1. Four plots were sprayed six times with calcium arsenate (two brands) combined with dry lime-sulfur and flotation sulfur, 6 pounds lime added to each 100 gallons spray in all treatments. A third brand of calcium arsenate was used with flotation sulfur and lime. Synthetic cryolite was used in one plot with lime and flotation sulfur. Manganar and barium fluosilicate without lime in one plot, the barium fluosilicate being applied up until July, manganar after July 1. One plot with magnesium arsenate and dry lime-sulfur and a few trees with zinc arsenate. Six applications of all insecticides (except zinc arsenate and magnesium arsenate) were applied, the last on July 28.

Results: Foliage burn resulted from all sprays but was unimportant in the case of cryolite and barium fluosilicate. Manganar caused some yellow leaf shortly after application, but since only two applications with this material were made, it cannot be compared directly with calcium

FIGURE 73. The Greening tree (left) was almost completely defoliated by calcium arsenate sprays. (Right) A Gravenstein tree which received the same treatment with little or no defoliation. Photographed in September.

arsenate and others. Calcium arsenate caused some burn (Figure 74) in all cases but was considerably slower appearing in plots sprayed with flotation sulfur, lime and stabilized calcium arsenates than in other plots. Cryolite sprayed trees were in perfect condition at the end of the season. Control of curculio was good with calcium arsenates and cryolite. Cryo-

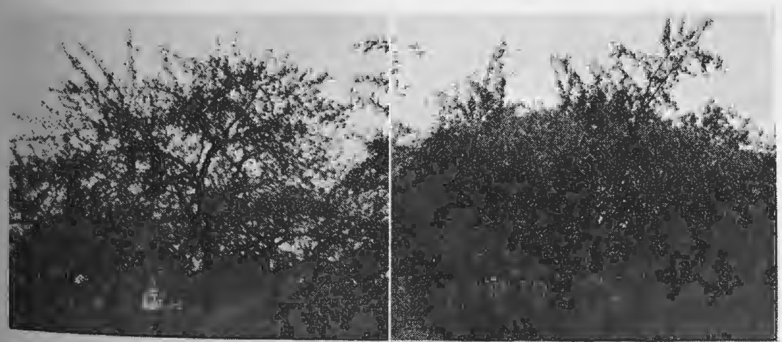

FIGURE 74. (Left) View of Baldwin trees in a plot which was given six sprays of calcium arsenate lime and dry lime-sulfur. (Right) Baldwin tree that received six sprays of synthetic cryolite, flotation sulfur and lime. Photographed in September.

lite did not control codling moth as well as calcium arsenate. Maggot control with cryolite appeared to be good but was very poor with manganar. Maggot control with calcium arsenate was fair to good, unsatisfactory in some plots, but more tests are needed for this material, as well as cryolite.

(3) Orchard of S. H. MacDonald, Wallingford, Conn. Plot of about 70 Wagener trees was sprayed with "Sulfocide," calcium arsenate and casein-lime. Applications began with pink and continued until mid-June. Only insect on which observations were made was the leafhopper, on which counts of emerging nymphs were made during the early part of the season.

Results: Direct comparison of leaf burn and drop with portions of the orchard sprayed with lead arsenate, indicated that lead arsenate was superior because much less drop occurred. Dusts of lime and calcium arsenate which were applied in this block for maggot control also caused considerable injury indicating that the variety is quite susceptible to calcium arsenate burn. There was little indication that the special sprays prevented leafhopper nymphs from hatching since there was no advantage over the regular lead arsenate sprays. Abundance of the second brood leafhoppers appeared to be about the same in both plots.

(4) Orchard of Elijah Rogers and Son, Southington. Plot was sprayed with calcium arsenate, 2 pounds, flotation sulfur, and lime, 6 pounds, four sprays being applied during the season. No count was made of insect injuries, but from casual examination control appeared to be good. Direct comparison with trees sprayed with lead arsenate showed little or no difference as far as foliage condition was concerned. Trees were examined several times during the season and at picking time.

(5) Orchard of the Connecticut State College, Storrs. Sprayed with calcium arsenate in combination with lime-sulfur, dry lime-sulfur, flotation sulfur, Kolofog, and dry-mix. Calcium arsenate used at the rate of 2 pounds per 100 gallons, plots sprayed four and five times. Sprays were supervised by C. O. Dunbar.

Results: Differences in the various plots were quite marked early in the season and showed severe burn with liquid lime-sulfur, lime and calcium arsenate. This was traced to the liquid lime-sulfur. Dry lime-sulfur was substituted in these plots and reduced subsequent injury but did not eliminate it. Other combinations with various wettable sulfurs were not nearly so injurious as liquid lime-sulfur and were about the same as the trees in No. 4 at picking time. Little or no difference could be seen in the safety of the different brands used. Baldwin russeting appeared from counts of picked fruit to have been less severe on trees sprayed with dry-mix and calcium arsenate and most severe on trees sprayed with lime-sulfur and calcium arsenate. Insect control was very good, especially curculio. Apple maggot did not show up in the orchard in any great quantity.

Peaches

(6) Peach orchard at the Mount Carmel farm of the Agricultural Experiment Station. Orchard divided into 12 plots of about 24 trees each. Two check plots were left without treatment. Standard lead arsenate with zinc sulfate, basic lead arsenate, magnesium arsenate, barium fluosilicate and potassium fluosilicate were used as insecticides. Three different fungicides were used, all wettable sulfurs. Two applications, shuck fall and two weeks later, were made. The plots also received

one application in July with the same mixtures but without insecticides.

Results: Magnesium arsenate gave serious leaf burn, fruit drop and bark cankers. Potassium fluosilicate completely defoliated the trees and caused the fruit to drop, but did not cause injury to the bark and the trees recovered before the end of the season. Barium fluosilicate gave little or no injury. Standard lead arsenate (3 pounds to 100 gallons) gave slight to no injury. Basic lead arsenate (4 pounds to 100 gallons) gave no injury. Control of curculio was determined from examination of drops collected twice. The best control was obtained with standard lead arsenate and barium fluosilicate.

General conclusions covering the whole season's work are given below. It should be stated, however, that the conclusions are based on the work of only one year and much more work should be done with some of the materials before the data from this state will be of much value.

Residues

Examination of 43 samples submitted to the Chemistry Department of the Station by the Dairy and Food Commissioner, showed that none of them were above the tolerance for either lead or arsenic. Samples from the experimental plots likewise gave low arsenic and lead residues. It is apparent, however, that the methods of lead analysis developed during 1933 will be much more accurate than those hitherto employed and the very great saving in time should enable investigators to secure much more data in a single year than heretofore. Rainfall was slightly above normal this year, but it was apparent from analyses that 10 inches rainfall between the last spray and the picking date, reduced arsenic to tolerance. McIntosh apples sprayed with lead arsenate were in part above and in part below for lead residue after 51 days, all below tolerance after 75 days. In years of normal rainfall it is apparent that two to two and a half months between the last spray and picking dates should be allowed. This period will not occur with early varieties which should in our opinion be dusted with lead arsenate dusts or sprayed with calcium arsenate and lime. Dust will leave less residue.

Fluorine residues on Baldwin was determined by Dr. Fisher to be below the tolerance established (.01 grains per pound). The last spray was applied July 28.

TABLE 16. RESULTS OF BARIUM FLUOSILICATE AND LEAD ARSENATE [redacted] SPRAYS ON PEACHES — MOUNT CARMEL, 1933.

[redacted]	Total fruits examined	Number picked	Number drops	Number with curculio	Per cent curculio	Drops: per cent of total
Barium fluosilicate	2,929	1,893	1,036	340	11.5	35
(2) Standard lead arsenate with zinc sulfate	2,745	1,315	1,430	304	11.0	52
(3) Basic lead arsenate	2,889	1,793	1,096	557	19.2	38
(4) Check—no treatment	5,094	2,720	2,374	1,169	22.9	46

[redacted]ions: May 26 and June 7

Materials and dilutions		
(1) Barium fluosilicate	4 lbs.	
Wettable sulfur No. 1	4 lbs.	
Lime	4 lbs.	Repeated in another plot with wettable
Water	100 gals.	sulfur No. 2—5 lbs. per 100 gals.
(2) Standard lead arsenate	3 lbs.	
Zinc sulfate (crystalline, granular)	4 lbs.	Repeated in another plot with wettable
Lime	4 lbs.	sulfur No. 3—6 lbs. per 100 gallons
Water	100 gals.	added.
(3) Basic lead arsenate	4 lbs.	
Wettable sulfur No. 1	4 lbs.	
Lime	4 lbs.	Repeated in another plot with wettable
Water	100 gals.	sulfur No. 2—5 lbs. per 100 gallons.

TABLE 17. CONTROL OF APPLE INSECTS WITH CALCIUM ARSENATE AND SYNTHETIC CRYOLITE. MOUNT CARMEL, 1933

Materials	Total fruits examined	Per cent curculio	Per cent codling moth	Per cent other insects	Per cent free
Calcium arsenates	59,597	2.98	.32	4.6	92.1
Synthetic cryolite	13,946	2.98	2.14	4.8	90.0
Check—no treatment	13,164	12.38	4.32	9.4	71.0

Materials and dilutions

Calcium arsenates used in four plots at 3 lbs. per 100 gals. In one plot at 2 lbs. per 100 gals. Combined with flotation sulfur or dry or liquid lime-sulfur, and lime.

Cryolite used at 4 lbs. per 100 gals. with flotation sulfur and lime.

Applications

Six sprays were applied beginning with the pink spray May 9 to 11 and ending with maggot spray July 28.

TABLE 18. CONNECTICUT STATE COLLEGE, STORRS — 1933
CALCIUM ARSENATE SPRAYS: INSECT CONTROL
VARIETY — BALDWIN

Row	Total	Insect injuries	Per cent injured	Per cent free	Treatment
2	92	13	14.1		
4	104	5	4.8		
6	129	6	4.6		Lime-sulfur (liquid or dry),
8	114	11	9.6		lime and calcium arsenate.
10	116	1	.8		
Sum and average	555	36	6.49	93.5	
12	102	47	46.0	54.0	Lime-sulfur and lime, no calcium arsenate.
14	105	8	7.6		
16	117	10	8.5		Wettable sulfur (Kolofog, Flo-
18	127	11	8.6		tation sulfur and dry-mix), lime
20	117	9	7.6		and calcium arsenate.
22	108	6	5.5		
24	135	2	1.4		
26	134	19	14.1		
28	121	6	4.9		
30	97	1	1.0		
32	105	2	1.9		
Sum and average	1,166	74	6.3	93.7	

Materials and dilutions

Calcium arsenate used at 2 lbs. per 100 gals.
Hydrated lime added in all plots except two, at the rate of 6 lbs. per 100 gals.
The exceptions received 9 and 0 lbs. respectively. Dry-mix 25 lbs. per 100 gals. was used in these plots.
Liquid lime-sulfur 2½ gals. per 100 gals. water.
Dry lime-sulfur 6 lbs. per 100 gals.
Flotation sulfur 6 2/5 lbs. per 100 gals. (dry); paste 10 lbs. per 100 gals.
Kolofog 6 lbs. per 100 gals.

Applications

Pink about May 5. Calyx about May 24. First cover about June 2. Maggot about July 6. No sprays after July 6. Sprays were begun on the dates mentioned but required a day or so to complete in most cases.

Conclusions

Apples

I. Calcium arsenates.
1. Calcium arsenate controls insects commonly troublesome in Connecticut. It does not control quite as well as lead arsenate.
2. Calcium arsenate has a tendency to burn foliage if heavily applied, the injury becoming more apparent as the season advances. Certain varieties, notably Greening, are burned severely while others such as Gravenstein are not harmed.
3. In many commercial orchards applying calcium arsenate only in July maggot sprays, there was no appreciable injury. In others there was noticeable damage towards the end of the season.
4. Spray burn was of common occurrence in 1933 on trees sprayed with lead arsenate as well as those sprayed with calcium arsenate.
5. Residue from heavy applications of calcium arsenate was removed by rains in two months. It required 10 inches of rain to bring residues within tolerance for arsenic. Normal rainfall for July, August and September is 12 inches or about four inches per month.
6. Lime is necessary in the spray mixture when using calcium arsenate. It is believed not less than 6 pounds per 100 gallons should be employed.
7. Calcium arsenates containing stabilizers burned foliage as well as other brands. In one case, the damage was severe where a stabilized calcium arsenate was used without lime. Stabilizers retarded the foliage injury considerably in some plots.
8. The chemical analysis of water soluble arsenic gave little indication of the injurious nature of the brands tested this year.
9. Lime-sulfur solution either from liquid concentrates or dry powder should not be used with calcium arsenates as manufactured in 1933.
10. Russeted fruit in the Connecticut State College orchard was greatest in plots sprayed with lime-sulfur and calcium arsenate, and least in plots sprayed with dry-mix and calcium arsenate.

II. Lead arsenate.
1. There was considerable foliage burn from lead arsenate this year.
2. Arsenical residue and lead residues were below tolerance on McIntosh after 75 days. Some below some above tolerance after 51 days. All winter varieties were below tolerance in our experimental orchard at Mount Carmel. Only one tree approached tolerance in lead residues.
3. Oil used with lime and lead arsenate did not increase the residue at picking time. Analyses from other stations, however, indicate that where lime is not used there may be an increase in lead residue from the use of oil.

III. Cryolite (synthetic).
1. This material gives promise for insect control and has the advantage when combined with lime and flotation sulfur of giving no spray burn.

2. Residues of fluorine were below tolerance on Baldwin at picking time (last spray July 28).

IV. Barium fluosilicate and Manganar.

1. Tests are inconclusive but insect control was not good. Further tests are desirable.

V. Magnesium arsenate, zinc arsenate.

1. Foliage burn severe. Insect data not extensive enough to warrant conclusions.

Peaches

1. Trees sprayed with barium fluosilicate and wettable sulfur were not injured. Curculio larvae were less abundant in drop fruit from this plot than in drop fruit from unsprayed trees.
2. Trees sprayed with potassium fluosilicate were severely defoliated and most of the fruit dropped.
3. Zinc sulfate prevented spray burn from applications of standard lead arsenate (3 pounds to 100 gallons).
4. Basic lead arsenate (4 pounds to 100 gallons) did not injure foliage, but did not control as well as standard lead arsenate.
5. Magnesium arsenate caused severe defoliation, fruit drop and bark cankers.
6. Zinc arsenate caused severe foliage drop and bark cankers.
7. Judging from examinations of dropped fruit in June and July the best curculio controls were secured with barium fluosilicate and standard lead arsenate with zinc sulfate corrective.

STUDY OF APHICIDES

Philip Garman

Comparison of Ten Commercial Products

The number of commercial preparations for killing aphids has increased rapidly within the last five years. Many claims have been made for this or that product, but their comparative value has been difficult to judge because of changes of formulae and the fact that they have not all been available at one time. Tests reported herein were made entirely with the bean aphid, *Aphis rumicis* Linn., infesting nasturtium leaves. Laboratory sprays were applied under 10 pounds pressure, with a No. 29, DeVilbiss atomizer nozzle placed nine inches from the object to be sprayed. The leaves were placed on a revolving turn table while spraying was in progress. Afterwards they were kept under 6 by 8 inch glass battery jars containing a saturated salt solution which maintained humidity at about 70 per cent saturation. Room temperature averaged about 75° F. Counts were made after 24 hours.

Greenhouse tests were carried on with growing nasturtium plants infested with the same aphid. The nasturtiums were in flats 1 by 2 feet in size and were sprayed when the plants became two to three inches high. Results were based on the number of infested leaves before and after spraying. Applications were made with a quart hand sprayer, and the flats were protected against migration of aphids from one to another by metal tanglefooted collars. The main object of these experiments was to learn if there was any delayed action of the insecticides. All counts were made three days after applications. It was also considered desirable to compare laboratory and greenhouse results with the same materials.

The insecticides used involve several different classes of products. (1) Nicotine preparations; (2) preparations from derris or cubé containing rotenone or allied extractives; (3) those made from pyrethrum and containing pyrethrins; (4) anabasine sulfate and related compounds; and finally (5) those said to contain thiocyanates. There are also a number of commercial preparations containing both pyrethrum and rotenone.

Results in general show that most of the preparations do not afford quite as good toxicity for *Aphis rumicis* as nicotine sulfate. It is appar-

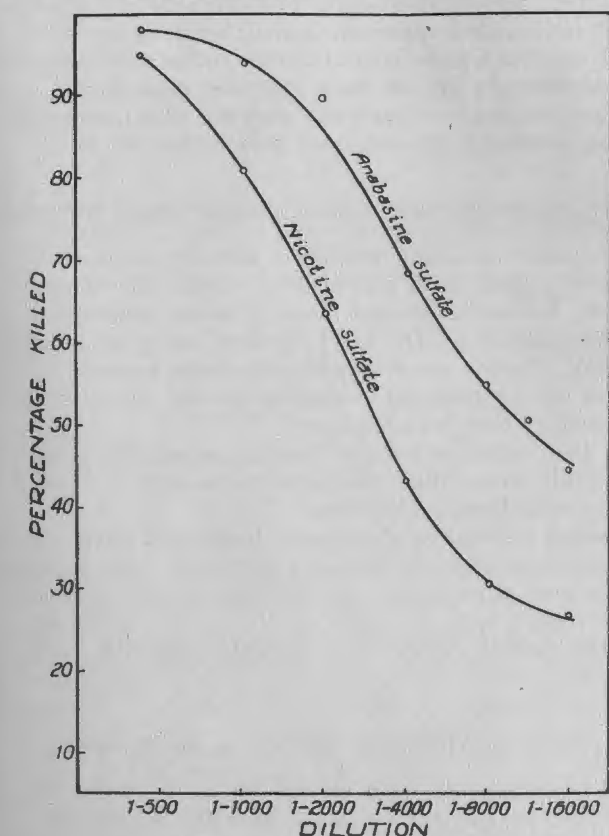

Figure 75. Comparison of the kill of *Aphis rumicis* obtained in laboratory tests with anabasine sulfate and nicotine sulfate. Dilution by weight in all tests.

ent, furthermore, that most of the aphicides tried aim at fairly good kills with dilutions of 1 to 800. They are supposed to compete with nicotine sulfate but apparently their manufacturers do not take into account the fact that nicotine sulfate has considerable reserve strength at 1 to 800. The differences are best shown at dilutions of 1 to 1600 with soap (6 grams 35–40 per cent coconut oil soap). In such a series none of the other materials equalled the clean-up obtained with nicotine and anabasine sulfate. At 1 to 3200 with the same amount of soap per cc. with each insecticide, anabasine sulfate was superior to nicotine sulfate, thus corroborating the results of laboratory tests. Table 19 and Figure 75 include some of this data.

It is apparent that the rotenone and pyrethrum sprays tried are not strong enough in general and that the rotenone or pyrethrin contents should be increased if they are to compare favorably as aphicides with nicotine and anabasine products. The cost of some of the nicotine substitutes is considered prohibitive for large scale operations. Rotenone extracts in acetone are believed to deteriorate slowly on standing. It is quite possible and in fact apparent from laboratory tests that the same material used one year after purchase was considerably weaker than at the time of purchasing. So far there has been no apparent deterioration of anabasine sulfate and it is generally accepted that nicotine sulfate does not weaken on standing if the container is kept closed.

Comparison of Pure Anabasine and Pure Nicotine

In order to make sure that anabasine was the main active ingredient in the anabasine sulfate used, and also to obtain some data on the comparative toxicity for anabasine and nicotine, water solutions of chemically pure anabasine, isolated by Dr. H. J. Fisher, and pure nicotine alkaloid from Dr. G. W. Pucher were sprayed on *Aphis rumicis*. Only mature agamic females were considered in making counts. The method described above for laboratory tests was employed.

Because of their equal molecular weights, equal molecular volumes of the poisons result from equal dilutions by weight. Comparison of the two is thereby considerably simplified.

All experiments resulted in a decidedly better kill where anabasine was used when compared with the kill obtained from pure nicotine alkaloid. In some of the tests pure soaps (two different kinds) were added, but in each case the results were in favor of anabasine. Dilutions were great enough so that partial rather than complete mortality resulted in all experiments.

Notes on Anabasine Sulfate as an Aphicide

Several field experiments were carried on to determine the effects of anabasine sulfate in comparison with nicotine sulfate for rosy apple aphid (*Anuraphis roseus* Baker) control on apples. The sprays were applied too late to give control since the leaves had begun to curl. Plot comparisons at the farm of Emery Smith, Cheshire, indicated as good or better kills where the aphids were hit as were obtained with nicotine sulfate. The materials used were flake soap 4 pounds, anabasine or nicotine sulfate, 1 quart, and water, 200 gallons. In addition A. T. Henry, of Wallingford, kindly applied some of the materials at dilutions of 1 to 800, and 1 to 1600, with soap. The kill with 1 to 1600 appeared to be poor, but that with 1 to 800 was good and little difference could be seen between nicotine and anabasine sulfate at this dilution. Anabasine sulfate combined with lime-sulfur was also tried at the Mount Carmel farm of the Experiment Station. Results were favorable.

On May 15, 1933, 8 to 10 flats of peach seedlings infested by the green peach aphid (*Myzus persicae* Sulz.) were sprayed with anabasine sulfate, diluted 1 part in 1000 parts water by weight, with 1 part of a bead soap added, using a hand sprayer. A complete clean-up resulted and only a few aphids remained in the curled leaves. The following day four infested flats were sprayed with a commercial rotenone preparation, diluted 1 to 1000, with 1 gram bead soap added. This material gave relatively poor results and many live aphids remained not only in the curled leaves but on the stems of the peach seedlings as well.

It should be remarked at this point that anabasine sulfate has little value as an ovicide according to tests with Oriental fruit moth eggs, which may account for its failure in the hands of other investigators to control insects of this type. It is also believed that it has no stomach poison value and cannot compete with products containing rotenone in this respect.

TABLE 19. RESULTS OF SPRAY APPLICATIONS TO CONTROL *Aphis rumicis* ON NASTURTIUM LEAVES. FIGURES GIVE PERCENTAGE REDUCTION OF INFESTED LEAVES

Active principles	Material	Dilution 1-800*		Dilution 1-1600†	
Anabasine	Anabasine sulfate	100	100	100	99
Nicotine	Nicotine sulfate	100	100	97	82
Rotenone	Commercial preparation No.				
	(1)	95	24	40	54
	(2)	93	00	84	21
	(3)	56	30	53	65
	(4)	85	27	19	60
	(5)	62	00	00	00
Pyrethrum rotenone combinations	Commercial preparation No.				
	(1)	34	00	23	00
	(2)	83	62	45	80
Thiocyanate	Commercial preparation No.				
	(1)	44	23	00	00
	Soap	39	00	1	00
	Check—no spray	00	00	00	00

Notes: Temperature variations in house. Max. 92° F.; min. 52° F.
* 35 per cent coconut oil soap added—6 grams in 800 grams of mixture. This is about 6 lbs. per gallon.
† Soap added at rate of 3 grams in 800 grams of mixture. This is about 3 lbs. per 100 gallons.

REPORT ON FRUIT MOTH PARASITES

PHILIP GARMAN

Parasite distribution was continued in 1933 and the statistics are shown in Table 21. More than 28 million Trichogramma egg parasites were delivered or sent out and about 7,250 larval parasites. Of these 4,656 were *Macrocentrus ancylivorus* Roh., bred in the laboratory at New Haven. This year a total of 227 growers applied for the service as compared with 157 in 1932. Studies of several new species are in progress. Mr. Schread reports on one of these on page 463.

In the spring of 1933, information was received through the coöperation of county agents showing conditions in four of the most heavily infested counties. The results are given in Table 20. It will be noted that there is a reduction of about 21 per cent in the number of orchards placed in the heavily infested class which is apparently due to parasitic action. Experiments with Macrocentrus were continued and breeding has been successful throughout the entire year, although at critical times the conditions have not been entirely satisfactory in the breeding rooms. Some improvements have been made which should enable greater production in 1934. A change in methods of hibernation has also been made. Most of the data obtained in Macrocentrus work so far have been assembled and published in Bulletin 356.

TABLE 20. RESULTS OF REPORTS FROM GROWERS IN SEVERAL COUNTIES
1932 SEASON

Orchards receiving no parasites			Orchards receiving parasites in 1931 and 1932		
Total orchards	Heavily infested*	Per cent heavily infested	Total orchards	Heavily infested*	Per cent heavily infested
Hartford and Tolland Counties					
12	8	66	39	10	25
Fairfield County					
19	12	63	25	14	56
New London County					
15	6	40	10	2	20
Totals					
46	26	56	74	26	35

Through coöperation with the Bureau of Entomology Laboratory at Moorestown, N. J., a number of foreign parasites were introduced by them into central Connecticut orchards. These are indicated in Table 21 as "other species supplied".

A check up of infested orchards continued to show the beneficial action of parasites, particularly Macrocentrus, which was found heavily parasitizing second brood larvae in several places. Continued liberation of Trichogramma in the orchard of the Connecticut State College at Storrs failed to control the fruit moth in late peaches although there was some reduction in early fruit compared with last year. The Macrocentrus population is not yet sufficient there to take care of any large number of fruit moth larvae but it is believed the combination will show results in the near future.

*"Heavily infested" means in general an infestation of more than 25 per cent wormy fruit.

TABLE 21. STATISTICS OF PARASITE SHIPMENTS IN 1933
Arranged by Counties

County	Number peach growers applying for parasites	Number trees reported	Number shipments of parasites	Estimated number of Trichogramma supplied	Number Macrocentrus supplied	Number Ascogaster supplied	Number other species supplied
Fairfield	59	28,720	68	5,318,900	700	150	—
		17.6%		18.7%	15 %	15 %	
Hartford	55	58,720	77	10,454,000	1,535	310	550
		36.0%		37.0%	32.9%	31 %	34%
Litchfield	8	3,130	9	709,000	206	53	—
		1.9%		2.4%	4.4%	5.3%	
Middlesex	6	9,000	7	860,000	—	—	291
		5.5%		3.0%			18%
New Haven	49	40,960	48	4,711,700	—	200	567
		25.0%		16.5%		20 %	35%
New London	31	10,150	44	3,981,500	600	100	—
		6.2%		14.0%	12.9%	10 %	
Tolland	16	11,650	19	2,075,000	1,200	—	195
		7.1%		7.3%	25.7%		12%
Windham	3	450	2	190,000	415	178	—
		.2%		.6%	8.9%	18 %	
	227	162,780	274	28,300,100	4,656	991	1,603
	Total larval parasites — 7,250						

STUDIES ON A EUROPEAN SPECIES OF TRICHOGRAMMA

(Trichogramma euproctidis Girault)[1]

JOHN C. SCHREAD

This introduced species of European origin was obtained by the Connecticut Experiment Station from the laboratory of the United States Bureau of Entomology at Moorestown, N. J., where it had been reared and liberated since its importation in 1931. It was originally intended to make a thorough biological study of the species and a comparison with the species of Trichogramma native to the United States. However, on obtaining permission to make field liberations, large scale production of *T. euproctidis* and subsequent mass dissemination was undertaken as an adjunct to the Oriental fruit moth[2] parasite program. The results of this undertaking have been disappointing in field and laboratory. Data pertaining to the winter hardiness of *T. euproctidis* are unavailable from our records, as the parasite has been in the field but one season. However, due to the unsatisfactory response of *T. euproctidis* to laboratory treatment, it may be expected that the unusual low temperatures of this winter (1933-34)

[1]Described as *Pentarthron euproctidis* — Trans. Amer. Ent. Soc. Vol. XXXVII, pp. 48-55.
[2]*Grapholitha molesta* Busck.

followed by sudden rises in temperature will be deleterious, and virtually few, if any, of the parasites will survive. Although over 100,000 individuals of the species were liberated in peach orchards during the 1933 season, none were recovered, while both of the American species, *Trichogramma pretiosa* and *T. minutum* were taken in appreciable numbers in Oriental fruit moth eggs on trees in which *T. euproctidis* dispersed. This seems to be a fair indication of the potentiality of the parasite and future concentrated efforts on the use of Trichogramma species will be governed accordingly.

Fundamentally the life history for all species of Trichogramma is the same. The adult female wasps oviposit in host eggs in which the entire life cycle is passed. On emerging, gravid females are ready for action and may reproduce regardless of fecundation. With one exception unfertilized females gave rise to males only. However, a biological study of *T. euproctidis* reveals variations in the reaction of the parasite to treatment under controlled conditions which, in conjunction with related factors, give the species a unique place among the other members of the genus so far investigated at this Station.

T. euproctidis normally exceeds in size the two American species discussed in detail in Bulletin 353 of this Station. Due to the apparent inadequacy of Angoumois grain moth[1] eggs to supply a sufficiency of food material for *T. euproctidis,* the rate of increase of the latter on the former is practically nothing. For this reason adaptability of the parasite to mass production is impractical when Angoumois grain moth eggs are used as a laboratory host. From the standpoint of rearing tens of millions of Trichogramma in a restricted length of time, no other host has as yet been able to displace or equal the Angoumois grain moth in importance. Bagworm eggs (*Thyridopteryx ephemeraeformis* Haworth) being larger in size than Angoumois grain moth eggs are more acceptable to *T. euproctidis* and produce normal sized individuals. Because of the fact that *T. ephemeraeformis* is limited in its natural range and abundance and as no practical methods of mass production of the species have been worked out, large scale rearing of *T. euproctidis* on this host is difficult in regions having climatic conditions similar to those existing in Connecticut.

In an intensive study of *Trichogramma euproctidis* it revealed nothing in common with the two American species. It is slow in response to abundant host material, regardless of the stage of development attained by the latter. Gravid females, fecundated or otherwise, are loth to immediate and continuous oviposition in grain moth eggs. The longevity of the adults when reared on Angoumois grain moth eggs is no longer than its related American species while in most instances it is shorter. The life cycle of *Trichogramma euproctidis* is noticeably longer than that of *T. pretiosa* or *T. minutum.* The minimum period of development at 80° F. and 60 per cent relative humidity is seven and three-quarter days with a maximum of from twelve to thirteen days at the same temperature. The average duration of the combined immature stages was eight and one-half days when reared continuously for a number of successive generations. An interesting phenomenon relative to the duration of the

[1]*Sitotroga cerealella* Oliv.

T. euproctidis life cycle was observed in cultures of the species hibernated at 38° F. and 60 per cent relative humidity. Not only was there a marked retardation in initial emergence of the refrigerated material, but likewise a corresponding delay in emergence of the first generation removed from the hibernated generation.

TABLE 22. *Trichogramma euproctidis* HIBERNATED AT 38° F. AND 60 PER CENT R. H.

Days refrigerated	Average percentage of emergence	Sex ratio		1st generation from hibernated generation		2nd gen. from hib. gen.		3rd gen. from hib. gen.		4th gen. from hib. gen.	
		males	females	males	females	m.	f.	m.	f.	m.	f.
3	37	1	1	1	1	1.3	1	1.3	1	1	1
14	26	1	1	1	1	1.3	1	1.2	1	1	1
24	17	1.7	1	1.6	1	1.3	1	1.0	1	1	1
35	3	1.8	1	1.5	1	1.4	1	1.3	1	1	1
60	less than 1%	3.1	1	1.5	1	1.3	1	1.2	1	1	1

Inhibited cultures of *T. euproctidis* under the above stated conditions of 38° F. and 60 per cent R. H. have responded in a similar manner as did *T. minutum* and *T. pretiosa* to prolonged periods of detention (Table 22). However, there is a tendency for *T. euproctidis* to require a greater number of successively reared generations to revert to a normal sex ratio of 10 males to 15 females (Table 23). Furthermore under hibernating conditions *T. euproctidis* succumbed more rapidly than did either *minutum* or *pretiosa* as the period of refrigeration lengthened.

TABLE 23. *T. euproctidis* SEX RATIO

Males	females	Males	females
1	1.7	1	1.6
1	1.4	1	1.2
1	2.2	1	1.5
1	1.8	1	1.6
1	1.4	1	1.7
1	1.7	1	1.5
1	1.7	1	1.0
			1.57 average

Wing deformity in *T. euproctidis* is more generally noticeable in cultures that have been subjected to variable periods of refrigeration than in material reared for successive generations at developmental temperatures. For a period of 15 days at 38° F. there was a 40 per cent cumulative wing deformity in males and 50 per cent in females. These data are comparable to the results of wing deformity obtained for *T. minutum* males (which for a like period was 48 per cent) but not for the females having a 28 per cent wing deformity. *T. pretiosa* is less subject to the deleterious effects of low temperatures on development; the average deformity for 15 days' hibernation at 38° F. was 11 per cent for the males and 17 per cent for the females.

Regarding the abundance of increase, *T. euproctidis* falls much below the American species in this respect. The average number of ovipositions per female was 12.5 with a minimum of 5 and a maximum of 18. These figures refer to *Sitotroga* eggs actually parasitized and not to the potentiality of the species. Results on the use of bagworm eggs are questionable and therefore will not be presented. Most of the bagworm eggs exposed to Trichogramma collapsed before parasitism or during the development of the parasite providing oviposition was successful. On an average not more than 15 to 25 per cent of bagworm eggs produced adult Trichogramma. Occasionally 40 to 60 per cent of the eggs were productive. However, the usual parasitism of Angoumois grain moth eggs, from 90 to 100 per cent, was unrecorded for bagworm eggs.

A genetic study of *T. euproctidis* failed to produce successful fecundation of females of the species by males of either of the two American species, *T. minutum* and *T. pretiosa;* nor was it possible to obtain progeny of both sexes from females of the latter species that from all indications cohabited with males of the former species. Many combinations of males and females were employed without success, despite the fact that in a number of instances individuals of the different species showed affinity for one another.

DAMAGE BY THE ASIATIC OR JAPANESE GARDEN BEETLE

Autoserica castanea Arrow

W. E. Britton

Some 25 or 30 adults of this insect were brought to the Station on October 3, from a garden on Hillhouse Avenue, New Haven, with the statement that several kinds of plants in the garden had been wholly or partially defoliated by them. No beetles could be seen on the plants in the daytime, but by digging in the soil at the base of the plants plenty of them were found.

A visit was made to this garden on October 7. Leaves of several kinds of plants showed injury by the feeding of the beetles but no beetles were present so late in the season. I learned that the beetles submitted were collected in July and held until October 3, before sending them

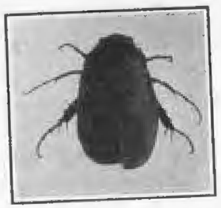

Figure 76. The Asiatic or Japanese garden beetle, *Autoserica castanea* Arrow. Twice enlarged.

for identification. The plants that had been injured were heliotrope, hardy chrysanthemum, petunia and lemon verbena. By digging in the soil of the flower beds several larvae were obtained, and these were identified by Dr. Friend as some kind of *Serica* grubs. There had been no particular injury to the lawn and the gardener had not found any of the grubs in the turf.

Although an adult beetle was found in New Haven in the summer of 1928, and grubs of the same species were found in nursery diggings in Cromwell, Manchester, Mansfield, New Canaan and Southport in 1929, this is the first record for the state of plants having actually been injured by this insect. A short article was included in the Report of this Station for 1929, Bulletin 315, page 607, in which the species was called *Aserica castanea*. It has since been learned that the correct name is *Autoserica castanea.*

The adult beetle, shown in Figure 76, is about three-eighths of an inch in length, and dull cinnamon brown in color. The wing covers are marked lengthwise with shallow grooves or striae. The beetles feed and

Figure 77. Zinnia and chrysanthemum leaves eaten by the Asiatic or Japanese garden beetle, *Autoserica castanea* Arrow. Somewhat reduced.

fly on warm nights and are attracted to electric lights. In the daytime they hide under rubbish and in the soil around the bases of the plants and in adjacent lawns and grassy fields. They feed upon many kinds of plants, including aster, barberry, bean, catalpa, cherry, chrysanthemum, currant, dahlia, geranium, hydrangea, rose, zinnia and coniferous seedlings. If any of these plants are in bloom during the beetle season, the beetles will eat the petals. Injured foliage is shown in Figure 77.

In densely infested localities the grubs may injure or even kill herbaceous plants in the flower borders by eating the roots. They also devour the roots of strawberry plants and those of beet, corn and onion in the vegetable garden, and the roots of yew seedlings in nurseries. The chief damage by the grubs is to lawns and sod land and the roots have been eaten off and the grass killed in many areas around New York, varying from a few square inches to more than an acre in extent. The injury to lawns and sod land is about the same as that caused by the Japanese beetle, *Popillia japonica* Newm., and the Asiatic beetle, *Anomala orientalis* Waterh.

Autoserica castanea is a native of Japan and China and was first collected in the United States at Rutherford, N. J., in the summer of 1921, but was not recognized as a foreign insect until 1926. During this interim of five years it increased in numbers and became increasingly destructive in New Jersey and New York. It is now known to occur at a number of widely separated points in Connecticut, Delaware, Maryland, New Jersey, New York, Pennsylvania and Virginia.

Control measures: The foliage of preferred plants may be protected by spraying not later than July 10 with lead arsenate, 1 ounce, flour 1 ounce, water 1 gallon. In larger quantities, 3 pounds of lead arsenate and 2 pounds of flour may be used in 50 gallons of water. Such treatment will probably be effective in slight and moderate infestations, but in case of heavy infestations where there are enormous numbers of beetles much damage is sure to be done. The beetles feed readily on the poisoned foliage and therefore may ruin it before obtaining enough poison to be killed. In such instances, it may be possible to protect the flowers and even the foliage of choice plants by a netting cover. No good repellent has yet been developed.

There is a possibility of developing light traps that will collect and kill the beetles at night, but no satisfactory trap has yet been perfected. Consequently, this method is not recommended.

Lawns may be protected from grub injury in the same manner as for the Asiatic beetle and the Japanese beetle, by applications of lead arsenate, 3 pounds to 100 square feet. This may be spread over the surface in dry form or may be mixed with water and applied with a sprinkler. Directly after the application, the lawn should be well watered with a fine spray from the hose to wash the poison from the grass blades into the soil. There should be no run-off into the gutter. In some cases it may be advisable to mix the dry poison with sifted loam, and spread it evenly over the surface of the lawn as a top dressing.

In case the lawn needs to be rebuilt, the poison may be raked into or mixed with the upper three inches of soil. Germination of the ordinary varieties of grass seed is somewhat retarded by the application of poison. In any case, careful watering is advisable.

When properly applied, this lead arsenate treatment should protect the lawn for seven or eight years, and possibly longer.

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INJURY TO FRUIT BY ROSE LEAF BEETLE

Nodonota puncticollis Say

W. E. BRITTON

The rose leaf beetle was generally quite common in 1933, and was observed on roses at a number of localities. Mr. Johnson brought in several adults from Southport June 9, and the writer saw it in his own garden, and also in Essex, Mass., June 9, where it had injured rose leaves and buds.

This is a small, shining, metallic, green beetle, one-sixth of an inch in length. It is found throughout the state and is common in collections obtained by sweeping over alder and other low sprout growth on cut-over woodlands. The Station collection contains 55 specimens collected in various parts of the state, as follows: Cheshire, Cornwall, East Haven, Green's Farms, Greenwich, Hamden, Marlborough, Milford, Middletown, New Canaan, New Haven, North Branford, Orange, Portland, Ridgefield, Rockville, Salisbury, Scotland, Southington, Rainbow, Union and Wilton.

This beetle is recorded as feeding upon rose, blackberry, raspberry, strawberry, clover and chestnut, but it probably feeds also on many other kinds of food plants, because it is nearly always collected in the net when one sweeps over young sprouts where woodland areas have been cut.

Dr. Lugger[10] in Minnesota records this beetle as feeding upon the young shoots of willow.

Chittenden[5] records observing this beetle on wild roses at Ithaca, N. Y., and on blackberry, Staten Island, N. Y., in 1886, and on strawberry at Washington, D. C., in 1891. In 1891, Dr. Riley found it troublesome on cultivated roses near Washington, D. C.

From Baltimore, Md.,[6] in 1897, specimens of this insect were sent to the Bureau of Entomology at Washington with a statement that it was "consuming all the leaves from the trees". No particular kinds of trees are specified but Mr. Chittenden says that they were presumably fruit trees. In 1898, the species was abundant on the tender terminal leaves of ornamental willow near Washington and also occurred in smaller numbers on blackberry in the immediate vicinity. F. C. Pratt in 1898, collected a large series from blackberry and wild rose at Woodstock, Va.

The rose leaf beetle[7] was reported as injurious to roses in Maryland in 1902, and was also found feeding upon corn. In 1906[3] and 1908[4], it injured roses in the vicinity of the District of Columbia. Houghton[9] reports this insect as very abundant on blackberry in Delaware in 1904. A great variety of plants was eaten by the beetles but no list was kept. Eggs were obtained but no larvae could be found.

In 1908, *Nodonota puncticollis*[1] was received from Stamford, June 10, with a statement that the beetles were devouring the leaves and tender shoots of choice young Japanese chestnut trees. It was finally necessary to spray with poison in order to prevent further destruction. In 1909, Dr. Henry Skinner[11] reported it as very abundant and injurious to rose bushes at Ardmore, Pa., June 8. As many as 15 beetles were found feeding in one blossom, and the flowers were soon ruined.

In 1920, Stear[12] reported this insect as causing considerable injury to apples in several orchards in the vicinity of Chambersburg, Pa. The beetles fed upon both leaves and fruit. One orchard was injured to such an extent that it was sprayed with lead arsenate and Bordeaux mixture, but on account of the lateness of the application, the effectiveness of the spray could not be determined. Dr. Felt[8] reported injury to apple in Duchess and St. Lawrence counties, New York, in 1921. In one case from 10 to 20 per cent of the fruit had holes eaten in it.

On June 19, 1923,[2] specimens of the rose leaf beetle were received from Bridgeport, with a statement that they were eating the buds of roses.

In June, 1933, Mr. Zappe noticed that something had eaten into some of the fruit on a Bartlett pear tree in his garden. He kept watch and

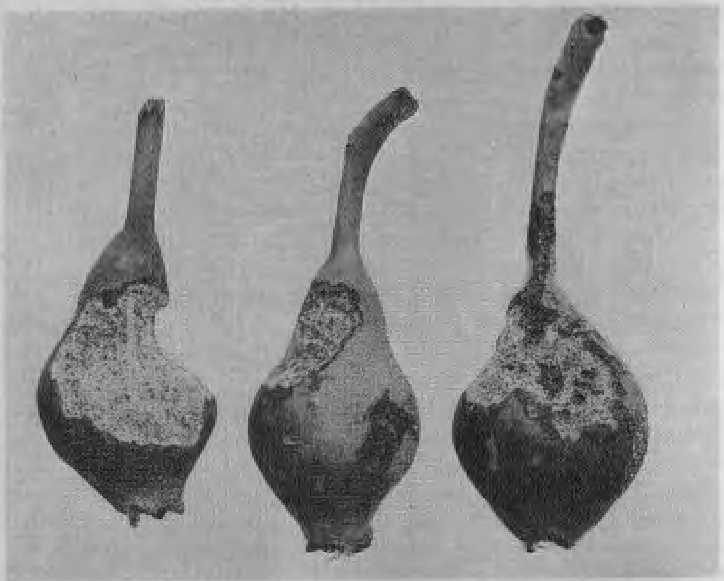

FIGURE 78. Pears eaten by the rose leaf beetle, *Nodonota puncticollis* Say. Natural size.

found that the rose leaf beetle was responsible for the injury, which is shown in Figure 78. In some instances holes had been eaten into the lobes near the calyx, and in others a ring encircling the fruit had been eaten. Altogether, nearly 50 per cent of the pears had been mutilated; some very badly, and others only slightly injured. The tree was not sprayed with poison because the owner was curious to learn how much injury the beetles would do if unmolested. Rose bushes in the garden had an occasional leaf somewhat eaten but there was no particular damage to them.

A similar and closely related species called the plum leaf beetle, *Nodonota tristis* Oliv., has been recorded as devouring the foliage of peach, plum, cherry and strawberry, but so far this beetle has not been found

in Connecticut. Both species can probably be controlled by spraying with lead arsenate.

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(Injury to apples in Pennsylvania. In one orchard so severe that a spray was applied).

THE GREEN GOLD LEAF BEETLE AS A PEST OF ROSES

Chrysochus auratus Fabr.

W. E. BRITTON

On July 24, several adults of this beetle were received from Sharon, with the statement that they had caused considerable injury to roses by eating the leaves. They were also on some adjacent native shrubbery and fed upon adventitious plants of buckwheat, but as the owner did not care for these plants no damage was reported except to the roses. The owner sprayed the infested plants with a pyrethrum soap but doubted the effectiveness of the application. This beetle is often abundant on the spreading dogbane, *Apocynum androsaemifolium* L. on which it feeds. At the Station the records show that this beetle feeds upon dogbane and milkweed. In 1930, a specimen was received from Norwalk on tomato. Some persons observe these iridescent green beetles and think that they are Japanese beetles, although they are much smaller than that species.

Walsh and Riley[5], in 1869, identified this beetle for a correspondent in Alton, Ill., who found it plentiful amongst the standing wheat. No statement is made regarding damage. G. H. French of Illinois is said to have reported it in the *Prairie Farmer* as feeding on corn, but I have not seen the published reference.

Lintner[3] published a record of *Chrysochus auratus* feeding on potato in Bayport, Suffolk County, New York, in 1887. It had "appeared only on a dozen or so plants in a field of two acres, but as many as 30 or 40 were found on a single plant."

J. L. Zabriskie[6], in 1895, published a description of the egg-capsules found near a patch of spreading dogbane on Long Island. Dr. Felt[2], in 1901, published an illustrated description of the egg-capsules and mentioned Zabriskie's description.

Newell and Smith[4], in 1904, reported that this beetle did much damage by defoliating the trees in a small pecan grove in northern Georgia.

E. M. Craighead[1], in 1923, published a brief note on the life history of this beetle, which he found feeding on dogbane, *Apocynum cannabinum*, at Chambersburg, Pa.

From an examination of the literature herein cited it may be seen that the eggs are deposited in small black conical capsules, usually on the under sides of the leaves of the host plant or on nearby objects. A capsule may contain three or four eggs. The eggs are yellowish white, and are about 1.5 mm. long and .5 mm. thick. On hatching from the eggs the larvae drop to the ground and feed on the bark of the larger roots of the dogbane from one to six inches beneath the surface of the ground. They hibernate in the larval stage and pupate in May. The adults begin to emerge in June, and may be found until August. There is one generation each year.

Although the beetles vary considerably in size the larger ones are about three-eighths of an inch in length and about half as broad as long. The under surface and legs are distinctly greenish blue and the upper surface shining, iridescent, coppery green. They glisten in the sunlight and are very beautiful and conspicuous. The species occurs throughout the state.

Literature

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THE GLADIOLUS THRIPS

B. H. Walden

Gladiolus plants in Connecticut were not as severely injured by thrips during 1933 as in 1932. In many gardens where the corms were treated and planted early most of the blooms were free from injury. Late blooms, although showing some spotting by the thrips, especially on dark colored varieties, were not entirely ruined as in the previous season. A few reports, however, were received to the effect that the thrips appeared rather suddenly during the last half of August and ruined the late flowers.

Another season's use of flake naphthalene indicated that this is one of the most satisfactory materials for the small grower to use for treating the corms. The corms should be cured and cleaned as usual and placed in tight paper bags. For each 100 corms scatter in one ounce (four tablespoonfuls) of the flakes and close the top of the bag. In the average cellar four to six weeks should be sufficient time to keep the bags closed in order to kill all the thrips. Although the writer has kept corms in the flakes for over 18 weeks without apparent injury, some growers claim that keeping them in the flakes until planting time retards the development of the corms and that they are slow and irregular in starting.

For controlling the thrips on the plants the following formula has proven to be one of the most satisfactory.

Paris green	1 rounded tablespoonful
Brown sugar	2 pounds
Water	3 gallons

Three-fourths of a pint of light molasses can be substituted for the sugar.

The material must be kept well agitated and all the foliage thoroughly wet with the spray. The plants should be watched carefully for the appearance of the thrips and as soon as any of the whitish spots on the leaves are seen the spraying should be started. Spray once a week until the blossom spikes develop.

Often the thrips appear to attack certain varieties first and the grower instead of cutting and destroying the injured spikes may leave them on the plants to dry up. The thrips will desert the dry flowers and may attack uninfested plants. The thrips undoubtedly increase much more rapidly in a field where the infested blossoms are not removed than they will where all the blossoms are cut and the infested blossoms destroyed.

MISCELLANEOUS INSECT NOTES

The Sorrel Weevil. In the Report of this Station for 1932, Bul. 349, page 455, there was published a note regarding the occurrence in Connecticut of the sorrel weevil, *Phytonomus rumicis* Linn., and the injury caused by it. In 1933, specimens of this weevil were received from two seed growers from Milford, May 20 and June 1, feeding upon sorrel or sour grass growing for seed. [W. E. Britton]

Another European Weevil in Connecticut. The Station collection now contains four specimens of *Polydrusus sericeus* Schall., a small blue-green weevil said to be common in Europe. All four were collected in nurseries by Mr. Zappe; one in Greenwich, June 6, 1928, one in Thompsonville, June 30, 1932, and two in New Canaan, July 8, 1932. This species has been recorded from the vicinity of Indianapolis, Ind., but had not previously been recorded from Connecticut. It is not listed in Leonard's Insects of New York. [W. E. Britton]

Injury to Raspberry Plants by June Beetles. On May 27, a report was received of injury to raspberry plants in Orange, and on June 7, similar damage was reported from Easton. The specimens submitted in each case were those of one of the smaller species of June beetles, *Phyllophaga tristis* Fabr. Doctor Friend visited the raspberry patch in Orange and although there had been some feeding, he did not consider the damage as severe. This beetle has rather prominent erect yellowish hairs on the thorax, abdomen, femora and base of the wing covers. It was received from grass land in Willimantic, April 21, and feeding on garden beans in New Haven, May 12. [W. E. Britton]

Severe Damage to Grapevines by the Light-loving Grapevine Beetle. On June 29, several adults of the light-loving grapevine beetle, *Pachystethus lucicola* Fabr., were brought to the Station from Beacon Falls. A vineyard of 1,200 vines had been almost completely defoliated in two or three days. (See Figure 79). Some rose chafers and spotted grapevine beetles were also present, but the light-loving grapevine beetles were much more abundant and were considered chiefly responsible for the injury. A neighboring vineyard of 5,000 vines only 1,000 feet away, had not been injured at that time, and a heavy spray of lead arsenate was recommended. [W. E. Britton]

Poplar Trees Defoliated by the Satin Moth. On June 30, pupae and adults of the satin moth, *Stilpnotia salicis* Linn., were brought to the Station from Waterside Park, New Haven, where some of the Carolina poplar trees had been partially defoliated by the larvae. Mr. Walden visited the park on July 5, and made the photograph shown in Figure 80. Some five or six of the trees, particularly those in sheltered situations near Water Street, were about three-fourths stripped. Other trees showed some feeding but no particular injury. On July 12, the writer examined the trees in Beaver Park Playgrounds, where six large Carolina poplars

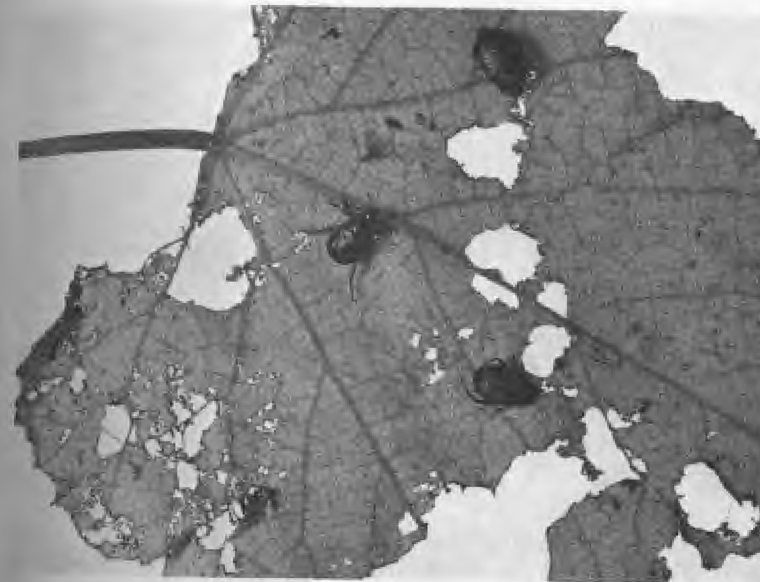

FIGURE 79. Grape leaf and adults of the light-loving grapevine beetle, *Pachystethus lucicola* Fabr. Natural size.

FIGURE 80. Poplar trees in Waterside Park, New Haven, partially stripped by satin moth caterpillars.

had been about half stripped. At this time, only a few moths were present but there were many egg-masses on the trees. Spraying with lead arsenate will prevent defoliation. [W. E. Britton]

Large Scale Breeding of Dibrachys Parasites. It may be of interest to note that in 1933 there was an unusual abundance of the supposed secondary parasite, *Dibrachys boucheanus* Ratz. This parasite became so numerous towards the latter part of the season in some of the grain moth units used for Trichogramma work that it was possible to collect them in large numbers. The insects were attracted to lights in the room and congregated beneath them. On one occasion nearly half a pint were scooped up. From estimates made by Mr. Schread, this lot alone contained about 112,000 individuals. It is well known that Dibrachys works both as a primary and a secondary parasite, and it is believed that, if this species ever proves to be of enough importance for control of such pests as codling moth or Oriental fruit moth, it can be produced in fairly large quantities. [Philip Garman]

Sprays for the Control of the European Pine Shoot Moth. In 1933 Dr. R. B. Friend and A. S. West, Jr., conducted experiments with sprays to control the European pine shoot moth in red pine plantations in Branford and Middletown. Four different mixtures were each applied three times, on June 13, 23 and July 3. The two mixtures that gave the highest percentages of control were (1) lead arsenate 3 pounds, fish oil 1 quart and water 100 gallons, and (2) nicotine sulfate .5 per cent, Penetrol .5 per cent, lead arsenate 3 pounds, and water 100 gallons. A paper read by Mr. West at the annual meeting of the American Association of Economic Entomologists, at Boston, December 28, 1933, giving the details of these tests, will be published in the Journal of Economic Entomology, Volume 27. [W. E. Britton]

Further Damage by Pseudocneorrhinus setosus Roelofs. In the report of this Station for 1932, page 434, there was published a brief account of definite injury to cultivated plants in Connecticut by this weevil from the Orient. Early in June 1933, a report was telephoned to my office regarding peculiar beetles that fed upon the foliage of forsythia, lilac, mountain laurel and weigela in a garden on Westwood Road in New Haven. I suggested that specimens be submitted and a large number were received June 7. Mr. Zappe visited this garden June 16. The shrubs had been sprayed with lead arsenate, and he could find no beetles either living or dead. Apparently the poison serves to repel the beetles but does not kill them, because they do not feed on it. Beetles in cages were given poisoned foliage but they would not eat it and soon hid away in the soil. Mr. Zappe then visited the place in West Haven where the beetles occurred last year, and he found plenty of them. They had eaten off nearly all of the new growth from young hemlock trees and the ground underneath was covered with severed tips. Thus far no one in the Department has been able to find the grubs of this weevil. [W. E. Britton]

The Strawberry Root Weevil in Houses. Adults of the strawberry root weevil, *Brachyrhinus ovatus* Linn., have the habit of congregating in houses. They have no wings, so cannot fly. The larvae feed upon the roots of strawberry plants, young conifers, grass and clover. Conifers in nurseries, particularly young plants of yew and hemlock, have had their roots damaged by this weevil. Larvae on yew roots, together with larvae of the black vine weevil, *Brachyrhinus sulcatus* Fabr., were received from Hamden, June 14. The adults are active at night and crawl into dark places and hide during the day. In 1933, three lots of adults collected in houses were received at the Station, as follows: Cheshire, July 10; West Haven, July 14; New Canaan, July 20. In all probability, these weevils came from the garden or adjacent fields where plants had been infested, and found their way into the back part of the house, where they found a convenient hiding place, usually in the kitchen. So far as is known these weevils do no harm in the house and probably leave it at the first opportunity, but sometimes they congregate there by the dozens or by the hundreds. Similar occurrences have been recorded from Maine and Montana. [W. E. Britton]

Lesser European Elm Bark Beetle. Dr. E. P. Felt at the ninth conference of Connecticut Entomologists held in New Haven, October 28, 1932, reported that the lesser European elm bark beetle, *Scolytus multistriatus* Marsh., was present in Connecticut at Stamford. During 1933, Dr. H. J. MacAloney and Mr. J. F. Knull of the Federal Bureau of Entomology found this insect in Darien, Fairfield, Greenwich, Meriden, Naugatuck and New Milford. This beetle was first discovered in the United States in Cambridge, Mass., in 1909, and reported by J. W. Chapman in *Psyche,* Vol. xvii, page 63, April, 1910. It infests weakened, dying and dead trees and branches, stumps, logs, and cut branches of elm. Recently it has been found in large numbers in connection with trees infested with the Dutch elm disease in New Jersey and in the vicinity of New York City. There is some question whether or not it ever injures perfectly healthy and vigorous trees. The inference is obvious. All choice trees should be kept as healthy and vigorous as possible. All dead wood and branches should be burned or otherwise disposed of, in order to prevent this species from multiplying and becoming abundant. [W. E. Britton]

Injury to Tomatoes by the Common Field Cricket. On September 7, information was received that crickets had injured a field of tomatoes at Windsor. Although crickets are omnivorous feeders, it is unusual for them definitely to attack cultivated crops, and a visit was made to the place the same day, to observe the extent of the injury. Three acres of tomatoes were planted in a block on a large tract of former tobacco land. The piece bordered the Farmington river on one side and adjoined grass land on the other three sides. The large black field cricket, *Gryllus assimilis* Fabr., was very abundant in the grass and many were leaving it to attack the tomatoes. It was expected that most of the injury would be found on tomatoes that had cracked open or were over ripe, but this was not the case. The tomatoes were being grown for a local cannery which required fruit well ripened and of good color, but due to the cricket injury the owner was obliged to pick the first of the crop before it had quite reached this condition. Much of the injury occurred on the ripest tomatoes, but crickets were seen feeding on those that were only partly colored and even on those that were entirely green. The crickets were well distributed over the field and probably about 20 per cent of the tomatoes had been injured, as shown in Figure 81. It was suggested that the owner try a poisoned bran mash such as is used in controlling grasshoppers. [B. H. Walden]

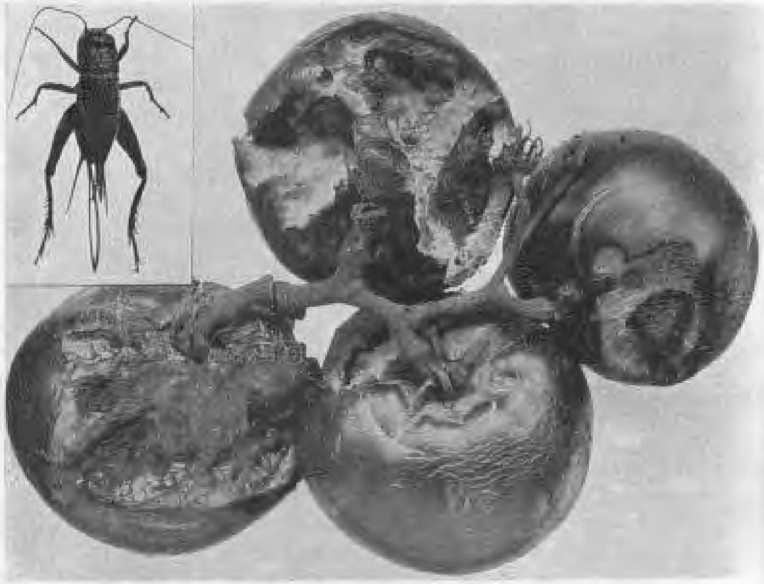

FIGURE 81. Tomatoes eaten by crickets. Insert—the black field cricket, *Gryllus assimilis* Fabr. Somewhat reduced.

A Tropical Moth in Connecticut. An unusual sphinx moth was brought to the Station August 25, by Mr. A. F. Hooghkirk, an attendant at a gasoline filling station in New Haven. He had never before seen one like it and wished to have it identified. It proved to be *Pseudosphinx tetrio* Linn., a species indigenous to Central and South America, the West Indies and southern Florida. It has a wing spread of five and one-fourth inches, and is marked with light and dark gray patches as shown in Figure 82. It is not known just how this moth reached Connecticut, but for two or three days before it was caught, there had been a heavy storm with strong southerly and easterly winds having a velocity of between 30 and 40 miles an hour. Wind-borne moths are apt to be broken and battered, particularly if brought from a great distance. Yet this specimen was fresh and nearly perfect. Moths are said to hide in cargoes of bananas, and thus may be transported long distances before

they leave the ship, and possibly this moth reached Connecticut in this manner. Dr. William Schaus of the United States National Museum states that so far as he knows, this moth has not before been recorded from a point so far north as Connecticut. [W. E. Britton]

FIGURE 82. A tropical sphinx moth, *Pseudosphinx tetrio* Linn. Somewhat reduced.

Pepper Plants Severely Damaged by Variegated Cutworm. On June 22, Mr. Zappe and the writer visited the field of J. B. Lewis, Southington, where Mr. Turner and Mr. McFarland were engaged in making spray tests to control the Mexican bean beetle. An adjacent field of pepper plants had been severely damaged by climbing cutworms. The leaves were riddled, as shown in Figure 83, and some plants had lost all their leaves. No larvae could be found on the plants but by digging in the soil around the stems from one to three cutworms were found around each plant. On the ground and in the soil, there were many dead cutworms that had been killed by the poisoned bait placed on the ground around the injured plants. Yet there were also plenty of living cutworms. Some 25 or 30 were collected and brought to the laboratory, a portion of them were placed in preservative, and the others in cages for rearing. No adult moths were obtained. Although there may have been more than one species present, it is certain that some of them were the variegated cutworm, *Lycophotia margaritosa saucia* Hbn. Altogether, three applications of poisoned bait were required to control them. Although some of the plants lost nearly all of their leaves, they finally recovered and produced a fair crop. [W. E. Britton]

Control of Clothes Moths in Pianos. The webbing clothes moth, *Tineola bisselliella* Hummel, seriously damages the felt in pianos. Re-felting is an expensive process, and apparently no moth-proofed felts are available. A piano may be fumigated, using paradichlorobenzene and covering the piano with a tight tarpaulin. This fumigation will kill the moths present, but will not prevent re-infestation. Therefore an experiment was performed in moth-proofing piano felts. An upright piano moderately infested with clothes moths was thoroughly cleaned by a piano tuner. A powerful vacuum cleaner was used for this purpose. The tuner removed the panels and keys so that all felt parts were accessible. All these felts were treated with a solution of rotenone in carbon tetrachloride at the rate of 1 part in 500. The solution was applied to the felts by means of a camel's hair brush. The piano was treated in June, 1932, and two subsequent examinations, the latter made in January, 1934, have disclosed no additional damage to the felts. Clothes moths are still present in the house but have not established an infestation in the piano. Rotenone is particularly suitable for this purpose because it is soluble in carbon tetrachloride. Aqueous solutions of moth-proofing materials might injure the piano. [Neely Turner and J. F. Townsend]

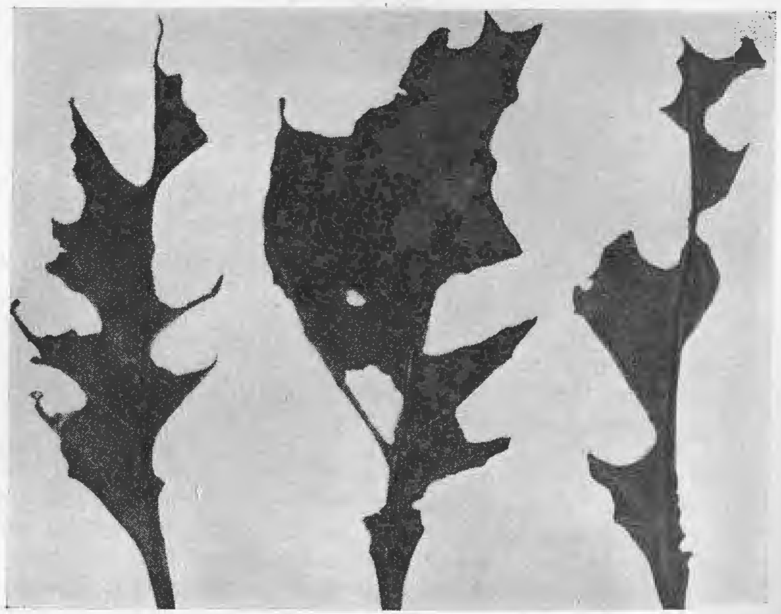

FIGURE 83. Pepper leaves injured by climbing cutworms at Southington. Natural size.

Control of Onion Thrips. The onion thrips, *Thrips tabaci* Lind., appeared on set onions during the period of May 17 to 25. No important injury was noted until June 8. The population increased steadily until the crop was mature. Sprays of nicotine sulfate (40 per cent) 1-800, pyrethrum soap 1-600 and rotenone solution, 1-400, all with .5 per cent dry soap reduced the population of the thrips, but failed to prevent serious injury after the tops of the onions went down. There was little difference in the efficiency of the three materials. The pyrethrum and rotenone products were diluted according to the manufacturer's directions. These sprays were applied by means of a garden tractor sprayer on June 9 and 20. The yield of the sprayed plots was no better than the yield of untreated plots. In a second test, nicotine sulfate (40 per cent) 1-800, with .5 per cent dry soap, was applied June 2, 9, 19 and 28. These applications kept the population at a low level, but failed to give adequate protection after the tops went down. In view of the difficulty in obtaining a satisfactory sprayer and the relatively poor protection afforded by use of contact materials, spraying onions to control thrips does not seem advisable. [Neely Turner and R. B. Friend]

Mexican Bean Beetle Investigations. The effect of spacing of bean plants on injury by the Mexican bean beetle, *Epilachna corrupta* Muls., was studied in 1933. The results obtained were entirely different from the results of the 1932 experiments. In 1933, the maximum yield occurred on beans spaced two inches apart in the row, and the yield decreased sharply when the plants were 4, 6 and 8 inches apart. Spraying, according to the recommended schedule, reduced the percentage of in-

FIGURE 84. View of garden tractor spray outfit, spraying beans in Southington.

jured pods and increased the total yield. More beetle injury occurred on the plants spaced 2 inches apart, and relatively more egg-masses were deposited on these plants than on the plants spaced 4, 6 and 8 inches apart. Sprays were more effective when the plants were 4 or more inches apart. Experiments to determine relation between date of planting and bean beetle injury showed that beans planted May 11, May 20 and June 1, matured a marketable crop without spray applications. However, injury to pods was decreased by spraying. Beans planted June 10 required one spray on June 22, and those planted June 20 required one spray on July 1. Plantings on June 30 required two sprays on July 29 and August 7. Those planted on July 10 required two sprays on August 7 and 22. July 21 plantings required one spray on August 30. No spray was necessary after the pods were formed. Tests of insecticides showed that copper-calcium arsenate dust (monohydrated copper sulfate, 19 per cent, calcium arsenate, 17 per cent, and lime, 64 per cent) was the most satisfactory dust. Magnesium arsenate, 3 pounds, casein-lime, 2 pounds, and water, 100 gallons, was very satisfactory as a spray. The use of pyrethrum and rotenone dusts following applications of arsenicals prevented beetle damage, and a higher percentage of marketable pods resulted. These non-poisonous dusts were also effective when used throughout the season. Lima and horticultural beans required spray applications on July 29 and August 7. These sprays did not apparently lessen foliage injury, but the yield was higher on sprayed plots. In a second test, sprays on June 9 and July 27 adequately controlled the larvae and left no residue on the pods. The sprays were applied with the cultivator tractor spray outfit shown in Figure 84. [Neely Turner and R. B. Friend]

Six Species of Pine Tip Moths Occurring in Connecticut. In the course of field work with the European pine shoot moth, *Rhyacionia buoliana* Schiff., and state nursery inspection during the last two years, several species of tip moths have been found infesting pines. In addition to *R. buoliana,* the following occur more or less commonly in the state: *Rhyacionia rigidana* Fernald, *R. comstockiana* Fernald, *R. frustrana* Comstock, *Eucosma gloriola* Heinrich, and *Battaristis vittella* Busck. Most of these are readily distinguished in the field by their appearance and habits. *Rhyacionia buoliana* is a serious pest of two-needle pines and is very abundant in the western half of Connecticut. It is particularly injurious to red pine, and mugho pine in ornamental plantings is usually infested. Although the insect occurs to a limited extent on white pine, it is of no economic importance to that tree. The larva tunnels in the bases of the needles in the summer, going into the buds the latter part of the season. It hibernates there and then enters a growing shoot in May. Pupation occurs in the injured shoot in May and June. *Rhyacionia rigidana* has been found commonly on red pine, particularly in the eastern half of the state. The larvae drill into the buds and continue downward into the twigs two or three inches. Hibernation occurs in the pupal stage in the twig, three to six pupae usually being found in one twig. There are two generations a year. This species may have been confused in the field with *R. frustrana* which is similar to it in appearance and habits. Our adult specimens agree in coloration and male genital characters with Heinrich's description of *rigidana* (U. S. Nat. Mus. Bul. 123, 1923). *Rhyacionia frustrana* has been found on pitch pine more frequently than on any other tree in Connecticut. It eats its way into the buds and tunnels two or three inches down the twig, pupating in the tunnel. Its life cycle and habits are similar to those of *rigidana. Rhyacionia comstockiana* is common on Austrian, Scotch and pitch pines. During the fall of 1933 this insect was frequently found on Scotch pine in northern Connecticut

and on Austrian and Scotch pines in nurseries throughout the state. The larva tunnels from one to six inches inside the twig, and its presence is indicated by a mass of pitch, often an inch in diameter. Hibernation occurs in the larval stage in the twig. *Eucosma gloriola* was described by Heinrich in 1931, from specimens collected in Connecticut by Dr. E. P. Felt. The larvae have been frequently found boring in the twigs of white pine in early summer. The terminal six or eight inches of the infested twig dies and is shown in Figure 85. Pupation occurs in the soil.

FIGURE 85. White pine twigs injured by the pine tip moth, *Eucosma gloriola.* Somewhat reduced.

Battaristis vittella has been found most frequently on red and mugho pines. The small yellowish larvae are borers in the tips in May and cause the terminal half inch to bend over sharply in a very characteristic manner.

[R. B. Friend]

PUBLICATIONS, 1933

W. E. BRITTON

Plant Pest Handbook for Connecticut: I. Insects. Bul. 344, 114 and viii pp., 88 figs. January, 1933, (issued in March, 1933).

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R. B. Friend

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R. B. Friend and A. S. West, Jr.

The European Pine Shoot Moth, *Rhyacionia buoliana* Schiff., with Special Reference to its Occurrence in the Eli Whitney Forest. Yale University School of Forestry, Bul. No. 37, 65 pp., 8 plates, 11 figs., and frontispiece. August, 1933.

B. H. Walden

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M. P. Zappe

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M. P. Zappe and E. M. Stoddard

Tests of Various Apple Sprays in 1932. Proc. 42nd Ann. Meeting, Conn. Pomol. Soc., p. 15. May, 1933.

J. P. Johnson

Hints on Clean-up Measures for the European Corn Borer.
1. Stalks and the Corn Borer. March, 1933.
2. Vegetables and Weeds. April, 1933.
3. Clean Plowing and Corn Stubble. May, 1933.
4. Cover Crops versus Clean-up Measures.
5. Cornstalks versus Barnyard Manure.
6. Corn on the Cob.

(This series of brief articles was printed in the monthly publication of the Farm Bureau in each county in the State.)

J. C. Schread

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J. C. Schread and Philip Garman

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D. S. Lacroix

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Neely Turner

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Cultural Practices in Relation to Mexican Bean Beetle Control. Jour. Econ. Ent., 26, p. 115; 6 pp., 2 plates. February, 1933.

R. C. Botsford

New Developments in Mosquito Work in Connecticut. Proc. 20th Ann. Meeting, New Jersey Mosq. Exterm. Assoc., p. 102. July, 1933.

SUMMARY OF OFFICE AND INSPECTION WORK

Insects received for identification	569
Nurseries inspected	380
Regular nursery certificates granted (362 nurseries)	374
Duplicate nursery certificates for filing in other states	109
Miscellaneous certificates and special permits granted	134
Nursery dealer's permits issued	157
Shipper's permits issued to nurserymen in other states	245
Certification and inspection	
Parcels of nursery stock	167
Narcissus bulbs (in field 125,000) for sale (40 certificates)	30,000
Corn borer certificates	385
Packages of shelled corn and other seeds	161
Blister rust control area permits issued	162
Japanese beetle certificates issued for the shipment of nursery and floral stock and farm products	8,950
Japanese beetle certificates issued for the shipment of sand	9
Orchards and gardens examined	92
Shipments of imported nursery stock inspected	14
Number cases	103
Number plants	764,500
Apiaries inspected	1,342
Colonies inspected	10,927
Apiaries infested with American foul brood	32
Apiaries infested with European foul brood	0

Towns covered by gipsy moth scouts	52
Infestations found	11
Egg-clusters creosoted	19,02
Larvae and pupae killed by hand	68,26
Infestations sprayed	20
Lead arsenate used (pounds)	47,919
Miles of roadside scouted	1,02
Acres of woodland scouted	14,02
Letters written[1]	5,70
Circular letters issued	1,65
Bulletins and circulars mailed on request or to answer inquiries	3,83
Packages sent by mail and express	312
Lectures and addresses at meetings	68

FINANCIAL STATEMENT

The report of the receipts and expenditures of the State Entomologi (Insect Pest Appropriation) for the year ending June 30, 1933, may b found in the Report of the Treasurer, on the first few pages of the 57t Report of this Station for 1933.

ILLUSTRATIONS

Figure 75 was prepared by Philip Garman; Figure 84 is from a photo graph by W. E. Britton; all others are from photographs by B. H. Walde

[1]Includes 1,985 written from the Japanese beetle office and 110 from the gipsy moth office at Danielson.

Bulletin 361 April, 1934

CROSSED SWEET CORN

Donald F. Jones and W. Ralph Singleton

Connecticut
Agricultural Experiment Station
New Haven

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CROSSED SWEET CORN

Donald F. Jones and W. Ralph Singleton

Vigorous healthy plants, well-filled ears on every stalk, ears even in size and shape and ripening at the same time; these are some of the reasons why crossed sweet corn seed is being used more and more each year. The first cross-bred seed of field corn produced by inbred plants was grown in 1920. The first commercial seed field of the same kind was grown by George S. Carter in 1921 at Clinton, Connecticut. By 1930, the use of cross-bred seed corn had increased to 34,000 acres. In 1931 it was estimated that 64,000 acres were grown and in 1932 there were more than 80,000 acres planted to crosses including both field and sweet corn.

History of Crossing

More than fifty years ago, William J. Beal of the Michigan Agricultural College proposed a method for crossing field corn seed by planting two different varieties in the same field in alternating rows and pulling out all the tassels of one variety before pollen was shed. It was found that such crossed seed had a considerable advantage from hybrid vigor. The increased growth resulting from crossing somewhat unrelated types had long been noted and used in animal breeding. Mules, the sterile hybrid of the horse and ass, crossbred swine, sheep and cattle had a recognized place in animal production.

Up to recent times the use of plant hybrids has been restricted to vegetatively propagated species. Nearly all cultivated varieties of orchard and bush fruits owe their superiority in some measure to vigor derived from crossing somewhat unrelated forms. The hybrid condition is maintained from generation to generation by budding, grafting or other forms of vegetative reproduction. Potatoes, sweet potatoes, sugar cane, also perpetuate a hybrid condition by vegetative propagation. The luxurious growth of many ornamental trees and bushes is associated with their hybrid nature.

Although it has been known that crossing often benefits seed-propagated plants, little was done to utilize this advantage largely because of the difficulty and expense of producing crossed seed. Corn is so constituted that it can be cross-fertilized easily. But it has been so continually interpollinated naturally that the cross breeding of similar varieties has not given enough advantage to bring about the use of varietal crosses.

Inbreeding Before Crossing

Early in the present century it was discovered that a process of close inbreeding applied for several generations before crossing produced a remarkable result in increased production and an even more striking effect in uniformity. This uniformity had no particular advantage in field corn, other than its effect on yield, but it was realized that it was especially desirable in sweet corn for the market and for canning.

Selection in Self-Fertilized Lines

At first the advantage from crossing was thought to be derived from the stimulus to increased growth, rapid maturity and greater hardiness, manifestations that were summed up in the term hybrid vigor. Nearly every cross of inbred strains gave such an astonishing increase in yield when compared with its inbred parents that it did not seem to make much difference what was used to make the cross. When these crosses were compared critically, with the original variety and against other varieties, it was soon realized that much depended on the inbred strains themselves. Crosses made with inbred strains were so uniform that if they had any defects these became most apparent when every plant had the undesirable feature. Many crosses did well one year and in one place, but failed in adaptability to other locations and to other seasons.

For all of these reasons attention was soon directed to the production of the inbred strains themselves. This subject is being presented in a series of bulletins under the general title of "The Improvement of Naturally Cross-Pollinated Plants by Selection in Self-Fertilized Lines". The first of this series has been published as Bulletin 266 of the Connecticut Agricultural Experiment Station under the title of "The Production of Inbred Strains of Corn". The results may be summarized briefly. Selection is only partially effective in isolating desirable characters during the process of reduction to uniformity and constancy. During the early generations of inbreeding much defective heredity is brought into visible expression and eliminated by natural selection. After this process is completed then selection is most effective in discovering the best material to work with. It is important to have as many inbred lines as possible in order to find those qualities that are desired. In the inbred condition they are sometimes hard to recognize. This usually means that many different combinations must be made and tested under different soil and seasonal conditions. Various ways of making these tests and comparisons are now being tried out. The results will be brought together as the second publication of the series.

This bulletin is designed to bring together in a brief form as much of this information as is already available. Many of the statements made here are supported by experimental evidence that will be published later.

Maximum Hybrid Vigor in First Generation

Having once obtained a valuable combination it is necessary to make the cross each year to gain the full value of this method of producing

seed. The plants grown from the cross-fertilized seed are usually referred to as the first generation hybrid or the F_1, (first filial generation) to distinguish them from later generations.

The uniformity, vigor and productiveness resulting from the crossing of inbred strains is shown only the first year. The second generation falls off in yield from 15 to 20 per cent and loses much of the uniformity that is so noticeable in the first generation. This inability of a seed-propagated plant to reproduce itself is a new feature in plant culture, one that growers are not familiar with, and at first they are not willing to accept the facts. The falling off in yield has been well established in repeated tests. It is shown by all hybrids although some will show more of a reduction than others. It is unavoidable and results from the mechanism of heredity that is fundamentally the same for all plants and animals. Animal breeders know that cross-bred pigs, sheep and cattle, after the first cross, are not worth growing for the market. Cross-bred poultry are sometimes carelessly allowed to reproduce into later generations with the production of bizarre forms that most poultrymen would be ashamed to have around the farm.

Corn growers have not had enough experience with cross-bred seed to realize their loss in saving seed from the splendid plants of the first cross. In some cases the second generation is enough better than ordinary varieties to justify its use where the first generation seed can not be obtained. Most growers who have used second generation seed have made no critical comparison and do not realize the loss they are taking in the form of reduced yield and increased variability.

Uniformity of Crosses of Inbred Strains

The uniformity of crosses in which inbred strains are used is apparent in all parts of the plant. It is most noticeable in the evenness in height, in the size and shape of the tassels and in time of tasseling and silking. This similarity continues to the time of ripening. If the corn is grown on soil of the same texture and fertility nearly all of the ears can be harvested at one time. This enables the market gardener to clean up a field in a short time and have it ready for another crop. It is particularly important for the canner. Usually only one picking is made. In the past, many ears were left in the field because they were not ready to gather and many ears that were harvested were too green or too ripe to make the best grade of canned product. With this evenness in maturity there is also a marked similarity in size and shape of ear, as well as in color and formation of the kernels. This uniformity in shape is important in corn that is being cut for the whole-grain pack.

Although uniformity is desirable in many ways it does have certain disadvantages in corn. This plant is so constructed that there is a critical stage in its development when pollination takes place. The tassels and silks are so exposed that severe heat, low humidity and lack of moisture in the soil may seriously reduce the set of seed. Adverse conditions at any stage may stunt the plants and reduce the size and development of the ear. Crossed plants being all alike are usually in the same stage of development and may be affected in the same way. This applies particularly to crosses between two inbred strains. Other kinds of crosses permit more variation and under some conditions this is desirable. This sensitiveness to adverse weather conditions is also shown in the behavior of crosses grown on different soils. Certain hybrid combinations that have done remarkably well one year in one locality have given poor results when grown another year in the same place or in different places the same year. This has been overcome by finding strains that are sufficiently hardy and adaptable to give good results nearly every year and in almost all localities where reasonably good growing conditions prevail. Such strains have great value but are not easily obtained. Crosses must

FIGURE 86. A first generation cross of two inbred strains showing evenness in height and tassel formation.

be tested over a wide range of soil and seasonal conditions before they can be generally recommended, and few crosses will do well over any large territory. This means that seed corn production will always be a local problem. Each locality should be able to produce better types of corn for its own conditions than can be produced from afar. Until locally adapted types are developed, some of the hybrid combinations that are available may do better than any local variety, but this should always be established by test.

Hybrid Sweet Corn

Redgreen

One of the first cross-bred sweet corns to be widely grown is Redgreen (Red-leaved white-seeded Evergreen), a product of the Connecticut Agricultural Experiment Station, first distributed for trial in 1924. It

is a cross of an inbred strain of Stowell's Evergreen No. 77 as a pollen parent on inbred No. 75, a small-seeded, sweet corn with reddish plant color. This color is developed only in sunlight. The record of the origin of this inbred No. 75 has been lost. The original seed resulted from the study of aleurone color reported in bulletin 167 on "Inheritance in Maize". It probably had a mixed origin. The plant color and texture of the seed is quite similar to a local variety of corn called Farmers' Club. The shape of ear is considerably different.

The original seed was self-fertilized for several generations and used as an aleurone tester, having the composition *A C r pr*. It was used in a number of crosses in a study of inheritance. The well-developed ears that resulted from these crosses were noted for several years. Various crosses with other sweet corn strains were tried on the table. When crossed

FIGURE 87. Redgreen sweet corn showing uniformity of earing.

with Evergreen inbred 77, the plants were notably uniform in growth. Nearly every plant had two ears that ripened at the same time. These ears were nearly always well filled to the tips. The color of the seeds was seen to be beautifully white and in tenderness, sweetness and flavor this combination was so much superior to ordinary sweet corn that it was grown in the home garden for table use.

This hybrid proved to be so productive and good in quality that a small amount of seed was produced in a crossing field in 1923. This seed was sent to various places for trial. A small quantity was grown by the W. N. Clark Canning Company of Rochester, N. Y. It proved to be well adapted to that section and produced a superior product when canned. Production of crossed seed was soon started by the E. B. Clark Seed Company at Milford, Conn.

It has since been tested in many parts of the country and seems to be best adapted to southern New England and central New York and in certain sections of the Northwest, particularly Nevada and central Washington. Under exceptionally good growing conditions Redgreen has made three and four well filled ears on each stalk. The plants tiller freely these increase production where there is no lack of water. Severe conditions coming after a period of luxuriant growth may curtail

FIGURE 88. Redgreen growing in Connecticut.

formation of ears more severely than on other kinds of corn of the sa season that do not tiller so freely.

The stalk growth and ear characters are shown in the accompany illustrations. The plants grow from 6 to 11 feet tall varying with th

FIGURE 89. Redgreen growing in Nevada.

time of planting and growing conditions. About the time of tasseling plants begin to turn a brownish red that becomes darker as the mature. This color develops only in sunlight. The cob and kernels

also color if exposed to light. The glumes on the tassels are colored giving a field of Redgreen a characteristic appearance that can be easily recognized from a distance. The ears are mostly twelve-rowed, well filled to the tips, and well protected by long tight husks. The whiteness of the kernels and the tenderness of the hull are important features of this corn.

Redgreen is not adapted to localities south of Connecticut nor to the central states. It is susceptible to root rot and to bacterial wilt although it usually escapes damage on account of its late maturity. In time of ripening it is about the same as early Evergreen.

FIGURE 90. Ears of Redgreen at the eating stage.

The No. 77 pollen parent of Redgreen is a typical Evergreen with short cylindrical ears. There is a tendency to have more than one ear per stalk. The plants are without color in every part and are susceptible to smut and bacterial wilt. They are good pollen producers, the tassels maturing early, and numerous large tillers also increasing the amount and extending the time of pollen production. The ears are small, frequently smutted and moldy, and mature slowly. This inbred is generally used as the pollen parent. The outstanding characteristic of this inbred is the pure white color of the seeds. This quality it imparts to the cross together with a tender pericarp and other kernel features that go to make up good quality both for canning and for table corn.

The No. 75 inbred parent of Redgreen produces a single stalk from four to six feet high. Under favorable conditions it usually forms tw small ears and sometimes three. The second ear often silks before th topmost ear. Shortly after silking the leaves, husks and glumes begin t color a brownish red wherever exposed to sunlight. The silks are re after exposure to light, the glumes on the tassels red, the anthers greer

The mature ears of this inbred are from three to five inches long wit ten to twelve rows of small, round, finely wrinkled, glassy seeds. Th tip of the ear often terminates in a small bare spike-like structure sug gesting an abortive tassel. The pericarp has a tendency to crack as th seeds are maturing. This is especially noticeable when the seeds ar crossed and should be guarded against by topping the plants and strippin

FIGURE 91. Ears of Redgreen at maturity showing uniformity of kernel type.

down the husks as soon as the cracking starts or before. The cracke seeds usually mold. This cracking is an indication of a tender pericarp.

In order to improve the general vigor, size of plant, and productiveness this No. 75 inbred was crossed with Golden Giant, a yellow variety, an backcrossed to No. 75 for three generations, selecting yellow seed eacl time. After the third backcross and then selfing, the white seeds wer planted and off-pollinated. This new white-seeded strain No. 78 gives similar results when crossed with 77 and has the advantage of being easier to grow and more productive. In appearance and uniformity it can hardly be distinguished from 75. A yellow-seeded strain similar in every respect except in color of seed was also established from the yellow seeds of the third backcross. This strain, numbered 85, is used in the production of Yellow Cross.

Crosgreen

Crosgreen is a first generation hybrid of Crosby corn with the No. 77 Evergreen inbred used in Redgreen. This white-seeded sweet corn is outstanding in early maturity and high production. The ears are often

FIGURE 92. Crosgreen combines the quality and earliness of Crosby with some of the size of ear of Evergreen.

as large as Evergreen and mature a week or more earlier. For the seed parent several inbred strains obtained from the Maine Agricultural Experiment Station were used at first. These all seemed to give equally good results. In 1927, seven of these inbred strains were composited and used as a synthetic variety for a seed parent.

This stock of Crosby is so early that it is difficult to produce seed when Evergreen inbred No. 77 is used as the pollen parent. It has to be planted from three to four weeks later. When planted so late it does not give a good production of seed. This early Crosby is also quite susceptible to bacterial wilt. It has since been found that the top cross of No. 77 Evergreen on a naturally pollinated variety of Crosby of somewhat later maturity gives equally good results in yield and is nearly as uniform and early maturing.

Crosgreen produces one good sized ear to a stalk. The stalks are medium in height with a few medium sized tillers. The ears are long, cylindrical to slightly tapering with 14-18 rows of medium broad and deep kernels. The color is not so white as Redgreen but is satisfactory for canning. The quality and texture of the canned product compares favorably with Crosby. Its outstanding feature is the heavy tonnage of ears in those localities where it is well adapted and where bacterial wilt is not a serious factor.

Crosgreen was first produced in a crossing field in 1925 and sent out for trial the following year. The first commercial seed was grown by the E. B. Clark Seed Company in 1926.

Yellow Cross

This yellow inbred, No. 85, has been crossed with a number of yellow seeded inbreds of Evergreen type and season. No final selections have been made. This combination is a yellow-seeded Redgreen. The plants have the same reddish color. The first ear of most of these Yellow Crosses is larger than for Redgreen and there is less tendency to make second ears. The ears are well protected by long husks and the ears usually fill out well at the tips. The number of rows vary from 10-16, mostly 12.

Yellow Cross has not yet been generally tested but should be adapted to all sections where Redgreen is grown successfully. In season it is a little later than Golden Cross Bantam. The color and shape of the kernel is better for canning purposes. Quality and productiveness have not yet been tested.

Green Cross

The production of a first generation hybrid of inbred strains of Evergreen sweet corn was begun in 1921. About 50 open-pollinated ears of the Charles Treat strain of Stowell's Evergreen were self-pollinated. These 50 ears had been selected from 200 on the basis of a seed germination test showing them to be free from root rot infection. Later results have shown that this preliminary selection was probably a mistake.

The several lines were self-pollinated. Three progenies in each line were grown and the best appearing progeny at the time of pollination was selected for bagging.

After several generations of self-fertilization six of the most promising lines were used as pollinators and crossed by hand-pollination on all of the lines except a few that had been discarded. The entire series of crosses was grown both at the Mount Carmel farm and at the Charles Treat farm in Orange. From this test about a dozen of the best combinations were selected for further testing. This was continued to the third year, final selection being made after the best combinations had been tested three years and in three different places in New Haven county the last year.

Based on all the results obtained the combination of 63 by 50 was selected and named Green Cross. This cross when at its best is remarkably uniform and large-eared. The stalks are large with a few tillers. There is very little color in any part of the plants. The ears are broad, cylindrical with a slight taper, usually filled out well to the tips. They have from 16 to 22 rows of kernels. The kernels are medium in width, and deep. The plants mature late but when well grown are remarkably productive. The corn is typically Evergreen in type.

FIGURE 93. Green Cross, a first generation hybrid of two inbred strains of Evergreen sweet corn.

Unfortunately this hybrid is not adaptable to sections outside of Connecticut and even at home develops a serious root weakness probably associated with root rot. The preliminary ear selection was based on plants that were free from infection. During the inbreeding process, the plants were grown on land that was rotated with other crops every two years and probably did not have much infection. This resulted in the plants not being subjected to disease and therefore they had no opportunity to show a resistance to this trouble. Green Cross is a striking example of the lack of adaptability of first generation hybrids between two uniform inbred strains. Where the plants do well and stand erect the uniformity of ear production and the size of the ears is truly remarkable as shown in the accompanying illustrations. Where there is a lack of fertility or moisture and the plants are unable to stand erect, the results may be very poor.

It should be noted that Green Cross is the first hybrid produced where the parental inbreds are both from the same variety, and in this case from the same strain of that variety.

The Associated Seed Growers produced seed of Green Cross in 1929. They have since produced Evergreen combinations that are much more

FIGURE 94. In size of ear Green Cross is outstanding.

adaptable over a wide territory and have the ability to stand erect under nearly all conditions. Other seedsmen have produced Evergreen hybrids that are more adaptable and productive over a wider range of soils and

FIGURE 95. The evenness in size and shape of kernel characteristic of crosses of two inbred strains is apparent in Green Cross.

seasons. No Evergreen sweet corn has yet been found that will produce larger ears than Green Cross when at its best.

Whipple Cross

The sweet corn most generally grown for the market in southern New England is Whipple Yellow. This variety produces a large ear in the same length of time that Golden Bantam takes to ripen a small ear. It does not equal Golden Bantam in tenderness, sweetness or flavor but sells more readily on the general market to uncritical buyers who have not yet learned to appreciate quality. In this connection it should be noted that quality tends to disappear after corn has been picked for some time, so other things being equal, size is important. No other variety in this territory will produce as large and as attractive ears in the same time.

This variety originated with Silas S. Whipple at Norwich, Conn. He had been growing a local variety of white sweet corn having many rows

FIGURE 96. Whipple Cross, like the variety from which it came, has the ability to make a large ear in a short time.

of kernels and maturing early. The origin of this corn is not known, but seems to have been developed locally. In 1913 this corn was crossed with Golden Bantam. The yellow kernels resulting from the mixed yellow and white ears were saved and the yellow color selected for five years until in 1918 the ears were nearly all pure yellow. The Harris Seed Company of Coldwater, N. Y., was among the first to appreciate the desirable qualities of this corn and make it available to market gardeners.

Mr. Whipple selected this variety for short, broad ears having many rows. His ideal was 18 to 20 rows on an ear not over 6 or 7 inches in length and many shorter. This corn was sold to the hotel trade where a short ear fitted easily in a side dish. As grown now, the Whipple variety usually has from 12 to 16 rows on ears from 7 to 10 inches long.

From seed obtained from the originator and from a local market gardener the Connecticut Agricultural Experiment Station began selection in self-fertilized lines with this variety in 1925. After self-pollinating four or more generations the six most promising inbreds were crossed on all the other inbreds and on each other. After testing these combinations certain inbreds were noted to give good results in crosses and many combinations have been made among these and tested since the first crosses were grown in 1928. One of the best producers resulted from the cross of 12 by 2. The plants are medium in size with one good ear on every stalk. The uniform earing is an outstanding feature of this cross as shown in Figure 97.

FIGURE 97. One good ear on every plant is characteristic of this cross of two inbred strains of Whipple corn.

When bacterial wilt became prevalent in 1932 it was quickly apparent that this combination was quite susceptible to the disease, so much so that it can not be used in wilt-infested territory.

The susceptibility of this combination comes almost entirely from the 12 inbred parent. Plants of this inbred are shown in Figure 13, growing alongside Purdue Bantam on one side and resistant Whipple on the other. It is notable that this inbred strain is injured much more than the variety from which it originated at the same time other inbreds are injured hardly at all. When grown free from wilt the 12 inbred produces a good stalk with a medium sized ear. It was one of the most productive of this series of inbreds until wilt appeared.

Whipple inbred 2 makes short, stocky plants with large, full tassels seldom growing taller than four feet. There are usually from one to two well-developed tillers that also produce tassels that are well filled with

pollen. The ears are small and poorly filled and usually mold badly. This inbred is not satisfactory as a seed parent but makes a fairly good pollen parent. It produces pollen over a period of a week or more. The plants are too short to distribute this pollen well but so far it has given good results.

This inbred is resistant to bacterial wilt. During the past two seasons it has made its usual growth in fields where wilt has been prevalent. Innoculation trials in the greenhouse have shown it to be resistant. It does not have the ability to overcome the susceptibility of 12 but other

FIGURE 98. An inbred strain of Whipple sweet corn, highly susceptible to bacterial wilt, growing between other strains that are free from serious injury.

crosses in which it has been tested in limited trials have shown no plants diseased.

Of all the inbreds grown this is the only one that is markedly susceptible to rust. Rust is rarely seen on corn and seldom injures vigorous plants to any noticeable extent in this region. This particular inbred is apparently quite susceptible. The disease develops late and apparently does not impair its ability to produce pollen. It does not produce well-developed ears under the best conditions and this production is considerably reduced when attacked by rust. Susceptibility to rust is apparently a recessive character since none of the F_1 hybrids with this inbred has shown this disease.

There are two inbreds that combine particularly well with 2. These are 6 and 7. Both are free from serious injury by bacterial wilt and when crossed with 2 are uniformly well-eared and productive. Strain 6 produces medium sized, dark green plants with few tillers. The one ear per stalk is medium in size and usually well filled. The kernels are large, plump and dark colored, making this strain desirable as a seed parent. It works well when 2 is the pollen parent, the silks coming at the right time to receive the pollen when both are planted at the same time.

Strain 7 produces tall plants with few tillers. The ears are well filled and uniformly light-colored. The seeds are small and light in weight. It is not as good a seed parent as 6. It also can be planted at the same time when 2 is the pollen parent.

The five best Whipple Crosses grown in 1933 compared with the original variety are as follows:

Hybrid	Ave. Date of Silking in July	Percent Wilted Plants	Ear Length In.	No. of Rows of Grain	Ave. No. ears per plant Mktble.	Not mktble.	Ave. wt. of Mktble. ears in lbs. per plant	per ear
6 x 2	26	0	7	12-16	.94	.38	.23	.24
6 x 9	23	0	7.5	10-14	.88	.25	.28	.32
2 x 7	24	25	7	12-16	.81	.62	.22	.27
7 x 24	26	18	7	12-18	.62	.44	.19	.31
5 x 2	27	13	7.5	12-16	1.00	.62	.32	.32
Whipple variety	28	18	6.5	8-14	.81	.25	.18	.23

All produced a greater total weight of marketable ears than the o[illegible] variety and these ears averaged heavier. All but one cross produ[illegible] same or more marketable ears per plant. All crosses ripened as e[illegible] earlier. Other hybrids produced equally good results or better in some respects than the two described above. All crosses with 24 produce large ears but these are not well filled at the tips. This inbred is also not satisfactory either as a seed parent or as a pollen parent. Strain 9 and 5 have not been tested sufficiently to know what they will do under varied conditions but from the one year's results in combination with 2 and 6, they are promising. These strains will be tested further. All things [illegible] sidered. 6 x 2 and 7 x 2 are the best Whipple single crosses obta[illegible] so far.

Other Sweet Corn Crosses

The most widely grown sweet corn cross at the present time is probably Golden Cross Bantam, a product of the United States Departm[illegible] of Agriculture and the Indiana Agricultural Experiment Station. This is a first generation hybrid of two inbred strains considerably different in type. Its history and description are given in circular 268 from the United States Department of Agriculture.

Golden Cross Bantam has been grown at the Mount Carmel farm since 1930. Every year it has produced a good crop of cylindrical, well filled ears, mostly twelve rowed. There is always one and often two go[illegible] ears on each plant. In some years under dry conditions the second [illegible] fails to set seed. In tenderness and sweetness this corn is equal to the best Golden Bantam. It is also markedly resistant to bacterial wilt. The plants

at an early stage may show some infection but later they have the ability to grow out and show very little injury.

As a market garden corn Golden Cross Bantam is too late in maturity to sell to the best advantage. The ears are slender due principally to a small cob and tight fitting husks. The average weight of the mature dry ear is slightly more than for Whipple but it appears to be a much smaller ear at the eating stage.

FIGURE 99. Golden Cross Bantam usually produces two marketable ears on each stalk. (Photograph from the Robson Seed Farms, Hall, N. Y.)

The outstanding feature of Golden Cross Bantam is its wide adaptability as shown by its good performance in many parts of the country. It has yielded well from Maine to Illinois and is one of the most promising yellow sweet corns in the principal canning regions. Very few first generation hybrids of two inbred strains of either sweet corn or field corn have the ability to grow so well in such varied soils and climatic conditions. It seems to be well suited to Connecticut where in many trials it has produced the most marketable ears of any yellow sweet corn of which seed is available at the present time.

Golden Cross Bantam is the product of Purdue inbred No. 51 as the pollen parent and Purdue No. 39 as the seed parent. Purdue 51 is an eight and ten rowed strain of Golden Bantam type. The plants are short, tiller freely and produce a good supply of pollen over a period of several days. This inbred strain is somewhat susceptible to bacterial wilt. Purdue 39 has a short thick stalk and few short tillers with from one to three well filled ears. These ears have from ten to twelve rows, are cylindrical, and well filled to the tip. The kernels are small and light in color. This inbred strain often produces more corn than many open-pollinated varieties of Golden Bantam and has been used as a variety. It is not typically Golden Bantam in type but has the same tenderness of pericarp, and in sweetness and flavor it also compares quite favorably with Golden Bantam.

FIGURE 100. The ears of Golden Cross Bantam are long and slender with tight fitting husks.

This inbred combines well with many other kinds of corn. It has been used as a pollen parent to top cross on several varieties, one of which is Sunshine. This cross is more uniform and productive than Sunshine but ripens later. While it is appreciably less injured by bacterial wilt than the parental variety it is far from immune.

The top cross of Purdue 39 on Spanish Gold in 1933 produced more than 10,000 marketable ears per acre compared with 7,000 for Top Crossed Sunshine and 2,000 for Golden Early Market, under conditions of severe wilt infection. The first ears were picked three days earlier than Top Crossed Sunshine and five days after Golden Early Market. The ears are well filled to the tips, long and slender, mostly with ten rows. This cross is somewhat difficult to produce on account of the wide difference in time of flowering. The Spanish Gold seed parent must be planted about three weeks after the pollen parent and when planted so late does not

make as good growth and yield of seed as when planted at the normal time.

The top cross of Purdue 39 on Whipple Yellow is outstanding in yield of large well-filled ears. The comparison with the variety itself and with Golden Cross Bantam is as follows:

Variety or cross	Ave. Date of Silking in July	Percent Wilted Plants	Ear Length In.	No. of Rows of Grain	Ave. No. ears per plant Mktble.	Ave. No. ears per plant Not mktble.	Ave. wt. of Mktble. ears in lbs. per plant	Ave. wt. of Mktble. ears in lbs. per ear
Whipple Yellow	28	19	6.5	8-14	.81	.25	.18	.23
Whipple x Purdue 39	28	6	7.5	10-14	1.25	.19	.34	.27
Golden Cross Bantam	32	19	7	8-14	1.06	.81	.28	.26

FIGURE 101. The uniformity in size and shape of ear is a regular feature of Golden Cross Bantam.

In season this top cross is earlier than Golden Cross Bantam, produces more marketable ears and these ears average larger in size and somewhat heavier. Although it has been tested only one year it seems to be as resistant to bacterial wilt as Golden Cross Bantam. It should be adapted to all sections where the Whipple variety is grown successfully. Considering its probable wide usefulness and ease of producing seed this combination seems to be one of the best in its season.

Many new sweet corn crosses are being produced by the Agricultural Experiment Stations in the corn growing states and by seedsmen. The Associated Seed Growers, Landreth Seed Company, Northrup, King and

Company and several sweet corn canning companies have taken a leading part in the production of valuable new sweet corn combinations.

The Production of Inbred Strains

One of the results of the increased use of cross-bred sweet corn is an active interest in the production of inbred strains. Some of the princip involved and the results obtained are discussed in Bulletin 266 of th station. It has been found that self-fertilization for three or four gene- ations brings about enough uniformity and fixity of type in some lines give worthwhile results and that further close inbreeding is not desirab

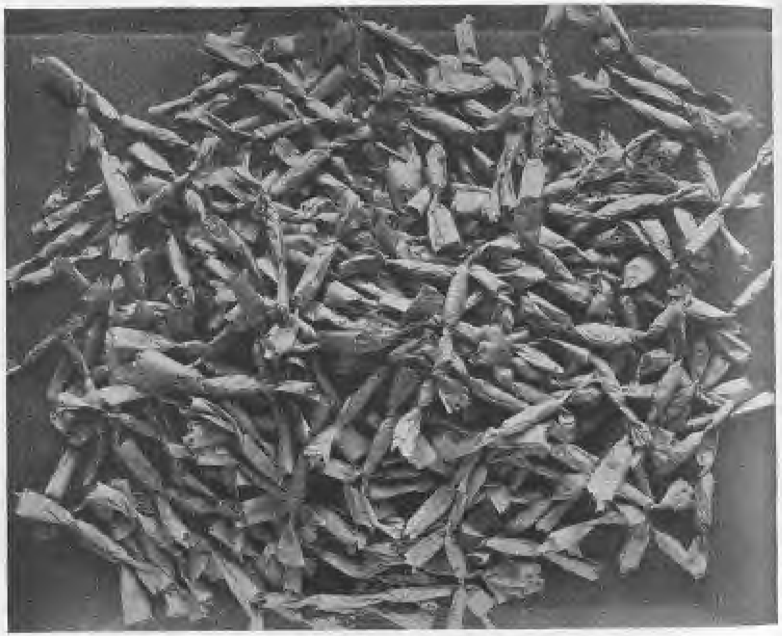

FIGURE 102. The seeds in these 322 tissue paper wrappers are planted in hills, each lot represents one inbred line.

It is important to have as many inbred strains as possible to select from. Selection during the first few inbred generations is effective in establishin specific characters not associated with reproductive ability, but selectio for productiveness is of little value because this is so closely associated wit hybrid vigor that the selection of vigorous and productive plants for pro- genitors of the inbred lines merely delays the reduction to uniformit Unless other characters such as time of maturity, color, shape of ear, kernel characters or disease resistance are more important the best pro- cedure is to grow only a few plants in each line and pollinate only enoug to make sure of seed to continue the line. These pollinations are mad mostly at random, using normal healthy plants of the type desired. In thi

way it is possible to produce a large number of inbred lines on a small area with a minimum of labor of hand-pollination. Some of these lines when tested should be found to give desirable results when crossed.

One method that we have used is to plant one ear to a hill. Six seeds are taken from each ear, wrapped in tissue paper and one packet dropped by hand in each hill. The hills are thinned to three stalks, and two ears in each hill are hand-pollinated. At harvest both ears are examined, but only one is saved. This is continued for three generations. Each ear resents one line. No individual labelling of the lines is necessary at y time. In this way a large number of inbred lines are available for ection after homozygosity is reached. In the fourth or later generations ough plants can be grown to have an estimation of the line's worth al- ough it is possible to obtain some idea from a single hill.

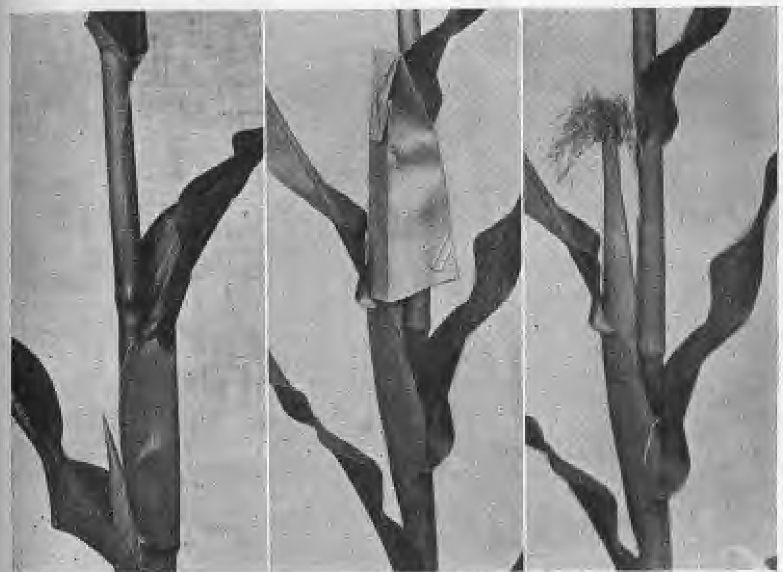

FIGURE 103. Ear shoot ready to bag, bag in place, and ear shoot showing silks ready to pollinate.

Theoretically there is a possibility of better recombination of characters when the inbreeding is done by sib mating (one plant pollinated by another in the same progeny) than by self-fertilization. Off-pollination is more y performed than self-pollination. The plants are less injured by the ipulation of bagging when only one bag is used and the silks and tassels be selected to come more nearly at the same time. This is especially worthwhile with very early corn that makes small plants after they are inbred for a few generations. A report on the results obtained from sib- pollinated lines will be given later. It is sufficient to say here that it is a mising method of procedure, one that gives inbred strains that are not too much reduced in vigor.

The Technique of Hand-Pollination

In securing inbreds of corn it is of course necessary to hand-pollinate each year all of the ears that are used for seed. To be sure that all foreign pollen is kept out the ear shoot must be covered before any silks appear and likewise we must protect the tassel so that foreign pollen does not lodge on it to be carried to the silks when the pollination is made.

Manilla bags are used for both tassels and ears. An eight pound strong

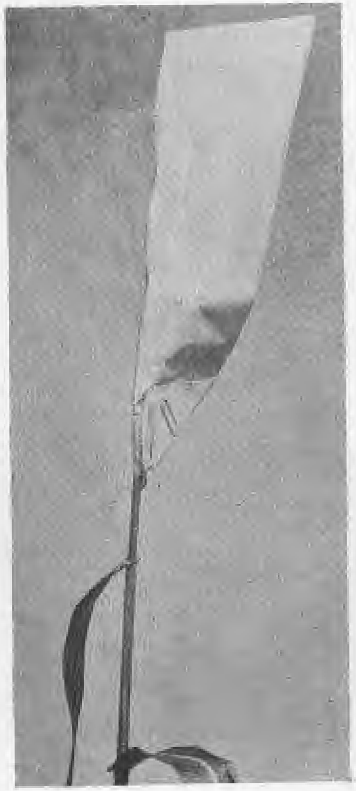

Figure 104. Bag on tassel. The upper leaf is usually removed.

Figure 105. Sheath to hold knife. Two flat lamp wicks sewed together at their edges and covered with tape, the lower end immersed in alcohol, keep the knife blade sterile.

V-bottom bag is fastened over the tassel, while a square bottom three pound nail bag covers the ear. The ear bag is applied with the bottom of the bag still folded so as to afford extra protection to the developing ear shoot. An ear just ready for bagging and one with bag in place may be seen in Figure 103. A tassel just bagged is shown in Figure 104. Both the tassel and ear bags are secured with paper clips.

The ear bag is applied any time before the silks emerge, but usually as soon as the ear shoot appears. The tassel bag is put on about the time the main spike begins to shed pollen. Pollen is not gathered from this bag for at least 24 and preferably 48 hours. This allows sufficient time for any foreign pollen lodged on the tassel to become inviable.

The proper time for making the pollination to obtain a full set of seeds is when the silks have just formed a brush about two inches long (Figure 103). If the silks have grown longer, they are difficult to pollinate and are likely to hang below the bag. They may be cut off with a sterile knife, before pollinating, care being taken not to touch with the hand the silks to be pollinated. This can be accomplished by grasping the outer end of the silks while cutting and then throwing away the portion held (Figure 106). It is comparatively simple to keep a knife sterile by always carrying it in a sheath made with two lamp wicks wrapped with electrician's tape. The lower part of the wick extends into a small bottle filled with alcohol

Figure 106. Cutting silks, shaking pollen into tassel bag, and dusting this pollen over the cut silks.

(70–95 per cent). See Figure 105. The sheath around the knife is moist with alcohol and keeps it sterile. It is held in a special pocket in the pollinating apron (Figure 106). The pollinating apron also provides separate pockets for tassel bags, ear bags, paper clips, and pencils.

It is best to do the pollinating as quickly as possible in order to avoid contamination from pollen in the air. Another safeguard against contamination is to hold the ear bag directly over the ear while completing the operation. Probably the most important precaution to avoid contamination is, so far as possible, not to make pollinations for an hour or more in the morning, when most of the pollen is being shed. Ten o'clock is about the time of maximum pollen shedding. If the work can be arranged so that ear and tassel bags may be put on at this period and pollinations made later in the day, considerable contamination will be avoided. Then, too, the tassels on the stalks to be pollinated can be pulled out before pollination, provided they will not be needed later for pollen.

After pollination the ear bag is replaced over the ear and then the tassel bag over that. Both are secured by one paper clip. The two bags afford extra protection for the developing ear, especially needed during windy, wet weather. Before the ears are ready to harvest the pedigree of the

FIGURE 107. Hand-pollinated ears labeled to show pedigree.

cross or self is put on a small string tag which is fastened to the paper clip. When the ear is harvested one prong of the clip is straightened and stuck into the end of the ear (Figure 107). The ears are then dried by

putting only a single layer in wire crates (Figure 108). Crates are 16 x 30 x 7 inches outside dimensions and hold about one bushel. They are mouse proof since each crate forms a lid for the one below when stacked.

Multiple Pollinations

It is often desirable to make a large number of pollinations from a small amount of pollen. This often happens when a common pollinator is used for a whole series of crosses. Several schemes have been devised to accomplish this. The insect powder gun is used by some. A modification of a glass atomizer is also employed for this purpose. The objection to these pollinators is that they have to be sterilized when changing pollen. A simple inexpensive pollinator can be made from a small glassine bag, 2½ x 6½ inches, the one used for ear bags by a good many workers.

FIGURE 108. Hand-pollinated ears in a wire crate used for drying.

A fresh bag can be utilized for each batch of pollen and then discarded. If the bag is creased crossways about half way up, the pollen and anthers can be poured into the top half. Then by gently tapping the bag at the crease the pollen alone will run down into the lower half. When all the pollen is thus transferred, the anthers are dumped out and the top folded over. A paper clip is used to fasten the bag. By cutting off one corner of the bag containing the pollen, the pollen is shaken out much the same as from a salt shaker. By this method as many as 30 to 50 pollinations have been made from the pollen of a single plant.

Another method of making multiple pollinations is to cut a small hole in the tassel bag after the pollen has been collected and use the tassel bag as a "salt shaker" without removing the anthers. This is simpler than the glassine bag method and is recommended in case only 10 or 20 pollinations are desired from each pollinator plant.

Production of Crossed Seed in Field Plots

General Method

After the inbreds have been secured and by crossing them we have obtained the corn we desire, we are faced with the problem of producing crossed seed in quantity. The object is to get all of one specified inbred or variety pollinated by another given inbred. This is comparatively simple in corn, since the male and female inflorescences are on different parts of the plant. If the seed parent is planted in every other row and the pollen parent in the alternate rows, we can obtain crossed seed by pulling out all of the tassels of one at pollinating time. The detasseled plants will then be pollinated by the other. For example, if we wish to make a cross of Spanish Gold x Connecticut 2 (a Whipple inbred) we would plant these two strains in alternate rows and then remove *all* the tassels from the Spanish Gold. All the seed produced on the Spanish Gold must then be crossed by Connecticut 2. The seed produced on the Connecticut 2 is selfed or sib-pollinated and represents an increased lot of this inbred.

In this crossing plot the Spanish Gold is designated as the seed parent or female (♀), while the Connecticut 2 is the pollen parent or male (♂).

FIGURE 109. Crossing plot showing alternate rows detasseled.

Number of Rows of Seed Parent and Pollen Parent

If we grow an equal number of rows of both the seed parent and the pollinator, a yield of crossed seed will be obtained from only one half of the acreage grown. Thus two acres in a crossing plot will give one acre of crossed seed and one of the pollinator. A low yield of crossed seed to the acre will be obtained. If we can increase the number of rows of the seed parent in comparison to the pollen parent greater yields of crossed seed can be produced. Care must be taken not to plant too many rows of the seed parent to one of the pollen parent; a poor pollination will result if the proportion is not right. Most of the inbreds put out by the Connecticut Station as male parents will produce sufficient pollen for three to four times as many rows of the female parent. In the production of Redgreen seed complete pollination has been obtained when five rows of Connecticut 75, the seed parent, have been planted with one row of Connecticut 77, the pollen parent. However, we do not recommend more than four rows of the seed parent to one of the pollen parent. Growing them in this proportion, four-fifths of the acreage in a crossing plot will result in crossed seed. The inbred Connecticut 2 is a good pollinator and one row under normal growing conditions should completely pollinate four rows of seed parent. We recommend growing them in these proportions.

Yield of Inbreds

Inbred strains are fully as uniform as first generation hybrids and are more easily injured by adverse weather conditions because of the lack of vigor in the inbreds. Consequently the yield of inbreds over a period of years can be expected to vary greatly.

The yield of Connecticut 75, when grown in a crossing plot four rows to one of the male parent over a period of years, has fluctuated from 400 to 1300 pounds of shelled grain to the acre. In an average season this inbred will yield about 500 pounds to the acre when planted at the ratio mentioned above. Open-pollinated early sweet varieties will produce about 600 pounds of shelled grain to the acre.

Other inbreds are not so productive as Connecticut 75. On certain Country Gentleman inbreds the yield has been as low as 200 pounds to the acre. No yield records are available for the Whipple inbreds, but it is estimated that they will yield 400 to 500 pounds to the acre. This low yield of inbred strains is the chief reason for the higher price of crossed sweet corn seed.

Time of Planting

In order to get complete pollination it is essential that the male and female parents mature at approximately the same time. If they are of different seasons then the planting of the earlier variety or inbred must be delayed to bring it to silking and tasseling at the same time as the later corn. This is an important point that cannot be over-emphasized. If the precaution is not followed, a poor pollination will result.

If both parents in the Spanish Gold cross are planted at the same time, the silks of the female parent, Spanish Gold, will come out before there is any pollen available on the male parent, Connecticut 2. These silks do not long remain receptive. There is a period of only a few days after the silks first begin to emerge that they will receive pollen. After that pollen will not grow down the silks and fertilize the ovules, even though the silks look perfectly fresh.

It is better to have pollen available not later than three or four days after most of the plants show silks. Cases have been reported in which silks have remained receptive for two or three weeks, but such an eventuality is not to be relied upon if a full set of seed is desired.

Two weeks after Connecticut 2 is planted is the recommended time for seeding Spanish Gold. This does not mean that Spanish Gold is fully two weeks earlier. Two weeks' spread in the planting dates will not make that much difference in the time of silking. Possibly the variation in time of silking will be only four days to a week. This will be sufficient, since the Spanish Gold should have its silks out when the pollen parent begins to shed.

Planting corn at different dates causes quite a problem in farm management. The entire field must be marked to obtain proper spacing at the time of the first planting. Probably at the second planting the field will need to be cultivated and re-marked to kill the weeds that have started. This makes extra work, but is well worth while as a means of obtaining a good stand.

There are other difficulties in producing crossed seed corn. If a very dry spell follows the planting of the first parent, then the planting of the second parent will necessarily be delayed. Probably it is a good rule in the case of Spanish Gold x Connecticut 2 to wait before seeding Spanish Gold until the inbred is mostly through the ground and is about two or three inches high. Unfortunately a severe dry spell following the second planting might delay it so much that the silks would not be ready before all the pollen had been shed.

Such uncertainties in part explain why crossed seed is more expensive than varietal seed. The difference in price in most cases does not truly represent the difference in cost of production. For reasons set forth we recommend that growers of crossed seed do not plant too large an acreage until they are thoroughly familiar with the inbreds and with the production of crossed seed.

Detasseling

It cannot be emphasized too strongly that detasseling must be thorough if crossed seed is to be produced. Some growers who do a really efficient job have covered the field to detassel the seed parent as many as eleven times. This watchfulness is not excessive. To get all the tassels out before they shed any pollen it is probably necessary to go over the field *every day* after the first female parent plants are ready to shed pollen. Certainly a crossing plot should be covered every two days in good weather. In cold, cloudy, rainy weather the tassels will not develop so fast, but the field should be watched constantly to see that no female plants shed pollen. This is very important. The first detasseling can be made the day the first tassels on female rows have emerged and before pollen has been shed. All tassels should be removed that can be pulled out whole without taking too much out of the top of the plant. One or two small leaves may come out with the tassel. These will not seriously injure the plant. It is better not to take more than two leaves as the plant may be damaged and a poor ear result. The tillers must be watched carefully to see that none sheds pollen. After about a week or ten days of detasseling a field the tops of all the tillers can be pulled out. Even if the tillers are injured slightly by the detasseling, there will be sufficient foliage on the rest of the plant to produce a good ear. A little severity to the tillers is warranted if necessary. All tassels must be pulled before they shed any pollen.

On the thoroughness with which a field is detasseled will depend the quality of the crossed seed. If a field is covered only twice it is a safe estimate that not more than half of the seed will be crossed. The remainder will be selfed or pollinated by the female parent, and it will be no more productive than the female inbred or variety. This inferior seed from a poorly detasseled field may go on the market in direct competition with seed from a well-cared for plot.

Curing Seed Corn

Sweet corn can be harvested and dried any time after it has begun to wrinkle. Artificial heat may be necessary to dry the corn quickly before

FIGURE 110. Crossing field grown in 1921 at Clinton, Connecticut.

it molds. Harvesting the corn early also guards it from the ravages of birds, racoons, woodchucks, skunks, pheasants and other pests in the field. Most of the seed firms are equipped with well-aerated seed barns for drying. To those who have had little experience in curing seed it might be well to emphasize ventilation. Circulation of air is more important than heat in corn drying. A seed barn should be so constructed that all sides may be opened up and a good draft of air drawn through. The corn may be piled on racks but should never be in layers more than six inches deep. Otherwise ears in the center will mold. Green sweet corn is an ideal medium for the growth of mold that will develop without circulation of air. Artificial so-called tunnel driers are used in some of the western states that produce a large quantity of sweet corn seed. These driers are constructed with a large fan at one end of a long narrow room or tunnel. Warm air is introduced and blown by the fan across the green corn. As more corn is put into the tunnel on racks, it is moved up toward the fan, and the dry corn is taken out near the fan. By this method green corn can be dried for shelling in about a week. The more rapidly corn can be dried, the better the seed. Mold will develop at the slightest opportunity.

After the corn is dried, the ears should be looked over and if there are any off type ears they should be discarded. After shelling, the seed is cleaned and graded so that the chaff and the small, light or irregular shaped kernels are removed. Some of the kernels taken out will produce just as good corn as the regular shaped and larger kernels, but they will not work so well in a corn planter.

Maintenance of Stock Seed

Maintaining different lots of stock seed, keeping them separate and properly identified, and increasing the stock seed of different inbreds for use in a crossing plot are additional exacting requirements for the producer of crossed corn seed. These are highly important, for the quality of the crossed seed rests fundamentally on the excellence of the stock from which it comes.

Increase from Original Hand-pollinated Seed

The first step in producing a quantity of an inbred line of sweet corn is to get seed for a small increase plot. It must be hand-pollinated. One can obtain a fair quantity of hand-pollinated seed by growing two rows of the inbred side by side. At pollinating time the good plants in the first row are pollinated by a mixture of pollen from the plants in the second row. Likewise the second row will be pollinated by the first row. This will give enough seed for a small increase plot.

Isolated Fields

Since corn is wind-pollinated, increase plots of different inbreds must be far enough apart (1,000 to 2,500 feet) to prevent pollen from blowing from one plot to the other. It is essential to have the first increase plot well isolated. Otherwise a few stray pollen grains will get in and the result will be crossed seed instead of inbred. When grown the next year the crossed plants will shed a disproportionately large amount of pollen and in a short time the inbred seed will become badly mixed. Good increase plots are so important that we are following, at the Connecticut Station, the policy of few increase plots and those well isolated. All our inbred lines are carried in hand-pollinated lots until we are sure which lines are best, and then grown in well protected plots. The distance between isolation plots can be materially cut down if there are natural barriers for pollen, such as orchards or small forest groves. A strip of hemp, 30 feet wide, has been used as a barrier between different plots but has not proved to be entirely satisfactory. It makes a rapid growth and is always taller than the corn, but this cannot be relied upon, for some pollen gets through. This is especially apt to happen if the plots

on each side of the hemp mature at about the same season. If hemp is to be used to isolate inbreds there should be at least 50 feet of it between plots and also the varieties should be separated by season as well. We could grow with comparative safety seed of Spanish Gold and seed of our Stowell Evergreen inbred separated by a hemp plot. They differ so much in time of ripening that this combined with the hemp would probably result in two lots of pure seed. Such practice is not advisable for our two Whipple inbreds Conn. 6 and 2. There would be some mixing of these if grown on opposite sides of a hemp strip. In nearly every section small fields naturally well isolated by woodland can be found. Where possible, these should be fully utilized in increasing stock seed, rather than depending upon an artificial barrier such as hemp.

Hand-pollination of Foundation Stock

Since keeping inbred lines pure is so difficult in crossed corn production inbred lines should not be more than one or two generations removed from hand-pollinated ears. The plan at the Connecticut Station is each year to go into the small increase plots and hand-pollinate about 50 typical plants. This will give enough seed to grow a similar isolation plot the following year. The seed from this increase plot will be sold to producers of crossed seed or be used to produce a large acreage of inbred seed the following year. By this method it is possible to make certain that all seed used for crossing is true to the type of the inbred. The following inbred strains of sweet corn are being maintained for the present. This foundation seed is available to commercial seed growers within the state and outside as far as the supply permits.

Connecticut	2	Pollen parent of Whipple Cross and Early Top Cross
Connecticut	6	Seed parent of Whipple Cross
Connecticut	7	Seed parent of Whipple Cross
Connecticut	50	Pollen parent of Green Cross
Connecticut	63	Seed parent of Green Cross
Connecticut	75	Seed parent of Redgreen
Connecticut	77	Pollen parent of Redgreen and Crosgreen

Rogueing

Rogueing, removing plants not true to type from an inbred line, is an extremely important step in keeping increase seed pure. Fields should be rogued once or twice thoroughly just *before* any silks are out or any pollen is shed. At this time outcrossed plants can usually be distinguished from the inbreds, by the much larger, ranker growth of the outcrossed plants, provided the plants are grown on even ground. Also, crossed plants tiller more profusely than inbreds. Once a grower has become familiar with the typical appearance of the inbred plants, he can detect most of the outcrossed individuals. These undesirables should be uprooted, tillers and all, and the dirt knocked off of the roots. Otherwise in moist weather the uprooted plants will continue to grow and shed considerable pollen.

Any plant that appears suspicious should be pulled up. In going over crossing plots it is essential that the male parent in particular be rogued thoroughly. A crossed plant in the male parent will shed as much pollen as many inbred plants and the crossed seed from a field not rogued will be inferior. In spite of all precautions in keeping lines pure a few crosses will appear. Just one stray pollen grain when making the first hand-pollinations will result in a healthy vigorous crossed plant, which, if not pulled out, will thoroughly contaminate the field for an area of several yards around.

In a crossing plot the female should be rogued also, but here the need is not so great as in the male. Every plant of the female rows is detasseled so that it exerts no influence on others. Off type ears can be thrown out at harvest time. However, much labor can be saved in sorting ears if the seed parent is thoroughly rogued.

Use of Pollen Parent Seed from Crossing Field

In the earlier days of crossed seed corn production, it was thought that the seed produced by the pollen rows could be used as an increase lot of the male parent. Theoretically the seed produced on the male rows has been pollinated only by the male pollen and hence is just like seed from an isolation plot of the male parent. However, this is true only if every tassel has been removed from the female rows before any pollen was shed. Actually such an ideal condition cannot be obtained, for even with the best detasseling, a few tassels of the female rows will shed some pollen before they are removed. It is probably safe to say that even in the fields most strictly watched, from 1 to 5 per cent of the pollen has come from the female rows supposed to produce none whatever. This contamination is not great enough to lower materially the quality of the crossed seed, but the male parent would be seriously harmed if the seed were used again. A contamination as low as 1 per cent would mean that if the seed from the male rows was planted, one in every hundred plants would be crossed by the female parent. This crossed plant would be more vigorous and would shed a large amount of pollen. If not rogued out it would seriously mix the increase plot of the male parent.

Therefore it is best never to use seed from the male rows in a crossing plot to increase the stock. Any increase plot of the male inbred should be isolated from all other corn.

Nor is it advisable to use seed from the male rows again as a male parent. Here a few crossed plants would shed an unusually large amount of pollen and the female parent would receive this pollen just as readily as pollen from the male inbred. So we repeat that seed from the male rows of a crossing plot must not be sown for increase, nor can it be used again safely as a male parent. However, the seed grown on the male rows is not entirely worthless. It can be planted in a crossing field the following year as a female parent. In this field all plants will be detasseled. Even if there are a few crossed plants they are not a serious factor of contamination, since they are detasseled.

The following diagram represents the uses of seed from male and female rows produced in a crossing plot:

♂ .... Seed of ♂ inbred to be used as ♀ in crossing field. Not to be used again as ♂ parent in crossing field nor to increase supply of ♂ parent.

♀ ....
♀ ....
♀ .... Crossed seed for general planting.
♀ ....

♂ ....

Storage of Reserve Seed

It is usually quite a problem to keep reserve seed for a few years without damage by insects and other pests. This is especially true where there are a number of small lots of seed. Seed in envelopes may be held safely by adding a small quantity of hydrated or slaked lime to each envelope and shaking it well. This covers each seed with a dust film and seeds so covered are not injured by the usual insects attacking grain, such as weevils, domestids and grain moths.

Larger lots of increase seed, in small cloth bags containing from a quart to a bushel, can be stored in covered metal cans. To each can is added a half pound or more of moth balls. The odor of the naphthalene thoroughly permeates the cans and keeps out all insects. Moth balls are better than flake naphthalene since they last longer and are in more convenient form.

Seedsmen usually hold over seed corn in a dry cool basement or in cold storage. We have found a small, nearly air tight room satisfactory for a limited quantity of seed in burlap bags. The room is, of course, mouse proof. Naphthalene scattered about and paradichlorobenzine in cloth bags hung from the ceiling fill the air in the warmer weather with a strong odor of both the paradichlorobenzine and the naphthalene. Under these conditions no insects of any kind have been able to live. Before the construction of this storage room, grain moths and mice were a serious factor in destroying considerable seed held over in larger lots.

Testing Inbred Lines

After the inbred strains are obtained there is the difficult problem of testing them to discover the best ones for the purpose in mind as well as deciding upon the method of crossing by which they can be used to the best advantage. In our early experiments the method of testing followed was to cross all good lines in every possible combination. With 100 lines to be tested there are 4,950 combinations, not counting reciprocal crosses, to be made and compared for performance. With many strains the number of combinations soon becomes so large as to be almost impossible to handle adequately. Some accurate method is needed of reducing the number of combinations to be tested, at the same time not risking the loss of good combinations before they can be recognized.

The plan first followed was to select a small number of inbred strains that were outstanding either in stalk growth or ear development or both. Such strains were selected that would make desirable seed parents. These few strains were then used as pollinators and crossed on all of the other strains to be tested after eliminating the poorest producers and those that had undesirable characters that were not likely to be suppressed in crosses. When these combinations were grown those strains were looked for that gave good results in several combinations. Also the inbreds that gave outstanding results were noted. As many combinations as seemed promising were made between the members of this selected group and tested until the best one was found.

It took considerable time to do this and many crosses had to be grown and even when this was done there was no certainty that some combinations that were never tried at all might have been better than the ones finally chosen.

A simpler method was next tried. All surviving inbreds were crossed with one open-pollinated variety. Pollen was collected from a number of plants planted at different times so that a representative lot of pollen was used for the early as well as the late inbreds. All of these crosses were compared at one time with a variety of similar season. The best of these combinations were noted and the inbreds that produced them were used in various ways. Here again it is not axiomatic that two inbreds that do well when crossed with the same thing will do well when crossed with each other. Where the inbreds are to be used in producing a top cross then this method indicates at once the most promising strains to use and further testing of a relatively small number of the best combinations should locate the best strains to be used for the purpose in view.

Disease Resistance

With the prevalence of bacterial wilt, root, stalk and ear rots, smut and other serious diseases of corn, the testing of inbred strains for resistance to disease is an important problem. During the course of the inbreeding process considerable selection towards natural immunity can be made provided the disease is prevalent. In many cases infection is not plentiful every year in which case artificial innoculations should be made either in the greenhouse or in the open field.

Bacterial wilt can be induced in corn either indoors or out with the use of a virulent culture applied at the same time the tissues of the plants are broken. A simple procedure is to inject a few drops of a culture of bacteria into the young seedling with a hypodermic needle.

For information concerning bacterial wilt see United States Technical Bulletin 362 by Rand and Cash, or Circular 96, Connecticut Agricultural Experiment Station.

Smut infection can be increased by mixing, with manure, smut-balls collected from diseased plants as shown by Garber and Quisenberry (1925) in the Journal of the American Society of Agronomy. This mixture spread over the field before planting and worked into the surface soil gives the over-wintering spores a medium on which to grow and produce the summer spores that spread the infection among the growing plants. Artificial innoculation with cultures of the smut fungus has not given satisfactory results. There are several physiological forms of smut. Resistance to all of these is difficult to secure.

Kyle (1929) in Technical Bulletin 120 of the United States Department of Agriculture has shown a direct association between husk protection and freedom from smut infection on the ear. The most serious damage, however, is on the plant.

Long tight husks also help to reduce the injury from corn ear worms. On the other hand, husks that are too long and tight interfere with the extrusion of silks and may reduce the set of seed, especially in the inbreds themselves.

Many organisms are involved in the production of rots on the ears, stalks, and roots of corn. Excellent descriptions and discussions of control measures are given by Koehler and Holbert (1930) in Illinois Agricultural Experiment Station bulletin 354. Many of these diseases are carried in the soil. This indicates the desirability of growing inbred strains and testing them in fields that are known to carry these diseases. Holbert and others (1924) in Illinois Agricultural Experiment Station Bulletin 255 give directions for artificial inoculation.

Time of Ripening

Early maturity is an important character in sweet corn grown for the market as well as the home garden. The time of silking is a fairly reliable indication of the relative time of ripening. It is a character that is easily seen. Selection for early maturity during the inbreeding process is effective in establishing quick ripening strains. To a certain extent maturity is delayed by the weakened condition brought about by inbreeding but is restored by crossing. One of the most noticeable manifestations of hybrid vigor is rapid growth and early maturity. In general the crosses will ripen sooner than the inbred parents but the earliest parental strains will tend to produce the earliest crosses.

Quick maturation is usually associated with a short stalk and the placement of the ear low down on the stalk. There is necessarily a sacrifice in size of ear when selecting for earliness. This can be overcome to a certain extent by an increase in number of tillers. There is a positive correlation between number of tillers per plant and the weight of ears in early corn. It has been shown that the leaves on the tillers help to nourish the ears on the main stalk. If the tillers are removed there is usually a reduction in yield. This may not always be true. A sudden dry spell sometimes reduces the yield of plants that have a large amount of foliage but, in general, tillers are a distinct advantage to the corn plant and especially to early corn. All varieties of sweet corn tiller somewhat and the early varieties regularly do. It is the only way that they can produce a sufficient area of foliage to produce a well-filled ear. Later varieties have a large enough leaf expanse on one stalk to give a satisfactory ear but in some cases even late varieties may be benefitted by tillers. Corn breeders have been slow to recognize the value and importance of tillers. This is due in part to the mistake of calling them "suckers". Under some conditions the tillers may form small ears themselves of no value. This is usually an indication of good growth and such extra production usually does not reduce the yield of good ears on the main stalk. Such production is a waste of effort in sweet corn and should be directed to the main stalk by selecting those types that produce few or no ears on the side branches under all conditions. In early corn it is also important that the entire energies of the plant should be concentrated on one ear. The production of more than one ear per stalk should be selected against. The number and size of the ears can be regulated somewhat by the distance of planting.

Quality

Quality in sweet corn is difficult to measure accurately. Among the things that are involved in good quality are tenderness, sweetness and flavor. Tenderness is principally concerned with the pericarp or outer hull. This is a protective coating. If it is too thin or brittle it cracks allowing molds to enter and reducing the vitality of the seed. On the other hand, in some varieties the pericarp is so tough as to be decidedly objectionable. In other kinds of corn the pericarp is noticeably tougher than in sweet corn, and for that reason it is difficult to cross sweet corn with other types of corn and reëstablish a desirable sweet corn kernel from such a mixture.

The toughness of the pericarp can be measured with a puncture-testing machine. This is best done with the mature seeds since the condition of the pericarp varies rapidly with the maturity of the individual kernel. The mature seeds after soaking in water can be measured and the relative pressure necessary to puncture the pericarp gives some indication of the tenderness in the eating stage.

Tenderness doubtless involves other characters inside the kernel such as the thickness and nature of the cell walls, as well as the type and varying amounts of starches, celluloses and sugars in the endosperm.

All varieties of sweet corn show varying amount of opaqueness in the kernels. This opaque condition, spoken of as pseudo-starchiness, has been described and its inheritance studied by the senior writer (Genetics 1919, 4:364-393). It is commonly believed that this opaqueness in sweet corn has come from crossing with field corn. This may or may not be the case, usually not. All field corn has this material in the kernels, covered over by the well-filled starch grains. The main difference between field corn and sweet corn is the sugary gene that does not allow the starch grains to be normally filled. Instead, they are small, angular in shape, closely packed together, and cemented with amorphous material, mostly sugars of various kinds. This failure of the starch grains to develop normally causes the kernels to shrink on drying, giving the characteristically wrinkled appearance of the sweet corn kernel. By selecting the smoothest and most opaque kernels in a variable variety of sweet corn, a perfectly smooth and opaque type of kernel can be established that on external examination appears to be much like flint or dent corn. An examination of the starch grains shows that this condition is far from being true starchy, and when such a type is crossed with true field corn, wrinkled, translucent kernels appear in the second generation as if a pure sweet corn had been used.

Chemically these pseudo-starchy seeds are much like true starchy seeds in having a low percentage of soluble carbohydrates, sugar of various types, and a high percentage of insoluble carbohydrates. In the structure of the starch grains and in breeding behavior they are true sweet corn.

In general a large amount of this opaque material is associated with poor quality. It is nearly always present in early corn, apparently giving the seed a greater ability to germinate and grow under the adverse conditions of early spring planting. It is also more prevalent in sweet corn grown in hot dry regions, than under cool and moist conditions. A certain amount of this type of starch is desirable in canning corn to give it the right consistency. Too much is highly undesirable and should be guarded against. Many varieties of corn that are considered to have good quality, such as Golden Bantam and Black Mexican, show considerable amounts of this opaque starch so that it is not always an indication of poor quality. This complex material needs more study to determine its proper place in the nutrition of the plant and its effect on the product as used.

FIGURE 111. When all of the plants ripen at one time they are more subject to favorable or unfavorable growing conditions.

Adaptability of First Generation Hybrids

The more general use of first generation hybrids of inbred strains is showing quite clearly the difference in adaptability between these crosses and open-pollinated varieties. Especially is this true for crosses of two breeds. Varietal corn is so genetically variable in all characters that some plants can survive and even do well where others are severely handicapped. The poor development of some of the plants is not so noticeable where many do fairly well and a few give exceptionally good results. It is a poor field of corn indeed that does not produce a few good ears. Where the plants are all genetically alike they may all be very good, medium, or very poor, and being all alike are more conspicuous whatever they are. Corn being a plant of strictly determinate growth, budding, flowering and ripening at one time, it is easily affected by adverse growing conditions, and is especially dependent upon an adequate supply of moisture in the soil and in the air. Under conditions of high temperature and low humidity corn will sometimes not set a single seed even though abundant water is supplied to the roots by irrigation. High humidity in the air will sometimes delay serious injury from lack of moisture in the soil but can not prevent such injury. It is becoming increasingly apparent that crosses must be tested for as many different soils and seasons as possible, and planted at different times to determine their usefulness. A single cross of two inbred strains can not be expected to have the wide adaptability of naturally pollinated varieties or crosses having more germinal diversity.

Utilization of Inbred Strains

Single Crosses

The first generation of a cross of two uniform inbred strains is called a single cross. The immediate offspring of such a combination are as uniform as the two parents and in most cases are exceedingly vigorous and productive. The uniformity shown in the accompanying illustrations extends to all parts of the plant and is most noticeable at the time of tasseling and ripening. The similarity in size and shape of ear and in kernel characters is a valuable characteristic in sweet corn both for canning and for the market. The color of the kernels may be variable depending upon the genetic difference between the two parental strains. The seeds borne on a hybrid plant are in reality the second generation. If a white-seeded strain is crossed with a yellow, the kernels immediately resulting from the cross-pollination are all a uniform yellow but the crop grown from that seed will be mixed yellow and white. Similarly, if a light yellow is crossed with a dark yellow strain, the seeds on the F_1 plants may show considerable variation. This variation may result if the parents are exactly alike in shade of color. A plant having the composition *A C r i* when crossed with an *A C R I* individual will show no aleurone color in either parent or in the crossed seeds, but in the F_2 seeds produced by F_1 plants the seeds will be colored and uncolored in the ratio of 3 to 13. Shades of color and differences in texture of endosperm, which may not be so conspicuous, are inherited in the same way and may produce considerable variation in kernel characters. In size and shape of ear and kernel remarkable uniformity is obtained provided the parental strains have been reduced to some degree of homozygosity.

Because the parental strains are so reduced in size, vigor and productiveness, single crossed seed is difficult to produce and will always be expensive. Very few uniform strains of corn have been produced that are more than half as productive as the original variety. The seeds are small and often irregular in outline. Inbred plants are much reduced in pollen production so that seed produced by inbreds in a crossing field is often less than in a field by itself. The plants mature slowly and the seed is difficult to ripen and cure in such a way that good germination is secured. Even under the best of conditions the F_1 seedlings are handicapped by starting from a small seed and being poorly nourished in early stages of growth.

This handicap they usually more than overcome before the end of the growing period. In sweet corn the crop is harvested before the end of the season and this initial handicap may not be completely overcome especially in early maturing corn.

It has been shown that the size of the embryo is important in the early growth of corn. Selection of a large embryo may be worth while. In general reciprocal crosses even between widely different inbred strains are closely alike at the end of the growing season provided the plants have a full time to mature. In plants that are harvested prematurely there may be an important difference in reciprocal crosses that should be taken into consideration.

There are ways of overcoming some of these objections to single crosses. First, it is important to secure the best inbred strains obtainable. It is theoretically possible to have homozygous plants more vigorous and productive than the variable variety from which they come. No matter how desirable these plants may be themselves, there is always the probability

FIGURE 112. Uniformity in all characters is the outstanding feature of a single cross.

that they can be improved by crossing. Strains approaching this ideal are being obtained by the extensive inbreeding now being carried out.

Greater vigor in the parental strains can be obtained by inbreeding less intensively, that is, some form of sib mating instead of self-fertilization or by stopping the inbreeding before the plants are completely reduced. Many different sub-strains in the same line all descending from one plant may be inbred until all weaknesses and abnormalities are eliminated and then combined into one strain. By making the separation in the first, second or third generation, various degrees of uniformity and vigor can be had. In every case vigor and productiveness in the inbred strains will be had at the expense of uniformity and fixity of type in the inbreds themselves and the crosses made from them. However, if enough of the right characters are fixed in the inbreds, desirable results can be obtained in the hybrids.

Double Crosses

A ready means of overcoming some of the objections to single crosses is at hand in the use of double crosses. A double cross is the first generation combination of two single crosses. In this way four inbred strains are brought together by three crossings in two years as follows:

Inbred strains	A B	C D
Single crosses	A × B	C × D
Double cross	(A×B) × (C×D)	

A double cross produced in this way, by one hybrid detasseled and cross-pollinated by another, is usually no less productive than either parent, and may be considerably more. All of the gametes produced by the hybrid parents are different so that every plant of the double cross is germinally dissimilar from every other plant. If the four inbred strains are such that they give good results in all single combinations then every plant will usually be vigorous and productive.

All four inbreds may come from the same variety or from different varieties. The best results are usually obtained when the two strains that form the seed parent single cross are from the same variety and are the same in type while both strains used for the pollen parent are from another variety of different type. In a cross of this kind the maximum hybrid vigor may be expected together with enough uniformity for all practical purposes in field corn. In a modification of this method one inbred is used for a pollen parent. Such a combination has been called a "three-way cross." The result is usually greater uniformity. The difficulty lies in finding an inbred strain sufficiently vigorous and dependable to use as a pollen parent with the large cross-bred seed-parental plants.

Both double crosses and three-way crosses have been used with field corn successfully but have not been used extensiveely with sweet corn. The principal advantage is in the quality of seed. Produced on vigorous F_1 plants the seed is uniform, well matured, and attractive in appearance. With this seed a good stand of plants can be obtained under field conditions. The difficulty comes in maintaining three or four stock strains true to type and making the preliminary crosses. Other methods give almost equally good results and are easier to apply.

Multiple Crosses

Theoretically the second generation of a cross of two inbreds produces the same kind of gametes and in the same proportion as the first generation if all plants have the same number of germ cells and enough plants are used to secure a random sample. For this reason, the cross of F_2 would be expected to give about the same result as $F_1 \times F_1$. The above F_2 would be expected to give about the same result as ... conditions are never entirely fulfilled but in actual practice the results are very nearly the same. Successive generations from a single cross reproduced by natural inter-pollination have been crossed with similar generations from another cross and compared with the original double cross

The yield and appearance has been closely alike. The plants that produce the seed and the pollen are not so uniform. This is an advantage in

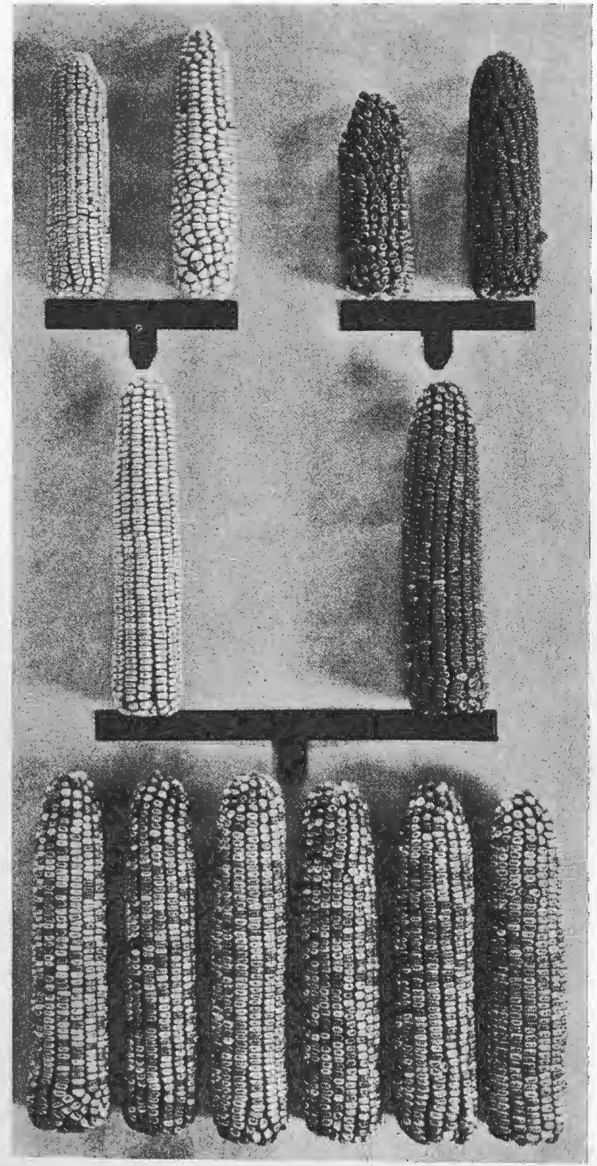

FIGURE 113. Illustrating by actual field results the bringing together of four inbred strains by three crossings to produce a double cross.

spreading the pollinating period and avoiding some of the risk of adverse growing conditions and faulty timing of tassels with silks. On the other hand, the seed is variable in size and shape and the yield of seed is reduced.

The results with this method suggested the combination of a number of inbred strains out of one variety to be used as a composite propagated by natural inter-pollination in the usual way. Such a composite as a seed parent can be crossed with one inbred as a pollen parent or another composite to produce a first generation hybrid called a multiple cross. This is being done in Burr-Leaming and Canada-Leaming, two field corn hybrids well adapted to New England for the production of grain and ensilage. In the former several inbred strains of Burr White, a smooth-seeded, slen-

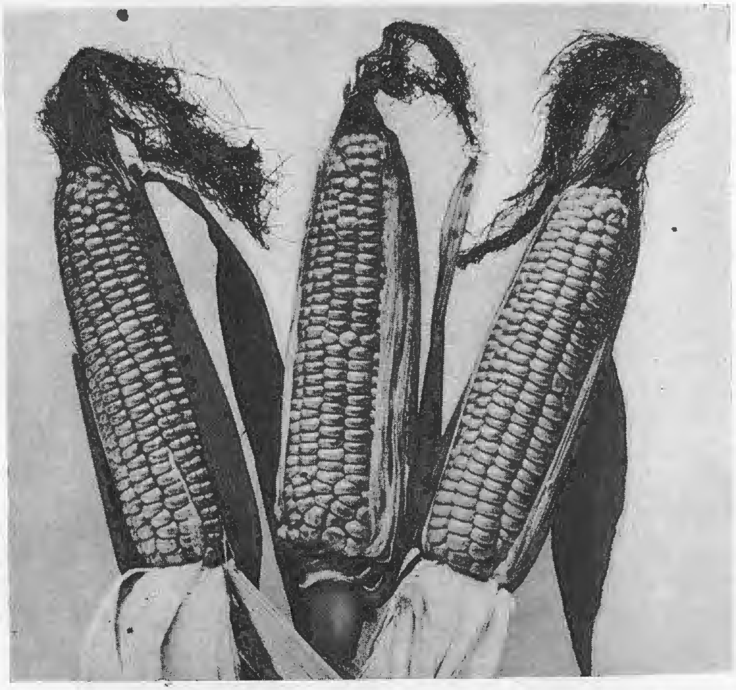

FIGURE 114. Spanish Gold is the result of bringing together in a new variety several self-sterilized strains of sweet corn.

der-eared white dent corn were combined into what may be called a synthetic variety. This stock is used as the seed parent. Similarly a number of strains of Leaming were combined to form a pollen parent stock. The two original varieties are different in type and individual strains gave good results when crossed singly. A double cross was then made, using two inbreds from each variety. Later the multiple cross was found to give as good yields, to be about the same in uniformity and was much easier to produce. With this method only two seed stocks have to be maintain

Canada-Leaming is a similar hybrid using the same Multiple Leami stock for the pollen parent with a seed stock made up of a number inbreds of eight-rowed Canada Yellow Flint. There is a wide differen

in the time of flowering so that the flint stock has to be planted about two weeks later to insure proper pollination. This cross is exceedingly vigorous and productive giving larger yields than most varieties in the same season of ripening.

The composite of inbreds itself is uniform and productive and in some cases may be a marked improvement over the original variety. Where certain desirable characters can be established in this way, such a synthetic variety may have value without crossing. Spanish Gold is such a variety made up of a number of inbred strains selected for early maturity. The original material came from an early yellow flint corn from Spain crossed with several local sweet varieties, some having yellow seeds, some white and some purple. By self-pollination yellow-seeded sweet strains ripening early were established in a few years and when combined these strains produced a vigorous variety, outstanding in its season. The development and description of Spanish Gold sweet corn are given in circular 75.

Top Crosses

In 1917 a series of single crosses between inbred strains of field corn was tested for yield of grain. With these were grown a number of first generation hybrids made by pollinating a variety as a seed parent with one inbred strain as a pollen parent. The varieties used were local flint and dent types that were well adapted to this region and had been proved to be high yielding. The inbred was one of the original Leaming strains, No. 1-6, (243), described in bulletin 207. The variety from which this inbred was derived came from Illinois.

In this series of about 60 crosses in all, 10 yielded more than 100 bushels of dry shelled grain per acre. Of these, eight were crosses of a variety by an inbred. The highest yielding combination was Canada Yellow Flint by Inbred Leaming No. 1-6. This corn was well matured, uniform in its intermediate flint-dent type and similar to the Canada-Leaming previously described. The original Leaming variety crossed by inbred No. 1-6 out of this variety produced 103 bushels per acre and compared favorably with many of the single crosses.

The cross of a variety by an inbred is generally called a Top Cross, a term borrowed from animal breeding practice where a pure-bred sire is used with grade dams. Dr. E. W. Lindstrom at the Iowa Experiment Station has called attention to the valuable results obtained with top crosses in corn. This method has many outstanding advantages and has not been used to the extent that it deserves.

The seed parent stock is easily maintained. A good yield of seed from a crossing field is obtained with well-filled kernels of the same size and condition as the varietal seed. Such seed can be planted by drills commonly in use without any change in adjustment. Of more importance is the adaptability to different soils and varying seasons. Top crosses are sufficiently variable to make this adjustment at the same time they are noticeably more uniform than the variety. In making a top cross everything depends upon the inbred used for the production of pollen. Some inbreds produce much greater uniformity in their cross-bred progeny than do others. This is desirable if it is expressed in good plant and ear characters, disease resistance and good yield without sacrificing too much in adaptability.

FIGURE 115. Top Crossed Spanish Gold—the result of pollinating a variety by an inbred.

Many inbreds can be tested at one time by reversing the cross, using the inbreds as the seed parent and the variety as a pollinator. While the crosses will be slightly handicapped by their poor start from inbred seed

the most promising combinations should be easily noted and repeated tests, from crosses made in the way seed is to be produced, will finally determine the best combination.

Top crosses have not been used with sweet corn extensively enough to determine fully their usefulness. It was assumed at the start that the greater uniformity of other methods of combining inbred strains would justify the greater cost of producing seed and this may well be true. In the present stage of development, however, top crossing can be used to advantage with sweet corn. Crosses well adapted to local conditions can be developed quickly by using the varieties that are known to do well in that locality. By crossing a few good inbred strains, already available, with a number of varieties results can be obtained more quickly than by the slow process of producing and testing a large number of inbred strains to get the combinations with the right quality, size and shape of ear, time of ripening, resistance to disease and all of the many details necessary to make a profitable sweet corn. Inbred strains of extra early varieties are so small and unproductive that it is questionable if they can ever be used in single crosses for seed production. Top crossing an inbred of a slightly later season on to an extra early variety has given promising results.

A variety used for top crossing can be more closely selected to type than when used for production. The loss in yield from such close selection is not serious in a seed field and the resulting gain in uniformity and increased production from the crossed plants may be well worth while. For this purpose it might be well to use the progeny of a single plant propagated by natural pollination. Some strains of sweet corn used for canning have come from single plants tested in ear-row plots. Such strains should give good results when combined with an inbred of the right type.

Inbreds to be used for top crossing should make a good stalk growth and produce an adequate supply of pollen. Since they have to compete with more vigorous plants it is well to plant them earlier.

Crosses of Different Types Compared with Crosses within Varieties

Top crosses that are now being used represent combinations of Golden Bantam, Sunshine, Whipple and Spanish Gold with inbreds out of different varieties. It is generally true that the best results are obtained when varieties of different type are brought together. This is the case whatever method of crossing is used.

Many varietal crosses have been tested, but appreciable increases in yield are usually obtained only when distinctly dissimilar kinds of corn are brought together, such as flint and dent, early eight-rowed sweet corn with a late many-rowed sweet corn, long-eared pointed pop corn with a short-eared round-seeded pop corn. Chinese varieties of corn crossed with local types have given some remarkable increases in yield. The same principal applies when inbred strains are used whether they are used in single, double, multiple or top crosses.

Before the varieties to be inbred are selected they should be tested in varietal crosses to give some idea of the general reaction between the materials to be used. If a varietal cross is vigorous and productive and produces the type of ear desired at the right time, then inbred strains can be produced from those varieties with the expectation that good results can be obtained. This does not mean that desirable inbreds can not be found in varieties that do not combine well. Sometimes they are.

Ability of Crosses to Repeat Their Performance

The outstanding advantage of crosses in which inbred strains are used is their ability to give good results year after year. Inbreeding gives to corn a fixity and stability of type that can not be obtained in any other way. Varieties of corn may give good results for a period of years and then change in some unaccountable way so that they are less productive or less well suited for the purpose desired. Change in quality, size or shape of ear, time of ripening or resistance to disease may greatly reduce the value of an open-pollinated variety. With crosses the results once obtained can be repeated if the soil and seasonal conditions are the same provided the inbred stocks are maintained true to type and kept free from mixing with other kinds of corn. In some ways inbred strains are more easily kept true to type than varieties because out-crossing is immediately apparent in the next generation. If proper precautions are taken inbred strains can be kept true to type and will give the same genetic constitution every time they are crossed in the right combination. Everything depends upon the proper maintenance of these stock strains, the care with which they are handled and the thoroughness of detasseling. Failure to carry out the necessary steps may not be apparent in the seed. Until growers realize that everything depends upon the skill and reliability of the seed producer, some poorly produced seed will undoubtedly be planted to the discredit of crossed corn in general.

When sweet corn growers see the crop that can be grown from crossed seed of the right kind adapted to the conditions in which it is grown, they are not going to be satisfied with the variable varieties they have raised in the past.

Bulletin 362 April, 1934

COMMERCIAL FEEDING STUFFS

REPORT ON INSPECTION

1933

E. M. BAILEY

Connecticut
Agricultural Experiment Station
New Haven

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REGISTRATION OF FEEDS

Manufacturers, jobbers or individuals outside the State who ship concentrated commercial feeding stuffs into Connecticut are expected to register the brands so shipped and to pay the necessary fees thereon, and they generally do so. However, under the provisions of our law, if manufacturers or others outside the State neglect or refuse to register, the local dealer who handles such feeds is responsible for such registrations, registration fees and other legal requirements.

In the course of trade, feeds manufactured in another State frequently pass through the hands of several middlemen, none of whom is within the immediate jurisdiction of our law, before they reach the local distributor. This Station makes reasonable investigation to find out the source of shipment of feeds found to be unregistered, but the law imposes no obligation upon it to do so. It is the plain duty therefore of local dealers who purchase feed for resale and distribution to assure themselves that the brands they purchase are registered, or else be prepared to assume that responsibility themselves.

COMMERCIAL FEEDING STUFFS

REPORT ON INSPECTION

1933

E. M. Bailey

THE FEED LAW

The text of the law relating to concentrated commercial feeding stuffs and of regulations made jointly by the Dairy and Food Commissioner and the Director of this Station for carrying out its provisions, are given in Bulletin of Immediate Information, No. 60, June, 1927.

Some essential provisions of the law and the regulations may be briefly restated here.

Exemptions. It is held that the law exempts from classification as concentrated commercial feeding stuffs, and therefore from registration, (1) roughages such as hays, straws, corn stover, ensilage and all materials containing more than 60 per cent of water; (2) whole grains and mixtures thereof; (3) meals made from whole grains when not mixed with other materials or with each other; (4) feed ground from whole grains and sold by the manufacturer directly to the consumer; (5) feed ground from materials furnished by the consumer; or (6) feed mixed according to a formula furnished by the consumer, for his own use.

Under the provision of clause 6 above, a feed must be sold as a formula only, without a private brand name and without analysis. But a feed cannot be offered for general trade as a formula in order to avoid registration and the registration fee.

Labelling. All concentrated commercial feeding stuffs must be labelled either by a statement printed on the bag or upon a properly attached tag; except that in the case of cottonseed meal sold for fertilizer, or of any concentrated feeding stuff sold in bulk, a certificate, which shall contain the information otherwise required to appear upon the bag or upon the tag, may be issued by the dealer in lieu thereof.

The law requires a statement of (1) the net weight of the feed contained in the package; (2) the name, brand or trademark under which the feed is sold; (3) name and address of the manufacturer or importer; (4) the minimum percentages of (a) crude protein and (b) crude fat, and the maximum percentage of (c) crude fiber contained in the feed; and (5) the separate ingredients of which the feed is composed.

NOTE: Analyses are by Messrs. Nolan, Mathis and Walden; microscopic examinations by Mr. Shepard and Miss Shepard; sampling by Mr. Churchill; and compilations by Mrs. Vosburgh.

While the law requires only a statement of the items enumerated above, no objection will be raised to more complete statements of chemical composition.

Our regulations provide that definitions and standards for feeding stuffs as adopted from time to time by the Association of American Feed Control Officials are accepted as official in carrying out the provisions of our law; and the rules and regulations of that association are followed whenever they are consistent with our statutes. In order to secure greater uniformity in the labelling of feeds and in the statement of ingredients, that association has adopted a number of rules that manufacturers should heed in submitting registrations. Particularly the following points should be noted:

(1) The protein percentage of cottonseed and linseed meals should be incorporated in the brand name, e.g. "XX Cottonseed Meal 41 per cent" or "XX 41 per cent Protein Cottonseed Meal".

(2) Feeds should not be designated as "molasses feeds" or "buttermilk feeds" but rather as feeds "with molasses" or "with buttermilk", or "containing molasses" or "containing buttermilk". Example: "XX Dairy Feed with molasses", not "XX Molasses Dairy Feed".

(3) If screenings are present their source should be indicated, e.g. "wheat screenings", "rye screenings".

(4) Ground oats hulls should not be designated as "ground oat feed".

(5) The presence of any proportion of screenings in wheat bran or in wheat shorts should be indicated as a part of the brand name and the source of the screenings given, e.g. "Wheat Bran with ground wheat screenings not exceeding mill run".

Affixing tags. The use of wire or any metal in affixing tags to feed packages is prohibited by law.

Registration and registration fee. The law requires an annual registration of all concentrated feeds sold or offered for sale in this State. Registrations are to be made with the Connecticut Agricultural Experiment Station and beginning January 1, 1928, the registration period is for the duration of the calendar year. The registration fee is fifteen dollars ($15), for each brand, a distinct brand name or a distinct analysis constituting a distinct brand.

Duties of manufacturers, jobbers and dealers. All concentrated commercial feeding stuffs must be registered annually on January 1, or before they are offered for sale.

Manufacturers, jobbers or individuals shipping feeds into Connecticut will be expected to register their brands and pay the necessary fees thereon. Connecticut dealers should assure themselves that the brands they handle are properly registered and labelled. In case the manufacturer or jobber outside the State neglects or refuses to register, the dealer who handles such feeds will be held responsible for such registrations, registration fees and other legal requirements.

Dealers within the State who mix their own brands are responsible for the registration and proper labelling thereof.

Cottonseed meal. Cottonseed meal sold as a fertilizer is required to be registered under the terms of the fertilizer law; if sold also as a feeding stuff it is required also to be registered under the provisions of the feed law; if sold exclusively for one or the other of these purposes, it may be registered only under the law that applies.

EXPLANATION OF TERMS USED IN AN ANALYSIS OF FEEDING STUFFS

In registering feeding stuffs the law requires that the minimum percentages of crude protein and crude fat, and the maximum percentage of crude fiber, shall be given; that is, the registrant must guarantee that the feeds registered will contain *not less* than the stated percentages of crude protein and of crude fat and *not more* than the stated percentage of crude fiber.

The term *crude protein* denotes those nutrients that contain nitrogen, and is obtained by multiplying the percentage of total nitrogen in the feed by the factor 6.25.

The term *crude fat* denotes those substances that are soluble in ether and includes, besides fat, such non-fatty materials as chlorophyll and coloring matter.

The term *crude fiber* denotes the coarse, woody tissues characteristic of all forms of roughage and that are present in the outer coats of cereal and other fodder grains.

Although the law requires only a statement of the three nutrients just defined, no objection is taken to more complete statements of composition, but such further statements, if given, must be correct. Thus, tags sometimes bear guaranties for nitrogen-free-extract and for carbohydrates.

The term *nitrogen-free-extract* denotes those nutrients of the starch and the sugar types. This group is never determined directly but is obtained by subtracting from 100 per cent the sum of the percentages of moisture, ash, crude protein, crude fiber and crude fat.

The term *carbohydrates* denotes the combined percentages of crude fiber and nitrogen-free-extract.

DEFINITIONS OF FEEDING STUFFS[1]

ALFALFA PRODUCTS

1. *Chopped Alfalfa* is the entire alfalfa hay, chopped and not ground finely enough to become a meal. It must not contain an admixture of alfalfa straw or other foreign material. (Adopted prior to 1928).

2. *Alfalfa Meal* is the product obtained from the grinding of the entire alfalfa hay, without the addition of any alfalfa stems, alfalfa straw or foreign material, or the abstraction of leaves. It must be reasonably free from other crop plants and weeds, and must not contain more than 33 per cent of crude fiber. (Adopted 1928).

3. *Alfalfa Leaf Meal* is the ground product consisting chiefly of leafy materials separated from alfalfa hay. It must be reasonably free from other crop plants and weeds and must not contain more than 18 per cent of crude fiber. (Adopted 1928).

[1]As announced by the Association of American Feed Control Officials, 1933-34.

4. *Alfalfa Stem Meal* is the ground product remaining after the separation of the leafy material from alfalfa hay or meal. It must be reasonably free from other crop plants and weeds. (Adopted 1928).

ANIMAL PRODUCTS

5. *Blood Meal* is ground, dried blood. (Adopted 1926).
6. *Blood Flour* is dried blood, prepared by special processes and reduced to a fine powder. (Adopted prior to 1928).
7. *Digester Tankage, Meat Meal Tankage or Feeding Tankage* is the residue from animal tissues exclusive of hoof, horn, manure and stomach contents, except in such traces as might occur unavoidably in good factory practice, especially prepared for feeding purposes by tanking under live steam or by dry rendering or a mixture of the products made suitable by drying and grinding. It must not contain more than 10 per cent of phosphoric acid (expressed as P_2O_5). If it bears a name descriptive of its kind, composition or origin, the material must correspond thereto. (Adopted 1928—Amended 1933).
8. *Digester Tankage with Bone, Meat and Bone Meal Digester Tankage, Meat and Bone Meal Tankage, or Feeding Tankage with Bone* is the residue from animal tissues exclusive of hoof, horn, manure and stomach contents, except in such traces as might occur unavoidably in good factory practice, especially prepared for feeding purposes by tanking under live steam or by dry rendering or a mixture of the products made suitable by drying and grinding, and containing more than 10 per cent of phosphoric acid (expressed as P_2O_5). If it bears a name descriptive of its kind, composition or origin, it must correspond thereto. (Adopted 1928—Amended 1933).
9. *Meat Scraps* is the ground, dry-rendered residue from animal tissues exclusive of hoof, horn, manure and stomach contents, except in such traces as might occur unavoidably in good factory practice. When this product contains more than 10 per cent of phosphoric acid (expressed as P_2O_5), it shall be designated Meat and Bone Scrap. If it bears a name descriptive of its kind, composition or origin it must correspond thereto. (Adopted 1928).
10. *Raw Bone Meal* is the dried, ground product suitable for animal feeding, obtained by cooking in water at atmospheric pressure, undecomposed bone, just enough to remove excess fat and meat. It must not contain less than 23 per cent of protein. (Adopted 1929).
11. *Steamed Bone Meal* is the dried, ground product suitable for animal feeding obtained by cooking bones with steam under pressure. (Adopted 1929).
12. *Special Steamed Bone Meal* is the dried, ground product suitable for animal feeding obtained by cooking dried bone, after the removal of grease and meat fiber with steam under pressure in the process of obtaining gelatine or glue. (Adopted 1929).

APPLE PRODUCTS

13. *Dried Apple Pomace* is the sound, dried residue obtained by the removal of cider from apples. (Adopted 1929).
14. *Dried Apple Pectin Pulp* is the sound, dried residue obtained by the removal of pectin from apple products. (Adopted 1929).

BARLEY PRODUCTS

15. *Barley Hulls* is the product consisting of the outer coverings of the barley. (Adopted prior to 1928).
16. *Barley Feed* is the entire by-product resulting from the manufacture of pearl barley from clean barley. (Adopted prior to 1928).
17. *Barley Mixed Feed* is the entire offal from the milling of barley flour from clean barley and is composed of barley hulls and barley middlings. (Adopted prior to 1928).
18. *Ground Barley* is the entire product obtained by grinding clean sound barley containing not less than 90 per cent of pure barley and not more than 10 per cent of other grains, weed seeds and other foreign material and not more than 6 per cent of crude fiber; provided that no portion of this stated 10 per cent of other grains, weed seeds or other foreign material shall be intentionally added. (Adopted prior to 1928).
19. *Mixed Feed Barley* is the entire product obtained by grinding country run barley containing not less than 75 per cent of pure barley and not more than 25 per cent of other grains, weed seeds and other foreign material; provided that no portion of this stated 25 per cent of other grains, weed seeds or foreign material shall be intentionally added. The ingredients must be stated as barley, other grains, weed seeds and foreign material. (Adopted prior to 1928).

BEET PRODUCTS

20. *Dried Beet Pulp* is the dried residue from sugar beets which have been cleaned and freed from crowns, leaves and sand, and from which the sugar has been extracted. (Adopted prior to 1928).

BREWERS' AND DISTILLERS' PRODUCTS

21. *Brewers' Dried Grains* is the dried residue obtained in the manufacture of beer. (Adopted prior to 1928).
22. *Distillers' Corn Dried Grain or Distillers' Rye Dried Grains* is the dried residue obtained in the manufacture of alcohol and distilled liquors. The product must bear the designation indicating the cereal predominating. (Adopted prior to 1928).
23. *Distillers' Corn Solubles* is a by-product from the manufacture of alcohol from corn solids obtained by the evaporation of the mash liquor after the removal of the alcohol and wet grains. (Adopted prior to 1928).
24. *Distillers' Rye Solubles* is a by-product from the manufacture of alcohol from rye solids obtained by the evaporation of mash liquor after the removal of the alcohol and wet grains. (Adopted prior to 1928).
25. *Distillers' Corn and Rye Solubles* is a by-product from the manufacture of alcohol from corn and rye solids obtained by the evaporation of mash liquor after the removal of the alcohol and wet grains. (Adopted prior to 1928).
26. *Malt Sprouts* are the sprouts of the barley grain obtained from malted barley. Sprouts derived from any other malted cereal must be designated by the name of that cereal. (Adopted prior to 1928).
27. *Yeast Dried Grains or Vinegar Dried Grains* is the properly dried residue from the mixture of cereals, malt and malt sprouts (sometimes cottonseed meal) obtained in the manufacture of yeast or vinegar, and consists of corn or corn and rye from which most of the starch has been extracted, together with malt added during the manufacturing process to change the starch to sugars, and malt sprouts (sometimes cottonseed meal) added during the manufacturing process to aid in filtering the residue from the wort and to serve as a source of food supply for the yeast. (Adopted prior to 1928).

BUCKWHEAT PRODUCTS

28. *Buckwheat Shorts or Buckwheat Middlings* are the portions of the buckwheat grain immediately inside the hull secured after separation from the flour. (Adopted prior to 1928).

CHOP

29. *Chop* is a ground or chopped feed composed of one or more different cereals or by-products thereof. If it bears a name descriptive of the kind of cereals, it must be made exclusively of the entire grains of those cereals. (Adopted prior to 1928).

COCOANUT PRODUCTS

30. *... Per Cent Protein Cocoanut Oil Meal or ... Per Cent Protein Copra Oil Meal* is the ground residue from the extraction of part of the oil from the dried meat of the cocoanut. (Adopted prior to 1928).

CORN PRODUCTS

31. *Corn Meal* (Feeding) is finely ground, unbolted corn. (Adopted prior to 1928).

32. *Corn Bran* is the outer coating of the corn kernel, with little or none of the starchy part or germ. (Adopted 1931).

33. *Corn Feed Meal* is the fine siftings obtained in the manufacture of screened corn chop, screened ground corn or screened cracked corn, with or without its aspiration products added. (Adopted 1931).

34. *Corn Chop, Ground Corn or Cracked Corn* is the entire product made by grinding, cutting or chopping the grains of sound Indian corn, and may be fine, medium or coarse, and must not contain more than 4 per cent of foreign material. (Adopted 1931).

35. *Screened Corn Chop, Screened Ground Corn, or Screened Cracked Corn* is the coarse portion of corn chop, ground corn or cracked corn from which most of the fine particles have been removed, and must not contain more than 4 per cent of foreign material. (Adopted 1931).

36. *Corn Grits or Hominy Grits* is the product consisting of the fine or medium sized, hard flinty portions of sound Indian corn containing little or none of the bran or germ. (Adopted 1931).

37. *Ear Corn Chops* is corn and cob chopped, without the husk, with no greater proportion of cob than occurs in the ear corn in its natural state. (Adopted prior to 1928).

38. *Corn Gluten Meal* is that part of commercial shelled corn that remains after the separation of the larger part of the starch, the germ and the bran, by the processes employed in the manufacture of corn starch. It may or may not contain corn solubles. (Adopted prior to 1928).

39. *Corn Gluten Feed* is that part of commercial shelled corn that remains after the separation of the larger part of the starch and the germs by the processes employed in the manufacture of corn starch. It may or may not contain corn solubles. (Adopted prior to 1928).

40. *Maltose Process Corn Gluten Feed* is the dried residue from degermed corn, after removal of starch in the manufacture of malt syrup. (Adopted prior to 1928).

41. *Hominy Feed, Hominy Meal or Hominy Chop* is the kiln-dried mixture of the mill-run bran coating, the mill-run germ, with or without a partial extraction of the oil, and a part of the starchy portion of the white corn kernel obtained in the manufacture of hominy, hominy grits, and cornmeal by the degerming process. (Adopted prior to 1928).

42. *Yellow Hominy Feed, Yellow Hominy Meal or Yellow Hominy Chop* is the kiln-dried mixture of the mill-run bran coating, the mill-run germ, with or without a partial extraction of the oil, and a part of the starchy portion of the yellow corn kernel obtained in the manufacture of yellow hominy grits and yellow corn meal by the degerming process. (Adopted prior to 1928).

43. *Corn Oil Cake* consists of the corn germ from which part of the oil has been pressed and is the product obtained in the wet milling process of manufacture of corn starch, corn syrup, and other corn products. (Adopted prior to 1928).

44. *Corn Oil Meal* is ground corn oil cake. (Adopted prior to 1928).

45. *Corn Germ Cake* consists of corn germ with other parts of the corn kernel from which part of the oil has been pressed, and is the product obtained in the dry milling process of manufacture of corn meal, corn grits, hominy feed, and other corn products. (Adopted prior to 1928).

46. *Corn Germ Meal* is ground corn germ cake. (Adopted prior to 1928).

47. *Corn Screenings* is the product consisting of the small light grains of corn, parts of grains of corn and, or, other cereals, and other materials having feeding value, obtained by screening shelled corn, excluding sand, dirt and other similar inert materials. (Adopted 1931).

COTTONSEED PRODUCTS

48. *Cottonseed Meal* is a product of the cottonseed only, composed principally of the kernel with such portion of the hull as is necessary in the manufacture of oil; provided that nothing shall be recognized as cottonseed meal that does not conform to the foregoing definition and that does not contain at least 36 per cent of protein. Cottonseed meal shall be graded and classed as follows: (Adopted prior to 1928).

49. *...Per Cent Protein Cottonseed Meal, Prime Quality.* Cottonseed meal, prime quality, must be finely ground, not necessarily bolted, of sweet odor, reasonably bright in color, yellowish, not brown or reddish, free from excessive lint, and shall contain not less than 36 per cent of protein. It must be designated and sold according to its protein content. Cottonseed meal with 36 per cent of protein must be termed "36 per cent Protein Cottonseed Meal, Prime Quality", and higher grades similarly designated e.g. "43 per cent Protein Cottonseed Meal, Prime Quality", etc. (Adopted prior to 1928).

50. *...Per Cent Protein Cottonseed Meal, Off Quality.* Cottonseed meal not fulfilling the above requirement as to color, odor and texture must be graded "36 per cent Protein Cottonseed Meal, Off Quality", and higher grades similarly designated. (Adopted prior to 1928).

51. *Cottonseed Feed* is a mixture of cottonseed meal and cottonseed hulls, containing less than 36 per cent of protein. (Adopted prior to 1928).

52. *...Per Cent Protein Whole Pressed Cottonseed, Prime Quality,* is the product resulting from subjecting the whole, sound, mature, clean undecorticated cottonseed to pressure for the extraction of oil, and includes the entire cottonseed less the oil extracted and the lint removed. It must be designated and sold according to its protein content. (Adopted 1932).

53. *...Per Cent Protein Ground Whole Pressed Cottonseed, Prime Quality,* is whole pressed cottonseed, ground. It must be designated and sold according to its protein content. (Adopted 1932).

GARBAGE

54. *Processed Garbage* is composed of dried animal and vegetable waste from garbage collected sufficiently often that harmful decomposition has not set in, and separated from material such as crockery and glass. Its odor must not be suggestive of the presence of decomposition and it must contain less than one per cent of glass. None of it shall contain knife-like or needle-like particles, and the maximum percentage of glass should be stated on the label when present in excess of one-fifth of one per cent. (Adopted prior to 1928).

IVORY NUT PRODUCTS

55. *Ivory Nut Meal* is the ground waste material resulting from the manufacture of buttons and similar articles from the vegetable ivory nut. (Adopted prior to 1928).

LINSEED AND FLAX PRODUCTS

56. *...Per Cent Protein Linseed Cake or Linseed Meal* is the product obtained in the removal of the oil from flaxseed; provided that the final product contains less than 6 per cent of weed seeds and other foreign materials; and provided, further, that no portion of the stated 6 per cent of weed seeds and other foreign materials shall be deliberately added. It shall not contain more than 0.5 per cent of acid insoluble ash. (Adopted 1933).

57. *...Per Cent Protein Old Process Oil Meal or ... Per Cent Protein Old Process Linseed Meal* is oil meal as defined below, produced by crushing, cooking and hydraulic pressure. (Adopted prior to 1928).

58. *...Per Cent Protein New Process Oil Meal or ... Per Cent Protein New Process Linseed Meal* is oil meal as defined below, produced by crushing, heating and the use of solvents. (Adopted prior to 1928).

59. *Flax Plant By-Product* is that portion of the flax plant remaining after the separation of the seed, the bast fiber and a portion of the shives, and consists of flax shives, flax pods, broken and immature flax seeds, and the cortical tissues of the stem. (Adopted prior to 1928).

60. *Ground Flaxseed or Flaxseed Meal* is the product obtained by grinding flaxseed which has been screened and cleaned of weed seeds and other foreign materials by the most improved commercial process; the final product must contain less than 4 per cent of weed seeds and other foreign materials, and no portion of the stated 4 per cent of weed seeds and other foreign materials shall be intentionally added. (Adopted prior to 1928).

61. *Unscreened Flaxseed Oil Feed Cake* is the product obtained by extraction of part of the oil from unscreened flaxseed by crushing, cooking and hydraulic pressure, or by crushing, heating and the use of solvents. The ingredients must be stated as "partially extracted flaxseed and foreign seeds (wheat, wild buckwheat, pigeon grass, wild mustard, etc.)." (Adopted prior to 1928).

62. *Ground Unscreened Flaxseed Oil Feed* is the ground unscreened flaxseed oil feed cake. (Adopted prior to 1928).

63. *Screenings Oil Feed* is the ground product obtained after extraction of part of the oil by crushing, cooking and hydraulic pressure, or by crushing, heating and the use of solvents from the smaller imperfect flaxseed, weed seeds and other foreign materials having feeding value, separated in cleaning flaxseed. The name of the grain from which the screenings are separated must be prefixed to "screenings oil feed." (Adopted prior to 1928).

64. *...Per Cent Protein Oil Cake* is the product obtained after the extraction of part of the oil by crushing, cooking, and hydraulic pressure, or by crushing, heating and the use of solvents, from flaxseed which have been screened and cleaned of weed seeds and other foreign materials by the most improved commercial process. When used alone the term "Oil Cake" shall be understood to designate linseed cake as defined. When used to cover any other products the name of the seed from which it is obtained must be prefixed to the words "Oil Cake." (Adopted prior to 1928).

65. *...Per Cent Protein Oil Meal or ... Per Cent Protein Ground Oil Cake* is oil cake ground to a meal. (Adopted prior to 1928).

MARINE PRODUCTS

66. *Fish Meal* (Feeding) is clean, dried, ground tissues of undecomposed whole fish and/or fish cuttings with or without the extraction of part of the oil, and contains not more than 3 per cent of salt (NaCl). If it contains more than 3 per cent of salt (NaCl) the amount of salt must constitute a part of the brand name, provided that in no case shall the salt content of this product exceed 7 per cent. (Adopted 1933).

67. *Fish Residue Meal* (Feeding) is the clean, dried, undecomposed residue from the manufacture of glue from non-oily fish, and contains not more than 3 per cent of salt (NaCl). If it contains more than 3 per cent of salt (NaCl) the amount of salt must constitute a part of the brand name, provided that in no case shall the salt content of this product exceed 7 per cent. (Adopted 1933).

68. *Crab Meal* (Feeding) is prepared from the undecomposed dried waste of the crab industry and contains the shell, viscera and part or all of the flesh. It contains not less than 25 per cent of protein and not more than 3 per cent of salt (NaCl). If it contains more than 3 per cent of salt (NaCl) the amount of salt must constitute a part of the brand name, provided that in no case shall the salt content of this product exceed 7 per cent. (Adopted 1933).

69. *Shrimp Meal* (Feeding) is prepared from the undecomposed dried waste of the shrimp industry and contains the heads, hull and/or the whole shrimp and not more than 3 per cent of salt (NaCl). If it contains more than 3 per cent of salt (NaCl) the amount of salt must constitute a part of the brand name, provided that in no case shall the salt content of this product exceed 7 per cent. (Adopted 1933).

70. *Whale Meal* (Feeding) is prepared from the clean, dried undecomposed flesh of the whale, after part of the oil has been extracted. It contains not more than 3 per cent of salt (NaCl). If it contains more than 3 per cent of salt (NaCl) the amount of salt must constitute a part of the brand name, provided that in no case shall the salt content of this product exceed 7 per cent. (Adopted 1933).

71. *Cod Liver Oil* is the product obtained by extraction of part of the oil from cod livers. (Adopted 1932).

72. *Sardine Oil or Pilchard Oil* is the product obtained by extraction of part of the oil from the whole Pacific sardine or pilchard or from cannery refuse of this species of fish. (Adopted 1932).

73. *Salmon Oil* is the product obtained by extraction of part of the oil from the cannery refuse of salmon. (Adopted 1932).

74. *Tuna Oil* is the product obtained by extraction of part of the oil from the cannery refuse of tuna. (Adopted 1932).

75. *Menhaden Oil* is the product obtained by extraction of part of the oil from whole Menhaden. (Adopted 1932).

76. *Herring Oil* is the product obtained by extraction of part of the oil from the whole herring or part of the herring. (Adopted 1933).

77. *Salmon Liver Oil* is the product obtained by extraction of part of the oil from Salmon livers. (Adopted 1933).

MILK PRODUCTS

78. *Dried Buttermilk* (Feeding) is the product resulting from the removal of water from clean, sound buttermilk derived from natural cream to which no foreign substances have been added, excepting such as are necessary and permitted in the manufacture of butter. It contains not more than 8 per cent of moisture, not more than 13 per cent of mineral matter (ash), and not less than 5 per cent of butterfat, as determined by the Roese-Gottlieb method. (Adopted 1932).

79. *Evaporated Buttermilk* (Feeding), *Concentrated Buttermilk* (Feeding) or *Condensed Buttermilk* (Feeding) is the product resulting from the removal of a considerable portion of water from clean, sound buttermilk derived from natural cream to which no foreign substances have been added excepting such as are permitted and necessary in the manufacture of butter. It contains not less than 27 per cent of total solids, not less than 2 per cent of butterfat, and not more than .14 per cent of ash for each per cent of solids. This definition does not prohibit the use of a distinctive trade name, provided it is followed by one of the names given. (Adopted prior to 1928).

80. *Dried Skimmed Milk* (Feeding) is the product resulting from the removal of water from clean, sound skimmed milk. It contains not more than 8 per cent of moisture. (Adopted 1930).

81. *Dried Soured Skimmed Milk* (Feeding) is the product resulting from the removal of water from clean, sound skimmed milk which has been soured by a suitable culture of lactic bacteria. It contains not more than 8 per cent of moisture. (Adopted 1932).

82. *Evaporated Soured Skimmed Milk* (Feeding), *Concentrated Soured Skimmed Milk* (Feeding) or *Condensed Soured Skimmed Milk* (Feeding) is the product resulting from the removal of a considerable portion of water from clean, sound skimmed milk which has been soured by a suitable culture of lactic bacteria. It contains not less than 27 per cent of total solids. (Adopted 1932).

83. *Condensed Skimmed Milk* (Feeding) is the product resulting from the removal of a considerable portion of water from clean, sound skimmed milk. It contains not less than 27 per cent of total solids. (Adopted 1930).

84. *Milk Sugar Feed or Dried Whey* (Feeding) is the by-product from the manufacture of cheese and should contain at least 70 per cent of lactose (milk sugar). (Adopted 1932).

MINERAL FEEDS

85. Mixed feeds containing both feed and more than 5 per cent of mineral ingredients require, in addition to the usual declaration of the chemical feed analysis, a declaration of each ingredient contained therein and the minimum percentages of lime expressed as (CaO), phosphoric acid expressed as (P_2O_5), iodine (I), and the maximum percentage of salt (NaCl) if same be present. If minerals predominate in the mixture, the usual declaration of the chemical feed analysis, with the exception of protein, may be omitted.

In mineral feeds containing no organic ingredient, the usual chemical feed guarantee need not be made. A declaration should be made of each ingredient contained therein and the minimum percentage of lime expressed as (CaO), phosphoric acid expressed as (P_2O_5), iodine (I), and the maximum percentage of salt (NaCl) if same be present.

The mineral ingredients should be stated in the common English terms, if any such terms exist.

It being impossible to classify separately the drug ingredients and the mineral ingredients, be it resolved:

(a) That all mixtures containing mineral ingredients generally regarded as dietary factors essential for the normal nutrition of animals and which are sold or represented for the primary purpose of supplying these minerals as additions to rations in which these same mineral factors may be deficient, be classified as mineral feeds.

(b) That all other preparations which are sold or represented primarily for the cure, mitigation or prevention of disease be classified by this Association as drugs, medicines or specifics. (Adopted prior to 1928).

OAT PRODUCTS

86. *Oat Hulls* is the product consisting of the outer covering of the oat. (Adopted prior to 1928).

87. *Oat Middlings* is the product consisting of the floury portions of the oat groat obtained in the milling of rolled oats. (Adopted prior to 1928).

88. *Oat Shorts* is the product consisting of the covering of the oat grain lying immediately inside the hull, being a fuzzy material carrying with it considerable portions of the fine floury part of the groat obtained in the milling of rolled oats. (Adopted prior to 1928).

89. *Oat Chop, Ground Oats, Pulverized Oats, Crushed Oats, or Crimped Oats* consists of the entire product made by chopping, cutting, grinding, crushing, or crimping whole oats. (Adopted 1931).

90. *Oat Groats* are the kernels produced from cleaned and dried oats in the process of manufacturing oat meal. (Adopted 1931).

91. *Hulled Oats, or Undried Oat Groats* are the kernels produced from the undried grain in the process of hulling oats. (Adopted 1931).

92. *Oat Meal, or Ground Oat Groats* is the product produced by cutting, cracking or grinding oat groats. (Adopted 1931).

93. *Rolled Oat Groats or Rolled Oats* is the product obtained in the process of rolling oat groats. (Adopted 1931).

94. *Clipped Oat By-Products* is the by-product obtained in the manufacture of clipped oats. It may contain the light chaffy material broken from the end of the hulls, empty hulls, light immature oats and dust. It must not contain an excessive amount of oat hulls. (Adopted prior to 1928).

95. *Oat Mill Feed* (Oat Hulls, Oat Shorts and Oat Middlings) is the entire by-product in the manufacture of oat groats and consists of oat hulls, oat shorts and oat middlings. If used in a mixed feed, it shall be called Oat Mill Feed (Oat Hulls, Oat Shorts and Oat Middlings). (Adopted 1932).

PALM PRODUCTS

96. *Palm Kernel Oil Meal* is the ground residue from the extraction of part of the oil by pressure or solvents from the kernel of the fruit of Elaeis guineensis or Elaeis molanococco. (Adopted prior to 1928).

PEANUT PRODUCTS

97. ...*Per Cent Protein Peanut Oil Cake* is the residue after the extraction of part of the oil by pressure or solvents from peanut kernels. (Adopted prior to 1928).

98. ...*Per Cent Protein Peanut Oil Meal* is ground peanut oil cake. (Adopted prior to 1928).

99. *Unhulled Peanut Oil Feed* is the ground residue obtained after extraction of part of the oil from whole peanuts, and the ingredients must be designated as *Peanut Meal and Hulls*. (Adopted prior to 1928).

RICE PRODUCTS

100. *Rice Bran* is the pericarp or bran layer of the rice, with only such quantity of hull fragments as is unavoidable in the regular milling of rice. (Adopted prior to 1928).

101. *Rice Hulls* is the product consisting of the outer coverings of the rice. (Adopted prior to 1928).

102. *Rice Polish* is the finely powdered material obtained in polishing the kernel. (Adopted prior to 1928).

103. *Rice Meal* is ground brown rice or ground rice after the hull has been removed. (Adopted prior to 1928).

104. *Ground Rough Rice* is ground rice from which the hull has not been removed or ground paddy rice. (Adopted prior to 1928).

105. *Rice Stone Bran* is the siftings from the materials secured in removing hulls from rice and contains rice germs, broken rice and some rice hulls. (Adopted prior to 1928).

106. *Rice Huller Bran* is a product secured by the huller and cones from brown rice and consists mostly of the bran and germs. (Adopted prior to 1928).

RYE PRODUCTS

107. *Rye Bran* is the coarse outer covering of the rye kernel as separated from the cleaned and scoured rye. (Adopted prior to 1928).

108. *Rye Feed* is a by-product obtained in the usual process of the milling of rye flour from cleaned and scoured rye grain, consisting principally of the mill-run of the outer covering of the rye grain and the germ with small quantities of flour and aleurone. (Adopted prior to 1928).

109. *Rye Red Dog* is a by-product obtained in the usual process of the milling of rye flour, consisting principally of aleurone with small quantities of flour and fine bran particles and must not contain more than 3.5 per cent of crude fiber. (Adopted prior to 1928).

110. *Rye Low-Grade Feed Flour* consists principally of dark rye flour and small quantities of aleurone and fine bran particles and must not contain more than 1.5 per cent of crude fiber. (Adopted prior to 1928).

111. *Rye Middlings* consists of rye feed and rye red dog combined in the proportions obtained in the usual process of milling rye flour. (Adopted prior to 1928).

112. *Rye Flour Middlings* consist of rye feed, rye red dog and pure dark rye flour combined in the proportions obtained in the milling of rye flour and must not contain more than 5 per cent of crude fiber. (Adopted prior to 1928).

SORGHUM PRODUCTS

113. *Head Chops* is the product consisting of the entire heads of the grain sorghums chopped, and should bear the name of the sorghum from which it is made. This includes, among others, kaffir head chops, milo head chops, feterita head chops, and sorghum head chops. (Adopted prior to 1928).

114. *Head Stems* is the product consisting of the stems from the heads of the grain sorghums after the grain has been removed, and should bear the name of the sorghum from which it is made. (Adopted prior to 1928).

SOYBEAN PRODUCTS

115. *Ground Soybeans* is the product obtained by grinding whole soybeans without cooking or removing any of the oil. (Adopted 1933).

116. ...*Per Cent Protein Soybean Oil Cake* or *Soybean Oil Chips* is the product obtained by crushing, cooking and removing part of the oil from soybeans. (Adopted 1933).

117. ...*Per Cent Protein Soybean Oil Meal* is ground soybean oil cake or ground soybean oil chips. (Adopted 1933).

VELVET BEAN PRODUCTS

118. *Velvet Bean Meal* is ground velvet beans containing only an unavoidable trace of hulls or pods. (Adopted prior to 1928).

119. *Ground Velvet Bean and Pod* is the product derived by grinding velvet beans with the pod. It contains no additional pods or other materials. (Adopted prior to 1928).

WHEAT PRODUCTS

120. *Wheat Bran* is the coarse outer covering of the wheat kernel as separated from cleaned and scoured wheat in the usual process of commercial milling. (Adopted prior to 1928).

121. *Standard Middlings* consists mostly of fine particles of bran, germ, and very little of the fibrous offal obtained from the "tail of the mill." This product must be obtained in the usual commercial process of milling and must not contain more than 9.5 per cent of crude fiber. (Adopted prior to 1928).

122. *Flour Middlings* shall consist of standard middlings and red dog flour combined in the proportions obtained in the usual process of milling and must not contain more than 6.0 per cent of crude fiber. (Adopted prior to 1928).

123. *Wheat Red Dog* is a by-product obtained in the usual commercial process of flour milling, consisting principally of aleurone with small quantities of flour and fine bran particles and must not contain more than 4.0 per cent of crude fiber. (Adopted prior to 1928).

124. *Wheat Low-Grade Feed Flour* is a by-product obtained in the usual commercial process of flour milling, consisting principally of flour with small quantities of aleurone and fine bran particles and must not contain more than 1.5 per cent of crude fiber. (Adopted prior to 1928).

125. *Wheat Bran and Standard Middlings* consists of the two commodities as defined above, mixed in the proportions obtained in the usual process of commercial milling. (Adopted prior to 1928).

126. *Hard Wheat Mixed Feed* (mill-run wheat feed) consists of pure wheat bran and flour middlings combined in the proportions obtained in the usual process of commercial milling. This product must not contain more than 9.5 per cent of crude fiber. (Adopted prior to 1928).

127. *Brown Shorts* (Red Shorts) consists mostly of the fine particles of bran, germ and very little of the fibrous offal obtained from the "tail of the mill." This product must be obtained in the usual commercial process of milling and must not contain more than 7.5 per cent of crude fiber. (Adopted prior to 1928).

128. *Gray Shorts* (Gray Middlings or Total Shorts) consists of the fine particles of the outer bran, the inner bran or bee-wing bran, the germ and the offal or fibrous materials obtained from the "tail of the mill." This product must be obtained in the usual process of commercial milling and must not contain more than 6.0 per cent of crude fiber. (Adopted prior to 1928).

129. *White Shorts or White Middlings* consists of a small portion of the fine bran particles and the germ and a large portion of the fibrous offal obtained from the "tail of the mill." This product must be obtained in the usual process of flour milling and must not contain more than 3.5 per cent of crude fiber. (Adopted prior to 1928).

130. *Wheat Mixed Feed* (Mill-run wheat feed) consists of pure wheat bran and the gray or total shorts combined in the proportions obtained in the usual process of commercial milling. This product must not contain more than 8.5 per cent of crude fiber. (Adopted prior to 1928).

131. *Screenings* consists of the smaller imperfect grains, weed seeds, and other foreign materials, having feed value, separated in cleaning the grain. (Adopted prior to 1928).

132. *Scouring* consists of such portions of the cuticle, brush, white caps, dust, smut and other materials as are separated from the grain in the usual commercial process of scouring. (Adopted prior to 1928).

NOTE: If to any of the wheat or rye by-product feeds there should be added screenings or scourings—as above defined, either ground or unground, bolted or unbolted, such brand shall be so registered, labeled and sold as clearly to indicate this fact. The word "Screenings" or "Scourings", as the case may be, shall appear as part of the name or brand and shall be printed in the same size and face of type as the remainder of the brand name. When the word "Screenings" appears it is not necessary to show also on the label the word "Scourings." (Adopted prior to 1928).

REGISTRATIONS

For the period January 1, 1933 to December 31, 1934

One hundred and eighty-eight firms and individuals registered 1,022 brands of feeding stuffs. As required by Statute these registrations are listed as follows:

Acme-Evans Co., Indianapolis, Ind.
Acme Hominy Feed

Albers Bros. Milling Co., Seattle, Wash.
Calf Manna

Alfalfa Products Co., 832—7th St., San Francisco, Calif.
Alfalfa Leaf Meal

Allied Mills, Inc., Chicago, Ill.
Amco 20% Dairy Ration
Amco 24% Dairy Ration
Amco 20% National Dairy Ration
Amco 16½% Sucrene Dairy Ration
Amco 32% Supplement Dairy Ration
Amco 12% Fitting Ration
Arab Horse Feed
Brewers' Dried Grains
Emergency Hog Feed
Empire Egg Mash
Empire 20% Dairy Ration
Empire 24% Dairy Ration
June Pasture
Pure Corn and Oats Provender
Red Feather Egg Mash
Red Feather Scratch Feed
Screened Cracked Corn
Wayne All Mash Chick Starter
Wayne All Mash Chick Starter with Cod Liver Oil and Sardine Oil
Wayne All Mash Grower
Wayne All Mash Grower with Cod Liver Oil and Sardine Oil
Wayne Broiler Ration
Wayne Calf Meal
Wayne Chick Feed
Wayne Egg Mash
Wayne Egg Mash with Cod Liver Oil and Sardine Oil
Wayne Intermediate Scratch Feed
Wayne 26% Mash Supplement
Wayne Pig Meal

Allied Mills, Inc., Chicago, Ill.—*(Continued)*
Wayne Poultry Fattener
Wayne Scratch Feed
Wayne Starter and Grower
Wayne Supreme Horse Feed
Wayne Turkey Mash
Wayne 25% Turkey Starting Mash

American Maize-Products Co., 100 E. 42nd St., New York City
Cream of Corn Gluten Feed

Anchor Mills, Hagerstown, Md.
Zip Egg Mash

Anheuser-Busch, Inc., St. Louis, Mo.
Anheuser-Busch Corn Gluten Feed

Arcady Farms Milling Co., 223 W. Jackson Blvd., Chicago, Ill.
Advanced Registry Dairy Feed
Arcady All Mash Chick Starter & Grower
Arcady Besbet Growing Mash
Arcady Besbet Laying Mash
Arcady Besbet Starting Mash
Arcady Open Formula Production Ration
Arcady 24% Open Formula Production Ration
Arcady Scratch Grains
Arcady Stock Feed
Economy Egg Mash
Milkers Ready Ration
Old Colony Feed
Producer's 20% Ready Ration
Riverside Scratch Grains
Wonder Horse & Mule Feed

Archer-Daniels-Midland Co., Minneapolis, Minn.
Midland Linseed Meal and Flaxseed Screenings Oilfeed (30%)
Pure Old Process Linseed Meal (32%)
Pure Old Process Linseed Meal (34%)
Pure Old Process Linseed Meal (37%)
Pure Old Process Soybean Oil Meal

Ashcraft-Wilkinson Co., Atlanta, Ga.
Helmet Brand—Prime Cottonseed Meal
Monarch Brand—Prime Cottonseed Meal
Paramount Brand—Prime Cottonseed Meal

E. W. Bailey & Co., Montpelier, Vt.
Bailey's 16% Dairy Ration
Bailey's Fitting Ration
Capital Dairy Ration
Capital Mixed Feed
Favorite Dairy Ration
Our 20% Special Dairy Ration
Pennant Brand Chick Starter
Pennant Brand Coarse Chick Feed
Pennant Brand Fine Chick Feed
Pennant Brand Growing Feed
Pennant Brand Laying Mash
Pennant Brand Laying Mash (with Cod Liver Meal)
Pennant Scratch Feed

E. W. Bailey & Co., Montpelier, Vt.—*(Continued)*
Pennant Brand Stock Feed
Pennant Horse Feed
Pennant Mixed Feed
Sweetened Bailey's 16% Dairy Ration
Sweetened Bailey's Fitting Ration
Sweetened Capital Dairy Ration
Sweetened Favorite Dairy Ration
Sweetened with Molasses Pennant

The Beacon Milling Co., Inc., Cayuga, N. Y.
Auburn Dairy Feed
Beacon Breeders Mash with Buttermilk
Beacon Broiler Feed
Beacon Calf Meal
Beacon's Cayuga Developer Feed
Beacon's Cayuga Growing Mash
Beacon's Cayuga Horse Feed
Beacon's Cayuga Laying Mash with Buttermilk
Beacon's Cayuga Scratch Feed
Beacon Chick Feed
Beacon Complete Starting Ration
Beacon Dairy Ration
Beacon Egg Mash with Buttermilk
Beacon Fitting Ration
Beacon Fleshing Mash and Crate Fattener
Beacon Growing Mash
Beacon Horse Feed
Beacon Pheasant-Quail Starter and Grower Mash
Beacon Scratch Grains
Beacon Special Coccidiosis Mash
Beacon Special Scratch Grains
Beacon Sweet '20'
Beacon Sweet '24'
Beacon Turkey Growing Feed
Beacon Turkey Starter
Beacon '20'
Cayuga Stock Feed
Corn and Oats Chop

Bisbee Linseed Co., Broad & Chestnut Sts., Philadelphia, Pa.
Bisbee Brand Pure Old Process Linseed Meal

Black Rock Milling Corp., Buffalo, N. Y.
Bidwell Dry-Mash
Bidwell 20% Dairy Ration
Bidwell 24% Dairy Ration
Bidwell Scratch Feed
Paramount 20% Dairy Ration

Blatchford Calf Meal Co., Waukegan, Ill.
Blatchford's Calf Meal

Blatz Brewing Co., Milwaukee, Wis.
Blatz Brewers Dried Grains

Borden Sales Co., Inc., 350 Madison Ave., New York City.
Borden's Anilac

Amos D. Bridge's Sons, Inc., Hazardville, Conn.
Success Dairy Ration

L. Broder Grain Store, Colchester, Conn.
L. B. Milk Ration

C. Buckingham & Co., Inc., Southport, Conn.
C. B. Dairy
C. B. 20% Dairy
C. B. Egg Mash
C. B. Growing Mash
C. B. Scratch
C. B. Starter

C. E. Buell, Inc., 6 Beacon St., Boston, Mass.
"Buell-Boston" Dried Skim Milk

C. W. Burckhalter, Inc., 177 Franklin St., New York City.
Burck Brand Dried Buttermilk
Burck Brand Powdered Skim Milk

Cairo Meal & Cake Co., Cairo, Ill.
"Miss Cairo" Brand 41% Cottonseed Meal

Caledonia Mills, Inc., St. Johnsbury, Vt.
Brooks' Fancy Mixed Feed

C. W. Campbell Co., Westerly, R. I.
Camco Horse Feed
Campbell Fitting Ration
Egg-O Chick Feed
Egg-O Chick Starter
Egg-O Growing Feed
Egg-O Intermediate
Egg-O Laying Mash
Egg-O Scratch
Egg-O Turkey Grower
Milky Ration
No-Botheration Dairy
Provender
Xtra Vim Molasses Horse Feed

A. B. Caple Co., Toledo, Ohio.
Alfalfa Meal

Center Milk Products Co., Middlebury Center, Pa.
Vita Brand Dried Skim Milk

The Chapman-Doake Co., Decatur, Ill.
Hominy Feed

Clinton Corn Syrup Refining Co., Clinton, Iowa.
Clinton Corn Gluten Feed

Herbert K. Clofine, 509 Bulletin Bldg., Philadelphia, Pa.
Supreme Brand Poultry Feed

Clyde Renco Milling Corp., Clyde, N. Y.
"Renco Scratch Feed"

Coles Co., Middletown, Conn.
Capital 20% Molasses Dairy Feed
Fortune Chick Starter
Fortune Egg Mash with Dried Buttermilk
Fortune Growing Feed with Cod Liver Oil
Fortune Intermediate Scratch
Fortune Scratch Feed
Selco 24% Molasses Dairy Feed

Collis Products Co., St. Paul, Minn.
Collis Process Dried Buttermilk

Commander-Larabee Corp., Minneapolis, Minn.
Sunfed Red Dog
Sunfed Wheat Bran with ground screenings not exceeding mill run
Sunfed Wheat Standard Middlings with ground screenings not exceeding mill run

G. E. Conkey Co., Cleveland, Ohio.
Conkey's All Grain Horse & Mule Feed (with Linseed Meal, Molasses & Salt)
Conkey's All Mash Chick Ration with Y-O
Conkey's Dairy Feed 24% Protein
Conkey's Gecco Chick Grains
Conkey's Gecco Dairy Feed 20% Protein
Conkey's Gecco Egg Mash
Conkey's Gecco Egg Mash with Y-O
Conkey's Gecco Growing Grains
Conkey's Gecco Growing Mash
Conkey's Gecco Growing Mash with Buttermilk and Y-O
Conkey's Gecco Scratch Grains
Conkey's Geccofat Station Fattener
Conkey's Scratch Grains
Conkey's (The Original) Starting Feed with Buttermilk and Y-O
Superior Scratch Grains

Connecticut Fat Rendering & Fertilizer Corp., West Haven, Conn.
Meat Scrap 45%

Consolidated Rendering Co., 178 Atlantic Ave., Boston, Mass.
Corenco Bone Meal, an All Animal Feed for Cattle, Hogs and Poultry
Corenco Cod & Haddock Meal
Corenco 45% Meat and Bone Scrap
Corenco 50% Meat Scrap
Corenco 55% Meat Scrap
Corenco 60% Meat Scrap

Consumers Food Stores, Inc., 478 Water St., Bridgeport, Conn.
Gold Bond "All-Mash" Starter
Gold Bond Baby Chick Feed
Gold Bond 16% Dairy Feed
Gold Bond 20% Dairy Feed
Gold Bond 24% Dairy Feed
Gold Bond Egg Mash
Gold Bond Growing Mash
Gold Bond Horse Feed

Consumers Food Stores, Inc., 478 Water St., Bridgeport, Conn.—*(Continued)*
Gold Bond Intermediate Chick Feed
Gold Bond Scratch Feed

Consumers Import Co., Inc., 115 Broad St., New York City.
Cico Bone Meal

Corn Products Sales Co. of Corn Products Mfg. Co., 17 Battery Place, New York City.
Buffalo Corn Gluten Feed
Diamond Corn Gluten Meal

E. A. Cowee Co., Fitchburg, Mass.
Coweco Growing Mash
Coweco Laying Mash
Coweco 20% Ration
Coweco Scratch Feed

C. A. Cowles, Inc., Plantsville, Conn.
C. A. Blue Seal Mash
Cowles 20% Dairy Ration
Cowles 24% Dairy Ration
Cowles Molasses Horse Feed

Chas. M. Cox Co., Boston, Mass.
Lake Woods Wheat Bran
Ogilvie's Wheat Bran (Manufactured by Ogilvie Flour Mills Co., Ltd., Montreal, Canada)
Ogilvie's Wheat Shorts (Manufactured by Ogilvie Flour Mills Co., Ltd., Montreal, Canada)

Crosby Milling Co., Brattleboro, Vt.
Crosby's Scratch Feed
Crosby's Stock Feed

P. Cutler, Inc., Colchester, Conn.
Prosperity Dairy Ration
Prosperity Economy Dairy Ration
Prosperity Laying Mash
Prosperity Scratch Feed
Prosperity Special Dairy Feed
Prosperity Stock Feed

Dairymen's League Co-operative Assoc., Inc., 11 West 42nd St., New York City.
Dairylea Choice Feed Grade Dried Skim Milk

R. G. Davis & Sons, Inc., New Haven, Conn.
Basic Dairy Ration
Davis Buttermilk Mash
Davis Horse Feed
Davis No. 1 Provender
Davis Scratch Feed
Davis Stock Feed
20% Open Formula

Decatur Milling Co., Inc., Decatur, Ill.
Homco

Delaware Mills, Inc., Deposit, N. Y.
Delaware All Mash Chick Starter
Delaware Chick Grains
Delaware Chick Starting-Mash (with Dried Buttermilk)
Delaware Dairy Feed
Delaware Growing Mash (with Dried Skim Milk)
Delaware 85% Horse Feed
Delaware Intermediate Chick Grains
Delaware Scratch Grains
Delaware Stock Feed
Delaware Sweet 24% Dairy Feed
Delco Sweet 20% Dairy Feed
Double Circle Scratch Grains
Indian Growing Mash (with Dried Skim Milk)
Indian Laying Mash (with Dried Skim Milk)

The Denver Alfalfa Milling & Products Co., Lamar, Colo.
Alfalfa Meal
Alfalfa Leaf Meal

Dietrich & Gambrill, Inc., Frederick, Md.
D. & G. Dairy Feed
Frederick Growing Mash
Frederick Laying Mash
Frederick Stock Feed
Gambrill's Chick Feed
Gambrill's Chick Starter
Gambrill's Growing Mash
Gambrill's Horse Feed
Gambrill's Laying Mash
Gambrill's Scratch Feed
Pen Mar Dairy Feed

Duluth-Superior Milling Co., Minneapolis, Minn.
Duluth Imperial Wheat Bran with ground screenings
Wheat Standard Middlings with ground screenings not exceeding mill run

Eagle Roller Mill Co., New Ulm, Minn.
Eagle Pure Wheat Bran
Eagle Wheat Standard Middlings with ground screenings not exceeding mill run

Eastern States Farmers' Exchange, Springfield, Mass.
Eastern States Combination Mash
Eastern States Controller Mash
Eastern States Developer Mash
Eastern States Developer Mash with Oil
Eastern States Fitting Ration
Eastern States Fulpail Dairy Ration
Eastern States Highland 12
Eastern States Highland 16
Eastern States Highland 20
Eastern States Horse and Calf Ration
Eastern States Intermediate Scratch Grains
Eastern States Milkmore Dairy Ration
Eastern States Producer Mash
Eastern States Producer Mash with Oil
Eastern States Scratch Grains with Coarse Cracked Corn
Eastern States Sixteen Dairy Ration
Eastern States Starting and Broiler Ration with Oil

Eastern States Farmers' Exchange, Springfield, Mass.—*(Continued)*
Eastern States Turkey-Fat
Eastern States Turkey-Grow
Eastern States Turkey-Start

B. A. Eckhart Milling Co., 1300 Carroll Ave., Chicago, Ill.
Pure Wheat Bran
Standard Wheat Middlings and Screenings not exceeding mill run

Elmore Milling Co., Inc., Oneonta, N. Y.
Elmore Chick Feed
Elmore Chixsaver
Elmore Complete Broiler Ration
Elmore Complete Starting and Growing Ration
Elmore Eggmaker
Elmore Egg Mash
Elmore Growing Mash
Elmore Horse Feed with Molasses
Elmore Intermediate Chick Feed
Elmore Milk Grains
Elmore Milk Grains Junior
Elmore Scratch Feed
Elmore Stock Feed
Elmore's Sugared Feedall
Elmore's 32% Supplemental Dairy Ration
Elmore's Sweet Digesto Dairy Feed
Elmore "Three Point" Calf Meal
Elmore-Waldorf Formula
Elmore's "Xtragood" Wheat Feed with ground screenings not exceeding mill run
Granger 20% Dairy Ration
Granger 24% Dairy Ration
R-Own Egg Mash

John W. Eshelman & Sons, Lancaster, Pa.
Certified 20% Dairy Ration
Eshelman Certified 24% Dairy Ration
Eshelman Challenge Dairy Feed
Eshelman Choice Mixed Wheat Feed
Eshelman Conestoga 20 Dairy Feed
Eshelman Conestoga Horse Feed
Eshelman Dried Beet Pulp
Eshelman Garden Spot Horse Feed
Eshelman Golden Rod 25 Dairy Feed
Eshelman Lancaster 20 Dairy Feed
Eshelman Lancaster 60 Horse Feed
Eshelman Lancaster Scratch Grains
Eshelman Liberty Horse Feed
Eshelman Open Formula 20 Dairy Feed
Eshelman Pennsy Chick Grains
Eshelman Pennsy 16 Dairy Feed
Eshelman Pennsy Laying Mash
Eshelman Pennsy Scratch Grains
Eshelman Red Rose Alfalfa Meal
Eshelman Red Rose All Mash Starter
Eshelman Red Rose Calf Starter
Eshelman Red Rose Chick Grains
Eshelman Red Rose Chick Starter
Eshelman Red Rose 24 Dairy Feed
Eshelman Red Rose Fattening Mash

John W. Eshelman & Sons, Lancaster, Pa.—*(Continued)*
Eshelman Red Rose Growing Mash
Eshelman Red Rose Growing Mash—Cod Liver Oil
Eshelman Red Rose Hog Meal
Eshelman Red Rose 85 Horse Feed
Eshelman Red Rose Laying Mash
Eshelman Red Rose Laying Mash with Cod Liver Oil
Eshelman Red Rose Pure Ground Corn and Oats
Eshelman Red Rose Scratch Grains
Eshelman Red Rose Stock Feed
Eshelman Red Rose Turkey Mash
Eshelman Red Rose Wheat Flour Middlings with screenings not exceeding mill run
Eshelman SOS Feed
Eshelman Steam Cooked Horse Feed
Eshelman Wheat Red Dog with screenings not exceeding mill run

Evans Milling Co., Indianapolis, Ind.
Emco Hominy Feed
Evans 41% Soybean Cake Meal

Excelsior Milling Co., Minneapolis, Minn.
Pure Camel Fancy Wheat Feed

The Fairchild Milling Co., Cleveland, Ohio.
Wheat Bran with ground screenings not exceeding mill run
Wheat Standard Middlings with ground screenings not exceeding mill run

The Fairmont Creamery Co., Omaha, Neb.
Fairmont's Better Pure Flake Buttermilk

Farmers Feed Co., 532 E. 76th St., New York City.
"Bull Brand" Dried Brewers Grains
Dried Brewers Grains with Molasses "Bull Brand"

Faroll Brothers, 50 Broadway, New York City.
Wheat Standard Bran (with ground screenings not exceeding mill run)
Wheat Standard Middlings

Fernando Valley Milling & Supply Co., Los Angeles, Calif.
Fernando Alfalfa Meal, Fine Ground
Fernando Alfalfa Stock Meal
Fernando Ideal Greens, Suncured

First National Stores, Inc., 5 Middlesex Ave., Somerville, Mass.
Henfield Egg Mash
Henfield Scratch Grains

Flory Milling Co., Inc., Bangor, Pa.
Blue Mountain Horse Feed
Corn Feed Meal
Flory's All-Mash Chick Starter
Flory's All-Mash Growing Ration
Flory's Baby Chick Feed
Flory's Egg Mash
Flory's Growing Mash with Cod Liver Oil
Flory's Horse Feed
Flory's Intermediate Chick Feed
Flory's Stock Feed

Flory Milling Co., Inc., Bangor, Pa.—*(Continued)*
Golden Egg Laying Mash
Golden Egg Laying Mash with Cod Liver Oil
Golden Egg Scratch Feed
Ground Corn and Oats
Record Dairy Feed
Reddog Flour
Sunray Dairy Feed
Sunray Laying Mash
Sunray Scratch Feed

A. W. Forbes, East Haven, Conn.
R-Own Dairy Ration
R-Own Laying Mash
R-Own Scratch Feed

Forbes Bros.—Central Mills, Inc., Topeka, Kansas.
Hominy Feed

J. A. Forrest, 819 Security Bldg., Minneapolis, Minn.
Alpine Ground Feeding Oatmeal
Lake Woods Wheat Shorts
Pioneer Pure Wheat Bran

J. B. Garland & Son, Worcester, Mass.
Garland's Economy 20% Dairy Ration with Cane Molasses
Garland's Growing Mash with Dried Milk
Garland's Poultry Mash with Dried Milk
Royal Worcester Complete Ration with Cane Molasses
Royal Worcester Scratch Feed

General Commodity Corp., 409 Chamber of Commerce Bldg., Buffalo, N. Y.
"Bison" Dried Skimmilk
Old Sol Dried Buttermilk
Old Sol Dried Skimmilk

General Mills, Inc., Minneapolis, Minn.
Eventually Gold Medal Chick Feed—No Grit
Eventually Gold Medal Chick Ration
Eventually Gold Medal Dairy Ration
Eventually Gold Medal Developing Feed—No Grit
Eventually Gold Medal Egg Mash for Breeding and Laying with Dried Buttermilk
Eventually Gold Medal Growing Mash—with Dried Buttermilk
Eventually Gold Medal Scratch Feed—No Grit
Washburn's Gold Medal Fancy Mixed Feed
Washburn's Gold Medal Hard Wheat Bran and Wheat Screenings
Washburn's Gold Medal Hard Wheat Flour Middlings and Wheat Screenings
Washburn's Gold Medal Hard Wheat Standard Middlings and Wheat Screenings
Washburn's Gold Medal Pure Hard Wheat Adrian Red Dog

Gorton-Pew Fisheries Co., Ltd., Gloucester, Mass.
Gorton's Codfish Meal

D. H. Grandin Milling Co., Jamestown, N. Y.
Grandin's Baby Chick Feed
Grandin's Baby Chick Starter with Buttermilk—Cod Liver Oil

D. H. Grandin Milling Co., Jamestown, N. Y.—*(Continued)*
Grandin's 24% Balanced Dairy Ration
Grandin's Combined Chick and Broiler Ration
Grandin's Complete Starting Ration with Buttermilk—Cod Liver Oil
Grandin's 32% Dairy Feed
Grandin's Growing Mash with Buttermilk
Grandin's Growing Mash with Buttermilk—Cod Liver Oil
Grandin's Intermediate Chick Feed
Grandin's Laying Mash with Buttermilk
Grandin's Laying Mash with Buttermilk—Cod Liver Oil
Grandin's Milk Maker
Grandin's Poultry Green Food
Grandin's Screened Scratch Feed
Grandin's Stock Food
Grandin's Sweetened 20% Dairy Feed
Grandin's Sweetened Horse Feed
Grandin's 12 Twin Six 12 Dairy Feed
M-S (Money Saver) 20% Sweet Dairy Feed
M-S (Money Saver) 24% Sweet Dairy Feed

Grand Union Co., 233 Broadway, New York City.
Peerless All Mash Chick Starter & Grower
Peerless Chick Grains
Peerless Laying Mash
Peerless Scratch Grains

Great Atlantic & Pacific Tea Co., 1104 Hodgson Bldg., Minneapolis, Minn.
Daily Egg Mash Feed
Daily Egg Scratch Feed
Daily Growth Chick Starter
Daily Growth Fine Chick Feed
Daily Growth Growing Mash
Milky Way Dairy Feed 20%

Hales & Hunter Co., 166 West Jackson Blvd., Chicago, Ill.
College Horse Feed
H. & H. White Stock Feed
Red Comb Broiler Mash with Dried Buttermilk
Red Comb Chick Starter with Dried Buttermilk
Red Comb Coarse Chick
Red Comb Crate Fattener with Rolled Oats
Red Comb Egg Mash with Dried Buttermilk
Red Comb Fine Chick
Red Comb Growing Mash with Dried Buttermilk
Red Comb Scratch Feed
Red Horn 20% Dairy Feed

Frank B. Ham & Co., Ltd., Royal Bank Bldg., Toronto, Canada.
"Hamco" Wheat Bran
"Hamco" Wheat Shorts

J. B. Ham Co., Auburn, Maine.
Farmer Boy All Mash Starter and Grower with Dried Skim Milk and Cod Liver Oil
Farmer Boy Chick Scratch Feed
Farmer Boy 18% Dairy Ration with Molasses
Farmer Boy 20% Dairy Ration with Molasses
Farmer Boy 24% Dairy Ration with Molasses
Farmer Boy Egg Mash with Dried Skim Milk and Cod Liver Oil
Farmer Boy Growing Mash with Dried Skim Milk and Cod Liver Oil

J. B. Ham Co., Auburn, Maine.—*(Continued)*
Farmer Boy Horse Feed
Farmer Boy Intermediate Scratch Feed
Farmer Boy Scratch Feed
Farmer Boy Starting Mash with Dried Skim Milk and Cod Liver Oil
Farmer Boy Stock Feed

William Hamilton & Son, Inc., Caledonia, N. Y.
Standard Wheat Bran with ground screenings not exceeding mill run
Standard Wheat Middlings

Dwight Hamlin Co., Pittsburgh, Pa.
Hamlin's Dried Brewers Grains

Hecker H-O Company, Inc., Buffalo, N. Y.
Oat Mill Feed

Hecker-Jones-Jewell Milling Div. of Standard Milling Co., 503 Seneca St., Buffalo, N. Y.
Choice Wheat Bran with ground screenings not exceeding mill run
Wheat Red Dog
Wheat Standard Middlings with ground screenings not exceeding mill run

Hirst & Begley Linseed Works, 2013 Mendel St., Chicago, Ill.
Pure Old Process Linseed Meal

Hoosier Condensed Milk Co., Bluffton, Ind.
Mil-Ko-Lac

Humphreys-Godwin Co., Memphis, Tenn.
Bull Brand 43% Protein Prime Cottonseed Meal
Dixie Brand 41% Protein Prime Cottonseed Meal

Imperial Grain & Milling Co., Toledo, Ohio.
Imperial Steam Cooked Feed

International Milling Co., Minneapolis, Minn.
Blackhawk Pure Wheat Bran
Blackhawk Wheat Red Dog
Blackhawk Wheat Standard Middlings with ground screenings not exceeding mill run

Jersee Co., Minneapolis, Minn.
Just Right Egg Mash

Jones & Quinn, Inc., Produce Exchange, New York City.
Wheat Bran (Product of Argentine) with wheat screenings
Wheat Standard Middlings (Product of Argentine) with wheat screenings

The Kansas Flour Mills Corp., Kansas City, Mo.
Big Flake Pure Wheat Bran

Spencer Kellogg & Sons, Inc., Buffalo, N. Y.
Diamond K Linseed Meal with Flaxseed Screenings Oil Feed 30% Protein
Kellogg's 34% Protein Pure Old Process Linseed Meal
Kellogg's 37% Protein Pure Old Process Linseed Meal

Kellogg Co., Battle Creek, Mich.
White Hominy Feed

Kelloggs & Miller, Inc., Amsterdam, N. Y.
"K & M" Brand Pure Old Process Linseed Oil Meal

H. H. King Flour Mills Co., Minneapolis, Minn.
"Gold Mine" Feed

King Midas Mill Co., Minneapolis, Minn.
Snowball Wheat Flour Middlings and ground wheat screenings
Wheat Standard Middlings and ground wheat screenings

Chas. A. Krause Milling Co., Milwaukee, Wisconsin.
Badger White Hominy Feed

H. P. Kysor Feed & Grain Co., New Haven, Conn.
Kysor's A-1 20% Dairy Ration
Kysor's A-1 Growing Mash
Kysor's A-1 Horse Feed
Kysor's A-1 Laying Mash
Kysor's A-1 Scratch Grains
Kysor's A-1 Self Starter Ration

A. S. Labieniec, Kensington, Conn.
Reliable 20% Dairy Feed
Reliable 24% Dairy Feed
Reliable Laying Mash

The Laden Bros., Co., Inc., 109-115 S. Colony St., Wallingford, Conn.
Laden's Baby Chick Starter
Laden's Dairy Feed
Laden's Growing Mash
Laden's Laying Mash
Laden's Starter and Broiler Ration

Lake County Oil Mill, Tiptonville, Tenn.
Prime 41% Cottonseed Meal

J. T. Lampman & Co., Claverack, N. Y.
Red Mills, Rye Feed

The Larabee Flour Mills Co., Kansas City, Mo.
"Sunfed" Pure Winter Wheat Bran
"Sunfed" Winter Wheat Bran with ground wheat screenings not to exceed mill run or 8%

The Larrowe Milling Co., Box 68, North End Station, Detroit, Mich.
Dried Beet Pulp
Dried Molasses-Beet Pulp
41% Protein Cottonseed Meal Prime Quality
Larro Broiler Feed
Larro Calf Meal
Larro Chick Grains
Larro Chick Starter
Larro Egg Mash
Larro Growing Grains
Larro Growing Mash

The Larrowe Milling Co.,Box 68, North End Station, Detroit, Mich.—*(Continued)*
Larro Poultry Fattening Feed
Larro Pork-Maker
Larro—the Ready Ration for Dairy Cows
Larro Scratch Grains
Larro Turkey and Game Bird Adult Mash
Larro Turkey Grower

Libner Grain Co., Inc., 27 Commerce St., Norwalk, Conn.
Libner's Blue Ribbon Chick Starter
Libner's Blue Ribbon Growing Mash
Libner's Blue Ribbon Milk Egg Mash
12% Libner's Blue Ribbon Fitting Ration
20% Libner's Blue Ribbon Dairy Ration
24% Libner's Blue Ribbon Dairy Ration

Lincoln Farm Products Corp., New York City.
Farm Brand Meat and Bone Scrap

The C. W. Lines Co., New Britain, Conn.
Homestead Dry Mash
Homestead Scratch Feed
Mill Pride Dairy Ration
Mill Pride Fancy Scratch Feed
Mill Pride Milk Mash

Litchfield County Co-operative Assoc., Torrington, Conn.
Common Sense Dairy
Common Sense Growing Mash
Common Sense Laying Mash
Common Sense Scratch

Long Hill Feed Store, Long Hill, Conn.
Square Deal Buttermilk Laying Mash
Square Deal Dairy Ration

L. B. Lovitt & Co., Memphis, Tenn.
"Lovit Brand" 41% Cottonseed Meal
"Lovit Brand" 43% Cottonseed Meal

Maine Fish Meal Co., Portland, Maine.
Maine Sardine Fish Meal

E. Manchester & Sons, Winsted, Conn.
Huntington Red Star Egg Mash
Red Star Egg Mash
Red Star Flour Middlings
Red Star Mixed Feed
Red Star Scratch Feed
Red Star Special Dairy Feed
Sweet Sixteen Red Star Dairy Feed

The Mann Bros., Co., Buffalo, N. Y.
The Mann Bros. Co. 37% Protein Pure Old Process Linseed Meal

Maritime Milling Co., Inc., Buffalo, N. Y.
B-B Daisy All Mash Starter and Growing Feed Vitamized with Cod Liver Oil, Milk Sugar Feed, Dried Buttermilk
B-B Daisy Chick Feed

Maritime Milling Co., Inc., Buffalo, N. Y.—*(Continued)*
B-B Daisy Egg Mash with Dried Buttermilk
B-B Daisy Egg Mash Vitamized with Cod Liver Oil and Dried Buttermilk
B-B Daisy Scratch Feed
B-B Dealer's Mixing Feed with Molasses
B-B Egg Red-E-Mixt Mash with Dried Buttermilk
B-B Hi-Test Dairy Feed 20% Protein, Sweetened
B-B Hi-Test Dairy Feed 24% Protein, Sweetened
B-B Marmico 16% Protein Dairy Feed with Molasses
Bull Brand All Mash Broiler Growing Ration Vitamized with Cod Liver Oil, Milk Sugar Feed, Dried Buttermilk
Bull Brand All Mash Chick Starter Ration Vitamized with Cod Liver Oil, Milk Sugar Feed, Dried Buttermilk
Bull Brand Breeders' Laying Mash Vitamized with Cod Liver Oil, Milk Sugar Feed, Dried Buttermilk
Bull Brand Calf Meal
Bull Brand Chick Feed
Bull Brand Fitting Ration
Bull Brand Horse Feed with Alfalfa and Molasses
Bull Brand Laying Mash with Milk Sugar Feed and Dried Buttermilk
Bull Brand Scratch Feed
Dollar Maker Egg Mash
Dollar Maker Egg Mash Vitamized with Cod Liver Oil
Sweetened Bull Brand "20" Dairy Ration
Sweetened Bull Brand "24" Dairy Ration
Sweetened Dollar Maker 20% Protein Dairy Feed
Sweetened Dollar Maker 24% Protein Dairy Feed

Meader Milling Co., Inc., Hoboken, N. J.
Purifine Linseed Oil Meal

Meech & Stoddard, Inc., Drawer 700, Middletown, Conn.
Red Wing 20% Dairy Ration
Red Wing Mixed Feed
Red Wing Molasses Horse Feed
Red Wing Special Buttermilk Chick Starting Feed
Red Wing Special Buttermilk Growing Feed
Red Wing Special Buttermilk Laying Mash
Red Wing Special Chick Feed
Red Wing Special 24% Dairy Ration
Red Wing Special Intermediate Chick Feed
Red Wing Special Scratch Feed
Red Wing Special Stock Feed

Miller Cereal Mills, Omaha, Neb.
Hominy Feed

Miner-Hillard Milling Co., Wilkes-Barre, Pa.
No. 1 Scratch Feed
Rye Middlings
"1795" Steam Cooked Corn and Oats
Steam Cooked Hominy Feed
Wheat Bran with screenings not exceeding mill run
Wheat Middlings with screenings not exceeding mill run

Monti-Van Iderstine, Inc., 272 Hudson Ave., Brooklyn, N. Y.
Movan

Geo. Q. Moon & Co., Inc., Binghamton, N. Y.
Moon's Baby Chick Grains
Moon's 20% Dairy Feed with Molasses
Moon's 24% Dairy Ration
Moon's Developing Grains
Moon's Fresh Ground Mixed Feed with ground screenings not to exceed mill run
Moon's Fresh Ground White Middlings
Moon's Growing Mash
Moon's Horse Feed with Molasses
Moon's Laying Mash with Dried Buttermilk
Moon's Special A Scratch Feed
Moon's Stock Feed
Moon's Wheat Bran with ground screenings not to exceed mill run
Moon's White Hominy Feed
Old Times Horse Feed
Special A Dairy 20% Ration

Fred C. Morse & Son, Guilford, Conn.
Old Mill 20% Dairy Feed
Old Mill Dairy Feed 24%
Old Mill Fitting Feed
Old Mill Growing Mash
Old Mill Horse Feed
Old Mill Laying Mash with Milk and Oil
Old Mill Laying Mash with Skim Milk
Old Mill Provender
Old Mill Scratch Feed
Old Mill Starting Mash

Jas. F. Morse & Co., Somerville, Mass.
Morse's Meat Scrap

Moseley & Motley Milling Co., Rochester, N. Y.
Big B Wheat Bran
Big B Wheat Middlings with ground screenings not exceeding mill run

National Milling Co., Toledo, Ohio.
Namico Wheat Middlings with ground screenings not exceeding mill run
Pure Wheat Bran (Extra Broad)

New Orleans Export Co., Ltd., New Orleans, La.
Prime Cottonseed Meal 41%

Niagara Falls Milling Co., Lockport, N. Y.
Niagara Choice Wheat Bran
Niagara Standard Wheat Midds with ground screenings not exceeding mill run

Northern Oats Co., 1201 Jackson St., N.E., Minneapolis, Minn.
Go-Fer Brand Feeding Oatmeal

North Western Consolidated Milling Div. of Standard Milling Co., Minneapolis, Minn.
Planet Feed
Pure Wheat Bran
Wheat Flour Middlings and ground wheat screenings
Wheat Mixed Feed
Wheat Standard Middlings and ground wheat screenings
XXX Comet

Norwalk Grain Co., 48 Main St., Norwalk, Conn.
Favorite Egg Mash with Milk
Favorite Scratch

Nowak Milling Corp., Hammond, Ind.
Domino Chick Pel-ets
Domino Egg Pel-ets
Domino Growing Mash with Buttermilk
Domino Growing Pel-ets
Domino Laying Mash with Buttermilk
Domino Scratch Feed
Export Scratch Feed
Fidelity Scratch Feed

P. Fred'k Obrecht & Son, Baltimore, Md.
Egg-O-Milk

Ontario Milling Co., Inc., Oswego, N. Y.
Aunt Mary's Chick Starting Mash with Cod Liver Oil
Aunt Mary's Laying Mash
Aunt Mary's Laying Mash with Cod Liver Oil
Aunt Mary's Scratch Feed
Big Value 20% Dairy Feed with Molasses
Butterfat Dairy Feed with Molasses
Onto Horse Feed with Molasses
Oswego 20% Dairy Feed with Molasses
Oswego 24% Dairy Feed with Molasses
Oswego Laying Mash
Oswego Scratch Feed
Uncle John's 24% Cream Pot Ration

S. V. Osborn Estate, Branford, Conn.
Osborn Provender
Osborn Scratch

Park & Pollard Co., Buffalo, N. Y.
All-In-One Starting Feed
Bet-R-Milk 20% Ration
Claco Dairy Ration
Corn and Oats 1/2 and 1/2
Fawthrop's Special 20% Dairy Ration
(Manufactured for Walter Fawthrop, Cromwell, Conn.)
Feed Meal
Go-Tu-It Pig & Hog Ration
Growing Feed
Growing Feed with Cod Liver Oil
Herdhelth 16% Ration
Holcomb's Milk Egg Mash
(Manufactured for R. H. Holcomb & Co., Newtown, Conn.)
Holcomb's Sweetened 20% Dairy Ration
(Manufactured for R. H. Holcomb & Co., Newtown, Conn.)
Intermediate Chick Feed
Lay or Bust Dry-Mash
Lay or Bust Dry-Mash with Cod Liver Oil
Milkade Calf Meal
Milk-Maid 24% Sweetened Dairy Ration
Overall 24% Dairy Ration
Park & Pollard Breeder Mash
Park & Pollard Broiler Ration
Park & Pollard Chick Scratch

Park & Pollard Co., Buffalo, N. Y.—*(Continued)*
- Park & Pollard Chick Starter
- Park & Pollard Fitting Ration
- Park & Pollard Heavy Wheat Mixed Feed
- Park & Pollard Horse Feed
- Park & Pollard Stock Feed
- Park & Pollard Turkey Grower
- Park & Pollard Turkey Starter
- Red Ribbon Chick Feed
- Red Ribbon Scratch Feed
- Top Notch 16% Ration
- Yankee Dairy Ration

The Patent Cereals Co., Geneva, N. Y.
- Hominy Feed

Pecos Valley Alfalfa Mill Co., Hagerman, New Mexico.
- Alfalfa Meal
- Alfalfa Stem Meal
- Peevee Alfalfa Leaf Meal

Penick & Ford Ltd., Inc., Cedar Rapids, Iowa.
- Douglas Corn Gluten Feed
- Douglas Corn Gluten Meal

Perkins Oil Co., Inc., Memphis, Tenn.
- Goldenrod Brand Cottonseed Meal 41%

Pillsbury Flour Mills Co., Minneapolis, Minn.
- Pillsbury's Fancy Mixed Feed and Screenings
- Pillsbury's Hard Wheat Bran and Screenings
- Pillsbury's Hard Wheat A. Middlings and Screenings
- Pillsbury's Hard Wheat Standard B. Middlings and Screenings
- Pillsbury's Rye Middlings and Screenings
- Pillsbury's Wheat Bran and Screenings
- Pillsbury's XX Daisy

Maurice Pincoffs Co., Houston, Texas.
- Pinco Cottonseed Meal 41%
- Pinco Cottonseed Meal 43%

The Frank S. Platt Co., 450 State St., New Haven, Conn.
- Platco Laying Mash
- Platco Perfection Grain Mixture

Postum Co., Inc., Battle Creek, Mich.
- Burt's Hominy Feed

Pratt Food Co., Buffalo, N. Y.
- Pratt's Baby Chick Food
- Pratt's Chick Scratch Feed
- Pratt's Growing Mash with Buttermilk
- Pratt's Intermediate Scratch Feed
- Pratt's Laying Mash with Buttermilk
- Pratt's Utility Horse Feed
- Pratt's White Hominy Feed

H. C. Puffer Co., 194 Lyman St., Springfield, Mass.
- Egg-Em-On Growing Feed
- Egg-Em-On Laying Mash
- Egg-Em-On Scratch Grains
- Sweetened Producer Dairy Feed
- 20% Producer Dairy Feed
- 24% Producer Dairy Feed

The Quaker Oats Co., 141 W. Jackson Blvd., Chicago, Ill.
- Banner Feed
- Barley Feed
- Bell Cow Bran with ground screenings not exceeding mill run
- Bell Cow Shorts with ground screenings not exceeding mill run
- Big Egg Scratch Grains No Grit
- Buckeye Feed
- Early Bird Coarse Chick Feed
- Early Bird Fine Chick Feed No Grit
- Quaker Ful-O-Pep Chick Starter
- Quaker Ful-O-Pep Coarse Chick Feed
- Quaker Ful-O-Pep Egg Mash
- Quaker Ful-O-Pep Fine Chick Feed
- Quaker Ful-O-Pep Growing Mash
- Quaker Ful-O-Pep Scratch Grains
- Quaker Ful-O-Pep Station Grade Fattening Feed
- Quaker Green Cross Horse Feed
- Quaker 16% Protein Dairy Ration
- Quaker 20% Protein Dairy Ration
- Quaker 24% Protein Dairy Ration
- Quaker Schumacher Feed
- Quaker Sugared Schumacher Feed
- Schumacher Calf Meal
- Sugared Vim Feed
- Vim Feed
- White Hominy Feed
- Yellow Hominy Feed

Ralston Purina Co., St. Louis, Mo.
- Corn Feed Meal
- Corn and Oat Provender
- Dried Beet Pulp
- Fine Ground Poultry Alfalfa Meal
- Protena 16% Dairy Feed
- Protena 20% Dairy Feed
- Protena 24% Dairy Feed (Buffalo Mill)
- Protena Scratch Feed (Buffalo Mill)
- Protena Sweet Roughage Feed (Buffalo Mill)
- Purina All Mash Egg Chowder
- Purina All Mash Growena Chow
- Purina All Mash Startena Chow
- Purina Breeder Egg Chowder
- Purina Broiler Chow
- Purina Bulky Cow Chow
- Purina Bulky Las Chow (Buffalo Mill)
- Purina Bulky Omolene Chow
- Purina Calf Chow
- Purina Checkerboard Rolled Oats (Steam Cooked)
- Purina Chick Chow
- Purina Chicken Fatena Chow
- Purina Chick Growena Chow
- Purina Chick Growena Chow (with Cod Liver Oil)

Ralston Purina Co., St. Louis, Mo.—*(Continued)*
Purina Chick Startena Chow
Purina 20% Cow Chow
Purina 24% Cow Chow
Purina 32% Chowder
Purina Egg Chowder
Purina Egg Chowder (with Cod Liver Oil)
Purina Fitting Chow
Purina Hen Chow
Purina Hog Fatena Chow
Purina Intermediate Hen Chow
Purina Lay Chow
Purina Lay Chow (with Cod Liver Oil)
Purina Lay Chow (with Cod Liver Oil and Dried Buttermilk)
Purina Omolene Chow
Purina Steer Fatena Chow
Purina Turkey Growing and Fattening Chow
Purina Turkey Startena Chow

John Reardon & Sons Co., 51 Waverly St., Cambridge, Mass.
Register Brand Meat and Bone Scraps 45%
Register Brand Meat Scraps 55%
Register Brand Cod and Haddock Fish Meal

James Richardson & Sons, Ltd., Board of Trade Bldg., Montreal, Canada.
Richardson Pure Wheat Bran

Robin Hood Mills, Ltd., Moose Jaw & Calgary, Canada.
Blackhawk Standard Middlings with ground screenings not exceeding mill run
Superior Wheat Bran
Superior Wheat Reddog

Ronck & Bevis Co., 940 N. Front St., Philadelphia, Pa.
Ro-Be Fish Meal

Rotex Milling Co., Cleveland, Ohio.
Rotex Egg Mash
Rotex Starting and Growing Mash

Sigmond Rothschild Co., Houston, Texas.
41% Protein Cottonseed Meal

Russell-Miller Milling Co., Minneapolis, Minn.
Alta Hard Wheat Middlings
Hard Wheat Occident Bran
Hard Wheat Occident Flour Middlings
Hard Wheat Occident Mixed Feed
Hard Wheat Occident Standard Middlings

Seymour Grain & Coal Co., Seymour, Conn.
18 Dairy Ration
Miracle Chick Feed
Miracle Chick Grower
Miracle Chick Starter
Miracle Cow Feed
Miracle Fitting Ration
Miracle Laying Mash with Skim Milk
Miracle Molasses Horse Feed

Seymour Grain & Coal Co., Seymour, Conn.—*(Continued)*
Miracle Scratch Feed
See More Milk Dairy Feed

J. C. Shaffer Grain Co., 406 Merchants Exchg. Bldg., St. Louis, Mo.
Shafco Wheat Bran with Screenings

Sheffield Farms Co., Inc., 524 W. 57th St., New York City.
Sheffield Skim Milk Powder

Shelton Feed Co., 73 Bridge St., Shelton, Conn.
Nelson Mixed Chicken Feed

The Sherwin-Williams Co., 101 Prospect Ave., N.W., Cleveland, Ohio.
Sherwin Williams Company Old Process Linseed Meal 32%
Sherwin Williams Pure Old Process Linseed Meal 34%

Southland Cotton Oil Co., Paris, Texas.
Southland's 41 Cottonseed Meal

Ike Sovitsky, Ansonia, Conn.
Ansonia Baby Chick Starter with Buttermilk and Cod Liver Oil
Ansonia 20% Sweetened Dairy Feed
Ansonia Egg Mash with Buttermilk and Cod Liver Oil
Ansonia Scratch Feed
Ansonia Stock Feed
Connecticut State Open Formula Dairy Ration

Soya Products, Inc., Chicago, Ill.
Soybean Oil Meal
Super Soy

Sparks Milling Co., Alton, Ill.
Try Me Wheat Bran

A. E. Staley Mfg. Co., Decatur, Ill.
Staley's Corn Gluten Feed
Staley's Soybean Oil Meal

D. A. Stickell & Sons, Inc., 67 West Baltimore St., Hagerstown, Md.
Mixed Wheat Feed
Snap Scratch Grains
Stickell's Certified 20% Ration
Stickell's Intermediate Chick Feed
Stickell's Poultry Fatner
Su-Pur Growing Mash
Su-Pur Horse and Calf Feed
Two in One Scratch Grains
Victor Scratch Grains

St. Albans Grain Co., St. Albans, Vt.
Corn Distillers' Dried Grains
Hygrade Fitting Ration
Hygrade Pure Cod and Haddock Fish Meal
Hygrade 16 Sweetened Milk Ration
Hygrade 20 Sweetened Milk Ration
Hygrade 24 Sweetened Milk Ration
Mornin' Call Poultry Grains

St. Albans Grain Co., St. Albans, Vt.—*(Continued)*
Paragon Dairy Feed
Paragon Hominy Feed
Pure Dried Skim Milk Powder
Utility Dairy Ration
Utility Pasture Ration
Wirthmore All-Purpose Chick and Broiler Ration
Wirthmore Baby Chick Scratch
Wirthmore Baby Chick Starter, a Complete Balanced Feed for the First Six Weeks containing Fortified Cod Liver Oil
Wirthmore 25 Balanced Ration Sweetened
Wirthmore Breeder Mash
Wirthmore Calf Meal
Wirthmore Complete Growing Ration
Wirthmore Complete Ration for Layers
Wirthmore 16 Dairy Ration Sweetened
Wirthmore 20 Dairy Feed Sweetened
Wirthmore Dairy Feed with Beet Pulp Sweetened
Wirthmore 14 Fitting Ration
Wirthmore Flour Middlings
Wirthmore Fleshing and Fattening Mash
Wirthmore Fodder Greens
Wirthmore Growing Mash
Wirthmore Growing Mash (containing Fortified Cod Liver Oil)
Wirthmore Horse Feed
Wirthmore Intermediate Scratch Feed
Wirthmore Laying Mash
Wirthmore Laying Mash (containing Fortified Cod Liver Oil)
Wirthmore Pig and Hog, a Growing and Fattening Feed
Wirthmore Scratch Feed
Wirthmore Stock Feed
Wirthmore Turkey Breeder Ration
Wirthmore Turkey Fattening Ration
Wirthmore Turkey Growing Ration
Wirthmore Turkey Starting Ration
Wirthmore Wheat Feed

St. Lawrence Flour Mills Co., Ltd., Montreal, Canada.
Bran

Chas. M. Struven Co., Baltimore, Md.
Struven's Fish Meal

Syracuse Milling Co., Syracuse, N. Y.
Onondaga Dairy Feed Sweetened
Onondaga Scratch Grains
Syragold Chick Starter
Syragold Dairy Feed
Syragold Dairy Feed, Sweetened
Syragold Egg Mash
Syragold Feed Meal
Syragold Flour Middlings with Mill Run Screenings
Syragold Ground Corn and Oat Feed
Syragold Growing Mash
Syragold Horse Feed with Molasses
Syragold Laying Mash with Buttermilk
Syragold Laying Mash with Buttermilk and Cod Liver Meal
Syragold Milk Ration
Syragold Milk Ration, Sweetened
Syragold Scratch Grains
Syragold Stock Feed

Thomaston Supply Co., Thomaston, Conn.
Thomaston Dairy Ration
Thomaston Egg Mash
Thomaston Growing Mash
Thomaston Scratch

Tioga-Empire Feed Mills, Inc., Waverly, N. Y.
Broilertine
Chicatine
Chicatine with Cod Liver Oil Added
Derby-E-Gee Chick Grains
Derby E-Gee Scratch Feed
Derby Ground Corn and Oats
Ducatine
Egatine
Egatine with Cod Liver Oil Added
E-Gee Dairy Feed
Neverfail Horse Feed
Or-Co Feed
Red Brand Tioga Dairy Feed
Tioga Calf Food
Tioga Chick and Growing Mash
Tioga Chick and Growing Mash with Cod Liver Oil Added
Tioga Growing Shoat Feed
Tioga Laying Food
Tioga Laying Food with Cod Liver Oil Added
Tioga-Neverfail Chick Grains
Tioga-Neverfail Growing Grains
Tioga-Neverfail Poultry Grain

Traders Feed & Grain Co., Inc., 736 Chamber of Commerce Bldg., Buffalo, N. Y.
Bonny Hard Wheat Bran and Screenings
Maple Leaf Pure Wheat Bran
(Manufactured by Maple Leaf Milling Co., Ltd., Toronto, Canada)
Rex Wheat Middlings and Screenings
(Manufactured by Maple Leaf Milling Co., Ltd., Toronto, Canada)

Transit Milling Co., Galveston, Texas.
Texas Bull Brand Cottonseed Meal 41%
Texas Bull Brand Cottonseed Meal 43%
Tranco Brand 41% Cottonseed Meal

Jacob Trinley & Sons, Linfield, Pa.
Corn Feed Meal
Favorite 20% Dairy Ration
Favorite Horse Feed
Favorite Laying Mash
Favorite Scratch Grains
Mixing Special
Real Chick Starter
Real Fattening Mash with Buttermilk
Real Growing Mash
Real Laying Mash
Real Scratch Grains
Real Stock Feed
Supreme 85% Horse Feed
Trinley's 16% Dairy Feed
Trinley's 24% Dairy Feed

Union Starch & Refining Co., Columbus, Ind.
Union Corn Gluten Feed

United Cooperative Farmers, Inc., Fitchburg, Mass.
United Farmers Milk Egg Mash
United Farmers Milkmaker
United Farmers Starting and Growing Mash

United Mills Co., Inc., Grafton, Ohio.
U.M.C. Wheat Middlings with ground screenings not exceeding mill run

Upper Hudson Rye Flour Mills, Inc., 7 Madison St., Troy, N. Y.
Upper Hudson Rye Feed

Van Iderstine Co., Long Island City, N. Y.
Vico Quality Meat and Bone Scrap for Poultry
Vico Quality Meatine for Poultry

Victor Flour Mills, Inc., Pittsford, N. Y.
Victor Spring Wheat Bran with ground screenings
Victor Spring Wheat Middlings with ground screenings

Ward Dry Milk Co., St. Paul, Minn.
Ward's Pure Dried Buttermilk
Ward's Pure Dried Skim Milk

Watertown Co-operative Assoc., Watertown, Conn.
Sterling Scratch Feed

Wayne County Grangers Feed Corp., Clyde, N. Y.
Clyde 20% Dairy Feed
Galen 24% Dairy Feed
Grange Scratch Feed
Hy-Yan-Ka Farms 20% Dairy Feed with Beet Pulp
Milkproducer 24% Dairy Feed
Superior Chick Starter with Buttermilk and Cod Liver Oil
Superior 20% Dairy Feed
Sweetened 16% Dairy Feed
Superior Laying Mash with Buttermilk and Cod Liver Oil
Universal Horse Feed

F. S. Wertz & Son, Reading, Pa.
Faramel Horse Feed
Reading Egg Mash
Special 24 Dairy Feed

West-Nesbitt, Inc., Oneonta, N. Y.
All Pure 20% Milk Ration
Connecticut State Formula Mash
Pure Feed Dairy Ration
Pure Feed Egg Mash
Pure Feed Egg Mash with Buttermilk
Pure Feed Horse Ration
Pure Feed Scratch Grains
Pure Feed Starting and Growing Mash
Super Pure Feed Dairy Ration
Super Pure Sweetfeed Dairy Ration

Wolf's Feed Store, Shelton, Conn.
Wolf's 20% Dairy Ration
Wolf's Egg Mash
Wolf's Scratch Feed

Worcester Rendering Co., Auburn, Mass.
P. W. Fish Meal

Yantic Grain & Products Co., Norwich, Conn.
All in All Egg Ration
Al-Mo
Big (Y) All-In-All Growing Ration
Big (Y) Chick Grain
Big (Y) Chick Starter with Cod Liver Oil
Big (Y) Complete Broiler and Chick Ration
Big (Y) Dairy, 16%
Big (Y) Dairy, 20%
Big (Y) Dairy, 24%
Big (Y) Fitting Ration
Big (Y) Flour Middlings
Big (Y) Growing Feed with Cod Liver Meal and Dried Milk
Big (Y) Horse Feed
Big (Y) Intermediate Chick Feed
Big (Y) Laying Mash
Big (Y) Laying Mash with Dried Milk and Cod Liver Meal
Big (Y) Laying Mash with Buttermilk and Cod Liver Oil
Big (Y) Mixed Feed
Big (Y) Scratch Feed
Big (Y) Stock Feed
Big (Y) Sugared Oat Feed
Big (Y) Sugared Stock Feed
Big (Y) Turkey Growing
Big (Y) Turkey Starter
Calico Girl Scratch Feed
Columbia Dairy Feed
Columbia Laying Mash with Dried Milk and Cod Liver Meal
Columbia Scratch Feed
Economy Pasture Ration
O. F. D. Ration, 20%
O. F. D. Ration, 24%
Uncas Scratch Feed

Young Bros., Co., Inc., Danielson, Conn.
Dried Skim Milk

INSPECTION

For the year 1933 a total of 1,299 samples of feeding stuffs and related materials have been examined. They are classified as follows:

Concentrated feed stuffs	815
Miscellaneous feeds examined for individuals	76
Feeds examined for poisons, etc.	3
Pasture grass samples and other fodder materials from Storrs' station	385
Check samples, cottonseed meal and feed	20
Total	1299

Samples submitted by the Storrs Agricultural station are not discussed in this report.

Analyses of official samples are given in Table I. Tables I*a* and I*b* show summaries of the deficiencies found in guaranteed nutrients and the distribution of the deficiencies. Deficiencies of 0.75 per cent in protein and fiber, and of 0.25 per cent in fat, are disregarded in compiling these summaries.

Of 815 official samples 95 were deficient in one or more of the guaranteed nutrients. About 88 per cent, therefore, substantially met or exceeded guaranties in all respects.

The total number of guaranties made was 2,429 and the total number of deficiencies was 108. About 96 per cent of the guaranties made were met or exceeded.

Since the present Statute concerning commercial feeding stuffs was enacted, in 1925, the experience in the matter of deficiencies as summarized above has been as follows:

Year	No. of official samples	Samples meeting guaranties %	Individual guaranties met %
1925	488	83	94
1926–7	670	83	94
1928	716	78	92
1929	646	82	94
1930	678	81	93
1931	739	88	96
1932	836	85	95
1933	815	88	96

These figures show that the proportion of samples meeting guaranties has increased notably in the past three years. The proportion of individual guaranties met has been high during the whole period but especially so since 1930.

The miscellaneous feeds examined for individuals, and the samples examined for poisons, need no special comment. In the examination of feeds submitted by purchasers for purposes of checking guaranties, the Station assumes no responsibility for the sampling.

Correction: In our report of inspection for 1932, Bulletin 351, p. 567, the guaranties given for fiber and fat in *Imperial Steam-Cooked Feed*

(Imperial Grain and Milling Co.) are reversed due to the firm's error in registering. The correct guaranties should read fiber 4.60 per cent and fat 4.00 per cent. On this guaranty, although our analysis showed 4.83 per cent of fiber, the sample would not have been classed as deficient, and the percentage shown on p. 639 of the report should therefore have been 100 instead of 67. We acknowledge our oversight in not noting the discrepancy between the tags and the registration; but our analysis report sent to the firm several months before publication of our bulletin should have served to detect the error. This is the purpose of the practice of sending preliminary reports to both purchaser and manufacturer.

TABLE I. ANALYSES OF COMMERCIAL FEEDS, INSPECTION OF 1933

Station No.	Manufacturer and brand	Retail dealer	Pounds per hundred: Water	Protein (N x 6.25): Found	Protein (N x 6.25): Guaranteed, not less than	Fiber: Found	Fiber: Guaranteed, not more than	Fat: Found	Fat: Guaranteed, not less than
	Oil Seed Products								
	Cottonseed Meal		%	%	%	%	%	%	%
2269	Ashcraft-Wilkinson Co., Atlanta, Ga. Helmet	Thomaston: Thomaston Supply Co.	7.43	41.56	41.00	9.18	10.00	6.30	5.50
3240	Ashcraft-Wilkinson Co., Atlanta, Ga. Monarch	Putnam: Dayville Grain Co.	7.35	42.63	43.00	7.70	10.00	6.28	6.00
2134	Cairo Meal & Cake Co., Cairo, Ill. Miss Cairo Brand	Amston: Amston Grain Mill	6.43	40.50	41.00	10.35	10.00	7.05	5.00
2126	Humphreys-Godwin Co., Memphis, Tenn. Bull Brand 43%	Colchester: P. Cutler, Inc.	6.68	43.25	43.00	7.88	11.00	6.70	5.00
3242	Humphreys-Godwin Co., Memphis, Tenn. Dixie Brand 41%	Norwich: A. E. Shedd	8.45	41.00	41.00	8.65	12.00	7.83	5.00
2086	Larrowe Milling Co., Detroit, Mich. 41% Prime Quality	Branford: S. V. Osborn Est.	6.15	40.56	41.00	8.53	10.00	6.63	6.00
3136	L. B. Lovitt & Co., Memphis, Tenn. "Lovit Brand" 41%	New Milford: Geo. T. Soule & Co.	8.28	40.00	41.00	9.47	10.00	5.80	6.00
3697	Maurice Pincoffs Co., Houston, Texas Pinco 41%	Rockville: Rockville Grain & Coal Co.	7.23	39.50	41.00	12.20	14.00	6.20	5.00
3761	Maurice Pincoffs Co., Houston, Texas Pinco 43%	Colchester: P. Cutler, Inc.	7.70	42.06	43.00	10.58	12.00	6.38	6.00
4125	Transit Milling Co., Galveston, Texas Texas Bull Brand 41%	Mt. Carmel: Hamden Grain Co.	7.13	42.19	41.00	11.03	11.00	6.48	5.00
3637	Transit Milling Co., Galveston, Texas Texas Bull Brand 43%	Norwalk: Libner Grain Co.	8.78	42.25	43.00	10.43	11.00	5.90	5.00
	Linseed Meal								
3487	Archer-Daniels-Midland Co., Minneapolis, Minn. Pure Old Process 32%	Plantsville: C. A. Cowles	9.40	32.06	32.00	8.05	9.00	5.49	5.00
3160	Archer-Daniels-Midland Co., Minneapolis, Minn. Pure Old Process 37%	Tariffville: Tariffville Grain Co.	9.88	38.75	37.00	6.30	9.00	4.55	4.50
3207	Bisbee Linseed Co., Chicago Heights, Ill. Bisbee Pure Old Process 34%	Thompsonville: Geo. S. Phelps & Co.	9.50	35.00	34.00	7.18	10.00	5.93	5.00
3218	Kelloggs & Miller, Inc., Amsterdam, N. Y. "K & M" Brand Pure Old Process 34%	Willimantic: Boston Grain Co.	9.20	38.50	34.00	6.75	9.00	6.15	5.00
3090	Spencer Kellogg & Sons, Inc., Buffalo, N. Y. Kellogg's 37% Pure Old Process	Colchester: P. Cutler, Inc.	9.80	39.25	37.00	6.40	10.00	5.45	4.50
3596	The Mann Bros. Co., Buffalo, N. Y. The Mann Bros. Co. 37% Pure Old Process	Southbury: Southbury Grain Co.	10.20	38.13	37.00	6.23	10.00	6.29	6.00
3600	Meader Milling Co., Hoboken, N. J. Purifine 34%	Watertown: Watertown Co-op. Asso.	9.48	33.00	34.00	7.60	8.00	4.60	5.00
2090	The Sherwin-Williams Co., Cleveland, Ohio. Sherwin-Williams Pure Old Process 34%	Branford: S. V. Osborn Est.	8.10	38.13	34.00	7.38	10.00	5.48	5.00
	Soy bean meal								
3712	Allied Mills, Inc., Chicago, Ill. Super-Soy. (Mfr's. Soya Products, Inc.)	Bristol: A. J. Bowers	8.75	40.00	37.00	5.25	6.50	5.63	5.00
2135	Archer-Daniels Midland Co., Minneapolis, Minn. Pure Old Process	Amston: Amston Grain Mill	11.18	43.56	41.00	5.30	7.00	4.45	4.50
2257	A. E. Staley Mfg. Co., Decatur, Ill. Staley's	Kensington: A. S. Labieniec	10.00	42.25	41.00	5.25	7.00	5.63	4.50

TABLE I. ANALYSES OF COMMERCIAL FEEDS, INSPECTION OF 1933—*Continued*

Station No.	Manufacturer and brand	Retail dealer	Pounds per hundred: Water	Protein (N x 6.25): Found	Protein (N x 6.25): Guaranteed, not less than	Fiber: Found	Fiber: Guaranteed, not more than	Fat: Found	Fat: Guaranteed, not less than
	Wheat Products								
	Wheat Bran		%	%	%	%	%	%	%
3062	Chas. M. Cox Co., Boston, Mass. Lakewoods	New Haven: R. G. Davis & Sons	12.70	15.81	15.00	10.98	11.50	5.30	3.50
3216	Chas. M. Cox Co., Boston, Mass. Ogilvie's	Willimantic: Boston Grain Co.	13.25	17.00	15.00	10.50	11.50	5.15	3.50
3569	Duluth Superior Milling Co., Minneapolis, Minn. Duluth Imperial	East Winsted: Leonard Grain Co.	11.60	17.44	15.00	8.68	13.00	4.63	3.75
3589	Eagle Roller Mill Co., New Ulm, Minn. Eagle Pure	Hartford: New York Feed Corp.	12.98	16.88	15.00	9.15	12.00	4.73	4.00
3738	B. A. Eckhart Milling Co., Chicago, Ill. Pure	Putnam: Dayville Grain Co.	11.53	16.50	14.00	9.05	12.00	4.30	3.50
3892	Faroll Bros., New York City. Wheat Standard	Norwich: Yantic Grain & Products Co.	9.65	16.69	13.00	10.58	13.00	3.98	4.00
2091	J. A. Forrest, Minneapolis, Minn. Pioneer Pure	Branford: S. V. Osborn Est.	11.65	16.13	15.00	10.18	11.50	5.65	3.50
3636	General Mills, Inc., Minneapolis, Minn. Washburn Gold Medal Hard Wheat Bran and Wheat Screenings	Norwalk: Libner Grain Co.	11.78	15.81	14.00	8.50	12.00	4.73	4.00
3466	Frank B. Ham & Co., Ltd., Toronto, Canada. "Hamco"	Wallingford: A. E. Hall	11.83	15.63	13.50	5.50	12.00	5.05	3.00
1918	*Hecker-Jones-Jewell Milling Co.,* Buffalo, N. Y. Choice	Plantsville: C. A. Cowles	10.78	15.81	13.50	10.28	14.00	4.88	3.50
3161	International Milling Co., Minneapolis, Minn. Black Hawk Pure	Granby: E. H. Rollins	12.38	18.00	15.00	9.60	12.00	5.20	3.20
3849	Jones & Quinn, New York City. Argentine	Southport: C. Buckingham & Co.	11.20	15.63	13.00	10.25	13.00	3.55	4.00
2232	Kansas Flour Mills Corp., Kansas City, Mo. Big Flake	Wallingford: A. E. Hall	11.45	15.25	15.00	8.98	11.00	4.30	3.50
3467	The Larabee Flour Mills Co., Kansas City, Mo. "Sunfed" Winter, with Screenings	Wallingford: A. E. Hall	12.90	16.69	15.00	9.18	11.00	4.23	3.50
3065	The Larabee Flour Mills Co., Kansas City, Mo. "Sunfed" Pure	Bridgeport: Brooklawn Feed Co.	11.75	15.25	15.00	8.62	11.00	4.58	3.50
1931	Geo. Q. Moon & Co., Inc., Binghamton, N. Y. Moon's	Stratford: Z. C. Ingersoll	11.05	15.50	15.00	7.13	10.00	3.58	3.00
3774	Moseley & Motley Milling Co., Rochester, N. Y. Big B	Westerly: C. W. Campbell Co.	10.95	16.63	13.50	9.95	13.00	5.50	3.00
3522	National Milling Co., Toledo, Ohio. Pure (Extra Broad)	Brookfield: S. A. Smith & Son	12.03	17.63	14.00	7.83	10.00	4.00	3.00
3706	Niagara Falls Milling Co., Lockport, N. Y. Niagara Choice	New Haven: Moran—Paton Co.	12.33	16.00	15.50	10.08	11.00	5.43	4.00
2301	Northwestern Consolidated Milling, Div. of Standard Milling Co., Minneapolis, Minn. Pure	Bloomfield: Bloomfield Farmers' Exchange	12.28	17.13	14.00	8.65	12.00	5.33	4.00
3510	Pillsbury Flour Mills Co., Minneapolis, Minn. Pillsbury's Hard with Screenings	Bethel: Morrison & Dunham	11.98	16.88	14.00	9.30	12.00	5.23	4.00
4141	The Quaker Oats Co., Chicago, Ill. Bell Cow	Manufacturer's sample	8.98	17.38	15.00	10.00	10.00	5.25	3.50
2101	Jas. Richardson & Sons, Ltd., Montreal, Canada. Richardson Pure	Groton: C. W. Campbell Co.	11.85	17.19	15.00	9.35	11.50	5.53	3.50
3741	Robin Hood Mills, Ltd., Moose Jaw, Canada. Superior	Danielson: Dayville Grain Co.	11.35	18.13	15.00	9.73	11.50	5.55	3.50
3584	Russell-Miller Milling Co., Minneapolis, Minn. Hard Wheat Occident	Middletown: Meech & Stoddard Inc.	12.25	17.38	14.00	8.95	11.50	5.25	4.00

TABLE I. ANALYSES OF COMMERCIAL FEEDS, INSPECTION OF 1933—*Continued*

Station No.	Manufacturer and brand	Retail dealer	Water	Protein (N x 6.25) Found	Protein (N x 6.25) Guaranteed, not less than	Fiber Found	Fiber Guaranteed, not more than	Fat Found	Fat Guaranteed, not less than
	Wheat Products—*Continued*		%	%	%	%	%	%	%
	Wheat Bran—Concluded								
3191	J. C. Shaffer Grain Co., St. Louis, Mo. Shafco with Screenings	Rockville: Rockville Grain & Coal Co.	11.83	15.38	14.50	8.10	10.00	4.85	3.50
3246	St. Lawrence Flour Mills Co., Ltd., Montreal, Canada	Danielson: Young Bros. Co.	9.95	17.31	15.00	10.10	11.50	3.55	3.50
3656	Traders Feed & Grain Co., Buffalo, N. Y. Maple Leaf Pure	Westville: Westville Grain Co.	11.40	17.00	15.00	10.35	11.50	5.38	3.50
	Wheat middlings and similar products								
3611	Commander-Larabee Co., Minneapolis, Minn. Sunfed Wheat Standard Middlings	Naugatuck: Naugatuck Grain Co.	11.25	19.25	14.50	7.25	9.50	4.60	4.00
3217	Chas. M. Cox Co., Boston, Mass. Ogilvie's Wheat Shorts	Willimantic: Boston Grain Co.	10.65	18.75	16.00	7.78	8.00	5.75	5.00
3914	Faroll Bros., New York City. Wheat Standard Middlings	Norwich: Yantic Grain & Products Co.	11.28	17.00	14.00	6.25	9.50	6.40	4.00
2092	J. A. Forrest, Minneapolis, Minn. Lakewood Wheat Shorts	Branford: S. V. Osborn Est.	11.30	18.75	16.00	7.03	8.00	6.48	5.00
3635	General Mills, Inc., Minneapolis, Minn. Washburn's Gold Medal Hard Wheat Standard Middlings and Wheat Screenings	Norwalk: Libner Grain Co.	10.58	18.19	15.00	6.13	9.50	5.15	4.00
3479	Frank B. Ham & Co., Ltd., Toronto, Canada. "Hamco" Wheat Shorts..	Wallingford: Laden Bros., Co., Inc. ..	12.45	18.94	15.00	6.48	10.50	5.93	3.50
3011	Wm. Hamilton & Son, Inc., Caledonia, N. Y. Standard Wheat Middlings	Cheshire: Center Grain Co.	11.18	17.63	16.00	4.71	8.50	4.98	4.50
3015	Hecker-Jones-Jewell Milling Co., Buffalo, N. Y. Wheat Standard Middlings	Southington: Southington Lumber Co.	10.15	19.25	15.00	7.55	9.50	5.68	4.75
3162	International Milling Co., Minneapolis, Minn. Black Hawk Wheat Standard Middlings	Granby: E. H. Rollins	11.15	18.75	16.00	7.48	8.50	5.48	4.50
3698	Jones & Quinn, Inc., New York City. Argentine Wheat Standard Middlings	Rockville: Rockville Grain & Coal Co.	11.10	16.19	14.00	9.00	9.50	4.45	4.00
3484	King Midas Mill Co., Minneapolis, Minn. Wheat Standard Middlings.	Meriden: Reliable Feed Store	11.05	17.38	15.00	7.75	9.50	5.75	4.00
2285	E. Manchester & Sons, Winsted, Conn. Red Star Flour Middlings..	Winsted: E. Manchester & Sons	11.23	17.88	15.00	4.95	6.00	4.90	4.00
3676	Geo. Q. Moon & Co., Inc., Binghamton, N. Y. Moon's Fresh Ground White Middlings	Higganum: Felix Petrofsky	11.13	18.75	15.00	4.75	7.50	5.43	3.50
3775	Mosely & Motley Milling Co., Rochester, N. Y. Big B Wheat Middlings with Ground Screenings	Westerly: C. W. Campbell Co.	10.35	19.56	15.00	6.90	9.00	5.63	4.50
3451	Niagara Falls Milling Co., Lockport, N. Y. Niagara Standard Wheat Midds	Derby: Derby Feed Store	12.10	17.50	15.50	6.90	7.50	5.20	4.50
2300	Northwestern Consolidated Milling, Div. of Standard Milling Co., Minneapolis, Minn. Wheat Standard Middlings	Bloomfield: Bloomfield Farmers' Exchange	9.68	17.88	15.00	8.23	9.50	5.58	4.00

TABLE I. ANALYSES OF COMMERCIAL FEEDS, INSPECTION OF 1933—*Continued*

Station No.	Manufacturer and brand	Retail dealer	Pounds per hundred						
				Protein (N x 6.25)		Fiber		Fat	
			Water	Found	Guaranteed, not less than	Found	Guaranteed, not more than	Found	Guaranteed, not less than
	Wheat Products—*Continued*								
	Wheat middlings and similar products—Concluded		%	%	%	%	%	%	%
3541	Pillsbury Flour Mills Co., Minneapolis, Minn. Pillsbury's Hard Wheat A Middlings and Screenings	New Milford: Geo. T. Soule Co.	11.65	18.31	16.00	2.80	6.00	4.23	4.00
3571	Pillsbury Flour Mills Co., Minneapolis, Minn. Pillsbury's Hard Wheat Standard B Middlings and Screenings	Torrington: F. L. Wadham & Sons	11.90	17.25	15.00	6.85	9.50	5.23	4.00
4142	The Quaker Oats Co., Chicago, Ill. Bell Cow Shorts	Manufacturer's sample	8.75	18.94	15.00	6.55	8.00	5.88	4.00
2229	Russell Miller Milling Co., Minneapolis, Minn. Hard Wheat Occident Standard Middlings	Wallingford: A. E. Hall	10.15	15.38	15.00	8.18	9.50	6.10	4.00
3547	St. Albans Grain Co., St. Albans, Vt. Wirthmore Flour Middlings and Screenings	Kent: H. H. Taylor & Son	11.90	17.19	15.00	4.40	6.00	4.10	4.00
2023	Syracuse Milling Co., Syracuse, N. Y. Syragold Flour Middlings with Mill Run Screenings	So. Norwalk: Ferris-Devine Co.	10.20	17.69	15.00	5.10	6.00	5.03	4.00
2152	Traders Feed & Grain Co., Inc., Buffalo, N. Y. Rex Wheat Middlings	Willimantic: Willimantic Grain Co.	11.00	18.50	16.50	6.53	7.50	5.88	5.00
3612	Yantic Grain & Products Co., Norwich, Conn. Big Y Flour Middlings	Naugatuck: Naugatuck Grain Co.	11.50	18.00	16.50	5.25	6.00	5.13	4.00
	Wheat red dog								
2196	Flory Milling Co., Inc., Bangor, Pa. Red Dog Flour	Sandy Hook: Consumers Food Stores, Inc.	11.20	15.63	13.50	2.58	4.00	3.20	2.50
3540	General Mills, Inc., Minneapolis, Minn. Washburn Gold Medal Pure Hard Wheat Adrian Red Dog	Danbury: F. C. Benjamin	11.10	16.56	16.00	1.73	4.00	3.65	3.50
4124	Hecker-Jones-Jewell Co., Buffalo, N. Y.	Mt. Carmel: Hamden Grain Co.	11.03	18.00	15.00	2.43	4.00	4.10	4.25
3164	International Milling Co., Minneapolis, Minn. Black Hawk	Bloomfield: Bloomfield Farmers' Exchange	11.30	21.56	16.00	3.08	4.00	4.90	3.50
3542	Pillsbury Flour Mills Co., Minneapolis, Minn. Pillsbury's XX Daisy	New Milford: Geo. T. Soule Co.	11.50	18.31	16.00	1.30	4.00	3.95	4.00
3733	Robin Hood Mills, Ltd., Calgary, Canada. Superior	Willimantic: Willimantic Grain Co.	10.35	20.00	16.00	3.73	4.00	6.05	3.50
	Wheat feed (mixed feed)								
4144	Excelsior Milling Co., Minneapolis, Minn. Pure Camel Fancy Wheat	Putnam: Dayville Grain Co.	10.43	15.63	16.00	5.35	8.50	4.50	5.00
3797	General Mills, Inc., Minneapolis, Minn. Washburn's Gold Medal Fancy	Kensington: S. F. Labieniec	11.48	16.50	15.00	5.73	7.50	4.10	3.50
3499	H. H. King Flour Mills Co., Minneapolis, Minn. "Gold Mine"	Plantsville: C. A. Cowles	12.75	18.00	15.00	6.83	9.50	4.53	4.50
3565	E. Manchester & Sons, Winsted, Conn. Red Star	Winsted: E. Manchester & Sons	12.03	17.38	16.00	6.80	7.50	4.68	4.00
2302	Meech & Stoddard, Inc., Middletown, Conn. Red Wing	Bloomfield: Bloomfield Farmers' Exchange	11.10	16.88	15.00	6.80	10.00	5.10	4.50
3559	Geo. Q. Moon & Co., Binghamton, N. Y. Moon's Fresh Ground (with ground screenings)	Norfolk: Aug. P. Curtis	11.40	14.75	15.00	7.05	10.00	3.45	5.00
2290	Northwestern Consolidated Milling Div. of Standard Milling Co., Minneapolis, Minn. XXX Comet	Bloomfield: Bloomfield Farmers' Exchange	10.70	18.94	16.00	1.60	4.00	4.53	4.00

TABLE I. ANALYSES OF COMMERCIAL FEEDS, INSPECTION OF 1933—*Continued*

Station No.	Manufacturer and brand	Retail dealer	Water	Protein (N x 6.25) Found	Protein Guaranteed, not less than	Fiber Found	Fiber Guaranteed, not more than	Fat Found	Fat Guaranteed, not less than
			Pounds per hundred						
	Wheat Products—*Concluded*								
	Wheat feed (mixed feed)—Concluded		%	%	%	%	%	%	%
3598	Park & Pollard Co., Buffalo, N. Y. P & P Heavy Wheat	Woodbury: C. L. Adams Co.	11.58	17.50	15.50	6.38	8.00	5.01	3.35
3539	Pillsbury Flour Mills Co., Minneapolis, Minn. Pillsbury's Fancy, with Screenings	Danbury: F. C. Benjamin	11.70	17.38	15.00	5.45	8.50	4.38	4.00
4156	The Quaker Oats Co., Chicago, Ill. Buckeye	Manufacturer's sample	8.08	19.81	15.50	7.25	10.00	4.25	4.50
3183	Russell Miller Milling Co., Minneapolis, Minn. Hard Wheat Occident	Bloomfield: Bloomfield Farmers' Exchange	11.70	15.75	15.00	6.80	9.50	4.63	4.50
3602	D. A. Stickell & Sons, Hagerstown, Md.	Bethlehem: A. T. Miner	11.55	17.38	15.00	5.83	9.00	4.53	4.50
3658	St. Albans Grain Co., St. Albans, Vt. Wirthmore	Branford: S. V. Osborn Est.	11.85	17.13	15.00	6.60	8.00	4.33	4.50
3158	Yantic Grain & Products Co., Norwich, Conn. Big Y	Tariffville: Tariffville Grain Co.	12.58	18.75	16.00	7.15	8.00	4.28	4.00
	Maize Products								
	Corn Gluten Feed								
3896	American Maize Products Co., New York City. Cream of Corn Gluten Feed	Manufacturer's sample	8.00	27.50	25.00	7.23	8.50	3.78	2.00
2133	Anheuser-Busch, Inc., St. Louis, Mo. Corn Gluten Feed	Amston: Amston Grain Mill	10.80	25.88	25.00	5.85	8.50	2.30	2.00
3238	Clinton Corn Syrup Refining Co., Clinton, Iowa. Clinton Corn Gluten Feed	Putnam: Dayville Grain Co.	10.35	27.75	25.00	5.80	8.50	2.35	2.00
2230	Corn Products Sales Co., New York City. Buffalo Corn Gluten Feed	Wallingford: A. E. Hall	11.23	25.63	25.00	6.55	8.50	1.65	2.00
3110	Corn Products Sales Co., New York City. Diamond Corn Gluten Meal	Kensington: A. S. Labieniec	9.38	41.88	43.00	2.55	4.00	2.13	1.00
2195	Flory Milling Co., Inc., Bangor, Pa. Corn Feed Meal	Sandy Hook: Consumer's Food Stores, Inc.	13.38	10.25	10.00	3.68	5.00	6.88	5.00
2171	Penick & Ford, Ltd., Inc., Cedar Rapids, Iowa. Douglas Corn Gluten Feed	Shelton: Wolf Savitsky	10.33	27.94	25.00	6.75	8.50	2.48	1.50
3606	Ralston Purina Co., St. Louis, Mo. Corn Feed Meal	Waterbury: Waterbury Feed Store	11.65	10.25	8.50	2.55	5.00	5.10	3.00
2127	A. E. Staley Mfg. Co., Decatur, Ill. Staley's Corn Gluten Feed	Colchester: P. Cutler, Inc.	10.30	28.44	25.00	4.78	8.00	3.20	1.00
3502	Jacob Trinley & Sons, Linfield, Pa. Corn Feed Meal	West Cheshire: Cheshire Grain & Coal Co.	11.98	9.56	8.00	3.45	4.00	6.13	3.00
3114	Union Starch & Refining Co., Columbus, Ind. Union Corn Gluten Feed	Plainville: State Farmers' Co-op.	12.50	27.13	25.00	6.21	8.00	1.65	1.00
	Hominy feed								
1914	Acme-Evans Co., Indianapolis, Ind. Acme	West Cheshire: Cheshire Grain & Coal Co.	11.25	10.63	10.00	4.08	6.00	7.65	7.00
3709	Decatur Milling Co., Inc., Decatur, Ill. Homco	New Haven: Moran-Paton Co.	11.28	11.25	10.00	4.08	6.00	7.35	7.00
2291	Evans Milling Co., Indianapolis, Ind. Emco	Bloomfield: Bloomfield Farmers' Exchange	8.50	12.50	10.00	5.25	6.00	7.63	6.00
3854	Forbes Bros.—Central Mills, Topeka, Kansas	Manufacturer's sample	9.33	11.38	10.00	4.50	6.00	8.05	7.00
2261	Kellogg Co., Battle Creek, Mich. White	Naugatuck: Naugatuck Grain Co.	8.18	11.13	10.00	3.78	5.00	6.78	6.00
3239	Chas. A. Krause Milling Co., Milwaukee, Wis. Badger White	Putnam: Dayville Grain Co.	9.80	10.88	10.00	4.35	5.00	6.40	6.00

TABLE I. ANALYSES OF COMMERCIAL FEEDS, INSPECTION OF 1933—*Continued*

Station No.	Manufacturer and brand	Retail dealer	Pounds per hundred: Water	Protein (N x 6.25): Found	Protein (N x 6.25): Guaranteed, not less than	Fiber: Found	Fiber: Guaranteed, not more than	Fat: Found	Fat: Guaranteed, not less than
	Maize Products—*Concluded*		%	%	%	%	%	%	%
	Hominy Feed—Concluded								
2124	Miller Cereal Mills, Omaha, Neb.	Lebanon: Berkman Grain Co.	9.85	9.94	11.00	3.50	4.50	6.15	7.00
3078	Miner-Hillard Milling Co., Wilkes Barre, Pa. Steam Cooked	New London: New London Grain Co.	10.50	9.75	10.00	3.60	5.00	5.25	5.00
3682	Geo. Q. Moon & Co., Inc., Binghamton, N. Y. Moon's White	Middletown: P. Levson & Son	8.78	10.81	10.00	6.45	6.00	8.20	5.00
3460	The Patent Cereals Co., Geneva, N.Y.	Ansonia: Ansonia Flour & Feed Co.	11.98	10.94	10.00	4.55	5.00	5.90	5.00
3108	Postum Co., Inc., Battle Creek, Mich. Burt's	Kensington: A. S. Labieniec	11.88	11.06	10.00	4.62	5.00	6.78	6.00
1984	Pratt Food Co., Buffalo, N. Y. White	Bristol: Bristol Supply Co.	10.15	10.69	10.00	3.55	6.00	6.25	5.00
4123	The Quaker Oats Co., Chicago, Ill. White	Mt. Carmel: Hamden Grain Co.	10.28	10.50	10.00	4.00	5.00	6.73	5.00
3893	The Quaker Oats Co., Chicago, Ill. Yellow	Long Hill: Long Hill Feed Store	9.80	10.44	10.00	3.88	5.00	4.95	5.00
3763	St. Albans Grain Co., St. Albans, Vt. Paragon	Norwich: Norwich Grain Co.	9.88	11.13	10.00	4.20	7.00	7.15	6.00
	Rye Products								
3192	Upper Hudson Rye Flour Mills, Inc., Troy, N. Y. Upper Hudson	Rockville: Rockville Grain & Coal Co.	10.90	17.75	15.50	4.48	6.00	3.40	3.00
	Brewers' and Distillers' Grains								
3084	Allied Mills, Inc., Chicago, Ill. Brewers Dried Grains	Colchester: P. Cutler, Inc.	6.58	25.38	20.00	14.30	18.00	7.50	4.50
3208	Farmers Feed Co., New York City. Bull Brand Dried Brewers Grains	Thompsonville: Geo. S. Phelps & Co.	8.30	28.50	24.00	13.95	17.00	6.40	6.00
	Dried Beet Pulp								
3126	Larrowe Milling Co., Detroit, Mich.	Plantsville: C. A. Cowles	11.20	9.94	8.00	18.87	22.00	0.68	0.40
1913	Larrowe Milling Co., Detroit, Mich. Dried Molasses	Long Hill: Long Hill Feed Store	4.80	12.69	8.00	14.32	20.00	0.58	0.40
	Proprietary Mixed Feeds								
	Horse feeds								
3236	Alfalfa Products Co., San Francisco, Calif. Alfalfa Leaf Meal	Putnam: Dayville Grain Co.	9.55	21.88	20.00	15.50	18.00	2.80	2.00
4128	Allied Mills, Inc., Chicago, Ill. Arab	Plainville: Sunshine Feed Store	11.20	11.25	10.00	9.60	12.00	3.10	2.00
3520	Allied Mills, Inc., Chicago, Ill. June Pasture	Danbury: C. S. Barnum & Son	11.40	13.25	10.00	18.73	21.00	0.53	0.50
2315	Allied Mills, Inc., Chicago, Ill. Pure Corn and Oats Provender	Danbury: C. S. Barnum & Son	10.83	10.50	9.00	5.18	10.00	4.15	3.50
4127	Allied Mills, Inc., Chicago, Ill. Wayne Supreme	Plainville: Sunshine Feed Store	11.75	11.25	9.50	5.10	8.00	3.38	3.00
3483	Arcady Farms Milling Co., Chicago, Ill. Wonder Horse and Mule Feed	Meriden: Reliable Feed Store	11.80	10.38	9.00	4.80	10.00	3.35	3.00
3759	E. W. Bailey & Co., Montpelier, Vt. Pennant	Lebanon: Berkman Grain Co.	13.10	12.13	10.75	5.35	6.50	3.50	3.50
3625	Beacon Milling Co., Inc., Cayuga, N. Y. Beacon's Cayuga	Bridgeport: H. C. Ferris	13.63	10.06	8.00	6.20	10.00	2.23	2.00
3624	Beacon Milling Co., Inc., Cayuga, N. Y. Beacon	Bridgeport: H. C. Ferris	12.38	11.69	9.00	6.00	10.00	2.70	2.50
2164	Beacon Milling Co., Inc., Cayuga, N. Y. Corn and Oats Chop	Shelton: Shelton Feed Co.	12.55	9.88	9.50	5.13	7.00	4.33	4.00
3773	C. W. Campbell Co., Westerly, R. I. Camco	Westerly: C. W. Campbell Co.	13.30	11.06	10.00	5.60	10.00	3.10	3.00

TABLE I. ANALYSES OF COMMERCIAL FEEDS, INSPECTION OF 1933—*Continued*

Station No.	Manufacturer and brand	Retail dealer	Pounds per hundred						
			Water	Protein (N x 6.25)		Fiber		Fat	
				Found	Guaranteed, not less than	Found	Guaranteed, not more than	Found	Guaranteed, not less than
	Proprietary Mixed Feeds—*Continued* *Horse feeds—Continued*		%	%	%	%	%	%	%
3771	C. W. Campbell Co., Westerly, R. I. Provender	Westerly: C. W. Campbell Co.	11.05	11.50	10.00	6.20	8.00	5.48	4.00
3772	C. W. Campbell Co., Westerly, R. I. Xtra Vim Molasses	Westerly: C. W. Campbell Co.	10.90	10.00	10.00	10.95	12.00	3.09	2.00
2125	A. B. Caple Co., Toledo, Ohio. Alfalfa Meal	Colchester: P. Cutler, Inc.	9.78	14.88	13.00	26.20	33.00	2.23	1.00
3458	G. E. Conkey Co., Cleveland, Ohio. Conkey's All Grain Horse and Mule Feed (with Linseed Meal, Molasses and Salt)	Ansonia: A. Hodos & Son	12.35	10.13	9.50	6.10	9.50	3.35	3.00
2207	Consumers Food Stores, Inc., Bridgeport, Conn. Gold Bond	Bethel: Consumers Food Stores, Inc.	11.70	10.25	9.00	7.85	10.00	3.35	2.50
3118	C. A. Cowles, Plantsville, Conn. Cowles' Molasses	Plantsville: C. A. Cowles	13.13	11.25	10.00	7.28	10.00	3.20	3.00
3060	R. G. Davis & Sons, Inc., New Haven, Conn. Davis	Westville: Westville Grain Co.	14.45	9.50	9.00	5.79	10.00	3.03	3.00
3459	R. G. Davis & Sons, Inc., New Haven, Conn. Davis No. 1 Provender	Ansonia: Ansonia Flour & Feed Co.	12.00	10.69	10.00	5.45	8.00	4.08	3.50
3033	Delaware Mills, Inc., Deposit, N. Y. Delaware 85%	Manchester: Manchester Grain Co.	13.23	10.00	9.00	6.49	10.00	3.50	3.00
3500	Denver Alfalfa Milling & Products Co., Lamar, Colo. Alfalfa Leaf Meal	West Cheshire: Cheshire Grain & Coal Co.	9.40	18.75	20.00	15.80	18.00	2.29	2.50
3762	Dietrich & Gambrill, Inc., Frederick, Md. Gambrill's	Colchester: P. Cutler, Inc.	11.90	12.69	10.00	5.08	12.00	3.25	3.50
4150	Eastern States Farmers' Exchange, Springfield, Mass. Eastern States Highland 12	Norwich: A. E. Shedd	9.60	14.63	12.00	10.33	11.50	3.80	3.50
3133	Eastern States Farmers' Exchange, Springfield, Mass. Eastern States Highland 16	New Milford: Paul Caldwell	12.23	18.13	16.00	9.59	11.00	2.95	3.50
3131	Eastern States Farmers' Exchange, Springfield, Mass. Eastern States Horse & Calf Ration	New Milford: Paul Caldwell	12.23	11.63	10.50	5.85	7.00	3.75	3.50
3186	E'more Milling Co., Inc., Oneonta, N. Y. Elmore, with Molasses	Glastonbury: Stanley Melzen	13.40	9.81	9.00	5.30	11.00	3.20	2.50
3710	John W. Eshelman & Sons, Lancaster, Pa. Eshelman Conestoga	New Haven: Moran-Paton Co.	9.70	11.13	9.00	6.33	10.00	3.83	3.00
2022	John W. Eshelman & Sons, Lancaster, Pa. Eshelman's Garden Spot	So. Norwalk: Roodner Feed Co.	5.65	9.56	7.00	9.53	10.00	3.30	2.00
3509	John W. Eshelman & Sons, Lancaster, Pa. Eshelman Lancaster 60	Bethel: Morrison & Dunham	14.03	9.94	9.00	9.80	11.00	2.83	2.50
3631	John W. Eshelman & Sons, Lancaster, Pa. Eshelman Liberty	Southport: C. Buckingham & Co.	8.20	9.00	7.00	11.95	10.00	2.00	2.00
3701	John W. Eshelman & Sons, Lancaster, Pa. Eshelman Red Rose Alfalfa Meal	Thompsonville: Geo. S. Phelps & Co.	8.55	13.94	13.00	29.20	33.00	1.88	1.50
3471	John W. Eshelman & Sons, Lancaster, Pa. Eshelman Red Rose 85	Wallingford: A. E. Hall	11.60	11.13	9.00	6.28	10.00	4.10	3.00
3744	John W. Eshelman & Sons, Lancaster, Pa. Eshelman Red Rose Pure Ground Corn and Oats	Danielson: Kennedy Corp.	9.93	10.63	10.00	5.80	9.00	4.03	4.00
3792	John W. Eshelman & Sons, Lancaster, Pa. Steam Cooked	Westerly: C. W. Campbell Co.	8.90	10.88	9.00	4.15	6.00	3.65	4.00
2194	Flory Milling Co., Inc., Bangor, Pa. Ground Corn and Oats	Sandy Hook: Consumers Food Stores, Inc.	10.80	10.25	8.00	8.35	15.00	4.95	3.00

TABLE I. ANALYSES OF COMMERCIAL FEEDS, INSPECTION OF 1933—*Continued*

Station No.	Manufacturer and brand	Retail dealer	Pounds per hundred: Water	Protein (N x 6.25): Found	Protein (N x 6.25): Guaranteed, not less than	Fiber: Found	Fiber: Guaranteed, not more than	Fat: Found	Fat: Guaranteed, not less than
	Proprietary Mixed Feeds—*Continued* *Horse feeds—Continued*		%	%	%	%	%	%	%
2150	J. A. Forrest, Minneapolis, Minn. Alpine Ground Feeding Oatmeal	Willimantic: Willimantic Grain Co.	13.58	10.13	14.00	3.28	3.90	3.98	5.00
3686	D. H. Grandin Milling Co., Jamestown, N. Y. Grandin's Sweetened	Manchester: O. E. Bailey	12.15	11.38	9.50	5.55	11.00	3.80	3.50
4151	Hales & Hunter Co., Chicago, Ill. College	Lebanon: Berkman Grain Co.	10.58	11.88	9.00	5.45	10.00	3.60	2.50
3006	H. P. Kysor Feed & Grain Co., New Haven, Conn. Kysor's A-1	Kensington: A. S. Labieniec	12.45	12.00	10.00	5.17	8.00	5.36	4.00
3480	Maritime Milling Co., Inc., Buffalo, N. Y. Bull Brand	Wallingford: Laden Bros. Co., Inc.	13.38	10.50	8.00	5.88	10.00	3.15	2.00
3482	Meech & Stoddard, Inc., Middletown, Conn. Red Wing Molasses	Meriden: Meriden Grain & Coal Co.	12.80	10.00	9.00	6.50	10.00	2.85	5.00
3675	Geo. Q. Moon & Co., Inc., Binghamton, N. Y. Moon's with Molasses	Higganum: Felix Petrofsky	11.83	9.38	9.00	8.05	10.00	3.33	3.00
3557	Geo. Q. Moon & Co., Inc., Binghamton, N. Y. Old Times	Norfolk: Aug. P. Curtis	11.03	10.25	8.50	9.00	9.00	5.45	4.50
3662	Fred C. Morse & Son, Guilford, Conn. Old Mill	Guilford: Fred C. Morse & Son	12.55	12.25	12.00	5.28	8.00	4.25	4.00
2096	Fred C. Morse & Son, Guilford, Conn. Old Mill Provender	Guilford: Fred C. Morse & Son	11.65	10.44	10.00	6.05	6.00	5.13	3.25
2162	Ontario Milling Co., Inc., Oswego, N. Y. Onto, with Molasses	Middletown: P. Levson & Son	13.00	11.31	10.00	6.45	10.00	3.60	3.20
2088	S. V. Osborn Est., Branford, Conn. Osborn Provender	Branford: S. V. Osborn Est.	11.05	10.81	10.00	5.58	8.00	4.33	4.00
1923	Park & Pollard Co., Buffalo, N. Y. Corn and Oats 1/2 and 1/2	Plainville: State Farmers Co-op. Assoc.	11.98	10.81	10.00	6.03	8.00	4.05	3.00
3184	Park & Pollard Co., Buffalo, N. Y. Park & Pollard	Bloomfield: Bloomfield Farmers' Exchange	14.20	11.44	10.00	6.80	9.00	4.30	3.50
3616	Pecos Valley Alfalfa Mill Co., Hagerman, New Mexico. Alfalfa Meal	Stratford: Farmers' Flour & Grain Co.	7.68	12.50	13.00	32.95	33.00	1.33	1.50
3109	Pecos Valley Alfalfa Mill Co., Hagerman, New Mexico. Peevee Alfalfa Leaf Meal	Kensington: A. S. Labieniec	10.78	20.13	20.00	15.04	18.00	2.50	2.50
1986	Pratt Food Co., Buffalo, N. Y. Pratt's Utility	Bristol: Bristol Supply Co.	12.60	8.25	7.50	7.93	10.00	3.53	2.00
3050	The Quaker Oats Co., Chicago, Ill. Banner Feed	Seymour: Seymour Grain & Coal Co.	7.38	14.38	13.00	15.56	18.00	4.95	4.50
3700	The Quaker Oats Co., Chicago, Ill. Quaker Green Cross	Thompsonville: Geo. S. Phelps & Co.	11.13	11.88	10.00	9.38	12.00	3.00	2.50
3209	The Quaker Oats Co., Chicago, Ill. Sugared Vim Feed	Thompsonville: Geo. S. Phelps & Co.	8.83	5.50	5.00	24.18	27.50	1.48	1.25
3464	The Quaker Oats Co., Chicago, Ill. Vim Feed	Seymour: Seymour Grain & Coal Co.	7.43	4.88	5.00	28.95	30.00	1.70	2.00
3717	Ralston Purina Co., St. Louis, Mo. Corn & Oat Provender	Portland: Valley Mills	9.70	11.63	10.00	7.03	10.00	5.28	4.00
3647	Ralston Purina Co., St. Louis, Mo. Protena Sweet Roughage Feed (Buffalo Mills)	New Canaan: Clapboard Hill Co.	12.08	8.75	6.00	19.08	30.00	1.30	1.00
3648	Ralston Purina Co., St. Louis, Mo. Purina Bulky Las Chow (Buffalo Mills)	New Canaan: Clapboard Hill Co.	11.68	13.38	9.00	11.85	15.00	2.63	1.30
3719	Ralston Purina Co., St. Louis, Mo. Purina Bulky Omolene Chow	Portland: Valley Mills	11.63	11.50	10.00	7.98	11.00	4.05	3.20
2082	Ralston Purina Co., St. Louis, Mo. Purina Checkerboard Rolled Oats (Steam-Cooked)	Stamford: Clapboard Hill Co.	8.90	15.00	15.00	1.45	2.00	5.85	5.00

Table I. Analyses of Commercial Feeds, Inspection of 1933—*Continued*

Station No.	Manufacturer and brand	Retail dealer	Pounds per hundred						
			Water	Protein (N x 6.25)		Fiber		Fat	
				Found	Guaranteed, not less than	Found	Guaranteed, not more than	Found	Guaranteed, not less than
	Proprietary Mixed Feeds—*Continued* *Horse feeds—Concluded*		%	%	%	%	%	%	%
3683	Ralston Purina Co., St. Louis, Mo. Purina Omolene Chow	Manchester: Manchester Grain Co.	11.23	11.75	10.00	6.65	9.00	4.03	3.20
3463	Seymour Grain & Coal Co., Seymour, Conn. Miracle Molasses	Seymour: Seymour Grain & Coal Co.	12.50	10.88	10.00	8.70	7.00	4.13	3.50
3106	St. Albans Grain Co., St. Albans, Vt. Wirthmore Fodder Greens	Meriden: H. Grulich	12.15	10.63	9.00	12.01	19.00	2.30	1.25
3107	St. Albans Grain Co., St. Albans, Vt. Wirthmore	Meriden: H. Grulich	12.58	10.06	9.80	6.76	9.00	4.00	3.25
3580	D. A. Stickell & Sons, Inc., Hagerstown, Md. Super Horse & Calf Feed	Middlefield: Terrill & Burnham	11.08	9.94	9.00	6.60	12.00	2.83	2.50
2025	Syracuse Milling Co., Syracuse, N. Y. Syragold, with Molasses	So. Norwalk: Ferris-Devine Co.	11.53	9.69	8.00	8.50	12.00	2.93	2.50
3987	Tioga-Empire Feed Mills, Inc., Waverly, N. Y. Derby Ground Corn and Oats	Hawleyville: W. A. Honan	9.83	11.25	9.20	7.05	8.00	4.23	4.00
3508	Tioga-Empire Feed Mills, Inc., Waverly, N. Y. Neverfail	Bethel: Morrison & Dunham	16.19	12.13	10.00	6.18	10.00	2.24	3.50
4158	Tioga-Empire Feed Mills, Inc., Waverly, N. Y. Neverfail	Bethel: Morrison & Dunham	11.55	11.50	10.00	4.60	10.00	4.00	3.50
3054	Jacob Trinley & Sons, Linfield, Pa. Supreme 85%	Bridgeport: Conn. Feed Co.	14.68	10.00	9.00	7.08	11.00	3.40	3.00
3115	Wayne County Grangers Feed Corp., Clyde, N. Y. "Universal"	Plainville: W. S. Eaton	12.75	11.88	10.00	4.59	9.00	3.30	3.00
3562	West-Nesbitt, Inc., Oneonta, N. Y. Pure Feed Ration	Winsted: Chas. R. Hawley	12.95	12.25	9.00	9.78	10.00	2.83	3.00
3672	Yantic Grain & Products Co., Norwich, Conn. Almo	East Haddam: East Haddam Grain Co.	10.20	11.69	10.00	16.88	16.00	1.90	1.50
3091	Yantic Grain & Products Co., Norwich, Conn. Big Y	Middlefield: Middlefield Center Feed Co.	13.55	10.25	9.00	6.84	8.00	3.30	3.00
3734	Yantic Grain & Products Co., Norwich, Conn. Big (Y) Sugared Oat Feed	Abington: Weeks Bros.	8.85	6.13	5.00	24.00	27.50	1.80	1.25
	Dairy feeds								
3518	Allied Mills, Inc., Chicago, Ill. Amco 20% Dairy Ration	Danbury: C. S. Barnum & Son	10.05	20.56	20.00	7.65	9.00	4.03	3.50
3519	Allied Mills, Inc., Chicago, Ill. Amco 24% Dairy Ration	Danbury: C. S. Barnum & Son	10.30	25.38	24.00	7.25	9.00	3.73	3.50
4131	Allied Mills, Inc., Chicago, Ill. Amco 32% Supplement Dairy Ration	Plainville: Sunshine Feed Store	8.75	32.50	32.00	6.03	9.00	4.55	4.00
3457	Allied Mills, Inc., Chicago, Ill. Empire 20% Dairy Ration	Ansonia: A. Hodos & Son	11.20	20.00	20.00	8.80	12.00	2.23	3.00
3898	Arcady Farms Milling Co., Chicago, Ill. Advanced Registry Dairy Feed	New Britain: S. P. Strople	8.70	27.75	25.00	8.08	10.00	4.33	4.00
2243	Arcady Farms Milling Co., Chicago, Ill. Arcady Open Formula Production Ration	Meriden: Raymond Ives	11.80	21.56	20.00	5.83	9.00	2.68	3.50
3758	Arcady Farms Milling Co., Chicago, Ill. Arcady 24% Open Formula Production Ration	Lebanon: Berkman Grain Co.	10.08	25.75	24.00	6.53	9.00	4.10	4.00
3485	Arcady Farms Milling Co., Chicago, Ill. Milkers Ready Ration	Meriden: Reliable Feed Store	10.58	21.75	22.00	9.85	12.00	4.00	4.00
3249	E. W. Bailey & Co., Montpelier, Vt. Our 20% Special Dairy Ration	Jewett City: Jewett City Grain Co.	11.10	20.13	20.00	7.40	9.00	3.55	3.50

TABLE I. ANALYSES OF COMMERCIAL FEEDS, INSPECTION OF 1933—*Continued*

Station No.	Manufacturer and brand	Retail dealer	Water	Protein (N x 6.25) Found	Protein (N x 6.25) Guaranteed, not less than	Fiber Found	Fiber Guaranteed, not more than	Fat Found	Fat Guaranteed, not less than
	Proprietary Mixed Feeds—*Continued* *Dairy feeds—Continued*		%	%	%	%	%	%	%
3757	E. W. Bailey & Co., Montpelier, Vt. Sweetened Bailey's 16% Dairy Ration	Lebanon: Berkman Grain Co.	9.53	17.38	16.00	6.25	9.00	5.53	5.00
3756	E. W. Bailey & Co., Montpelier, Vt. Sweetened Favorite Dairy Ration	Lebanon: Berkman Grain Co.	10.25	21.50	20.00	6.45	7.50	4.78	4.50
3749	E. W. Bailey & Co., Montpelier, Vt. Sweetened Capital Dairy Ration	Jewett City: Jewett City Grain Co.	11.15	25.19	24.00	6.43	9.00	4.08	5.00
3516	Beacon Milling Co., Inc., Cayuga, N. Y. Auburn Dairy Feed	Danbury: C. S. Barnum & Son	10.78	21.56	20.00	8.05	10.00	4.80	4.00
3544	Beacon Milling Co., Inc., Cayuga, N. Y. Beacon Dairy Ration	New Milford: W. L. Richmond & Son	11.50	24.63	24.00	8.38	9.00	4.90	4.50
3650	Beacon Milling Co., Inc., Cayuga, N. Y. Beacon 20	Danbury: C. S. Barnum & Son	9.53	20.88	20.00	7.43	9.00	4.94	4.50
3622	Beacon Milling Co., Inc., Cayuga, N. Y. Beacon Sweet '20'	Bridgeport: H. C. Ferris	11.78	21.44	20.00	7.08	9.00	4.28	4.50
3515	Beacon Milling Co., Inc., Cayuga, N. Y. Beacon Sweet '24'	Danbury: C. S. Barnum & Son	10.98	25.69	24.00	8.00	9.00	4.45	4.00
4147	Black Rock Milling Corp., Buffalo, N. Y. Bidwell 20% Dairy Ration	Putnam: Bosworth Bros.	10.33	21.88	20.00	7.58	11.00	3.53	4.00
3607	Black Rock Milling Corp., Buffalo, N. Y. Bidwell 24% Dairy Ration	Waterbury: Spencer Grain Co.	10.38	23.25	24.00	6.85	11.00	3.53	4.00

Station No.	Manufacturer and brand	Retail dealer	Water	Protein Found	Protein Guaranteed, not less than	Fiber Found	Fiber Guaranteed, not more than	Fat Found	Fat Guaranteed, not less than
3597	Black Rock Milling Corp., Buffalo, N. Y. Paramount 20% Dairy Ration	Woodbury: C. L. Adams Co.	9.95	21.38	20.00	9.45	10.00	4.04	4.00
2311	Amos D. Bridge's Sons, Hazardville, Conn. Success Dairy Ration	Hazardville: Amos D. Bridge's Sons	9.33	22.63	20.00	8.78	9.50	4.58	4.20
2129	L. Broder Grain Store, Colchester, Conn. L. B. Milk Ration	Colchester: L. Broder Grain Store	9.23	21.25	20.00	6.80	8.50	4.95	5.00
2005	C. Buckingham & Co., Southport, Conn. C. B.	Southport: C. Buckingham & Co.	9.38	24.88	22.81	8.70	9.40	5.35	4.61
3848	C. Buckingham & Co., Southport, Conn. C. B. 20%	Southport: C. Buckingham & Co.	9.75	20.88	20.00	7.40	10.00	4.28	4.00
3769	C. W. Campbell Co., Westerly, R. I. Milky Ration	Westerly: C. W. Campbell Co.	9.75	21.00	20.00	8.40	8.00	4.13	4.50
3770	C. W. Campbell Co., Westerly, R. I. No Botheration	Westerly: C. W. Campbell Co.	9.53	20.94	20.00	7.15	8.00	4.75	4.00
3103	The Coles Co., Middletown, Conn. Capital 20% Molasses Dairy Feed	Middletown: The Coles Co.	11.63	21.50	20.00	10.68	11.00	4.28	4.00
3102	The Coles Co., Middletown, Conn. Selco 24% Molasses Dairy Feed	Middletown: The Coles Co.	11.73	24.38	24.00	8.78	10.00	4.15	4.50
2193	Consumers Food Stores, Inc., Bridgeport, Conn. Gold Bond 16% Dairy Feed	Sandy Hook: Consumers Food Stores, Inc.	10.00	17.19	16.00	10.08	12.00	3.75	3.50
3652	Consumers Food Stores, Inc., Bridgeport, Conn. Gold Bond 20% Dairy Feed	Sandy Hook: Consumers Food Stores, Inc.	11.03	21.88	20.00	7.90	9.00	3.64	5.00
2205	Consumers Food Stores, Inc., Bridgeport, Conn. Gold Bond 24% Dairy Feed	Bethel: Consumers Food Stores, Inc.	10.43	25.00	24.00	9.10	11.00	4.55	4.50
3224	E. A. Cowee Co., Fitchburg, Mass. Coweco 20% Ration	Quinebaug: M. T. Dartt	10.55	21.25	20.00	6.75	10.00	4.15	4.00
3119	C. A. Cowles, Plantsville, Conn. Cowles 20% Dairy Ration	Plantsville: C. A. Cowles	10.03	22.50	20.00	8.62	10.00	5.13	5.00
3486	C. A. Cowles, Plantsville, Conn. Cowles 24% Dairy Ration	Plantsville: C. A. Cowles	11.08	23.38	24.00	6.70	10.00	4.95	5.00
3089	P. Cutler, Inc., Colchester, Conn. Prosperity Dairy Ration	Colchester: P. Cutler, Inc.	10.85	25.00	24.00	6.63	12.00	4.48	4.00

TABLE I. ANALYSES OF COMMERCIAL FEEDS, INSPECTION OF 1933—*Continued*

Station No.	Manufacturer and brand	Retail dealer	Pounds per hundred: Water	Protein (N x 6.25): Found	Protein (N x 6.25): Guaranteed, not less than	Fiber: Found	Fiber: Guaranteed, not more than	Fat: Found	Fat: Guaranteed, not less than
	Proprietary Mixed Feeds—*Continued* *Dairy feeds—Continued*		%	%	%	%	%	%	%
2128	P. Cutler, Inc., Colchester, Conn. Prosperity Economy Dairy Ration	Colchester: P. Cutler, Inc.	9.15	24.88	24.00	8.55	12.00	4.25	4.00
3087	P. Cutler, Inc., Colchester, Conn. Prosperity Special Dairy Feed	Colchester: P. Cutler, Inc.	10.58	21.63	20.00	9.13	12.00	4.15	4.00
3069	R. G. Davis & Sons, Inc., New Haven, Conn. Basic Dairy Ration	Westville: Westville Grain Co.	11.70	22.63	20.00	6.82	9.00	4.10	4.50
3653	R. G. Davis & Sons, Inc., New Haven, Conn. Basic Dairy Ration	Westville: Westville Grain Co.	10.85	22.38	20.00	6.98	9.00	4.50	4.50
3657	R. G. Davis & Sons, Inc., New Haven, Conn. 20% Open Formula	Westville: Westville Grain Co.	11.33	19.88	20.00	6.55	8.00	3.80	4.00
3014	Delaware Mills, Inc., Deposit, N. Y. Delaware Dairy Feed	Southington: Southington Lumber Co.	9.40	23.50	23.00	8.15	10.00	6.18	5.00
3032	Delaware Mills, Inc., Deposit, N. Y. Delaware Sweet 24% Dairy Feed	Manchester: Manchester Grain Co.	11.33	19.13	24.00	6.96	10.00	4.23	4.50
3590	Delaware Mills, Inc., Deposit, N. Y. Delaware Sweet 24% Dairy Feed	Hartford: New York Feed Corp.	11.13	24.25	24.00	7.65	10.00	4.20	4.50
3450	Delaware Mills, Inc., Deposit, N. Y. Delco Sweet 20% Dairy Feed	Derby: Derby Feed Store	11.00	19.13	20.00	9.90	10.00	5.00	4.50
3591	Delaware Mills, Inc., Deposit, N. Y. Delco Sweet 20% Dairy Feed	Hartford: New York Feed Corp.	12.08	21.69	20.00	8.25	10.00	3.73	4.50
3740	Dietrich & Gambrill, Inc., Frederick, Md. D & G Dairy Feed	Danielson: Young Bros. Co.	10.85	20.75	20.00	10.23	12.00	3.90	4.00
3668	Eastern States Farmers' Exchange, Springfield, Mass. Eastern States Fulpail Dairy Ration	Clinton: A. L. Lockwood	10.90	21.88	20.00	6.60	8.00	4.40	4.50
2109	Eastern States Farmers' Exchange, Springfield, Mass. Eastern States Highland 20	Norwich: A. E. Shedd	10.90	22.06	20.00	8.23	12.00	5.38	4.00
4149	Eastern States Farmers' Exchange, Springfield, Mass. Eastern States Milkmore Dairy Ration	Norwich: A. E. Shedd	10.05	26.25	24.00	6.80	8.00	4.58	4.50
3132	Eastern States Farmers' Exchange, Springfield, Mass. Eastern States Sixteen Dairy Ration	New Milford: Paul Caldwell	11.13	19.06	16.00	6.78	8.00	4.85	4.00
4138	Elmore Milling Co., Inc., Oneonta, N. Y. Elmore Waldorf Formula	Hazardville: A. D. Bridge's Sons	8.35	23.50	20.00	8.55	9.00	3.98	4.00
3152	John W. Eshelman & Sons, Lancaster, Pa. Certified 20% Dairy Ration	Simsbury: H. B. Bunnell & Co.	10.15	22.06	20.00	7.43	8.00	4.80	4.00
3986	John W. Eshelman & Sons, Lancaster, Pa. Eshelman Certified 24% Dairy Feed	Cos Cob: A. R. Belmont	9.08	25.94	24.00	7.20	8.00	4.63	4.50
3743	John W. Eshelman & Sons, Lancaster, Pa. Eshelman Challenge Dairy Feed	Danielson: The Kennedy Corp.	9.93	23.50	24.00	8.83	11.00	4.28	4.00
3470	John W. Eshelman & Sons, Lancaster, Pa. Eshelman Conestoga 20 Dairy Feed	Wallingford: A. E. Hall	9.83	23.00	20.00	7.30	11.00	4.55	4.00
3985	John W. Eshelman & Sons, Lancaster, Pa. Eshelman Lancaster 20 Dairy Feed	Cos Cob: A. R. Belmont	9.95	22.56	20.00	8.65	11.00	4.23	4.00
3707	John W. Eshelman & Sons, Lancaster, Pa. Eshelman Open Formula 20 Dairy Feed	New Haven: Moran-Paton Co.	10.10	22.13	20.00	8.23	9.00	4.25	4.00
3630	John W. Eshelman & Sons, Lancaster, Pa. Eshelman Pennsy 16 Dairy Feed	Southport: C. Buckingham & Co.	11.20	18.63	16.00	8.73	11.00	3.65	3.00
3469	John W. Eshelman & Sons, Lancaster, Pa. Eshelman Red Rose 24 Dairy Feed	Wallingford: A. E. Hall	10.05	25.00	24.00	7.65	11.00	4.18	4.00

TABLE I. ANALYSES OF COMMERCIAL FEEDS, INSPECTION OF 1933—*Continued*

Station No.	Manufacturer and brand	Retail dealer	Water	Protein (N x 6.25) Found	Protein (N x 6.25) Guaranteed, not less than	Fiber Found	Fiber Guaranteed, not more than	Fat Found	Fat Guaranteed, not less than
				Pounds per hundred					
	Proprietary Mixed Feeds—*Continued* *Dairy feeds—Continued*		%	%	%	%	%	%	%
4136	Flory Milling Co., Inc., Bangor, Pa. Sunray Dairy Feed	Ansonia: Farmers Feed & Grain Co.	9.38	21.13	20.00	7.95	9.00	3.90	4.50
2085	A. W. Forbes, East Haven, Conn. R-Own Dairy Ration	East Haven: A. W. Forbes	8.95	21.88	20.00	10.80	12.00	3.95	3.00
4146	J. B. Garland & Son, Worcester, Mass. Garland Economy 20% Dairy Ration with Cane Molasses	No. Grosvenordale: Thompson Grain Co.	10.83	21.38	20.00	7.00	9.00	4.35	3.50
3231	J. B. Garland & Son, Worcester, Mass. Royal Worcester Complete Ration with Cane Molasses	No. Grosvenordale: Thompson Grain Co.	11.50	21.13	20.00	9.20	10.00	3.83	3.00
4152	D. H. Grandin Milling Co., Jamestown, N. Y. Grandin's 24% Balanced Dairy Ration	Falls Village: H. E. Dean	9.13	26.00	24.00	8.20	10.00	6.02	5.00
3689	D. H. Grandin Milling Co., Jamestown, N. Y. Grandin's Sweetened 20% Dairy Feed	Manchester: O. E. Bailey	10.88	21.56	20.00	6.43	10.00	4.38	4.00
3688	D. H. Grandin Milling Co., Jamestown, N. Y. M-S (Money Saver) 20% Sweet Dairy Feed	Manchester: O. E. Bailey	10.23	21.56	20.00	9.48	12.00	4.10	4.00
3716	Hales & Hunter Co., Chicago, Ill. Red Horn 20% Dairy Feed	Mt. Carmel: Mt. Carmel Grain Store	10.00	26.63	20.00	7.73	8.00	4.65	5.00
2136	J. B. Ham Co., Auburn, Me. Farmer Boy 18% Dairy Ration with Molasses	Stafford Springs: Stafford Farmers' Co-op. Assoc.	10.30	20.50	18.00	11.55	12.00	3.15	4.00
2142	J. B. Ham Co., Auburn, Me. Farmer Boy 20% Dairy Ration with Molasses	Stafford Springs: Stafford Farmers' Co-op. Assoc.	11.48	20.00	20.00	6.78	8.00	4.75	4.50
3725	J. B. Ham Co., Auburn, Me. Farmer Boy 24% Dairy Ration with Molasses	Stafford Springs: Denis Grain Mill	11.45	25.19	24.00	6.93	8.00	4.28	4.50
3007	H. P. Kysor Feed & Grain Co., New Haven, Conn. Kysor's A-1 20% Dairy Ration	Plainville: State Farmers' Co-op. Assoc.	10.82	23.00	20.00	7.20	8.50	3.73	3.50
2258	A. S. Labieniec, Kensington, Conn. Reliable 20% Dairy Feed	Kensington: A. S. Labieniec	9.95	20.75	20.00	7.88	9.00	5.00	4.00
2259	A. S. Labieniec, Kensington, Conn. Reliable 24% Dairy Feed	Kensington: A. S. Labieniec	9.68	25.00	24.00	7.33	9.00	4.90	4.50
3477	Laden Bros. Co., Inc., Wallingford, Conn. Laden's Dairy Feed	Wallingford: Laden Bros. Co., Inc.	13.55	18.13	20.00	9.80	9.00	3.68	4.50
3127	Larrowe Milling Co., Detroit, Mich. Larro The Ready Ration for Dairy Cows	Plantsville: C. A. Cowles	11.18	21.00	20.00	9.05	12.00	4.23	4.00
3633	Libner Grain Co., Inc., Norwalk, Conn. 20% Libner's Blue Ribbon Dairy Ration	Norwalk: Libner Grain Co., Inc.	10.88	20.88	20.00	6.93	9.00	4.13	4.00
3634	Libner Grain Co., Inc., Norwalk, Conn. 24% Libner's Blue Ribbon Dairy Ration	Norwalk: Libner Grain Co., Inc.	10.68	24.94	24.00	6.78	9.00	4.45	4.50
3113	C. W. Lines Co., New Britain, Conn. Mill Pride Dairy Ration	New Britain: C. W. Lines Co.	10.45	24.63	24.00	8.02	10.00	4.53	5.00
2279	Litchfield County Co-op. Assoc., Torrington, Conn. Common Sense Dairy Ration	Torrington: Litchfield County Co-op. Assoc.	9.85	20.69	20.00	7.23	9.00	4.53	4.50
1912	Long Hill Feed Store, Long Hill, Conn. Square Deal Dairy Ration	Long Hill: Long Hill Feed Store	8.90	19.75	20.00	9.24	10.00	4.30	5.00
3564	E. Manchester & Sons, Winsted, Conn. Red Star Special Dairy Feed	Winsted: E. Manchester & Sons	10.68	21.00	20.00	7.20	10.00	4.65	4.00

TABLE I. ANALYSES OF COMMERCIAL FEEDS, INSPECTION OF 1933—*Continued*

Station No.	Manufacturer and brand	Retail dealer	Pounds per hundred: Water	Protein (N x 6.25): Found	Protein (N x 6.25): Guaranteed, not less than	Fiber: Found	Fiber: Guaranteed, not more than	Fat: Found	Fat: Guaranteed, not less than
	Proprietary Mixed Feeds—*Continued* Dairy feeds—*Continued*		%	%	%	%	%	%	%
3563	E. Manchester & Sons, Winsted, Conn. Sweet Sixteen Red Star Dairy Feed	Winsted: E. Manchester & Sons	11.13	18.63	16.00	7.35	10.00	4.90	4.00
3705	Maritime Milling Co., Inc., Buffalo, N. Y. B-B Marmico 16% Protein Dairy Feed with Molasses	Collinsville: Chas. H. LeGeyt	10.73	18.31	16.00	10.78	12.00	4.38	4.00
3704	Maritime Milling Co., Inc., Buffalo, N. Y. Bull Brand "24" Dairy Ration, Sweetened	Collinsville: Chas. H. LeGeyt	9.78	25.13	24.00	9.30	11.00	4.55	4.50
3799	Maritime Milling Co., Inc., Buffalo, N. Y. Sweetened Bull Brand "20" Dairy Ration	Windsor: Lewis Bros.	10.08	20.81	20.00	7.23	11.00	2.80	4.50
3481	Maritime Milling Co., Inc., Buffalo, N. Y. Sweetened Dollar Maker 20% Protein Dairy Feed	Meriden: Meriden Grain & Coal Co.	10.75	21.63	20.00	10.33	12.00	3.53	3.50
3523	Maritime Milling Co., Inc., Buffalo, N. Y. Sweetened Dollar Maker 24% Protein Dairy Feed	Brookfield: S. A. Smith & Son	10.30	24.00	24.00	10.03	12.00	3.43	3.50
2239	Meech & Stoddard, Inc., Middletown, Conn. Red Wing 20% Dairy Ration	Meriden: Meriden Grain & Coal Co.	10.13	21.75	20.00	7.35	12.00	4.90	5.00
2240	Meech & Stoddard, Inc., Middletown, Conn. Red Wing Special 24% Dairy Ration	Meriden: Meriden Grain & Coal Co.	8.93	24.50	24.00	7.70	12.00	6.03	5.00
3677	Geo. Q. Moon & Co., Inc., Binghamton, N. Y. Moon's 20% Dairy Feed with Molasses	Middletown: P. Levson & Son	10.18	20.31	20.00	10.90	11.00	3.80	4.50
3068	Geo. Q. Moon & Co., Inc., Binghamton, N. Y. Moon's 24% Dairy Feed	Stratford: S. Z. Ingersoll	9.40	25.25	24.00	6.60	10.00	4.85	5.00
3678	Geo. Q. Moon & Co., Inc., Binghamton, N. Y. Special A Dairy 20% Ration	Middletown: P. Levson & Son	10.58	21.88	20.00	7.05	10.00	4.13	4.00
3661	Fred C. Morse & Son, Guilford, Conn. Old Mill 20% Dairy Feed	Guilford: Fred C. Morse & Son	10.73	22.63	20.00	7.83	9.00	4.50	4.50
3664	Fred C. Morse & Son, Guilford, Conn. Old Mill 24% Dairy Feed	Guilford: Fred C. Morse & Son	10.48	25.00	24.00	7.13	9.00	4.65	4.75
2161	Ontario Milling Co., Inc., Oswego, N. Y. Big Value 20% Dairy Feed with Molasses	Middletown: P. Levson & Son	11.18	21.88	20.00	6.85	10.00	4.43	4.50
3553	Ontario Milling Co., Inc., Oswego, N. Y. Oswego 20% Dairy Feed with Molasses	Sharon: Frank A. Wike & Co.	11.18	20.44	20.00	7.10	12.00	3.58	4.00
2163	Ontario Milling Co., Inc., Oswego, N. Y. Oswego 24% Dairy Feed with Molasses	Middletown: P. Levson & Son	10.53	21.94	24.00	6.68	12.00	4.43	4.00
3753	Park & Pollard Co., Buffalo, N. Y. Bet-R-Milk 20% Dairy Ration	Norwich: A. E. Shedd	10.75	18.75	20.00	7.40	9.00	3.60	4.00
3501	Park & Pollard Co., Buffalo, N. Y. Claco Dairy Ration	West Cheshire: Cheshire Grain & Coal Co.	10.75	21.75	20.00	6.78	9.00	4.40	4.50
3588	Park & Pollard Co., Buffalo, N. Y. Fawthrop's Special 20% Dairy Ration	Cromwell: Walter Fawthrop	11.83	22.13	20.00	5.80	9.00	3.48	3.50
2202	Park & Pollard Co., Buffalo, N. Y. Holcomb's Sweetened 20% Dairy Ration	Newtown: R. H. Holcomb & Co.	10.53	21.44	20.00	7.75	9.00	4.23	4.00
3567	Park & Pollard Co., Buffalo, N. Y. Milk Maid 24% Sweetened Dairy Ration	East Winsted: Leonard Grain Co.	11.38	21.88	24.00	7.55	11.00	3.90	4.50

TABLE I. ANALYSES OF COMMERCIAL FEEDS, INSPECTION OF 1933—*Continued*

Station No.	Manufacturer and brand	Retail dealer	Pounds per hundred						
			Water	Protein (N x 6.25)		Fiber		Fat	
				Found	Guaranteed, not less than	Found	Guaranteed, not more than	Found	Guaranteed, not less than
	Proprietary Mixed Feeds—*Continued* Dairy feeds—*Continued*		%	%	%	%	%	%	%
3568	Park & Pollard Co., Buffalo, N. Y. Overall 24% Dairy Ration	East Winsted: Leonard Grain Co.	10.25	24.19	24.00	7.60	9.00	4.55	4.50
3754	Park & Pollard Co., Buffalo, N. Y. Top Notch 16% Dairy Ration	Norwich: A. E. Shedd	9.55	17.31	16.00	9.65	12.00	3.73	3.50
1977	Park & Pollard Co., Buffalo, N. Y. Yankee Dairy Ration	Plainville: State Farmers' Co-op. Assoc.	11.05	20.25	20.00	6.27	9.00	3.10	3.50
4133	H. C. Puffer Co., Springfield, Mass. 20% Producer Dairy Feed	Simsbury: H. B. Bunnell & Co.	9.85	22.63	20.00	6.70	8.50	4.40	3.50
3153	H. C. Puffer Co., Springfield, Mass. 24% Producer Dairy Feed	Simsbury: H. B. Bunnell & Co.	9.90	27.50	24.00	7.30	8.50	4.60	4.00
4154	The Quaker Oats Co., Chicago, Ill. Quaker 16% Protein Dairy Ration	Manufacturer's sample	6.65	16.63	16.00	12.73	13.50	3.70	3.50
4153	The Quaker Oats Co., Chicago, Ill. Quaker 20% Protein Dairy Ration	Manufacturer's sample	6.95	21.25	20.00	11.50	12.00	3.98	3.25
4155	The Quaker Oats Co., Chicago, Ill. Quaker 24% Protein Dairy Ration	Manufacturer's sample	6.60	25.94	24.00	11.50	12.00	4.38	4.00
3387	Ralston Purina Co., St. Louis, Mo. Protena 16% Dairy Feed	New Milford: W. L. Richmond & Son	12.50	21.25	16.00	7.34	14.00	5.03	3.00
3604	Ralston Purina Co., St. Louis, Mo. Protena 20% Dairy Feed	Waterbury: Waterbury Feed Store	12.35	21.88	20.00	6.80	14.00	4.03	3.00
3845	Ralston Purina Co., St. Louis, Mo. Protena 24% Dairy Feed (Buffalo Mill)	Stratford: Farmers' Flour & Grain Co.	9.33	24.63	24.00	10.10	14.00	4.15	3.00
3468	Ralston Purina Co., St. Louis, Mo. Purina 20% Cow Chow	Wallingford: A. E. Hall	10.90	22.25	20.00	9.85	12.00	3.93	3.00
3603	Ralston Purina Co., St. Louis, Mo. Purina 24% Cow Chow	Waterbury: Waterbury Feed Store	11.45	25.19	24.00	9.85	12.00	4.38	3.00
2189	Seymour Grain & Coal Co., Seymour, Conn. 18% Dairy Ration	Seymour: Seymour Grain & Coal Co.	9.83	19.69	18.00	9.78	10.00	3.88	4.00
3063	Seymour Grain & Coal Co., Seymour, Conn. 18% Dairy Ration	Seymour: Seymour Grain & Coal Co.	10.10	19.81	18.00	10.69	10.00	4.08	4.00
3051	Seymour Grain & Coal Co., Seymour, Conn. Miracle Cow Feed	Seymour: Seymour Grain & Coal Co.	10.20	21.25	20.00	7.76	9.00	4.93	4.25
3462	Seymour Grain & Coal Co., Seymour, Conn. See-More Milk Dairy Feed	Seymour: Seymour Grain & Coal Co.	11.10	21.00	20.00	6.90	8.50	5.00	4.50
2157	Ike Sovitsky, Ansonia, Conn. Ansonia 20% Sweetened Dairy Feed	Ansonia: Ike Sovitsky	8.85	20.75	20.00	9.25	11.00	4.50	4.50
3593	Ike Sovitsky, Ansonia, Conn. Conn. State Open Formula Dairy Ration	Ansonia: Ike Sovitsky	11.05	21.19	20.00	9.00	9.00	4.30	4.50
3555	St. Albans Grain Co., St. Albans, Vt. Hygrade 16 Sweetened Milk Ration	Canaan: Community Service Stores	12.43	17.00	16.00	6.70	8.50	4.00	3.50
3104	St. Albans Grain Co., St. Albans, Vt. Hygrade 20% Sweetened Milk Ration	Meriden: H. Grulich	11.80	18.63	20.00	5.83	8.50	3.98	3.50
3402	St. Albans Grain Co., St. Albans, Vt. Hygrade 20% Sweetened Milk Ration	Meriden: H. Grulich	12.78	20.88	20.00	6.11	8.50	4.18	3.50
3545	St. Albans Grain Co., St. Albans, Vt. Hygrade 24 Sweetened Milk Ration	Kent: H. H. Taylor & Son	11.65	27.25	24.00	6.65	9.00	4.05	3.50
3894	St. Albans Grain Co., St. Albans, Vt. Paragon Dairy Feed	Stepney: M. Nusbaum	9.18	21.06	20.00	10.73	11.00	4.23	3.25
3134	St. Albans Grain Co., St. Albans, Vt. Utility Dairy Ration	New Milford: Geo. T. Soule & Co.	10.65	20.50	20.00	9.65	10.50	3.45	3.50
3556	St. Albans Grain Co., St. Albans, Vt. Wirthmore 16 Dairy Ration, Sweetened	Canaan: Community Service Stores	12.68	16.00	16.00	6.15	8.00	3.95	4.00

TABLE I. ANALYSES OF COMMERCIAL FEEDS, INSPECTION OF 1933—*Continued*

Station No.	Manufacturer and brand	Retail dealer	Pounds per hundred: Water	Protein (N x 6.25): Found	Protein (N x 6.25): Guaranteed, not less than	Fiber: Found	Fiber: Guaranteed, not more than	Fat: Found	Fat: Guaranteed, not less than
	Proprietary Mixed Feeds—*Continued* *Dairy feeds—Concluded*		%	%	%	%	%	%	%
3012	St. Albans Grain Co., St. Albans, Vt. Wirthmore 20 Dairy Feed, Sweetened	Cheshire: Center Grain Co.	10.63	20.25	20.00	6.98	8.00	4.65	4.75
3638	St. Albans Grain Co., St. Albans, Vt. Wirthmore 25 Balanced Ration, Sweetened	Noroton Heights: Davis Grain Co.	10.73	25.13	25.00	7.95	8.50	4.65	4.75
3037	D. A. Stickell & Sons, Inc., Hagerstown, Md. Stickell's Certified 20% Ration	Derby: Derby Feed Store	10.38	22.19	20.00	7.89	8.00	5.00	4.00
3620	Syracuse Milling Co., Syracuse, N. Y. Onondaga Dairy Feed, Sweetened	East Bridgeport: J. Simon	10.50	20.81	20.00	9.48	12.00	4.13	4.00
3674	Syracuse Milling Co., Syracuse, N. Y. Syragold Dairy Feed	Higganum: Felix Petrofsky	9.33	24.69	24.00	7.70	12.00	5.09	4.50
2024	Syracuse Milling Co., Syracuse, N. Y. Syragold Dairy Feed, Sweetened	So. Norwalk: Ferris-Devine Co.	9.93	25.00	24.00	7.85	12.00	4.60	4.50
3796	Syracuse Milling Co., Syracuse, N. Y. Syragold Milk Ration	Cobalt: Ed. Elkins	9.70	21.13	20.00	8.25	12.00	4.55	4.00
3851	Syracuse Milling Co., Syracuse, N. Y. Syragold Milk Ration, Sweetened	Saugatuck: Saugatuck Grain Co.	9.50	22.38	20.00	7.85	12.00	4.60	4.00
3577	Thomaston Supply Co., Inc., Thomaston, Conn. Thomaston Dairy Ration	Thomaston: Thomaston Supply Co., Inc.	11.10	21.63	20.00	8.20	9.00	4.89	5.00
3135	Tioga-Empire Feed Mills, Inc., Waverly, N. Y. E-Gee Dairy Feed	New Milford: Geo. T. Soule & Co.	11.50	22.25	20.00	6.68	10.00	3.70	3.50
2021	Tioga-Empire Feed Mills, Inc., Waverly, N.Y. Red Brand Ti-O-Ga Dairy Feed	So. Norwalk: Roodner Feed Co.	10.18	25.00	24.00	7.03	10.00	4.20	4.50
3645	Jacob Trinley & Sons, Linfield, Pa. Favorite 20% Dairy Feed	Cos Cob: A. R. Belmont	10.75	21.88	20.00	9.35	10.50	3.85	4.00
1899	Jacob Trinley & Sons, Linfield, Pa. Trinley's 24% Dairy Feed	Stratford: Farmers' Flour & Grain Co.	10.03	24.38	24.00	5.25	10.00	3.73	4.00
3642	Wayne County Grangers Feed Corp., Clyde, N. Y. Clyde 20% Dairy Feed	Cos Cob: A. R. Belmont	11.48	21.31	20.00	8.20	8.50	4.08	4.00
3643	Wayne County Grangers Feed Corp., Clyde, N. Y. Galen 24% Dairy	Cos Cob: A. R. Belmont	11.05	23.38	24.00	8.05	8.50	4.08	4.00
3561	West-Nesbitt, Inc., Oneonta, N. Y. All Pure 20% Milk Ration	Winsted: Chas. R. Hawley	10.20	22.38	20.00	8.40	10.00	4.15	4.50
3560	West-Nesbitt, Inc., Oneonta, N. Y. Pure Feed Dairy Ration	Winsted: Chas. R. Hawley	9.93	23.50	20.00	7.95	10.00	4.03	4.00
3852	West-Nesbitt, Inc., Oneonta, N. Y. Super Pure Sweetfeed Dairy Ration	Georgetown: Connery Bros.	9.28	24.75	24.00	8.15	10.00	4.28	4.50
2170	Wolf's Feed Store, Shelton, Conn. Wolf's 20% Dairy Ration	Shelton: Wolf's Feed Store	9.03	22.56	20.00	7.60	9.00	4.78	4.50
3610	Yantic Grain & Products Co., Norwich, Conn. Columbia Dairy Feed	Naugatuck: Naugatuck Grain Co.	10.23	21.50	20.00	10.15	12.00	4.80	3.75
3768	Yantic Grain & Products Co., Norwich, Conn. Big (Y) Dairy 16%	Norwich: Yantic Grain & Products Co.	11.10	20.06	16.00	6.80	9.00	4.48	4.00
1943	Yantic Grain & Products Co., Norwich, Conn. Big (Y) Dairy 20%	Mt. Carmel: Hamden Grain Co.	10.13	22.06	20.00	7.20	9.00	5.65	4.75
3671	Yantic Grain & Products Co., Norwich, Conn. Big (Y) Dairy 24%	East Haddam: East Haddam Grain Co.	10.43	25.00	24.00	6.88	9.00	4.75	4.75
3159	Yantic Grain & Products Co., Norwich, Conn. O.F.D. Ration, 20%	Tariffville: Tariffville Grain Co.	11.35	22.88	20.00	7.38	9.00	4.10	4.00
3693	Yantic Grain & Products Co., Norwich, Conn. O.F.D. Ration, 24%	East Hartford: East Hartford Grain Store	10.75	25.19	24.00	6.70	9.00	3.90	4.00

TABLE I. ANALYSES OF COMMERCIAL FEEDS, INSPECTION OF 1933—*Continued*

Station No.	Manufacturer and brand	Retail dealer	Pounds per hundred: Water	Protein (N x 6.25): Found	Protein (N x 6.25): Guaranteed, not less than	Fiber: Found	Fiber: Guaranteed, not more than	Fat: Found	Fat: Guaranteed, not less than
	Proprietary Mixed Feeds—*Continued*								
	Stock feeds		%	%	%	%	%	%	%
3049	Allied Mills, Inc., Chicago, Ill. Amco 12% Fitting Ration	Ansonia: A. Hodos & Son	12.85	12.50	12.00	5.20	9.00	4.60	3.00
4137	Arcady Farms Milling Co., Chicago, Ill. Arcady	Ansonia: Farmers Feed & Grain Co.	8.45	9.50	9.00	16.40	12.00	3.10	3.50
2118	E. W. Bailey & Co., Montpelier, Vt. Bailey's Fitting Ration	Lebanon: Berkman Grain Co.	10.48	14.56	14.00	6.83	9.00	4.85	4.00
2117	E. W. Bailey & Co., Montpelier, Vt. Pennant Brand	Lebanon: Berkman Grain Co.	8.93	10.88	9.50	8.90	9.50	5.28	4.00
3760	E. W. Bailey & Co., Montpelier, Vt. Sweetened Bailey's Fitting Ration	Lebanon: Berkman Grain Co.	9.55	15.81	14.00	7.00	9.00	5.40	4.00
3731	E. W. Bailey & Co., Montpelier, Vt. Sweetened with Molasses Pennant	Mansfield Depot: M. M. Hansen	10.40	10.38	9.50	9.03	9.50	4.33	4.00
3621	Beacon Milling Co., Inc., Cayuga, N. Y. Beacon Fitting Ration	Bridgeport: H. C. Ferris	11.50	16.19	15.00	6.30	8.00	4.03	4.00
3543	Beacon Milling Co., Inc., Cayuga, N. Y. Cayuga	New Milford: W. L. Richmond & Son	11.13	16.69	15.00	8.30	9.00	5.58	3.50
3776	C. W. Campbell Co., Westerly, R. I. Campbell Fitting Ration	Westerly: C. W. Campbell Co.	10.53	14.56	14.00	7.90	8.00	4.43	4.00
2019	Crosby Milling Co., Brattleboro, Vt. Crosby's	So. Norwalk: Roodner Feed Co.	9.68	9.56	9.00	11.55	12.00	5.00	4.00
3086	P. Cutler, Inc., Colchester, Conn. Prosperity	Colchester: P. Cutler Inc.	10.65	10.63	9.00	10.68	12.00	4.83	4.00
2186	R. G. Davis & Sons, Inc., New Haven, Conn. Davis	Ansonia: Ansonia Flour & Grain Co.	7.45	11.00	10.00	11.75	14.00	4.78	2.00
3031	Delaware Mills, Inc., Deposit, N. Y. Delaware	Manchester: Manchester Grain Co.	9.88	11.19	9.00	10.62	12.00	6.48	3.00
2107	Dietrich & Gambrill, Inc., Frederick, Md. Frederick	Norwich: A. E. Shedd	10.63	7.88	7.50	12.48	12.00	3.68	3.00
2100	Eastern States Farmers' Exchange, Springfield, Mass. Eastern States Fitting Ration	Clinton: A. L. Lockwood	13.00	12.63	12.00	5.13	7.00	4.00	3.50
3699	Elmore Milling Co., Inc., Oneonta, N. Y. Elmore	Hazardville: Amos D. Bridge's Sons	8.65	10.31	10.00	10.25	12.00	5.60	3.00
3456	John W. Eshelman & Sons, Lancaster, Pa. Eshelman Red Rose	Ansonia: A. Hodos & Son	10.00	9.50	9.00	10.98	11.00	3.23	3.00
3745	John W. Eshelman & Sons, Lancaster, Pa. Eshelman SOS Feed	Danielson: Kennedy Corp.	11.05	13.50	11.00	15.13	15.00	2.45	2.00
3687	D. H. Grandin Milling Co., Jamestown, N. Y. Grandin's	Manchester: O. E. Bailey	10.20	9.38	8.50	9.45	12.00	4.18	4.00
3010	Hales & Hunter Co., Chicago, Ill. H & H White	Mt. Carmel: Mt. Carmel Grain Store	10.65	12.13	10.00	5.75	12.00	4.55	2.50
3212	J. H. Ham Co., Auburn, Maine. Farmer Boy	Stafford Springs: Stafford Farmers' Co-op. Assoc.	12.50	12.50	10.00	9.85	12.00	3.60	3.00
3632	Libner Grain Co., Inc., Norwalk, Conn. 12% Libner's Blue Ribbon Fitting Ration	Norwalk: Libner Grain Co., Inc.	12.03	14.13	12.00	6.45	10.00	4.30	4.00
2270	Maritime Milling Co., Inc., Buffalo, N. Y. B.B. Dealers Mixing Feed with Molasses	Thomaston: Thomaston Supply Co.	12.75	10.63	10.00	9.28	12.00	3.58	3.50
3586	Meech & Stoddard, Inc., Middletown, Conn. Red Wing Special	Middletown: Meech & Stoddard, Inc.	11.68	9.69	9.00	9.95	12.00	3.85	3.00
3673	Geo. Q. Moon & Co., Inc., Binghamton, N. Y. Moon's	Higganum: Felix Petrofsky	9.23	11.13	9.00	11.78	12.00	5.15	3.00
3663	Fred C. Morse & Son, Guilford, Conn. Old Mill Fitting Feed	Guilford: Fred C. Morse & Son	12.30	14.75	12.00	5.53	8.00	4.15	4.00

TABLE I. ANALYSES OF COMMERCIAL FEEDS, INSPECTION OF 1933—*Continued*

Station No.	Manufacturer and brand	Retail dealer	Pounds per hundred: Water	Protein (N x 6.25): Found	Protein (N x 6.25): Guaranteed, not less than	Fiber: Found	Fiber: Guaranteed, not more than	Fat: Found	Fat: Guaranteed, not less than
	Proprietary Mixed Feeds—*Continued* *Stock feeds—Concluded*		%	%	%	%	%	%	%
3895	Park & Pollard Co., Buffalo, N. Y. Feed Meal	Torrington: Torrington Grain Co.	11.30	10.69	9.00	3.48	4.00	4.30	2.50
3735	Park & Pollard Co., Buffalo, N. Y. Park & Pollard Fitting Ration	Putnam: Bosworth Bros.	11.73	14.50	12.00	6.18	7.00	4.38	3.50
3608	Park & Pollard Co., Buffalo, N. Y. Park & Pollard	Waterbury: Spencer Grain Co.	8.83	9.56	8.50	9.30	12.00	4.98	4.00
3766	The Quaker Oats Co., Chicago, Ill. Barley Feed	Norwich: Yantic Grain & Products Co.	8.70	15.00	12.00	8.45	12.00	3.58	3.00
3517	The Quaker Oats Co., Chicago, Ill. Quaker Schumacher Feed	Danbury: C. S. Barnum & Son	9.50	10.13	10.00	10.35	12.00	3.23	3.00
3117	The Quaker Oats Co., Chicago, Ill. Quaker Sugared Schumacher Feed	Plainville: W. S. Eaton	10.80	8.81	10.00	10.88	12.00	3.03	3.00
3646	Ralston Purina Co., St. Louis, Mo. Purina Bulky Cow Chow	New Canaan: Clapboard Hill Co., Inc.	11.08	17.00	16.00	9.20	12.00	3.03	3.00
3142	Ralston Purina Co., St. Louis, Mo. Purina Fitting Chow	New Milford: W. L. Richmond & Son	14.40	14.38	13.50	9.86	12.00	3.15	2.60
3461	Seymour Grain & Coal Co., Seymour, Conn. Miracle Fitting Ration	Seymour: Seymour Grain & Coal Co.	11.75	14.88	12.00	6.45	8.00	4.43	4.00
2184	Ike Sovitsky, Ansonia, Conn. Ansonia	Ansonia: Ike Sovitsky	8.90	8.94	8.00	10.48	15.00	4.33	2.00
3072	St. Albans Grain Co., St. Albans, Vt. Hygrade Fitting Ration	New Haven: R. G. Davis & Sons, Inc.	12.63	14.00	12.00	5.05	8.00	4.03	4.50
3071	St. Albans Grain Co., St. Albans, Vt. Utility Pasture Ration	New Haven: R. G. Davis & Sons, Inc.	10.95	14.63	14.00	11.66	13.00	3.13	3.00
3073	St. Albans Grain Co., St. Albans, Vt. Wirthmore 14 Fitting Ration	New Haven: R. G. Davis & Sons, Inc.	12.40	15.44	14.00	5.33	7.00	3.93	4.00
3546	St. Albans Grain Co., St. Albans, Vt. Wirthmore	Kent: H. H. Taylor & Son	11.05	10.44	9.00	8.60	9.50	4.63	4.00
3619	Syracuse Milling Co., Syracuse, N. Y. Syragold	East Bridgeport: J. Simon	10.65	11.00	9.00	9.20	12.00	4.88	3.00
3506	Tioga-Empire Feed Mills, Inc., Waverly, N. Y. Or Co Feed	Bethel: Morrison & Dunham	11.98	21.19	18.00	7.15	12.00	3.55	2.50
2263	Yantic Grain & Products Co., Norwich, Conn. Big Y Fitting Ration	Naugatuck: Naugatuck Grain Co.	12.03	14.56	12.00	5.63	8.00	4.54	4.00
3157	Yantic Grain & Products Co., Norwich, Conn. Big Y	Tariffville: Tariffville Grain Co.	10.13	9.44	9.00	11.85	12.00	4.08	4.00
3694	Yantic Grain & Products Co., Norwich, Conn. Big Y Sugared	East Hartford: East Hartford Grain Store	10.48	8.25	9.00	10.25	12.00	3.95	3.50
	Calf feeds and other products								
4126	Allied Mills, Inc., Chicago, Ill. Emergency Hog Feed	Plainville: Sunshine Feed Store	10.38	14.88	14.00	5.08	7.00	4.93	3.00
3521	Allied Mills, Inc., Chicago, Ill. Wayne Calf Meal	Danbury: C. S. Barnum & Son	9.98	25.63	24.00	6.63	7.00	4.65	4.00
3514	Beacon Milling Co., Inc., Cayuga, N. Y. Beacon Calf Meal	Danbury: C. S. Barnum & Son	10.13	25.63	25.00	2.85	6.00	3.30	3.00
3585	Blatchford Calf Meal Co., Waukegan, Ill. Blatchford Calf Meal	Middletown: Meech & Stoddard, Inc.	10.93	24.69	24.00	4.98	6.75	4.53	5.00
4139	Elmore Milling Co., Inc., Oneonta, N. Y. Elmore "Three Point" Calf Meal	Hazardville: A. D. Bridge's Sons	9.68	25.00	24.00	3.23	4.00	3.68	4.00
3151	John W. Eshelman & Sons, Lancaster, Pa. Eshelman Red Rose Calf Starter	Simsbury: H. B. Bunnell & Co.	10.13	24.00	20.00	4.05	5.00	4.38	3.00
2289	John W. Eshelman & Sons, Lancaster, Pa. Eshelman Red Rose Hog Meal	Simsbury: H. B. Bunnell & Co.	10.15	18.25	16.00	6.15	10.00	4.70	5.00
3660	Larrowe Milling Co., Detroit, Mich. Larro Calf Meal	Branford: S. V. Osborn Est.	9.50	24.38	23.00	3.50	4.00	3.90	4.00

TABLE I. ANALYSES OF COMMERCIAL FEEDS, INSPECTION OF 1933—*Continued*

Station No.	Manufacturer and brand	Retail dealer	Pounds per hundred: Water	Protein (N x 6.25): Found	Protein (N x 6.25): Guaranteed, not less than	Fiber: Found	Fiber: Guaranteed, not more than	Fat: Found	Fat: Guaranteed, not less than
	Proprietary Mixed Feeds—*Continued*								
	Calf feeds and other products —Concluded		%	%	%	%	%	%	%
3703	Larrowe Milling Co., Detroit, Mich. Larro Pork Maker	Unionville: Lawton-Miner Co.	8.63	28.13	25.00	8.20	10.00	6.13	5.00
3736	Park & Pollard Co., Buffalo, N. Y. Go-Tu-It Pig and Hog Ration	Putnam: Bosworth Bros.	10.45	17.50	15.00	6.25	8.00	4.15	3.50
3609	Park & Pollard Co., Buffalo, N. Y. Milkade Calf Meal	Waterbury: Spencer Grain Co.	9.20	25.44	20.00	4.90	6.50	5.60	7.00
3684	The Quaker Oats Co., Chicago, Ill. Schumacher Calf Meal	Manchester: Little & McKinney	8.83	18.25	18.00	2.55	4.00	7.10	7.00
3795	Ralston Purina Co., St. Louis, Mo. Purina Calf Chow	New London: New London Grain Co.	9.80	29.38	27.00	3.23	4.50	3.29	3.20
3708	Ralston Purina Co., St. Louis, Mo. Purina Hog Fatena Chow	New Haven: Moran-Paton Co.	11.43	15.25	14.00	4.70	7.00	3.88	3.00
3726	St. Albans Grain Co., St. Albans, Vt. Wirthmore Calf Meal	Stafford Springs: Valley Grain Co.	10.00	22.94	24.00	3.10	4.00	5.33	5.50
3070	St. Albans Grain Co., St. Albans, Vt. Wirthmore Pig and Hog, A Growing and Fattening Feed	New Haven: R. G. Davis & Sons, Inc.	11.65	17.25	17.00	4.29	9.00	4.13	4.00
	Poultry feeds								
4130	Allied Mills, Inc., Chicago Ill. Empire Egg Mash	Plainville: Sunshine Feed Store	10.10	16.75	16.50	4.95	7.00	5.59	4.00
3897	Allied Mills, Inc., Chicago, Ill. Red Feather Egg Mash	Bristol: A. J. Bower	9.63	19.38	18.00	4.93	8.00	4.38	3.50
3038	Allied Mills, Inc., Chicago, Ill. Red Feather Scratch Feed	Ansonia: A. Hodos & Son	12.68	10.00	9.00	1.86	4.00	2.43	2.50
3039	Allied Mills, Inc., Chicago, Ill. Screened Cracked Corn	Ansonia: A. Hodos & Son	13.90	8.88	8.50	1.13	2.50	2.25	2.50
4132	Allied Mills, Inc., Chicago, Ill. Wayne All Mash Chick Starter	Plainville: Sunshine Feed Store	9.75	19.50	17.00	4.95	6.00	6.15	4.00
1924	Allied Mills, Inc., Chicago, Ill. Wayne All Mash Chick Starter with Cod Liver Oil and Sardine Oil	Bristol: A. J. Bower	10.45	17.81	17.00	4.28	6.00	5.20	4.00
3173	Allied Mills, Inc., Chicago, Ill. Wayne All Mash Grower	Guilford: David Cohen	11.60	15.88	16.00	3.70	6.00	4.00	4.00
1944	Allied Mills, Inc., Chicago, Ill. Wayne All Mash Grower with Cod Liver Oil and Sardine Oil	Bristol: A. J. Bower	10.23	18.56	16.00	4.87	6.00	5.40	4.00
1925	Allied Mills, Inc., Chicago, Ill. Wayne Broiler Ration	Bristol: A. J. Bower	9.90	19.25	18.00	5.08	8.00	6.15	3.50
1926	Allied Mills, Inc., Chicago, Ill. Wayne Chick Feed	Bristol: A. J. Bower	11.65	11.38	9.00	1.34	4.00	3.23	2.00
2216	Allied Mills, Inc., Chicago, Ill. Wayne Egg Mash	Danbury: C. S. Barnum	9.73	19.69	18.00	5.50	7.00	5.70	3.50
3174	Allied Mills, Inc., Chicago, Ill. Wayne Egg Mash with Cod Liver Oil and Sardine Oil	Guilford: David Cohen	10.88	18.38	18.00	5.76	7.00	5.10	3.50
2214	Allied Mills, Inc., Chicago, Ill. Wayne Intermediate Scratch Feed	Danbury: C. S. Barnum	11.90	10.38	10.00	1.88	4.00	2.78	2.00
3713	Allied Mills, Inc., Chicago, Ill. Wayne 26% Mash Supplement	Bristol: A. J. Bower	8.73	27.88	26.00	6.80	8.00	4.39	4.00
3715	Allied Mills, Inc., Chicago, Ill. Wayne Poultry Fattener	Bristol: A. J. Bower	10.23	15.81	13.50	5.48	7.00	4.03	4.00
4129	Allied Mills, Inc., Chicago, Ill. Wayne Scratch Feed	Plainville: Sunshine Feed Store	11.93	10.75	10.00	2.45	4.00	3.12	2.50
3453	Allied Mills, Inc., Chicago, Ill. Wayne Starter and Grower	Ansonia: A. Hodos & Son	10.40	18.13	16.00	5.95	6.00	4.73	3.50
3144	Allied Mills, Inc., Chicago, Ill. Wayne Turkey Mash	Bristol: A. J. Bower	11.03	17.50	15.00	7.75	8.00	5.25	3.50

TABLE I. ANALYSES OF COMMERCIAL FEEDS, INSPECTION OF 1933—*Continued*

Station No.	Manufacturer and brand	Retail dealer	Pounds per hundred: Water	Protein (N x 6.25): Found	Protein (N x 6.25): Guaranteed, not less than	Fiber: Found	Fiber: Guaranteed, not more than	Fat: Found	Fat: Guaranteed, not less than
	Proprietary Mixed Feeds—*Continued* *Poultry feeds—Continued*		%	%	%	%	%	%	%
3714	Allied Mills, Inc., Chicago, Ill. Wayne 25% Turkey Starting Mash	Bristol: A. J. Bower	9.20	25.88	25.00	6.25	8.00	5.76	4.00
3582	Anchor Mills, Hagerstown, Md. Zip Egg Mash	Middlefield: Terrill & Burnham	10.45	19.13	18.00	5.75	6.00	5.43	4.00
1987	Arcady Farms Milling Co., Chicago, Ill. Arcady All Mash Chick Starter and Grower	New Britain: S. P. Strople	10.18	16.75	17.00	5.05	5.00	5.38	5.00
1990	Arcady Farms Milling Co., Chicago, Ill. Arcady Besbet Growing Mash	New Britain: S. P. Strople	10.25	15.50	16.00	6.18	7.50	4.70	4.00
1988	Arcady Farms Milling Co., Chicago, Ill. Arcady Besbet Laying Mash	New Britain: S. P. Strople	9.50	19.75	20.00	5.43	7.00	4.95	4.00
1991	Arcady Farms Milling Co., Chicago, Ill. Arcady Besbet Starting Mash	New Britain: S. P. Strople	11.30	13.69	13.00	5.38	6.00	4.65	3.50
2244	Arcady Farms Milling Co., Chicago, Ill. Arcady Scratch Grains	Meriden: Raymond Ives	13.38	10.00	10.00	1.90	5.00	2.93	2.50
1989	Arcady Farms Milling Co., Chicago, Ill. Riverside Scratch Grains	New Britain: S. P. Strople	13.23	9.88	10.00	2.40	5.00	3.23	2.50
2147	E. W. Bailey & Co., Montpelier, Vt. Pennant Brand Chick Starter	West Willington: H. M. Hansen	9.83	17.00	17.00	4.48	5.00	5.48	5.00
2148	E. W. Bailey & Co., Montpelier, Vt. Pennant Brand Coarse Chick Feed	West Willington: H. M. Hansen	11.20	12.13	10.00	2.08	3.00	3.83	3.00
2149	E. W. Bailey & Co., Montpelier, Vt. Pennant Brand Fine Chick Feed	West Willington: H. M. Hansen	12.13	11.88	10.00	1.33	3.00	2.85	3.00
2119	E. W. Bailey & Co., Montpelier, Vt. Pennant Brand Laying Mash	Lebanon: Berkman Grain Co.	9.98	21.88	20.00	4.18	6.00	4.80	5.00
3729	E. W. Bailey & Co., Montpelier, Vt. Pennant Growing Feed	West Willington: H. M. Hansen	10.13	17.25	15.00	4.15	5.00	4.62	5.00
3793	E. W. Bailey & Co., Montpelier, Vt. Pennant Laying Mash (with Cod Liver Meal)	New London: B. J. McCarthy	10.05	22.13	20.00	4.53	6.00	4.53	5.00
2122	E. W. Bailey & Co., Montpelier, Vt. Pennant Scratch Feed	Lebanon: Berkman Grain Co.	11.58	11.31	10.00	2.58	6.50	2.73	3.00
2213	Beacon Milling Co., Inc., Cayuga, N. Y. Beacon Broiler Feed	Danbury: C. S. Barnum & Son	10.30	17.88	17.00	4.43	6.00	4.90	4.00
1932	Beacon Milling Co., Inc., Cayuga, N. Y. Beacon's Cayuga Developer Feed	Bridgeport: Herbert C. Ferris	12.10	11.38	10.00	1.61	5.00	3.50	2.50
1902	Beacon Milling Co., Inc., Cayuga, N. Y. Beacon's Cayuga Growing Mash	Bridgeport: Herbert C. Ferris	10.45	17.06	16.00	5.28	7.00	4.70	4.00
1904	Beacon Milling Co., Inc., Cayuga, N. Y. Beacon Cayuga Laying Mash with Buttermilk	Bridgeport: Herbert C. Ferris	9.98	20.75	20.00	5.34	7.00	5.08	4.00
2166	Beacon Milling Co., Inc., Cayuga, N. Y. Beacon's Cayuga Scratch Feed	Shelton: Shelton Feed Co.	13.03	10.88	9.00	2.55	5.00	2.40	2.50
2165	Beacon Milling Co., Inc., Cayuga, N. Y. Beacon Chick Feed	Shelton: Shelton Feed Co.	11.55	11.38	10.00	1.45	3.50	4.13	2.50
1903	Beacon Milling Co., Inc., Cayuga, N. Y. Beacon's Complete Starting Ration	Bridgeport: Herbert C. Ferris	10.18	18.31	17.50	4.00	6.00	4.25	4.00
1905	Beacon Milling Co., Inc., Cayuga, N. Y. Beacon Egg Mash with Buttermilk	Bridgeport: Herbert C. Ferris	9.60	22.88	22.00	5.13	7.00	4.90	4.50
3623	Beacon Milling Co., Inc., Cayuga, N. Y. Beacon Fleshing Mash and Crate Fattener	Bridgeport: Herbert C. Ferris	9.38	17.00	15.00	4.48	5.00	4.37	4.50

TABLE I. ANALYSES OF COMMERCIAL FEEDS, INSPECTION OF 1933—*Continued*

Station No.	Manufacturer and brand	Retail dealer	Pounds per hundred: Water	Protein (N x 6.25): Found	Protein (N x 6.25): Guaranteed, not less than	Fiber: Found	Fiber: Guaranteed, not more than	Fat: Found	Fat: Guaranteed, not less than
	Proprietary Mixed Feeds—*Continued* *Poultry feeds—Continued*		%	%	%	%	%	%	%
1901	Beacon Milling Co., Inc., Cayuga, N. Y. Beacon Growing Mash	Bridgeport: Herbert C. Ferris	9.95	18.38	17.00	5.08	7.00	4.48	4.00
3228	Beacon Milling Co., Inc., Cayuga, N. Y. Beacon Pheasant-Quail Starter and Grower Mash	Bridgeport: Herbert C. Ferris	9.13	22.88	22.00	5.95	6.00	4.88	4.00
3651	Beacon Milling Co., Inc., Cayuga, N. Y. Beacon Scratch Grains	Danbury: C. S. Barnum & Son	12.10	10.00	9.00	2.30	5.00	2.37	2.00
3626	Beacon Milling Co., Inc., Cayuga, N. Y. Beacon Special Coccidiosis Mash	Bridgeport: Herbert C. Ferris	9.30	19.50	18.00	2.85	5.00	2.68	1.00
2217	Beacon Milling Co., Inc., Cayuga, N. Y. Beacon Special Scratch Grains	Danbury: C. S. Barnum & Son	13.20	11.19	9.00	2.48	3.50	2.50	2.00
3143	Beacon Milling Co., Inc., Cayuga, N. Y. Beacon Turkey Growing Feed	New Milford: W. L. Richmond & Son	9.78	20.25	18.00	5.71	7.00	5.23	4.00
3077	Black Rock Milling Corp., Buffalo, N. Y. Bidwell Dry Mash	New London: New London Grain Co.	11.48	20.13	18.00	5.32	8.00	4.30	3.00
2203	Black Rock Milling Corp., Buffalo, N. Y. Bidwell Scratch Feed	Newtown: R. H. Holcomb & Co.	13.23	10.31	10.00	2.30	5.00	3.10	1.50
200[illegible]	C. Buckingham & Co., Southport, Conn. C.B. Growing Mash	Southport: C. Buckingham & Co.	9.43	16.31	15.00	4.53	6.00	5.70	4.00
2002	C. Buckingham & Co., Southport, Conn. C.B. Egg Mash	Southport: C. Buckingham & Co.	9.05	20.38	19.00	5.95	8.00	5.78	5.00
2001	C. Buckingham & Co., Southport, Conn. C.B. Scratch Feed	Southport: C. Buckingham & Co.	12.35	11.63	10.00	2.80	3.80	2.25	2.50
2004	C. Buckingham & Co., Southport, Conn. C.B. Starter	Southport: C. Buckingham & Co.	9.35	19.19	17.00	4.20	5.00	5.35	4.00
2105	C. W. Campbell Co., Westerly, R. I. Egg-O Chick Feed	Groton: C. W. Campbell Co.	11.53	11.63	10.00	1.45	5.00	3.05	2.00
3080	C. W. Campbell Co., Westerly, R. I. Egg-O Chick Starter	Groton: C. W. Campbell Co.	10.55	20.25	17.00	5.58	5.00	4.98	4.00
3082	C. W. Campbell Co., Westerly, R. I. Egg-O Growing Feed	Groton: C. W. Campbell Co.	10.85	20.75	18.00	5.73	8.00	4.15	4.00
3083	C. W. Campbell Co., Westerly, R. I. Egg-O Intermediate	Groton: C. W. Campbell Co.	12.73	11.88	10.00	1.45	4.00	3.50	2.00
2102	C. W. Campbell Co., Westerly, R. I. Egg-O Laying Mash	Groton: C. W. Campbell Co.	9.93	20.44	18.00	7.20	8.00	5.00	4.00
2104	C. W. Campbell Co., Westerly, R. I. Egg-O Scratch	Groton: C. W. Campbell Co.	12.18	11.44	10.00	2.55	5.00	2.68	2.00
3791	C. W. Campbell Co., Westerly, R. I. Egg-O Turkey Grower	Westerly: C. W. Campbell Co.	9.35	22.88	20.00	7.05	8.00	5.70	5.00
3100	The Coles Co., Middletown, Conn. Fortune Chick Starter	Middletown: The Coles Co.	11.10	17.56	14.00	3.80	5.00	5.65	5.00
3098	The Coles Co., Middletown, Conn. Fortune Egg Mash with Dried Buttermilk	Middletown: The Coles Co.	11.85	20.69	17.00	4.95	9.00	5.00	3.50
3101	The Coles Co., Middletown, Conn. Fortune Growing Feed with Cod Liver Oil	Middletown: The Coles Co.	11.65	16.81	18.00	3.80	5.00	5.58	4.00
3099	The Coles Co., Middletown, Conn. Fortune Intermediate Scratch	Middletown: The Coles Co.	13.68	10.81	10.00	2.06	3.00	2.33	5.00
2233	The Coles Co., Middletown, Conn. Fortune Scratch Feed	Wallingford: Laden Bros. Co., Inc. ...	11.88	11.19	10.00	2.13	5.00	2.93	2.50
3045	The G. E. Conkey Co., Cleveland, Ohio. Conkey's All Mash Chick Ration with Y-O	Ansonia: A. Hodos & Son	11.53	16.13	16.00	4.54	5.50	5.75	4.50

TABLE I. ANALYSES OF COMMERCIAL FEEDS, INSPECTION OF 1933—*Continued*

Station No.	Manufacturer and brand	Retail dealer	Pounds per hundred: Water	Protein (N x 6.25): Found	Protein (N x 6.25): Guaranteed, not less than	Fiber: Found	Fiber: Guaranteed, not more than	Fat: Found	Fat: Guaranteed, not less than
	Proprietary Mixed Feeds—*Continued* *Poultry feeds—Continued*		%	%	%	%	%	%	%
3454	The G. E. Conkey Co., Cleveland, Ohio. Conkey's Gecco Egg Mash	Ansonia: A. Hodos & Son	10.78	20.38	20.00	4.73	7.00	5.28	5.00
3455	The G. E. Conkey Co., Cleveland, Ohio. Conkey's Gecco Egg Mash with Y-O	Ansonia: A. Hodos & Son	11.68	20.63	20.00	5.00	7.00	4.85	5.00
3048	The G. E. Conkey Co., Cleveland, Ohio. Conkey's Gecco Growing Mash	Ansonia: A. Hodos & Son	11.68	18.19	18.00	5.33	7.00	5.03	4.50
3057	The G. E. Conkey Co., Cleveland, Ohio. Conkey's Gecco Growing Mash with Buttermilk and Y-O	New Haven: Frank S. Platt Co.	11.75	18.19	18.00	4.82	7.00	5.20	5.00
3639	The G. E. Conkey Co., Cleveland, Ohio. Conkey's Gecco Scratch Grains	Cos Cob: A. R. Belmont	11.85	10.63	9.00	1.95	3.50	2.58	2.00
3041	The G. E. Conkey Co., Cleveland, Ohio. Conkey's Geccofat Station Fattener	Ansonia: A. Hodos & Son	10.50	14.00	12.50	5.22	5.00	6.45	4.50
3040	The G. E. Conkey Co., Cleveland, Ohio. Conkey's Scratch Grains	Ansonia: A. Hodos & Son	13.23	11.00	9.50	2.28	3.50	2.55	2.00
2132	The G. E. Conkey Co., Cleveland, Ohio. Superior Scratch Grains	Amston: Amston Grain Mill	14.00	9.38	9.00	2.00	3.50	2.60	2.00
2204	Consumers Food Stores, Inc., Bridgeport, Conn. Gold Bond "All Mash" Starter	Bethel: Consumers Food Stores, Inc.	10.35	20.31	17.00	5.90	5.00	5.85	4.00
2206	Consumers Food Stores, Inc., Bridgeport, Conn. Gold Bond Baby Chick Feed	Bethel: Consumers Food Stores, Inc.	11.25	10.38	9.00	1.35	5.00	3.50	2.50
3505	Consumers Food Stores, Inc., Bridgeport, Conn. Gold Bond Egg Mash	Bethel: Consumers Food Stores, Inc.	14.66	20.75	20.00	6.45	7.00	3.19	4.00
2197	Consumers Food Stores, Inc., Bridgeport, Conn. Gold Bond Growing Mash	Sandy Hook: Consumers Food Stores, Inc.	10.05	18.38	17.00	6.18	6.00	5.10	4.50
3504	Consumers Food Stores, Inc., Bridgeport, Conn. Gold Bond Intermediate Chick Feed	Sandy Hook: Consumers Food Stores, Inc.	12.00	12.13	9.00	2.00	5.00	2.41	2.50
2192	Consumers Food Stores, Inc., Bridgeport, Conn. Gold Bond Scratch Feed	Sandy Hook: Consumers Food Stores, Inc.	11.10	10.19	9.00	1.83	4.00	2.45	2.50
4145	E. A. Cowee Co., Fitchburg, Mass. Coweco Growing Mash	Quinebaug: M. T. Dartt	8.73	18.38	14.00	4.25	6.00	6.55	4.50
3223	E. A. Cowee Co., Fitchburg, Mass. Coweco Laying Mash	Quinebaug: M. T. Dartt	9.20	22.50	20.00	4.60	7.50	6.48	4.00
4143	E. A. Cowee Co., Fitchburg, Mass. Coweco Scratch Feed	Quinebaug: M. T. Dartt	11.30	11.75	10.00	2.38	3.00	2.55	2.50
1976	C. A. Cowles, Plantsville, Conn. C.A. Blue Seal Mash	Plantsville: C. A. Cowles	9.33	20.00	18.00	7.39	6.00	4.93	4.00
3727	Crosby Milling Co., Brattleboro, Vt. Crosby's Scratch Feed	Stafford Springs: Valley Grain Co.	11.95	11.88	11.00	2.45	5.00	3.03	3.00
3085	P. Cutler, Inc., Colchester, Conn. Prosperity Laying Mash	Colchester: P. Cutler, Inc.	11.15	15.69	16.00	5.97	10.00	5.35	4.00
3088	P. Cutler, Inc., Colchester, Conn. Prosperity Scratch Feed	Colchester: P. Cutler, Inc.	13.55	9.63	10.00	2.15	6.00	2.60	2.00
2185	R. G. Davis & Sons, Inc., New Haven, Conn. Davis Buttermilk Mash	Ansonia: Ansonia Flour & Grain Co.	9.25	20.19	18.00	5.13	7.00	5.15	5.00
1897	R. G. Davis & Sons, Inc., New Haven, Conn. Davis Scratch Feed	Milford: Milford Grain Co.	11.63	12.25	10.00	2.03	5.00	2.63	2.00

TABLE I. ANALYSES OF COMMERCIAL FEEDS, INSPECTION OF 1933—*Continued*

Station No.	Manufacturer and brand	Retail dealer	Pounds per hundred: Water	Protein (N x 6.25): Found	Protein (N x 6.25): Guaranteed, not less than	Fiber: Found	Fiber: Guaranteed, not more than	Fat: Found	Fat: Guaranteed, not less than
	Proprietary Mixed Feeds—*Continued* Poultry feeds—*Continued*		%	%	%	%	%	%	%
3017	Delaware Mills, Inc., Deposit, N. Y. Delaware All Mash Chick Starter	Manchester: Manchester Grain Co. ...	10.55	17.13	15.00	5.91	6.00	5.33	4.00
3019	Delaware Mills, Inc., Deposit, N. Y. Delaware Chick Grains	Manchester: Manchester Grain Co. ...	13.08	10.63	10.00	1.20	3.00	2.98	3.00
1906	Delaware Mills, Inc., Deposit, N. Y. Delaware Chick Starting Mash (with Dried Buttermilk)	Bridgeport: Brooklawn Feed Co.	10.65	17.75	16.00	5.29	5.00	5.13	4.00
1907	Delaware Mills, Inc., Deposit, N. Y. Delaware Growing Mash (with Dried Skim Milk)	Bridgeport: Brooklawn Feed Co.	11.20	17.75	17.00	5.19	6.00	5.28	5.00
3034	Delaware Mills, Inc., Deposit, N. Y. Delaware Intermediate Chick Grains	Manchester: Manchester Grain Co. ...	13.30	11.25	10.00	1.57	5.00	2.63	2.00
3013	Delaware Mills, Inc., Deposit, N. Y. Delaware Scratch Grains	Southington: Southington Lumber Co.	13.03	10.00	10.00	2.39	5.00	2.33	2.50
3035	Delaware Mills, Inc., Deposit, N. Y. Double Circle Scratch Grains	Derby: Derby Feed Store	13.28	12.25	10.00	2.35	5.00	2.50	2.50
3018	Delaware Mills, Inc., Deposit, N. Y. Indian Growing Mash (with Dried Skim Milk)	Manchester: Manchester Grain Co. ...	11.00	16.88	15.00	5.86	7.00	5.00	4.50
1908	Delaware Mills, Inc., Deposit, N. Y. Indian Laying Mash (with Dried Skim Milk)	Bridgeport: Brooklawn Feed Co.	11.53	17.50	18.00	4.93	7.00	5.33	5.00
2108	Dietrich & Gambrill, Inc., Frederick, Md. Gambrill's Chick Feed	Norwich: A. E. Shedd	13.53	10.56	10.00	1.35	3.00	2.58	2.50
4148	Dietrich & Gambrill's Inc., Frederick, Md. Gambrill's Laying Mash	Danielson: Young Bros. Co.	9.13	23.13	20.00	6.20	7.00	5.58	5.00
2112	Dietrich & Gambrill, Inc., Frederick, Md. Gambrill's Scratch Feed	Norwich: A. E. Shedd	14.00	10.81	10.00	2.78	4.00	3.20	2.50
3755	Eastern States Farmers' Exchange, Springfield, Mass. Eastern States Combination Mash	Norwich: A. E. Shedd	9.65	17.19	15.00	5.05	6.50	4.98	4.00
3256	Eastern States Farmers' Exchange, Springfield, Mass. Eastern States Controller Mash	Norwich: A. E. Shedd	8.75	20.75	18.50	2.43	4.00	3.20	2.50
3129	Eastern States Farmers' Exchange, Springfield, Mass. Eastern States Developer Mash	New Milford: Paul Caldwell	10.70	19.25	18.50	5.76	6.50	5.53	4.00
3075	Eastern States Farmers' Exchange, Springfield, Mass. Eastern States Developer Mash with Oil	Clinton: A. L. Lockwood	10.60	18.94	18.50	5.30	6.50	5.20	4.00
3130	Eastern States Farmers' Exchange, Springfield, Mass. Eastern States Intermediate Scratch Grains	New Milford: Paul Caldwell	13.00	10.50	9.50	1.66	3.00	2.38	2.00
3076	Eastern States Farmers' Exchange, Springfield, Mass. Eastern States Producer Mash	Clinton: A. L. Lockwood	10.48	17.94	17.00	5.08	6.50	5.23	4.00
2110	Eastern States Farmers' Exchange, Springfield, Mass. Eastern States Producer Mash with Oil	Norwich: A. E. Shedd	10.45	17.56	17.00	5.08	6.50	5.38	4.00
3128	Eastern States Farmers' Exchange, Springfield, Mass. Eastern States Scratch Grains with Coarse Cracked Corn	New Milford: Paul Caldwell	12.90	11.00	10.00	2.93	4.00	2.93	2.50
2099	Eastern States Farmers' Exchange, Springfield, Mass. Eastern States Starting and Broiler Ration with Oil	Clinton: A. L. Lockwood	10.83	19.25	18.50	3.90	5.00	5.10	4.00

TABLE I. ANALYSES OF COMMERCIAL FEEDS, INSPECTION OF 1933—*Continued*

Station No.	Manufacturer and brand	Retail dealer	Water	Protein (N x 6.25) Found	Protein (N x 6.25) Guaranteed, not less than	Fiber Found	Fiber Guaranteed, not more than	Fat Found	Fat Guaranteed, not less than
	Proprietary Mixed Feeds—*Continued* *Poultry feeds—Continued*		%	%	%	%	%	%	%
3855	Eastern States Farmers' Exchange, Springfield, Mass. Eastern States Turkey Fat	Norwich: A. E. Shedd	9.53	17.00	16.00	4.45	6.00	4.55	3.50
3254	Eastern States Farmers' Exchange, Springfield, Mass. Eastern States Turkey Grow	Norwich: A. E. Shedd	9.60	20.63	20.00	3.98	5.00	5.65	4.00
3255	Eastern States Farmers' Exchange, Springfield, Mass. Eastern States Turkey Start	Norwich: A. E. Shedd	9.25	25.19	24.00	3.75	5.00	5.80	4.50
3204	Elmore Milling Co., Inc., Oneonta, N. Y. Elmore Chick Feed	Hazardville: Amos D. Bridge's Sons	12.40	11.69	10.00	1.65	3.50	3.98	2.50
2309	Elmore Milling Co., Inc., Oneonta, N. Y. Elmore Chixsaver	Hazardville: Amos D. Bridge's Sons	9.25	18.69	16.50	4.68	8.00	6.15	4.00
2308	Elmore Milling Co., Inc., Oneonta, N. Y. Elmore Eggmaker	Hazardville: Amos D. Bridge's Sons	10.05	19.38	17.00	5.05	8.00	6.25	4.50
2310	Elmore Milling Co., Inc., Oneonta, N. Y. Elmore Egg Mash	Hazardville: Amos D. Bridge's Sons	9.13	20.50	18.00	5.75	8.00	4.73	4.00
3205	Elmore Milling Co., Inc., Oneonta, N. Y. Elmore Growing Mash	Hazardville: Amos D. Bridge's Sons	11.00	19.31	17.00	5.50	8.00	5.18	4.00
3202	Elmore Milling Co., Inc., Oneonta, N. Y. Elmore Intermediate Chick Feed	Hazardville: Amos D. Bridge's Sons	12.93	11.13	10.00	1.90	3.00	2.85	2.50
3488	Elmore Milling Co., Inc., Oneonta, N. Y. Elmore Milk Grains Jr.	Plantsville: C. A. Cowles	9.90	20.63	20.00	7.43	10.00	5.41	5.00
2312	Elmore Milling Co., Inc., Oneonta, N. Y. Elmore Scratch Feed	Hazardville: Amos D. Bridge's Sons	11.20	11.13	10.00	2.70	7.00	2.80	2.50
3847	John W. Eshelman & Sons, Lancaster, Pa. Eshelman Lancaster Scratch Grains	Stratford: Farmers Flour & Grain Co.	12.25	9.75	9.00	1.93	4.00	2.58	2.50
3629	John W. Eshelman & Sons, Lancaster, Pa. Eshelman Pennsy Chick Grains	Southport: C. Buckingham & Co.	12.65	11.75	9.00	1.55	3.00	3.53	3.00
3507	John W. Eshelman & Sons, Lancaster, Pa. Eshelman Pennsy Laying Mash	Bethel: Morrison & Dunham	10.05	22.31	18.00	7.55	8.00	5.80	5.00
2210	John W. Eshelman & Sons, Lancaster, Pa. Eshelman Red Rose All Mash Starter	Bethel: Morrison & Dunham	8.48	19.06	16.00	4.68	6.50	5.20	4.00
1996	John W. Eshelman & Sons, Lancaster, Pa. Eshelman Red Rose Chick Grains	New Britain: Wm. Cohen, Inc.	10.78	12.19	10.00	2.00	3.00	3.90	3.00
1998	John W. Eshelman & Sons, Lancaster, Pa. Eshelman Red Rose Chick Starter	New Britain: Wm. Cohen, Inc.	8.28	17.38	15.00	4.63	6.00	4.85	4.00
3644	John W. Eshelman & Sons, Lancaster, Pa. Eshelman Red Rose Fattening Mash	Cos Cob: A. R. Belmont	10.23	14.88	14.00	3.43	5.00	5.00	4.00
1995	John W. Eshelman & Sons, Lancaster, Pa. Eshelman Red Rose Growing Mash	New Britain: Wm. Cohen, Inc.	9.88	18.63	16.00	5.10	7.00	5.48	4.00
2211	John W. Eshelman & Sons, Lancaster, Pa. Eshelman Red Rose Growing Mash with Cod Liver Oil	Bethel: Morrison & Dunham	10.20	18.38	16.00	5.43	7.00	5.65	4.00
1997	John W. Eshelman & Sons, Lancaster, Pa. Eshelman Red Rose Laying Mash	New Britain: Wm. Cohen, Inc.	9.73	21.44	20.00	5.53	7.00	6.33	5.00
4135	John W. Eshelman & Sons, Lancaster, Pa. Eshelman Red Rose Laying Mash with Cod Liver Oil	Simsbury: H. B. Bunnell & Co.	9.23	21.25	20.00	5.70	7.00	6.25	5.00

TABLE I. ANALYSES OF COMMERCIAL FEEDS, INSPECTION OF 1933—*Continued*

Station No.	Manufacturer and brand	Retail dealer	Pounds per hundred: Water	Protein (N x 6.25): Found	Protein (N x 6.25): Guaranteed, not less than	Fiber: Found	Fiber: Guaranteed, not more than	Fat: Found	Fat: Guaranteed, not less than
	Proprietary Mixed Feeds—*Continued* *Poultry feeds—Continued*		%	%	%	%	%	%	%
2212	John W. Eshelman & Sons, Lancaster, Pa. Eshelman Red Rose Scratch Grains	Bethel: Morrison & Dunham	12.75	11.50	10.00	2.43	4.00	2.63	2.50
3150	John W. Eshelman & Sons, Lancaster, Pa. Red Rose Turkey Mash	Simsbury: H. B. Bunnell & Co.	11.13	19.63	18.00	7.93	7.00	5.33	4.50
3452	Fernando Valley Milling & Supply Co., Los Angeles, Calif. Fernando Ideal Greens, Sun-Cured	Shelton: Wolf Savitsky	8.55	19.56	20.00	19.83	18.00	2.47	3.00
3696	First National Stores, Inc., Somerville, Mass. Henfield Egg Mash	Burnside: First National Stores, Inc.	10.08	20.63	20.00	6.75	7.00	4.83	5.00
3695	First National Stores, Inc., Somerville, Mass. Henfield Scratch Grains	Burnside: First National Stores, Inc.	12.43	10.13	10.00	2.13	5.00	3.18	2.50
3846	Flory Milling Co., Inc., Bangor, Pa. Golden Egg Laying Mash	Stratford: Farmers' Flour & Grain Co.	11.45	20.75	20.00	6.70	7.00	2.83	4.00
3185	Flory Milling Co., Inc., Bangor, Pa. Golden Egg Scratch Feed	East Hartford: Stowe & Rondeau	12.75	10.50	9.00	2.13	5.00	2.50	2.50
2083	A. W. Forbes, East Haven, Conn. R-Own Laying Mash	East Haven: A. W. Forbes	10.20	17.44	18.00	4.48	7.00	5.03	4.00
2084	A. W. Forbes, East Haven, Conn. R-Own Scratch Feed	East Haven: A. W. Forbes	11.43	10.81	10.00	2.25	5.00	2.95	2.00
323[illegible]	J. B. Garland & Son, Worcester, Mass. Garland's Growing Mash with Dried Milk	No. Grosvenordale: Thompson Grain Co.	11.50	19.19	14.00	4.53	8.00	5.50	4.00
3234	J. B. Garland & Son, Worcester, Mass. Garland's Poultry Mash with Dried Milk	No. Grosvenordale: Thompson Grain Co.	9.25	20.63	20.00	4.10	8.00	5.90	4.00
3235	J. B. Garland & Son, Worcester, Mass. Royal Worcester Scratch Feed	No. Grosvenordale: Thompson Grain Co.	11.70	10.38	10.00	2.10	4.00	2.88	2.00
3730	General Mills, Inc., Minneapolis, Minn. Eventually Gold Medal Scratch Feed—No Grit	West Willington: H. M. Hansen	12.60	11.00	10.00	2.03	4.00	2.96	3.00
2158	D. H. Grandin Milling Co., Jamestown, N. Y. Grandin's Baby Chick Feed	Portland: Valley Mills	12.55	10.31	10.00	1.35	5.00	2.88	2.50
3685	D. H. Grandin Milling Co., Jamestown, N. Y. Grandin's Complete Starting Ration with Buttermilk and Cod Liver Oil	Manchester: O. E. Bailey	10.15	16.88	16.00	3.95	6.00	4.50	4.00
3718	D. H. Grandin Milling Co., Jamestown, N. Y. Grandin's Growing Mash with Buttermilk	Portland: Valley Mills	8.80	16.00	15.00	6.08	8.00	5.38	4.00
2153	D. H. Grandin Milling Co., Jamestown, N. Y. Grandin's Growing Mash with Buttermilk and Cod Liver Oil	Portland: Valley Mills	9.60	16.00	15.00	5.20	8.00	4.95	4.00
2156	D. H. Grandin Milling Co., Jamestown, N. Y. Grandin's Intermediate Chick Feed	Portland: Valley Mills	12.40	10.56	10.00	1.58	5.00	2.78	2.50
2154	D. H. Grandin Milling Co., Jamestown, N. Y. Grandin's Laying Mash with Buttermilk	Portland: Valley Mills	9.55	21.38	20.00	5.45	8.00	4.95	4.00
3552	D. H. Grandin Milling Co., Jamestown, N. Y. Grandin's Laying Mash with Buttermilk and Cod Liver Oil	Sharon: Frank A. Wike & Co.	10.03	21.25	20.00	5.55	8.00	4.95	4.00

TABLE I. ANALYSES OF COMMERCIAL FEEDS, INSPECTION OF 1933—*Continued*

Station No.	Manufacturer and brand	Retail dealer	Pounds per hundred: Water	Protein (N x 6.25): Found	Protein (N x 6.25): Guaranteed, not less than	Fiber: Found	Fiber: Guaranteed, not more than	Fat: Found	Fat: Guaranteed, not less than
	Proprietary Mixed Feeds—*Continued* *Poultry feeds—Continued*		%	%	%	%	%	%	%
2155	D. H. Grandin Milling Co., Jamestown, N. Y. Grandin's Poultry Green Food	Portland: Valley Mills	12.20	11.94	10.00	20.08	25.00	1.35	1.00
3690	D. H. Grandin Milling Co., Jamestown, N. Y. Grandin's Screened Scratch Feed	Manchester: O. E. Bailey	11.93	11.25	10.00	2.48	5.00	3.13	2.50
3945	The Grand Union Co., New York City. Peerless Laying Mash	Stamford: Grand Union Co.	8.33	19.81	20.00	5.50	7.00	5.05	4.00
3946	The Grand Union Co., New York City. Peerless Scratch Grains	Stamford: Grand Union Co.	11.13	10.44	10.00	2.05	5.00	3.18	2.50
3691	Great Atlantic & Pacific Tea Co., Minneapolis, Minn. Daily Growth Chick Starter	So. Manchester: Great Atlantic & Pacific Tea Co.	10.48	18.25	16.00	4.85	5.00	5.02	4.00
3692	Great Atlantic & Pacific Tea Co., Minneapolis, Minn. Daily Growth Fine Chick Feed	So. Manchester: Great Atlantic & Pacific Tea Co.	11.28	12.13	10.00	1.65	5.00	3.28	3.00
2313	Great Atlantic & Pacific Tea Co., Minneapolis, Minn. Daily Egg Mash Feed	Burnside: Great Atlantic & Pacific Tea Co.	9.25	20.00	20.00	5.10	4.50	4.88	4.50
2314	Great Atlantic & Pacific Tea Co., Minneapolis, Minn. Daily Egg Scratch Feed	Burnside: Great Atlantic & Pacific Tea Co.	12.80	10.38	10.00	2.35	5.00	2.98	2.50
1922	Hales & Hunter Co., Chicago, Ill. Red Comb Broiler Mash with Dried Buttermilk	Plantsville: C. A. Cowles	9.65	19.25	18.00	5.68	7.00	5.10	4.00
2093	Hales & Hunter Co., Chicago, Ill. Red Comb Chick Starter with Dried Buttermilk	Guilford: Fred C. Morse & Son	10.38	17.38	15.00	5.00	5.00	5.10	4.00
3009	Hales & Hunter Co., Chicago, Ill. Red Comb Crate Fattener with Rolled Oats	Mt. Carmel: Mt. Carmel Grain Store	10.25	15.13	13.00	4.86	6.00	5.13	4.00
1900	Hales & Hunter Co., Chicago, Ill. Red Comb Egg Mash with Dried Buttermilk	Stratford: Farmers' Flour & Grain Co.	8.40	21.25	18.00	5.96	7.00	5.68	4.00
2123	Hales & Hunter Co., Chicago, Ill. Red Comb Growing Mash with Dried Buttermilk	Lebanon: Berkman Grain Co.	9.50	18.94	15.00	6.33	6.00	5.85	4.00
3008	Hales & Hunter Co., Chicago, Ill. Red Comb Scratch Feed	Mt. Carmel: Mt. Carmel Grain Store	12.08	10.69	10.00	2.44	5.00	2.78	2.50
2145	J. B. Ham Co., Auburn, Me. Farmer Boy Egg Mash with Dried Skim Milk and Cod Liver Oil	Stafford Springs: Stafford Farmers' Co-op. Assoc.	10.25	19.19	18.00	4.65	7.00	4.80	5.00
2144	J. B. Ham Co., Auburn, Me. Farmer Boy Growing Mash with Dried Skim Milk and Cod Liver Oil	Stafford Springs: Stafford Farmers' Co-op. Assoc.	11.50	18.88	18.00	4.38	5.00	4.83	4.00
2143	J. B. Ham Co., Auburn, Me. Farmer Boy Intermediate Scratch Feed	Stafford Springs: Stafford Farmers' Co-op. Assoc.	12.98	11.56	10.00	2.30	3.00	2.68	3.00
2137	J. B. Ham Co., Auburn, Me. Farmer Boy Scratch Feed	Stafford Springs: Stafford Farmers' Co-op. Assoc.	13.13	11.63	10.00	2.73	4.00	3.05	3.00
2146	J. B. Ham Co., Auburn, Me. Farmer Boy Starting Mash with Dried Skim Milk and Cod Liver Oil	Stafford Springs: Stafford Farmers' Co-op. Assoc.	11.30	17.56	17.00	3.63	5.00	4.80	4.00
3613	Jersee Co., Minneapolis, Minn. Just Right Egg Mash	Stratford: Farmers' Flour & Grain Co.	10.40	22.50	18.00	7.00	8.00	4.35	5.00
3004	H. P. Kysor Grain Co., New Haven, Conn. Kysor's A-1 Growing Mash	Plainville: State Farmers' Co-op. Assoc.	10.33	17.38	15.50	5.48	6.00	5.24	4.00

TABLE I. ANALYSES OF COMMERCIAL FEEDS, INSPECTION OF 1933—*Continued*

Station No.	Manufacturer and brand	Retail dealer	Pounds per hundred: Water	Protein (N x 6.25): Found	Protein (N x 6.25): Guaranteed, not less than	Fiber: Found	Fiber: Guaranteed, not more than	Fat: Found	Fat: Guaranteed, not less than
	Proprietary Mixed Feeds—*Continued* *Poultry feeds—Continued*		%	%	%	%	%	%	%
3005	H. P. Kysor Grain Co., New Haven, Conn. Kysor's A-1 Laying Mash...	Plainville: State Farmers' Co-op. Assoc.	10.15	19.06	18.00	4.83	5.00	4.73	4.00
3003	H. P. Kysor Grain Co., New Haven, Conn. Kysor's A-1 Scratch Grains	Plainville: State Farmers' Co-op. Assoc.	11.70	11.25	10.00	2.87	4.00	3.05	2.50
3002	H. P. Kysor Grain Co., New Haven, Conn. Kysor's Self Starter Ration	Plainville: State Farmers' Co-op. Assoc.	9.99	19.13	18.00	4.46	5.00	5.30	4.00
2255	A. S. Labieniec, Kensington, Conn. Reliable Laying Mash	Kensington: A. S. Labieniec	10.53	18.38	17.00	4.50	8.00	4.00	4.00
2235	Laden Bros. Co., Inc., Wallingford, Conn. Laden's Baby Chick Starter	Wallingford: Laden Bros. Co., Inc.	12.20	17.13	17.50	5.13	5.00	5.55	5.00
3473	Laden Bros. Co., Inc., Wallingford, Conn. Laden's Growing Mash	Wallingford: Laden Bros. Co., Inc.	13.28	16.00	17.00	3.95	5.00	4.65	5.50
4157	Laden Bros. Co., Inc., Wallingford, Conn. Laden's Growing Mash	Wallingford: Laden Bros. Co., Inc.	11.53	17.56	17.00	5.05	5.50	5.55	5.00
2234	Laden Bros. Co., Inc., Wallingford, Conn. Laden's Laying Mash	Wallingford: Laden Bros. Co., Inc.	10.73	20.94	20.00	4.88	5.00	6.48	5.50
2236	Laden Bros. Co., Inc., Wallingford, Conn. Laden's Starter and Broiler Mash	Wallingford: Laden Bros. Co., Inc.	11.43	18.25	17.00	4.33	5.00	5.15	4.50
1909	The Larrowe Milling Co., Detroit, Mich. Larro Broiler Feed	Bridgeport: Brooklawn Feed Co.	9.88	15.94	15.00	4.45	7.00	4.50	4.50
2015	The Larrowe Milling Co., Detroit, Mich. Larro Chick Grains	So. Norwalk: Roodner Feed Co.	11.28	10.50	10.00	1.60	3.50	3.13	2.00
2017	The Larrowe Milling Co., Detroit, Mich. Larro Chick Starter	So. Norwalk: Roodner Feed Co.	9.20	17.25	16.50	4.25	5.00	4.68	4.50
2014	The Larrowe Milling Co., Detroit, Mich. Larro Egg Mash	So. Norwalk: Roodner Feed Co.	8.85	20.38	19.00	5.43	7.50	5.30	5.00
3125	The Larrowe Milling Co., Detroit, Mich. Larro Growing Grains	Plantsville: C. A. Cowles	14.30	9.88	10.00	1.64	3.50	2.20	2.00
3120	The Larrowe Milling Co., Detroit, Mich. Larro Growing Mash	Plantsville: C. A. Cowles	11.33	17.13	16.00	4.66	6.50	4.85	4.50
2018	The Larrowe Milling Co., Detroit, Mich. Larro Poultry Fattening Feed	So. Norwalk: Roodner Feed Co.	9.25	15.44	14.00	5.80	7.50	4.80	4.00
2016	The Larrowe Milling Co., Detroit, Mich. Larro Scratch Grains	So. Norwalk: Roodner Feed Co.	11.18	11.25	10.00	2.40	3.50	2.80	2.00
2020	The Larrowe Milling Co., Detroit, Mich. Larro Turkey Grower	So. Norwalk: Roodner Feed Co.	9.23	25.50	24.50	5.03	6.50	5.10	4.00
2011	Libner Grain Co., Norwalk, Conn. Libner's Blue Ribbon Chick Starter	Norwalk: Libner Grain Co.	8.63	19.69	18.00	4.45	6.00	6.15	4.00
2006	Libner Grain Co., Norwalk, Conn. Libner's Blue Ribbon Growing Mash	Norwalk: Libner Grain Co.	8.93	19.63	18.00	5.33	6.00	6.10	4.00
2010	Libner Grain Co., Norwalk, Conn. Libner's Blue Ribbon Milk Egg Mash	Norwalk: Libner Grain Co.	8.83	19.06	17.00	5.53	6.50	6.35	3.00
1993	C. W. Lines Co., New Britain, Conn. Homestead Dry Mash	New Britain: C. W. Lines Co.	9.55	21.06	18.00	6.33	7.00	4.93	4.00
3112	C. W. Lines Co., New Britain, Conn. Homestead Scratch Feed	New Britain: C. W. Lines Co.	13.93	10.13	9.00	2.43	5.00	2.65	2.50
3111	C. W. Lines Co., New Britain, Conn. Mill Pride Fancy Scratch Feed ...	New Britain: C. W. Lines Co.	13.30	10.63	9.00	2.42	4.00	2.78	2.00
1992	C. W. Lines Co., New Britain, Conn. Mill Pride Milk Mash	New Britain: C. W. Lines Co.	9.18	18.94	18.00	6.45	7.50	4.68	4.50
2278	Litchfield County Co-op. Assoc., Torrington, Conn. Common Sense Growing Mash	Torrington: Litchfield County Co-op. Assoc.	9.90	20.25	15.00	5.88	7.00	5.60	4.00

TABLE I. ANALYSES OF COMMERCIAL FEEDS, INSPECTION OF 1933—*Continued*

Station No.	Manufacturer and brand	Retail dealer	Pounds per hundred: Water	Protein (N x 6.25): Found	Protein (N x 6.25): Guaranteed, not less than	Fiber: Found	Fiber: Guaranteed, not more than	Fat: Found	Fat: Guaranteed, not less than
	Proprietary Mixed Feeds—*Continued*								
	Poultry feeds—Continued		%	%	%	%	%	%	%
2280	Litchfield County Co-op. Assoc., Torrington, Conn. Common Sense Laying Mash	Torrington: Litchfield County Co-op. Assoc.	10.18	19.31	15.00	5.90	7.00	4.95	4.00
4216	Litchfield County Co-op. Assoc., Torrington, Conn. Common Sense Scratch Feed	Torrington: Litchfield County Co-op. Assoc.	11.95	10.88	9.00	2.68	4.00	3.30	2.50
1911	Long Hill Feed Store, Long Hill, Conn. Square Deal Buttermilk Laying Mash	Long Hill: Long Hill Feed Store	8.65	20.75	20.00	6.53	7.00	4.73	5.00
2283	E. Manchester & Sons, Winsted, Conn. Huntington Red Star Egg Mash	Winsted: E. Manchester & Sons	9.95	17.88	13.00	6.13	6.00	5.48	4.00
2284	E. Manchester & Sons, Winsted, Conn. Red Star Egg Mash	Winsted: E. Manchester & Sons	9.13	20.63	18.00	7.00	8.00	5.58	4.00
2286	E. Manchester & Sons, Winsted, Conn. Red Star Scratch Feed	Winsted: E. Manchester & Sons	11.98	11.25	9.00	2.93	6.00	2.65	2.00
2304	Maritime Milling Co., Inc., Buffalo, N. Y. Bull Brand All Mash Broiler & Growing Ration Vitamized with Cod Liver Oil, Milk Sugar Feed and Dried Buttermilk	Windsor: Lewis Bros.	10.50	15.38	15.00	4.98	7.00	5.38	4.00
2303	Maritime Milling Co., Inc., Buffalo, N. Y. B-B Daisy All Mash Starter and Growing Feed Vitamized with Cod Liver Oil, Milk Sugar Feed and Dried Buttermilk	Windsor: Lewis Bros.	11.23	16.75	15.00	4.93	7.00	5.43	3.50
2287	Maritime Milling Co., Inc., Buffalo, N. Y. B-B Daisy Egg Mash with Dried Buttermilk	Collinsville: Chas. H. Legeyt	10.85	18.75	18.00	6.20	7.00	5.60	3.50
3478	Maritime Milling Co., Inc., Buffalo, N. Y. B-B Daisy Scratch Feed	Wallingford: Laden Bros. Co., Inc.	12.78	10.38	9.00	2.38	5.00	3.10	2.50
3669	Maritime Milling Co., Inc., Buffalo, N. Y. Bull Brand All Mash Chick Starter Ration Vitamized with Cod Liver Oil, Milk Sugar Feed and Dried Buttermilk	Essex: Meech & Stoddard, Inc.	10.43	18.06	17.00	5.05	6.00	4.85	4.00
2305	Maritime Milling Co., Inc., Buffalo, N. Y. Bull Brand Laying Mash with Milk Sugar Feed and Dried Buttermilk	Windsor: Lewis Bros.	10.50	20.75	20.00	5.88	7.00	5.43	4.50
2288	Maritime Milling Co., Inc., Buffalo, N. Y. Bull Brand Scratch Feed	Collinsville: Chas H. Legeyt	12.20	10.00	10.00	2.25	4.00	2.55	2.50
3141	Maritime Milling Co., Inc., Buffalo, N. Y. Dollar Maker Egg Mash	New Milford: W. L. Richmond & Son	10.35	18.38	17.00	7.11	9.00	5.65	3.50
2242	Meech & Stoddard, Inc., Middletown, Conn. Red Wing Special Buttermilk Chick Starting Feed	Meriden: Meriden Grain & Coal Co.	8.85	17.69	13.00	5.73	5.00	5.43	4.00
2237	Meech & Stoddard, Inc., Middletown, Conn. Red Wing Special Buttermilk Growing Feed	Meriden: Meriden Grain & Coal Co.	8.78	16.88	17.00	7.93	8.00	5.23	5.50
2241	Meech & Stoddard, Inc., Middletown, Conn. Red Wing Special Buttermilk Laying Mash	Meriden: Meriden Grain & Coal Co.	9.58	18.94	17.00	8.83	8.00	6.18	5.50
3587	Meech & Stoddard, Inc., Middletown, Conn. Red Wing Special Chick Feed	Middletown: Meech & Stoddard, Inc.	12.45	11.44	10.00	1.45	5.00	4.35	3.00

TABLE I. ANALYSES OF COMMERCIAL FEEDS, INSPECTION OF 1933—*Continued*

Station No.	Manufacturer and brand	Retail dealer	Water	Protein (N x 6.25) Found	Protein (N x 6.25) Guaranteed, not less than	Fiber Found	Fiber Guaranteed, not more than	Fat Found	Fat Guaranteed, not less than
	Proprietary Mixed Feeds—*Continued*								
	Poultry feeds—Continued		%	%	%	%	%	%	%
3670	Meech & Stoddard, Inc., Middletown, Conn. Red Wing Special Intermediate Chick Feed	Essex: Meech & Stoddard, Inc.	13.05	10.00	10.00	1.90	5.00	3.05	3.00
2238	Meech & Stoddard, Inc., Middletown, Conn. Red Wing Special Scratch Feed	Meriden: Meriden Grain & Coal Co.	13.93	10.06	10.00	2.13	5.00	2.20	3.00
3066	Geo. Q. Moon & Co., Inc., Binghamton, N. Y. Moon's Baby Chick Grains	Stratford: Z. C. Ingersoll	12.20	11.63	10.00	0.96	2.50	1.20	3.00
1929	Geo. Q. Moon & Co., Inc., Binghamton, N. Y. Moon's Developing Grains	Stratford: Z. C. Ingersoll	12.15	10.88	10.00	1.66	5.00	3.73	2.00
3558	Geo. Q. Moon & Co., Inc., Binghamton, N. Y. Moon's Growing Mash	Norfolk: Aug. P. Curtis	10.80	16.56	17.00	4.43	7.00	4.55	4.00
3067	Geo. Q. Moon & Co., Inc., Binghamton, N. Y. Moon's Laying Mash with Dried Buttermilk	Stratford: Z. C. Ingersoll	10.20	19.88	20.00	4.83	9.00	4.85	4.00
1930	Geo. Q. Moon & Co., Inc., Binghamton, N. Y. Moon's Special A Scratch Feed	Stratford: Z. C. Ingersoll	13.73	10.13	10.00	2.81	5.00	2.60	2.00
2098	Fred C. Morse & Son, Guilford, Conn. Old Mill Growing Mash	Guilford: Fred C. Morse & Son	8.95	17.75	15.00	3.50	6.00	4.80	5.00
2097	Fred C. Morse & Son, Guilford, Conn. Old Mill Laying Mash with Skim Milk	Guilford: Fred C. Morse & Son	10.70	19.31	17.00	5.18	8.00	4.83	4.00
2094	Fred C. Morse & Son, Guilford, Conn. Old Mill Laying Mash with Milk and Oil	Guilford: Fred C. Morse & Son	9.95	21.63	20.00	6.03	8.00	4.80	5.00
3665	Fred C. Morse & Son, Guilford, Conn. Old Mill Scratch Feed	Guilford: Fred C. Morse & Son	12.88	11.25	10.00	2.10	4.00	2.63	2.50
2095	Fred C. Morse & Son, Guilford, Conn. Old Mill Starting Mash	Guilford: Fred C. Morse & Son	10.28	17.63	17.00	3.60	3.50	4.60	4.50
2012	Norwalk Grain Co., Norwalk, Conn. Favorite Egg Mash with Milk	Norwalk: Libner Grain Co.	8.78	18.75	17.00	6.65	9.00	5.50	3.00
2013	Norwalk Grain Co., Norwalk, Conn. Favorite Scratch Feed	Norwalk: Libner Grain Co.	10.55	10.63	10.00	2.30	5.00	2.48	2.00
3655	Nowak Milling Corp., Hammond, Ind. Domino Chick Pel-ets	Westville: Westville Grain Co.	10.13	17.38	16.00	3.70	5.00	5.93	4.00
3654	Nowak Milling Corp., Hammond, Ind. Domino Egg Pel-ets	Westville: Westville Grain Co.	9.75	20.50	20.00	5.43	7.50	5.00	4.50
3548	Nowak Milling Corp., Hammond, Ind. Domino Growing Mash with Buttermilk	Sharon: Frank A. Wike & Co.	9.68	19.31	18.00	5.68	6.00	6.10	4.50
3551	Nowak Milling Corp., Hammond, Ind. Domino Laying Mash with Buttermilk	Sharon: Frank A. Wike & Co.	9.70	19.50	20.00	6.13	8.00	5.39	4.50
3853	Nowak Milling Corp., Hammond, Ind. Domino Scratch Feed	Sharon: Frank A. Wike & Co.	12.13	10.88	10.00	2.53	4.00	2.55	2.00
3550	Nowak Milling Corp., Hammond, Ind. Export Scratch Feed	Sharon: Frank A. Wike & Co.	12.23	10.63	9.00	2.10	5.00	2.55	2.00
3554	Nowak Milling Corp., Hammond, Ind. Fidelity Scratch Feed	Sharon: Frank A. Wike & Co.	12.20	10.94	10.00	2.28	4.00	2.60	2.00
3984	P. Fred'k Obrecht & Son, Baltimore, Md. Egg-O-Milk	Plantsville: C. A. Cowles	10.00	17.75	12.00	0.78	3.00	3.70	3.00
2159	Ontario Milling Co., Inc., Oswego, N. Y. Aunt Mary's Laying Mash with Cod Liver Oil	Middletown: P. Levson & Son	9.88	18.88	19.00	6.40	8.50	4.70	4.00

TABLE I. ANALYSES OF COMMERCIAL FEEDS, INSPECTION OF 1933—*Continued*

Station No.	Manufacturer and brand	Retail dealer	Pounds per hundred: Water	Protein (N x 6.25): Found	Protein (N x 6.25): Guaranteed, not less than	Fiber: Found	Fiber: Guaranteed, not more than	Fat: Found	Fat: Guaranteed, not less than
	Proprietary Mixed Feeds—*Continued* *Poultry feeds—Continued*		%	%	%	%	%	%	%
2160	Ontario Milling Co., Inc., Oswego, N. Y. Oswego Scratch Feed	Middletown: P. Levson & Son	12.68	10.50	10.00	2.23	5.00	2.78	2.50
2087	S. V. Osborn Est., Branford, Conn. Osborn Scratch	Branford: S. V. Osborn Est.	13.03	12.00	10.00	2.08	5.00	2.48	2.00
1916	Park & Pollard Co., Buffalo, N. Y. All-In-One Starting Feed	West Cheshire: Cheshire Grain & Coal Co.	12.05	15.13	17.00	2.79	5.00	4.13	3.50
1898	Park & Pollard Co., Buffalo, N. Y. Growing Feed	Stratford: Farmers' Flour & Grain Co.	10.65	17.25	14.00	4.73	7.00	4.38	3.00
2016	Park & Pollard Co., Buffalo, N. Y. Growing Feed with Cod Liver Oil	Norwich: A. E. Shedd	11.90	16.25	14.00	4.63	7.00	4.45	3.00
2199	Park & Pollard Co., Buffalo, N. Y. Holcomb's Milk Egg Mash	Newtown: R. H. Holcomb & Co.	10.30	18.31	17.00	5.05	6.50	4.33	4.00
3570	Park & Pollard Co., Buffalo, N. Y. Intermediate Chick Feed	East Winsted: Leonard Grain Co.	12.65	11.00	10.00	1.70	3.50	2.58	3.00
2256	Park & Pollard Co., Buffalo, N. Y. Lay or Bust Dry Mash	Kensington: A. S. Labieniec	10.85	22.75	18.00	5.25	7.00	4.40	3.00
3172	Park & Pollard Co., Buffalo, N. Y. Lay or Bust Dry Mash with Cod Liver Oil	Norwich: A. E. Shedd	11.13	19.63	18.00	4.63	7.00	4.30	3.00
1915	Park & Pollard Co., Buffalo, N. Y. Park & Pollard Chick Starter	West Cheshire: Cheshire Grain & Coal Co.	11.18	17.00	17.00	2.74	5.00	4.10	3.50
3079	*Park & Pollard Co., Buffalo, N. Y. Park & Pollard Turkey Starter*	New London: New London Grain	10.63	18.75	17.00	4.55	5.00	4.68	3.50
1917	Park & Pollard Co., Buffalo, N. Y. Red Ribbon Chick Feed	West Cheshire: Cheshire Grain & Coal Co.	12.80	11.06	10.00	1.50	3.50	3.30	3.00
3599	Park & Pollard Co., Buffalo, N. Y. Red Ribbon Scratch Feed	Woodbury: C. L. Adams Co.	12.55	10.50	10.00	2.08	5.00	2.58	3.00
3058	Frank S. Platt Co., New Haven, Conn. Platco Laying Mash	New Haven: Frank S. Platt Co.	10.65	25.69	20.00	5.13	7.00	6.00	5.50
3059	Frank S. Platt Co., New Haven, Conn. Platco Perfection Grain Mixture	New Haven: Frank S. Platt Co.	12.28	11.75	10.50	3.37	3.50	2.85	3.00
1980	Pratt Food Co., Buffalo, N. Y. Pratt's Baby Chick Food	Bristol: Bristol Supply Co.	10.20	17.69	16.00	2.65	4.00	4.28	3.50
1982	Pratt Food Co., Buffalo, N. Y. Pratt's Chick Scratch Feed	Bristol: Bristol Supply Co.	11.35	10.94	10.00	1.33	4.00	2.90	2.00
1979	Pratt Food Co., Buffalo, N. Y. Pratt's Growing Mash with Buttermilk	Bristol: Bristol Supply Co.	10.05	18.94	17.50	5.14	6.00	4.85	4.50
1981	Pratt Food Co., Buffalo, N. Y. Pratt's Intermediate Scratch Feed	Bristol: Bristol Supply Co.	12.03	10.19	10.00	1.64	4.00	2.10	2.00
1978	Pratt Food Co., Buffalo, N. Y. Pratt's Laying Mash with Buttermilk	Bristol: Bristol Supply Co.	9.95	21.75	20.00	5.49	6.75	5.48	4.50
3154	H. C. Puffer Co., Springfield, Mass. Egg-Em-On Scratch Grains	Simsbury: H. B. Bunnell & Co.	14.53	9.81	10.00	2.90	5.00	2.60	1.50
3201	The Quaker Oats Co., Chicago, Ill. Early Bird Coarse Chick Feed	Rockville: Rockville Grain & Coal Co.	11.80	9.88	9.50	2.28	3.50	2.95	2.00
3206	The Quaker Oats Co., Chicago, Ill. Early Bird Fine Chick Feed—No Grit	Thompsonville: Geo. S. Phelps & Co.	12.65	9.88	10.00	1.55	2.00	2.03	2.00
2215	The Quaker Oats Co., Chicago, Ill. Quaker Ful-O-Pep Chick Starter	Danbury: C. S. Barnum & Son	8.45	16.13	17.00	5.78	7.00	5.60	5.00
3194	The Quaker Oats Co., Chicago, Ill. Quaker Ful-O-Pep Coarse Chick Feed	Rockville: Rockville Grain & Coal Co.	12.00	9.88	10.00	2.13	2.50	2.75	2.00
1994	The Quaker Oats Co., Chicago, Ill. Quaker Ful-O-Pep Egg Mash	New Britain: C. W. Lines Co.	9.08	20.19	20.00	5.68	8.00	5.43	4.50
2306	The Quaker Oats Co., Chicago, Ill. Quaker Ful-O-Pep Fine Chick Feed	Thompsonville: Geo. S. Phelps & Co.	10.80	11.56	11.00	1.73	2.00	3.10	2.50

TABLE I. ANALYSES OF COMMERCIAL FEEDS, INSPECTION OF 1933—*Continued*

Station No.	Manufacturer and brand	Retail dealer	Pounds per hundred						
			Water	Protein (N x 6.25)		Fiber		Fat	
				Found	Guaranteed, not less than	Found	Guaranteed, not more than	Found	Guaranteed, not less than
	Proprietary Mixed Feeds—*Continued* *Poultry feeds—Continued*		%	%	%	%	%	%	%
2209	The Quaker Oats Co., Chicago, Ill. Quaker Ful-O-Pep Growing Mash	Bethel: Morrison & Dunham	8.23	18.69	19.00	6.15	6.00	5.80	5.00
3116	The Quaker Oats Co., Chicago, Ill. Quaker Ful-O-Pep Scratch Grains	Plainville: W. S. Eaton	12.95	9.75	9.00	2.14	3.00	2.90	2.00
3800	The Quaker Oats Co., Chicago, Ill. Quaker Ful-O-Pep Station Grade Fattening Feed	New Haven: R. G. Davis & Sons, Inc.	8.83	14.38	12.00	3.43	5.50	6.18	4.50
2075	Ralston Purina Co., St. Louis, Mo. Protena Scratch Feed (Buffalo Mill)	Stamford: Clapboard Hill Feed Co.	13.70	10.38	9.50	2.68	4.00	2.75	2.00
2076	Ralston Purina Co., St. Louis, Mo. Purina All Mash Egg Chowder	Stamford: Clapboard Hill Feed Co.	10.50	16.88	15.50	5.38	8.00	5.08	3.50
3605	Ralston Purina Co., St. Louis, Mo. Purina All Mash Growena Chow	Waterbury: Waterbury Feed Store	10.88	17.25	15.00	5.73	7.00	4.93	3.50
2073	Ralston Purina Co., St. Louis, Mo. Purina All Mash Startena Chow	Stamford: Clapboard Hill Feed Co.	10.45	20.13	18.00	4.63	7.00	5.15	4.00
2077	Ralston Purina Co., St. Louis, Mo. Purina Breeder Egg Chowder	Stamford: Clapboard Hill Feed Co.	9.68	20.75	19.00	7.25	8.00	4.85	3.50
2079	Ralston Purina Co., St. Louis, Mo. Purina Broiler Chow	Stamford: Clapboard Hill Feed Co.	10.73	19.25	18.00	4.30	7.00	4.85	4.00
2081	Ralston Purina Co., St. Louis, Mo. Purina Chick Chow	Stamford: Clapboard Hill Feed Co.	11.78	11.38	10.00	2.38	4.00	3.05	2.00
3794	Ralston Purina Co., St. Louis, Mo. Purina Chicken Fatena Chow	New London: New London Grain Co.	10.53	14.00	12.00	5.08	6.60	4.74	3.00
3030	Ralston Purina Co., St. Louis, Mo. Purina Chick Growena Chow	Manchester: Manchester Grain Co.	11.60	18.75	17.00	5.81	7.00	4.93	3.50
2078	Ralston Purina Co., St. Louis, Mo. Purina Chick Growena Chow (with Cod Liver Oil)	Stamford: Clapboard Hill Feed Co.	10.18	18.94	17.00	6.73	7.00	5.68	3.50
3649	Ralston Purina Co., St. Louis, Mo. Purina Chick Startena Chow	Ridgefield: Ridgefield Lumber Co.	9.80	21.88	19.00	5.03	7.00	4.58	4.00
2111	Ralston Purina Co., St. Louis, Mo. Purina Egg Chowder	Norwich: A. E. Shedd	10.38	19.44	19.00	7.33	8.00	4.50	3.50
3572	Ralston Purina Co., St. Louis, Mo. Purina Hen Chow	Torrington: F. L. Wadhams & Sons	12.78	11.75	10.00	2.98	4.00	3.40	2.50
2080	Ralston Purina Co., St. Louis, Mo. Purina Intermediate Hen Chow	Stamford: Clapboard Hill Feed Co.	11.95	10.38	10.00	2.05	4.00	2.95	2.50
2074	Ralston Purina Co., St. Louis, Mo. Purina Lay Chow	Stamford: Clapboard Hill Feed Co.	10.45	19.44	17.00	5.95	8.00	4.30	2.50
3016	Ralston Purina Co., St. Louis, Mo. Purina Lay Chow with Cod Liver Oil	Manchester: Manchester Grain Co.	11.03	20.63	17.00	5.96	8.00	4.45	2.50
2231	Ralston Purina Co., St. Louis, Mo. Purina Lay Chow (with Cod Liver Oil and Dried Buttermilk)	Wallingford: A. E. Hall	10.78	21.00	17.00	6.28	8.00	5.38	2.50
3253	Ralston Purina Co., St. Louis, Mo. Purina Turkey Growing and Fattening Chow	Norwich: A. E. Shedd	11.95	21.88	21.00	5.35	8.00	4.50	3.50
3252	Ralston Purina Co., St. Louis, Mo. Purina Turkey Startena Chow	Norwich: A. E. Shedd	9.98	27.00	26.00	4.05	6.00	7.05	4.50
3046	Rotex Milling Co., Cleveland, Ohio. Rotex Egg Mash	Ansonia: A. Hodos & Son	11.90	19.13	20.00	4.85	7.00	4.93	4.00
3047	Rotex Milling Co., Cleveland, Ohio. Rotex Starting and Growing Mash	Ansonia: A. Hodos & Son	12.53	17.13	18.00	3.31	7.00	5.25	3.50
3053	Seymour Grain & Coal Co., Seymour, Conn. Miracle Chick Feed	Seymour: Seymour Grain & Coal Co.	12.83	12.50	10.00	1.46	5.00	3.18	2.50
3052	Seymour Grain & Coal Co., Seymour, Conn. Miracle Chick Grower	Seymour: Seymour Grain & Coal Co.	11.83	18.31	16.00	4.50	6.00	4.20	4.00

TABLE I. ANALYSES OF COMMERCIAL FEEDS, INSPECTION OF 1933—*Continued*

Station No.	Manufacturer and brand	Retail dealer	Water	Protein (N x 6.25) Found	Protein (N x 6.25) Guaranteed, not less than	Fiber Found	Fiber Guaranteed, not more than	Fat Found	Fat Guaranteed, not less than
	Proprietary Mixed Feeds—*Continued* *Poultry feeds—Continued*		%	%	%	%	%	%	%
2191	Seymour Grain & Coal Co., Seymour, Conn. Miracle Chick Starter	Seymour: Seymour Grain & Coal Co...	8.60	18.75	16.00	5.50	6.00	5.25	4.00
2187	Seymour Grain & Coal Co., Seymour, Conn. Miracle Laying Mash with Skim Milk	Seymour: Seymour Grain & Coal Co...	8.45	21.38	19.00	5.43	6.00	5.08	4.50
2188	Seymour Grain & Coal Co., Seymour, Conn. Miracle Scratch	Seymour: Seymour Grain & Coal Co...	11.20	11.56	10.00	2.98	6.00	2.85	2.50
2167	Shelton Feed Co., Inc., Shelton, Conn. Nelson Mixed Chicken Feed	Shelton: Shelton Feed Co., Inc.	14.03	10.00	10.00	2.20	5.00	2.20	1.50
2053	Ike Sovitsky, Ansonia, Conn. Ansonia Baby Chick Starter with Buttermilk and Cod Liver Oil	Ansonia: Ike Sovitsky	9.45	19.50	17.00	4.60	5.00	4.28	4.00
2172	Ike Sovitsky, Ansonia, Conn. Ansonia Egg Mash with Buttermilk and Cod Liver Oil	Ansonia: Ike Sovitsky	9.03	21.00	20.00	5.80	7.00	5.10	4.00
2173	Ike Sovitsky, Ansonia, Conn. Ansonia Scratch Feed	Ansonia: Ike Sovitsky	11.30	10.50	9.00	2.20	4.00	2.50	2.00
3105	St. Albans Grain Co., St. Albans, Vt. Mornin' Call Poultry Grains	Meriden: H. Grulich	12.45	11.31	10.00	2.25	4.00	2.90	2.50
1896	St. Albans Grain Co., St. Albans, Vt. Wirthmore All Purpose Chick and Broiler Ration	Milford: Milford Grain Co.	9.43	20.25	17.50	3.16	5.50	4.48	4.00
2089	St. Albans Grain Co., St. Albans, Vt. Wirthmore Baby Chick Scratch ...	Branford: S. V. Osborn Est.	11.50	12.00	10.00	1.53	3.50	3.05	2.50
1894	St. Albans Grain Co., St. Albans, Vt. Wirthmore Baby Chick Starter, A Complete Balanced Feed for the first six weeks, containing Fortified Cod Liver Oil	Milford: Milford Grain Co.	9.68	20.63	18.00	3.40	5.00	4.48	4.00
2113	St. Albans Grain Co., St. Albans, Vt. Wirthmore Breeder Mash	Norwich: Norwich Grain Co.	9.98	22.31	20.00	4.78	7.00	4.53	4.50
1983	St. Albans Grain Co., St. Albans, Vt. Wirthmore Complete Growing Ration	Bristol: Bristol Supply Co.	9.88	16.56	14.00	4.95	6.00	4.80	3.75
1921	St. Albans Grain Co., St. Albans, Vt. Wirthmore Complete Ration for Layers	Plantsville: C. A. Cowles	10.38	18.38	15.00	4.21	5.00	4.40	4.00
2114	St. Albans Grain Co., St. Albans, Vt. Wirthmore Fleshing and Fattening Mash	Norwich: Norwich Grain Co.	9.83	15.81	15.00	4.18	6.00	5.03	4.50
1999	St. Albans Grain Co., St. Albans, Vt. Wirthmore Growing Mash	Southport: C. Buckingham & Co.	10.10	17.13	15.00	5.40	6.00	4.78	4.50
3408	St. Albans Grain Co., St. Albans, Vt. Wirthmore Growing Mash	Monroe: Henry Lord	11.83	18.00	15.00	5.95	6.00	4.90	4.50
1920	St. Albans Grain Co., St. Albans, Vt. Wirthmore Growing Mash (containing Fortified Cod Liver Oil)	Plantsville: C. A. Cowles	10.33	17.31	15.00	5.07	6.00	5.25	4.50
2000	St. Albans Grain Co., St. Albans, Vt. Wirthmore Intermediate Scratch Feed	Southport: C. Buckingham & Co.	11.38	12.50	10.00	2.30	3.50	2.83	2.50
1919	St. Albans Grain Co., St. Albans, Vt. Wirthmore Laying Mash	Plantsville: C. A. Cowles	9.63	21.88	20.00	4.64	7.00	4.63	4.00
1895	St. Albans Grain Co., St. Albans, Vt. Wirthmore Laying Mash containing Fortified Cod Liver Oil	Milford: Milford Grain Co.	9.58	21.00	20.00	4.72	7.00	4.53	4.00

TABLE I. ANALYSES OF COMMERCIAL FEEDS, INSPECTION OF 1933—*Continued*

Station No.	Manufacturer and brand	Retail dealer	Pounds per hundred: Water	Protein (N x 6.25): Found	Protein (N x 6.25): Guaranteed, not less than	Fiber: Found	Fiber: Guaranteed, not more than	Fat: Found	Fat: Guaranteed, not less than
	Proprietary Mixed Feeds—*Continued* *Poultry feeds—Continued*		%	%	%	%	%	%	%
3595	St. Albans Grain Co., St. Albans, Vt. Wirthmore Scratch Feed	Southbury: Southbury Grain Co.	13.15	11.25	10.00	2.15	4.00	2.78	2.50
3659	St. Albans Grain Co., St. Albans, Vt. Wirthmore Turkey Fattening Ration	Branford: S. V. Osborn Est.	11.10	16.63	16.00	5.40	7.00	4.40	4.50
3409	St. Albans Grain Co., St. Albans, Vt. Wirthmore Turkey Growing Ration	Monroe: Henry Lord	11.45	20.00	20.00	5.96	7.00	4.73	4.00
3074	St. Albans Grain Co., St. Albans, Vt. Wirthmore Turkey Growing Ration	New Haven: R. G. Davis & Sons, Inc.	10.40	20.44	20.00	5.25	7.00	4.88	4.00
3061	St. Albans Grain Co., St. Albans, Vt. Wirthmore Turkey Starting Ration	Westville: Westville Grain Co.	10.48	23.38	24.00	4.45	7.00	4.53	4.50
3579	D. A. Stickell & Sons, Inc., Hagerstown, Md. Snap Scratch Grains	Middlefield: Terrill & Burnham	13.05	9.94	10.00	2.43	5.00	2.15	2.50
3581	D. A. Stickell & Sons, Inc., Hagerstown, Md. Stickell's Intermediate Chick Feed	Middlefield: Terrill & Burnham	12.90	10.25	10.00	1.65	5.00	3.68	2.50
3592	D. A. Stickell & Sons, Inc., Hagerstown, Md. Stickell's Poultry Fatner	Hartford: H. L. Solloway	9.88	14.06	12.00	4.00	4.00	5.48	4.50
3583	D. A. Stickell & Sons, Inc., Hagerstown, Md. Su-Pur Growing Mash	Middlefield: Terrill & Burnham	9.65	18.75	17.00	5.30	6.00	4.99	4.00
1933	D. A. Stickell & Sons, Inc., Hagerstown, Md. Two-in-One Scratch Grains	Long Hill: Long Hill Feed Store	13.20	10.50	10.00	1.55	5.00	2.00	2.50
3850	Syracuse Milling Co., Syracuse, N. Y. Onondaga Scratch Grains	Saugatuck: Saugatuck Grain Co.	12.30	10.25	10.00	2.40	5.00	3.10	2.50
2072	Syracuse Milling Co., Syracuse, N. Y. Syragold Egg Mash	So. Norwalk: Ferris-Devine Co.	9.83	19.88	18.00	5.78	8.00	5.40	3.00
2282	Syracuse Milling Co., Syracuse, N. Y. Syragold Feed Meal	Winsted: E. Manchester & Sons	11.38	10.50	9.00	3.15	8.00	5.65	3.00
3627	Syracuse Milling Co., Syracuse, N. Y. Syragold Growing Mash	Southport: C. Buckingham & Co.	12.90	19.06	16.00	4.05	7.00	4.03	4.00
3618	Syracuse Milling Co., Syracuse, N. Y. Syragold Laying Mash with Buttermilk	East Bridgeport: J. Simon	9.53	19.19	18.00	7.30	9.00	4.85	3.00
2071	Syracuse Milling Co., Syracuse, N. Y. Syragold Scratch Grains	So. Norwalk: Ferris-Devine Co.	12.18	10.88	10.00	2.63	5.00	2.80	2.50
2265	Thomaston Supply Co., Inc., Thomaston, Conn. Thomaston Egg Mash	Thomaston: Thomaston Supply Co., Inc.	9.98	19.00	18.00	7.38	7.00	4.45	4.00
2266	Thomaston Supply Co., Inc., Thomaston, Conn. Thomaston Growing Mash	Thomaston: Thomaston Supply Co., Inc.	9.53	15.88	15.00	6.83	7.00	4.58	4.00
2267	Thomaston Supply Co., Inc., Thomaston, Conn. Thomaston Scratch Feed	Thomaston: Thomaston Supply Co., Inc.	12.60	12.00	10.00	2.85	5.00	3.15	3.00
3538	Tioga-Empire Feed Mills, Inc., Waverly, N. Y. Broilertine	Hawleyville: W. A. Honan	10.33	18.94	15.50	4.60	7.00	4.58	3.50
2208	Tioga-Empire Feed Mills, Inc., Waverly, N. Y. Chicatine	Bethel: Morrison & Dunham	9.48	20.50	18.00	4.88	7.00	6.23	3.50
1985	Tioga-Empire Feed Mills, Inc., Waverly, N. Y. Derby E-Gee Scratch Feed	Bristol: Bristol Supply Co.	13.33	10.63	9.00	2.50	4.50	3.23	2.00
3988	Tioga-Empire Feed Mills, Inc., Waverly, N. Y. Ducatine	Hawleyville: W. A. Honan	9.50	20.88	18.00	5.20	6.50	4.70	4.00
3525	Tioga-Empire Feed Mills, Inc., Waverly, N. Y. Egatine	Hawleyville: W. A. Honan	9.73	25.19	23.00	5.43	7.00	4.78	3.50
3524	Tioga-Empire Feed Mills, Inc., Waverly, N. Y. Tioga Chick and Growing Mash	Hawleyville: W. A. Honan	10.63	20.88	16.50	5.43	7.00	4.80	3.50

TABLE I. ANALYSES OF COMMERCIAL FEEDS, INSPECTION OF 1933—*Continued*

Station No.	Manufacturer and brand	Retail dealer	Pounds per hundred: Water	Protein (N x 6.25): Found	Protein (N x 6.25): Guaranteed, not less than	Fiber: Found	Fiber: Guaranteed, not more than	Fat: Found	Fat: Guaranteed, not less than
	Proprietary Mixed Feeds—*Continued* *Poultry feeds—Continued*		%	%	%	%	%	%	%
3537	Tioga-Empire Feed Mills, Inc., Waverly, N.Y. Tioga Laying Food	Hawleyville: W. A. Honan	10.78	20.00	18.00	5.25	7.50	4.28	4.00
2276	Tioga-Empire Feed Mills, Inc., Waverly, N. Y. Tioga Neverfail Growing Grains	Torrington: Litchfield Co-op. Assoc.	12.25	10.94	10.00	1.63	3.50	3.05	3.00
2277	Tioga-Empire Feed Mills, Inc., Waverly, N. Y. Tioga Neverfail Poultry Grains	Torrington: Litchfield Co-op. Assoc.	11.53	11.25	9.00	2.75	4.50	3.45	2.00
3056	Jacob Trinley & Sons, Linfield, Pa. Favorite Laying Mash	Bridgeport: Conn. Feed Co.	10.30	19.63	18.00	6.97	7.00	5.20	4.00
3064	Jacob Trinley & Sons, Linfield, Pa. Favorite Scratch Grains	Bridgeport: Conn. Feed Co.	12.43	11.19	9.00	2.71	5.00	2.75	2.00
3801	Jacob Trinley & Sons, Linfield, Pa. Real Fattening Mash with Buttermilk	New Haven: R. G. Davis & Sons, Inc.	9.58	17.88	14.00	3.05	6.00	5.65	4.50
3055	Jacob Trinley & Sons, Linfield, Pa. Real Growing Mash	Bridgeport: Conn. Feed Co.	10.65	19.13	17.00	7.00	10.00	6.13	4.00
2264	Watertown Co-op. Assoc., Watertown, Conn. Sterling Scratch Feed	Watertown: Watertown Co-op. Assoc.	11.83	12.19	10.00	3.03	4.00	2.88	2.50

3640	Wayne County Grangers Feed Corp., Clyde, N. Y. Superior Laying Mash with Buttermilk and Cod Liver Oil	Cos Cob: A. R. Belmont	9.85	22.44	18.00	5.00	7.00	4.94	4.00
2130	West-Nesbitt, Inc., Oneonta, N. Y. Connecticut State Formula Mash	Amston: Amston Grain Mill	10.73	19.13	18.00	4.30	7.00	5.63	4.00
2281	West-Nesbitt, Inc., Oneonta, N. Y. Pure Feed Egg Mash with Buttermilk	Winsted: Chas. R. Hawley	10.93	22.13	18.00	5.45	7.00	4.90	5.00
2131	West-Nesbitt, Inc., Oneonta, N. Y. Pure Feed Scratch Grains	Amston: Amston Grain Mill	13.63	10.88	10.00	1.93	5.00	2.40	3.50
2168	Wolf's Feed Store, Shelton, Conn. Wolf's Egg Mash	Shelton: Wolf's Feed Store	9.53	19.94	18.00	6.03	7.00	5.53	4.50
2169	Wolf's Feed Store, Shelton, Conn. Wolf's Scratch Feed	Shelton: Wolf's Feed Store	11.85	10.31	10.00	2.65	4.00	2.45	2.00
1934	Yantic Grain & Products Co., Norwich, Conn. All-in-All Egg Ration	Mt. Carmel: Hamden Grain Co.	9.80	17.25	15.00	3.70	5.00	4.90	4.00
3092	Yantic Grain & Products Co., Norwich, Conn. Big Y All-in-All Growing Ration	Middlefield: Middlefield Center Feed Co.	10.90	18.25	15.00	3.74	5.00	5.65	4.00
1936	Yantic Grain & Products Co., Norwich, Conn. Big Y Chick Grains	Mt. Carmel: Hamden Grain Co.	10.90	11.13	10.00	1.13	4.00	3.50	2.00
1935	Yantic Grain & Products Co., Norwich, Conn. Big Y Chick Starter with Cod Liver Oil	Mt. Carmel: Hamden Grain Co.	8.90	18.75	18.00	3.55	6.00	5.58	4.00
1941	Yantic Grain & Products Co., Norwich, Conn. Big Y Complete Broiler and Chick Ration	Mt. Carmel: Hamden Grain Co.	8.98	18.63	17.50	3.86	6.00	5.43	4.00
1938	Yantic Grain & Products Co., Norwich, Conn. Big Y Growing Feed with Cod Liver Meal and Dried Milk	Mt. Carmel: Hamden Grain Co.	9.00	18.63	16.50	5.00	7.00	4.43	4.00
3093	Yantic Grain & Products Co., Norwich, Conn. Big Y Intermediate Chick Feed	Middlefield: Middlefield Center Feed Co.	12.95	11.38	10.00	1.73	5.00	3.15	2.50
3747	Yantic Grain & Products Co., Norwich, Conn. Big Y Laying Mash	Jewett City: Big Y Feed Store	10.15	18.06	16.00	6.10	7.00	5.39	4.00

TABLE I. ANALYSES OF COMMERCIAL FEEDS, INSPECTION OF 1933—*Continued*

Station No.	Manufacturer and brand	Retail dealer	Pounds per hundred: Water	Protein (N x 6.25): Found	Protein (N x 6.25): Guaranteed, not less than	Fiber: Found	Fiber: Guaranteed, not more than	Fat: Found	Fat: Guaranteed, not less than
	Proprietary Mixed Feeds—*Continued* *Poultry feeds—Concluded*		%	%	%	%	%	%	%
3097	Yantic Grain & Products Co., Norwich, Conn. Big Y Laying Mash with Buttermilk and Cod Liver Meal	Middlefield: Middlefield Center Feed Co.	10.95	18.44	18.00	5.73	7.00	5.08	4.00
1939	Yantic Grain & Products Co., Norwich, Conn. Big Y Laying Mash with Dried Milk and Cod Liver Meal	Mt. Carmel: Hamden Grain Co.	9.53	18.00	18.00	5.12	7.00	4.45	4.00
1940	Yantic Grain & Products Co., Norwich, Conn. Big Y Scratch Feed	Mt. Carmel: Hamden Grain Co.	11.15	11.38	10.00	2.62	5.00	2.58	2.00
4297	Yantic Grain & Products Co., Norwich, Conn. Big Y Turkey Growing Feed	Middlefield: Middlefield Center Grain Co.	9.68	20.63	20.00	4.88	6.00	6.18	4.50
4122	Yantic Grain & Products Co., Norwich, Conn. Big Y Turkey Starter Feed	Mt. Carmel: Hamden Grain Co.	8.68	23.88	24.00	5.00	5.00	6.14	4.50
4140	Yantic Grain & Products Co., Norwich, Conn. Calico Girl Scratch Feed	Willimantic: Boston Grain Co.	11.98	12.13	10.00	2.80	5.00	2.63	2.00
1937	Yantic Grain & Products Co., Norwich, Conn. Columbia Laying Mash with Dried Milk and Cod Liver Meal	Mt. Carmel: Hamden Grain Co.	9.65	16.00	16.00	7.24	7.00	4.73	4.00
2260	Yantic Grain & Products Co., Norwich, Conn. Columbia Scratch Feed	Naugatuck: Naugatuck Grain Co.	11.83	11.00	10.00	2.13	5.00	2.45	3.00
3767	Yantic Grain & Products Co., Norwich, Conn. Uncas Scratch Feed	Norwich: Yantic Grain & Products Co.	11.70	11.56	10.00	2.73	5.00	2.93	3.00
	Beef scraps, and other products								
3566	C. E. Buell, Inc., Boston, Mass. Buell Boston Dried Skim Milk	Winsted: E. Manchester & Sons	5.98	34.13	31.10	....	....	0.70[1]	0.20
3728	C. W. Burckhalter, Inc., New York City. Burck Brand Powdered Skim Milk	Stafford Springs: Stafford Granery	6.90	33.38	32.00	....	....	1.38[1]	0.75
2307	Collis Products Co., St. Paul, Minn. Collis Process Dried Buttermilk	Thompsonville: Geo. S. Phelps & Co.	10.20	31.88	30.00	....	....	5.55[1]	5.00
3465	Conn. Fat Rendering & Fertilizer Corp., West Haven, Conn. Meat Scraps	Wallingford: A. E. Hall	7.45	50.56	45.00	....	....	10.05	10.00
3594	Consolidated Rendering Co., Boston, Mass. Corenco Bone Meal, An All Animal Feed for Cattle, Hogs and Poultry	Southbury: Southbury Grain Co.	8.28	25.00	20.00	....	....	0.55	2.00
3802	Consolidated Rendering Co., Boston, Mass. Corenco Cod and Haddock Meal	New Haven: L. T. Frisbie Co.	9.00	63.63	62.00	....	....	2.90	2.00
3503	Consolidated Rendering Co., Boston, Mass. Corenco 45% Meat and Bone Scrap	West Cheshire: Cheshire Grain & Coal Co.	8.78	47.94	45.00	....	....	8.44	6.00
3573	Consolidated Rendering Co., Boston, Mass. Corenco 50% Meat Scrap	Thomaston: Thomaston Supply Co.	9.03	49.63	50.00	....	....	8.35	6.00
3702	Consolidated Rendering Co., Boston, Mass. Corenco 55% Meat Scrap	Bloomfield: Bloomfield Farmers' Exchange	7.68	58.69	55.00	....	....	9.75	6.00
3163	Consumer's Importing Co., New York City. Cico Bone Meal	Granby: E. H. Rollins	4.00	5.81	5.14	....	....	0.35	1.00
2116	Dairymen's League Co-op. Assoc., New York City. Dairylea Choice Feed Grade Dried Skim Milk	Norwich: Norwich Grain Co.	4.20	35.13	33.00	....	....	0.88[1]	0.50

[1]Roese-Gottlieb Method.

TABLE I. ANALYSES OF COMMERCIAL FEEDS, INSPECTION OF 1933—*Concluded*

Station No.	Manufacturer and brand	Retail dealer	Pounds per hundred: Water	Protein (N x 6.25): Found	Protein (N x 6.25): Guaranteed, not less than	Fiber: Found	Fiber: Guaranteed, not more than	Fat: Found	Fat: Guaranteed, not less than
	Proprietary Mixed Feeds—*Concluded*								
	Beef scraps, and other products —Concluded		%	%	%	%	%	%	%
3891	General Commodity Corp., Buffalo, N. Y. Old Sol Dried Skim Milk..	Norwich: Yantic Grain & Products Co.	4.95	35.50	32.00	....	....	0.93[1]	0.50
2268	Gorton Pew Fisheries Co., Lt., Gloucester, Mass. Gorton's Codfish Meal	Thomaston: Thomaston Supply Co. ...	8.18	56.44	55.00	0.48	1.00	2.90	0.10
3667	Gorton Pew Fisheries Co., Ltd., Gloucester, Mass. Gorton's Codfish Meal	Guilford: Fred C. Morse & Son	7.53	60.25	55.00	0.60	1.00	1.30	0.10
3890	Lincoln Farm Products Corp., New York City. Farm Brand Meat and Bone Scrap	Norwich: Yantic Grain & Products Co.	7.35	49.63	50.00	1.88	3.00	8.38	8.00
3739	Maine Fish Meal Co., Portland, Me. Maine Sardine Fish Meal	Putnam: Dayville Grain Co.	12.13	52.63	55.00	0.30	1.00	16.87	1.00
2007	Monti-Van Iderstine Co., Brooklyn, N. Y. Movan Meat Scrap	Norwalk: Libner Grain Co.	5.63	53.13	50.00	2.55	3.00	10.68	7.00
3748	James F. Morse & Co., Somerville, Mass. Morse's Meat Scrap	Jewett City: Jewett City Grain Co. ...	6.25	42.06	40.00	....	....	9.46	8.00
3764	John Reardon & Sons Co., Cambridge, Mass. Register Brand Meat & Bone Scraps, 45%	Norwich: Norwich Grain Co.	5.68	44.38	45.00	1.60	3.00	9.08	6.00
3765	John Reardon & Sons Co., Cambridge, Mass. Register Brand Meat Scraps, 55%	Norwich: Norwich Grain Co.	6.95	52.63	55.00	1.70	3.00	10.30	6.00
2115	Ronck & Bevis Co., Philadelphia, Pa. Ro-Be Fish Meal	Norwich: Norwich Grain Co.	10.40	52.31	55.00	3.93	3.00	6.78	5.00
3798	Sheffield Farms Co., Inc., New York City. Sheffield Skim Milk Powder	New Britain: C. W. Lines	5.63	33.75	32.00	....	....	0.83[1]	0.50
3578	St. Albans Grain Co., St. Albans, Vt. Hygrade Pure Cod and Haddock Fish Meal	Middlefield: Middlefield Grain & Coal Co.	15.60	61.31	63.00	0.43	1.00	0.89	1.50
3711	St. Albans Grain Co., St. Albans, Vt. Pure Dried Skim Milk Powder ...	Plantsville: C. A. Cowles	6.63	34.25	32.00	....	....	2.15[1]	0.50
3472	Chas. M. Struven Co., Baltimore, Md. Struven's Fish Meal	Wallingford: A. E. Hall	7.15	55.13	55.00	0.65	2.00	9.63	4.00
3746	The Van Iderstine Co., Long Island City, N. Y. Vico Quality Meat and Bone Scrap for Poultry	Moosup: Moosup Grain Co.	6.80	49.69	50.00	1.80	3.00	10.78	5.00
2190	Ward Dry Milk Co., St. Paul, Minn. Ward's Pure Dried Skim Milk	Seymour: Seymour Grain & Coal Co...	7.40	32.50	32.00	....	....	3.73[1]	1.00
3732	Worcester Rendering Co., Auburn, Mass. P. W. Fish Meal	So. Coventry: E. W. Latimer	7.10	52.63	50.00	0.90	2.00	8.03	4.00
3248	Young Bros., Co., Inc., Danielson, Conn. Dried Skim Milk, Animal and Poultry Feed	Danielson: Young Bros. Co.	....	32.63	32.63	....	....	0.99	0.99

[1]Roese-Gottlieb Method.

TABLE 1a. SUMMARY OF INSPECTION OF OFFICIAL SAMPLES

Feed	Samples examined	Samples deficient	Deficiencies in Protein	Deficiencies in Fiber	Deficiencies in Fat	Total deficiencies
Cottonseed meal	11	3	3	0	0	3
Linseed meal	8	1	1	0	1	2
Soybean meal	3	0	0	0	0	0
Wheat bran	28	1	0	0	1	1
Wheat middlings and similar products	24	0	0	0	0	0
Wheat red dog	6	0	0	0	0	0
Wheat feed (mixed feed)	14	2	0	0	2	2
Corn gluten feed	11	2	1	0	1	2
Hominy feed	15	1	1	0	1	2
Rye products	1	0	0	0	0	0
Brewers' and distillers' grains	2	0	0	0	0	0
Dried beet pulp	2	0	0	0	0	0
Horse feeds	76	10	2	3	6	11
Dairy feeds	153	31	7	1	28	36
Stock feeds	45	3	1	1	2	4
Calf feeds and other products	16	5	1	0	4	5
Poultry feeds	371	30	6	5	21	32
Beef scraps, etc.	29	6	4	1	3	8
Total	815	95	27	11	70	108

TABLE 1b. SUMMARY OF DEFICIENCIES IN GUARANTEED NUTRIENTS

Manufacturer or Jobber	Samples	Guaranties	Deficiencies Protein	Deficiencies Fiber	Deficiencies Fat	Percentages of guaranties met
Acme-Evans Co.	1	3	0	0	0	100
Alfalfa Products Co.	1	3	0	0	0	100
Allied Mills, Inc.	32	96	0	0	1	99
American Maize Products Co.	1	3	0	0	0	100
Anchor Mills	1	3	0	0	0	100
Anheuser-Busch, Inc.	1	3	0	0	0	100
Arcady Farms Milling Co.	12	36	0	1	2	92
[redacted]-Daniels-Midland Co.	3	9	0	0	0	100
Ashcraft-Wilkinson Co.	2	6	0	0	0	100
Bailey, E. W., & Co.	16	48	0	0	4	92
Beacon Milling Co., Inc.	26	78	0	0	0	100
Bisbee Linseed Co.	1	3	0	0	0	100
Black Rock Milling Corp.	5	15	0	0	2	87
Blatchford Calf Meal Co.	1	3	0	0	1	67
Bridge's, Amos D. Sons, Inc.	1	3	0	0	0	100
Broder, L., Grain Store	1	3	0	0	0	100
Buckingham, C., & Co.	6	18	0	0	1	83
Buell, C. E., Inc.	1	2	0	..	0	100
Burckhalter, C. W., Inc.	1	2	0	..	0	100
Cairo Meal & Cake Co.	1	3	0	0	0	100
Campbell, C. W., Co.	13	39	0	0	1	97
Caple, A. B., Co.	1	3	0	0	0	100
Clinton Syrup Refining Co.	1	3	0	0	0	100
Coles Co.	7	21	1	0	2	86
Collis Products Co.	1	2	0	..	0	100
Commander-Larabee Corp.	1	3	0	0	0	100
Conkey, G. E., Co.	10	30	0	0	0	100
Conn. Fat Rendering & Fertilizer Corp.	1	2	0	..	0	100
Consolidated Rendering Co.	5	10	0	..	1	90
Consumers Food Stores, Inc.	10	30	0	1	2	90
Consumers Importing Co.	1	2	0	..	1	50
Corn Products Sales Co.	2	6	1	0	1	67
Cowee, E. A. Co.	4	12	0	0	0	100
Cowles, C. J.	4	12	0	1	0	92
Cox, Chas. M., Co.	3	9	0	0	0	100
Crosby Milling Co.	2	6	0	0	0	100
Cutler, P. Inc.	6	18	0	0	0	100
Dairymen's League Co-op. Assoc., Inc.	1	2	0	..	0	100
Davis, R. G., & Sons, Inc.	8	24	0	0	1	96
Decatur Milling Co.	1	3	0	0	0	100

TABLE 1*b*. SUMMARY OF DEFICIENCIES IN GUARANTEED NUTRIENTS (*Continued*)

Manufacturer or Jobber	Samples	Guaranties	Deficiencies: Protein	Deficiencies: Fiber	Deficiencies: Fat	Percentages of guaranties met
Delaware Mills, Inc.	16	48	2	0	3	90
Denver Alfalfa Milling & Products Co.	1	3	1	0	0	67
Dietrich & Gambrill, Inc.	6	18	0	0	0	100
Duluth Superior Milling Co.	1	3	0	0	0	100
Eagle Roller Mill Co.	1	3	0	0	0	100
Eastern States Farmers' Exchange	20	60	0	0	1	98
Eckhart, B. A., Milling Co.	1	3	0	0	0	100
Elmore Milling Co., Inc.	12	36	0	0	1	97
Eshelman, John W., & Sons	33	99	0	2	2	96
Evans Milling Co.	1	3	0	0	0	100
Excelsior Milling Co.	1	3	0	0	1	67
Farmers' Feed Co.	1	3	0	0	0	100
Faroll Bros.	2	6	0	0	0	100
Fernando Valley Milling & Supply Co.	1	3	0	1	1	33
First National Stores, Inc.	2	6	0	0	0	100
Flory Milling Co., Inc.	6	18	0	0	2	89
Forbes, A. W.	3	9	0	0	0	100
Forbes Bros., Central Mills	1	3	0	0	0	100
Forrest, J. A.	3	9	1	0	1	78
Garland, J. B., & Sons	5	15	0	0	0	100
General Commodity Corp.	1	2	0	..	0	100
General Mills, Inc.	5	15	0	0	0	100
Gorton-Pew Fisheries Co., Ltd.	2	6	0	0	0	100
Grandin, D. H., Milling Co.	14	42	0	0	0	100
Grand Union Co.	2	6	0	0	0	100
Great Atlantic & Pacific Tea Co.	4	12	0	0	0	100
Hales & Hunter Co.	9	27	0	0	1	96
Ham, Frank B., & Co., Ltd.	2	6	0	0	0	100
Ham, J. B., Co.	9	27	0	0	2	93
Hamilton, William, & Son, Ltd.	1	3	0	0	0	100
Hecker-Jones-Jewell Milling Co.	3	9	0	0	0	100
Humphreys-Godwin Co.	2	6	0	0	0	100
International Milling Co.	3	9	0	0	0	100
Jersee Co.	1	3	0	0	1	67
Jones & Quinn	2	6	0	0	1	83
Kansas Flour Mills Corp.	1	3	0	0	0	100
Kellogg Co.	1	3	0	0	0	100
Kellogg & Miller, Inc.	1	3	0	0	0	100
Kellogg, Spencer & Sons, Inc.	1	3	0	0	0	100

TABLE 1*b*. SUMMARY OF DEFICIENCIES IN GUARANTEED NUTRIENTS (*Continued*)

Manufacturer or Jobber	Samples	Guaranties	Deficiencies: Protein	Deficiencies: Fiber	Deficiencies: Fat	Percentages of guaranties met
King, H. H., Flour Mills Co.	1	3	0	0	0	100
King Midas Mill Co.	1	3	0	0	0	100
Krause, Chas. A., Milling Co.	1	3	0	0	0	100
Kysor, H. P., Feed & Grain Co.	6	18	0	0	1	94
Labieniec, A. S.	3	9	0	0	0	100
Laden Bros. Co., Inc.	6	18	2	1	2	72
Larabee Flour Mills Co.	2	6	0	0	0	100
Larrowe Milling Co.	15	45	0	0	0	100
Libner Grain Co.	6	18	0	0	0	100
Lincoln Farm Products Corp.	1	3	0	0	0	100
Lines, C. W., Co.	5	15	0	0	1	93
Litchfield County Co-op. Assoc.	4	12	0	0	0	100
Long Hill Feed Store	2	6	0	0	2	67
Lovitt, L. B., & Co.	1	3	1	0	0	67
Maine Fish Meal Co.	1	3	1	0	0	67
Manchester, E., & Sons	7	21	0	0	0	100
Mann Bros. Co.	1	3	0	0	0	100
Maritime Milling Co., Inc.	15	45	0	0	1	98
Meader Milling Co.	1	3	1	0	1	33
Meech & Stoddard, Inc.	11	33	0	1	3	91
Miller Cereal Mills	1	3	1	0	1	33
Miner-Hillard Milling Co.	1	3	0	0	0	100
Monti-Van Iderstine, Inc.	1	3	0	0	0	100
Moon, Geo. Q., & Co., Inc.	15	45	0	0	3	93
Morse, Fred C., & Son	10	30	0	0	0	100
Morse, Jas. F., & Co.	1	3	0	0	0	100
Mosely & Motley Milling Co.	2	6	0	0	0	100
National Milling Co.	1	3	0	0	0	100
Niagara Falls Milling Co.	2	6	0	0	0	100
Northwestern Consolidated Milling Co.	3	9	0	0	0	100
Norwalk Grain Co.	2	6	0	0	0	100
Nowak Milling Corp.	7	21	0	0	0	100
Obrecht, P. Fred'k, & Son	1	3	0	0	0	100
Ontario Milling Co., Inc.	6	18	1	0	1	89
Osborn, S. V., Estate	2	6	0	0	0	100
Park & Pollard Co., Inc.	27	81	3	0	6	89
Patent Cereals Co., The	1	3	0	0	0	100
Pecas Valley Alfalfa Mill Co.	2	6	0	0	0	100
Penick & Ford, Ltd., Inc.	1	3	0	0	0	100
Pillsbury Flour Mills Co.	5	15	0	0	0	100
Pincoffs, Maurice, Co.	2	6	2	0	0	67

TABLE 1*b*. SUMMARY OF DEFICIENCIES IN GUARANTEED NUTRIENTS
(Concluded)

Manufacturer or Jobber	Samples	Guaranties	Deficiencies: Protein	Deficiencies: Fiber	Deficiencies: Fat	Percentages of guaranties met
Platt, Frank S., Co., The	2	6	0	0	0	100
Postum Co., Inc.	1	3	0	0	0	100
Pratt Food Co.	7	21	0	0	0	100
Puffer, H. C., Co.	3	9	0	0	0	100
Quaker Oats Co., The	25	75	2	0	1	96
Ralston Purina Co.	35	105	0	0	0	100
Reardon, John, & Sons Co.	2	6	1	0	0	83
Richardson, Jas., & Sons, Ltd.	1	3	0	0	0	100
Robin Hood Mills, Ltd.	2	6	0	0	0	100
Ronck & Bevis Co.	1	3	1	1	0	33
Rotex Milling Co.	2	6	2	0	0	67
Russell Miller Milling Co.	3	9	0	0	0	100
Seymour Grain & Coal Co.	11	33	0	1	0	97
Shaffer, J. C., Grain Co.	1	3	0	0	0	100
Sheffield Farms Co., Inc.	1	2	0	..	0	100
Shelton Feed Co.	1	3	0	0	0	100
Sherwin-Williams Co.	1	3	0	0	0	100
Sovitsky, Ike	6	18	0	0	0	100
Staley, A. E. Manufacturing Co.	2	6	0	0	0	100
Stickell, D. A., & Sons, Inc.	8	24	0	0	2	92
St. Albans Grain Co.	41	122[1]	3	0	2	96
St. Lawrence Flour Mills Co.	1	3	0	0	0	100
Struven Chas. M., Co.	1	3	0	0	0	100
Syracuse Milling Co.	14	42	0	0	0	100
Thomaston Supply Co., Inc.	4	12	0	0	0	100
Tioga-Empire Feed Mills, Inc.	15	45	0	0	2	96
Traders Feed & Grain Co., Inc.	2	6	0	0	0	100
Transit Milling Co.	2	6	0	0	0	100
Trinley, Jacob & Sons	8	24	0	0	1	96
Union Starch & Refining Co.	1	3	0	0	0	100
Upper Hudson Rye Flour Mills, Inc.	1	3	0	0	0	100
Van Iderstine Co.	1	3	0	0	0	100
Ward Dry Milk Co.	1	2	0	..	0	100
Watertown Co-op. Assoc.	1	3	0	0	0	100
Wayne County Grangers Feed Corp.	4	12	0	0	0	100
West-Nesbitt, Inc.	7	21	0	0	2	90
Wolf's Feed Store	3	9	0	0	0	100
Worcester Rendering Co.	1	3	0	0	0	100
Yantic Grain & Products Co.	31	93	0	1	1	98
Young Bros. Co., Inc.	1	2	0	..	1	100
	815	2429	27	11	70	96

[1]Includes one sample with only two guaranties.

Bulletin 363 July, 1934

THE THIRTY-EIGHTH REPORT ON

FOOD PRODUCTS

AND THE TWENTY-SIXTH REPORT ON

DRUG PRODUCTS

1933

Connecticut
Agricultural Experiment Station
New Haven

CONTENTS AND SUMMARY

Material	Page	Sampled by or submitted to: The Station	Sampled by or submitted to: The Dairy and Food Commissioner	Total	Adulterated, below standard or otherwise illegal
FOODS					
Apple butter		....	11	11	....
Baking powder		1	0	1	0
Beverages, carbonated		....	142	142	4
malt		....	105	105	....
Coffee		....	2	2	0
Eggs and egg products		1	8	9	1
Fats and oils					
Butter		2	6	8	0
Olive oil		5	25	30	10
Fruit juices		1	6	7	0
Honey		2	1	3	0
Ice cream		13	150	163	8
Maple syrup, etc.		1	3	4	0
Milk and milk products					
Market milk		338	23	361	0
Evaporated milk		....	2	2	0
Cream		16	11	27	2
Nuts, shelled		....	16	16	0
Salad dressing		2	0	2	....
Spray residue		103	67	170	0
Squash		14	0	14	....
Vinegar		10	4	14	2
Unclassified materials		59	10	69	....
Total for foods		568	592	1160	27
DRUGS					
Ammonia water		....	8	8	5
Antimony-potassium tartrate		....	5	5	0
Aspidium, oleoresin of		....	4	4	1
Belladonna, ointment of		....	12	12	3
Boric acid		....	20	20	0
Calcium carbonate, precipitated		....	15	15	0
Calcium hydroxide, solution of		....	13	13	2
Chlorinated lime		....	4	4	1
Chlorinated soda		....	5	5	5
Ferric phosphate, soluble		....	3	3	0
Ferrous carbonate, saccharated		....	4	4	1

CONTENTS AND SUMMARY—*Concluded*

Material	Page	Sampled by or submitted to: The Station	Sampled by or submitted to: The Dairy and Food Commissioner	Total	Adulterated, below standard or otherwise illegal
Formaldehyde, solution of		....	9	9	0
Hypophosphorous acid		....	2	2	0
Iodine, compound solution of		....	11	11	8
Lactic acid		....	4	4	0
Magnesium citrate, solution of		....	23	23	11
Mercurous chloride, compound pills of		....	8	8	2
Methenamine		....	5	5	0
Potassium arsenite, solution of		....	21	21	5
Sulphuric acid, dilute		....	14	14	5
Theobromine sodio-salicylate		....	4	4	0
Whiskey		2	32	34	8
Witch hazel, extract of		....	8	8	2
Yellow mercuric oxide, ointment of		....	6	6	1
Unclassified drugs, etc.		7	....	7	....
Total for drugs		9	240	249	60
MISCELLANEOUS					
Materials, examined for poisons		67	....	67	....
Tobacco, collaborative work		52	....	52	....
Total for miscellaneous		119	....	119	....
Total for all exclusive of Babcock glassware, etc.		672	856	1528	87
BABCOCK GLASSWARE, ETC.		2164	....	2164	2

THE THIRTY-EIGHTH REPORT ON FOOD PRODUCTS AND THE TWENTY-SIXTH REPORT ON DRUGS

E. M. Bailey

This report summarizes food and drug control work for the year 1933 including samples submitted by the Dairy and Food Commissioner and samples taken by the station agent.

Collaboration with other departments of the Station, chiefly the Department of Soils, has been continued.

Various members of the staff of the department have served as collaborators in the study of analytical methods for the Association of Official Agricultural Chemists, and Dr. Fisher has served that association as an associate referee on drugs. The chemist in charge has served as a member of the Food Standards Committee of the U. S. Department of Agriculture, and as a member of the Council on Pharmacy and Chemistry, and of the Committee on Foods of the American Medical Association.

Grateful acknowledgment is made to the staff of this department for loyal and efficient coöperation in carrying on our work.

FOODS

APPLE BUTTER

Among definitions and standards for food products announced by the Secretary of Agriculture from time to time is a definition for apple butter announced May 15, 1933. No numerical standards are included but the identity of the product is defined thus:

> *Apple butter* is the semi-solid product obtained by cooking to a suitable consistency the strained edible portion of apples with sugar and/or dextrose, with or without one or more of the following: apple juice, boiled cider, spice, salt. In its preparation not less than 5 parts by weight of the strained apples are used to each 2 parts by weight of sugar and/or dextrose. The product has a characteristic apple flavor and is commonly spiced.

Eleven samples of commercial brands of apple butter were collected early in 1933, prior to the announcement of the above definition. Only total solids and insoluble solids were determined. Solids that are insoluble in water represent insoluble material from the fruit and spices used. The remainder of the total solids is largely sugar.

Analyses are given in Table I.

TABLE 1. ANALYSES OF APPLE BUTTER

No.	Manufacturer or Distributor	Total Solids	Insoluble Solids
		%	%
53546	The Great Atlantic & Pacific Tea Co., New York, N. Y. *Sultana*	51.39	2.59
53757	Armour & Co., Chicago, Ill. *"Veribest"*	51.82	2.46
53777	Austin, Nichols & Co., Inc., New York, N. Y. *"Sunbeam"*	48.55	2.10
54104	Curtice Bros. Co., Portchester, N. Y. *"Blue Label"*	42.10	2.45
54105	Curtice Bros. Co., Portchester, N. Y. *"Blue Label"*	41.61	2.79
53776	H. J. Heinz Co., Pittsburgh, Pa. *Heinz*	44.27	2.24
53781	Francis H. Leggett & Co., New York, N. Y. *"Premier"*	53.91	1.92
53778	Preserves & Honey, Inc., New York, N. Y. *"Shady Dell"*	40.99	1.79
53775	Tea Garden Products Co., San Francisco, Calif. *Tea Garden*	55.30	2.47
53543	Tremont Kraut Co., Pittsburgh, Pa. *Snow Drift*	45.21	2.72
53547	R. G. Williams & Co., Inc., New York, N. Y. *Royal Scarlet*	43.97	2.42

BAKING POWDER

One sample of baking powder was examined with the following result:

2708. *Clabber Girl* Double Acting Baking Powder.
Analysis: Total CO_2, 16.25 per cent; residual CO_2, 1.51 per cent; available CO_2, 14.74 per cent. The standard for available carbon dioxide in baking powder is not less than 12 per cent.

CARBONATED BEVERAGES

One hundred and forty-two samples of soft drinks of the soda water type were examined. Artificial color, if present, was declared in all cases with one exception, 54836. Sugar content, required by statute to be not less than 5 per cent, was in excess of that minimum in all samples. One sample, 53893, ginger ale reinforced with vitamin, was labelled "bottled sunshine". While it is doubtful that such a fantastic legend seriously misleads the purchaser, yet the implication that this product has the nutritional effect that exposure to sunshine produces is not warranted. Such implications are not uncommon in connection with foods reinforced with certain vitamins. Two other samples, 54961 and 54844, contained foreign material which suggested lack of care and cleanliness in the bottling establishments. None of the samples was found to contain saccharin.

BEER

W. T. Mathis and E. M. Bailey

Beer is essentially a fermented beverage prepared from an infusion of hops and malted barley, with or without unmalted cereal grains other than barley. The beer of early Teutonic tribes is said to have been a sweet fermented liquor containing honey. The Slavs appear to have used hops to impart a bitter taste and hops finally became a characteristic constituent of beers, although for a time their use was prohibited in England. Barley has been the grain almost universally used in beer-making since the earliest times, and in some parts of Germany the supplementary use of other grains was prohibited by law. In England, however, wheat is used as a supplement to barley, and corn and rice are used in a similar way in American practice. Other starchy cereals are adaptable and are probably used.

Manufacture of beer. The various steps in the manufacture of beer involve many technical details. Volumes have been written on the scientific as well as the practical aspects of these processes. Great stress is laid, particularly in Germany, on the character of water used in mashing and other operations. The choice of grain for malting and for use as supplement to the malt is given careful attention. Mashing operations and fermentation are subject to control depending on the characters desired in the finished products; and storage conditions are important.

The first step is the preparation of the malt. Because of its peculiar advantages barley is chosen. The grain is steeped in water until it is thoroughly moistened in order to facilitate germination. The water is drawn off and the moist grain allowed to sprout or germinate. When the sprout or acrospire has grown to a length just a little shorter than the grain itself, the grain is spread on a perforated floor and artificial heat is applied. This is the process of kiln drying. It serves to remove the excess of moisture, checks the growth of the sprout, and interrupts the action of the enzymes, chiefly diastase and protease, that have been produced in the germination process. The development of these enzymes is the primary object of malting. The kiln dried malted barley is the brewers' malt of commerce. The temperature at which the germinated grain is dried has an important bearing on the character of the beer subsequently produced. Drying at low temperatures produces light colored beers; darker colored products result from kiln drying at higher temperatures which effect partial caramelization of the starch. Many brewers buy their malt already prepared and thus eliminate the malting process in their own plants.

The next essential step is the preparation of the mash. The diastase of malt is sufficient to convert much more than the starch in the malt itself into fermentable sugar, hence the practice of mashing a mixture of malt with raw (unmalted) cereals. The malt and raw grains are crushed, mixed with water, and the "mash" allowed to stand at suitable and controlled temperatures. During this process the cereal starches are converted into fermentable sugars and the proteins are in part transformed into soluble forms such as amides, peptones and albumoses. The liquid portion of the mash is drawn off and the residual mash washed several times with hot water to exhaust it of soluble constituents. The washings are added to the drawn-off liquid and this constitutes the beer wort.

The wort is then boiled, after which hops are added and the boiling continued. Boiling accomplishes several results. The volume of wort is reduced, enzymes are destroyed, certain protein substances not desired in the finished beer are precipitated, color is enhanced by caramelization of the sugars, hop resins and oil are extracted and impart flavor and aroma to the wort, and, finally, the wort is sterilized.

After cooling and sedimentation the wort is drawn off or filtered and the clear liquor is ready for fermentation. Selected cultures of yeast are used, and the effect sought is the conversion of fermentable carbohydrates into alcohol, a process that is accompanied by a simultaneous evolution of carbonic acid gas (carbon dioxide). The alcohol produced is approximately one-half the weight of the fermentable sugar in the wort. The yeast feeds on the soluble protein substances that remain in the wort. Temperature has a marked effect on the character of the fermentation process. At relatively low temperatures, 10° C or less, the yeast falls to the bottom of the fermentation vat and so-called bottom fermentation proceeds. At higher temperatures, 15° to 22°, the yeast rises to the surface of the wort and top-fermentation takes place. Top fermentation is the more rapid process and requires but a few days; bottom fermentation is slower, requiring from 8 to 16 days. Both of these processes are of the open fermentation type. Fermentation may also be conducted in closed tanks by the vacuum system. By this method the fermenting wort is not in contact with the atmosphere. Only sterilized air is admitted and carbon dioxide is removed as fast as it is formed. The method is rapid and permits of accurate control.

After the principal or primary fermentation has taken place the beer is stored or rested in vats where a secondary fermentation takes place. After this the product is clarified by filtering to remove yeast cells and other materials that would impair its keeping qualities. It is then put into commercial packages. Bottled beer, especially that not intended for immediate consumption, may be pasteurized to increase its stability.

Types of beer. Wahl and Henius have described the characteristics of some of the common types of beer as follows:

Bavarian type lager. Dark in color, malt flavor, sweetish taste; aroma and bitter taste of hops not pronounced; usually lively and sparkling.

Bohemian type lager. Light in color, pronounced hop aroma and bitter taste; malt flavor not pronounced; usually lively and sparkling.

American type lager. Light in color with pronounced hop aroma; less bitter than Bohemian; high degree of brilliancy; lively and sparkling.

Ale. Light in color; hop aroma and bitter taste very marked; alcohol rather high and tart taste in aged product; either lively or still; usually clear.

Stout. Very dark in color, malt flavor and sweet taste; brewed stronger than ale and has tart taste in aged product. Less alcohol than ale; usually lively.

Porter may be described as a mild stout. It contains less alcohol and extract than stout.

Weiss beer. Very light in color; malt and hop flavor not pronounced; quite tart, very lively but not sparkling; usually turbid.

Common or Steam beer. Light in color; hop aroma and bitter taste not pronounced; very lively but not necessarily brilliant.

Commercial products sold under these names vary considerably and these distinctions do not always hold.

Terms used in describing beers. In describing beers the term "body" refers to the amount of solids or extract. "Life" refers to the amount of carbonic acid gas in the product. Beer containing less than 0.25 per cent of

carbon dioxide will be "flat." "Color" depends on caramel content; "malt flavor" also depends on this constituent. "Hop flavor" depends upon the content of hop oil. "Bitter", "sweet" and "tart" are terms that refer to hop resin, residual sugar and lactic acid respectively. "Stimulating effect" depends on the alcoholic content. "Brilliance" refers to the degree of transparency. "Stability" is the power or property of retaining characteristic features in the finished product. Yeast cells, bacteria and protein substances do not favor stability; alcohol, carbon dioxide, lactic acid and hop resin are said to enhance stability. Pasteurization favors the stability of bottled beers.

Standards. Beer is officially defined and standardized in the laws or regulations of some countries. A special committee of the U. S. Senate gave consideration to this and related questions in 1899-1900. The conclusions of this committee inclined to the English view which took no exception to the use of raw cereals other than barley as supplements to barley and malt. Testimony before the committee unanimously favored a legal definition and standard for beer and the committee recommended such action. In 1902 the Congress delegated power to the Secretary of Agriculture to establish standards of purity for food products generally. The first pronouncement of standards under this authority was in 1903 but it contained no standards for beer. The circular stated that the schedule for malt liquors was in preparation.

In 1906, however, the Committee on Food Standards of the Association of Official Agricultural Chemists, with which committee the Secretary of Agriculture was authorized to consult, proposed a tentative schedule of definitions and standards for malt liquors, and in 1907-8 this schedule was adopted by the association just named and by the Association of National Food and Dairy Departments upon recommendation of a joint committee of the two associations. The status and the fate of these definitions are obscure. Apparently they were not issued officially by the Secretary; and the present schedule of food definitions and standards contains no schedule for malt liquors. These early definitions are of interest however and they are quoted here:

"*Malt liquor* is a beverage made by the alcoholic fermentation of an infusion, in potable water, of barley malt and hops, with or without unmalted grains or decorticated and degerminated grains.

"*Beer* is a malt liquor produced by bottom fermentation, and contains, in one hundred (100) cubic centimeters (20° C.), not less than five (5) grams of extractive matter and sixteen one-hundredths (0.16) gram of ash, chiefly potassium phosphate, and not less than two and twenty-five one-hundredths (2.25) grams of alcohol.

"*Lager beer,* stored beer, is beer which has been stored in casks for a period of at least three months, and contains, in one hundred (100) cubic centimeters (20° C.), not less than five (5) grams of extractive matter and sixteen one-hundredths (0.16) gram of ash, chiefly potassium phosphate, and not less than two and fifty one-hundredths (2.50) grams of alcohol.

"*Malt beer* is beer made of an infusion, in potable water, of barley malt and hops, and contains, in one hundred (100) cubic centimeters (20° C.), not less than five (5) grams of extractive matter, not less than two-tenths

(0.2) gram of ash, chiefly potassium phosphate, nor less than two and twenty-five one-hundredths (2.25) grams of alcohol, nor less than four-tenths (0.4) gram of crude protein (nitrogen x 6.25).

"*Ale* is a malt liquor produced by top fermentation, and contains, in one hundred (100) cubic centimeters, (20° C.) not less than two and seventy-five one-hundredths (2.75) grams of alcohol, nor less than five (5) grams of extract, and not less than sixteen one-hundredths (0.16) gram of ash, chiefly potassium phosphate.

"*Porter* and *stout* are varieties of malt liquor made in part from highly roasted malt."

Composition. The chemical composition of beer is very complex. In general the constituents may be grouped as follows:

(a) Volatile, including water, alcohol, acetic and carbonic acids and other volatile acids.

(b) Fixed organic, including sugars, dextrin complexes, glycerol, lactic and succinic acids, proteins and the extractive materials of hops.

(c) Mineral, including chiefly potassium, calcium and magnesium phosphates.

Groups (b) and (c) comprise the solids or extract.

The composition of various types of beer as shown by the usually determined constituents is illustrated by the following data, Table II, taken from Wahl and Henius and from König. As a matter of interest and comparison, averages of recent analyses for the several types of beers represented are inserted, these being taken from Tables III and IV.

TABLE II. COMPARATIVE ANALYSES OF EARLY BEERS AND THOSE OF 1933

	Specific gravity	Alcohol By weight	Alcohol By volume	Extract	Sugar	Protein	Phosphoric acid (P_2O_5)
Beer		%	%	%	%	%	%
Average of 222 lager beers from all parts of U. S. 1873 to 1887	.....	3.85	....	5.79	1.53	0.62	0.095
Average of 210 American lager beers in 1890	.....	4.01	....	5.70	1.20	0.56	.....
Average of 247 American lager beers in 1896	.....	3.82	....	5.29	1.62	0.46	0.068
Average of 258 lager beers (König)	1.0162	3.93	....	5.79	3.73[1]	0.71	0.077
Average of 205 Schenk beers (König)	1.0114	3.36	....	5.34	4.06[1]	0.74	0.055
Average of 84 Bock beers (König)	1.0213	4.69	....	7.21	5.78[1]	0.73	0.089
Average of 26 Weiss beers (König)	1.0137	2.73	....	5.34	4.04[1]	0.58	0.034
Average of 37 domestic light beers in 1933 (before repeal)	1.0156	2.96	3.70	6.38	4.97[1]	0.49	0.058
Average of 8 domestic dark beers in 1933 (before repeal)	1.0154	2.89	3.61	6.28	4.79[1]	0.47	0.057
Average of 7 imported light beers in 1933 (before repeal)	1.0092	2.94	3.68	4.69	3.41[1]	0.36	0.058
Two imported dark beers in 1933 (before repeal)	1.0133	2.97	3.71	5.77	4.38[1]	0.46	0.098
	1.0186	3.20	4.00	7.28	5.69[1]	0.55	0.106
Average of 10 domestic light beers in 1933 (after repeal)	1.0155	3.71	4.64	6.68	5.22[1]	0.50	0.060
Average of 3 domestic dark beers in 1933 (after repeal)	1.0146	3.29	4.11	6.25	4.75[1]	0.51	0.065
Ale							
Average of 9 American stock ales, 1896	.....	5.55	....	5.64	1.81	0.46	0.061
American Cream Ale, 1901	.....	4.75	....	4.45	1.06	0.37	0.040
Bass Ale, 1887	.....	5.66	....	4.42	0.49	0.50	0.056
Bass Ale, 1896	.....	5.58	....	4.32	0.76	....	.....
Bass Ale, 1901	.....	5.18	....	5.76	1.68	0.58	0.060
Average of 38 Ales (König)	1.0141	4.75	....	5.65	1.81[1]	0.61	0.086
Average of 11 domestic ales in 1933 (before repeal)	1.0137	2.95	3.69	5.92	4.53[1]	0.40	0.041
Average of 9 imported ales in 1933 (before repeal)	1.0080	3.01	3.76	4.43	2.99[1]	0.39	0.047
Average of 12 domestic ales in 1933 (after repeal)	1.0154	3.84	4.80	6.70	5.24[1]	0.46	0.056

[1]Includes dextrins; older analyses apparently did not.

TABLE II. COMPARATIVE ANALYSES OF EARLY BEERS AND THOSE OF 1933—*Concluded*

	Specific gravity	Alcohol By weight	Alcohol By volume	Extract	Sugar	Protein	Phosphoric acid (P_2O_5)
Miscellaneous		%	%	%	%	%	%
Nurenberger, 1884	.....	4.27	....	6.31	....	1.08	0.103
Nurenberger, 1898	.....	3.88	....	6.80	....	....	.....
Nurenberger, 1895	.....	4.31	....	7.07	2.06	0.51	0.095
Muenchener, Hofbrau, 1846	.....	4.02	....	6.77	0.35	....	.....
Muenchener, Hofbrau, 1866	.....	3.88	....	4.93	....	0.43	.....
Muenchener, Löwenbrau, 1888	.....	3.46	....	5.33	2.60	....	.....
Muenchener, Pschorrbrau, 1901	.....	3.72	....	6.12	1.72	0.41	0.054
Pilsener, 1897	.....	3.82	....	4.82	....	....	.....
Kulmbacher, 1887	.....	4.48	....	6.80	1.77	0.44	0.080
Kulmbacher, 1888	.....	4.18	....	9.71	3.11	....	.....
Average of 40 analyses of Porter (König)	1.0141	4.75	....	5.65	2.88[1]	0.61	0.086
Weibel's Porter, domestic, 1933 (before repeal)	1.0139	2.93	3.66	5.92	4.48[1]	0.40	0.047
Average of 2 analyses of Porter, 1933 (after repeal)	1.0211	4.00	5.01	8.27	6.29[1]	0.62	0.069
Beers apparently not made with malt (Parsons 1902)							
1	1.0074	1.34	1.68	2.52	....	0.11	0.010
2	1.0098	2.10	2.63	3.40	....	0.22	0.023
3	1.0062	1.82	2.27	2.25	....	0.15	0.015
4	1.0112	1.69	2.11	3.53	....	0.13	0.015
5	1.0041	1.48	1.85	1.73	....	0.03	0.010

[1]Includes dextrins; older analyses apparently did not.

Before the advent of national prohibition, the sale of intoxicating liquor, including beer, was prohibited in certain states or in certain communities of the state under the plan of local option. Because of the language of these laws, some of which presumably are still in effect, it is sometimes necessary to establish to the satisfaction of the court or jury that seized liquor is beer or malt liquor as defined in the statutes. It is necessary to prove the presence of malt, or of malt and hops, in addition to alcohol. Some of the characteristics of all-malt beverages as compared with those made from malt and supplemental raw cereals and brewers' sugar are pointed out in studies made by Tolman and Riley (U. S. Dept. Agr., Bull. 93, 1917). They observed that percentages of ash, protein and phosphoric acid were higher in all-malt beverages than in any such beverages made with mixtures of malt and supplementary cereals. Parsons (Jour. Am. Chem. Soc., *24*, 1170, 1902), studied this problem specifically and concluded that protein and phosphoric acid were valuable indices upon which to judge the character of malt liquors, and that such liquors, as made at that time and before, would not contain less than 0.25 per cent of protein and not less than 0.04 per cent of phosphoric acid. The following figures are taken from data supplied or cited by him and supplemented by similar data taken from Tables III and IV of this report.

"Protein" and Phosphoric Acid in Malt Liquors

Description		Protein (N x 6.25) %	Phosphoric acid, (P_2O_5) %
American malt liquors, old analyses			
28 analyses (Crampton)	maximum	0.763	0.104
	minimum	0.400	0.056
	average	0.563	0.077
76 analyses (Parsons)	maximum	0.614	0.095
	minimum	0.290	0.045
	average	0.470	0.061
Beer apparently not made with malt, old analyses			
5 analyses (Parsons)	maximum	0.215	0.023
	minimum	0.031	0.010
	average	0.129	0.015
American beers, light and dark, 1933 (before repeal)			
45 analyses	maximum	0.65	0.092
	minimum	0.39	0.049
	average	0.47	0.057
American beers, light and dark, 1933 (after repeal)			
13 analyses	maximum	0.60	0.080
	minimum	0.38	0.039
	average	0.50	0.061
Imported beers, light and dark, 1933 (before repeal)			
9 analyses	maximum	0.55	0.106
	minimum	0.22	0.037
	average	0.39	0.068

American ale, 1933 (before repeal)

12 analyses	maximum	0.48	0.054
	minimum	0.33	0.027
	average	0.40	0.041

American ale, 1933 (after repeal)

12 analyses	maximum	0.62	0.075
	minimum	0.29	0.031
	average	0.46	0.056

Imported ale, 1933 (before repeal)

9 analyses	maximum	0.53	0.094
	minimum	0.24	0.026
	average	0.39	0.047

It should be understood that "protein" is nitrogenous material expressed in the conventional manner. Bearing in mind the limit of 0.25 per cent suggested by Parsons, it is seen that domestic beers as sold in this State in 1933 are all in excess of that minimum; and that the range of protein values is not very different from that shown by older analyses. Among the imported beers sold here one falls very slightly below 0.25 per cent. Ales, both domestic and imported, exceed the minimum value except in one case in which the variation is negligible.

As regards phosphoric acid also the minimum of 0.04 per cent, postulated on the basis of old analyses, is practically justified according to analyses of products sold in this State in 1933. One imported beer contained 0.037 per cent P_2O_5 and this same product, No. 55753, was slightly under the minimum value for protein. Among ales, six domestic products (one in the repeal group) contained less than 0.04 per cent P_2O_5, and three imported ales had less than that figure. Values distinctly less than 0.04 per cent P_2O_5, accompanied by protein values below the average and approaching those values herein cited for non-malt beverages, appear to warrant the conclusion that little if any malt was used in their manufacture.

When beers are made without the use of malt, raw cereals cannot be employed because malt is necessary to convert their starch into fermentable carbohydrate. The "wort" in such cases is a direct solution of a sugar, dextrose, derived from starch by acid hydrolysis. Fermentation of such a "wort" is not possible without the presence of some albuminous or protein material to serve as a food for yeast during the fermentation process, hence some suitable nitrogenous material must be added. To a large extent this accounts for the "protein" found in non-malt beers.

The total amount of ash found in malt and non-malt beverages is small, being of an order of magnitude of about 0.25 per cent and 0.15 per cent respectively. Qualitatively, however, the ash in the two types of beverages is notably different, the malt product ash being conspicuous for its potassium phosphate, while the non-malt ash is relatively higher in sodium, sulphates and chlorides. The comparison is well illustrated by the following data:

Ash Constituents of Malt and Non-Malt Beers

	Malt beer (Blyth) %	*Malt beer* (König) %	*Non-malt beer* (Parsons) %
Potassium (K_2O)	37.22	33.67	12.93
Sodium (Na_2O)	8.04	8.94	19.61
Calcium (CaO)	1.93	2.78	....
Magnesium (MgO)	5.51	6.24	....
Iron (Fe_2O_3)	trace	0.48	....
Sulphuric acid (SO_3)	1.44	3.47	10.81
Phosphoric acid (P_2O_5)	32.09	31.35	10.71
Chlorine (Cl)	2.91	2.93	21.76
Silica (SiO_2)	10.82	9.29	7.50

Hops are the accepted source of bitter principles for the manufacture of beer. Commercial preparations of lupulin, derived from hops, are sometimes used in conjunction with whole hops. As already pointed out, hops is one of the characteristic ingredients of beer as defined in the statutes of some states. Hop bitters may be distinguished from other bitter principles such as aloes, gentian and quassia that have at times been used in beer, because they may be removed from the liquor by treatment with lead acetate. When beer has been so treated and excess lead has been removed, absence of a bitter taste in the filtrate is taken as positive evidence that foreign bitters are not present. Hop bitters are said to be desirable because they do not leave the unpleasant, bitter after-taste which characterizes so-called hop substitutes.

The summary given in Table II also furnishes data on other features of the composition of present-day beers as compared with earlier brews. It should be noted here that results are expressed uniformly in percentages although the 1933 analyses, except in the case of alcohol, are in terms of grams per 100 cc. instead of true percentages. For practical purposes, however, the figures may be regarded as comparable. In the 1933 analyses, alcohol was determined by volume. Approximately equivalent figures on the weight basis are inserted for comparison with older analyses. Sugar, as given in most of the older analyses cited, is probably expressed as maltose and does not include dextrins. In analyses cited from König "sugar" means maltose, dextrin and gum. In the 1933 analyses sugar means total reducing sugars after hydrolysis expressed as dextrose and the figures are closely comparable with the "sugar" as contemplated by König. Since dextrin complexes are present in beer in amounts considerably exceeding those of maltose the disparity between results for "sugar" as shown by newer and some of the older analyses is explained.

Because of the legal limitations upon alcoholic content it is obvious why various types of beer as made before repeal do not show the range observed in products as formerly manufactured. The effort apparently was to approach the legal limit as closely as possible without exceeding it, regardless of the type of beer. The legal limit for alcohol in beer at the time these analyses in Table II were made was 3.2 per cent by weight, equivalent to 4.0 per cent by volume. It is not difficult to find in older analyses alcohol contents of 3.2 per cent or less, by weight; but probably the bulk of production formerly would average 0.5 to 0.75 per cent more than the legal maximum of 3.2 per cent.

On the basis of averages it is clear that there is no significant difference as regards body (extract) between domestic light and dark beers. Imported dark beers as sold in this State before repeal show a more pronounced difference in this respect, but the number of samples represented is too small to make the comparison very significant. In general the extract of present day beers, both before and after repeal, is within the range shown by older analyses.

The domestic ales examined are higher in extract than imported ales, and the sugars correspondingly higher; but again both are within the range shown by older analyses.

Detailed analyses of 78 samples of malt liquors, as sold just prior to repeal, are given in Table III; and analyses of 27 samples as sold after repeal are given in Table IV.

CONCLUSIONS

The alcoholic content of the malt liquors examined prior to repeal was generally within the legal limit of 4 per cent by volume and did not appreciably exceed that limit in any case. On the other hand, none of the samples approached the low alcoholic content of "near beer." Since repeal the alcoholic strength has been somewhat increased.

Some earlier beers, particularly weissbeers, normally contained alcohol in amounts less than, or not greatly exceeding, 3.2 per cent by weight.

Extract in so-called 3.2 beer was of an order of magnitude within the range shown by older analyses of malt liquors. The same is true of domestic repeal beer.

Except in a few instances the character of composition indicates that the products examined were made with substantial amounts of malt.

There is no evidence that bitter principles other than those from hops were used.

TABLE III. ANALYSES OF MALT BEVERAGES (SAMPLES TAKEN SHORTLY BEFORE REPEAL)

No.	Brand and Manufacturer	Specific gravity	Alcohol by volume	Extract	Sugars as dextrose	Protein N x 6.25	P_2O_5
	Beer, domestic, light		%	Gms/100 cc	Gms/100 cc	Gms/100 cc	Gms/100 cc
55341	*Budweiser.* Anheuser-Busch, Inc., St. Louis, Mo.	1.0160	4.03	6.60	5.14	0.49	0.062
55782	*Budweiser.* Anheuser-Busch, Inc., St. Louis, Mo.	1.0184	3.85	7.14	5.85	0.41	0.056
55539	*Burgomaster.* Fitzgerald Bros. Brewing Co., Troy, N. Y.	1.0127	3.81	5.66	4.25	0.43	0.053
49990	*Connecticut Valley.* Conn. Valley Brewing Corp., Meriden, Conn.	1.0138	3.64	5.88	4.61	0.48	0.051
55767	*Connecticut Valley.* Conn. Valley Brewing Corp., Meriden, Conn.	1.0140	3.88	6.00	4.81	0.46	0.050
49987	*Ebling's Extra.* The Ebling Brewery Co., Inc., New York, N. Y.	1.0135	3.92	5.90	4.28	0.52	0.062
55540	*Edelbrau German Lager.* Edelbrau Brewing Co., Brooklyn, N. Y.	1.0129	4.03	5.77	3.86	0.59	0.072
55785	*Feigenspan's P.O.N.* Christian Feigenspan Brewing Co., Newark, N. J.	1.0173	3.56	6.74	5.46	0.42	0.060
55345	*Fidelio.* Fidelio Brewery, New York, N. Y.	1.0217	3.73	7.95	6.19	0.62	0.057
55779	*Fidelio.* Fidelio Brewery, New York, N. Y.	1.0177	3.90	6.98	5.65	0.53	0.051
55784	*Friedrick's Lager.* The Philadelphia Brewing Co., Philadelphia, Pa.	1.0137	4.00	5.97	4.63	0.48	0.064
55756	*Goldenrod Lager.* Hittleman Goldenrod Brewery, Inc., Brooklyn, N. Y.	1.0144	3.91	6.13	4.44	0.62	0.092
55338	*Horton's Pilsner.* Pilsner Brewing Co., New York, N. Y.	1.0146	3.70	6.11	4.80	0.41	0.060
49974	*King's Pilsner Style.* King's Brewery, Inc., Brooklyn, N. Y.	1.0146	3.56	6.05	4.80	0.39	0.054
55778	*King's Pilsner Style.* King's Brewery, Inc., Brooklyn, N. Y.	1.0145	3.51	6.02	4.80	0.39	0.052
55769	*Krueger's Special.* G. Krueger Brewing Co., Newark, N. J.	1.0193	3.61	7.24	5.82	0.53	0.055
55757	*Liberty.* American Brewing Co., Rochester, N. Y.	1.0167	3.78	6.67	5.21	0.48	0.049
55549	*Lion Pilsner.* Lion Brewery, New York, N. Y.	1.0149	3.50	6.12	4.90	0.45	0.054
49958	*Loewer's Pilsner Style Lager.* Loewer's Gambrinus Brewery Co., New York, N. Y.	1.0157	3.48	6.32	4.99	0.50	0.062
55541	*Michel Pilsner Style.* Michel Brewing Co., Brooklyn, N. Y.	1.0169	3.01	6.45	4.76	0.41	0.050
55783	*Blatz Old Heidelberg.* Blatz Brewing Co., Milwaukee, Wisconsin	1.0140	3.63	5.92	4.41	0.54	0.061
55333	*Pabst Blue Ribbon.* Pabst Corp., Milwaukee, Wisconsin	1.0168	3.89	6.75	5.35	0.51	0.061
55775	*Pabst Blue Ribbon Premier.* Pabst Corp., Milwaukee, Wisconsin	1.0163	3.81	6.59	5.22	0.56	0.058
55768	*Wm. Peter Palisade.* Wm. Peter Brewing Corp., Union City, N. Y.	1.0205	3.19	7.44	6.12	0.56	0.066
55340	*Piel's Real Lager.* Piel Bros. Inc., Brooklyn, N. Y.	1.0100	3.90	5.02	3.58	0.43	0.056
49988	*Piel's Real Lager.* Piel Bros. Inc., Brooklyn, N. Y.	1.0102	3.90	5.03	3.75	0.43	0.052
55335	*Rheingold.* Liebmann Breweries, Inc., New York, N. Y.	1.0156	3.64	6.34	4.87	0.50	0.061
55777	*Rheingold.* Liebmann Breweries, Inc., New York, N. Y.	1.0154	3.90	6.38	4.91	0.51	0.060

TABLE III. ANALYSES OF MALT BEVERAGES (SAMPLES TAKEN SHORTLY BEFORE REPEAL)—*Continued*

No.	Brand and Manufacturer	Specific gravity	Alcohol by volume	Extract	Sugars as dextrose	Protein N x 6.25	P_2O_5
			%	Gms/100 cc	Gms/100 cc	Gms/100 cc	Gms/100 cc
49971	*R & H Pilsner.* Rubsom & Horrmann Brewing Co., Stapleton, S. I., N. Y.	1.0187	3.69	7.15	5.53	0.65	0.069
55750	*R & H Pilsner.* Rubsom & Horrmann Brewing Co., Stapleton, S. I., N. Y.	1.0167	3.58	6.61	5.16	0.59	0.061
55334	*Ruppert's Knickerbocker.* Jacob Ruppert, New York, N. Y.	1.0164	3.88	6.63	5.33	0.46	0.064
55776	*Ruppert's Knickerbocker.* Jacob Ruppert, New York, N. Y.	1.0152	3.70	6.27	5.22	0.42	0.056
55336	*Schlitz.* Jos. Schlitz Brewing Co., Milwaukee, Wisconsin	1.0193	3.37	7.23	5.92	0.48	0.054
55766	*Utica Club Pilsner.* West End Brewing Co., Utica, N. Y.	1.0192	3.42	7.20	5.70	0.48	0.055
55770	*Valley Forge Special.* Adam Scheidt Brewing Co., Norristown, Pa.	1.0143	3.74	6.03	4.59	0.45	0.051
55751	*Wehle Lager.* The Wehle Brewing Co., West Haven, Conn.	1.0143	3.64	6.00	4.50	0.46	0.054
56503	*Weibel's Lager.* The Weibel Brewing Co., New Haven, Conn.	1.0135	3.65	5.79	4.31	0.41	0.054
	Maximum	1.0217	4.03	7.95	6.19	0.65	0.092
	Minimum	1.0100	3.01	5.02	3.58	0.39	0.049
	Average	1.0156	3.70	6.38	4.97	0.49	0.058
	Beer, domestic, dark						
49986	*Ebling's Extra.* The Ebling Brewing Co., Inc., New York, N. Y.	1.0154	3.71	6.33	4.80	0.42	0.052
55542	*Ebling's Extra.* The Ebling Brewing Co., Inc., New York, N. Y.	1.0160	3.41	6.35	4.64	0.47	0.055
49973	*King's Wurzburger.* King's Brewery, Inc., Brooklyn, N. Y.	1.0152	3.59	6.21	4.94	0.39	0.052
55339	*King's Wurzburger.* King's Brewery, Inc., Brooklyn, N. Y.	1.0148	3.58	6.11	4.72	0.40	0.053
49989	*Piel's Real Lager.* Piel Bros., Inc., Brooklyn, N. Y.	1.0098	3.82	4.89	3.66	0.40	0.053
49972	*R & H Wurzburger.* Rubsom & Horrmann, Stapleton, S. I., N. Y.	1.0200	3.61	7.45	5.83	0.63	0.066
55344	*Schaefer's.* E. & M. Schaefer, New York, N. Y.	1.0189	3.40	7.10	5.57	0.48	0.052
55343	*Trommer's Malt.* John T. Trommer, Inc., Brooklyn, N. Y.	1.0133	3.79	5.78	4.13	0.56	0.071
	Maximum	1.0200	3.82	7.45	5.83	0.63	0.071
	Minimum	1.0098	3.41	4.89	3.66	0.39	0.052
	Average	1.0154	3.61	6.28	4.79	0.47	0.057

TABLE III. ANALYSES OF MALT BEVERAGES (SAMPLES TAKEN SHORTLY BEFORE REPEAL)—*Continued*

No.	Brand and Manufacturer	Specific gravity	Alcohol by volume	Extract	Sugars as dextrose	Protein N x 6.25	P_2O_5
	Ale, domestic		%	Gms/100 cc	Gms/100 cc	Gms/100 cc	Gms/100 cc
55347	*Aetna Special Dinner.* Aetna Brewing Co., Hartford, Conn.	1.0130	3.70	5.68	4.35	0.46	0.043
49991	*Connecticut Valley.* Connecticut Valley Brewing Co., Meriden, Conn.	1.0147	3.71	6.13	4.82	0.48	0.054
55799	*Graham's XXX.* Huguenot Bottling Co., New Rochelle, N. Y.	1.0127	3.63	5.58	4.42	0.34	0.028
55543	*Hull's Cream.* Hull's Brewery, New Haven, Conn.	1.0129	3.56	5.61	4.22	0.33	0.027
55786	*Kingsbury's Pale.* Manitowoc Products Co., Manitowoc, Wis.	1.0189	3.96	7.32	5.72	0.44	0.053
55548	*Narragansett Banquet.* Narragansett Brewing Co., Cranston, R. I.	1.0095	3.68	4.77	3.55	0.36	0.036
55780	*Pickwick.* Haffenreffer & Co., Inc., Boston, Mass.	1.0165	3.81	6.63	5.04	0.48	0.049
55337	*Pickwick.* Haffenreffer & Co., Inc., Boston, Mass.	1.0176	3.44	6.78	5.18	0.43	0.050
55758	*Red Fox.* Largay Brewing Co., Waterbury, Conn.	1.0085	3.71	4.53	3.30	0.37	0.040
55537	*Weibel's.* The Weibel Brewing Co., New Haven, Conn.	1.0164	3.63	6.54	4.92	0.37	0.032
55538	*Wehle Colonial.* Wehle Brewing Co., West Haven, Conn.	1.0103	3.79	5.01	3.58	0.39	0.042
56509	*Cremo.* Cremo Brewing Co., New Britain, Conn.	1.0163	3.67	6.55	5.24	0.39	0.037
	Maximum	1.0189	3.96	7.32	5.72	0.48	0.054
	Minimum	1.0085	3.44	4.53	3.30	0.33	0.027
	Average	1.0139	3.69	5.92	4.53	0.40	0.041
	Beer, imported, light						
55754	*Bacardi Pilsner.* Cia Ron Bacardi S.A., Santiago De Cuba	1.0093	3.79	4.77	3.52	0.37	0.066
55753	*Bill Kristall Pilsner.* Bill-Brauerei, A.G., Hamburg, Germany	1.0059	3.57	3.79	2.38	0.22	0.037
55796	*Canada's Best Lager.* Cosgrave's Export Brewery, Toronto, Canada	1.0125	3.66	5.53	3.90	0.55	0.061
55332	*Carlsberg.* Copenhagen, Denmark	1.0099	3.74	4.88	3.69	0.29	0.046
55765	*Frydenlund's M.L. Lager.* Frydenlund's Brewery, Oslo, Norway	1.0078	3.74	4.34	3.22	0.33	0.071
55794	*Heineken's Dutch.* Heineken's Breweries, Rotterdam, Holland	1.0066	3.68	4.00	2.90	0.29	0.054
55761	*Wurzburger-Schlossbrau.* Wurzburg Hofbrau Brewery, Bavaria, Germany	1.0126	3.56	5.54	4.23	0.47	0.072
	Maximum	1.0125	3.79	5.53	4.23	0.55	0.071
	Minimum	1.0059	3.56	3.79	2.38	0.22	0.037
	Average	1.0092	3.68	4.69	3.41	0.36	0.058

TABLE III. ANALYSES OF MALT BEVERAGES (SAMPLES TAKEN SHORTLY BEFORE REPEAL)—*Concluded*

No.	Brand and Manufacturer	Specific gravity	Alcohol by volume	Extract	Sugars as dextrose	Protein N x 6.25	P_2O_5
			%	Gms/100 cc	Gms/100 cc	Gms/100 cc	Gms/100 cc
	Beer, imported, dark						
55764	*Erstes Kulmbacher.* Kulmbacher Brauerei, Bayern, Germany	1.0133	3.71	5.77	4.38	0.46	0.098
55544	*Pschorr-Brau.* Pschorrbrau, A.G., Munich, Germany	1.0186	4.02	7.28	5.69	0.55	0.106
	Ale, imported						
55795	*Auld Style Scotch.* Cosgrave Export Brewery Co., Toronto, Canada	1.0111	3.77	5.22	3.62	0.53	0.059
55331	*Bass.* Bass & Co., Burton-on-Trent, England	1.0067	3.81	4.08	2.60	0.26	0.028
55752	*Black Horse.* Dawes Breweries, Montreal, P.Q., Canada	1.0037	3.80	3.31	1.88	0.39	0.041
49992	*Bull Dog.* Robert Porter & Co,. Ltd., London, England	1.0082	3.73	4.43	2.94	0.45	0.094
55762	*Carling's Red Cap.* Carling Breweries, Ltd., London, Canada	1.0071	3.84	4.22	2.83	0.44	0.045
55797	*Copland's Stock.* The Copland Brewing Co., Toronto, Canada	1.0103	3.84	5.04	3.68	0.52	0.052
55545	*McEwans' Pale.* Wm. McEwans & Co., Ltd., Edinburgh, Scotland	1.0117	3.82	5.40	4.05	0.29	0.040
55546	*Oland's Red Ball Export. India Pale.* Oland's Brewery, Ltd., St. Johns, N.B., Canada	1.0077	3.79	4.34	2.80	0.40	0.038
55763	*Whitbread's Pale.* Whitbread & Co., Ltd., London, England	1.0060	3.48	3.79	2.55	0.24	0.026
	Maximum	1.0117	3.84	5.40	4.05	0.53	0.094
	Minimum	1.0037	3.48	3.31	1.88	0.24	0.026
	Average	1.0080	3.76	4.43	2.99	0.39	0.047
	Miscellaneous						
55547	*Boston Stout.* Commercial Brewing Co., Boston, Mass.	1.0185	3.94	7.20	5.07	0.67	0.068
55798	*Jeffrey's Stout.* Jeffrey's, Edinburgh, Scotland	1.0108	3.86	5.16	3.33	0.43	0.043
56504	*Weibel's Porter.* The Weibel Brewing Co., New Haven, Conn.	1.0139	3.66	5.92	4.48	0.40	0.047

TABLE IV. ANALYSES OF MALT BEVERAGES (SAMPLES TAKEN AFTER REPEAL)

No.	Brand and Manufacturer	Specific gravity	Alcohol by volume	Extract	Sugars as dextrose	Protein N x 6.25	P_2O_5
			%	Gms/100 cc	Gms/100 cc	Gms/100 cc	Gms/100 cc
	Light Beer						
57208	*Utica Club.* West End Brewing Co., Utica, N. Y.	1.0136	4.67	6.18	4.63	0.50	0.064
57209	*Schlitz.* Schlitz Brewing Co., Milwaukee, Wis.	1.0161	4.02	6.62	5.28	0.50	0.059
57211	*Beverwyck.* Beverwyck Breweries, Inc., New York, N. Y.	1.0150	4.43	6.47	5.26	0.38	0.048
56532	*Colonial.* Wehle Brewing Co., West Haven, Conn.	1.0177	5.23	7.45	5.90	0.43	0.068
56534	*Weibel's.* Weibel Brewing Co., New Haven, Conn.	1.0155	4.41	6.58	5.06	0.45	0.050
56537	*Old Brewster.* Aetna Brewing Co., Hartford, Conn.	1.0129	5.10	6.16	4.68	0.56	0.066
56539	*King's.* King's Brewery, Inc., Brooklyn, N. Y.	1.0139	4.27	6.12	4.72	0.46	0.066
56540	*Fidelio.* Fidelio Brewery, New York, N. Y.	1.0165	4.22	6.80	5.36	0.60	0.058
56541	*Rheingold.* Liebmann Breweries, Inc., Brooklyn, N. Y.	1.0157	4.94	6.85	5.22	0.59	0.080
56542	*Knickerbocker.* Jacob Ruppert, New York, N. Y.	1.0182	5.12	7.54	6.11	0.51	0.039
	Maximum	1.0182	5.23	7.54	6.11	0.60	0.080
	Minimum	1.0129	4.02	6.12	4.63	0.38	0.039
	Average	1.0155	4.64	6.68	5.22	0.50	0.060
	Dark Beer						
56549	*Ebling's Extra.* Ebling Brewing Co., Inc., New York, N. Y.	1.0142	3.69	5.99	4.50	0.48	0.062
57207	*Utica Club Wurzburger.* West End Brewing Co., Utica, N. Y.	1.0167	4.33	6.86	5.24	0.54	0.067
57211	*Beverwyck.* Beverwyck Breweries, Inc., New York, N. Y.	1.0130	4.30	5.90	4.50	0.52	0.065
	Maximum	1.0160	4.33	6.86	5.24	0.54	0.067
	Minimum	1.0130	3.69	5.90	4.50	0.48	0.062
	Average	1.0146	4.11	6.25	4.75	0.51	0.065

TABLE IV. ANALYSES OF MALT BEVERAGES (SAMPLES TAKEN AFTER REPEAL)—*Concluded*

No.	Brand and Manufacturer	Specific gravity	Alcohol by volume	Extract	Sugars as dextrose	Protein N x 6.25	P_2O_5
			%	Gms/100 cc	Gms/100 cc	Gms/100 cc	Gms/100 cc
	Ale						
57206	*Old England.* Old England Brewing Co., Derby, Conn.	1.0186	6.02	7.97	6.27	0.49	0.056
57215	*Fitzgerald's.* Fitzgerald Bros. Brewing Co., Troy, N. Y.	1.0125	4.71	5.92	4.60	0.39	0.059
57219	*Horton's Cream.* Horton Pilsener Brewing Co., New York, N. Y.	1.0107	5.36	5.68	4.28	0.51	0.065
57220	*Olde Maestro.* Elm City Brewing Co., New Haven, Conn.	1.0120	3.92	5.50	4.38	0.29	0.043
57221	*Hull's Cream.* Hull Brewing Co., New Haven, Conn.	1.0217	4.10	8.11	6.92	0.37	0.031
57223	*Utica Club Sparkling.* West End Brewing Co., Utica, N. Y.	1.0147	4.41	6.38	4.99	0.42	0.047
57224	*Utica Club Stock.* West End Brewing Co., Utica, N. Y.	1.0181	5.31	7.58	5.90	0.58	0.060
57225	*India Pale.* West End Brewing Co., Utica, N. Y.	1.0156	5.78	7.10	5.25	0.62	0.071
56533	*Colonial.* Wehle Brewing Co., West Haven, Conn.	1.0123	4.62	5.84	4.32	0.49	0.054
56535	*Weibel's Extra Light.* Weibel Brewing Co., New Haven, Conn.	1.0173	3.85	6.89	5.40	0.38	0.044
56538	*Special Dinner.* Aetna Brewing Co., Hartford, Conn.	1.0129	5.04	6.15	4.66	0.55	0.066
56543	*Cremo.* Cremo Brewing Co., New Britain, Conn.	1.0183	4.43	7.33	5.91	0.39	0.075
	Maximum	1.0217	6.02	8.11	6.92	0.62	0.075
	Minimum	1.0107	3.85	5.50	4.28	0.29	0.031
	Average	1.0154	4.80	6.70	5.24	0.46	0.056
	Porter						
57226	*Utica Club.* West End Brewing Co., Utica, N. Y.	1.0204	5.55	8.26	6.07	0.77	0.084
56536	*Extra.* Weibel Brewing Co., New Haven, Conn.	1.0218	4.47	8.27	6.51	0.47	0.054
	Average	1.0211	5.01	8.27	6.29	0.62	0.069

COFFEE

A sample of ground coffee was examined but no evidence of chicory or other material foreign to coffee was found.

A sample of liquid coffee, thought to contain some foreign material of an abrasive nature, was submitted, but no foreign substances were detected.

EGGS AND EGG PRODUCTS

Only eight official samples of shell eggs were examined. Six of these were sold as "fresh" eggs and five were of that character. One sample conformed to the specifications for fresh eggs but there was evidence that the specimens submitted had been preserved by dipping in oil. Two samples were not sold as fresh eggs. One of these was apparently a mixture of fresh and cold storage eggs and the other probably cold storage eggs.

A sample of noodles labelled Ken-Mac Egg Noodles was submitted by a health officer who suspected that the product was artificially colored. The noodles were of a very pronounced yellow color but no evidence of artificial color was found. It is possible by the use of commercial egg yolk to obtain a pronounced yellow color in egg noodles. Analysis of the sample showed moisture, 10.10 per cent; lipoids, 5.71 per cent; lipoid P_2O_5, 0.129 per cent; estimated egg solids, 7.02 per cent.

FATS AND OILS

BUTTER

Six official samples of butter were examined and all met the standard requirement of 80 per cent milk fat. Two samples examined for purchasers were found to be genuine butter.

OLIVE OIL

Twenty-five official samples of olive oil were examined. Of these eight were adulterated with cottonseed oil and two were short of the declared volume of contents. A summary of the inspection is given in Table V.

Five samples were examined for health officers and purchasers.

TABLE V. INSPECTION OF OLIVE OIL

D.C. No.	Dealer	Brand	Remarks
	Bridgeport		
56517	Washington Market	De Loro, Cream Italian	Pass
	Bristol		
56522	A. Mancini	Sopraffino D'oro	Pass
	Elmwood		
56502	Mrs. Rose Merlino	Italia, Superfine	Cottonseed oil and coal-tar dye present
	Naugatuck		
56510	R. Sabia	Italia	Cottonseed oil and coal-tar dye present
56511	Arnaldo Novi	Grande Italia	Pass
	New Britain		
49955	Cassarino & Carpinte	......	Pass
56514	Cassarino & Carpinte	Serto	Pass
53739	Federal Grocery Co., Inc.	Silvana	Pass
56512	Italian Olive Oil Co.	Virgin	Pass
56513	New Britain Macaroni Co.	Triestella	Short volume
56525	New Britain Macaroni Co.	Triestella	Short volume
56526	New Britain Macaroni Co.	Triestella	Pass
56515	Victoria Italia Importing Co.	Campagnolia	Pass
56516	Victoria Italia Importing Co.	Re-Gabbo	Pass
	New Haven		
56523	Joseph Abramovitz	High Star	Pass
56527	Cimino Bros., Inc.	Virgin	Cottonseed oil and coal-tar dye present
56528	Cimino Bros., Inc.	Paradise	Cottonseed oil and coal-tar dye present
56529	J. Minervino	Extra Sublime	Pass
56530	Morris Rosner	Purissimo Marca Reginella	Pass
56524	......	Sublime	Cottonseed oil present
	New London		
54135	Diamond Bellassi	......	Pass
53447	The Genova Importing Co.	Bulk	Cottonseed oil present
53774	The Genova Importing Co.	Bulk	Cottonseed oil present
	Waterbury		
53449	Milano Importing Co.	Bulk	Pass
	West Haven		
56531	E. Caccovale	Adriatic Star	Cottonseed oil and coal-tar dye present

FRUITS AND FRUIT JUICES

SWEET CIDER

One sample submitted by a purchaser was analyzed in some detail; determinations were made on the filtered liquid.

Analysis: Solids (in vacuo at 70° C) 12.72 per cent; ash 0.25 per cent; sucrose 2.80 per cent; invert sugar 8.26 per cent; total sugars 11.06 per cent; alcohol by volume 0.10 per cent; sodium benzoate present.

The results are within the limits for pure apple juice. The preservative, sodium benzoate, was added to retard fermentation.

Six official samples were examined. Solids ranged from 10.09 per cent to 13.42 per cent, and the ash content from 0.24 to 0.30 per cent. Three of the samples were examined for arsenic. In two no arsenic was found. The third contained 0.08 parts per million, which is far below the tolerance set by the U. S. Department of Agriculture (1.4 p.p.m.).

HONEY

Two samples of honey were examined for a producer. Both were within the limits for floral honey and no evidence of appreciable contamination with honeydew honey was found.

A sample of "honey butter" was examined with the following results:

54136. Moisture 11.01 per cent; ash 0.16 per cent; direct polarization at 20° — 12.6; direct at 87° + 10.3; invert polarization at 20° — 16.5; invert at 87° + 8.8; reducing sugars before inversion 69.75 per cent; after inversion 75.54 per cent; tests for glucose and invert sugar, negative. The calculated composition is sucrose, 5.50 per cent; levulose, 37.24 per cent; dextrose, 33.70 per cent.

The product is within the limits of composition of pure honey except that the solids are higher than usual. This may be the result of concentration to give the product a "butter" consistency. The sample was purchased from M. J. Burnham, So. Main St., West Hartford and manufactured by Allen Latham, Norwichtown, Conn.

ICE CREAM

D. C. Walden, H. C. Yale, O. L. Nolan and E. M. Bailey

The statutes relating to ice cream were revised by the Connecticut Legislature of 1933 as appears in Public Acts, Chapter 308.

The changes of interest from the standpoint of chemical control are: The provision raising the milk fat content of plain ice creams from 8 to 10 per cent, and of fruit and nut ice creams from 6 to 8 per cent; and the new provision for the control of overrun which requires that in no case shall any ice cream contain less than 1.6 pounds of food solids per gallon. This is equivalent to a total weight per gallon of about 4.6 pounds and represents approximately 100 per cent overrun in case of ice cream with [illegible] per cent solids.

"Overrun" means the difference in volume between the ice cream mix and the finished product. It is customary in commercial practice to find that a gallon of mix represents about two gallons of ice cream, the extra volume being secured by the process of incorporating air. Occasionally one hears complaints, facetious or otherwise, that profit accrues to ice cream manufacturers from this device for selling air. It must be remembered, however, that ice cream would not be the product that the consumer expects to buy unless a suitable volume of air had been incorporated. Frozen ice cream mix would not be ice cream. On the other hand excessive overrun is undesirable and the limit set in the present statute seems fair. The device adopted does not fix a definite figure for overrun. It allows for variation depending upon the solids (body) of the product. If solids are sufficiently in excess of 35 per cent, a greater overrun than 100 per cent may be represented and yet meet the requirement of food solids per gallon. This requirement could not be met, however, in case of an ice cream with less than 35 per cent of solids except by keeping the overrun well under 100 per cent.

Whether ice cream meets the statute requirement for food solids is difficult to determine exactly by objective examination of samples in the laboratory, because ready means of determining exact volumes are not at hand. Therefore we have not attempted to determine the overrun in bulk samples. In the case of packaged goods we have assumed that the volumes indicated on the containers were correct. Results showing a greater weight than 1.6 pounds of food solids per gallon mean, therefore, either that overrun was less than the limit permitted, or that the package contained more than the professed volume.

The results of the inspection are given in Table VI. One hundred and fifty samples were examined for the Dairy and Food Commissioner and thirteen for individuals.

A summary of 87 samples sold in manufacturers' packages, and for which the declared volume of contents was assumed to be correct, is as follows:

	Fat %	Solids %	Solids per gallon, lbs.
Maximum	21.0	44.9	3.3
Minimum	9.0	30.1	1.3
Average	13.9	38.6	1.9

The quantity of ice cream sold for 1 pint was weighed in each case as it was received in the laboratory. The maximum weight found was 465 grams, the minimum 111.5 grams, and the average 264.0 grams. In terms of ounces these values are approximately 16.3, 3.9 and 9.3, in the order named. A much narrower range of weight variation would include 81 of the 87 samples. Omitting the extreme high of 465, and 5 weights that were less than 150 grams, the maximum is 384 grams, the minimum 194 grams, and the average 270 grams, or approximately 13.5, 6.8 and 9.5 ounces, in the order named. This range is more nearly in accord with that shown in published overrun tables, one of which gives 11 ounces as the maximum and 8 ounces as the minimum weight of pint bricks of ice cream, representing overruns of from 65 to 125 per cent on the basis of a mix weighing 9 pounds to the gallon.

The sample that weighed 465 grams to the pint contained 40.6 per cent of solids and weighed 8.1 pounds per gallon. It therefore represents an overrun of only 11 per cent on the basis of a mix weighing 9 pounds to the gallon, or 15 per cent if the mix weighed as much as 9.3 pounds to the gallon. The weight received in this case was more nearly correct for a quart than for a pint; but the records indicate that a pint was requested and the price paid corresponded to that quantity. This sample was therefore practically frozen mix instead of ice cream. The food solids were 3.3 pounds per gallon which is nearly as much as was contained in the mix, 3.7.

The sample that weighed only 111.5 grams to the pint contained 40.7 per cent of solids and weighed 3.9 pounds to the gallon, representing an overrun of 131 per cent. The percentage of food solids present, however, was high enough to insure the legal minimum of 1.6 pounds per gallon in spite of the high overrun.

Of three samples that showed only 1.3 pounds of food solids per gallon, the lowest in food solids contained 30.9 per cent and weighed 4.2 pounds per gallon, representing an overrun of 114 per cent. The highest in food solids contained 36.1 per cent and weighed 3.6 pounds to the gallon, representing 150 per cent overrun. If the overrun in this case had been only 100 per cent, or if the solids had been 45 per cent, the legal minimum of 1.6 pounds of food solids would have been safely met. That is to say, if 100 per cent overrun is exceeded and the legal minimum of food solids per gallon is to be maintained, the solids must substantially exceed 35 per cent.

In the case of samples bought in bulk, records of weights were taken for only 36. One-half pint samples were taken in all cases. The maximum weight obtained was 268 grams, the minimum, 151 grams and the average, 204 grams. Thus the purchasers of half-pints of ice cream got from 5.3 ounces to 9.4 ounces, and on the average 7.1 ounces. Putting these weights on the one pint basis for comparison with the quantities obtained in factory packages or bricks we have the following:

	Factory packages, 1 pint (basis of 81 samples) ozs.	Dispensed in bulk for 1 pint (basis of 36 samples) ozs.
Maximum	13.5	18.8
Minimum	6.8	10.6
Average	9.5	14.2

The range quoted for factory packages omits the extreme high and low weights mentioned earlier and is probably more typical of prevailing practice in trade. According to the Laboratory Manual of the International Association of Milk Dealers, a pint brick of ice cream will weigh from 8 to 11 ounces, which is equivalent to from 4 to 5.5 pounds to the gallon. The range we have found for factory pints is somewhat wider, but it is evident that, assuming bulk ice cream to be of the same general composition and character as the brick product, the dealer who retails in bulk dispenses "pints" that are too generous.

For a number of years past we have observed that the fat content of ice cream as sold in this State was well above the legal minima of 8 per cent for plain ice cream and 6 per cent for fruit and nut ice cream. In 1929 nearly 90 per cent of the samples tested exceeded 10 per cent in fat and more than half of them were 12 per cent or more. The change in the statute raising the figures from 8 and 6 per cent to 10 and 8 per cent has not materially affected manufacturing practice here.

Thirty-nine samples of so-called frozen custard and two miscellaneous desserts were examined. "Frozen custard" must conform to the sanitary regulations provided for ice cream and is presumed to meet the standard for fat content of ice cream unless the actual fat content is declared.

TABLE VI. ANALYSES OF ICE CREAM

No.	Flavor and brand	Dealer	Manufacturer	Fat	Solids	Solids per gal.
		Ansonia		%	%	lbs.
55841	Strawberry, bulk	Laites No. End Pharmacy	Own make	14.0	....	....
55839	Vanilla, bulk	Purity Tea Room	Own make	13.0	....	....
55837	Vanilla, bulk	Vonetas Bros.	Own make	15.8	....	....
		Bridgeport				
55900	Vanilla, brick	Beechmont Creamery, Inc.	Own make	17.2	40.2	2.0
56355	Vanilla, brick	A. Bettels	Own make	15.2	38.5	1.8
55899	Fruit, brick	Ivar Bjorklund	Own make	14.0	43.7	2.0
55896	Neapolitan, brick	Collins Pharmacy	Clover Farms, Inc.	12.4	32.1	1.5
55897	Vanilla, brick	Collins Pharmacy	Clover Farms, Inc.	15.2	38.4	1.7
56351	Neapolitan, brick	Collins Pharmacy	Clover Farms, Inc.	12.4	34.9	1.8
56296	Vanilla and chocolate, brick	Decas Bros. Confectionery	Own make	15.0	41.3	2.0
55901	Neapolitan, brick	Hertz's Drug Store	Jersey Gold I. C. Co., N. Y.	11.2	39.1	2.0
56357	Neapolitan, brick—Fro-Joy	Liggett's Drug Co.	General I. C. Co.	17.2	44.8	2.1
55898	Neapolitan, brick	Ritz Soda Shoppe	Huber's I. C. Co.	11.8	39.7	1.7
		Bristol				
55942	Strawberry, bulk	Liberty Confectionery	Own make	16.2	....	....
55944	Peach, brick	Palace of Sweets	Own make	18.6	....	....
55947	Vanilla and Strawberry, brick	Sweetland Confectionery	Own make	14.4	....	....
		Canton				
55159	Vanilla, bulk	Margaret Dyer	Own make	15.6	37.9	....
		Danbury				
55932	Neapolitan, brick	Danbury Creamery, Inc.	Own make	14.6	41.6	1.9
55927	Neapolitan, brick	C. C. Hatch	Own make	11.6	34.3	1.5
55928	Neapolitan, brick	C. C. Hatch	Own make	13.0	35.8	1.6
55930	Neapolitan, brick	Rider's Dairy Co., Inc.	Own make	11.2	38.7	1.8

TABLE VI. ANALYSES OF ICE CREAM—*Continued*

No.	Flavor and brand	Dealer	Manufacturer	Fat	Solids	Solids per gal.
		Forestville				
55860	Neapolitan, brick	Kent Pharmacy	Nelson's Purity I. C. Co.	15.2	38.9	1.5
		Greenwich				
55192	Vanilla, bulk	Beach Club	Hydrox I. C. Co., N. Y.	12.6	39.8	....
55188	Vanilla and chocolate, brick	Old Field Point Market	Hershey's I. C. Co., N. Y.	12.8	35.8	1.7
55182	Vanilla, bulk	Schofield I. C. Shop	Own make	18.2	44.9	....
55184	Neapolitan, brick	Washington Confectionery Co.	Neilsen's I. C. Co., Portchester, N. Y.	12.6	38.5	1.5
		Old Greenwich				
55195	Vanilla, bulk	J. A. Griffin	Own make	16.8	41.3	....
		Groton				
56267	Strawberry, bulk	Scuris Bros.	Own make	19.0	....	....
		Hartford				
55749	Peach, bulk	J. L. Besse & Co.	Own make	12.2	37.8	....
55739	Chocolate, bulk	Carlyn's, Inc.	Own make	12.6	45.1	....
55745	Vanilla, bulk	G. Fox & Co.	Own make	23.0	43.5	....
55174	Vanilla, brick	Highland Dairy Co.	Own make	15.4	39.5	1.9
55175	Neapolitan fruit, brick	Highland Dairy Co.	Own make	12.2	34.8	1.8
55731	Strawberry, brick	Ice Cream Shoppe	Own make	14.2	38.1	2.0
55680	Vanilla, brick	Ideal Drug Co.	Ce Brook I. C. Co.	14.0	39.0	2.2
55737	Chocolate, bulk	F. G. Jensen's & Sons, Inc.	Own make	18.8	41.1	....
55733	Strawberry, brick	Mae Rose Tea Room	Own make	14.2	36.2	1.7
55743	Raspberry, bulk	Mills Spa, Inc.	Own make	16.8	39.9	....
55747	Strawberry, bulk	The New Paris	Own make	20.6	42.5	....
55676	Progress brick	Rivoli Soda Shop	Crown I. C. Co.	11.8	39.4	1.8
55741	Vanilla, bulk	Robbin's, Inc.	Own make	12.0	35.4	....
55735	Peach, bulk	Newton Robertson's Grocery Co.	Own make	18.0	39.7	....
55678	Thrift brick—Fro-Joy	Wylly's Shoppe	General I. C. Co.	10.4	37.2	1.7
55679	Vanilla, brick—Fro-Joy	Wylly's Shoppe	General I. C. Co.	15.0	39.7	2.1

TABLE VI. ANALYSES OF ICE CREAM—*Continued*

No.	Flavor and brand	Dealer	Manufacturer	Fat	Solids	Solids per gal.
		Litchfield		%	%	lbs.
55163	Chocolate, bulk	L. A. Dickinson	Own make	13.6	41.3	....
		Meriden				
55711	Chocolate, bulk	Billie Burns Candy Shoppe	Own make	11.8	33.4	....
55709	Vanilla, bulk	The Chocolate Shoppe	Own make	19.4	40.0	....
55713	Peach, bulk	Katt Bros.	Own make	12.4	32.2	....
56465	Vanilla and chocolate, brick	Loft's, Inc.	Own make	20.4	48.2	2.8
56466	Vanilla, bulk	Loft's, Inc.	Own make	20.2	....	....
55717	Vanilla, bulk	John Merino	Own make	7.4	29.2	....
55715	Neapolitan, brick	United Fruit & Vegetable Market	Cooper's I. C. Co., R. I.	11.2	34.3	1.4
		Middletown				
55725	Peach, brick	Cronin Drug Co.	Own make	18.0	35.4	1.7
55681	Neapolitan, brick	Kinsella Drug Co.	Millbrook I. C. Co.	12.8	39.2	1.8
55682	Yankee, brick	Kinsella Drug Co.	Millbrook I. C. Co.	10.4	36.1	1.7
55683	Neapolitan, brick	Millardo's Pharmacy	Linbrook I. C. Co.	10.0	36.0	1.6
55684	Futura brick	Millardo's Pharmacy	H. P. Hood's Sons, Cambridge, Mass.	13.8	38.8	1.9
55723	Caramel, bulk	Neville's Candy Co.	Own make	21.0	32.7	....
55721	Strawberry, brick	Olympia Candy Shop	Own make	17.4	37.6	1.5
56382	Vanilla, brick	Olympia Candy Shop	Own make	19.6	38.4	1.7
55719	Vanilla, bulk	J. W. Stueck & Sons	Own make	17.0	38.0	....
		Moosup				
55905	Neapolitan, brick—Fro-Joy	D. DiVersi	General I. C. Co.	10.0	34.5	1.6
55903	Neapolitan, brick	Moosup Pharmacy	Dairimaid I. C. Co., Worcester, Mass.	10.0	35.4	1.6
		Mystic				
56265	Vanilla, bulk	Riverside Ice Cream Parlor	Own make	18.6	....	....

TABLE VI. ANALYSES OF ICE CREAM—*Continued*

No.	Flavor and brand	Dealer	Manufacturer	Fat	Solids	Solids per gal.
		Naugatuck		%	%	lbs.
55830	Neapolitan, brick	Naugatuck Dairy Ice Cream Co.	Own make	15.4	39.9	1.9
55831	Neapolitan, brick	Naugatuck Dairy Ice Cream Co.	Own make	11.2	36.3	1.6
		New Britain				
55844	Vanilla, brick	Crown Ice Cream Co.	Own make	15.2	40.7	1.9
55855	Orange pineapple, brick	Linwood Market	Own make	16.4	39.9	2.2
55853	Strawberry, brick	Roger's Spa	Shuttle Meadow Farms	12.6	37.3	1.9
55846	Vanilla, brick	J. E. Seibert & Son	Own make	15.0	41.6	2.3
55848	Vanilla, bulk	Star Confectionery	Own make	15.0	....	....
55850	Strawberry, brick	St. Clair Confectionery	Own make	14.6	39.5	1.8
		New Haven				
56256	Country Club, brick	Cacace Confectionery Co.	Ridgewood Farm Dairy, No. Haven	14.6	41.9	1.7
56257	Neapolitan, brick	Cacace Confectionery Co.	Ridgewood Farm Dairy, No. Haven	11.0	36.1	1.3
56378	Chocolate and strawberry, brick	Edgewood Soda Shop	Own make	14.2	42.0	2.1
56380	Vanilla, brick	Edgewood Soda Shop	Own make	11.2	37.5	1.7
55686	Home Package, Neapolitan	Eld Pharmacy	Sagal Lou I. C. Co., New Haven	14.2	41.6	1.9
55685	Neapolitan, brick	Eld Pharmacy	Sagal Lou I. C. Co., New Haven	10.4	37.9	1.9
55687	Chocolate, brick	Harry's Bakery	Brock-Hall Dairy Co., Hamden	11.8	39.2	1.8
55688	Vanilla and chocolate	Harry's Bakery	Royal I. C. Corp., New York, N. Y.	9.0	35.5	....
56258	Futura, brick	H. P. Hood & Sons, Inc.	Own make	13.4	39.3	2.0
56259	Yankee, brick	H. P. Hood & Sons, Inc.	Own make	11.2	38.1	1.7
56467	Bulk	Loft's, Inc.	Own make	19.6	....	....
56261	Thrift, brick	Marioni Ice Cream Co.	Own make	9.2	30.9	1.3
56260	Neapolitan, brick	Marioni Ice Cream Co.	Own make	12.0	35.7	1.8

TABLE VI. ANALYSES OF ICE CREAM—*Continued*

No.	Flavor and brand	Dealer	Manufacturer	Fat	Solids	Solids per gal.
		New London		%	%	lbs.
56286	Brick	Capitol Candy Kitchen	Own make	15.6	40.6	3.3
56277	Neapolitan, brick	A. J. Maloof	Own make	15.4	40.1	1.9
56278	Neapolitan, brick	A. J. Maloof	Own make	11.2	36.9	1.7
56271	Vanilla, brick	Mumford Dairies	Own make	15.4	44.8	2.5
56290	Strawberry, brick	Olympia Tea Room	Own make	15.4	41.9	2.4
56269	Strawberry, bulk	G. P. Photos	Own make	13.4	....	....
56275	Chocolate, brick	Radway Dairy, Inc.	Own make	15.0	41.7	2.0
56283	Neapolitan, brick	United Fruit and Vegetable Store	Cooper I. C. Co.	10.2	36.0	1.4
		New Milford				
55921	Strawberry, bulk	Arthur Bona	Own make	13.6	....	....
55916	Neapolitan, brick	C. H. Hipp	Own make	13.6	37.8	2.0
55917	Neapolitan, brick	C. H. Hipp	Own make	11.6	36.1	1.9
55919	Vanilla, bulk	Geo. O. Nicholas	Own make	16.4	....	....
		Norwalk				
55450	Vanilla, bulk	Lowe's Soda Shop	Own make	13.6	37.6	....
55819	Strawberry, bulk	Lowe's Soda Shop	Own make	15.2	....	....
55817	Peach, bulk	Peter's Sweet Shop	Own make	12.0	....	....
		South Norwalk				
55825	Banana, brick	Bessie Abraham	Own make	13.2	31.3	1.3
55821	Vanilla, bulk	Palace of Sweets	Own make	9.4	....	....
55823	Peach, bulk	Strand Confectionery	Own make	10.4	....	....

TABLE VI. ANALYSES OF ICE CREAM—*Continued*

No.	Flavor and brand	Dealer	Manufacturer	Fat	Solids	Solids per gal.
		Norwich		%	%	lbs.
55652	Strawberry, bulk	A. N. Alexander & Co.	Own make	14.6	42.2	....
55498	Vanilla, bulk	Olympia Candy Kitchen	Own make	9.6	33.3	....
55650	Neapolitan, brick	C. C. Treat	Own make	16.4	41.0	2.2
55651	Vanilla, bulk	C. C. Treat	Own make	15.2	37.5	....
		Norwichtown				
55494	Progress, brick	Norwich Dairy Co.	Own make	10.4	36.6	1.6
55496	Neapolitan, brick	Norwich Dairy Co.	Own make	17.2	42.9	2.0
		Pawcatuck				
56263	Strawberry, bulk	Greek-American Fruit Co.	Own make	23.6	....	....
		Plainville				
55857	Vanilla, bulk	Palace of Sweets	Own make	16.4	....	....
		Shelton				
55833	Vanilla, bulk	E. J. Barden	Own make	11.2	....	....
		Somers				
55698	Neapolitan, brick	H. S. Kibbe	M. K. Skipton I. C. Co., Springfield, Mass.	11.4	37.2	1.5
55696	Vanilla, bulk	Old Homestead Inn	Turnhill, Greenfield, Mass.	15.8	42.0	....
		South Manchester				
55910	Neapolitan, brick	Manchester Dairy Ice Cream Co.	Own make	14.6	42.7	1.5
55912	Neapolitan, brick	Royal Ice Cream Co.	Own make	11.8	39.2	1.8
55914	Neapolitan, brick	Royal Ice Cream Co.	Own make	16.2	42.3	1.6
		Stafford Springs				
55704	Vanilla, bulk	Louis Campo	Own make	16.4	36.5	....
55700	Vanilla, bulk	Ed. Hotkowski	Own make	17.2	42.1	....

TABLE VI. ANALYSES OF ICE CREAM—*Continued*

No.	Flavor and brand	Dealer	Manufacturer	Fat	Solids	Solids per gal.
		Stamford		%	%	lbs.
55199	Neapolitan, brick	Pickwick Ice Cream Co.	Own make	12.2	39.5	2.1
55176	Vanilla and chocolate, brick	Richardson's, Inc.	Louis Sherry, N. Y. City	18.0	38.4	2.6
		Suffield				
55690	Strawberry, bulk	Jas. V. Mix	Own make	15.6	39.1	....
		Thompsonville				
55692	Chocolate, bulk	A. F. Scavotto	Own make	15.6	40.7	....
55694	Vanilla, bulk	A. Tatoian	Own make	15.4	39.5	....
		Torrington				
55165	Vanilla, bulk	Blue Plate Tea Room	Own make	11.6	30.1	....
55949	Neapolitan, brick	Jacob's Ice Cream Co.	Own make	11.8	35.4	1.7
55167	Neapolitan, brick	Jacob's Ice Cream Co.	Own make	13.4	35.5	1.4
55168	Neapolitan, brick	Jacob's Ice Cream Co.	Own make	20.2	39.8	1.8
55171	Vanilla, bulk	John Khoury	Own make	13.2	37.2	....
55872	Chocolate, brick	Torrington Creamery, Inc.	Own make	11.4	40.7	1.6
55169	Neapolitan, brick	Webbs & Seigel	Torrington Creamery, Inc., Torrington	12.6	40.2	2.1
		Union				
55702	Vanilla, bulk	Mashopaug Garage	Forest Lake I. C. Co., Palmer, Mass.	17.0	39.5	....
		Waterbury				
55482	Vanilla, bulk	Blue Bird Tea Room	Own make	16.4	38.8	....
55484	Neapolitan, brick	Lake Drug Co.	A. H. Merriman & Sons	15.2	38.9	2.0
55485	Neapolitan, brick	Litsky Pharmacy	R. F. Worden & Co.	14.8	41.9	1.9
56491	Vanilla, brick	Maple Hill Farm	Own make	20.0	35.0	2.2
55478	Vanilla, bulk	Whelan's Ice Cream Co.	Own make	13.2	35.5	....

TABLE VI. ANALYSES OF ICE CREAM—*Concluded.*

No.	Flavor and brand	Dealer	Manufacturer	Fat	Solids	Solids per gal.
		Waterville		%	%	lbs.
55480	Coffee, bulk	E. M. Cookson	Own make	19.2	40.4	....
		West Haven				
56372	Strawberry, bulk	Cameo Confectionery	Own make	12.6	....	....
56374	Chocolate, brick	Canfield's	Own make	19.2	44.3	3.0
56376	Neapolitan, brick	Clark Dairy Co., Inc.	Own make	15.4	38.1	1.8
56377	Progress, brick	Clark Dairy Co., Inc.	Own make	11.4	35.8	1.6
56370	Strawberry, bulk	Thompson Spa	Own make	10.4	....	....
		Willimantic				
55660	Vanilla, bulk	Albro's Soda Shop	Own make	15.8	36.8	....
55907	Neapolitan, brick	Bay State Drug Co.	H. P. Hood's Sons, Cambridge, Mass.	13.6	40.1	1.4
55662	Vanilla, bulk	Dimock Farm Products	Own make	18.4	40.4	....
55656	Thrift, brick	Hallock's Restaurant	B. C. Hallock Ice Cream Co.	12.4	35.6	1.9
55658	Neapolitan, brick	Hallock's Restaurant	B. C. Hallock Ice Cream Co.	18.2	41.3	1.9
55654	Vanilla, bulk	Thread City Candy Kitchen	Own make	16.4	36.5	....
		Winsted				
55161	Vanilla, bulk	Highland Sweet Shoppe	Own make	14.4	39.7	....

MAPLE SYRUP, ETC.

Three official samples of maple syrup were examined and all were passed as genuine.

Three samples submitted by health officers and others also appeared to be of standard quality.

A sample of syrup derived from squash, 1837, was examined with results as follows:

Moisture	28.36%
Ash	5.28
Total nitrogen	0.384
Protein (N x 6.25)	2.40
Ether extract (Roese-Gottlieb)	0.14
Reducing sugar (calc. as invert)	44.97
Sucrose	4.47
Insoluble ash	0.67
Alkalinity of soluble ash cc N.HCl/100 gms	46.41
Alkalinity insoluble ash	9.98
Acidity as acetic acid	1.48
Winton lead number	7.14
Starch	none
Nitrogen-free extract including dextrin (by diff.)	63.82

The syrup has about 64 per cent of carbohydrates including dextrin, and about 72 per cent of total food solids. Its composition resembles that of other common food syrups, such as molasses and sorghum syrup, for example.

MILK AND MILK PRODUCTS

MARKET MILK

Twenty-three official samples of market milk were examined for the Dairy and Food Commissioner. No instances of skimming or of dilution with water were found.

Three hundred and thirty-eight samples were tested for producers and others interested.

EVAPORATED MILK

Two official samples of evaporated milk were examined and both were of standard quality.

CREAM

Eleven samples of sour cream were tested for milk fat and the fat content was found to range from 10 to 38 per cent. Sour cream should not contain less than 16 per cent judged by the same standard as applies to sweet cream.

Sixteen samples of sweet cream were tested for producers and others interested.

SHELLED NUTS

Shelled nuts were examined for residual sulphur dioxide which might be present in the event of sulphuring to prevent insect infestation. Sixteen samples of mixed nuts were tested but no evidence of sulphur dioxide was found in any of them. All of the samples were submitted by the Dairy and Food Commissioner.

SALAD DRESSING

Two samples of salad dressing were submitted for examination. No. 1405, *Tasti-Gold Mayonnaise* is distributed by the Silver Distributing Co., Hartford, and No. 1811, *Rajah Brand Salad Dressing,* by the Great Atlantic and Pacific Tea Co., Cheshire, Conn.

Analyses of these two products are as follows:

	No. 1405 %	No. 1811 %
Solids	87.74	67.81
Fat	84.51	55.12
Ash	1.02	1.43
Salt (NaCl)	0.88	1.09
Total P_2O_5	0.108	0.109
Lipoid P_2O_5	0.067	0.054
Total nitrogen	0.23	0.28
Protein (N x 6.25)	1.44	1.75
Starch	none	1.70
Approx. egg content from total P_2O_5	7.7	7.8

No. 1405 conforms to the fat standard for mayonnaise dressing. The approximate egg content is based upon the total phosphoric acid content. No. 1811 is not claimed to be a mayonnaise and is not required therefore to meet the standard for mayonnaise. It is apparently an egg product containing approximately 7.8 per cent of egg.

SPRAY RESIDUE

The work on spray residue during the season of 1933 has involved the examination of 170 samples of fruits, vegetables and miscellaneous materials for arsenic, or lead, or both; and in a few experimental studies, tests for or determinations of fluorine and nicotine have been made. In addition to official samples of fruits and vegetables taken in open markets, samples submitted directly by growers have been examined and reported to them.

The tolerance established by the U. S. Department of Agriculture for the season of 1933 is 0.01 grain of arsenic (As_2O_3) and 0.014 grain of lead (Pb) per pound of food product. In the case of fruit, however, the somewhat more liberal tolerance for lead of 0.02 grain per pound has been allowed for the 1933 crop.

The results of the survey show that, excluding samples representing experimental or investigational work of the station, 59 in number, the limits of the tolerances were not exceeded by any significant amount. A summary of the work done is given as follows:

	Arsenic (As_2O_3) gr./lb.	Lead (Pb) gr./lb.
44 official samples of apples	none to 0.0107	none to 0.017
44 samples of apples submitted by growers	none to 0.009	none to 0.020
23 official samples of vegetables largely string beans	none to 0.009	....

The results of a similar survey made last year showed only 21 samples out of 153 that exceeded the tolerance for arsenic, and of these only 7 exceeded 0.014 grain per pound. This was regarded as a very satisfactory showing, but the results this year are remarkable. The improvement is probably due largely to the avoidance of late applications of arsenicals, particularly lead arsenate, during the season of 1933. So far as we are informed there has been no practice of washing of fruit before marketing.

Fifty-nine samples examined for arsenic and other spray materials in connection with investigations by other departments of the Station are not discussed here.

The method used for the determination of arsenic was the official Gutzeit method. For the determination of lead, the method employed was that outlined by the Food and Drug Administration of the U. S. Department of Agriculture, the so-called sulphide method, whereby the lead content was estimated colorimetrically as the sulphide by comparison with solutions containing known amounts of lead. This method was later improved, and recently a shorter and more accurate procedure has been suggested by the Department above mentioned, the so-called "dithizone" method. Apparently the sulphide procedure overestimates the lead content and may indicate traces of lead when none is present. So far as we have made comparative trials of the two procedures, the "dithizone" method appears to avoid that difficulty.

SQUASH

Fourteen samples of squash were examined for content of total solids. Samples were submitted by the Associated Seed Growers, Inc., New Haven. Solids were determined on the fresh material exclusive of the seeds. Solids ranged from 5.91 to 17.20 per cent.

VINEGAR

No special survey of vinegar was made during the past year. Four official samples were submitted by the Dairy and Food Commissioner and ten were submitted by individuals. Of the official samples, two were below standard in acid strength. Acidity is required to be not less than 4 per cent.

UNCLASSIFIED MATERIALS

Sixty-nine samples were submitted by the Dairy and Food Commissioner, health officers, physicians and others interested. These were of miscellaneous character and for the most part require no special comment.

2271. *"Diabetic sugar."* This sugar was submitted by a diabetic patient to whom it had been recommended. The sugar was identified as dextrose and the patient was advised that if used, the same precautions would be necessary as when eating ordinary sugar or starchy foods.

2942, 2943. *Almond milk* and *Cocoanut milk* respectively. They were water suspensions of the ground nuts. Analyses were made as follows:

	No. 2942 %	No. 2943 %
Solids	15.98	8.48
Ash	0.54	0.23
Protein (N x 6.25)	4.56	0.89
Fat	9.44	6.43
Fiber	trace	trace
Sugars (by difference)	1.44	0.93
Calcium (as oxide)	0.058	0.012
Phosphorus (as pentoxide)	0.202	0.052
Iron (as ferric oxide)	0.0013	0.0013

3628. *Soy Bean Flour.* Madison Rural Sanitorium and Hospital, Madison, Tennessee.

2859. *Breakfast Crisps;* 2860 *Fruit Sticks;* 2048 *Vigorost;* Madison Sanitorium Food Co., Madison, Tennessee. The breakfast crisps and fruit sticks are mixtures of cereals with soybean flour. Vigorost is a vegetable substitute for meat. Analyses of this group of products are as follows:

	No. 3628 %	No. 2859 %	No. 2860 %	No. 2048 %
Moisture	7.78	8.42	10.50	56.59
Ash	3.18	4.29	2.15	2.48
Protein (N x 6.25)	34.38	16.69	8.50	18.28
Fiber	9.13	1.95	1.51	0.48
Carbohydrate other than fiber	29.04	64.90	67.16	13.03[1]
Fat	16.49	3.75	10.18	9.14

DRUGS

AMMONIA WATER

Eight samples were examined. One of them was stronger ammonia water and labelled as such but it had not the content required. Ammonia water should contain not less than 9.5, nor more than 10.5 per cent, of ammonia (NH_3). Stronger ammonia water should contain not less than 27 per cent of ammonia. The sample that was labelled as stronger was declared to be 26 per cent and the analysis showed the declaration to be correct. Analyses are given in Table VII.

TABLE VII. ANALYSES OF AMMONIA WATER

No.	Dealer	Ammonia (NH_3) per cent
55320	Bursten's Pharmacy, Bridgeport	7.0
55309	Lombardi's Drug Store, Darien	9.4
55221	The Holcomb Drug Co., Inc., East Haven	2.5
54984	H. F. Bassett, New Milford	6.5
55102	G. E. Lemartre, Putnam	26.6
55116	McCormick Drug Co., Stafford Springs	1.9
55113	Wick's Drug Store, Stafford Springs	8.7
55324	Blank Bros. Pharmacy, Stratford	6.6

ANTIMONY AND POTASSIUM TARTRATE
(Tartar Emetic)

This substance should contain not less than 98.5 per cent of antimony-potassium tartrate.

[1]Starch 4.93 per cent, total sugars 1.69 per cent.

The five samples tested showed in excess of 99 per cent, and some of them slightly in excess of 100 per cent, due to loss of water of crystalization. The crystals readily effloresce on exposure to air.

Samples were purchased at the following places: Ideal Pharmacy, Danbury; E. J. Bardein, Shelton; Harding Drug Store, Derby; Terragna Drug Co., Hartford; Millard Drug Co., Devon.

OLEORESIN OF ASPIDIUM

This official product yields not less than 24 per cent of crude filicin. Samples were assayed by a modification of the U.S.P.X. procedure devised by Pabst and Bliss (Jour. Am. Pharm. Assoc., 21,435, 1932; 22,289, 1933), and regarded by these investigators as more reliable and expeditious than the U.S.P. method.

Four samples were examined and one was substandard. Analyses are given in Table VIII.

TABLE VIII. ASSAYS OF OLEORESIN OF ASPIDIUM

No.	Dealer	Crude filicin per cent
55091	Whalen's Drug Store, Bristol	27.93
55136	John A. Rosenthal, Hartford	16.40
55146	Liggett's Drug Store, Norwich	30.32
55201	Curran & Flynn, Willimantic	25.15

OINTMENT OF BELLADONNA

Based on the U.S.P. formula this preparation should contain not less than 0.118 nor more than 0.132 per cent of belladonna alkaloids. All samples were assayed by the paraffin method (Jour. A.O.A.C. XV, 83, 1932). Sample 55051 was also assayed by the shakeout method (same reference).

Twelve samples were examined of which three were below standard by substantial amounts. Analyses are given in Table IX.

TABLE IX. ASSAYS OF OINTMENT OF BELLADONNA

No.	Dealer	Belladonna alkaloids per cent
55083	C. F. Hotchkiss, Derby	0.117
55236	J. M. Dougherty, Hartford	0.094
55240	Parent's Drug Store, Hartford	0.111
55223	Adams Pharmacy, Meriden	0.127
55225	Whelan's Drug Store, Meriden	0.121
55230	Washington Ave. Pharmacy, New Haven	0.111
55305	The McNichols Drug Co., Norwalk	0.087
55081	Shelton Pharmacy, Shelton	0.108
55315	Monroe Drug Co., So. Norwalk	0.120
55051	Union City Pharmacy, Union City	0.126
55303	Silver's Drug Shop, West Haven	0.076
55316	Hugh T. Driscoll, Westport	0.135

BORIC ACID

Boric acid should contain not less than 99.5 per cent of H_3BO_3. All samples examined met this requirement within a reasonable tolerance and otherwise were of satisfactory quality.

Twenty samples were examined. Sample 55313 was conspicuously higher than the others in arsenic content but did not exceed the tolerance allowed by the Pharmacopoeia. Analyses are given in Table X.

TABLE X. ASSAYS OF BORIC ACID

No.	Dealer	Moisture per cent	Boric acid per cent	Arsenic (As_2O_3) p.p.m.	Heavy metals per cent
	Ansonia				
55065	McQuade's Drug Store	0.005	99.65	none	none
	Colchester				
55138	A. T. Van Cleave	0.005	97.06	none	none
	Darien				
55313	The Bell Pharmacy	0.00	98.15	2.5	none
	East Hartford				
55211	Prospect Pharmacy	0.02	97.40	none	none
	Hartford				
55088	Peter Glassman	0.00	98.93	1.0	none
55235	Hillside Pharmacy	0.005	97.85	none	none
55132	Temkin Drug Co.	0.01	98.85	none	none
55133	Temkin Drug Co.	0.005	97.78	none	none
54994	Wetmore Pharmacy	0.02	98.40	trace	none
	Hazardville				
55118	Hazardville Pharmacy	0.00	98.58	none	none
	New Haven				
55229	The Congress Pharmacy ...	0.01	98.63	trace	none
	Norwalk				
55306	Conroy's Pharmacy	0.01	97.66	none	none
	Norwich				
55141	Jaspin Cut Rate Store	0.035	98.26	trace	none
	Putnam				
55106	Donahue Drug Store, Inc...	0.00	99.25	trace	none
	Seymour				
55061	Geo. Smith & Son	0.00	98.90	trace	none
	South Norwalk				
55314	DeLux Pharmacy	0.00	98.26	none	none
55308	Wershaw's Drug Stores, Inc.	0.00	98.45	none	none
	Stratford				
55071	Hamilton Pharmacy	0.00	99.56	trace	none
	Union City				
55056	Union City Pharmacy	0.04	98.75	trace	none
	Waterbury				
55097	Ideal Pharmacy	0.00	99.05	trace	none

PRECIPITATED CALCIUM CARBONATE
(Precipitated Chalk)

When dried to constant weight at 200° C precipitated chalk contains not less than 98 per cent of calcium carbonate.

Fifteen samples were examined. Thirteen fully met the standard; two were slightly deficient but were passed.

Analyses will be found in Table XI.

TABLE XI. ASSAYS OF PRECIPITATED CHALK

No.	Dealer	$CaCO_3$ (dry basis) per cent
55063	McQuade's Drug Store, Ansonia	97.60
55064	McQuade's Drug Store, Ansonia	98.58
55202	People's Drug Store, Burnside	99.26
55212	W. B. Noble, East Hartford	97.50
55243	Washington Pharmacy, Hartford	98.10
55119	Hazardville Pharmacy, Hazardville	98.43
55109	Starr Bros. Inc., New London	98.05
55110	Starr Bros. Inc., New London	98.13
55105	Willis B. Carroll, Putnam	99.30
55219	Salisbury Pharmacy, Salisbury	98.16
55078	E. J. Bardein, Shelton	96.46
55080	E. J. Bardein, Shelton	98.75
55121	Steel's Corner Drug Store, Thompsonville	99.08
55055	Union City Pharmacy, Union City	98.43
55302	Myer's Drug Store, West Haven	98.23

SOLUTION OF CALCIUM HYDROXIDE
(Lime Water)

At 25° C this solution should contain not less than 0.14 grams of calcium hydroxide in 100 cc. At 15° C it contains about 0.17 grams and the strength diminishes as the temperature at which it is kept rises.

Of thirteen official samples all except two were satisfactory.

Analyses are given in Table XII.

TABLE XII. ASSAYS OF LIME WATER

No.	Dealer	Calcium hydroxide gms/100 cc
55067	The Bristol Drug Co., Ansonia	0.16
55323	Lincoln Pharmacy, Bridgeport	0.13
55128	Liggett's Drug Store, Hartford	0.17
55129	Whelan Drug Co., Inc., Hartford	0.17
54998	Cassiday's Pharmacy, Middletown	0.17
55085	Park View Pharmacy, Middletown	0.13
55058	Buckley's Drug Store, Naugatuck	0.25
55103	G. N. Lamatre, Putnam	0.16
55070	Blank Bros., Stratford	0.01
54973	Park Pharmacy, Torrington	0.19
54975	Webb & Siegel, Torrington	0.15
54992	Moran's Drug Store, Wallingford	0.16
54980	Sceery & Ivory, Winsted	0.15

CHLORINATED LIME

This official preparation should contain not less than 30 per cent of available chlorine. No objection can be taken to a product containing less than 30 per cent if the strength is declared and the declaration is met, provided the strength is not so low as to be worthless as a disinfectant. Chlorinated lime deteriorates rather rapidly in spite of precautions to preserve its strength.

Only four samples were examined. One of them was distinctly inferior and much below the declared strength. Analyses are given in Table XIII.

TABLE XIII. ASSAYS OF CHLORINATED LIME

No.	Dealer	Available chlorine	
		declared per cent	found per cent
55086	Park View Pharmacy, Middletown	24.00	21.85
55104	Joseph A. P. Gagne, Putnam	26.00	9.59
54981	Opperman's Drug Store, Torrington	24.00	24.25
55053	W. J. Dunphy, Waterbury	30.00	26.44

SOLUTION OF CHLORINATED SODA

This solution should contain not less than 2.5 per cent of available chlorine.

Five samples were examined and all were below standard. Analyses are given in Table XIV.

TABLE XIV. ASSAYS OF SOLUTION OF CHLORINATED SODA

No.	Dealer	Available chlorine per cent
55231	M. Epstein, New Haven	0.66
55143	Utley & Jones, Norwich	1.65
55126	Chafee's Drug Store, Southington	1.42
55310	The Church Pharmacy, Stamford	1.95
55300	Robert Aventin, West Haven	1.91

SOLUBLE FERRIC PHOSPHATE

This preparation should contain not less than 12 per cent of iron, (Fe).

Three samples were examined and all met this requirement.

The samples were taken at the following druggists: J. M. Rosenthal, Hartford, (14.5 per cent); Liggett's, Norwich, (14.9 per cent); and Echons Pharmacy, Westport, (15.1 per cent).

SACCHARATED FERROUS CARBONATE

This preparation should contain not less than 15 per cent of ferrous carbonate, $FeCO_3$.

Four official samples were examined and one was found to be considerably below standard.

Analyses are given in Table XV.

TABLE XV. ASSAY OF SACCHARATED FERROUS CARBONATE

No.	Dealer	Ferrous carbonate per cent
55238	Metropolitan Drug Co., Hartford	16.68
55224	Graeber Pharmacy, Meriden	11.42
55246	John T. Howes, Milford	19.14
54978	Claxton's Pharmacy, Torrington	14.96

SOLUTION OF FORMALDEHYDE

The standard for this preparation as given in the Pharmacopoeia requires that it contain not less than 37 per cent of formaldehyde.

Nine official samples were examined. Only one fully met the standard, but the others were not seriously deficient.

Analyses are given in Table XVI.

TABLE XVI. ASSAYS OF SOLUTION OF FORMALDEHYDE

No.	Dealer	Formaldehyde per cent
55089	Boulevard Pharmacy, Bristol	36.35
55239	Taylor's Drug Store, Hartford	37.24
55232	York & Oak Pharmacy, New Haven	36.24
55107	Town Hill Pharmacy, New London	36.43
55307	Harold A. Mead, Norwalk	36.60
54970	South End Pharmacy, Torrington	36.26
54976	Webb & Siegel, Torrington	36.87
55099	McCarthy Pharmacy, Waterbury	35.20
55327	The Bridge Pharmacy, Windsor Locks	36.41

HYPOPHOSPHOROUS ACID

The standard for this product requires that it contain not less than 30 per cent and not more than 32 per cent of hypophosphorous acid.

Only two samples were examined and both were passed.

55111, bought of Nichols and Harris, New London, contained 32.79 per cent of hypophosphorous acid.

55144, bought of Utley and Jones, Norwich, contained 30.97 per cent of hypophosphorous acid.

COMPOUND SOLUTION OF IODINE
(Lugol's Solution)

The Pharmacopoeia requires that this solution contain in 100 cc not less than 4.8 grams and not more than 5.2 grams of iodine; and not less than 9.8 grams nor more than 10.2 grams of potassium iodide.

Of eleven official samples examined only three were satisfactorily close to the limits prescribed.

Analyses are given in Table XVII.

TABLE XVII. ASSAYS OF COMPOUND SOLUTION OF IODINE

No.	Dealer	Iodine gms/100 cc	Potassium iodide gms/100 cc
55319	Whelan Drug Co., Bridgeport	6.0	12.6
55125	Gladding's Pharmacy, Cheshire	4.8	9.5
55228	Country Club Pharmacy, Hamden	4.1	9.5
55234	Highwood Pharmacy, Hamden	4.3	11.5
55237	The Hubert Drug Co., Hartford	5.2	11.2
55248	Milford Pharmacy, Milford	2.9	10.6
55087	Peter Glassman, New Britain	4.4	9.7
55093	Pilchar's Pharmacy, Terryville	4.2	9.9
55100	G. A. Lemmon, Thomaston	3.8	9.1
55301	The Campbell Drug Store, West Haven	4.2	11.2
55328	Paxson's Drug Store, Windsor	5.0	15.2

LACTIC ACID

Lactic acid is a syrupy liquid containing not less than 85 per cent and not more than 90 per cent of lactic acid.

Four official samples were examined and all were satisfactorily close to these limits.

Analyses are given in Table XVIII.

TABLE XVIII. ASSAYS OF LACTIC ACID

No.	Dealer	Lactic acid per cent
55227	Spring Glen Pharmacy, Hamden	83.50
54995	Wetmore Pharmacy, Hartford	85.47
54985	H. F. Bassett, New Milford	84.09
55060	Geo. D. Smith & Son, Seymour	84.24

SOLUTION OF MAGNESIUM CITRATE

This solution is usually called "citrate of magnesia" although that name is not an official synonym. The standard preparation should contain magnesium citrate equivalent to not less than 1.5 grams of magnesium oxide in 100 cc. According to the specifications given in the Pharmacopoeia total citric acid should be not less than 9.8 grams and free citric acid not less than 3.3 grams.

Of twenty-three samples only twelve were satisfactorily close to the standard specifications.

Analyses are given in Table XIX.

TABLE XIX. ASSAYS OF SOLUTION OF MAGNESIUM CITRATE

D.C. No.	Dealer	MgO	Free citric acid	Total citric acid	Remarks
		gms/100 cc	gms/100 cc	gms/100 cc	
	Ansonia				
55066	Bristol Drug Co.	1.79	3.31	9.63	O. K.
	Danbury				
54990	S. George	1.23	2.33	6.91	Low in magnesium and free and total citric acid
54988	Ideal Pharmacy	1.38	2.44	7.53	Low in free and total citric acid
54991	Kinner's Drug Store ..	1.66	2.99	9.06	Low in free citric acid
	East Haven				
55222	Metcalf's Drug Store..	1.50	3.41	8.81	Low in total citric acid
	Hartford				
55134	Forest Drug Co.	1.68	3.64	9.46	Pass
	Milford				
55245	A. H. Botsford	1.64	3.94	9.85	O. K.
	Naugatuck				
55057	Buckley's Drug Store..	1.67	3.52	9.59	Pass
	New London				
55108	Montauk Pharmacy ...	1.67	3.74	9.75	Pass
	New Milford				
54983	H. F. Bassett	1.50	4.09	9.67	Pass
	Seymour				
55062	The Seymour Pharmacy	1.56	3.99	9.63	Pass
55059	Geo. D. Smith & Son..	1.50	2.46	7.97	Low in free and total citric acid
	Stafford Springs				
55115	McCormick Drug Co. .	1.36	1.45	6.57	Low in free and total citric acid
	Stratford				
55069	Blank Bros.	1.67	3.68	9.29	Pass
	Thompsonville				
55122	Carroll Cut Rate Store	1.68	3.42	9.48	Pass
	Torrington				
54977	Claxton's Pharmacy ..	1.25	2.13	6.74	Low in magnesium and free and total citric acid
54972	Park Pharmacy	1.45	2.38	7.73	Low in free and total citric acid
54969	South End Pharmacy .	1.57	2.90	8.54	Low in free and total citric acid
	Wallingford				
55050	F. W. Marx	1.52	3.90	9.58	Pass
	Waterville				
55096	T. B. Carney & Co. ...	1.12	1.53	5.81	Low in magnesia and free and total citric acid
55095	W. J. Dunphy	1.67	2.46	8.47	Low in free and total citric acid
	Windsor				
55329	Windsor Drug Co.	1.68	4.14	10.01	O. K.
	Winsted				
54979	Sceery and Ivory	1.59	3.49	9.29	Pass

COMPOUND PILLS OF MILD MERCUROUS CHLORIDE

This mixture contains among other medicaments 60 grams of mild mercurous chloride in a pill mass sufficient for 1000 pills. The dosage of mild mercurous chloride in each pill, therefore, should be 60 milligrams. The preparation is generally known as Compound Cathartic Pills.

Eight samples were examined. One of them, 54997, was labelled "Calomel Tabs" 1/10 grain. These tablets were correct as labelled but they were not the article called for. In two other samples the deficiencies in mercurous chloride exceeded 10 per cent.

Results are given in Table XX.

TABLE XX. ASSAY OF COMPOUND PILLS OF MILD MERCUROUS CHLORIDE[1]

No.	Dealer	Mercurous chloride, milligrams per pill
55216	Freeman Dempsey, Canaan	56
55220	People's Pharmacy, Canaan	56
54997	Murphey Drug Store, Middletown	Calomel
55114	Wick's Drug Store, Stafford Springs	64
55120	Thompsonville Drug Co., Thompsonville	60
54971	South End Pharmacy, Torrington	53
55054	W. J. Dunphy, Waterbury	66
55326	R. J. Keefe, Windsor Locks	52

[1](Assays were made by the A.O.A.C. method, p.64, sec.155, 1930 Ed.)

METHENAMINE

This preparation is otherwise known as hexamethylenetetramine and should be 99 per cent pure.

Five samples were examined and found to be from 96 to 97 per cent pure and were passed. No ammonium salts were detected.

Samples were obtained from the following druggists: E. J. Bardein, Shelton; People's Pharmacy, Hamden; Parent Drug Store, Hartford; Silver Drug Shop, West Haven; and L. B. Switzer, Inc., Southport.

SOLUTION OF POTASSIUM ARSENITE
(Fowler's Solution)

This preparation should contain in each 100 cc, the equivalent of not less than 0.975, nor more than 1.025, grams of arsenic trioxide, As_2O_3.

Twenty-one samples were examined and five were deficient by amounts greater than 10 per cent.

Analyses are given in Table XXI.

TABLE XXI. ASSAYS OF SOLUTION OF POTASSIUM ARSENITE

No.	Dealer	Arsenic trioxide (As_2O_3) per cent
55092	Central Drug Co., Bristol	0.960
55203	Powell Drug Co., Burnside	0.894
55217	Farnum Drug Store, Canaan	0.933
55226	Broderick & Curtin, Meriden	0.978
54996	Murphey Drug Store, Middletown	0.928
55247	J. H. Barnes, Milford	0.827
55139	Treat's Drug Store, Norwich	0.785
55209	Vincent's Pharmacy, Rockville	0.967
55206	Miner's Pharmacy, So. Manchester	0.790
55112	Delmonica Drug Shoppe, Stafford Springs	0.935
55311	Jones' Drug Store, Stamford	0.987
55312	Whelan's Drug Co., Stamford	0.985
55072	Hamilton Pharmacy, Stratford	0.855
55123	O'Brien's Pleasant St. Pharmacy, Thompsonville	0.812
54974	Opperman's Drug Store, Torrington	0.960
55052	W. A. Dunphey, Waterbury	0.936
55098	Rielly & Burns, Waterbury	0.894
55148	Windham Pharmacy, Willimantic	0.929
55213	The City Pharmacy, Winsted	0.971
55214	Opera House Pharmacy, Winsted	0.931
55249	The Seaside Pharmacy, Woodmont	0.878

SULPHURIC ACID, DILUTE

Dilute sulphuric acid should contain not less than 9.5, nor more than 10.5, per cent of sulphuric acid, H_2SO_4.

The dilution should be made on the basis of weight and not on the basis of volume. If diluted on the volume basis the acid strength will be too high.

Fourteen samples were submitted. Five of them were considerably over-strength, in some cases practically twice the official strength. One sample, No. 55204, was slightly contaminated with quinine.

Analyses are given in Table XXII.

TABLE XXII. ASSAY OF DILUTE SULPHURIC ACID

No.	Dealer	Sulphuric acid per cent
55322	Laverty Drug Store, Bridgeport	9.48
55321	Tuckett's Drug Store, Bridgeport	9.71
55124	Warner's Drug Store, Cheshire	17.09
55130	Alderman Drug Co., Hartford	16.16
54999	Park View Pharmacy, Middletown	17.48
55140	Smith's Drug Store, Norwich	9.48
55142	Utley & Jones, Norwich	9.86
55210	J. J. Lee, Rockville	10.20
55127	Oxley's Drug Store, Southington	21.17
55204	Crosby's Pharmacy, South Manchester	8.68
55325	Brodie Drug Co., Stratford	9.59
55094	The Center Drug Store, Terryville	12.05
55149	The Wilson Drug Co., Willimantic	9.85
55215	Frank S. Bunnell, Winsted	10.12

REPEAL WHISKEY

(Survey made prior to announcement of regulations by the Federal Alcohol Control Administration)

C. E. Shepard and E. M. Bailey

Immediately following the repeal of the 18th Amendment numerous inquiries came to the Station and to the Dairy and Food Commissioner's office regarding the character and quality of the whiskey then available. The Dairy and Food Commissioner submitted a number of samples and they were examined in some detail in this laboratory. The results were interpreted in the light of government regulations in effect before prohibition and which at the time of our inspection had not been superseded by other official announcements.

No poisonous or deleterious substances foreign to whiskey were found in any of the samples, and there was no evidence of violation of Section 2728 of the General Statutes of this State or of the corresponding Section 734 b of the Liquor Control Act of 1933 regarding adulterated liquor.

The alcoholic strength as declared on labels or indicated by statements of proof was correct, or substantially so, in all cases. There was no evidence of undue dilution with water; proof ranged from 86° to 100°. Statements of net contents were found to be in agreement with the label declarations. There were no shortages in excess of reasonable tolerances provided in state regulations.

The label declarations as to identity of products were in general accord with official understanding and accepted practice prior to prohibition. Unmixed distillates from grain mashes, whether colored and flavored by storage in wood or by the addition of caramel and harmless flavoring, reduced to potable strength, were entitled to the name whiskey without qualification; and mixtures of such whiskies were properly called "blends".

"Straight" whiskey is the term used to designate a grain mash distillate which contains the full measure of fusel oil, acids, esters, aldehydes and furfural (sometimes spoken of as "congeners") which volatilize with water and alcohol at the usual temperature of distillation. Such whiskey may be new, young or old. Storage in wood develops those characters of flavor and aroma for which whiskey is prized as a beverage.

For medicinal purposes it is required that whiskey be matured in charred casks for at least four years. Specifications and tests for identity and purity of such whiskey are given in the United States Pharmacopoeia, and whiskey meeting those requirements is presumed to be of the substance and quality suitable for medicinal use.

"Blended" whiskey has usually contained some straight whiskey mixed in varying proportions with alcohol. Under recent regulations issued by the Federal Alcohol Control Administration blended whiskey must contain at least 20 per cent by volume of 100° proof straight whiskey or whiskies.

Of the 32 samples included in our inspection 16 were labelled as "blends" and they were passed as labelled. From our analyses we would judge that some of them contained very little straight whiskey, but under the regulations prevailing at that time no objection could be taken to the label descriptions if no straight whiskey were present. Thirteen samples were labelled "for medicinal purposes". Of these three were passed as of that description, eight were not and two were doubtful. Three samples were labelled "straight" whiskey or blends of straight whiskies and of these two were passed and one questioned.

Our criticism was chiefly that the declaration "for medicinal purposes" was not justified except on whiskey that conforms to the U.S.P. specifications for that article, and the distillers or distributors of whiskies so labelled and which did not meet those specifications were notified that such labelling should be abandoned. A ruling announced by the Food and Drug Administration, February 16, 1934, supported this view. It holds that "medicinal whiskey which does not conform to the pharmacopoeial standard must be labelled to differentiate it clearly from the official product".

Analyses of the samples examined are given in Table XXIII. It should be made clear that all of these samples were purchased and examined prior to the announcement of regulations by the Federal Alcohol Control Administration, and hence the composition of some of these brands, particularly the blends, may have been modified since the new regulations became effective. The analyses are given, however, as a matter of interest and for reference purposes.

The exhaustive study of changes taking place in authentic grain mash distillates, stored under various conditions, made by Crampton and Tolman (J. Am. Chem. Soc., 30, 98–136. 1908) shows that numerous factors must be taken into account in judging the character and quality of whiskey. The relationships among acids, esters, color and solids in whiskey are important factors in judging its maturity. The color of straight whiskey is acquired by storage in wood. The color so acquired is soluble in amyl alcohol (Marsh reagent) whereas caramel, which is used to simulate the natural color of whiskey, is insoluble. In the aging process acids and esters reach an equilibrium in about four years and remain so thereafter. The presence of tannin, if not excessive, indicates storage in wood and whiskey stored in charred casks acquires an oily appearance. Irish and Scotch whiskies are stored in uncharred casks and are lighter in color than American whiskies which are stored in charred wood. The smoky taste of Irish and Scotch whiskies is due to the practice of drying the malt over peat.

In interpreting our analyses of samples declared to be medicinal in character the specifications of the U. S. Pharmacopoeia were used as a guide. No objection was raised if the alcoholic content was somewhat less than 47 per cent by volume provided the declared proof was substantially met. A certain tolerance for the proportion of color insoluble in Marsh reagent appeared to be necessary also. Crampton and Tolman observed that in applying this test to their pure whiskies the lower aqueous layer was water-white. The U.S.P. specifications remark that this lower layer is colorless or very nearly so. In a previous examination (1915) we passed samples showing 10 per cent of amyl-alcohol insoluble color. In the present survey samples apparently genuine so far as color is concerned showed from 3 to about 7 per cent of insoluble color. The limits for acids and esters as fixed by the Pharmacopoeia, stated in terms of grams per 100 litres, are 36 to 120 for acids, and 30 to 123 for esters. In applying

these limits it should be kept in mind that these two constituents, whatever their magnitudes within the postulated limits, should be present in approximately equal amounts.

Samples 57200, 56544 and 57218 were labelled as medicinal products and they were passed as of that character. Samples 56545, 56546, 57230, 57213, 57229, 56893, 56896, and 57214 were also labelled as medicinal, but were not of that grade. Samples 57231 and 57202 were classed as doubtful, although the latter probably should be classed in the non-medicinal group.

Sample 57212, labelled as a blend of straight whiskies, has the composition of very new whiskey colored with caramel.

There is little to comment upon concerning the blends except to note that the acids and esters are so low in most cases as to indicate very little aged whiskey in the products. Sample 57217 was labelled as "Old Scotch whiskey" with the further declaration that it was a blend of aged brandy and spirits. The term "blend" as applied to whiskey is correctly used only in the case of mixed distillates from grain mashes; brandy is not derived from a grain mash.

Two unofficial samples were examined. No. 4700 was labelled as a blend for medicinal purposes but it did not meet the specifications for medicinal whiskey. No. 4727, also labelled "for medicinal purposes", met the U.S.P. requirements and appeared to be matured straight whiskey.

TABLE XXIII. ANALYSES OF WHISKEY

No.	Brand and label	Price per quart	Net volume: declared, fluid ounces	Net volume: found, fluid ounces	Alcohol by volume: declared %	Alcohol by volume: found %	Solids gms/100 cc	Color insoluble in amyl alcohol % of total	Acids, as acetic gms/100 litres	Esters, as ethyl acetate gms/100 litres	Tannin	No.
	U. S. P. Whiskey	......	....	....	47–53	......	not over 0.5	none or trace	36–120	30–123	present	
57200	*Old McBrayer, Bonded.* Aged in wood. Medicinal	$7.00	32.0	31.4	50.00	50.12	0.25	3.3	94.8	106.0	present	57200
57212	*Mayfair.* Blend of straight	2.75	32.0	31.1	45.00	43.96	0.09	17.0	9.6	4.2	present	57212
56544	*Golden Wedding.* Blend of old rye and other fine whiskies. No alcohol or spirits added. Medicinal	3.25	32.0	31.5	47.50	46.84	0.12	4.0	46.3	31.1	present	56544
56545	*Blackstone.* Blend of straight whiskey. Medicinal	2.50	32.0	31.5	50.00	49.40	0.09	4.0	36.7	15.8	present	56545
56546	*Belle of Anderson.* Blend of straight whiskies. Medicinal	2.50	32.0	31.8	46.00	45.12	0.10	5.3	40.3	20.8	present	56546
57230	*Melvale.* Blend of rye and other straight, no alcohol or spirits added. Medicinal	2.75	32.0	32.2	46.00	45.32	0.10	5.7	42.7	17.6	present	57230
57231	*Gibson.* Blend of rye and other straight, no alcohol or spirits added. Medicinal	3.00	32.0	31.7	46.00	45.12	0.10	5.3	41.5	25.2	present	57231
56890	*Walker's DeLux, Am. Rye, Bonded*	5.12	25.6	25.5	50.00	49.48	0.11	6.3	45.1	28.1	present	56890
56894	*Crab Orchard, Bourbon,* straight	1.50	32.0	31.1	46.50	45.96	0.09	6.7	55.7	20.7	present	56894
57218	*Old Sunny Brook, Bonded,* straight. Medicinal	6.95	32.0	31.7	50.00	50.04	0.19	5.0	83.0	71.3	present	57218
57202	*Tally-Ho.* Blend of whiskey with old rye, aged in wood. Medicinal	2.50	32.0	31.8	45.00	45.28	0.37	12.7	37.9	25.1	present	57202
57213	*Four Roses.* Blend. Medicinal use	3.50	32.0	32.3	45.00	44.64	0.19	70.0	28.6	10.4	present	57213
57229	*Hawthorne.* Blend. Medicinal use	2.50	32.0	31.3	45.00	44.56	0.36	51.0	25.0	3.5	present	57229
56893	*Green River.* Blend. Medicinal use	3.50	32.0	32.4	45.00	44.68	0.17	57.0	23.8	19.0	present	56893
56896	*Lucky Star.* Blend. Medicinal use	2.85	32.0	31.8	45.00	44.24	0.22	80.5	25.0	12.1	trace?	56896
57214	*Kentucky Judge.* Blend. Medicinal use	2.50	32.0	31.3	45.00	44.40	0.23	81.5	20.2	5.1	trace	57214
57201	*Canadian Club Whiskey.* Bonded. Matured in casks	6.27[1]	25.5	25.5	45.20	44.92	0.07	9.3	33.1	17.6	present	57201
57203	*Shenandoah.* Blend	2.25	32.0	31.9	45.00	43.75	0.16	78.0	14.2	11.4	present	57203
57204	*Mellwood.* Blend	3.15	32.0	31.5	45.00	44.28	0.17	71.0	17.8	6.2	present	57204
57205	*Oak Lawn.* Blend	2.00	32.0	21.8	45.00	44.24	0.43	83.0	11.8	5.1	trace?	57205
56548	*Cherry Grove.* Blend	2.25	32.0	31.8	45.00	44.32	0.36	70.7	13.0	1.8	none	56548
56547	*Snug Harbor.* Blend	2.00	32.0	31.8	45.00	45.16	0.25	27.0	36.7	9.7	present	56547
57227	*Sweep Stakes.* Blend	2.82[1]	25.6	25.5	45.00	45.40	0.12	17.3	20.2	0.9	present	57227
57228	*Captain Kidd.* Blend	2.00	32.0	31.3	45.00	44.96	0.17	24.7	28.6	3.3	present	57228
56883	*Chester Hills.* Blend	2.25	32.0	31.3	45.00	44.24	0.25	66.0	9.6	4.2	none	56883
56888	*Teachers Highland Cream. Old Scotch*	5.10[1]	25.0	25.6	43.00	43.04	0.13	72.0	15.4	12.2	present	56888
56889	*Irish Pot. Still* Whiskey	5.06[1]	25.0	25.8	43.00	43.12	0.08	45.0	15.4	12.1	present	56889
56891	*Martin's V.V.O. Scotch.* Blend	4.86[1]	26.0	25.7	44.00	44.00	0.05	14.0	16.6	15.6	trace?	56891
56892	*Original 13 States.* Blend containing old rye aged in wood	2.25	32.0	32.4	45.00	43.44	0.48	9.3	37.9	12.1	present	56892
56895	*Fireside.* Blend	1.85	32.0	31.3	45.00	43.60	0.25	82.0	9.6	4.4	trace?	56895
57216	*Belle of New York.* Blend of aged whiskey and spirits	2.00	32.0	31.1	45.00	45.08	0.40	84.0	11.8	2.6	trace?	57216
57217	*Old Scotch.* Blend of aged brandy and spirits	3.50[1]	25.6	24.7	45.00	44.20	0.64	81.5	11.8	4.4	trace?	57217
4700	*Paul Jones, Four Star.* Medicinal	......	....	....	45.00	44.92	0:47	62.0	36.0	18.5	present	4700
4727	*Glencoe, Bonded.* Aged in wood. Medicinal	......	....	....	50.00	49.41	0.25	3.0	86.4	100.3	present	4727

[1]Calculated to basis of 32 ounces.

THEOBROMINE SODIO-SALICYLATE

When dried at 110° C this compound should contain not less than 46.5 per cent of theobromine and not less than 35 per cent of salicylic acid.

The four samples examined substantially met the above requirements. Only one passed the solubility test, but this may have been due to absorption of carbon dioxide from the air after the samples were purchased.

Assays are given in Table XXIV.

TABLE XXIV. ASSAYS OF THEOBROMINE SODIO-SALICYLATE

No.	Dealer	Theobromine per cent dry basis	Salicylic acid per cent dry basis
55068	Bristol Drug Co., Ansonia	50.35	37.58
55090	Boulevard Pharmacy, Bristol	45.78	36.08
55082	Shelton Pharmacy, Shelton	44.75	32.71
55207	J. H. Quinn Co., South Manchester	51.40	38.22

EXTRACT OF WITCH HAZEL

This article is no longer a U.S.P. preparation, but it is described in the National Formulary where tests for identity and purity are given.

Eight samples were examined. No. 55473 was labelled U.S.P., which is incorrect. The sample also gave positive tests for acetone which should not be present.

No. 55705 also contained acetone.

Assays are given in Table XXV.

TABLE XXV. ASSAYS OF EXTRACT OF WITCH HAZEL

No.	Dealer	Alcohol per cent	Acetone
	Essex		
55473	Geo. W. Dow	13.90	present
	Hartford		
55706	Forest Drug Co.	14.50	faint trace
55773	Forest Drug Co.	14.43	none found
55781	L. W. Leib	14.86	none found
55772	Liggett's Drug Store	13.79	none found
55705	The Garden Pharmacy	14.18	present
55774	Timkin's Drug Co.	13.83	none found
	New Haven		
55707	Carroll's Cut Rate Perfume Store ...	14.35	none found

OINTMENT OF YELLOW MERCURIC OXIDE

This ointment should contain 1 per cent of yellow mercuric oxide. The official strength was formerly 10 per cent.

Of six samples submitted by the Dairy and Food Commissioner, one was considerably below standard in mercury.

Analyses are given in Table XXVI.

TABLE XXVI. ASSAYS OF YELLOW MERCURIC OXIDE

No.	Dealer	HgO per cent
55131	Ideal Drug Co., Hartford	0.94
55135	John M. Rosenthal, Hartford	1.01
55145	Liggett's Drug Store, Norwich	0.93
55208	Arthur Drug Stores, Inc., So. Manchester	0.34
55205	Magnell Drug Co., So. Manchester	1.04
55200	Curran & Flynn, Willimantic	0.92

UNCLASSIFIED DRUGS, ETC.

56876. *Epsotabs.* The Dill Company, Morristown, Pa. White-coated laxative pills. The ground sample has the odor of rhubarb. The average weight per pill is 12.6 grains, ash 41.5 per cent. Pills consist of, or contain, phenolphthalein and magnesium sulphate (Epsom salt), coated with a mixture of sugar and calcium carbonate.

4279. *Crazy Water Crystals.* These salts when added to drinking water are supposed to reproduce Crazy Mineral Water obtained from certain wells in Texas. Water so treated has been recommended for the treatment of various ailments such as constipation, rheumatism, neuritis, arthritis, kidney and liver trouble, high blood pressure, nervousness and common colds, when any of these are the results of faulty elimination.

Our analysis shows the crystals to consist essentially of 98.8 per cent of hydrated and anhydrous sodium sulphate (Glaubers salt), with a little ([illegible] per cent) sodium chloride (common salt), and a trace of magnesium. The significance of the qualifying phrase following the disease names mentioned above is, of course, that so far as laxative and diuretic effects aid in the treatment of these diseases, Crazy Mineral Water will give that aid. Sodium sulphate is a laxative agent and water in sufficient quantity will produce diuretic effects; but intelligent medical treatment of the diseases named requires more than repeated doses of mineral salts solution. Indeed continued medication with cathartics may not be at all advisable.

More recently the advertising of this product has been considerably altered and claims are more cautiously stated; symptoms are emphasized instead of diseases.

3843. *Harriet Hubbard Ayer Beautifying Face Cream.* Old analyses report this product as containing ammoniated mercury. The sample examined during the past year contained zinc oxide in a fatty base. Other ingredients, if present, were not detected. No evidence of ammonia or mercury was found.

3285. *Dunn's Razorless Shaving Powder.* A white, perfumed powder. Directions tell the user to mix the powder with warm water and apply it to the face with a stick. Allow it to remain for three or four minutes and then remove with the stick. The caution is added that the paste should not be applied immediately after bathing the face with hot water.

Examination showed the powder to consist of or contain, a perfumed mixture of barium sulphide and corn starch.

Alkaline sulphides are common in depilatory preparations. Texts referring to the external application of sulphides note that they are likely to cause irritation and reddening of the skin. Soothing creams are generally recommended to follow the application. Products of this type are not to be recommended because of the irritation that may follow their use, especially in the case of delicate or sensitive skins.

3026. *Venetian Acne Lotion,* Elizabeth Arden, N. Y. C. This is a colorless liquid with the odor of rose and containing a large amount of suspended materials. It is neutral to litmus.

Qualitative tests showed a large amount of zinc present (all in the insoluble portion) a little iron and sulphate, and traces of calcium and sodium. Phenol and glycerine were present. No phosphates, chlorides, alkaloids, phenolsulphonates or sugars were found.

The lotion is very nearly the same as Compound Calamine Lotion described in the National Formulary, V. Ash content was found to be 16.63 per cent; phenol 1.32 per cent.

2888. *Solva-Roma Applicator.* 2889, *Solva-Roma Application No. 1.* 2890. *Solva-Roma Application No. 2.*

This is a depilatory outfit. The applicator was a circular lens-shaped device on a wooden stick. The lens-shaped portion appeared to consist of pumice with a binder of rosin and dextrin or gum. Application No. 1 was a gray-colored ointment with a garlic-like odor. The active agent was calcium sulphide mixed with a pasty base consisting largely of calcium carbonate and fatty material. Application No. 2 was a white ointment with a carnation-like odor. It contained boric acid in a base of fatty material with probably a little soap and a trace of coloring matter.

Analysis of Application No. 1 is as follows:

> Volatile at 100° C 30.61 per cent; ash, sulphated, 54.14 per cent; total sulphur 1.71 per cent; sulphate sulphur 0.41 per cent; total calcium oxide 17.60 per cent; calcium hydroxide (direct titration), 1.75 per cent; non-volatile ether extract 21.94 per cent; carbonate present, in quantity; sulphide present. Other ingredients, if present, not detected.

The approximate composition calculated from the analysis is as follows:

> Calcium sulphide 2.70 per cent; calcium sulphate 1.74 per cent; calcium hydroxide 1.75 per cent; calcium carbonate 22.24 per cent; iron, magnesium and sodium salts 11.42 per cent; fat 21.94 per cent; water and "perfume" 30.61 per cent; undetermined 7.60 per cent.

The active agent in this preparation is calcium sulphide. The comments made in connection with Dunn's Razorless Shaving Powder apply also in this case.

1396. *Shadocol.* Sample submitted by a physician. The preparation is essentially a mixture of tetraiodophenolphthalein, lactose and citric acid.

The calculated composition of the mixture based on our analysis is as follows:

> Moisture 1.6 per cent; tetraiodophenolphthalein (disodium salt), 16.7 per cent; lactose 74.2 per cent; anhydrous citric acid 5.3 per cent; undetermined 2.2 per cent.

MISCELLANEOUS

MATERIALS EXAMINED FOR POISONS

Sixty-three samples of materials have been examined for poisons. These include animal tissues, feeding stuffs, foods, cosmetics and miscellaneous materials. In most cases no positive evidence of poisonous or injurious ingredients was detected, but a few cases are worthy of mention.

3527. *Stomach contents of cow.* The usual poisons—phosphorus, cyanide, arsenic and heavy metals—were tested for with negative results. When a portion of the stomach contents were made alkaline and distilled with steam, the distillate yielded a heavy precipitate with phosphomolybdic acid indicating the presense of an alkaloid. The distillate was extracted with chloroform and the residue left after evaporating the chloroform was treated with hydrochloric acid to form the hydrochloride of the alkaloid probably present. From this a picrate salt was prepared and its crystalline structure appeared to be identical with a picrate salt prepared from nicotine. The melting point of nicotine dipicrate was observed to be 216.5° C and the melting point of the unknown picrate prepared from our sample as above described was found to be 215.0°. The unknown picrate mixed with known nicotine dipicrate melted at 216.0°. From the fact that the alkaloid was volatile with steam from alkaline solution, and that the crystalline structure and melting point of the picrate salt was practically identical with known nicotine dipicrate, the presence of nicotine in the stomach contents was regarded as established.

Nicotine sulphate is often used in the treatment of animals, especially sheep, for stomach worms, but there was no history of such treatment in this case. Wild tobacco plants are known to be poisonous to cattle (Tech. Bul. No. 22, U. S. Dept. Agr. 1927), but whether such plants were available to this animal was not determined. Whether or not nicotine poisoning was the cause of death cannot be established; but the occurrence of nicotine in the stomach contents is a matter of interest and it is the first time that we have identified this alkaloid in such material. The examination was made by C. E. Shepard, who has investigated a number of interesting cases of animal poisoning in recent years.

3838. This was another sample of *stomach contents* of a cow and a large quantity of arsenic, 6.67 grams per kilo, was found.

3580. *Milk,* submitted by a physician, was found to contain cyanide equivalent to 0.363 gram of hydrocyanic acid per quart.

2651. A number of complaints were received from health officers and physicians concerning so-called Bubble (chewing) Gum thought to have been responsible for a peculiar skin rash in children. A number of samples of this gum were examined without definite indications of injurious ingredients. This particular sample, however, contained methyl salicylate for flavoring. Skin rash is one of the manifestations of methyl salicylate poisoning, symptoms of which are described in Petersen, Haines and Webster, Vol. II, 2nd edition; and Jour. Am. Med. Assoc., LXII, 22, 1919.

1817. *Eau Minerale Naturelle,* a French mineral water, was submitted by a physician who wished it tested for arsenic. Arsenic was found and its identity established by the characteristic crystals of arsenic trioxide. The amount was approximately 0.0027 grain per pint which is not in excess of the recognized tolerance for food products (0.01 grain per pound); but a daily intake of about one quart, continued over a period of time, might have an objectionable cumulative effect.

4111. *A Facial Mask,* a cosmetic device for the correction of wrinkles and acne, was submitted by the State Commission of Hairdressers and Cosmeticians. The device was suspected of causing irritation of the eyes. Partial analysis showed an ash content of 23.64 per cent; nitrogen 4.58 per cent; arsenic, a trace, less than 1 p.p.m. Qualitative tests indicated zinc in quantity, traces of aluminum, iron and sodium, with a possible trace of magnesium. No ammonium salts, carbonates, chlorides, sulphates, nitrates or phenols were detected. Glycerine was present. The mask was essentially glycerinated gelatine containing about 24 per cent of zinc oxide. A physician or an eye specialist can best advise whether the ingredients found, or any one of them, would cause irritation of the eyes.

Lead poisoning. Ten samples of urine and feces were examined for Dr. J. M. Mirman and for Dr. A. Shaefer of the Mt. Sinai Hospital, Hartford, in their studies of cases of lead poisoning.

TOBACCO

Collaboration with the Department of Soils of this Station has required analyses of 52 samples of tobacco. The results are not for discussion in this report.

BABCOCK GLASSWARE, ETC.

Babcock glassware and dairy thermometers tested during the past year are summarized as follows:

	Total	Inaccurate
Milk test bottles	1571	0
Cream test bottles	262	0
Pipettes, milk	223	2
Thermometers	108	0
Totals	2164	2

Bulletin 364 September, 1934

TOBACCO CULTURE IN CONNECTICUT

P. J. ANDERSON

Connecticut
Agricultural Experiment Station
New Haven

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TOBACCO CULTURE IN CONNECTICUT

P. J. ANDERSON

History failed to record the date, the residence and the name of the first white tobacco grower in Connecticut. He was probably one of the original settlers, for as early as 1640, seven years after the first settlement was made in the colony, it is recorded that tobacco was being raised at Windsor. From that time to the present, tobacco has been one of the important crops of Connecticut. In the early years most of the towns in the state grew some tobacco at one time or another. Eventually it was found that the best leaf could be grown in the valley of the Connecticut river and the industry gradually concentrated there. In periods of greater demand it has spread farther from the river only to recede again in times of low prices. About 1840 another center of concentration of acreage began in the Housatonic Valley. To-day the commercial production is confined to these two valleys.

Connecticut, however, owes its preëminence in the tobacco world to the cigar. The heyday of commercial expansion began when cigar smoking became popular. Although the Indians are known to have rolled leaves of the plant loosely together before smoking them, cigars such as we have now were hardly known in New England until about 1800.

In the first few years of the nineteenth century the farmers' wives began to roll cigars in their homes to be peddled in wagons from village to village. The most popular brands in those days were the "Long Nines" and "Windsor Particulars". In 1810 the first cigar factories were established, one in Suffield and one in East Windsor. Gradually the business of rolling cigars passed from the homes into small factories which grew up in all the towns. Then some of the manufacturers began to import tobacco from Cuba and Brazil for blending with the native leaf.

With the increase in cigar smoking it came to be recognized in other parts of the country that the soil and climate of the Connecticut Valley were adapted to growing the finest quality of cigar leaf. The outside demand, thus created, necessitated the establishment of warehouses where large quantities of tobacco could be packed and shipped to New York and other centers where cigars were being made in increasing numbers. Warehouse Point owes its name to the fact that the first tobacco warehouse in Connecticut was established there in 1825. The history of the tobacco industry from that date to the present was one of continuous expansion until 1921. Occasionally there were reverses for a few years, but these were followed by periods of growth and renewed prosperity. The last decade, however, has seen an irregular downward trend in acreage.

TYPES OR VARIETIES

Three varieties of tobacco are now grown in Connecticut. Two of these, Broadleaf and Havana Seed, are commonly called "out-door" or "sun-grown" tobacco. The third one, Cuban, is known as "Shade tobacco" because it is grown in fields covered, or shaded, by tents of cotton cloth.

In early colonial days in America, all tobacco was alike. As new centers of production were established, however, it was found that tobacco grown in one part of the country had different qualities from that grown in another section. Some produced a kind which suited best the taste of the pipe smoker; others, a snuff type; and others again, plug types, etc. The three varieties grown in Connecticut are most suitable for cigars and the entire crop is used for this purpose except for a small amount of damaged or inferior leaf which, as a by-product, is used for scrap chewing.

In the manufacture of cigars, three kinds of tobacco are needed corresponding to the three parts of a cigar: the filler, binder and wrapper. The filler is the central portion of a cigar consisting of a bunch of leaves laid parallel together. For this, there is needed a heavy leaf which burns well and has a pleasant aroma and taste. It constitutes the larger part of the cigar. The filler is first covered and held in place by the binder, a leaf of a different type, not so heavy as the filler. This in turn is covered with a thinner leaf, the wrapper. The wrapper must burn well and be uniform and light in color. It must have very fine veins only, and a pleasing luster and finish that appeals to the eye of the smoker and sells the cigar. The wrapper is the smallest part of the cigar, but the most expensive per pound. Every different combination of filler, binder and wrapper produces a different taste or aroma. On the proper blending of these three parts depends the popularity and success of any brand.

More than a hundred years ago it was recognized that Connecticut tobacco excelled in the qualities that are desirable for wrappers and New England has become known as a wrapper section. It is also one of the two leading binder sections of America. Filler types of tobacco are not grown here although a small percentage of the top leaves is sometimes used for that purpose.

Of the three types of tobacco produced in Connecticut at present, Cuban Shade is grown for wrappers while the other two, Havanna Seed and Broadleaf, are used mostly as binders. There is still some demand, however, for the best grades of the latter two types for wrappers. Each kind has distinct characteristics and a distinct use in the manufacture of cigars. In the latter field they are not interchangeable.

Indians who grew tobacco here before the white man came used it only for smoking in pipes and probably were not particular about such things as shape of leaves, luster, and size of veins. The type they grew probably could be found nowhere to-day. Almost as scanty are the records in regard to types grown by the colonists for a hundred years or more. At the beginning of the nineteenth century, farmers were growing "shoe string" tobacco, a narrow-leaf type probably much like the present day Maryland Narrow-Leaf.

BROADLEAF (U. S. TYPE 51)

When fickle fashion started the vogue for cigar smoking a century and a quarter ago, there arose a demand for a wider leaf suitable for binders and wrappers. Consequently, Mr. B. P. Barbour of East Windsor imported seed from Maryland and began growing the Broadleaf variety in 1833. This new tobacco was so superior to the type previously grown that within a few years it entirely supplanted "shoe string". With its

FIGURE 116. Broadleaf plant ready to harvest.

coming the tobacco growing business in New England entered a period of expansion and prosperity which continued for nearly a hundred years. The Barbour variety of Broadleaf is still grown in some localities, but during the past century new kinds have developed either by mutation and acclimatizing of the original or through fresh importation of seed. As a result we have a number of more or less distinct varieties or subtypes of Broadleaf, for example: John Williams, Bantle, Frank Roberts and Hockanum.

The bulk of the Broadleaf is grown in Connecticut east of the Connecticut river in the towns of Glastonbury, East Hartford, Manchester, South Windsor and East Windsor. A scattering acreage is found in the Havana Seed sections of Connecticut and Massachusetts. The plant is principally characterized by the drooping habit of its leaves (Fig. 116). The leaves also are longer and wider than those of the other two dominant types in New England.

Broadleaf is used mostly for cigar binders and as such is found in many of the most popular brands of nationally distributed cigars. The better grades also have a limited use as cigar wrappers. Compared with the more popular Shade and Sumatra wrappers, they make the cigar appear dark and rough but many experienced smokers prefer them. Broadleaf top leaves, when thoroughly re-sweated and aged, also make a good cigar filler and are used to some extent for this purpose. Badly damaged or poor crops, and damaged and short bottom leaves of the good crops, are sold at a low price for "stemming". When mixed with other types they appear on the market as scrap chewing tobacco. The average yield of Broadleaf for the past 12 years, 1922 to 1933, was 1,422 pounds per acre according to estimates of the New England Crop Reporting Service. Yields of 1,800 to 2,000 pounds are not uncommon, however, on good land.

HAVANA SEED (U. S. TYPE 52)

There is considerable uncertainty as to the circumstances under which Havana Seed tobacco was introduced into New England. Apparently the event was not considered worthy of published record. Its culture began sometime between 1870 and 1880 but the writer has found no report giving the name of the man who imported the seed or his object in doing so. Probably he hoped to duplicate in Connecticut the aroma or other qualities for which the tobacco of Cuba is famous. Although the seed evidently came from Cuba, to-day there is no district in that island which grows tobacco like it. However, as there is wide variation in leaf and habit of growth in the tobacco fields of Cuba, it is entirely possible that our seed was isolated from such a heterogeneous population. By generations of selection and acclimatization here, the size and shape of the leaf has so changed that we fail to recognize the Cuban ancestor. At any rate the culture of Havana Seed spread rapidly and has supplanted most of the Broadleaf west of the Connecticut river in this state, on both sides of the river in Massachusetts, and even up into southern New Hampshire and Vermont. It is the only type grown in the Housatonic Valley. Its acreage in New England in recent years has been about the same as the Broadleaf acreage.

The leaves are somewhat smaller and smoother than those of Broadleaf and they do not droop but stand upright from the stalk. The upright habit makes this type more suitable for machine culture. (Fig. 117).

Before shade tobacco became so popular, Havana Seed was widely used for cigar wrappers. Now only a very small percentage of the crop

serves that purpose while the bulk of it goes for binders. The taste and flavor of cigars bound with Havana Seed differ from those bound with Broadleaf. It is not, therefore, a substitute for Broadleaf on the same brands of cigars. The principal competitor of Connecticut Havana Seed is Wisconsin binder, and the price which the Connecticut farmer receives for Havana Seed is influenced to some degree by the character of the crop grown in Wisconsin. Many nationally popular brands of cigars

FIGURE 117. Havana Seed plant ready to harvest.

use Connecticut Valley Havana Seed binders. The stemming grades of this variety are used for scrap chewing tobacco just as those of Broadleaf are. Average yields for the 12 years, 1922-1933, were 1,404 pounds per acre according to the New England Crop Reporting Service. Yields of 1,800 to 2,000 pounds, however, are often obtained by skilful growers.

SHADE (CUBAN) (U. S. TYPE 61)

Growing of tobacco under cloth in Connecticut began in 1900 with an experimental half-acre in Poquonock under the direction of the Connecticut Agricultural Experiment Station. In the original tests, seed was imported from Sumatra. The experiment proved this variety unsuited to shade culture and seed from Cuba was tried. With a few years of

FIGURE 118. Mature Cuban Shade plant.

selection, the Cuban type became established and its culture spread until it reached about 9,000 acres. It is grown in the same sections as Havana Seed and Broadleaf on both sides of the Connecticut river from southern Vermont to Portland, Connecticut.

The variety is identical with the tobacco grown generally in Cuba today but has been more carefully selected for uniformity. The leaves are smaller and less pointed than are those of Broadleaf and Havana seed, and are set farther apart on the stalk. The plant as a whole is taller than the other types. (Fig. 118).

Shade tobacco is used primarily for wrappers, and appears as such on the most popular high-priced cigars in America. Its only competitor is the imported Sumatra wrapper. The leaves are light in color, smooth and glossy, with very small and inconspicuous veins. They make a cigar which appeals to the eye of the smoker. The top leaves and heavier grades are used to some extent as cigar binders. Connecticut Shade is

FIGURE 119. A field of Havana Seed Tobacco growing in Connecticut.

the highest priced tobacco grown in America. The price of Sumatra is somewhat higher but only because of the high import duty. According to records of the New England Crop Reporting Service, the average yield for the last twelve years, 1922 to 1933, was 987 pounds to the acre.

SOME LESS IMPORTANT VARIETIES

The three varieties which have been described are the dominant types and the only ones grown to any extent commercially in New England. Many attempts have been made to introduce other varieties without ultimate success. Some of these, however, should be mentioned.

Primed Havana is the same variety in the field as Havana Seed but in the trade it occupies a separate position. The difference comes from the method of harvesting and curing. Ordinary Havana Seed is harvested by cutting down the whole plant and curing it in the shed with all the leaves attached to the stalk. In the case of Primed Havana, the leaves are removed from the stalk (primed) in the field as they become mature starting at the bottom of the stalk. They are sewed on lath, and cured like shade leaves. Primed Havana has the same uses as Shade but is not of such good quality. Its popularity began about the same time that Shade was introduced but it was gradually supplanted by Shade from Connecticut and Florida.

Halliday's hybrid: Many attempts have been made to produce an acceptable variety by crossing two other varieties. Such crossing usually results in a hybrid that is vigorous, high-yielding but lacking in quality. One of the first of these that became popular was the Halliday Hybrid

FIGURE 120. Field of Broadleaf tobacco showing the method of wilting the leaves. They are cut down and thrown on the ground.

which was grown rather extensively in the Havana Seed sections about the beginning of the present century. Unfortunately its lack of uniformity and some other objectionable characters doomed it to an early fate and caused considerable financial loss to some who had grown it too extensively.

Mongrel: This rather indefinite name has been applied to a hybrid variety produced by interbreeding of Havana Seed and Broadleaf. Just when or how often this nondescript cross has been made is not recorded but it has been grown rather extensively in some sections in the past and is still raised on a few acres. It is a rank grower and heavy yielder with leaf characters midway between the parents. There is little market for it because it is neither Broadleaf nor Havana Seed.

Roundtip: This variety was developed at the Connecticut Station by selection from a Sumatra-Broadleaf cross. It is a rank grower, with

leaves of excellent shape, a high yielder, and resistant to rootrot. It was grown commercially first in 1920 and within a few years there were several hundred acres. However it did not meet with favor in the trade and is no longer grown commercially in Connecticut.

With the centralizing of cigar manufacture into a few large units has come a demand for large quantities of uniform leaf. Varieties or grades which can be supplied only in limited amount are not wanted. They do not fit into the scheme of wholesale production. This means less and less chance of introducing any new type or variety of tobacco. The opportunity of the future will be to improve by selection the types which we now have, rather than to introduce new ones.

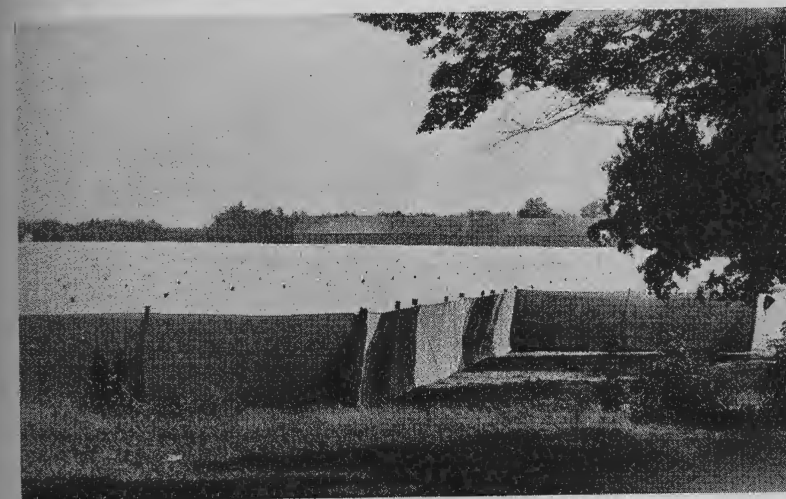

FIGURE 121. A tent in the Connecticut tobacco country under which Shade (Cuban) tobacco is grown.

ACREAGE AND DISTRIBUTION

For the first two centuries of tobacco growing in Connecticut there are no statistics to show how many acres were planted or how many pounds were raised annually in the state. Tobacco was grown at first mostly for home and local consumption. Yet the colonists apparently grew more than they could use, for early in the seventeenth century they were exporting it to the Dutch colony of New Amsterdam. During the next century tobacco was an important item of export in the West Indies' trade but no figures are on record by which we may judge the volume of this commerce. In 1753 the General Assembly made a law prohibiting the export from Connecticut of any tobacco that was not stamped and sealed by the official town packer. After that date, town packers were regularly elected at the annual meetings of the valley towns, indicating that export of tobacco was of some importance in these towns.

At the beginning of the nineteenth century the increasing popularity of cigars and the introduction of the Broadleaf tobacco induced a heavy expansion of acreage, but since no official statistics were kept, the extent of the increase cannot be stated. The first official figures which show the size of the industry in the state are in the Federal Census of 1840. According to this, there were 538,000 pounds of tobacco raised in New England in 1839. Assuming a yield of 1,413 pounds to the acre, which was the average annual yield of the first two decades for which we have acreage records, we may estimate that only about 380 acres were planted to tobacco in Connecticut and Massachusetts in 1839. In 1849 production had increased to 1,406,000 pounds. The next decade saw tremendous gain so that there was more than six times as much tobacco produced in 1859 as in 1849—about 6,500 acres. This wave of expansion continued until after the Civil War.

Beginning with 1862 there are official records showing the number of acres of tobacco cultivated, as well as the pounds produced each year. These figures are assembled in Table I[1]. They show a fairly steady production of 6,000 to 8,000 acres annually up to the end of the century. Then follows a gradual rise until the outbreak of the World War, and rapid expansion during and shortly after the war period, culminating in the peak of 31,000 acres in 1921. A violent drop came in 1925 followed by still further drastic reductions in 1932 and 1933.

Since 1920 there has been a slow but steady decline in consumption of cigars, largely due to the rising popularity of cigarette smoking. This was an important factor in reducing the acreage during the decade, 1920 to 1930. Another factor was the rapid substitution of cigar-making machines for hand work. In making a cigar a hand worker uses a double binder, while the machine uses only a single binder. Thus machine-made cigars require about half as many pounds of binders as hand-made cigars. During these years when the demand for binders was steadily declining, reduction of acreage lagged behind with the result that excessively large stocks of leaf accumulated, reaching a peak in about 1929. The ruinously low prices paid for tobacco after the economic depression set in resulted in reducing the acreage of outdoor types in 1933 to nearly the lowest point in the century.

The region of greatest concentration of tobacco acreage includes the towns on both banks of the Connecticut river northward from Glastonbury and Hartford to the Massachusetts line. The industry has been subject to wide fluctuations. In prosperous days tobacco growing has spread far to the east and to the west of the river towns, but in periods of lower price and depression, the acreage shrank first in the towns at the greatest distance from the river. But even disregarding these fluctuations the last hundred years has seen a steady tendency toward concentration of the industry in this part of the tobacco country. This is well illustrated by the maps of the state on page 727 which show the distribution in 1880 as compared with 1930. The distribution by towns in the state is shown in Table IV. (Appendix).

[1]For Tables I to IV see Appendix, page 801.

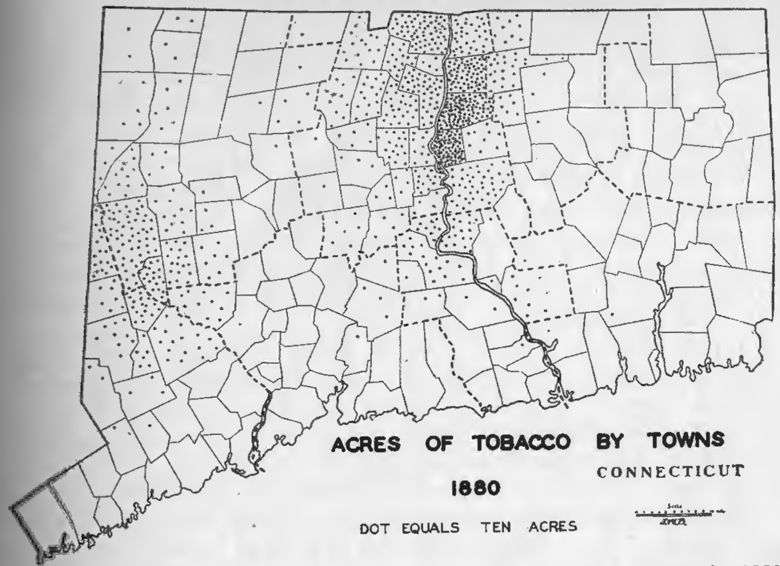

FIGURE 122. Map of the state showing acres of tobacco by towns in 1880. Each dot represents ten acres.

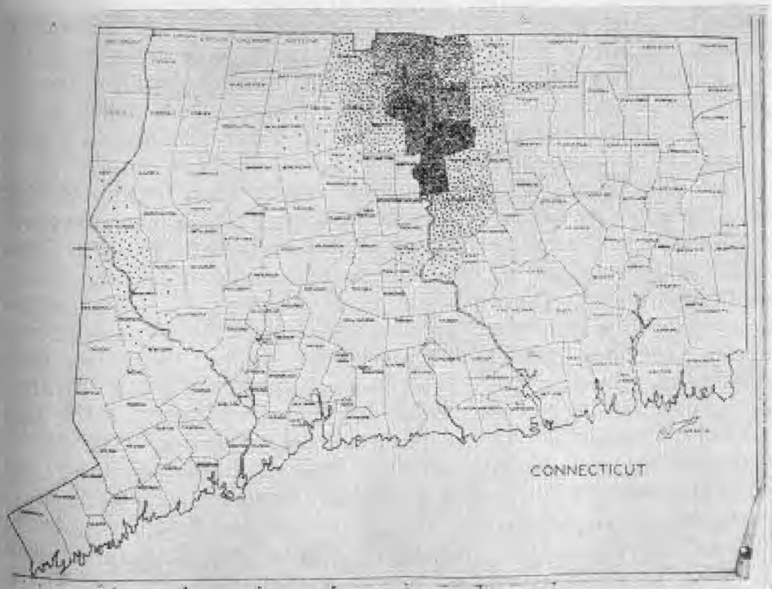

FIGURE 123. Acres of tobacco by towns in 1930. Each dot represents ten acres.

TYPES OF SOIL SUITABLE FOR TOBACCO

The tobacco plant will thrive in any fertile well-drained soil anywhere in the state, but commercial tobacco production is strictly localized in sections of the valleys of the Connecticut and Housatonic rivers. Each type of soil produces a different quality of tobacco. Many years of experience have shown that the soils in these two valleys impart a quality to the leaf which is most pleasing to the smoker. Therefore dealers purchase their supplies from these districts to the exclusion of other parts of the state. In times of increased demand the area has expanded to bring less suitable land into tobacco, but with each slump the acreage has receded to the same localities and all attempts to establish new permanent tobacco centers have failed.

The typical tobacco soil is a sandy loam containing from 60 to 80 per cent of particles more than .05 mm. in diameter. Variations in predominant size of the sand particles give coarse, fine and very fine sandy loams. The important tobacco soil types as classified by the Soils Department of the Experiment Station are: Merrimac sandy loam and fine sandy loam, Enfield very fine sandy loam and Manchester fine sandy loam. The Merrimac types compose the flat terraces along the Connecticut and Housatonic rivers. The Enfield and Manchester soils occur on gently rolling, somewhat higher, areas. To a smaller extent Wethersfield loam and Suffield clay loam are used but these two types are generally too heavy for best leaf quality.

The Merrimac coarse sandy loam is used for shade tobacco but is not so suitable for out-door types because it is susceptible to drought and leaching. Soils containing a considerable amount of clay are not good for tobacco culture. The plant prefers sandy, well aerated and well drained soils. The lighter soils produce a lighter-colored, thinner leaf and therefore a more desirable tobacco. Heavy black soils, peat and swamp soils, and the "meadow" soils along the river, produce rank growth, but the tobacco is darker, heavier and less desirable.

The best subsoils are of fine or medium sandy loam texture with good retentive capacity for water. Clay or "hard-pan" subsoils, however, do not permit sufficient drainage and are not usually satisfactory. Gravelly or coarse sandy subsoils permit too much leaching of the fertilizer and also drought injury in dry weather.

The average tobacco soil contains about 3 per cent of organic matter, an amount somewhat lower than that in other soils in the state. In very sandy soils this figure may drop as low as 1.5 per cent. With continuous culture of tobacco this percentage has not decreased except in the coarser sands where conditions are favorable to decomposition. There is no evidence that an increased amount of organic matter is desirable for tobacco. The average total nitrogen content, corresponding to the organic matter content, is also relatively low as compared with other soils types, being about .15 per cent. This small amount becomes available very slowly, hence the necessity of heavy nitrogen fertilization.

The quantity of phosphoric acid on old tobacco soils, however, is very high, due to accumulation. New tobacco soils (less than five years in tobacco) have an average of some 1,500 pounds of phosphorus (3,450

pounds phosphoric acid) to the acre, while those that have had tobacco 15 or 20 years often show more than double that amount. The tobacco crop takes very little phosphoric acid (15 pounds per acre) from the soil. In the average fertilizer practice, 100 pounds or more are added every year. Practically none is leached away. Thus constant accumulation makes the old tobacco soils very rich in phosphorus. All "availability" tests also show that there is a corresponding increase in available phosphorus. Therefore the addition of special phosphoric fertilizer materials such as various bone compounds is quite unnecessary on old tobacco soils.

The tobacco soils of Connecticut contain a very large total quantity of potash, 25,000 to 50,000 pounds to the acre. Unfortunately, however, this exists mostly in the form of relatively insoluble minerals and becomes available only very slowly. Therefore annual applications of fertilizer potash are necessary.

Total calcium amounting to about 15,000 pounds to the acre, is lower than in the other types of soils in the state.

Magnesium at about 7,000 pounds to the acre is still lower and is usually too slowly available. Therefore it is advisable to add magnesia for optimum tobacco production.

Our tobacco soils are fairly acid, averaging about 5.2 pH. The optimum reaction is between 5.00 and 5.6 pH. Those above 6.0 pH favor the development of black rootrot and should be avoided. Below 4.5 pH, the crop often suffers from manganese poisoning due to formation of soluble manganese compounds at this degree of acidity. Such soils should be limed to make them less acid. The presence of manganese compounds in the leaf gives an objectionable reddish brown color—commonly called "muddy" or "bricky"—to the ash. The more acid the soil, the greater the absorption of manganese by the plants.

SEED BEDS

The seed is started during the first weeks of April in long, narrow beds covered with glass sash or with cloth (Fig. 124). The size of the ordinary glass sash is 3 by 6 feet, but many prefer a wider bed and therefore use 8-foot, or even 10-foot, sash. From the standpoint of convenience in operation, weeding, pulling plants, etc., the 6-foot width is preferable. The length of the bed varies according to acreage of plants required. The side boards on one side of the bed are higher (10 to 14 inches above ground) than on the other, thus giving a slope to the sash. This slope, which is usually toward the south or east, drains off the water better and may possibly make the beds somewhat warmer. The boards are 1 to 2 inches thick. Since the parts of the boards in contact with the soil decay in two or three seasons, some growers use timber specially treated to prevent decay. Creosote is not suitable for this treatment because its fumes injure the young plants.

Instead of glass a fine-mesh white cotton cloth may be used to cover the beds. It is a common but not universal practice first to treat this cloth with linseed oil. Such treatment is said to keep the beds warmer and to preserve the cloth.* The cloth is supported at the center over a raised pole which runs longitudinally above the middle of the entire length of the bed. The margins of the material are stretched over small headed nails driven into the outer face of the side boards. Plants grown under cloth are just as good as those grown under glass, but are ready for setting about 10 days later.

A protected spot which insures a maximum amount of sunshine and minimum of cold winds is commonly selected for the location of the beds. Such conditions make the plants grow more rapidly and at the same time are more comfortable for working during the early spring months. Locations protected by tobacco sheds or other buildings, or by woods on the north and west, south slopes, nooks in the woods, or hollows, are favorite places. Some growers build high protecting board fences around the beds or place shade tents around and over them. The soil should be sandy, well drained and aerated, and of one of the types described above as favorable for tobacco culture. A good water supply close at hand is also essential.

FIGURE 124. Seed beds used for starting tobacco in April.

The beds are made in the same place year after year without change of soil. As long as the measures suggested below are practiced for keeping up the fertility of the soil, such continuous use of the same spot is generally advantageous and attended by no ill effects. Sometimes the soil becomes infested with certain insects or disease organisms, angle worms or unexplainable deterioration, especially when not sterilized yearly. Then the grower may find it best to replace the soil in the beds with new soil, or to select a new location.

*Mr. W. S. Pinney of Suffield, who has used oiled cloth over his beds sucessfully for many years, gives the following directions for treating the cloth: In a tub, make a mixture of 1 part boiling water in 2 parts of linseed oil. Add a little paint drier. Dip the cloth in this mixture until it is thoroughly saturated. Then run it through a wringer to remove excess oil. It is now ready to spread over the beds. *Do not leave cloth in a roll* on account of danger of spontaneous combustion.

TESTING THE SEED

Poor seed is very expensive and is often the cause of worry and dis-pointment. Before sowing, it is advisable to find out what percentage the seed will grow. Every grower may do this for himself. The test requires two weeks time for certainty. Light seed and chaff should be blown out first. One hundred seeds should be counted out and put on a moist blotter in a covered dish in a warm place—not over 90° F. The number of seeds which sprout give the percentage sought. The blotter must be kept moist all the time, but the seeds should not be covered with water. An average of several tests is more accurate than one. Good seed should germinate more than 80 per cent and many samples run more than 95 per cent. Seed usually germinates somewhat better the second year than the first. It should be good for at least five years. The Ex-riment Station makes these germination tests and blows out the light seed for growers free of charge.

RATE OF SEEDING

If the plants grow too sparsely, there is a waste of bed space and also they develop too short and squat for best setting. If they are too thick and crowded in the bed, they become weak and spindling, have not enough roots and do not start so well when set out. Such thick stands are also more subject to bed rot diseases. The stand of plants is more likely to be too dense than too sparse.

It is therefore important that the proper quantity of seed be sowed to produce optimum stand. One ounce of seed to 900 square feet of bed space is sufficient. This is equivalent to one ounce to fifty 3 by 6 sash.

STERILIZING THE SEED

As a common practice, sterilizing the seed is not recommended, but if wildfire is known to have been present on the seed plants, it is safest to immerse the seed for fifteen minutes in a 1-1000 solution of silver nitrate. Then wash it in running water for fifteen minutes and spread in a thin layer to dry quickly.

STEAM STERILIZING THE SOIL

Steaming the soil not only kills any wildfire germs which may have been carried to the beds, but it is beneficial in destroying the fungi which cause rootrot and bed rot as well as various other germs and insects. Steam kills weed seeds. Many growers consider this latter benefit alone worth the cost of the operation. It also makes the plant nutrients in the soil more available and produces a more vigorous growth.

Soil may be sterilized either in late autumn or in spring. The advantage of fall sterilization is that it distributes the labor better by avoiding the spring rush. Spring sterilization may delay considerably the time of seeding, especially during late springs. The disadvantage of fall sterilization is that the soil may become infested with weed-seeds, insect pests and fungi to some extent during the winter. On this account, the operation should be delayed until as late in the season as possible.

Injury to the germinating seeds sometimes results when the bed is seeded immediately after steaming. For this reason it is best to wait a few days before the sowing—ten days is better if it does not delay the time of seeding too seriously.

Of the various methods for steaming soils, the only one used in Connecticut is the "inverted pan" method. A galvanized iron pan, rein-

FIGURE 125. Sterilizing the beds by the steam pan method. The men are seen moving the pan forward. An old fire engine serves as a boiler.

forced with angle irons, about 10 inches deep, 12 to 16 feet long and just wide enough to fit inside the bed, is inverted over the soil and the sharp edges pressed a few inches into the loose earth (Fig. 125). Steam under high pressure from a steam boiler is forced through a pipe into the end of the pan and penetrates into and sterilizes the soil. The method is too well known to require further description except for the following precautions:

The soil should be well worked up and loose. Any manure or humus to be added should be applied before steaming. Commercial fertilizers may be added before or afterward. A moderately dry soil is more easily sterilized than one that is water-logged, because steam penetrates mud very slowly. Twenty to thirty minutes with a pressure of 75 to 125

pounds is usually sufficient. If, after removing the pan, the soil is so hot that you cannot hold your hand in it at a depth of five to six inches, the steaming is sufficient. Otherwise the length of steaming time should be prolonged. The soil should not be worked deeply after steaming because there is danger of turning up some of the unsterilized earth.

STERILIZING SOIL WITH FORMALDEHYDE OR ACETIC ACID

The soil may also be sterilized effectively with formaldehyde solution instead of steam, although this process does not kill all of the hard weed seeds. The solution should be made at the rate of 1 part to 50 of water and the soil soaked at the rate of one-half gallon to one square foot of soil if it is pretty damp. If the soil is dry, a more dilute solution of 1 to 100, and used at the rate of 1 gallon to 1 square foot, is advisable. Seed should not be sowed for ten days to two weeks after drenching, or until the odor of formaldehyde has disappeared. Stirring up the soil a few times may hasten escape of the fumes.

More recently it has been found that a 1 per cent solution of acetic acid is just as effective as formaldehyde and costs less. The solution is made by mixing 8 pounds of acetic acid (56 per cent) in 50 gallons of water and applying at the rate of one-half gallon to one square foot of soil. Otherwise the procedure is as with formaldehyde.

FERTILIZING THE BEDS

So many different systems of meeting the food requirements of the seedlings are employed by different successful growers that it is apparent that there is no single best method. The application of a complete commercial mixture at the time of sowing the seed—unless it be a very light application—is not recommended because there is danger of burning the first tender shoots and rootlets, and because the food requirements of the plants in the germination stage are light. Also the use of fresh organic materials such as cottonseed meal favors the growth of undesirable molds.

A safer practice is to make a heavy application of stable manure in the summer or autumn, work it into the ground and let it become thoroughly rotted during the winter. Cottonseed meal may also be applied in the fall; or a complete tobacco fertilizer may be added at that time. Any of these practices is good and eliminates the necessity of using fertilizer in the spring.

It is not advisable to force plants to grow too rapidly in the bed. Such plants become succulent, tender, have not enough roots for the size of the tops and do not live so well when set in the field. If, however, the growth is too slow in the bed or the plants begin to turn yellow after they have started, a top dressing may be applied to the soil. Nitrate of soda, nitrate of lime, or nitrate of potash may be dissolved in the water used for sprinkling the bed. The rate of dilution is about a tablespoonful to a sprinkler of water, or two pounds to a barrel. "Swiftsure", or dry ground fish, may be applied in a dry condition to the growing plants. The beds should be heavily watered immediately after application.

A heavy coating of peat or swamp soil composed mostly of decayed vegetable residues worked into the ground before seeding is used by some growers with good results. It increases the moisture-absorbing capacity of the soil and induces a better root system.

PRE-SPROUTING THE SEED

Seed may be sowed dry or may be sprouted before sowing in the bed. The sprouting process consists of keeping the seed moist and warm for several days previous to sowing. Then when the young white roots appear in four to eight days, the seed is ready for the beds. The object is to get the plants started more quickly. It is a common practice to mix the seed with damp, well rotted and pulverized wood (apple punk) or cocoa fibre or various other materials which will keep it moist. Some growers prefer to sprout the seed in bulk without any diluting material.

It is questionable whether any worthwhile advantage is derived from pre-sprouting. The majority of growers use unsprouted dry seed. Some growers mix sprouted and unsprouted seed in order to increase the length of the period during which the plants become successively ready for transplanting.

SOWING THE SEED

In preparation for sowing, the soil need not be worked very deeply but should be well pulverized and raked over until the surface is level. It may then be pressed down with a plank or rolled. Some times it is left loose at this time and rolled after seeding. The seed can be distributed better if first mixed with a diluting material like fine corn meal, coal ashes, fine sand, superphosphate, or land plaster. It is sowed by hand because no machine has yet been found which will distribute it in a satisfactory way. After spreading it over the soil, it may be raked over very lightly or it may be rolled in with a hand roller. An old method was to tramp the ground with the feet. The soil should then be thoroughly soaked with water using a fine gentle spray, gradually applied, so that no streams run over the surface.

The essential points are that it must not be buried deeply, if covered at all, and that the soil must be firm enough to be kept moist easily. Some growers of shade tobacco cover the ground with a layer or two of old shade cloth. This keeps the soil moist, prevents washing and has been very satisfactory in producing a uniform stand of plants.

WATERING

At the time when the seeds are just sprouting, it is extremely important that they be kept moist. No dry spots should be allowed to appear at this time, even though it may be necessary to sprinkle the beds twice a day. Uneven "stands" are usually traceable to neglect at this critical period.

When the plants have become established, however, the system of watering should be changed. Heavy watering at less frequent intervals is the best practice at this time. Too much water is objectionable, because it may start bed rot and because it makes the plants too tender and does not force them to develop a strong root system.

VENTILATION

Except in extremely severe weather, the beds should be ventilated for several hours every day by raising one end of the sash, or by removing the narrow boards sometimes placed between the sash. The temperature in the beds should never be allowed to rise above 100° F. The optimum temperature for germinating seed is 85° to 90° F.

SPRAYING

Since the advent of the wildfire disease in New England, about 1921, spraying or dusting of the plants in the seed beds has become a common practice. It not only prevents wildfire but also other diseases, repels flea beetles and is commonly recognized as a good practice in producing healthy plants.

The only sure way of preventing wildfire in the young plants is to keep the leaves covered with a copper fungicide continually. This may be applied as a dust or a liquid spray. Either method will prevent wildfire. The choice between them is largely a matter of personal preference, convenience and economy.

Our own preference is the ordinary 4-4-50 Bordeaux Mixture which is commonly used for spraying potatoes. It is the cheapest and safest material, and sticks to the leaves better than any other fungicide. Directions for making a convenient quantity for tobacco beds, are:

1. Slake 25 pounds of quick lime (granulated lime is perhaps best) in a barrel with just enough water to keep it boiling. Too much water at first will "drown" the lime, i. e., it will not heat. Stir the mixture continually until it is slaked. Afterward add water to fill the barrel up to 25 gallons. If hydrated lime is used the quantity should be increased to about 35 pounds.

2. Put 25 pounds of copper sulfate (blue-stone, blue vitriol) in a burlap bag (fertilizer or onion bag). Hang the bag in 25 gallons of water in a *wooden* barrel over night to dissolve the copper sulfate, or stir the compound about in the water until all of it is in solution.

The above are the "stock solutions" and may be kept all season. Keep them covered and stir well before using.

To make a barrel (50 gallons) of Bordeaux Mixture:

1. Pour four gallons of lime stock solution through cheesecloth stretched over the top of the mixing barrel. (The cloth may be held in place by a hoop slipped over the top). Much of the lime will be left on

the cloth. Wash as much of it as you can through with 25 to 30 gallons of water.

2. Pour four gallons of the copper stock solution through the same cheesecloth and add enough water to fill the barrel.

The solution is now ready for use. Stir each time before using. Don't mix together more than you need at one time. It will not keep until the next application.

Use one and one-half to two gallons of this solution per square rod of bed, depending on the size of the plants and fineness of the spray. Use a fine spray and high pressure.

Keep the leaves covered with the spray all the time after the second pair of leaves appears. This means spraying about every four or five days when the plants are growing rapidly.

Spray when the leaves are dry and then do not put the glass on again until the spray has dried. Don't spray at night, but earlier in the day when the spray will have time to dry.

If the mixture has been made and applied properly, the plants will appear blue when dry, and the spray will not wash off when the bed is watered.

Any kind of a spray pump that gives a fine spray and fairly high pressure is satisfactory for the work. The barrel pump or wheelbarrow type are convenient. The hose used in watering the beds may also be used for spraying.

COMMERCIAL BORDEAUX MIXTURES

Ready-made commercial products such as "Pyrox" may be purchased at hardware or farmers' supply stores. On the outside of each package there are directions for diluting the contents with water to make it equal to 4-4-50 Bordeaux. Follow the directions. A number of these products have been found to be satisfactory, and if a small bed is to be treated, they may be economical. None of them is as cheap or any better than the Bordeaux made at home.

COPPER LIME DUST

Copper lime dusts, such as Sanders' Dust, Niagara Dust, etc., are effective and in common use, being preferred by many good growers. They should be applied somewhat more frequently than Bordeaux, and they stick best if applied when the leaves are moist. The dusts are more expensive than Bordeaux but have the advantage of covering the underside of the leaves better than spray. It is not necessary that they should contain arsenicals if they are used only to control wildfire.

ERADICATION OF WILDFIRE SPOTS IN BEDS

Frequently wildfire appears only in isolated spots or areas in the beds. Whenever a spot infection is found, all the plants in the infected area, as well as those bordering on it for a foot or more, should be destroyed by

drenching it with formaldehyde diluted at the rate of about one part in 25 parts of water. Glass should be removed from the bed during this operation to prevent the fumes from spreading and injuring other plants.

If the infected spots are numerous or the disease is spread generally throughout the bed, it is best to destroy the bed entirely by drenching with a 1 to 50 solution of formaldehyde on a hot day and leaving the glass on tight. Wildfire is contagious. Tools used in infected beds should be dipped in formaldehyde before being brought into contact with healthy plants.

Under no conditions should plants which show lesions of wildfire be set in the field. It is better not even to pull plants from a bed which shows any infection whatever. This, however, is not always practicable.

FIGURE 126. Pulling the plants. After thoroughly moistening the soil, the workers take the tips of the largest leaves in their fingers and pull one plant at a time.

Do not neglect to keep the plants sprayed or dusted all the time.

After the disease is in the leaf it cannot be eradicated by application of spray or dust but it can be prevented from spreading to other plants.

PULLING THE PLANTS

When the stalk of a plant is four to six inches long it is ready to be transplanted to the field. Previous to this move it is best to remove the glass from the beds and leave them open day and night for several days or a week. This hardens the plants and makes them better able to withstand the shock of transplanting. Plants are pulled out singly by taking hold of the tips of the larger leaves (Fig. 126). They should be heavily watered beforehand to make the ground soft and prevent unnecessary breakage of roots. If a leaf breaks when pulled, or a plant does not come out easily, more water is needed. As soon as the larger plants are removed, others grow up and the bed may be pulled every two or three days. In order to keep the plants growing straight, the glass should be replaced after pulling. If the plants stop growing or turn yellow before enough have been transplanted, they should be fertilized again as prescribed in the previous section.

FITTING AND FERTILIZING THE LAND

Since plants usually are set in the field about the first of June, the land should be prepared during May. Some growers prefer to plow in April, especially if there is sod land to be turned under. Others practice fall plowing but it is questionable whether this is worth while unless old sod is being plowed. In that case the sod has a longer time to rot. There is no advantage in plowing to a depth of more than seven to eight inches. After turning the land with a plow, it is thoroughly pulverized with a disk harrow and then with a spike tooth or spring tooth harrow. Just before setting, the surface is leveled with a drag or a plank behind the harrow.

Fertilizer is spread broadcast on the field a week or two before setting and thoroughly mixed with the soil with the disk harrow. The ordinary fertilizer sower or lime spreader is used for applying fertilizer. Application in the row is not commonly practiced here.

SELECTION OF THE FERTILIZER

Until the middle of the last century, barnyard manure from the farms was the only fertilizer used on tobacco fields. But with increasing concentration of acreage and continuous growing of tobacco on the same land, the farm supply of manure became inadequate. Growers began to import manure from New York and other large cities, then to use more concentrated animal and plant residues such as fish scrap, Peruvian guano, tankage, and bone meal; and later, the vegetable meals, cottonseed meal, linseed meal and castor pomace. The earliest source of potash, wood ashes, was succeeded by cottonhull ashes. Then purely mineral compounds, cheaper and containing the plant nutrients in more concentrated form, supplanted the manures and organic materials to a greater extent each year. Manure is still used but the greater proportion of the plant food is now supplied in a mixture of mineral compounds and concentrated organic residues.

Under the conditions of continuous tobacco culture on our usual sandy soil types, it has been found best to use a larger proportion of organic material than is customary for other crops or for tobacco in other regions where it is grown in rotation with other crops. The plant makes most of its growth in six to eight weeks. During this short period it must have an abundant supply of plant food ever at hand in the soil in an easily available condition.

The actual quantity of each of the essential elements to be supplied varies somewhat with the character of the soil, but many experiments and long experience have led to the following general rules for rates and carrier materials:

Nitrogen should be supplied at the rate of about 200 pounds to the acre. On sandy places subject to rapid leaching, it is sometimes necessary to add more of the material later as a side dressing in seasons of heavy rainfall. In heavier, more retentive land, some growers reduce the amount to as little as 150 pounds without detriment. When the supply of nitrogen is too low, tobacco leaves become yellow in the field and, when cured, they are dead, yellow, and non-elastic. They are not only of inferior quality in general, but also the yield is reduced. When there is too much nitrogen, the cured leaves are dark and heavy, and the taste and aroma are not pleasant.

As for the materials in which the nitrogen should be furnished, there is wide diversity of opinion. The larger part of it should come from organic materials; some growers prefer to derive all of it from such sources. Cottonseed meal is used more than any other organic material. Nearly all formulas contain a considerable proportion of it. Linseed meal and castor pomace frequently are added to make up a part of it. Dry ground fish is also an excellent nitrogenous material which is used extensively because its nitrogen becomes available more quickly than that from other organics. It is a common belief that the mixture should contain several sources of nitrogen which will decompose at different rates and thus supplement each other in bringing their supply successively into an available state. Hoof and horn meal is another good organic source of nitrogen. Tankage and dried blood have a reputation for producing dark tobacco and are therefore rarely used here. Peruvian guano was a favorite source of nitrogen a generation ago but went off the market and only recently has become more plentiful.

Of the mineral sources of nitrogen, nitrate of soda has been used longest and most commonly. Recently nitrate of calcium has partly supplanted it. The latter nitrate is at least theoretically preferable because a good supply of calcium is essential for tobacco growing, while sodium is entirely useless. A five-year field test at the Windsor station where the two were compared on adjacent plots showed some advantage in favor of the calcium salt. Nitrate of potash is a third good nitrate form and furnishes the two most important plant foods in a single salt. Formerly very expensive, it has now become as cheap as any other nitrate material on account of its synthetic preparation from air nitrogen. Nitrogen in the nitrate form is ready to be taken into the roots immediately without further change and is therefore frequently used as "starter", and in side dressings for later application. It has the disadvantage, however, of leaching quickly from the soil—especially sandy soil—in seasons of heavy early rains. For this reason only a small part of the nitrogen—not more than one-fourth or one-fifth of the total—should be in this form.

Urea or calurea (a mixture of urea and nitrate of calcium) may be used as a substitute for a part of the organic materials. About one-half of the nitrogen in manure is in the urea form and in early days the crop received large doses. More recently urea has been synthesized from air nitrogen and is now supplied as pure chemical. It is usually a much cheaper source of nitrogen than the organic forms and is more quickly available. It does not leach seriously from the soil.

The ammonia forms of nitrogen are not recommended for tobacco mixtures. Field tests at the Windsor station showed that sulfate of ammonia produced dark tobacco of inferior quality and poor burn. Ammonium phosphate and ammonium nitrate have not been sufficiently tested. The objection to cyanamid is that it makes the soil too alkaline.

Potassium is the second important nutrient element. It is necessary for the proper growth of the plant and also a good supply of it insures a long fire-holding capacity of the leaf. It reduces wilting of the plants during hot days in the summer. Cured tobacco with a sufficient potash content also comes into "case" more readily in the shed and is more pliable and elastic on the bench. About 200 pounds of potash to the acre should be supplied. It does not leach away as rapidly as nitrogen and there is probably never a need of making additional applications during the summer. Yet it leaches slowly throughout the year. As a result there is no great accumulation of potash and it is necessary to apply about the same amount annually.

There is a considerable choice of materials in which potash may be furnished. Sulfate of potash has been used more than any other since the beginning of the present century. It falls short of being the ideal form in that it increases somewhat the percentage of sulfur in the leaf and thus reduces the fire-holding capacity. But this objection is usually not very serious because of the limited capacity of the tobacco plant to absorb sulfur. Sulfate of potash-magnesia (double manure salts) has been used to some extent and has the advantage of containing magnesia, an essential to the production of good burn. Its disadvantages are: First that it contains only about one-half as much potash as the high grade sulfate; and second, it contains twice as much sulfate in proportion to the potash supplied. It is somewhat more expensive per unit of potash than the high grade sulfate.

Nitrate of potash is an excellent source of potash because it contains no residues that may be objectionable if accumulated in the soil or taken into the plant. It is now as cheap as other sources of potash when allowance is made for the nitrogen it contains. The amount which can be used in the formula is limited by the quantity of nitrate that one wishes to use.

Carbonate of potash was originally supplied in wood ashes. The use of large enough quantities of wood ashes to furnish the requisite amount of potash for tobacco is undesirable because it makes the soil alkaline. Wood ashes may be used in small amounts, however, Cottonhull ashes also contain potassium in the carbonate form and in much higher percentage than wood ashes. At the close of the last century this material was a favorite source of potash but later it disappeared from the market. In recent years the supply has been renewed and is now used with satisfactory results by many growers. The magnesia which it contains (about 5 per cent) increases its value. Pure carbonate of potash is also a good

potash material which is used with success. It is now more expensive than carbonate in the form of cottonhull ash.

Tobacco stems are perhaps the ideal source of potash since it is safe to assume that they contain all the other elements which the growing plant needs as well. In a finely ground condition (residue from nicotine extraction) they may be mixed directly with the other ingredients of the formula. They are also much used in the unground condition (long stems) in which case they are spread directly on the soil with a pitch fork.

All of the organic materials mentioned above as sources of nitrogen also contain small percentages of potash which is readily available to the plant.

Muriate of potash is never used in Connecticut because the chlorine is greedily absorbed by the plant and injures the burn.

It is a good practice to get the potash from several carriers in the formula rather than from one.

Phosphorus is needed only in very small amounts by the tobacco plant. Less than seven pounds (15 pounds phosphoric acid) is taken up by an acre of tobacco. Since more than that amount is supplied in the nitrogenous organic materials (a ton of cottonseed meal contains 50-60 pounds) and since additional carriers of phosphorus are commonly added, such as various forms of bone, phosphorus accumulates in old tobacco soils. It does not leach away. Consequently fields which have had tobacco on them for five years or longer rarely respond to further application of phosphorus. Such applications only serve to build up the over-supply and represent wasted money. New lands may require phosphorus and it is advisable to add it. There are no very convincing experiments recorded to guide us in making recommendations in this case, but arbitrarily 100 pounds is assumed to be adequate. Otherwise it may be omitted entirely.

Magnesium is the fourth element which must be considered though it does not always have to be supplied on all lands. This is an essential constituent of chlorophyll and if the supply is inadequate, the leaves of the plant lose their green color, exhibiting the chlorotic symptoms known as "sand drown". Such tobacco is very poor in quality when cured. A second function of magnesium which is important in cigar leaf is to promote the burn. If the supply is poor, the cigar burns with a black or dark gray ash and the taste and aroma are unpleasant. With increase of magnesia the ash is correspondingly whiter and the taste and aroma are improved. However, care must be taken not to add too much magnesia else the ash will have an undesirable "flakiness".

With respect to the quantity of magnesia to be applied, the grower must be guided by the burn of the tobacco which is produced on a field. If the ash is satisfactory, it is not necessary to increase the magnesia supply. If it is inclined to be dark, however, magnesia must be added. About 75 pounds to the acre applied annually should keep the burn good. If the ash gets flaky the application may be omitted for a while or may be reduced. If it is too dark the dose may be increased.

Magnesian ground limestone, or hydrated lime, is perhaps the most economical and convenient material with which to meet the magnesium requirements. It should analyze as high in magnesia as can be obtained. Limestone with an MgO content up to 20 per cent and hydrated lime of 30 per cent are easily obtainable. If the material is to be mixed with the other ingredients, the ground limestone is better because of danger of liberating the ammonia from other materials when caustic lime is present.

Double manure salts have already been mentioned as a source of magnesia. Cottonhull ashes contain about 5 per cent. The percentages in other ingredients are given in Table V (page 810).

MIXING THE FERTILIZER

The grower may either purchase the materials and mix them at home or he may purchase ready mixed fertilizer. The principal argument in favor of home mixing is that it is less expensive. The amount saved varies with the kind and quantity of mixture and terms on which one is able to buy, but a saving of $10 to $25 an acre is not unusual. A second argument favoring home mixing is that it enables one to change his formula according to variations in his fields. Every grower learns by experience that different fields, or different parts of the same field, respond differently to the same fertilizer treatment. By mixing his own fertilizer he can easily adapt the mixture to his land. A third advantage is that he always knows just what goes into his mixture and on his soil.

The first argument against home mixing is the labor and time involved. Growers who have had long experience state that the labor does not cost over $1.00 a ton. Some find that it costs them nothing, because they mix it either in winter or on rainy days when the help would otherwise be idle. For the grower who raises only a small "patch" of tobacco, home mixing is not worth bothering about, but the larger grower can find no easier way of cutting down costs.

Another objection sometimes heard is that the farmer will not mix his fertilizer as thoroughly as does the machine. This may be literally true, but it has been demonstrated thoroughly on thousands of acres of good tobacco that the farmer can mix it well enough to suit the tobacco plant. Any farmer who can read and follow the directions given below can mix a fertilizer on which tobacco will grow as well as on machine-mixed products.

Many farmers hesitate to mix their own fertilizer because they do not know how to make up the formula. The following simple principles for making a formula, together with Table V, showing the percentage of plant food in each good material, will enable any grower to make his own.

Principles to be Followed in Making the Formula

1. Figure pounds of *plant food* per acre. Pounds of mixed fertilizer per acre mean nothing to the plant.
2. An acre of tobacco should receive 200 pounds of nitrogen and 200 pounds of potash. For new land, about 100 pounds of phosphoric acid should be used. For old tobacco land, phosphoric acid is not important.
3. About two-thirds of the nitrogen should be from natural organic carriers: Cottonseed meal, castor pomace, linseed meal, fish, etc. The other third may be taken from such sources as nitrate of potash, nitrate of soda, nitrate of lime, urea, or calurea.

4. It is better to derive each food element from several sources rather than from one.
5. Avoid all compounds containing more than 2 per cent of chlorine as far as possible.
6. The sulfur content should be kept as low as is practicable.
7. The mixture should contain a minimum of 25 to 30 pounds of magnesia per acre, and where a better ash is desired, as much as 75 pounds.
8. There is no one best formula. There are many good ones.

Method of Mixing

No special apparatus is necessary for mixing. A level floor of a barn or shed is convenient. Mix in one-acre batches. Spread the cottonseed meal, or other material of which there is the largest amount, in an even layer on the floor. On top of this, spread an even layer of each material in turn. Break up any large lumps. Now shovel the whole mixture into a high pile at one end of the floor taking each shovelful from the bottom of the pile and throwing it directly on top of the new pile. Then shovel this new pile to the other end into another pile. Next shovel it back through a sand-screen or other coarse-mesh screen. The screen removes lumps and at the same time makes the mixture more intimate. It should now be ready to bag, but if it does not appear uniform, it may be shovelled until it does.

Materials which may be used in tobacco mixtures with their approximate average analyses are listed in Table V (page 810).

As an example of how the formulas may be built:

I.

	Nitrogen	Phosphoric acid	Potash	Magnesia
1500 pounds cottonseed meal	102	45	30	10.5
500 pounds castor pomace	27	10	5	4.
100 pounds calurea	34			
300 pounds nitrate of potash	37		132	
100 pounds precipitated bone		38		
125 pounds double manure salts			33	14.
	200	93	200	28.5

Other examples:

II.	III.
1200 pounds cottonseed meal	1500 pounds castor pomace
300 pounds linseed meal	1000 pounds cottonseed meal
400 pounds castor pomace	200 pounds nitrate of lime (or soda)
100 pounds fish	100 pounds nitrate of potash
100 pounds urea	150 pounds double manure salts
200 pounds nitrate of potash	100 pounds ammophos
200 pounds cottonhull ash	100 pounds precipitated bone
100 pounds bone meal	200 pounds sulfate of potash
100 pounds sulfate of potash	

These formulas assume that no other source of magnesia has been used. When heavy applications of stems or manure are made, it is not necessary to use such carriers of magnesia as double manure salts. This can also be supplied very cheaply in limestone. If analysis of the limestone, for example, showed it contained 20 per cent of magnesia, 200 pounds per acre would be sufficient.

Some growers prefer an all-organic mixture. For these, some such mixtures as the following are favored:

2500 pounds cottonseed meal
400 pounds fish scrap
600 pounds cottonhull ash

or

2000 pounds cottonseed meal
2000 pounds tobacco stems
300 pounds hoof and horn meal
200 pounds cottonhull ashes

Such formulas will grow excellent tobacco but are bulky and ordinarily more expensive than formulas in which a part of the nutrients is supplied in minerals.

FIGURE 127. Setting the plants in a shade field. This transplanter makes the furrow, drops about a pint of water where each plant should be placed and draws the earth up around the plants.

SETTING THE PLANTS

The best time to set the stalk-cut tobacco is from the first to the twentieth of June. Shade tobacco is usually set a little earlier, beginning about May 20. The usual distance between rows for Havana Seed and Shade is 40 inches, while Broadleaf is usually 42 to 44 inches. Sometimes Shade is set as close as 36 inches (10 rows between poles). In the row, Shade plants are set 12 to 14 inches apart, Havana Seed 17 to 19 inches, and Broadleaf 20 to 27 inches apart.

A transplanting machine (usually "Bemis" or "Tiger") drawn by two horses makes the furrow, deposits about one-half pint of water where each plant is placed and then draws up the soil around the plant (Fig. 127). By means of this machine, operated by one driver and two "droppers", two or three acres per day may be set. Two-row tractor-drawn setters are now used with satisfactory results by a few growers. The plants should be set into the ground as deeply as possible without covering the bud ("chit"). Plants set late in the afternoon start better because they do not suffer so severely from the wilting of the first day and have an opportunity to start new roots during the first night.

A small amount of nitrate of soda (about one to two pounds per barrel) is sometimes dissolved in the water of the setter barrel to give the plants a quick start. Under the usual conditions of heavy fertilization however, the value of this practice is questionable.

RESTOCKING

Even under the most favorable conditions for setting, some of the plants will die. It is essential that the grower go over his field within a few days after setting and replace all plants which have failed to establish themselves. If this is delayed too long the "stand" is uneven and the restocked plants do not mature as soon as the others. Since all are harvested at the same time, the restocked plants will be immature and when cured will not be of as good quality. It is therefore important that the field be restocked as soon as possible after setting in order to minimize such differences in the age of plants. This operation should be repeated every two or three days until there are no missing plants.

In restocking, a hole is dug with a hoe or with a dibble and the plant set in by hand with about a half-pint of water. If this can be done during rains, it is not necessary to add the water, but it is not wise to wait too long for rain.

Cutworms and wireworms kill many plants at setting time and shortly afterwards and are the principal causes of poor stands and considerable restocking.

Since cutworms may be expected every year, control measures should be adopted as one of the routine operations of each season. Directions for control are presented below. Wireworms, on the other hand, are of more local and occasional occurrence and are discussed under the chapter on insects (see page 794).

CONTROL OF CUTWORMS

Cutworms are rather easily controlled by the use of poison baits. The most commonly used poison is Paris Green. Arsenate of lead has been used to a less extent and is probably just as effective and less likely to cause burning of the leaves. The poison must be mixed with some carrier which will be attractive to the worms.

The poison mixture may be applied to the field several days before the plants are set and thus kill the worms before they have an opportunity to destroy the plants; or it may be applied after setting. The former method seems to be more logical but the latter is more commonly followed.

Poisons Used Before Setting

For application previous to setting, the following mixture has been used successfully:

Bran (1 bag)	100 pounds
Paris Green	3 to 5 pounds
Oranges or lemons	½ dozen
Cheap molasses	4 quarts
Water	about 15 gallons

The amount of water to be used must be determined by the condition of the mixture. Enough must be added to make the bran stick together in small lumps so that it can be broadcast by hand but not enough to puddle it. The bran and Paris Green are first mixed thoroughly in a dry condition by shovelling them over on a floor or in a box just as one mixes fertilizers. The oranges are squeezed and cut into small pieces and mixed with molasses and water. After thorough stirring, the sweetened water is sprinkled over the bran and poison mixture while it is being shovelled over so that it will mix thoroughly. Several days before setting the plants this mixture is scattered broadcast over the field at the rate of 25 to 50 pounds dry weight to the acre. This should be done late in the afternoon or in the evening in order that it may be in a moist condition during the night when the worms are out.

Recent experiments in other tobacco sections throw some doubt on the attractive value of such substances as molasses and oranges. In Farmers' Bulletin 1494, issued by the United States Department of Agriculture the following mixture is recommended as being just as effective:

Bran	100 pounds
Paris Green	2 pounds
Water	enough to moisten

Method of mixing and application to the field late in the day, just the same as mentioned above, are recommended. Neither Lead Arsenate nor Calcium Arsenate is found as effective as Paris Green, according to this bulletin.

Poisons Used at Time of Setting

For application at time of setting or directly afterwards the following mixtures have been used successfully for years by good growers and are recommended:

(1) 100 pounds of cottonseed meal
2 pounds Paris Green
2 quarts molasses

Mix as described above and spread by hand directly over the row immediately after setting at the rate of about 75 pounds per acre. It is

argued by the advocates of this method that the cottonseed meal is not wasted since it has a fertilizer value for the young plants.

(2) 100 pounds fine hominy
1½ pounds Paris Green

Mix thoroughly in a dry condition. Use no water or molasses. Apply beside the plants in the row (not on the leaves) by means of a tin can "shaker" (Fig. 128). Make holes in the bottom of a two-quart can and fasten the can to a stick about two feet long. One vigorous shake near each plant is sufficient. The mixture should be applied immediately after setting and if a later brood of worms emerges the measure should be repeated.

FIGURE 128. Control of cutworms. Application of poison bait in the rows with "shaker" cans.

3. Some growers prefer to use the same mixture as No. 2, but with less Paris Green, and shake it directly on the plants. If this method is to be used, it is safer to substitute two to three pounds of arsenate of lead for the Paris Green, or for a part of the Paris Green.

Paris Green Injury

When Paris Green comes in contact with the leaves accidentally or intentionally, it frequently produces irregular dead brown spots. This may at times be so serious that it kills the leaves. Since most of these first leaves die before the plants get started anyway, the loss is not important.

CULTIVATION

As soon as the plants have become established—a week or ten days after setting—the cultivator should be started. The field should be tilled about once a week as long as it is practicable to drive a horse between the rows without breaking the leaves. Various types of cultivators are used—one-horse (Fig. 129), two-horse, riding cultivators, etc.,—but the principles are the same. The first cultivation should be with narrow shovels—one and one-half to two inches—set deep, to loosen as much soil as possible, and the inside shovel should be set as close to the row as can be done without covering or dislodging the plant. When the roots begin to spread, after about the second cultivation, it is best not to dig so deeply near the plant but to practice more shallow cultivation and keep further away. Broader shovels ("sweeps") may now be used and the soil gradually worked up toward the rows. This "ridging" practice is used more

FIGURE 129. One horse cultivator used for working the fertilizer side dressing into the soil. During early growth tobacco should be cultivated once a week.

under cloth than in the open, and during wet years than during dry years. The additional soil thrown against the base of the stalks enables them to produce brace roots which help support the stalk and keep it from toppling over during storms.

The Prout hoe is used to good advantage for ridging and for shallow cultivation during the later operations.

The rows are hoed with hand hoes about twice during the season, once after the first cultivation and again two weeks later. The object is to break up the soil between the plants in the row and to destroy weeds.

FERTILIZER SIDE DRESSINGS

Should all the fertilizer be applied to the field before setting or should some of it be "held out" and applied as a side dressing between the rows while the crop is growing? On this question there is considerable diversity of opinion and of practice. During heavy rains, nitrogen—and other elements to a less extent—leaches out of the soil into the drainage water. Hence there is danger that tobacco plants may suffer and stop growing because there is not sufficient nitrogen. It is common knowledge that the best tobacco is produced when it grows continuously without any periods of checked development. The only reason for using later side dressings is to replace the plant food which has been lost. During dry years, or years of moderate rainfall, this loss does not occur. It is more pronounced

FIGURE 130. Cultivating in the shade tent with three Prout hoes drawn by a tractor.

on sandy soils, especially where the subsoil is of a sandy or gravelly porous nature. Obviously the benefit to be derived from later applications depends first, on the amount and distribution of the rainfall, and secondly, on the character of the soil. Therefore, it is not possible to lay down any rule of procedure which will apply in all cases. Different seasons and different soils call for different treatments.

At the Experiment Station farm, tests of five years failed to show that there was any advantage in later applications. But on the sixth year—the unusually wet year of 1928—the reverse was true and the benefit was evidenced by increased yield and better quality where side dressed.

Side dressings, however, may be detrimental to quality and should be practiced cautiously and only when there is little doubt of the necessity. When a new supply of nitrogen becomes available too late in the development of the plant, the tobacco enters another period of active vegetative growth at the time when it should be maturing. This results in green and dark leaves when cured.

Probably the best rule is: Broadcast all the fertilizer which should be needed by a normal crop in a normal year before setting. Then if the rainfall of the growing season becomes excessive, apply some quickly available nitrogen, especially to those fields or parts of fields which are known to be "leachy". For best results, it is essential to side dress immediately after the hard rain and *before* leaves show the yellow cast which indicates nitrogen starvation. If applied by hand, the fertilizer may be worked in between the plants with a hoe. Where the customary "wheel barrow" drill (Fig. 131) is used, it may be worked in with a cultivator.

Fish meal, nitrate of soda and cottonseed meal are most commonly used for this purpose. Nitrate of lime, calurea, or urea may also be used to

FIGURE 131. Wheelbarrow fertilizer sowers are used for the application of fertilizer between rows of growing plants.

good advantage. These more concentrated materials should be mixed with some other substance like cottonseed meal or linseed meal in order to get a better distribution in the wheelbarrow sower. The following mixtures are only a few of many good ones that may be used:

Material	Per Acre
Nitrate of lime	200 pounds
Cottonseed meal	300 pounds
Nitrate of soda	200 pounds
Linseed meal	300 pounds
Fish	400-500 pounds
Calurea	100 pounds
Cottonseed meal	300 pounds

Fish	100 pounds
Nitrate of lime	100 pounds
Cottonseed meal	300 pounds

The quantity per acre may be varied according to the grower's judgment of the needs of the crop.

TOPPING AND SUCKERING

With respect to these two operations, there is a marked distinction between shade tobacco and the out-door or stalk tobacco. The latter should be topped at about the time that the first blossoms open. There is considerable difference of opinion among growers as to the amount of

FIGURE 132. Wilting Havana Seed tobacco in the field.

top which should be removed. In tests at the Experiment Station the best results were obtained when the tops were removed to about three or four leaves before the first spike sucker, (the lowest sucker which has no leaves on it). The tops are broken off by hand with a sudden side twist. Ordinarily there is a period of about two or three weeks between topping and harvesting.

After removal of the tops, lateral shoots (suckers) grow out from the axils of the upper leaves. These must be removed once or twice before the harvest, the last suckering immediately before. If the period between topping and harvesting is long, and the suckers are removed only once, they become very large and tough and come off with difficulty at the risk of breaking leaves on the plant. It is better to remove the suckers twice even though it involves more labor and causes the second crop of suckers to grow lower on the stalk.

One of the immediate effects of topping is to make the stalk stiff and more resistant to blowing over during storms. In order to hasten this stiffening process by a few days, some growers prefer to remove the flower bud as soon as it appears and the full top later when the suckers begin to grow. This process is called "budding".

The usual practice under shade is to "bud", as described above, but to omit any further topping or suckering.

FIGURE 133. Spearing Havana Seed tobacco.

HARVESTING

The two methods of harvesting will be described separately.

STALK CUTTING

This method is used on all the Broadleaf and almost all of the Havana Seed plants and the operation is performed with a specially made tobacco hatchet. Holding the stalk with his left hand and pushing it over slightly the workman severs it just at the surface of the soil with one clean slanting cut. The plants are then allowed to lie on the ground for an hour or two until the leaves are wilted and limp. During hot clear days one must be careful not to let the cut tobacco become "sunburned" or scorched. Such tobacco never cures out.

Next the plants are strung on four-foot lath by means of a steel spear head which slips loosely over the end of the lath (Fig. 133). The stalk is speared about six inches above the point where it was cut. Six plants on an average are hung on one lath. If they are large, five to a lath is better. When very small, more plants may be put on each lath. Since it requires a considerable "jerk" to force the spear through the stalk, the opposite end of the lath must be solidly supported. This may be done by setting the lath upright in the soil or more often, the opposite end of the lath is supported on a "stringing horse" (Fig. 133) which is specially constructed for this purpose and which the operator drags along with him. After removing the spear head, the lath of plants is transferred to a wagon rack (Fig. 134) where it is supported between two poles set about 44 inches apart and with the plants hanging upside down. A practice employed by many good growers is first to hang the lath of tobacco for a

FIGURE 134. Drawing Havana Seed tobacco to the curing shed.

few hours in the field on racks called "hurdles" (Fig. 135). This wilts the tobacco better and hastens and improves the cure. From the hurdles it is drawn on the wagon racks to the curing sheds.

The construction and dimensions of the curing shed vary. The usual type has a width of 32 feet, a length of some multiple of 16 feet, a height of about 16 feet at the eves and has a shingle ridge roof. The sheds are divided by the supporting posts into "bents", or sections, 16 feet square. Four of these squares furnish adequate space for hanging an acre of stalk tobacco. The size of the shed is designated by the number of bents on each side. For example, a shed 160 feet long is a 10-bent shed but actually contains 20 square bents. Such a shed is also commonly referred to as a five-acre shed. The sides of the sheds for stalk cut tobacco are made of vertical pine boards, an inch thick and 12 inches wide with each third board on hinges so that it may be opened wide for ventilation. Some growers prefer to hinge the boards at the top and let them swing out from the bottom. Most shade sheds have horizontal side boards which are hinged so that they swing upward and there is a ventilator board between each tier of leaves. (Fig. 136). The gables are also supplied with ventilator doors to allow air currents to blow lengthwise through the shed. Large swinging doors at both ends of the sheds permit the wagons to be driven through the length of the shed on either side. Raised ridges or metal ventilators of various types on the ridge are frequently added to allow upward currents of air during curing.

The poles on which the lath of tobacco are hung are 16 feet long and spaced 4 feet apart from center to center. There are usually three tiers of poles one above the other in the main body of the shed and one tier in the peak. Space between tiers is about five feet. The lath are placed on these poles about seven to eight inches apart depending on the size of the tobacco and the method of curing to be used. Larger tobacco should

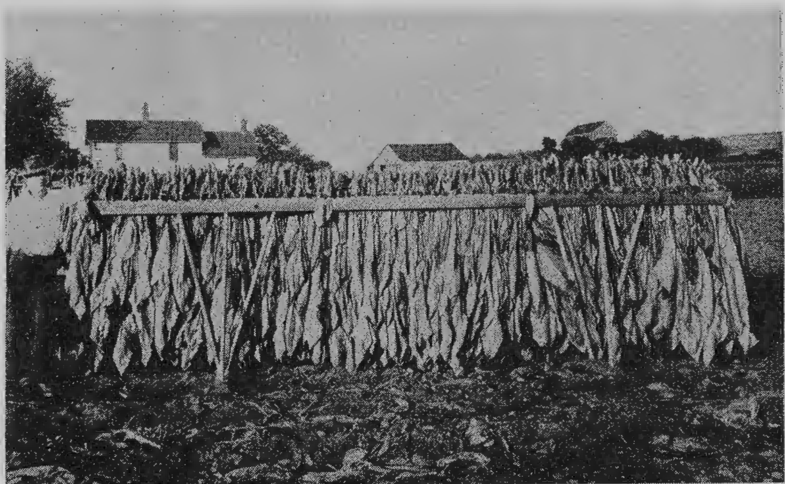

FIGURE 135. Havana Seed tobacco on a hurdle.

be hung farther apart. Closer setting of the lath may be practiced when the tobacco is to be cured by fire. For hanging shade leaves, the tiers are two and a half feet apart instead of five feet.

PRIMING

All shade tobacco is harvested by priming, i.e., picking the leaves from the stalks. A small percentage of Havana Seed is also harvested in the same way. Since the lower leaves mature first, they are picked off first. About four leaves are picked at each priming and the process is repeated on an average of once a week but the interval between primings depends on the stage of maturity of the leaves as judged by the experienced grower. Boys pass between the rows, pick the leaves and deposit them in piles in the rows. Another set of boys draw large canvas baskets between the rows and collect the leaves which are then drawn to the curing sheds. Here they are "sewed" on four foot lath by girls and women. Each end of the lath has a saw notch about one-half inch deep. The string on which the leaves are to be sewed is fastened by drawing it into this notch and

then winding it two or three times around the end of the lath. The leaves are placed in pairs—back to back—and the needle is passed through the midribs about an inch from the base. Twenty to twenty-two pairs of leaves are sewed on each lath. The lath are then hung on the poles just as in the case of stalk cut tobacco except that in the shade barn the tiers are only one-half as far apart and also the lath are crowded together closely on the poles.

FIGURE 136. Curing shed with partly harvested field of Broadleaf in foreground. The plants are cut down and laid on the ground to wilt.

CURING

During the time that the tobacco hangs in the shed, the color of the leaves changes from green to brown and there is a loss in weight of about 80 per cent, mostly in water. The drying—evaporation of water from the leaves—however, does not constitute curing; in fact it is merely incidental to the process. The essential part of the curing is a series of chemical changes in some of the compounds which make up the leaf, internal changes which transform raw, bitter, bad smelling leaves into mild, fragrant tobacco. For these processes to occur to the best advantage it is necessary that the cells remain alive for a considerable period and a certain amount of moisture be present. If the leaf is dried too rapidly ("hayed down"), the cells die, the leaf remains green, and curing does not take place.

Chlorophyll, the green coloring matter of the leaf, must be completely broken down, at which stage the leaf becomes yellow. Starch, which is abundant in the mature green leaf, is first transformed into sugar. Then the leaf, in an effort to prolong life as long as possible, burns up the sugar and respires the decomposition products as carbon dioxide and water. Next some of the nitrogenous compounds are broken down. Other chemical changes are taking place at the same time. Certain mineral salts must also have time to crystallize out as the small pebbles which constitute the grain of the leaf. If drying is too rapid, these crystals are not developed and combustion of the tobacco is adversely affected.

On the other hand, if the curing is prolonged for too long a time the leaf becomes darker in color and also is exposed for a longer period to the danger of pole rot and other curing troubles. There is then an optimum rate of cure, at which the above mentioned chemical changes take place to the best advantage and the fullest extent, and at which curing troubles are least dangerous.

Temperature and humidity of the air are the most important factors in determining the rate and character of the cure. Up to a certain point we may say that the higher the temperature, the more rapid and the better the cure. According to experiments at the Windsor Station the optimum temperature lies between 85° and 95° F. But the temperature alone cannot be considered without reference to humidity of the air, which is of at least equal importance. A high temperature, with low humidity maintained for any considerable period of time, causes too rapid loss of water from the leaf with consequent "haying-down", i.e., the leaves become dry while still green. A low temperature with high humidity, or even a high temperature with too high humidity, causes slow cure, dark colors and danger of curing disorders. Johnson found that under Wisconsin conditions, the percentage of relative humidity should correspond roughly numerically to the temperature as expressed in degrees Fahrenheit. For example with temperatures of 75°, 85° or 95° F, one should have respectively relative humidities of 75, 85 or 95 per cent. In Connecticut, working with shade tobacco, Street has found that better colors and quality are produced by somewhat lower corresponding degrees of humidity. Numerically the humidity percentage should be about 10 points below the temperature, for example with a temperature of 90°, the humidity should be 80 per cent.

Under actual shed conditions where no effort is made to control temperature and humidity artificially, there are naturally wide fluctuations in both of these factors. In clear weather the temperature falls at night and the humidity rises, while the reverse is true during the day. Atmospheric changes follow those of the outside air but do not swing in quite as broad a range. The temperature at the top of the shed is usually higher and the humidity lower, which accounts for the fact that during dry seasons the tobacco in the peak "hays down", while in bad pole sweat years the best tobacco is from this section. During prolonged rains conditions are static and the humidity may remain at 95 to 100 per cent for a sufficiently long period to cause serious pole sweat, stem rot or other disorders.

During the process of curing, there are three stages which are distinguished by differences in color of the leaf: (1) the green stage, during

which the leaf should wilt, (2) the yellow stage and (3) the brown or final stage. These are not sharply defined but in point of time they always follow in the order named. However, the leaves in a shed or on the same plant are not usually in the same stage at the same time. The lower leaves go through the stages more rapidly than the upper leaves, the tips more rapidly than the butts, and the more mature leaves before the less mature. Sometimes all three stages may be seen on the same leaf.

"Pole sweat" is the name commonly used in Connecticut to designate the various types of leaf rot which occur during curing. This disease is described more completely on page 784. "Stem rot" is the term used to designate a condition in which the midrib of the leaf becomes soft and rotten. This may progress to the point where the leaves actually fall from the stalks in the shed. Pole sweat appears during the late yellow stage and especially just when the leaf is turning from yellow to brown.

FIGURE 137. A row of curing sheds on a shade plantation.

At this critical stage moisture must be regulated to prevent pole sweat. The disease is especially favored by prolonged periods of high humidity, 95 to 100 per cent. At such times, water often collects in drops on the surface of the leaves, an ideal condition for infection.

The original method of curing was to hang the tobacco in the shed and trust all to the weather until time to take it down. This gave a successful cure during some seasons but was disastrous during others, especially when the weather was not so favorable. The weather outside cannot be changed but certain practices may be employed to modify the humidity and temperature inside the shed so that they may more nearly approach the desired optima.

Correct construction and manipulation of the sheds are of immense benefit here. The sheds should be tight but provided with ventilators which may be closed or opened as desired, as previously mentioned. During the curing of tobacco from one acre, about five tons of water must pass out of the shed into the air. The larger part of this goes out during the first ten days. With sufficient ventilation and air movement this can be accomplished easily in favorable weather. During rainy weather, however, the air is saturated with moisture and is less effective in evaporating moisture. Drops are likely to come to the surface and remain on the leaves. If this happens during the critical stages for pole sweat infection, some method of evaporating the water must be used. In good weather at this stage it is well to keep the ventilators open in daytime. On the other hand sometimes, especially in the later stages of the cure, the loss of water may be too rapid and it is better to open the ventilators during the night and close them during the day in order to keep up the humidity.

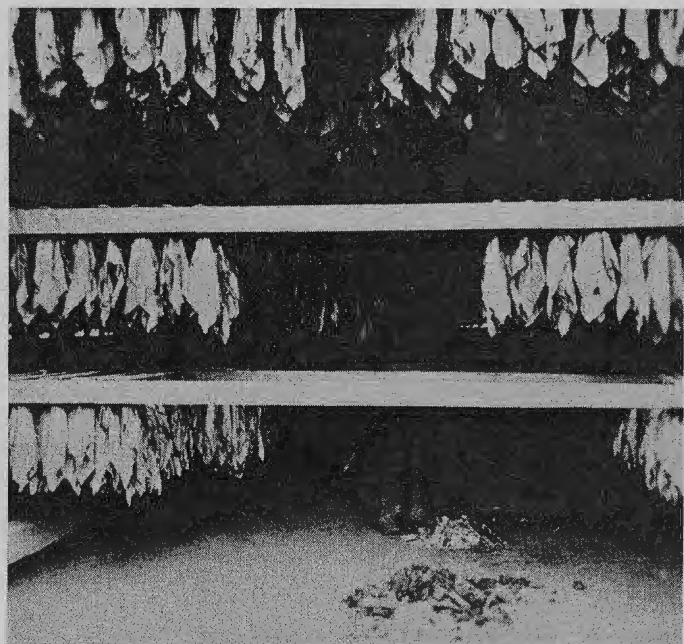

FIGURE 138. Curing shade tobacco. Note charcoal fires on the floor.

Nearly all growers of shade tobacco, and some growers of out-door tobacco, use charcoal fires to raise temperature and lower humidity. Thus they are able to approximate conditions that are optimum for wilting, for acceleration of chemical changes involved in curing and for prevention of pole sweat.

The fires are made in holes about 10 inches deep by 10 inches in diameter dug in the soil of the shed floor. From two to six fires to each bent of 16-foot square are used. Growers differ in their opinions as to the best number of fires. If a larger number is used the heat is better distributed. In this case more labor is required in tending the fires and each fire must necessarily be smaller to avoid raising the shed temperature too high. Thermometers are hung in the middle of the bents

so that the operator may keep the temperature between 85° and 95° F. It is important that no tobacco be hung directly over the fires in the first tier. A good method of hanging the first tier is to leave out the second run from each side through the whole length of the shed. This allows room for the fires and free walking space for the operator. The fires may be started by pouring a little kerosene or denatured alcohol over the first charcoal before igniting. More charcoal is added as the temperature dictates.

In firing to wilt, the fires are started immediately, or within a day or two after the shed is filled with tobacco, and continued for 48 to 72 hours, or until the leaves are well wilted. The experienced operator regulates his firing by watching the condition of the leaves. If the tips become stiff while they are still green or yellow, firing has continued long enough and he lets the fires die out. After three or four days the leaves have become damp again and shade growers frequently fire a second time but for a shorter period.

Later firings are not necessary except to prevent pole sweat. If the weather stays damp for two or more days in the critical stage of curing,

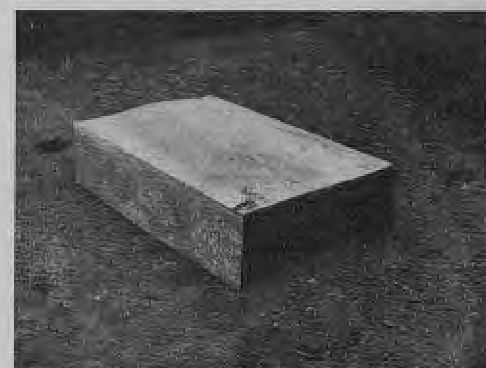

FIGURE 139. Metal fire cover, set over the fires in the curing sheds to distribute the heat.

and especially if there are drops of water standing on the leaves, the fires must be started again and continued until the surfaces of the leaves feel dry. Pole sweat first becomes evident by the "strutting" of the midribs and small brown spots on the leaves. One should not wait until these symptoms are present because it is then too late to prevent infection. If this has already occurred, however, it is best to fire at high temperature and low humidity until the leaves are entirely cured. Moderate firing at this time will only make conditions more favorable for development of the trouble.

Sometimes it is advisable to fire after the web of the leaf is cured but the midrib is still uncured. This is to prevent stem rot.

Metal spreaders are frequently used over the fires to disperse the heat and to keep the leaves directly above the fires from scorching. Spreaders are of various construction. A simple, cheap, but entirely adequate one is shown in Fig. 139. It is made from a piece of No. 22 galvanized sheet iron 32 by 30 inches in size. A 7-inch piece from each end is bent down at right angles.

The quantity of charcoal consumed varies naturally with the character of the season. If the grower has at hand 50 bushels to each acre, it should be sufficient.

Processed charcoal—such as Ford Briquets and Eastman Charkets—are used by some and certain advantages are claimed for them. Comparative tests with these are described in the annual reports of the Tobacco Substation for 1932 and 1933. They are more expensive than the ordinary charcoal. Coke has also been used successfully for this purpose (Report of Tobacco Substation for 1930). Coke requires a special burner.

It is generally agreed that alternate periods of drying and moistening are better than a continuous dry condition. This gives opportunity for the pigments to diffuse thus making the colors more uniform. Also chemical changes can continue to operate only when the leaves are damp.

TAKING DOWN, STRIPPING, BUNDLING

A month or more after harvesting, when the leaves are thoroughly cured and there are no more green midribs, they are taken down and put into bundles during a "damp". The leaves contain mineral salts and therefore absorb water when the air is saturated with moisture. After a few hours they become soft and pliable and may be handled without danger of breaking. The lath of tobacco may now be removed from the poles and piled on the ground in such a way that they will not dry out for several days even with the return of sunny weather. Primed or shade tobacco is laid so that only the lath themselves are on the outside, exposed to the air, while all the leaves are massed together inside so that they do not dry out quickly.

When stalk tobacco is removed from the poles, the lath are first laid in piles in the shape of wheels where the plants extend toward the center and overlap, while the wooden lath and stalk butts form the periphery. Next, the stalks of tobacco are stripped from the lath and laid in piles with the tops overlapping and the butts extending outward. This pile may be covered with burlap, stalks or other materials to prevent drying. The strippers may now work several days without danger of the tobacco becoming too dry. The tobacco should not be kept in piles too long however, else it will heat and become tender. For the same reason the piles should not be too high.

Holding the stalk in his left hand, the stripper pulls off the leaves beginning at the base of the stalk, with his right, keeping the butts of the leaves even. When he can hold no more leaves in his hand he passes the handful of leaves to the man who does the bundling. Box presses with foot clamps specially constructed for this purpose are used. After placing four heavy strings in the box, it is lined with heavy Manila paper which will be used to wrap the bundle. The leaves are laid in two parallel piles on the paper with the tips overlapping and the butts to the outside (ends) of the bundle. Thirty to fifty pounds are thus packed into each bundle. The foot press is applied and finally the loose ends of the paper are folded over the top of the bundle and the strings are tied as tightly as possible.

The tobacco is now ready for market.

COVER CROPS

Tobacco is a fast growing crop, occupying the land for only two or three months out of the twelve. For several reasons the fields should not be left uncropped and bare during the other nine or ten months. During its season of development tobacco needs an abundance of food and the grower is lavish in his application of fertilizer. But when the crop is removed there remains a large unused surplus, part of which may be lost by leaching, washing or blowing of the soil or by reversion into difficultly soluble compounds within the soil. By sowing a cover crop immediately after the harvesting of tobacco, the greater part of this surplus will be used by the growing plants, and when the cover crop is turned under to decay the next year, the nutrients will be liberated in a form highly available for the next tobacco crop. The first benefit of the cover crop then is in the conservation of plant food. In lysimeter experiments at Windsor it was found that a cover crop of oats prevented the leaching of 56 pounds of nitrogen, 44 pounds of calcium, 24 pounds of potassium and 8 pounds of magnesium to the acre in one year.

The turning under of a cover crop each year also maintains the humus content of the soil. Humus makes the soil more retentive of moisture and plant nutrients.

Cover crops prevent blowing of the soil. Most of the tobacco fields are sandy and loose. In dry, windy weather, if they are bare, as much as an inch of soil may be removed from the surface and deposited elsewhere like snowdrifts. There is necessarily a loss of some of the well fertilized soil which is not always re-deposited where it will be useful to the owner for the next crop. The large amount of dust in the air during windy periods is disagreeable and particularly irritating to the housewife who wishes to keep her house above reproach. Such blowing can be largely prevented by proper use of cover crops.

Cover crops prevent washing away (erosion) of the soil. When the fields are hilly, or even rolling, there may be considerable loss of plant nutrients and of the fertile soil itself through the washing out of gullies. The bare subsoil never produces as good tobacco. Furthermore additional time and labor is frequently necessary to level the land again in spring. The roots of the cover crop hold the earth in place and prevent such losses.

The maximum benefit from cover crops is obtained when they are sowed immediately after harvesting the tobacco. At that early period the soil is warm, the soluble nitrates are most abundant and therefore the danger of loss is greatest. Also the seed germinates more quickly and the plants make better fall growth.

A considerable number of species of plants may be used for cover crops. Theoretically, the legumes seem preferable because they not only conserve the plant food already in the soil but add nitrogen of the air. In practice, however, they are not commonly used. There are two objections to them. They start rather slowly and therefore do not make enough growth in the fall. Secondly, most of them are quite susceptible to winter killing when sowed at this time of the year. In experiments at Windsor, vetch has had a tendency to make the following crop of tobacco dark. On account of its growth habits alfalfa does not cover the ground so well and therefore does not prevent blowing.

In field tests at Windsor, oats gave the best results of any of ten crops used. Oats make a quick and heavy growth in the late summer and autumn and thus utilize the residual fertilizer to good advantage. They die down about the first of December but make a thick mat over the soil which prevents blowing and washing. Barley is very similar to oats in these respects.

Rye is preferred by many growers because it may be used for fall and spring pasture for stock. It is most popular on combination tobacco and dairy farms. In the 5-year field test at Windsor it stood next to oats in excellence. Rye grows rapidly in the spring and should be turned under before it gets too high. Otherwise it may make such a mat of loose material in the soil that during a dry early season, the ground will not retain sufficient moisture for best development of the young tobacco plants.

Timothy cover crops are used by some growers with good results, but it has been observed that brown rootrot of tobacco is worse after timothy on certain soils. It does not start as quickly or make as good a top growth as rye, but produces a luxuriant root growth. In tests at the Massachusetts Station red top has given better results than timothy. The growth habits of the two are quite similar.

TIME AND RATE OF SEEDING

The seed should be sowed just as soon as possible after the tobacco crop is removed. Seeding before removal of the tobacco has been tried but involves difficulties in management and is not advisable.

The following rates of seeding have been found satisfactory:

Oats, barley, rye or wheat ...	2 to 2½ bu. to the acre
Alfalfa, red top, timothy	20 pounds to the acre
Vetch	80 pounds to the acre

Unless vetch and alfalfa have been grown previously on the same land, it is best to inoculate these seeds before planting.

Preparation of the land for seeding is easy at this time. It is not necessary to turn the soil with a plow although some growers prefer to use a plow to split the tobacco rows if the ridge has been made high. One harrowing with the disc is sufficient before sowing. For oats, wheat, rye, vetch or barley, the disc may also be used in covering the seed.

Smaller seeds, such as timothy, should not be planted so deeply, and a spike harrow, or another fine tool, will serve better than a disc.

DISEASES

In the following pages only those diseases of tobacco are described which are of fairly common occurrence in the state. There are an additional number which appear rarely or are of so little economic importance that they are not mentioned here. The discussion is devoted mainly to descriptions of the symptoms by which the diseases can be recognized, the damage they cause and the methods by which they may be controlled. They are arranged approximately in the order in which they occur: First the seed bed diseases, those which occur both in seed bed and field, then those which occur only in the field, and finally those which occur only in the curing shed.

The appended "Key to Diseases" may be helpful in preliminary identification of any disorder in which the reader may be interested. For final identification, however, he must depend on the more complete description given under the head of each disease.

KEY TO DISEASES

I. Diseases in the seed bed
  1. Seedlings in two or four-leaf stage dropping over with lower part of stalk shrivelled, or devoid of roots. *Pythium Damping-off and Rootrot.*
  2. Older plants affected with slimy brown rot of stalk which spreads later to other parts of the plants. *Bed rot.*
  3. Patches of stunted yellow plants with rotted roots
     a. Some of the roots black *Black Rootrot.*
     b. Roots or part of them badly disintegrated but hardly discolored *Pythium Rootrot.*
     c. Roots brown *Brown Rootrot.*
  4. "Halo" spots on leaves. May be accompanied by patches of wet-rot plants *Wildfire.*
  5. Leaves "hobbly", with downward inrolled tips and margins, "rimbound", small yellow spots like premature ripening near margin *Potash hunger.*

II. In the field
  1. Stalk diseases
     a. Sunken black canker at base of stalk *Sore Shin.*
     b. Wet-rot of pith finally making the stalk hollow *Hollow Stalk.*
  2. Root diseases causing slow and stunted growth
     a. Roots brown *Brown Rootrot.*
     b. Some of the roots black *Black Rootrot.*
  3. Leaf diseases
     a. Leaves irregularly mottled with alternating areas of light green and dark green. Leaves frequently distorted *Mosaic.*
     b. Leaves narrow, strap-shaped and in abnormally large numbers *Frenching.*
     c. Dead spots on leaves
        (1) Spots with definite broad yellow halo *Wildfire.*
        (2) Spots without halo *Physiological Spots.*

d. Lower leaves chlorotic between veins, thick, without inrolled margins *Magnesia Hunger*

e. Leaf surface "hobbly", margins and tips of leaves inrolled downward *Potash hunger*

f. Plants stunted, dark green. Leaves narrow, spatulate, pinched, with bronze cast *Phosphorus starvation*

III. In the curing shed

1. Scattered dark spots on leaves, coalescing later into irregular blotches. Under moist conditions parts of leaves become soft and rotten *Pole Sweat*
2. A soft rot affecting the midribs of the leaves *Stem rot.*

PYTHIUM DAMPING OFF AND ROOTROT

This disease is confined to the seed bed. It is widespread and of long standing in the Connecticut Valley and is probably responsible for a considerable proportion of the poor "stands" of plants in the seed beds. On account of its inconspicuous symptoms, and the rapid disappearance of the affected seedlings, the disease has received scant attention and its ravages have been attributed largely to other agencies. For the same reason the extent of damage in the state can only be estimated, but it is safe to say that it is one of the very common seed bed troubles.

Symptoms: The symptom which the grower first notices is that the very young seedlings are disappearing shortly after germination. Every day the "stand" appears thinner. This may continue until there are not enough plants left to pay for further care and the bed is abandoned. More often, however, it results only in a reduced stand so that the grower has not sufficient plants to set his intended acreage and must purchase them elsewhere.

The stages of this mysterious disappearance of plants may be found by close observation of the beds in the germinating period. Some of the small two-leaved plants will be found prostrate on the ground with a part or all of the little stems (hypocotyls) dead and shrivelled to a mere thread. The shrivelled part is most often just at the surface of the soil. Other plants are prostrate, or entirely upside down, and are not attached to the ground at all. The hypocotyls are healthy but the roots are completely rotted away. Thus the disease may affect either the roots or the stem. After the plants topple over, they disappear very quickly. They may be covered by the splashing of soil while being sprinkled. Under dry conditions they disappear by shrivelling; under moist conditions, they rot and disintegrate quickly.

At about the time that the second pair of leaves appears, the stem becomes resistant to further attack but the roots remain susceptible for several weeks. This later rootrot causes the plants to become stunted and yellow in spots in the bed. Some of them die, but most of them linger for a long time with very little further growth. Such spots give the bed an uneven appearance. On careful examination the larger part of the roots are found to be soft, or completely disintegrated, except for a central thread-like strand which remains intact but may be pulled out of the rotted cortex easily.

Cause: The disease is caused by a parasitic fungus (*Pythium debaryanum* Hesse) which inhabits most fertile soils naturally. Here it

may live indefinitely on dead organic matter and spread under and over the soil with extreme rapidity. When its branches come in contact with the young stem or root they bore through the epidermis and live parasitically on the interior cells of the tobacco plant causing them to collapse and die. Spores are produced in great abundance and may be carried about by water, wind, tools and other agencies, thus spreading the disease to new centers. Many other seedlings such as beets, tomatoes, cucumbers and pines are also attacked by the same fungus.

Effect of environmental conditions: The growth of the fungus is favored by a high temperature, high humidity of air or moisture of the soil. There is also a belief that a high percentage of vegetable matter in the soil fosters growth but this has not been demonstrated satisfactorily.

Control: Steaming the soil, the common practice in this state, has not controlled the disease. In 1933, when the disease was severe and widespread, the writer found many of the worst cases in steamed beds. In recent tests at the Experiment Station, in which numerous materials for sterilizing the soil or the seed were tried, the best control was obtained by treating the soil at the time of seeding with formaldehyde dust at the rate of one and one-half ounces of the dust to each square foot of soil. The dust was worked into the top two inches of soil, the soil heavily watered, and the seed sowed immediately. The dust is a mixture of 15 parts by weight of commercial formaldehyde and 85 parts of an absorbent dust. Finely ground charcoal, or a peat soil composed mostly of decayed organic matter, gave good results when used as the absorbent dust. Because the formaldehyde fumes are irritating to the nose and eyes, it is best to mix the dust in a closed container such as a barrel or drum which may be rolled about until the mixture is complete. The mixture should be made only shortly before using and should be kept enclosed in a tight container until needed.

Treatment of the seed with cuprous oxide or with Semesan gave some degree of control but was not found nearly so efficient as treatment with formaldehyde dust.

Spraying the plants with Bordeaux Mixture did not control the disease.

When the plants are larger, sprinkling diseased areas with a 1 to 1,000 solution of formaldehyde, followed immediately by a sprinkle with clear water to wash the formaldehyde from the leaves, has been used by some growers with apparent success. The writer has had no personal experience with this method.

BED ROT

Most writers on tobacco diseases have considered "damping-off" and "bed rot" as synonomous terms for the same disease although they recognized that two or more parasitic organisms might be involved. Since the first symptom of bed rot is a rotting of the base of the stem, it could properly be called damping-off. To avoid confusion, however, in this bulletin the name "damping-off" refers to the disease previously described as caused by Pythium.

Bed rot is common wherever tobacco is grown in Connecticut and has probably been here as long as tobacco has been started in beds. The symptoms are more clearly recognized and it has been more often described than damping-off but probably it is not of more general occurrence. It is one of the major diseases of the seed bed and may be carried from there into the field.

Symptoms: Bed rot appears in the beds at a later stage than damping-off. Beginning about when the plants have developed five or six leaves, it becomes increasingly prevalent until they are large enough for transplanting. It usually occurs in circular patches from a few inches to a foot or more in diameter. The stems are affected first with a brown wet-rot followed quickly by rotting and collapse of the leaves. In severe cases, every plant in the center of the patch is killed. If less moist conditions are then introduced, the leaves fall flat and form a parchment-like dry covering over the soil. For a considerable distance about the margins of these dead patches one finds most of the plants with brown lesions on the stems. Under moist conditions these enlarge and kill the plants but under less humid conditions they dry out, seem to remain stationary and the affected plants do not die.

Cause: Bed rot is caused by the invasion of a parasitic fungus. This may not always be the same species of fungus however. In all instances where the writer has identified the fungus during the last ten years, it was found to be *Corticium vagum* Berk and Curt (*Rhizoctonia solani*) a common parasite which lives in most fertile soils here. Clinton earlier found instances in which a species of Sclerotinia was the parasite. Other species of fungi have been found in other tobacco sections. Under moist conditions the spider web-like threads (hyphae) of the first named fungus may be seen spreading over the surface of the ground and even through the air from one plant to another. Spores (basidiospores) are rarely produced, but the fungus is disseminated by the vegetative hyphae and also by hard black resting bodies (sclerotia) about the size of a pin head or sometimes larger, which may frequently be found on close examination on the surface of the soil in the infested patches.

Effect of environmental conditions: The disease develops only when humidity is high and the soil damp. Such conditions are ideal when the stand is thick and aeration about the stem base is poor. A relatively low temperature is more favorable for Rhizoctonia than a high temperature. Forced, succulent, rapidly growing plants are more susceptible than others.

Control: The first measure of control should be sterilization of the soil by steaming, acetic acid or formaldehyde. Soil sterilization, however, cannot be depended on always to give control, as can be seen from numerous severe cases which the writer has seen in sterilized beds. These exceptions are probably due to re-infection. Regulation of environmental conditions is the best method to prevent the trouble. Most cases are found in beds where the stand is too dense, in beds that are not sufficiently aired, or where the plants are kept too constantly moist or are forced too much. If such faults are avoided, there is little danger of bed rot. Watering should be thorough but not too frequent. Plants should not be forced by too generous applications of nitrogenous top dressings. There should be constant aeration by raising the sash except in most severe weather.

If there are only a few patches in the bed they should be destroyed with formaldehyde in the same manner recommended for eliminating wildfire patches (page 736).

Keeping the beds constantly sprayed with Bordeaux Mixture as recommended against wildfire is also effective against bed rot.

"GREEN MOLD" OR "MOSS" IN THE SEED BEDS

In the early seed bed period, while the soil must be kept constantly moist to insure good germination, growers often are troubled by appearances of a bright green scum over the surface which has received the popular name of "moss" or "green mold". Both of these names are unfortunate because this is neither a moss nor a mold but consists of a dense surface growth of one or more species of green algae. None of these algae is parasitic on tobacco seedlings but their dense growth may smother the sprouting seeds. There is considerable difference of opinion as to the extent of the damage but at least such a condition is not desirable.

Control: It is a common practice to sprinkle a thin coat of sharp dry sand over the ground to check the green algae. The benefit derived from this treatment, however, is probably more imagined than real. Applications of Bordeaux Mixture at intervals of two or three days give much better control, but there may be some detriment to the germinating seeds if this treatment is started before the cotyledons appear.

"Green mold" is usually eliminated by treating the soil at the time of seeding with formaldehyde dust as previously described for control of Pythium Damping-off.

These algae thrive only under high moisture conditions of soil and air. They can be checked by removing the sash during bright days and thus drying out the surface of the soil. However, this should not be attempted when the seeds are just germinating.

SORE SHIN

This disease, which is also called stem canker, stem rot, collar rot, or black leg, is of common occurrence in Connecticut tobacco fields. It is rarely of major importance because the number of affected plants is usually small, and the total loss is not heavy. Sometimes, however, under favorable conditions, it may take a serious toll and even necessitate replanting of entire fields. Growers have been familiar with it for many years but it has not been carefully investigated here and very little has been written about it.

Symptoms: The characteristic symptom most commonly observed is a brown or black, sunken, rotted canker at the base of the stalk when the plants in the field are half grown or larger. The canker may be only on one side or may entirely girdle the stalk at, or just below, the surface of the soil. Or it may extend several inches up the side of the stalk sometimes involving the lower leaves which drop off after the bases of the midribs become rotten. The canker reduces transfer of water and nutrients through the stalk so that the whole plant becomes sickly, yellow, and smaller than neighboring healthy plants. During strong winds many of these plants are broken off at the canker and fall over. In older plants the rotted portion extends inward to the woody part of the stalk. In younger plants it may go clear through, thus causing them to wilt and die. Although the grower sees the disease more often on plants after they are well grown, the most serious loss is among the younger ones. These die during the first weeks after setting which necessitates repeated restocking and sometimes replanting of the whole field.

Cause: Various fungi and bacteria, believed to be the causal agents, have been found in the diseased tissues by different investigators. The one most commonly found by the writer in this state is *Corticium vagum* Berk and Curt, which has been mentioned previously as causing bed rot (page 766).

Clinton also reported Pythium and Sclerotinia as causal fungi. It has been observed frequently that the most severe cases of sore shin were in fields set from beds known to be affected with bed rot. Sore shin, therefore, may be regarded for the most part as a later development of bed rot. It is not at all improbable however that some infection of previously healthy plants may occur directly in fields. Injuries to the stalk by tools or insects probably facilitate field infection.

Influence of environmental conditions: Heavy wet soils and periods of continuous rainfall favor development of sore shin. Under dry conditions the canker stops spreading and dry inactive scars which are apparently harmless may be observed on the stalk. With the return of moist conditions, however, activity of the parasite is renewed and the canker continues to spread.

Control: Since the seed bed is the focus of infection, all measures previously recommended (page 766) for controlling bed rot should be practiced. This offers the best means of preventing sore shin. If it is practicable, plants from beds which have bed rot should not be used. If this is impossible, the plants should be carefully inspected when pulled and all which show the smallest brown stem lesions should be discarded. Even under these conditions, all diseased plants will probably not be eliminated. Frequent restocking shortly after setting is advisable but late restocking is hardly worth while. Heavy wet soils and fields known to produce sore shin should be avoided.

WILDFIRE

Wildfire appeared first in Connecticut in 1919 having been brought from the southern states. It increased rapidly, became serious locally in 1920, and was widespread and very destructive throughout the Connecticut tobacco districts in 1921 and 1922. For a few years it was the most serious tobacco disease in the state. The damage varies from season to season but in general, during recent years, it has become less and less evident so that it is now regarded as one of the minor ailments. Whether this indicates a decline of virulence of the wildfire organism or is due to a succession of years unfavorable to its spread, or to a more thorough adoption of remedial measures by the growers, cannot be definitely stated. There is no demonstrated reason why, under favorable con-

ditions, it should not become as prevalent as it was in the early Twenties, and certainly precautionary measures against it should not be relaxed.

Symptoms: This is essentially a disease of the leaves but the lesions may appear on any green part of the plant above ground. It occurs both in the seed bed and in the field but does not spread on tobacco in the shed. The main damage is caused by the spots on the leaves, thus destroying or reducing their value as wrappers or binders. In early stages of development, spots caused by wildfire can be distinguished from all others by the presence of a broad chlorotic marginal band called the "halo" (Fig. 140). In the center of the spot there is

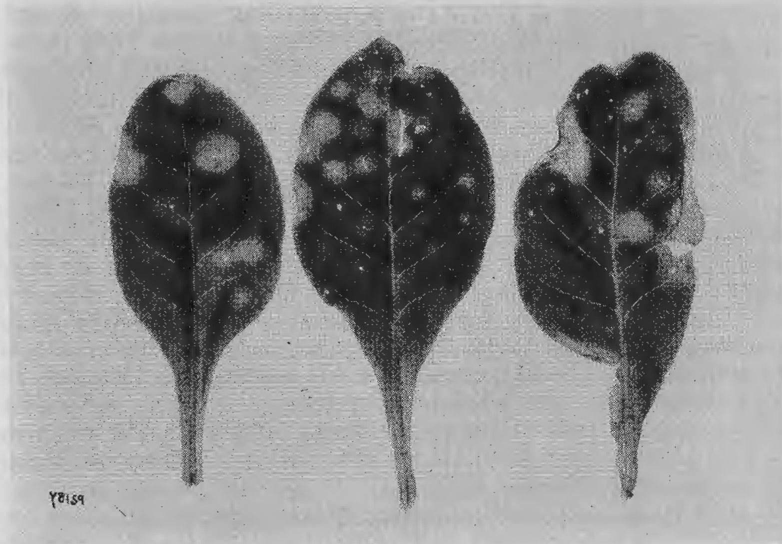

FIGURE 140. Wildfire. Young leaves from the seed bed showing halo spots.

a small, dry dead point, at first no larger than a pin head, surrounded by the yellow "halo" of living tissue, from an eighth to a quarter of an inch broad. The spots are circular—or semi-circular if on the leaf margin—with regular smooth outlines. They may run together, however, and produce large lesions of irregular shape. When the leaf is attacked before it is completely unfolded it becomes distorted. Severe infection in the bud causes all leaves which unfold from it later to be yellow, dwarfed and misshapen.

As the disease progresses the central dead part enlarges and in dry weather the entire chlorotic area may become dry, brittle and white, leaving no marginal yellow band. In this stage the spot is not easy to distinguish from various other kinds of leaf spots. Under moist conditions, however, the halo continues to develop in advance of the dry center. After the spots are dry and dead they often crack or fall out, leaving the leaf ragged. Badly diseased tobacco can be sold only for stemming.

In the seed bed, where the plants are thick and conditions more humid, the disease often takes the form of a wet-rot in which all the leaves in areas which may be a foot or more in diameter are reduced to a water-soaked, slimy pulp. This may occur at any time after the leaves are as large as the finger nail. It may be distinguished from bed rot, which it resembles, in two ways: First there is the presence of the regular halo spots on some of the leaves; and second, in this disease, the leaves are principally affected, while in the case of bed rot, the stalks are attacked first.

Cause: Wildfire is caused by the presence within the leaf tissues of enormous numbers of parasitic bacteria (*Bacterium tabacum* Wolf and Foster). A single bacterium is microscopically small and short-lived but it multiplies with extreme rapidity and a lesion is produced by the combined effect of a mass of millions of individuals. These live on the decomposition products of the leaf cells which they destroy. At the same time they secrete a toxin that spreads into adjacent cells and breaks down the green chlorophyll, thus creating the yellow halo. The bacteria then ooze out to the leaf surface and are carried by splashing rain drops or by wind to other leaves. They may also be carried by tools, horses, workmen and other agents. The surface of a healthy leaf must be wet for several hours at least after contact to permit infection. While infections take place most easily through wounds in the leaf, for example hail holes or wind rips, it is probable that a considerable proportion in the field is through the natural openings of the leaf surface, stomata and hydathodes. Bacteria may exist for a few weeks in the soil and be splashed or otherwise carried up to leaves, but it is doubtful whether they live over the winter to any extent under these conditions. They are more likely to winter under dry conditions, in diseased leaves in the sheds, or on sash, boards or tools stored in the sheds. Their transfer from these to the seed beds probably accounts for most spring infections and the start of the new season's epidemic.

Effect of environmental conditions: For reasons stated above, a wet year, characterized particularly by long continued rainy periods when the water stands a long time on the leaves, is particularly favorable to wildfire. Hailstorms and rains accompanied by high winds furnish excellent conditions for spreading the disease. Rapidly growing plants are more susceptible than slow growing ones. Variations in temperature are not known to have any influence.

Control: Practically all wildfire in the field starts from plants which came from diseased seed beds. Control measures are therefore directed mostly toward keeping the beds free from disease. The most effective method is to keep the seedlings constantly covered with Bordeaux Mixture or a copper lime dust. Since this is now generally considered one of the routine operations of seed bed management, it is discussed fully under the section on that subject (see page 735). If wildfire was prevalent on the farm during the preceding year, precautions should be taken against transferring any infected material from the sheds to the beds. If wildfire was in the beds, it is well to drench the sash and boards with formaldehyde diluted at the rate of 1 part in 25 parts of water. Directions for destroying isolated infected patches in the beds are given on page 736. If it is at all practicable, it is best not to pull any plants from beds in which wildfire is present.

Control measures taken after the disease is in the field are not dependable for the most part. If only a few diseased plants are found when the plants are quite young, they may be removed and carried from the field. If the infection is more general, this method is questionable because healthy plants, set where the diseased ones have been pulled, commonly become infected from bacteria left in the soil. Removal of diseased leaves generally has not been successful in stopping the disease when weather conditions favor its spread. Thorough spraying of the young plants in the field may reduce spread somewhat but this is not practicable or efficient when the plants are large. Plowing under a diseased stand and setting the field with healthy plants will eliminate wildfire only when following weather conditions are unfavorable for spreading it.

When there is any wildfire in the field, cultural operations should be carefully avoided while the leaves are wet.

MOSAIC OR CALICO

"Calico", "mongrel", "brindle", "mottle", and "grey top" are the most common names applied by growers to this malady which the pathologist calls mosaic. It can be found on almost every tobacco farm in the state but is usually not much feared because the percentage of plants affected is small. In some seasons, however, it becomes unusually severe in certain sections or in certain fields of the state. During such epidemics the writer has seen fields in which 98 per cent of the plants were affected. Under these conditions the loss is heavy and mosaic becomes a disease of major importance.

How long mosaic has existed here is not known. The first published account of it by the Experiment Station was in 1898 at which time it was apparently a common disease.

Symptoms: Although mosaic is said to originate in the seed bed, the symptoms are rarely seen there. In the field the disease can be recognized easily even at a considerable distance. Affected leaves have a mottled appearance due to irregularly shaped and alternating areas of light yellowish green and normal dark green giving the effect of a mosaic. All parts are commonly affected without any relation to position except that sometimes the darker areas follow the veins. On young, rapidly growing leaves, the darker spots are often puckered or puffed out (Fig. 141). Frequently they are otherwise distorted or narrower than normal leaves. In the field, mosaic is more prevalent on the top leaves and suckers than on lower leaves. The suckers which grow from the stumps after harvest frequently are affected severely. Plants which become infected at an early age remain smaller than normal plants. Calico leaves are less resistant to sun scorch than normal ones. As a result, during hot, dry days the sun kills irregular spots, particularly on the top leaves. Large areas thus killed turn a reddish brown color and account for the term "red dust" which growers apply to this stage of calico. When cured, such leaves are worthless for wrappers or binders.

Cause: The cause of calico is not definitely known. No parasitic organism has been found to have any connection with it. The disease, however, is highly infectious and is easily carried by various agents from diseased to healthy plants through a virus which exists in the plant juice. This virus permeates all parts of the plant although the symptoms appear only on those leaves which unfold after infection has occurred. Fortunately seeds do not contain the virus and healthy plants can be grown from the seed of those badly diseased. Neither does mosaic winter over in the soil of tobacco fields. Other plants, particularly those of the same family such as tomato, pepper and ground cherry, may contract the disease also, and it is possible that some of the wintering may be accounted

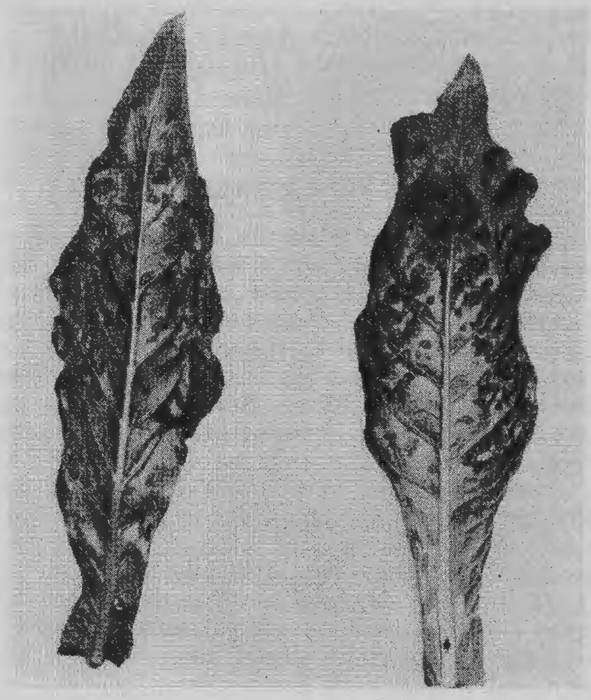

FIGURE 141. Virulent type of mosaic on Broadleaf, showing narrow distorted leaves with dark green puffed-out blisters between the veins.

for by perennial weed hosts. The virus does live for several years in dry, cured tobacco and such material probably accounts for most of the wintering over. Fragments of diseased leaves or other parts may carry the virus from sheds or shops to the beds where conditions for its spread are favorable and from which it is carried to the field. There it is spread on hands and tools of workmen during cultural operations and probably also by some insects, particularly plant lice. When a plant is once infected, regardless of its age, it never outgrows the disease.

Effect of environmental conditions: Variations in temperature, moisture or weather conditions are not known to have any influence on the occurrence or spread of mosaic. The nature of the soil in which the plant grows, and the kind of fertilizer or manure applied, are also without influence. Cultural operations have no effect except when they furnish opportunity for workmen to transfer the virus from one plant to another by contact.

Control: Since there is no known cure for the disease, all control measures must be precautionary rather than remedial. The most important measures come under the head of seed bed sanitation. The larger part of the field infection starts with plants which were diseased when they were taken from the seed bed. Steam sterilization for the purpose of controlling other troubles is also helpful here because it destroys any virus which may be in old leaves or other parts of the tobacco plant, or in weed plants. Every precaution should be taken against bringing into the bed any dry fragments of leaves or stems from the preceding crop. Trash raked up from the floor of the curing sheds should never be put on or near the beds. Tobacco stems should not be used as fertilizers for the beds.

In Kentucky it has been proved that seed bed infection may come from workmen spitting tobacco juice, or from handling the plants after handling infected chewing tobacco or smoking tobacco. There is a chance that cigar stubs and cigarette butts thrown into the bed may start infection. Although symptoms of mosaic are seldom seen in the beds, they should be carefully watched for. If they are found, it is not safe to pull plants from that bed because there are undoubtedly many more diseased ones than can be seen. When a workman gets the juice from an affected plant on his hands, he may spread the virus easily to hundreds of others. During the first few weeks after the plants are set in the field regular inspections should be made and any diseased plants found should be put in a basket and carried from the field. In doing this the workmen should not be allowed to touch any healthy plant. Also in later operations, up to the time of topping, diseased plants should not be touched by workmen. In topping and suckering, this precaution is not necessary because leaves which are to be marketed are developed before that time.

FRENCHING

Frenching is a rare disease in Connecticut. Not a dozen cases have been observed by the writer during the past ten years. Although a severely affected plant is a total loss, the disease does not usually mean a serious loss to a grower. Only a small percentage of plants in the field are likely to be affected and these are confined to certain definite areas and are not scattered promiscuously over the field. If the disease occurs during succeeding years, the location in the field is likely to be the same. Often it disappears entirely after one season. Frenching is a disease of long standing here, but the date of its first appearance is not recorded.

Symptoms: The earliest symptom is chlorosis, or fading of the bud to pale yellow. The most characteristic symptom comes somewhat later. The leaves become thick, brittle, narrow and strap- or sword-shaped, with wavy, scalloped or crinkled margins. They may or may not be mottled in a manner resembling mosaic. The leaf margins have a tendency to curl downward. In severe cases all the leaves on a plant are affected; in less severe cases, the lower leaves are normal, or nearly so, showing that the attack occurred after the plants were partly grown.

FIGURE 142. Frenching. A single plant showing branched stalk and numerous strap leaves.

The stem does not elongate naturally and the number of leaves is multiplied so that the whole plant appears as a bush of dagger like leaves in unusually large number set very close together (Fig. 142). This appearance may be intensified by abnormal branching of the stalk.

Cause: The cause of Frenching is not definitely known. It is not associated with any fungus, bacterium, insect or other foreign organism. It cannot be transmitted from a diseased to a healthy plant (non-infectious). It is probably a trouble caused by malnutrition. Opinions expressed by several investigators that it is caused by shortage of nitrogen, of potash or of phosphorus, or by excessive fertilization, however, are not supported by adequate experimental evidence. There is considerable observational and some experimental evidence to indicate that it is associated with poor aeration or excessive moisture in the soil. Such conditions may be due to poor drainage or heavy soils that pack easily. It occurs only on land of a high reaction (pH 6.0 or above). There is some recent evidence* that a toxic substance in such soils is the direct agent.

Control: No method of control is known. The elimination of unfavorable soil conditions before setting, mentioned above, should be helpful. Growing of tobacco on fields where the disease is wont to occur should be avoided.

BLACK ROOTROT

In extent of loss occasioned, black rootrot has probably been the most serious of all tobacco diseases in Connecticut during the last thirty years. Although first identified and investigated by the Experiment Station in 1906, it probably caused trouble before that date but the damage was attributed to other agencies. It occurs sometimes in the seed bed but is more serious as a field disease.

Symptoms: The first symptom of the disease that the grower notices in the field is that the tobacco doesn't grow. The plants are stunted, with narrow, thick, tough leaves that are either a starved yellow color or, where the nitrogen supply is high, a very dark green color commonly called "black" by the tobacco man. On hot days the leaves wilt or "flag" more quickly than on healthy tobacco. The dwarfed plants "top out" prematurely. Only rarely is a field equally affected in all parts. Usually there are "patches", from a square rod to several acres in extent, where the tobacco is short, while in other parts of the field growth is normal. In the diseased places the plants are frequently very uneven in development.

From the above ground symptoms, however, it is not possible for even an expert to be sure that this is black rootrot. Other troubles, such as brown rootrot, lack of fertilizer, or water-logged soil, may produce the same appearance. One must dig the plants and wash the soil from the roots to see the lesions which are unmistakable signs of black rootrot. Normal young roots are white, but on a diseased plant many are black (brown at first), either throughout their length or only in segments, with other segments appearing normal (Fig. 143). Most of the ends of the small roots are black, indicating that in digging the plants, the roots broke at this point and the decayed ends were left in the soil. The tissue of the smaller roots is rotted through, but on the large roots there occur enlarged, rough, scurfy lesions which may or may not kill the interior

*Shear, G. M. Field and laboratory studies on Frenching of tobacco. Va. Agr. Exp. Stat. Tech. Bul. 49. 1933.

tissues. Frequently the tap root is entirely rotted off at the bottom and there is an increased number of laterals. This results in a brush-work of intermingled brown, black and white small roots just above the blackened end of the main root. The character which distinguishes this disease from all other tobacco ailments is the coal black color of parts of the roots. The reduced root system is unable to secure sufficient water and soil nutrients for normal growth of the above ground parts of the plant. Hence the dwarfed growth and "flagging" on hot days.

Black rootrot may also occur in the seed beds where it exhibits the same symptoms: Slow growth, yellow or "black" color of leaves, "flagging", and black rotted roots. Many of the plants also die. The beds look very uneven.

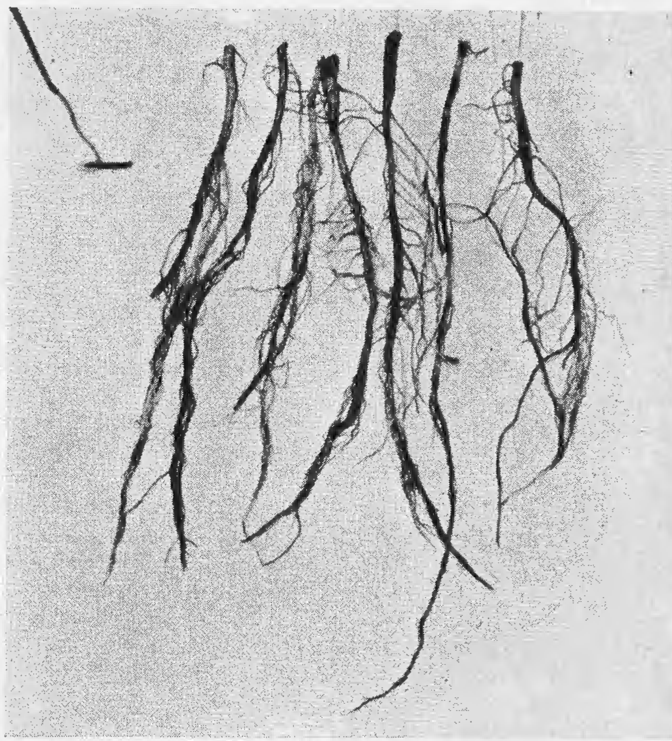

FIGURE 143. Black rootrot shows in the lesions (black portions) of these roots.

Cause: The disease is caused by a parasitic fungus (*Thielavia basicola* Berk and Br Zopf)* which is present in most, if not all, tobacco fields, living in the soil indefinitely on dead vegetable matter. It becomes parasitic on the tobacco roots when the environmental conditions mentioned below are favorable. Three kinds of spores are produced in the diseased roots. The black color of the affected roots is due to the great abundance of one type of spores (chlamydospores).

*McCormick (Conn. Agr. Exp. Sta. Bul. 269. 1925) presents evidence to show that there are really two fungi in constant association and that *Thielaviopsis basicola* (Berk) Ferraris is the parasite.

Effect of environmental conditions: Although the disease cannot occur in absence of the causal parasite, the extent of injury is much more dependent on the environmental conditions under which the tobacco grows than on the fungus.

The reaction (degree of acidity in the soil) is important. It is never serious in the more acid soils. Those testing above 6.0 pH, on the other hand, are favorable to the disease. A low temperature increases the disease and explains the variation in severity of black rootrot from year to year. For the same reason it is usually most injurious in the spring and early summer. Crops badly stunted in the cool early part of the growing season often make rapid recovery and almost normal growth with the advent of hot weather later. Poorly aerated, compact soils are more conducive to rootrot than soils which are loose and do not pack so easily. Wet seasons increase rootrot probably by keeping the soil at a lower temperature and more compact. Heavy applications of manure also increase rootrot.

Control: In the seed beds the disease is satisfactorily controlled by sterilizing the soil with steam, acetic acid or formaldehyde as described on page 731.

The most successful method of control in the field has been through regulation of the soil reaction. Connecticut Valley tobacco soils are for the most part rather acid, 5.2 pH or lower. It was only after this natural acidity had been neutralized by large applications of lime, wood ashes, or alkaline fertilizers that rootrot became serious. When such treatments are omitted for several years the soil gradually returns toward its original reaction. Avoidance of too much alkaline material on the land thus offers the most logical means of control. It has been found that black rootrot is rarely if ever serious on soils testing below 5.6 pH. Only those soils testing below 5.0 pH should be limed and then sparingly (not over 500 pounds to the acre at any one time except in extreme cases). Stable manure, wood ashes, or alkaline fertilizers should be avoided on soils testing near or above the danger point of 5.6.

A very successful method of combatting the disease in other tobacco sections has been through substitution of rootrot resistant varieties of tobacco. In Connecticut this method has not been generally used because the known resistant varieties have not been acceptable to the trade from a quality standpoint. A resistant shade variety, however, the 4R strain, was developed by the Experiment Station and is otherwise not distinguishable from ordinary Cuban Shade. It has been raised to some extent in the Valley with satisfactory results. There are also a number of Havana Seed strains under test at the Experiment Station which are quite resistant and of excellent quality, but they have not yet been raised in sufficient quantity for commercial test. No satisfactory resistant strains of Connecticut Broadleaf have yet been developed, but since Broadleaf withstands rootrot better than our other two types, there is less occasion to find a resistant variety.

Regular rotation of tobacco with other crops is a method of control which has been successful in certain sections of the country. This is not practicable in Connecticut where continuous cropping of tobacco year after year on the same land is considered better practice than rotation.

BROWN ROOTROT

This is a trouble of long standing in Connecticut. However, on account of its obscure nature and cause, it has only received recognition as a distinct disease within the last fifteen years. Under favorable conditions it may become serious and cause heavy losses, but over the Valley as a whole it is neither so general, nor so injurious, as black rootrot.

Symptoms: The above ground symptoms are indistinguishable from those of black rootrot and need no separate description. It is only by an examination of the roots that the two diseases can be distinguished. Here there are no black lesions or scurfy enlargements of the roots. The roots are brown, and many of them are rotten, so that the outer cortex slips easily away from the central strand when they are pulled. Death of the lateral roots induces new growth of successive crops of laterals from the main root, or bottom of the stalk, with the result that a veritable brown broom of roots appears when the disease is severe. When there are only a few brown roots diagnosis of the disease is attended with considerable uncertainty because roots killed by almost any agency turn brown.

Cause: The only diagnostic symptom of this disease is the presence of dead brown roots in smaller or larger number. Since a root naturally turns brown when it dies, regardless of the killing agent, and since no one species of fungus or bacterium has been found constantly associated with the malady, it is not at all certain that brown rootrot is a single disease always produced by the same agent. Some investigators believe that the cause is a parasitic organism which has not yet been isolated. Others are sure that it is a malnutrition trouble produced by such factors as lack of nitrates, lack of calcium, or excess of ammonia. Regardless of the direct cause, it has been demonstrated that the common type of brown rootrot found in the Connecticut Valley is an after effect of a preceding crop. Thus it often occurs when there was a crop of timothy, corn, clover, alfalfa or rye on the land the preceding year. It is rarely serious after a potato crop, and least of all when tobacco is grown continuously.

Control: For this type of brown rootrot, which is clearly linked with the previous cropping system, the obvious remedy lies in avoiding a rotation which will bring tobacco immediately after a hay or cereal crop. As a general rule there seems to be no advantage in rotating tobacco with other crops in Connecticut. The best tobacco is produced by growing the crop continuously on the same land. Under this condition, brown rootrot rarely is found.

For various reasons, however, a grower sometimes wishes to raise tobacco on a new field which has been in timothy or one of the other injurious crops mentioned above. If he goes directly from this to tobacco, he may have trouble from brown rootrot, or he may not. There is an inexplainable difference in fields in this regard. Some growers raise a crop of potatoes for the first year after timothy, and follow this the next year with tobacco, thus avoiding the danger of severe after effects. When tobacco is grown after hay or forage, the after effect may occasionally

continue through two or three years but becomes less pronounced each season.

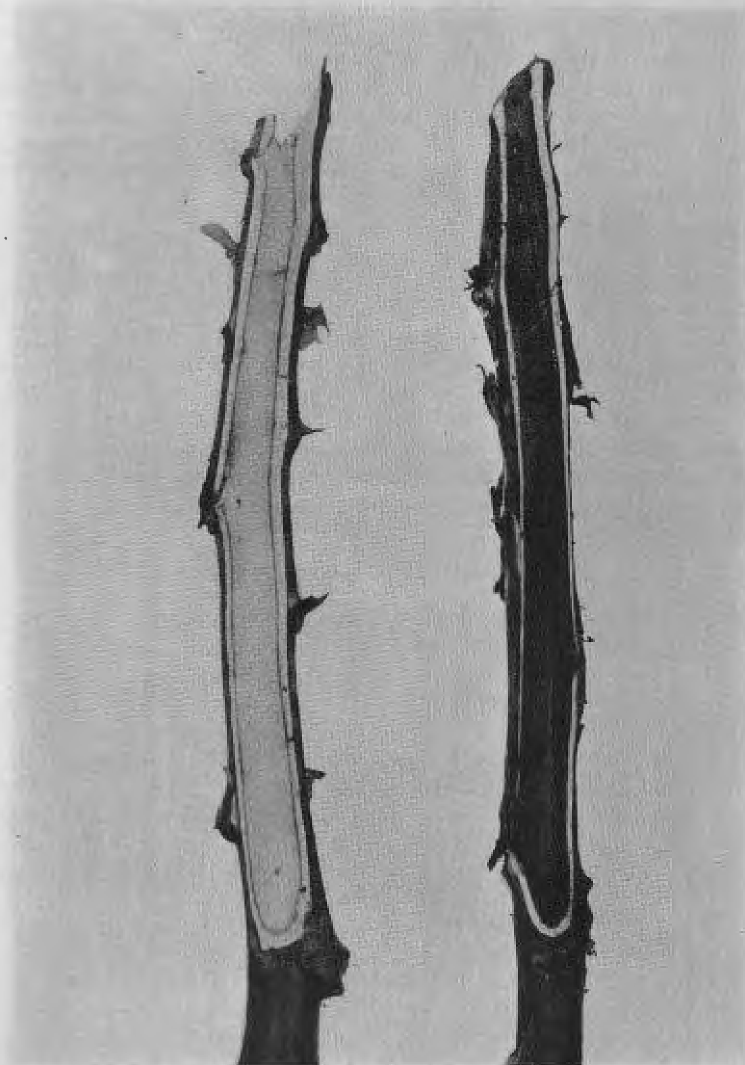

FIGURE 144. These sections show a normal tobacco stalk (left) compared with one affected by Hollow Stalk (right).

HOLLOW STALK

This is a rather common disease in sun grown tobacco some years but rarely affects enough plants to cause much loss. It is an old disease in this state.

Symptoms: Hollow stalk affects only plants which are mature or nearly so. The characteristic symptom is decay of the pith. With collapse of the succulent pith, the stalk becomes hollow through a part or all of its length. The decay may start in any part of the stalk but is most often seen in the upper part after the plants are topped. The leaves wilt and sometimes the rot may reach out into the midribs.

Cause: The rot is caused by growth of enormous numbers of parasitic bacteria (*Bacillus carotovorous,* Jones) in the pith. Entrance to the pith is through wounds caused by insects or tools, or by topping or suckering. The pathogen is the same organism which causes a soft rot of carrots and many other vegetables.

Effect of environmental conditions: Moisture is an important element in incidence of hollow stalk. It is most prevalent when there is continuous rainy weather during the topping season. In a field where it can hardly be found previous to this time, it becomes widespread and quite evident in the tops of the broken off stalks within a few days after topping. Wet, soggy soils are also said to foster it. Hot, humid weather is favorable to it in that this makes the pith more succulent and wounds do not dry out so quickly.

Control: Affected plants should not be touched by workmen during topping and suckering. If the bacteria get on the hands they may start infection in dozens of plants which are topped afterward.

NON-PARASITIC LEAF SPOTS

Dead spots on the growing leaves, varying in color from white to dark brown, and of various shapes and sizes, have always attracted attention because the leaf is the all important part of the tobacco plant and should be free from blemishes. We know that some of these spots are caused by parasitic organisms, for example, the wildfire spots; some by virus diseases, such as the "rust" following mosaic; and others are malnutrition spots as described in the previous section. Mechanical injuries, such as hail or Paris Green poisoning, may also leave spots. Besides these, there are several types of spots that do not appear to be due to any of the above mentioned causes. We have grouped these last arbitrarily under the name of non-parasitic spots. Growers commonly call leaf spots "rust". To prevent confusion, however, it seems best to restrict that name to the type of spot caused by mosaic.

For the most part the real cause of these spots is unknown. Some of them seem to follow a hereditary predisposition. For example, there are two types of spots characteristic only of Broadleaf tobacco. The more restricted of these is the John Williams spot, so called because it occurs only on this kind of Broadleaf. Just when the leaves are ripening, suddenly they become thickly peppered with small, round white spots, an eighth to a quarter of an inch in diameter. The presence of these spots is not considered a fault by tobacco handlers. On the contrary buyers like to see this development because it is a sign that the plant is the true John Williams type and that it is ripe tobacco.

The other kind of Broadleaf spot has sometimes been called the "star and crescent spot" because it frequently has a small central portion partly

surrounded, beyond an intervening band of green tissue, by a circular, white, narrow band of dead tissue. This marking suggests the Turkish star and crescent. Sometimes the circle is complete; sometimes there are two or more concentric circles or parts of circles. There are numerous modifications but the whole appearance is quite different from other types of spots. They occur only on Broadleaf, or hybrids which have been derived by crossing with Broadleaf.

FIGURE 145. The white spots peppering this leaf are peculiar to John Williams Broadleaf tobacco.

On Cuban Shade tobacco there occur at times numerous small, round, deep brown spots of less than a quarter of an inch in diameter. Somewhat similar but larger spots appear also on Havana Seed tobacco. It has never been definitely proved that a parasite causes these spots although various fungi may be found on them as they become older.

The writer has frequently noticed that all these kinds of non-parasitic spots are prone to break out suddenly a few days after hard rains. On the whole, they do not cause very serious injury to the tobacco crop and no method of preventing them is known.

MALNUTRITION DISORDERS

There are eight food elements which the tobacco plant absorbs from the soil: Nitrogen, potash, phosphorus, magnesium, calcium, iron, sulfur and boron. If there is an inadequate supply of any one of these, the plant becomes abnormal (diseased). The disease symptoms produced by a shortage of any one of them differ from those produced by deficiencies of any other, with the possible exception of sulfur. Three of the eight elements—iron, sulfur and boron—are always present in the soils of Connecticut in sufficient quantity. Therefore disease produced by shortage of any of these three is never seen in the field. Calcium also never occurs in such small amount as to produce starvation symptoms although it may occur in too small quantity for best growth and quality of leaf. There are also certain elements which are not nutrients but which may be taken into the plant from the soil under certain conditions in sufficient quantity to produce abnormal symptoms. Examples of these are manganese and aluminum.

All these disturbances are called malnutrition diseases. The most common of them are described below. Possibly brown rootrot and Frenching should also be included in this group.

Magnesia hunger or sand drown is seen perhaps most frequently because, until recent years, no effort was made to include a supply of this element in the fertilizer mixture and some sandy soils do not contain an amount that becomes available fast enough for the needs of the plant. The trouble is most often seen during wet years because magnesia is easily leached from the soil.

The characteristic symptom is chlorosis, or blanching of the leaves, beginning with the tips and margins of those on the lower stem and progressing inward and upward. The chlorosis is principally between the veins. It may continue until the leaf is almost white except for the network of veins which remain green. The leaves are somewhat thicker than normal and remain flat and stiff without puckering or rolling down on the margins. Dead spots are not ordinarily produced and the leaves do not die abnormally early. Cured leaves show uneven colors and burn with a black ash.

The remedy lies in keeping a sufficient supply of magnesia in the soil. Materials best suited for supplying magnesia are discussed on page 741 of this bulletin.

Potash deficiency produces characteristic symptoms which are readily distinguished after a little experience. The most severe cases that the writer has seen in this state were in seed beds, but mild cases have been found in the field also. Under the Connecticut Valley practice of heavy potash fertilization, however, they are not common.

In the earliest stages the potassium-starved leaves are mottled with yellow near the margins and tips, resembling somewhat the early stages

of ripening. Soon the surface of the leaf becomes rough and puckered, "hobbly". Meanwhile the centers of the mottled areas have died and the margins and tips of the leaves are speckled with numerous small white spots. As conditions grow worse, margins of the leaves turn downward, giving them a rim-bound appearance. In severe cases the dead portions may coalesce and fall out or break and make the leaf appear ragged. On large leaves in the field, when potassium deficiency is not great, we have found the only symptoms to be a yellowing and sharp downward recurving of the leaf tips.

Unlike magnesia hunger, the symptoms of potash hunger do not always appear first on the lower leaves. These may be quite normal and the worst symptoms occur on the middle leaves. In severe cases plants are dwarfed, but we have not seen such a case in the fields of the Connecticut Valley. Stunting of growth is apparently not uncommon in tobacco districts farther south.

Plants with low potash supply are the first to wilt during dry weather or on hot days. The cured leaves do not come into "case" in the shed so quickly as those which have more potash. They are dry, harsh, non-elastic and have poor fire-holding capacity.

When this disorder occurs in the beds, the plants should be sprinkled with a solution of nitrate of potash made by adding two pounds of this material to a barrel of water. After the spray has been applied, it should be washed from the leaves with clear water. Even when the plants are severely affected in the beds they may be set in the field safely since they recover rapidly there. The remedy in the field consists in supplying any of the potash materials as described on page 740 of this bulletin. The trouble in the field, however, is rarely observed until it is too late to undertake remedial measures for the current year.

Nitrogen starvation causes the entire plant to turn pale and in severe cases to remain smaller and produce narrower leaves than normal plants. This trouble is well known by tobacco growers and is remedied by nitrate applications in the bed, as mentioned on page 733, or by side dressings in the field, as described on page 749.

Phosphorus deficiency is evidenced by slow, "pinched" or stunted growth, and narrow, dark leaves. The narrowing is particularly evident at the heel of the leaves, giving them a somewhat spatulate shape. They do not become pale or yellow but, when viewed at an oblique angle, have a bronze cast. On old tobacco fields this trouble is rarely seen but sometimes may be found in new fields during the first year or two of tobacco culture.

Manganese poisoning: All tobacco leaves normally contain a small amount of manganese—usually less than one-quarter of 1 per cent of Mn_3O_4—although this element is not a nutrient and perfectly normal plants can be grown in complete absence of it. The more acid the soil, the higher the percentage of manganese in solution in the soil water and consequently in the plant. At a somewhat increased concentration it becomes toxic to the plant and produces symptoms of poisoning. Affected leaves grow pale and may be distorted. The yellow color develops between the minute ramifications of the veins. In later stages the leaf is dotted with small, irregular, brown dead spots. The plants remain stunted throughout the affected part of the field. Cured leaves are yellow, non-elastic and of inferior quality.

The remedy is to apply lime to correct the extreme acidity of the soil. The disease has been observed only on fields testing below 4.5 pH. Sufficient lime should be applied to bring this reaction up to 5.0 pH or somewhat above.

POLE SWEAT

After harvest the leaves must be dried out slowly. During the entire process, lasting from two to six weeks, they must not dry too rapidly, because they are worthless if they "hay down" quickly in a green state. The humidity and temperature must be kept high enough so that the leaves remain soft for a long time. In such condition they undergo those internal chemical changes at a proper speed to insure the desired color, elasticity, grain, texture and other characters which good cured cigar leaf must have.

During the curing process, while the cells of the leaf are slowly dying, although still soft and containing considerable moisture, they do not have the resistance of normal living cells and are favorable subjects for attack by decay organisms. The higher the humidity of the surrounding air, the greater the danger of damage from rot-producing organisms. Since the cells can no longer be considered normal living cells, attacking organisms should be called saprophytes rather than parasites. The injury produced by growth of these organisms in the leaves has received a variety of names in different parts of the country but is commonly called pole-sweat, pole rot, shed burn or just "sweat".

Symptoms: In the shed there is no danger of pole sweat while the leaves are in the green state or in the transition stage from green to yellow. It may be detected when the leaf is turning from yellow to brown. The first symptom is usually the appearance of numerous small dark spots, at first not over an eighth of an inch in diameter. If moisture conditions are favorable, these soon enlarge and run together to form large irregular blotches on the leaves. They occur mostly where the leaves overlap one another or are against the stalks where moisture collects. At times drops of water may be observed on the surface of the leaves. In the worst cases, the rot may continue until the affected parts are soft and slimy. "Strutting" of the midribs (the midribs stand out at right angles from the stalk instead of wilting down normally) is also a symptom.

The symptoms after the tobacco is cured are more familiar to growers. On the sorting bench, the affected parts of the leaf are found to be variously discolored, dry and brittle. It is difficult to get them into "case" for handling but when they are moistened they are "tender". They have no elasticity or tenacity and when leaves are opened for examination they tear apart between the hands. Sometimes the rot has gone so far that they fall apart when they are shaken out from the bundle. Such leaves are worthless for cigar purposes.

Cause: Various species of fungi and bacteria have been found in the affected tissues and declared to be the cause of the trouble. Probably no one of these is constantly the primary causal agent. It is more likely that any one of a number of species (Botrytis, Alternaria, Aspergillus and others) may invade the moribund tissues and make trouble. In Wisconsin, Johnson's investigations indicate that *Alternaria tenius* is the primary cause.

Effect of environmental conditions: As previously indicated, a high humidity in the shed is especially favorable to pole sweat. High temperatures are also favorable. Prolonged periods of fog or of rainy weather, since they give no opportunity for the leaf surface to become dry, are particularly conducive to sweat. Hanging tobacco too closely prevents proper air drafts between the leaves and is thus favorable to sweat.

Control: Since there is no known method of disinfecting the leaves or destroying the fungi, the logical method of control is to regulate the rate of cure properly. Keep the temperature and humidity in such a balance that the conditions are unfavorable for infection and spread of the disease, but favorable for curing. Methods of doing this are discussed under curing on page 735.

INSECT PESTS

All species of insects which have been reported as injurious to tobacco in Connecticut are discussed in this chapter. Some of them, like wireworms, cutworms and flea beetles, are of major importance and occur every year. Others, such as thrips and springtails, come only during certain seasons, but at these times may do serious injury, while such regular perennials as hornworms and grasshoppers rarely make trouble. Among those that appear infrequently in Connecticut and are relatively harmless are the stalk borer, corn root webworm, budworm, cranefly maggot and the tarnished plant bug. Various other insects may be found on tobacco at times, but since they do little or no damage, they are not listed here.

Insect pests may also be divided into groups according to the part of the plant they attack. The stalk borer, wireworm, seed corn maggot, cranefly maggot, etc., work only on the stalk. A much larger number—among them the flea beetles, hornworms and grasshoppers—damage the leaves. Cutworms injure both stalk and leaves, while budworms sometimes eat the seed pods. No insects are known to cause serious injury to the roots of tobacco.

The following key to insect injuries is included in the hope that it may facilitate identification of the insects through the type of injury produced.

KEY TO INSECT INJURIES

I. Small seedlings in beds in two or four-leaf stage defoliated. Tiny purple insects just visible to naked eye. *Springtail.*

II. Buds attacked before leaves unfold

1. Unfolding leaves distorted and curly but not with large holes. Brown mottled bug one-quarter inch long *Tarnished Plant Bug.*
2. Unfolding leaves ragged and misshapen with irregular large holes. Green slender worms with pale longitudinal stripes, up to one and one-half inches long *Budworm.*

III. Mature leaves in the field damaged
1. Main veins silvery above and peppered with minute black specks. Tiny, brown, slender, sucking insects one twenty-fifth inch long *Thrips.*
2. Numerous little "shot holes" eaten by small, black, active, jumping beetles, one-sixteenth inch long *Flea Beetle.*
3. Large rounded holes between the veins eaten by large, variously colored (never black) hoppers with prominent hind legs *Grasshoppers.*
4. Holes much as in 3, above, but eaten by dirty gray or brown, fat caterpillars *Climbing Cutworm.*
5. Large holes, or extensive areas without regard to veins, eaten away by large green caterpillars up to four inches long, with prominent horn-like appendage at rear *Hornworm.*

IV. Young plants cut off near surface of ground by plump gray or brown caterpillars, up to two inches long, which eat at night and curl up in the soil during the day *Cutworms.*

V. Inside of stalk of young plants tunnelled out, causing them to wilt and die.
1. Hard, brown, shiny, slender worms up to one and one-half inches long in tunnels or in surrounding soil *Wireworms.*
2. Soft little white maggots one-quarter inch long in stalk *Seed Corn Maggot.*
3. Single large, soft, grayish-brown caterpillar, up to one and one-half inches long, with longitudinal stripes on back and sides, in the tunnel *Stalk Borer.*

VI. Holes or notches eaten into sides of young stalks
1. Tough leathery gray maggots, one inch long, with four protuberances on head *Cranefly Maggot.*
2. Dirty yellow or brown worm one-half inch long accompanied by webwork. Girdles plant and tunnels to some extent *Corn Root Webworm.*

THE GARDEN SPRINGTAIL*

This species sometimes causes injury in the seed beds by eating off the leaves of the young plants in the very early stages. Shortly after the seed has germinated, and only the two cotyledons or the first pair of true leaves have appeared, the plants begin to disappear. Close examination of the beds at this time shows many naked stalks (hypocotyls) standing up without any leaves or with only remnants of partly eaten leaves. Large areas in the beds are entirely denuded of plants.

The insects which are responsible are so small and inconspicuous that they can be seen only by careful search at close range. When the sun is shining, however, they may be found on the plants, or on the surface of the ground or on the side boards. They are only about one-twenty-fifth of an inch in length, dark purple, spotted with yellow. When disturbed, they jump like fleas so that it is almost impossible to catch them. Each has a globular shaped body with a rather large head and slender neck. From beneath the body extends a forked tail-like appendage by means of which the insect is able to throw itself.

Remedy: The springtail can be controlled by spraying the beds on bright sunny days with nicotine sulfate diluted at the rate of one pint in 50 gallons of water. The glass sash should be kept tightly closed on the the beds just after spraying. It may be necessary to repeat this treatment

Sminthurus hortensis Fitch.

at intervals of two or three days. Two pounds of laundry soap may be added as a spreader.

TARNISHED PLANT BUG*

Although this insect is of common occurrence in Connecticut, the amount of damage caused is not large. It pierces the young growing buds in the field and sucks the juice. As a result of its feeding, the newly unfolding leaves become twisted and curly. The adult bug is about one-quarter of an inch long and less than half as broad. It is flat, oval in outline and brown, but mottled with irregular splotches of white, yellow, and black. Along the side of the body at the posterior third is a clear yellow triangle tipped with a small, round, intensely black spot. Apparently this bug does not breed on the tobacco plants but comes there only to feed. It winters under leaves, trash, bark of trees and in similar concealed places, and appears early in spring on weeds and grass. When disturbed it flies rapidly away.

Remedy: No method of controlling the tarnished plant bug is known.

TOBACCO BUDWORM**

Budworms are not often serious in Connecticut although in southern tobacco districts they are major tobacco insect pests. During certain years, however, they have been known to cause considerable damage here. They appear in the field when the tobacco is partly grown. Tiny, pale green, striped caterpillars[1] burrow through the young leaves which are still folded together in the bud. As the leaves unfold and become larger, the insect holes also become larger and the leaves ragged, distorted and worthless. As the caterpillars grow they feed on the more mature leaves. At the end of two or three weeks they are about one and one-half inches long, pale green and marked with longitudinal stripes. At maturity they leave the plants and burrow beneath the soil where they winter as mahogany-colored, hard-shelled, spindled-shaped pupae about three-quarters of an inch long. In the spring the moths emerge and deposit eggs singly on the underside of the leaves. The moths have a wing spread of about one and one-half inches. Front wings are light green crossed by oblique lighter bands. There are probably two broods of these moths in Connecticut yearly. Later in the season the larvae may be found boring holes into the seed pods.

Remedies: If these pests do not become more numerous than they are now in Connecticut, the most economical method of control probably will be careful hand picking.

In sections where they are more common, a pinch of a mixture of one pound of arsenate of lead in 75 pounds of corn meal is applied by hand, or by means of a sifter can, to the bud of each plant before the larvae get into it. During severe infestations it is necessary to do this twice a week.

**Lygus pratensis* Linn.
***Chloridea virescens* Fabr.
[1] Rusty brown when first hatched, change to pale, green striped when one-half inch long.

TOBACCO THRIPS*

Thrips are not usually considered serious insect pests of tobacco in Connecticut. It is only during dry growing seasons that they are noticed. All types of tobacco are affected but the injury to shade tobacco

FIGURE 146. Thrips damage. The white veins seen on these cured leaves are caused by feeding of thrips while the leaf is growing.

is most serious because of the higher value of the leaves. Symptoms of infestation appear first on the lowest leaves and then work upward toward the center of the plant. As seen in the field, the principal veins of the

*Frankliniella fusca Hinds.

affected leaves have a silvery appearance which makes them stand out from the remaining green tissue. The symptoms are seen only along the main veins of the upper leaf surface. Close examination shows the silver lines peppered over with tiny black specks. Badly affected leaves may sometimes turn yellow and die prematurely. The insects themselves are not so often seen as is their work. They are slender, yellow in the larval and brown in adult stage, and about one twenty-fifth of an inch long. When disturbed the adults fly suddenly and disappear like fleas.

In the cured leaves, affected veins are more conspicuous than in the green leaves, because they now appear white against a brown background. (Fig. 146). They may be distinguished from the ordinary "white vein", which comes during curing, by the irregular outlines of the white strips and the presence of tiny black specks in them. The commercial value of the leaves is seriously impaired because there is no demand for cigar wrappers with white veins.

Remedies: Methods of controlling thrips are not as thoroughly tested as those against other tobacco insects. Experiments with a number of dusts and liquid sprays at the Experiment Station show that none of the dusts are effective. Of the sprays, "Cubor" diluted in water at the rate of 1 part to 200, or nicotine sulfate diluted at the rate of 1 part to 400 and containing soap or penetrol as a "spreader", or Pyrethrol at the rate of 1 to 200, all give fairly good control. These should be applied at weekly intervals beginning when the work of the thrips is first seen.

FLEA BEETLES

The potato flea beetle* causes serious damage to all types of tobacco here and appears to have increased in abundance during recent years, probably due to increased potato acreage in the tobacco region.

The adult beetles are black, oval in outline, and about one-sixteenth of an inch in length. When disturbed they jump and disappear suddenly. They can fly and are very active. They eat numerous small, rounded "shot holes" into or through the leaves, mostly from the under side (Fig. 147). It takes only a few such holes to make a leaf unfit for wrapper purposes; if the holes are more numerous the leaves are also unsuitable for binders. The amount of damage varies from year to year. During years of severe infestation, the flea beetle is the most destructive of all tobacco insects.

Depredations of these insects are usually noticed first in the seed beds at about the time that the plants are becoming large enough to set in the field. Numerous holes weaken the plants so that they are less able to withstand the shock of transplanting and many die shortly after being set out. The insects propagate rapidly and eat voraciously. It has been estimated that a flea beetle eats ten times its own weight each day.

After the infestation in seed beds and at transplanting time, the injury becomes less evident for a while. Then a second brood, returning in July,

*_Epitrix cucumeris_ Harris. The tobacco flea beetle, _Epitrix parvula_ Fabr., which is the common species in southern tobacco districts, has been reported on tobacco only once in Connecticut and is probably of little importance here.

causes damage to the large leaves that is of much greater significance than the early injury.

The adult beetles hibernate in large numbers under grass, weeds, or trash around the fields or beds. Those which appear first in the seed beds are the over-wintered adults. They lay eggs on the surface of the soil under the plants. These hatch out in a week or less and the slender white larvae burrow into the soil and feed on the fibrous tobacco roots. They become full grown in about two weeks. Then after four or five days in the pupal stage they emerge as adult beetles.*

This same species attacks other plants of the tobacco family, the commonest members of which are potato, tomato, night shade, pepper, egg plant, Jimson weed and ground cherry. It is a common observation that flea beetle infestations are worst on edges of tobacco fields adjacent to

FIGURE 147. Flea beetles caused this damage. Note the numerous small holes in the cured leaf.

potato or tomato fields. When the potato vines die in midsummer, th beetles migrate in great numbers to the adjacent tobacco and cause ex tensive damage.

Remedies: In the seed beds, Bordeaux Mixture applied as recom mended for control of wildfire is also effective in repelling flea beetle

In the field, dusting the plants with barium fluosilicate at the rate four or five pounds to the acre is the best method of control found to dat Since it is difficult to distribute evenly so small a quantity of material o

*Lacroix was unable to find any young stages (eggs, larvae, pupae) in the soil of tobacco fiel They are common in soil of adjacent potato fields, however, and this suggests that they may r breed in tobacco fields but that the adults migrate to the tobacco plants from elsewhere.

an acre, this substance is usually diluted with some light dust. Finely ground tobacco dust mixed at the rate of one part of barium fluosilicate to five or six parts of the dust gives excellent control and the color of the mixture leaves no objectionable deposit. This treatment should be applied as soon as beetles begin working and ought to be repeated at intervals of a week until they disappear. The application should be made during a calm part of the day. It is not necessary, however, that it be applied when the dew is on the leaves because the glandular hairs on the surface secrete a viscid substance that holds the dust.

This same treatment may also be used on seed beds.

GRASSHOPPERS

Grasshoppers of several species* feed upon the leaves of tobacco, leaving large, rounded, smooth-edged holes an inch or two in diameter

FIGURE 148. Grasshopper holes in shade tobacco leaf. The regular rounded margins of holes are characteristic. Such a leaf is worthless for cigar wrappers.

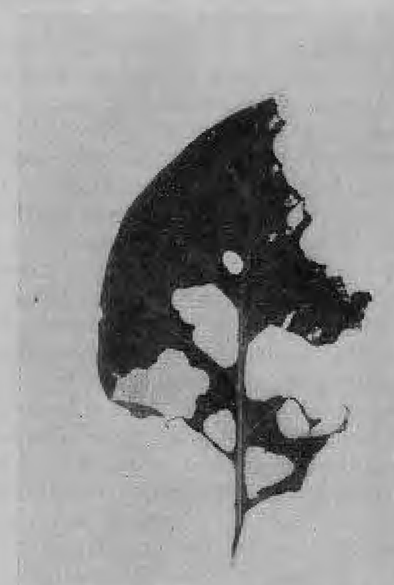

FIGURE 149. A climbing cutworm injured this leaf.

mostly between the veins (Fig. 148). Damage is usually worst around the edges of the field, especially when adjacent to grass or hay fields. Sometimes serious infestations occur, however, in the interior of fields, especially in new fields which were in grass the previous year.

*The red legged grasshopper, *Melanoplus femur-rubrum* DeG., is most common but frequently ccompanied by the Carolina grasshopper, *Dissosteira carolina* Linn. A number of other species, articularly the green grasshoppers or Locustidae, are responsible for considerable damage.

Remedies: Grasshoppers may be controlled by scattering a poison bran bait between the rows as for cutworms (see page 745). This should not be allowed to fall on the leaves because it will poison them and cause large dead spots. Another formula successfully used in Wisconsin is made up as follows:

Sawdust	100 pounds
Sodium arsenite	1 quart
Molasses	1 gallon
Salt	5 pounds
Water	7–10 gallons

This bait is spread on the ground 10 to 20 pounds to the acre. It is usually necessary to treat only the edges of the fields.

CUTWORMS

Cutworms cause considerable injury to young plants in the field every year. The amount of damage varies from season to season. Occasionally they cause extensive injury in the seed beds. The only reason the cutworm problem is not so serious as the wireworm problem is that effective remedies against cutworms are well known.

The type of injury most often observed is produced when the worms eat entirely or nearly through the stalk, just at the surface of the ground, and the plant drops over and dies. Frequently only the tender bud is cut off and the plant sends out several suckers from below, producing a many-stalked and worthless plant. Some kinds of cutworms climb the stem and eat holes in the leaves much like those produced by grasshoppers or hornworms. In severe infestations, the greater part of the leaf web may be eaten away (Fig. 149). Others sever the petioles of the leaves. Even the stalk eaters feed on the leaves also.

Cutworms are the larval or caterpillar stage of Noctuid moths. Twenty-two different species of them feed on tobacco in the eastern part of the United States. Probably a half-dozen species occur in New England.* They are soft, fat, dirty gray to brown, variously marked with darker spots or lines on the back, from one to two inches in length and curled into a perfect circle when resting in the soil. Most of the species have one generation annually in this section. The eggs are laid on grass or weeds in the late summer, and the larvae hatching from them feed upon the smaller weeds, grass and other vegetation of the field. They are about half grown on the approach of cold weather when they go into the ground or under rubbish for protection during the winter. With the return of warm weather and green vegetation in the spring, they emerge from winter quarters and resume feeding. When, in plowing, all the weed growth is turned under, they have difficulty in finding sufficient food. Therefore they are very hungry when the young tobacco plants are set in the field and they attack them voraciously. Some species pass the winter in the pupal stage and the moths emerge in the spring.

*_Agrotis ypsilon_ Rott, the black cutworm, and _A. c-nigrum_ L., the spotted cutworm, are found perhaps most frequently.

Cutworms do their feeding at night and hide during the day. They are usually found curled up just under the surface of the soil around the base of the injured plants. The adult moths range from grayish to brown or black and have a wing spread of about two inches. They fly and lay their eggs at night and rest during the day in protected places on fences, trees, sheds, etc.

Remedies: Application of insecticides for control of cutworms is one of the routine operations in the growing of tobacco and is therefore discussed under the chapter on setting the plants (page 745).

The poisoned bran bait described for field use may also be used to control the worms in the seed bed. A dosage of 4 pounds (dry weight) to 100 square yards of bed is recommended. This may cause some burning of the leaves.

HORNWORMS*

Hornworms are commonly called "tobacco worms" because their large size and striking appearance makes them the best known of the tobacco insects. They are bright green with white diagonal stripes on the side, plump, about the size of one's finger and three or four inches long when full grown. A slender, curved, soft horn-shaped protuberance on the back near the posterior end is responsible for the popular name of hornworm. They first appear in late June or early July and increase in number until harvest. They continue to eat the leaves, even in the sheds, as long as the foliage is green. It is not definitely known whether there is more than one brood during a season but worms of all sizes may be found at the same time in the latter part of the summer. The small worms eat holes between the veins but larger worms devour great areas of the leaf, avoiding nothing but the largest veins. In severe infestations many plants are rendered quite worthless. These worms vary greatly in abundance from year to year. During some seasons hardly one can be found; at other times they are everywhere. On the whole, however, they cause a comparatively small amount of injury in Connecticut, much less than in the southern states, and cannot be regarded as presenting a major insect problem here.

Hornworms are the larval or caterpillar stage of sphinx moths, also called hawk or humming bird moths. The moths are colored various shades of gray, have large heavy bodies and long narrow wings. Just at dusk, frequently, they may be seen poised like humming birds before deep throated flowers from which they sip the nectar by means of long tongues. At other times the tongues are coiled up like watch springs under the head. The moths lay their eggs singly on tobacco leaves. The larvae which hatch from the eggs feed three or four weeks on the leaves, growing rapidly, and then burrow under the ground. Here they transform into mahogany-brown, hard-shelled, spindle-shaped pupae, about two inches long, with slender tongue cases projecting from the front and bent forward on the body like jug handles. They pass the winter in this stage and emerge as moths about the first of June.

*There are two species in Connecticut, the northern tobacco worm, _Phlegethontius quinquemaculata_ Haw., and the southern tobacco worm, _Phelegethontius sexta_ Johan. The former is more common here.

Remedies: These worms would probably be much more numerous and destructive if they were not kept in check by natural enemies. It is not unusual to find numerous cylindrical white cocoons of a wasp-like parasite on the backs of some of the worms. Worms thus parasitized never recover but the parasites emerge and lay their eggs on other hornworms. When such parasitized worms are found they should not be killed because they serve to propagate parasites.

Dusting with arsenate of lead powder at the rate of 5 pounds to the acre, or spraying with the same material in water at the rate of 1-1/2 to 2 pounds to 50 gallons of water, is a method used in southern states to control hornworms. No doubt this could be used successfully here in severe infestations.

As a rule, however, the larvae are not so numerous but that they may be most economically picked off by hand and destroyed. Also during all cultural operations, workmen should be instructed to find and kill the worm every time they see an eaten leaf.

WIREWORMS*

The knottiest insect problem which confronts the Connecticut tobacco growers is the control of wireworms. These worms are the grubs or larvae of click beetles (Elateridae). They are slender, shiny, hard, about an inch in length, and colored from yellow to chestnut brown. They cause the greatest damage just after the plants are set in the field. Entering the stems below the surface of the ground, one or several of the worms eat out the interior and make tunnels up through the stalk. In severe infestations a dozen or more of them may be found in the soil close around one plant. The riddled plants usually wilt and die quickly; in fact many of them are attacked so soon after setting that they never recover from the initial wilt following transplanting. Some plants not too severely injured, however, recover and make normal but belated growth.

The infestation rarely affects a whole field with equal severity. Usually there are patches from a few square rods to several acres in size, where the worms are most abundant, while other parts of the field may be free from them. Such patches frequently persist in the same location through two or more seasons. This is probably due to the fact that the insect lives more than one year in the larval stage. The severity of infestation, however, varies from year to year. During some seasons they can hardly be found at all; during others they are widespread and destructive. Also they have a habit of disappearing very suddenly from a field, usually in the first half of June when the soil becomes hot and dry. They leave the plants and burrow deeper into the ground. During this same period the adults—flat, elongated, narrow, black or dark brown beetles, about an inch long—emerge and may be found in large numbers on the cloth of the tents of shade plantations. They appear especially on the side walls.

If the infestation is not too severe, the grower attempts to keep his "stand" by frequent restocking. Such a practice results in uneven stands in which the plants are in different stages of maturity at the time of harvesting, so that some leaves will be too green or others too ripe. This undesirable condition is more serious in shade tobacco than in outdoor types. When the number of affected plants is as high as 30 per cent, it is better to harrow up all of them and set the field again. Sometimes this measure must be repeated.

Pheletes ectypus Say, the Eastern field wireworm. *Limonius plebejus* Say has also been found in tobacco and there may be others.

Remedies: No entirely satisfactory remedy for wireworms has been found. Often they may be escaped by delaying the setting of the field until the middle of June. There are some disadvantages, however, from other standpoints, in late setting. Many growers, especially growers of shade tobacco, do not like to delay setting so long. Moreover, during some years, the worms are still present even at that late date. Yet as a general principle, it is worth while to set those fields, or parts of fields, last which were found to be infested during the previous year.

A great many repellent or toxic materials dissolved in the water of the setter barrel and thus deposited in the soil around each plant have been tried. Among these are camphor, turpentine, naphthalene, carbon disulfide, sulfonaphthol, pyrethrol, Red Arrow, rotenone and various proprietary repellents. None of them has given sufficient control to pay for the cost of the material.

The most promising results up to the present have come from using the cyanogas method. This consists in attracting worms to a bait crop and then poisoning them with cyanogas (calcium cyanide). Rows of corn, beans, peas, or cereals are planted in the infested soil in early May or perhaps the last of April. All the worms in the soil will be attracted and will congregate in and around the germinating seeds. Then the cyanogas, which is of about the consistency of gun powder and flows easily from a spout, is drilled into the row, three or four inches below the surface, by means of a fertilizer drill or seed drill. The gas diffuses out into the soil and kills all the worms within several inches. The plants are also killed. About 100 pounds of cyanogas to the acre is the recommended dose.

A more practical method for tobacco growers is to use tobacco plants themselves as the bait crop. The field is set with tobacco in the usual way. If it should happen to be a year when wireworm infestation is absent or very light, there is no need of further worry. If, however, the infestation of the field or parts of the field is severe, the cyanogas may be applied in the rows and the worms destroyed. After four to seven days the majority of the worms will be dead and the field may then be harrowed and reset with tobacco in the regular way.

The cost of material—about $20 to $25 an acre—is the main objection to this method.

SEED CORN MAGGOT*

The ravages of this insect are not often seen in Connecticut but during some years it has assumed destructive proportions locally. It is likely that the injury caused by seed corn maggots has often been attributed to wireworms because the tunnels of both are much alike. The plants are

Hylemyia cilicrura Rond.

attacked shortly after they are set in the field. The insects enter the stalk just below the surface of the soil and eat tunnels up through the interior. When the stalks are cut open, one or more soft, yellowish white maggots, about one-quarter inch long, with sharp pointed heads will be found in the tunnels. As a result the plants either wilt and die, or they remain sickly for a while and then make a belated growth. Such a condition necessitates restocking and often the whole field must be harrowed over and reset with fresh plants. The period of infestation is usually short and the insects disappear suddenly. The maggots are the larval stage of a two-winged fly which lays eggs in the spring in soil where there is an abundance of decaying vegetable matter. The most serious cases that the writer has seen were on fields where clover had been plowed under in the spring, or where a heavy application of manure had been made.

Remedy: The infestation lasts only a few days. By daily examinations of the plants, the grower may determine the date of disappearance of the maggots and it is then safe to set the field with fresh plants. This method has been successful in eliminating further trouble in all cases which have come to our attention.

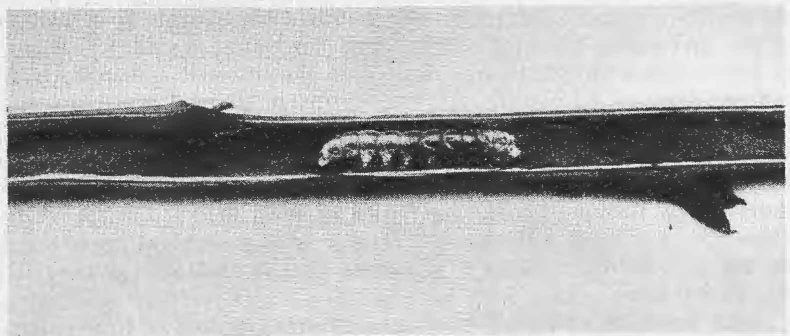

FIGURE 150. Stalk borer in tunnel. This stalk has been cut longitudinally to show the tunnel and insect.

STALK BORER

The stalk borer cannot be considered a serious insect pest of tobacco. Occasionally scattered plants, especially along the margins of the field near weed borders, are attacked. Their work is not noticed until the plants suddenly wilt. When the stalk is cut open longitudinally, the pith will be found entirely bored out and a single larva somewhere in the tunnel (Fig. 150). The mature worm is about one and one-half inches long, grayish brown, with one white longitudinal stripe along the back, paralleled by two white stripes on each side. Dark lateral stripes extend forward upon the sides of the head. A dark band or girdle encircles the third thoracic and first three abdominal segments. This borer is the larval stage of a moth.

Remedy: The insect has never been found sufficiently numerous in this state to warrant special efforts to control it.

CRANEFLY MAGGOT*

Damage to tobacco from this insect has been reported only once and it is probably of minor importance. Shortly after the plants were set in the field, holes or notches were eaten in the sides of the stalks just below or at the surface of the soil. This caused many of them to die while others were stunted so that it was necessary to harrow up and reset the whole field. The maggots are tough and leathery in texture, gray, about an inch long, with four horn-like protuberances at the head. They pupate in the soil and emerge as two-winged flies with extremely long legs, hence called "crane" flies.

Remedy: No method of control can be recommended.

CORN ROOT WEBWORM OR STALK GIRDLER**

Only one infestation of this sod webworm has been reported in Connecticut. However, it is known to cause damage in other tobacco sections, and since it is possible that it has caused other injuries here which were mistakenly ascribed to wireworms, it may be of more common occurrence than suspected. The following description is given by Lacroix who reported it in 1931.

"This worm, living beneath the soil, girdles the stalk of newly set plants just below the soil surface, and eventually enters the stalk and tunnels upward. It is a small active worm about one-half inch long, dirty yellow to light brown and always accompanied by a lot of web and silk strands. At first sight, a field infested with this insect looks much as though wireworms were at work, but an examination of the plant stems shows a girdling as well as a tunnelling.

"Pupation takes place in an earthen cell made up of silk webbing and loose soil. These tough cells are pear shaped and from one-half to three-fourths of an inch in length. They were found from one to three inches below the surface of the soil. The adult is a small light brown moth about half an inch long, of nervous temperament, flying with rapid zig-zag movements, and always darting to cover when disturbed.

"The insect belongs to a large group of stem girdlers that ordinarily feed on grass and weeds, and this fact probably explains how it happened to occur on tobacco. The plantation was in sod the year before tobacco was planted, which was ideal for the development of the girdler. On plowing and planting to tobacco, the natural food was not available, so the larvae attacked the crop present."

Nephrotoma ferruginia Fabr.
***Crambus caliginosellus* Clem.

APPENDIX

CONSTRUCTION OF A SHADE TENT

The object of growing tobacco under cheese cloth is to produce thinner, smoother leaves with smaller veins, thus more suitable for fine cigar wrappers. These changes in leaf characteristics are induced not alone by the shade effect of the tent but equally by the increased humidity, the reduced evaporation and wind velocity. Conditions in such a tent approach those of a moist tropical climate. The tent also affords some protection against hail, wind whipping and possibly some insects.

In the first tents constructed at the beginning of the present century the cloth was supported on cross beams of wood but these were soon

FIGURE 151. Scene under the shade tent in June.

supplanted by wires. All tents in the valley are almost uniform in pattern now. The wires over which the cloth is stretched are stapled to chestnut posts which are set 33 feet apart each way. These posts are in straight, exact rows, in either direction, the cross rows being exactly at right angles with the long rows. Peeled chestnut poles of a length of 12 feet, and a minimum top diameter of four or five inches, are now in use. These posts last five to ten years and when once set are not changed except when the grower wishes to abandon growing shade tobacco on a field. The poles are set three to three and a half feet in the ground and the wires are stapled to the sides of the post 6 to 12 inches from the top. The wires are commonly kept on the same side of all the posts, but some growers prefer to have the wires run alternately on opposite sides of the posts in a row, believing that this is a stronger construction. Wire is

spliced with a hand tool called a "wire splicer" such as is used by telephone linemen. Before the tent cloth is laid over these splices, they are wound and covered thoroughly with some extra pieces of material to prevent the top cloth from being torn.

Wire and staples are galvanized to avoid rust which would wear through and tear holes in the cloth. The staples are common, galvanized, one and a half inch fence staples. Two sizes of wire are used; number six gauge, a pound of which makes about 10.28 feet, and number eight, at about 14.37 feet to the pound. Number six is stronger and some growers prefer to use this size only. The more common practice, however, is to use number six the long way of the field—the cloth is thus sewed to the large wires—and the smaller number eight gauge for cross wires. Using number six wire alone would require about 260 pounds to the acre without any allowance for the bottom wires and anchor wires, while number eight alone would require about 185 pounds. The amount required for ground wires and anchor wires depends on the shape and size of the field.

All outside posts are anchored to "dead men", pieces of post about three feet long, laid horizontally three feet under ground at a distance of about four feet directly opposite and outside the post. The anchor wire is cut to a length of about 16 feet, wound around the top of the post and then around the center of the dead man at such a distance that when the dead man is dropped into place the wire will be taut. It is then firmly buried. When the top wires are stretched, the anchor wires become tighter. Many shade growers prefer to use double anchor wires. Larger timbers are used for corner posts and they are anchored in both directions.

The bottom of the side cloth is attached to a ground wire stretched along the outside base of the poles. Since it is necessary to open the ends of the tent for cultivating and other cultural operations, the ground wires along the ends are attached by loops or rings to taut, vertical wires on the corner posts, in such a way that they may be slipped readily up and down. The ground wires along the sides of the tent, however, are stapled fast like the top wires. An additional wire about half way between the top and ground wires is stapled on the sides. A wire in this position cannot be used on the ends of the tent but some growers place a wire within about a foot of the top wire for supporting the cloth when it is rolled up to open the ends for cultivation. The ground wire along the ends is kept in position by hooks at the bottom of the posts.

It is necessary that all wires be tightly stretched. First, the wires are securely attached to the posts at one end by wrapping them around the top and winding the loose end around the wire just inside the post. Then they are attached loosely to every second pole across the field by driving the staple only half way in. After the wire is stretched, by means of a double pulley block and tackle at opposite ends of the field, the staples are driven securely into every pole. Winches and various other wire stretching equipment are used by different growers.

The cloth, which is used to cover the tent and form the side walls, is a specially prepared cotton cloth sewed in strips just 400 inches wide and 125 feet long. It is purchased in bales of 400 to 450 pounds, four strips in a bale. One bale will cover about one and one-eighth acres. Two different weights of cloth are in use: A lighter cloth in which there are eight threads to the inch each way, and a stronger cloth in which there are eight one way and ten the other. Groups of re-inforcing closer strands are spaced about 18 inches apart the long way, and 14 inches the short way. The advantage of the heavier but somewhat more expensive cloth is that it will not be so easily torn by high winds or hail. The cloth is used only one year on the top of the tent but a part of the top cloth is commonly doubled and used as side wall the second year.

DIRECTIONS FOR ATTACHING THE CLOTH

Select a calm day. Do not attempt to sew the cloth to the wires in a strong wind.

Place the side wall cloth on the ground around the outside of the frame.

Place the first piece of top cloth on top of the wires lengthwise of the field, between the first and second rows of poles.

Begin at the outside wire on either end by tying one end of the top cloth to the corner post, allowing about one yard over-hang—enough so that you will have plenty of material to sew to the top wires at the end of the field.

Now, take one edge of the sidewall cloth and the edge of the top cloth. Place both together and roll around the side wire from the underside, pinning it into place by using ten penny wire nails. Place the pins about 16 inches apart.

The cloth should be pinned along the wire about 10 feet before sewing is begun. Always have cloth pinned to wires about 10 feet ahead of the sewer. Be sure to sew the cloth the full length of the field to the outside wire before starting to sew the cloth to the second wire.

When pinning the cloth to the wires, do not stretch it too tightly lengthwise of the field.

Begin sewing by starting as close as possible to the end post. Use 12-ply cotton twine doubled—with about 9 feet of string on the needle—and first wind the string around the wire and cloth two or three times and tie fast. You are now ready to sew. Use the lock stitch, spacing about four inches apart, and sew down the full length of the field.

Place the second piece of top cloth on top of the wires lengthwise of the field between the second and third rows of poles. Fasten the corner to the outside post in the second row, allowing one yard to overlap, and pin into position on the wires, following the same pinning process as that used on the first outside wire. Placing the two pieces of cloth together at the selvage, pin both to the second wire and sew.

When the cloth is stretched and pinned to the second wire, be sure to keep the cross re-enforcement threads at right angles to the wires. Otherwise the cloth will not be wide enough to reach from wire to wire at the end of the field. Keep the sheet straight.

Sew the top cloth to the ends of the frame by rolling all surplus cloth around the top wire, first fastening with pins.

Don't sew the side wall cloth on the ends until all the top cloth is in position. Stretch the side wall down tight, rolling any surplus around the wire, and sew it to the ground wire.

Table 1. Combined Production of all types of Tobacco in Connecticut. 1862–1933

Year	Acres	Yield per acre	Total pounds	Price per pound	Value
1839	.....	....	537,649*	....	....
1849	.....	....	1,405,920*	....	....
1859	.....	....	9,266,448*	....	....
1862	5,769	1300	7,500,166	14.0	$ 1,050,023
1863	6,000	1250	7,500,166	25.0	1,775,041
1864	6,828	1450	9,900,218	25.0	2,475,054
1865	6,050	1350	8,167,681	30.0	2,450,304
1866	6,534	1200	7,840,974	13.6	1,063,275
1867	5,263	1266	6,664,000	16.5	1,097,937
1868	4,871	1450	7,063,000	18.6	1,313,802
1869	4,482	1450	6,500,000	21.4	1,390,650
1870	5,996	1250	7,495,000	20.3	1,520,530
1871	4,761	1700	8,094,000	22.5	1,819,694
1872	5,052	1650	8,336,000	26.6	2,215,058
1873	5,220	1647	8,600,000	21.2	1,821,363
1874	7,224	1250	9,030,000	28.9	2,605,591
1875	6,600	1500	9,900,000	19.2	1,898,867
1876	6,203	1220	7,568,000	8.3	631,245
1877	.....	....	....	....	....
1878	5,800	1400	8,120,000	11.0	891,417
1879	6,900	1400	9,660,000	12.0	1,159,200
1880	10,070	1538	15,487,660	15.0	2,323,149
1881	8,753	1572	13,763,759	16.0	2,202,201
1882	8,665	1128	9,772,269	13.0	1,270,396
1883	8,145	1176	9,576,824	13.5	1,292,871
1884	8,064	1176	9,481,000	12.4	1,175,644
1885	7,661	1575	12,066,000	12.4	1,496,193
1886	7,292	1600	11,667,000	14.0	1,633,380
1887	6,198	1480	9,173,000	14.3	1,311,745
1888	6,136	1565	9,603,000	13.0	1,248,369
1889	6,331	1402	8,874,924	12.5	1,009,366
1890	6,394	1600	10,230,400	16.0	1,636,864
1891	6,458	1620	10,461,960	19.5	2,040,082
1892	7,104	1600	11,366,400	21.0	2,386,944
1893	7,459	1429	10,658,911	14.0	1,492,248
1894	6,713	1516	10,176,908	16.0	1,628,305
1895	6,579	1509	9,928,000	16.5	1,638,120
1896	6,579	1550	10,197,450	13.0	1,325,668
1897	6,908	1100	7,598,800	....	....
1898	6,563	1250	8,203,750	....	....
1899	10,119	1673	16,930,770	18.0	3,047,539
1900	10,948	1684	18,435,765	15.0	2,833,041
1901	11,782	1586	18,682,319	15.0	2,756,221
1902	12,725	1712	21,785,200	16.0	3,485,632
1903	13,234	1600	21,174,400	15.5	3,282,032
1904	12,705	1685	21,407,925	22.6	4,838,191
1905	13,340	1725	23,011,500	17.0	3,911,955
1906	14,140	1735	24,532,900	18.0	4,415,922
1907	14,400	1510	21,744,000	11.5	2,501,000
1908	13,824	1680	23,224,320	17.0	3,948,134
1909	16,000	1752	28,110,000	16.5	4,638,000
1910	16,000	1730	27,680,000	16.5	4,567,000
1911	17,000	1625	27,625,000	20.5	5,663,000
1912	17,500	1700	29,750,000	24.1	7,170,000
1913	18,400	1550	28,520,000	21.0	5,989,000

*All New England.

TABLE 1. COMBINED PRODUCTION OF ALL TYPES OF TOBACCO IN CONNECTICUT. 1862–1933—*Continued*

Year	Acres	Yield per acre	Total pounds	Price per pound	Value
1914	20,200	1770	35,754,000	18.5	6,614,000
1915	22,200	1350	29,970,000	17.0	5,095,000
1916	22,200	1630	36,186,000	27.0	9,770,000
1917	24,000	1400	33,600,000	38.4	12,902,000
1918	25,000	1500	37,500,000	44.0	16,500,000
1919	28,000	1535	42,980,000	48.1	20,673,000
1920	30,000	1365	40,950,000	45.7	18,714,000
1921	30,800	1440	44,352,000	31.3	13,882,000
1922	28,000	1065	29,820,000	40.5	12,077,000
1923	29,000	1410	40,890,000	47.5	19,423,000
1924	28,900	1368	39,535,000	29.3	11,584,000
1925	30,000	1352	40,560,000	26.5	10,748,000
1926	22,400	1340	30,016,000	36.7	11,016,000
1927	24,200	1223	29,597,000	36.2	10,714,000
1928	25,000	1190	29,750,000	37.0	11,008,000
1929	20,800	1370	28,496,000	48.1	13,707,000
1930	23,400	1385	32,409,000	37.1	12,024,000
1931	22,500	1300	29,250,000	23.8	6,970,000
1932	15,400	1435	22,099,000	18.7	4,143,000
1933	11,600	1352	15,683,000	25.7	4,037,000

TABLE 2. ACREAGE AND PRODUCTION OF SHADE TOBACCO IN ALL NEW ENGLAND. 1900–1933.

Year	Acres	Total thousands of pounds
1900	1/3	
1901	41	
1902	720	
1903	625	
1904	33	
1905	40	
1906	40	
1907	70	
1908	200	
1909	400	
1910	1000	
1911	1995	
1912	1906	
1913	1840	
1914	2574	
1915	3609	
1916	4939	
1917	5917	
1918	6223	
1919	4866	5772
1920	5930	5393
1921	7382	7543
1922	8000	6792
1923	8400	9639
1924	6900	7385
1925	4580	4830
1926	5210	5322
1927	7100	6387
1928	8000	6923
1929	8700	10215
1930	7400	7712
1931	5800	5693
1932	4500	4499
1933	4700	4928

TABLE 3. HISTORICAL RECORD OF CONNECTICUT TOBACCO BY TYPES. HARVESTED IN 1919–1933*

Year	Acres harvested	Acre yield	Total production	Farm price per pound	Total value
Broadleaf					
1919	16,800	1600	26,880,000	45.1	$ 12,109,000
1920	17,700	1465	25,930,000	40.0	10,365,000
1921	17,000	1546	26,282,000	20.0	5,273,000
1922	12,800	1120	14,336,000	30.0	4,296,000
1923	13,200	1510	19,932,000	35.0	6,984,000
1924	14,900	1497	22,305,000	20.0	4,461,000
1925	18,400	1400	25,760,000	19.1	4,908,000
1926	13,200	1400	18,480,000	26.1	4,814,000
1927	12,700	1309	16,624,000	21.0	3,483,000
1928	12,000	1310	15,720,000	21.0	3,303,000
1929	7,900	1451	11,463,000	27.1	3,106,000
1930	11,900	1495	17,790,000	25.1	4,461,000
1931	12,800	1409	18,035,000	14.0	2,525,000
1932	9,300	1580	14,694,000	11.5	1,690,000
1933	7,000	1490	10,430,000	11.5	1,199,000
Havana Seed					
1919	6,100	1580	9,638,000	31.0	2,988,000
1920	6,100	1449	8,839,000	36.0	3,182,000
1921	6,200	1500	9,300,000	23.0	2,139,000
1922	8,000	1125	9,000,000	29.0	2,610,000
1923	8,100	1460	11,826,000	35.0	4,139,000
1924	7,800	1345	10,491,000	19.0	1,993,000
1925	7,500	1380	10,350,000	17.0	1,760,000
1926	4,700	1463	6,876,000	28.0	1,925,000
1927	5,400	1343	7,252,000	23.0	1,668,000
1928	6,000	1300	7,800,000	24.0	1,872,000
1929	5,500	1508	8,294,000	30.0	2,488,000
1930	5,500	1518	8,349,000	23.0	1,920,000
1931	5,000	1383	6,915,000	13.0	899,000
1932	5,300	1556	8,247,000	9.0	742,000
1933	2,800	1458	4,082,000	9.0	367,000
Shade					
1919	3,900	1180	4,602,000	105.	4,832,000
1920	4,700	890	4,183,000	100.	4,183,000
1921	5,700	1040	5,928,000	95.	5,632,000
1922	6,300	846	5,330,000	90.	4,797,000
1923	6,800	1130	7,684,000	100.	7,684,000
1924	5,500	1050	5,775,000	85.	4,909,000
1925	3,800	1048	3,982,000	100.	3,982,000
1926	4,200	1000	4,200,000	98.	4,116,000
1927	5,700	900	5,130,000	105.	5,389,000
1928	6,600	858	5,663,000	100.	5,663,000
1929	7,200	1170	8,424,000	95.	8,003,000
1930	6,000	1045	6,270,000	90.	5,643,000
1931	4,700	915	4,300,000	82.	3,526,000
1932	3,700	1006	3,722,000	59.	2,196,000
1933	3,800	1070	4,066,000	80.	3,253,000

*Estimates of the Crop Reporting Service of the U. S. Department of Agriculture.

TABLE 3. HISTORICAL RECORD OF CONNECTICUT TOBACCO BY TYPES. HARVESTED IN 1919–1933—*Continued*

Year	Acres harvested	Acre yield	Total production	Farm price per pound	Total value
Primed Havana					
1919	1,200	1550	1,860,000	40.0	744,000
1920	1,300	1320	1,848,000	50.	924,000
1921	1,700	1495	2,542,000	30.	763,000
1922	700	1249	874,000	30.	262,000
1923	400	1600	640,000	42.	269,000
1924	600	1373	824,000	23.	190,000
1925	300	1560	468,000	21.	98,000
1926	300	1533	460,000	35.	161,000
1927	400	1478	591,000	30.	177,000
1928	400	1418	567,000	30.	170,000
1929	200	1575	315,000	34.9	110,000
Roundtip					
1920	100	1500	150,000	40.	60,000
1921	200	1500	300,000	25.	75,000
1922	200	1400	280,000	40.	112,000
1923	500	1616	808,000	43.	347,000
1924	100	1400	140,000	22.	31,000

TABLE 4. ACREAGE OF TOBACCO BY TOWNS AND BY TYPES. 1925–1933*

Town	Type	1925	1926	1927	1928	1929	1930	1931	1932	1933
Avon	H	67.5	38.0	28.0	31.0	35.5	34.5	31.0	29.5	8.0
	B	.....	.....	.....	.....	.....	.....	1.5	.5	.5
	S	25.	26.	57.5	57.5	60.	62.	52.	21.	25.2
		92.5	64.	85.5	88.5	95.5	96.5	84.5	51.0	33.7
Barkhamsted	H	20	14	14	29	13	13	12	12	8
Bloomfield	H	147	142	149	143	149	141	94.5	77	49.5
	S	276	270	415	456	518	460	384	200	260
		423	412	564	599	667	601	478.5	277	309.5
Bridgewater	H	43.7	36.7	35	33.5	28.5	19.2	15.9	10.5	6
Brookfield	H	69.8	67.8	58.8	49.3	44.8	38.8	28.5	21	7
Canton	H	49.5	42	36	33.5	42	41.5	44	38.8	13.8
	B	.....	.....	.....	.....	.....	.....	3	.....	.....
	S	23	23	23	23	21	17	.....	.....	.....
		72.5	65	59	56.5	63	58.5	47	38.8	13.8
Cromwell	H	73	67	63	63.5	49.5	49.5	48.5	48.5	8.8
	B	40.5	35.5	23	23	14	62	55	57	57
		113.5	102.5	86	86.5	63.5	111.5	103.5	105.5	65.8
East Granby	H	528.2	472.7	528.7	481.7	420.7	427.5	466.9	447.2	276.2
	B	8.5	34.5	8.5	8.5	8.5	14.5	31.5	.....	.....
	S	127	128	163	167	262	251	289	216	263
		663.7	635.2	700.2	657.2	691.2	693.0	787.4	663.2	539.2
East Haddam	B	15	33.1	3.5	10	5.5	10.5	6.5	.....	.....
East Hartford	H	51	32.5	32.5	86.5	77.5	55	51	22	22
	B	2152.2	2067.2	2163.7	2065.2	1930.7	1834.2	1836.2	1389.4	1009.1
	S	.....	.....	183	390	487	318	186	115	130
		2203.2	2099.7	2379.2	2541.7	2495.2	2207.2	2073.2	1526.4	1161.1
East Windsor	H	8	8	8	124	35	49	11	79.8	3
	B	1996	1867.3	1834.3	1727.3	1841.8	1893.5	1959.3	1380.3	1035.9
	S	251	331	543	691	794	364	205.5	150	191
		2255	2206.3	2385.3	2542.3	2670.8	2306.5	2175.8	1610.1	1229.9

*Census of acres planted. Data collected in January, 1934, by enumerators in each tobacco town under the provisions of the Civil Works Act.

TABLE 4. ACREAGE OF TOBACCO BY TOWNS AND BY TYPES. 1925–1933—*Continued*

Town	Type	1925	1926	1927	1928	1929	1930	1931	1932	1933
Ellington	H	.....	.....	.....	25	15	15	3	3	.....
	B	688	625	678.5	650	686.7	811.8	885.5	573.3	341.5
	S	357	375	380.5	368	330	141	85	69	74
		1045	1000	1059.0	1043	1031.7	967.8	973.5	645.3	415.5
Enfield	H	400.5	363.2	394.3	457	441	439.5	408.6	350.1	164.1
	B	748.7	717.8	741.2	729.2	798.2	804.7	822.2	718	545
	S	243	325	412	632	562	604	577	398.5	225
		1392.2	1406.0	1547.5	1818.2	1801.2	1848.2	1807.8	1466.6	934.1
Glastonbury	H	20	.....	.....	44	37	3	3	7	.....
	B	1423.3	1367.8	1365.8	1329.8	1386.3	1428.7	1434.2	1055.4	681.8
	S	36	20	25	25	25	25	.....	.....	.....
		1479.3	1387.8	1390.8	1398.8	1448.3	1456.7	1437.2	1062.4	681.8
Granby	H	307	298	286	281	271.5	262	249.2	189.7	55.2
	B	12	12	12	12	16	16	10	10	10
	S	224	91	218	573	603	571	382	332	369
		543	401	516	866	890.5	849	641.2	531.7	434.2
Hartford*	H	.....	.....	85	35	35	.....	.....	41	40
	B	145	40	325	350	255	935	624	220	315
		145	40	410	385	290	935	624	261	355
Kent	H	89	84.1	75.6	70.6	57.8	50	41.2	22.2	9.2
Manchester	H	.....	.....	22	.....	22	.....	.....	.....	.....
	B	563.5	492	477	505	471.5	504	549.5	399.9	231
	S	225	214	278	315	321	228	110	156	188.5
		788.5	706	777	820	814.5	732	659.5	555.9	419.5
Middletown	H	4	4	8	11.5	13.5	9	9.5	2	.....
	B	27	27	29.8	24.8	21.8	21.6	20.6	7	2
		31	31	37.8	36.3	35.3	30.6	30.1	9	2
New Hartford	H	22.5	20.5	23.5	24.5	25.5	35	32	28.5	9
	B	.....	.....	.....	.....	.....	14.5	14	.....	.....
	S	37	39	35	36	34	4	.....	.....	.....
		59.5	59.5	58.5	60.5	59.5	53.5	46	28.5	9
New Milford	H	727.6	676.4	668.6	615	536.8	519.8	454.5	348.3	154.6

*This acreage was reported by Hartford firms but grown in other towns. The enumerators did not allocate it to the towns. No tobacco is grown in Hartford.

TABLE 4. ACREAGE OF TOBACCO BY TOWNS AND BY TYPES. 1925–1933—*Continued*

Town	Type	1925	1926	1927	1928	1929	1930	1931	1932	1933
Portland	H	182	146	142.5	142	137.5	112	109.5	102.5	52.5
	B	15	15	15	15	15	15	15	7	4.5
	S	.....	.....	2	10	93	145	149	187.5	156.5
		197	161	159.5	167	245.5	272	273.5	297.0	213.5
Roxbury	H	45.5	44.7	38.7	37.2	28	20	20	11	9
Sherman	H	58.5	48.5	48	43.5	47	41.5	40.5	26.7	9.5
Simsbury	H	255.5	213	242	225.3	212.3	189.8	218.5	163.5	73
	B	18	18	15	24	29	49	6	.....	.....
	S	390	520	706	690	674	550	380	181	209
		663.5	751	963	939.3	915.3	788.8	604.5	344.5	282
Somers	H	55.3	53.3	56.3	69.3	62.3	60.3	60.3	58.4	25.5
	B	166.5	161	169	182	180	208	238.5	140.8	73.8
	S	45	43	45	.....	.....	.....	.....	.....	.....
		266.8	257.3	270.3	251.3	242.3	268.3	298.8	199.2	99.3
Southbury	H	2.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	.....
South Windsor	H	.....	18	18	33	20.5	20.5	18	22	18
	B	3611.6	3421.6	3363.6	4523.3	3366.3	3364.5	3355.5	2449.2	2108.5
	S	50	187	274	240	343	123	35	57	67
		3661.6	3626.6	3655.6	4796.3	3729.8	3508.0	3408.5	2528.2	2193.5
Suffield	H	2047.5	2025.0	2053.5	2023.2	2099.7	2272.5	2295.1	2180.0	1373.6
	B	450.5	481.5	543.5	551.5	544	612	663	522.5	414.9
	S	375	228	291	404	487	251	363	174	213
		2873.0	2734.5	2888.0	2978.7	3130.7	3135.5	3321.1	2876.5	2001.5
Vernon	H	.....	.....	.....	14	14	.....	.....	.....	.....
	B	146	155.5	131	112	129.5	142.5	155	126.5	75.8
	S	62	25	60	70	82	73	80	75	36
		208	180.5	191	196	225.5	215.5	235	201.5	111.8
Washington	H	25	23.5	18	11.5	7	7	7	6	4

TABLE 4. ACREAGE OF TOBACCO BY TOWNS AND BY TYPES. 1925–1933—*Continued*

Town	Type	1925	1926	1927	1928	1929	1930	1931	1932	1933
Windsor	H	1091.2	1028	965.7	1044.2	967.2	893.2	936.3	864.4	458
	B	200.5	164.5	128	189	207	316	210	44	65.7
	S	768.5	985	1389	1369	1557	1687	1394	1140.5	1356.5
		2060.2	2177.5	2482.7	2602.2	2731.2	2896.2	2530.3	2049.9	1877.2
Windsor Locks	H	139.5	125	135.5	142	124	63.5	118	100.2	25
	B	307	285	285	329.8	297.5	363.8	383.8	151.4	110.1
	S	107	107	160	161	175	150	54	.....	.....
		553.5	517	580.5	632.8	596.5	577.3	555.8	251.6	135.1
Total for the state*	H	6531	6993	6236	6475	6072	5884	5829	5314	2883
	B	12735	12021	12312	13361	12204	13422	13280	9252	7082
	S	3622	3937	5660	6678	7428	6024	4758	3473	3764

*Discrepancies between these totals and those in Table 3 are partly due to the fact that these represent acres *planted* while those in Table 3 are acres *harvested*. Moreover these are census figures while those in Table 3 are crop estimates.

TABLE V. AVERAGE ANALYSES OF MATERIALS WHICH MAY BE USED IN A TOBACCO MIXTURE

Materials	Nitrogen (N)	Phosphoric Acid (P_2O_5)	Potash (K_2O)	Magnesia (MgO)	Lime (CaO)	Sulfate (SO_3)	Chlorine (Cl)
Cottonseed meal	6.6	3.	2.	.7	.3	....	....
Castor Pomace	5.0	2.	1.	.8	.8	....	.8
Linseed meal	5.8	2.	1.	.7	.5	....	....
Dry ground fish	8.6	7.	1.1	.4	8.0	5.0	.2
Hoof and horn meal	15.0	......	...	.....	...	....	....
Peruvian guano	15.0	9.	2.	.....	...	....	1.6
Urea	46.0	......	...	.....	...	....	....
Calurea	34.0	......	...	.1	14.0	....	....
Nitrate of Soda	15.4	......	...	.....	...	....	.5
Nitrate of Lime	15.4	......	...	.3	28.0	....	....
Nitrate of Potash (German)	12.3	......	44.	.....	...	....	.6
Nitrapo (Nitrate of Soda and Potash)	14.5	......	12.	.....	...	....	.7
Ammonium Phosphate (Ammophos A)	11.0	46.	...	.....	...	....	....
Ammophos (20–20) (Ammophos B)	16.5	20.	...	.....	...	....	....
Precipitated bone	....	38.	...	.....	45.0	.7	1.5
Steamed bone	1.7	28.	...	.....	33.0	.4	.2
Bone meal	2.5	24.	...	.....	28.0	.4	.2
Superphosphate	....	16.	...	.....	28.0	5.4	....
Cottonhull ash	....	3.	28.0	5.	11.0	2.4	.2
Wood ashes	....	2.1	6.5	5.7	36.0	2.4	.5
Sulfate of potash	....	......	48.0	1.3	.2	43.6	1.6
Double manure salts	....	......	26.0	11.	...	46.7	2.0
Carbonate of potash	....	......	64.0	.....	...	....	.5
Ground tobacco stems	1.3	.7	5.5	1.5	10.0	1.2	....

With these analyses before him and keeping in mind the principles on which the mixture should be based, the grower may figure out dozens of good formulas.

If he buys ready-mixed goods, he should insist that they conform to the principles laid down above.

CIRCULARS

ISSUED AND DISTRIBUTED DURING 1933-34

Circular 94 December, 1933

Connecticut Agricultural Experiment Station
New Haven

TESTING VEGETABLES FOR CONNECTICUT

RESULTS FOR 1933

LAWRENCE C. CURTIS

Plant growth and crop production show differences from year to year according to the prevailing weather conditions. Consequently the best strain or variety of any kind of vegetable for any one year cannot be expected to be the most desirable or productive every year. Promising strains and varieties must, therefore, be grown for several years before their worth and adaptability can be determined.

The 1933 season at Windsor was characterized by a marked deficiency in rainfall during the principal growing months of May, June, July and August. During these same months there was also an increase in the mean temperature as compared to the averages over a period of years. The figures are given in Table 1. The rainfall for 1933 was obtained at Windsor, and the average rainfall and the temperature records from the Weather Bureau at Hartford.

Seasonal conditions for even a series of years may run above or below the average for rainfall, temperature, humidity, and wind velocity. Whatever results are obtained from growing crops must be interpreted in relation to the weather conditions prevailing during the seasons in which the crops were grown.

Considerable interest has been shown in the production of sweet potatoes. During the past several years this crop has made a good growth and has given satisfactory yields of marketable roots. However, growing conditions for this crop have been unusually favorable. The next few years may not be so advantageous to sweet potatoes, and satisfactory results may be difficult to obtain. Sweet potatoes have long been grown for home use in southern New England, but have seldom proved to be profitable as a market garden crop.

TABLE 1. WEATHER IN 1933

Month	Rainfall		Mean temperature	
	1933	Average	1933	Average
April	4.13	3.36	47.4	46.7
May	1.58	3.60	62.2	57.5
June	1.96	3.08	69.5	67.1
July	2.43	4.37	72.5	71.6
August	3.42	4.29	71.2	68.9
September	4.85	3.49	65.6	61.7

Beans

Considerable difficulty has been experienced by Connecticut growers in obtaining a satisfactory strain of Horticultural beans, particularly of the pole variety. Some of the common faults are that the plants fail to grow properly, the pods are not large enough, and the color markings are not distinct.

Several strains of climbing beans known as Worcester, Italian, and Cranberry were grown at Windsor, but all varieties were so badly infected with mosaic disease that no crop was obtained. There is a real need for beans of this type resistant to mosaic infection.

The dwarf varieties of Horticultural beans are apparently more immune to this trouble. Satisfactory crops were obtained, although the pods were not as large or as well colored as most growers prefer. The varieties grown were as follows.

French Dwarf Horticultural — F. H. Woodruff and Sons
French Dwarf Horticultural — Comstock-Ferre and Co.

Both lots practically identical, pods large, well filled, brightly colored. Latest to mature. Yields ranged from 515 to 711 pounds of dry shelled beans per acre.

Ruby Dwarf Horticultural — F. H. Woodruff and Sons; F. S. Platt Seed Co.

Both lots practically identical, small, well filled pods, very little color on pods. First to mature. Yields ranged from 755 to 1002 pounds of dry shelled beans per acre.

Low's Champion

Pods well filled, green, stringless. Medium maturity. Can be used as a green pod, green shelled, or dry shelled bean. Yielded 900 pounds of dry shelled beans per acre.

Edible Soy Beans

Soy beans are being grown in increasing quantities in the Middle Western states where they are used for cattle feeding and for the production of oil. In Asia the soy bean has long been a staple crop. There,

many different varieties have been developed especially for human consumption. W. J. Morse, of the United States Department of Agriculture kindly sent us a collection of 27 different lots of these edible soy beans for trial. They were sown at Mount Carmel early in June and most of them matured dry seed. A few were still green at the time of the

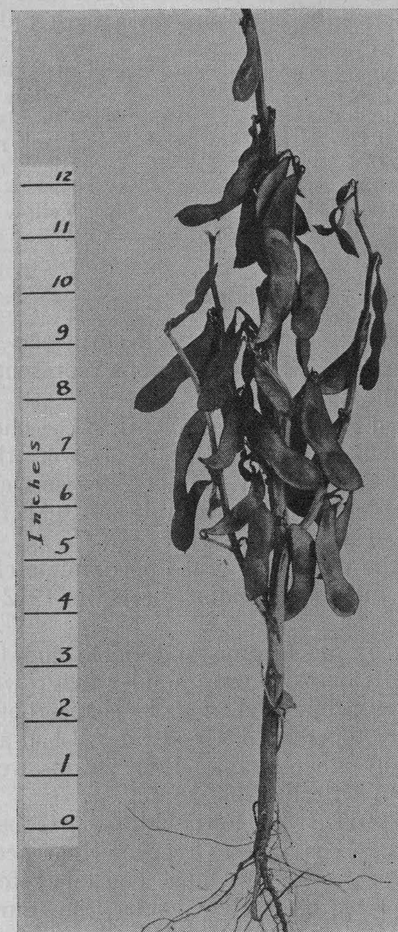

FIGURE 1. Edible soy beans with seeds as large as small lima beans

first killing frost, but were apparently not injured for table use. Lima beans growing at the same time were completely destroyed.

These soy beans are used as green shell beans. The pods are small and rather difficult to shell. The green beans have an excellent flavor, are drier, and slightly different in taste from shell or lima beans. If it were not for the difficulty in picking and shelling, they would be a valuable addition to the list of garden vegetables. Their use will probably be confined to those sections where lima beans do not produce well. Soy beans are attacked by the bean beetle, but usually less damage is done than to other beans. Most of the varieties have an upright growth with scant foliage and are easy to dust or spray.

The following varieties have the largest pods and seeds of those grown. The color given is that of the mature seed. Before maturity the black seeded varieties vary from a light pink to a dark red.

U. S. D. A. No.	Color of mature seeds
81031	Yellow
81039	Greenish black
81042	Black mottled
86024	Black mottled
86038	Black
89006	Yellow

Beets

The number of Detroit Dark Red strains of beets was reduced from nine in 1932, to five in 1933. These selections represented, in our opinion, some of the best of the 1932 trials.

The seed was drilled in the field on April 23. The rows were made 70 feet long and 14 inches apart, and the roots were thinned to 4 inches. In the first part of the season, they did not grow as well as was expected. Observations were made and recorded July 24. All figures in the table represent percentage of marketable roots.

For the most part the trials this year approximate closely those of last year. Three of the most outstanding beets in 1932 were outstanding this year.

Ohio Canner from J. M. Lupton and Sons, and Good-for-All from the Ferry Morse Seed Company were similar in growth, habit, and size. Ohio Canner had a low proportion of globe-shape roots, only 4 per cent. Most of the roots were top-shaped. Good-for-All had a higher percentage of globe-shape than any other strain. Both strains were uniformly dark in color and free from objectionable zoning.

Detroit Dark Red 9011 from Ferry Morse has been a high quality beet for several years. It is true to type and has been free from wide white zones. This indicates its hereditary constancy for these characters.

Among the Crosby type, or Early Wonder, the four most outstanding strains were: L7.11M, T4.10M, T1.5M, all of the Associated Seed Growers, and 9309 from Ferry Morse. They produced a high proportion of beets with indistinct zones and they were uniform in shape and size.

The Wyman strain of Crosby's Egyptian from which the Early Wonder strains are supposed to have originated, was grown this year. This strain has been continued by the Waltham Vegetable Field Station at Waltham, Mass. Only 3 per cent of the roots of this strain had a dark interior color and only 16 per cent were free from wide white internal zones. When we compare this strain with what seedsmen consider ideal for garden beets there is indeed a wide discrepancy. For example, of the strain L7.11M from the Associated Seed Growers, 72 per cent of the

roots had a dark interior color as compared with 3 per cent for the Waltham Station strain. Similarly, this strain had few beets that were free from zoning—only 17 per cent, while L7.11M had 88 per cent.

Table 2. Beets

Variety	Percentage of marketable roots							
	Size	Shape			Inside color			Zones
	Medium	Globe	Top	Oblate	Dark	Medium	Light	Indistinct
Good For All Ferry-Morse Seed Co.	50	51	33	15	94	6	0	100
Detroit Dark Red, 9011 Ferry-Morse Seed Co.	64	41	54	5	92	8	0	100
Detroit Dark Red, 318 Joseph Harris Seed Co.	82	26	66	8	83	17	0	96
Ohio Canner J. M. Lupton and Sons	53	4	94	0	93	7	0	95
Detroit Dark Red L4.1M Associated Seed Growers	38	18	80	2	60	32	8	88
Early Wonder L7.11M Associated Seed Growers	54	1	98	0	72	23	5	88
Early Wonder T4.10M Associated Seed Growers	58	2	98	0	45	42	13	83
Crosby's Egyptian T1.5M Associated Seed Growers	60	5	90	0	62	31	7	79
Early Wonder 9309 Ferry-Morse Seed Co.	61	12	85	0	35	55	10	73
Crosby's Egyptian J. M. Lupton and Sons	58	24	72	0	33	33	34	69
Early Wonder Field Station, Waltham, Mass.	45	0	100	0	3	15	73	17
Early Wonder 332-62 F. H. Woodruff and Sons	68	5	95	0	35	54	0	11

Carrots

Like the beets, the carrots were drilled in rows 70 feet long, and 14 inches apart on April 23. Observations were recorded on July 24.

Only nine lots of carrots were grown this year. Each was quite consistent as to type and shape. However, a large percentage of the roots was small, probably due to the prevailing dry weather.

Among those grown were representatives of the long types: Tendersweet and Perfection from the Joseph Harris Seed Company, Imperator from Associated Seed Growers, and Hutchinson from the Waltham Field Station.

These all have long slender roots, even longer, as a rule, than Danvers Half Long. Some are pointed and others have what is called a rat-tail root end. These roots were all put under the Danvers type, but in many cases it was difficult to determine in what class a particular strain should belong. Each of these varieties was distinct in some one characteristic. For example, Imperator had cylindrical roots and resembled an exaggerated Nantes type; Hutchinson was long and tapering; Tendersweet had a dark orange color with a purplish tinge at the crown. Perfection has a short top. None of these types fit into our interpretation of a true Danvers type, although we have called them such in our classification. In Table 3, the first column gives the percentage of all roots that were marketable, and the other columns show the classification in percentage of these marketable roots.

TABLE 3. CARROTS

Variety	Grade	Percentage of marketable roots						
		Type			Size			Core
	Marketable	Chantenay	Danvers	Nantes	Small	Medium	Large	Indistinct
Red Cored Chantenay 26766x Associated Seed Growers	62	91	9	..	73	15	2	93
Red Cored Chantenay 338 Joseph Harris Seed Co.	69	88	12	..	74	26	..	93
Chantenay No. 16 Pieters Wheeler Seed Co.	57	74	26	..	58	42	..	88
Chantenay 337 Joseph Harris Seed Co.	59	66	33	..	57	43	..	90
Danvers Half Long Pieters Wheeler Seed Co.	64	..	100	..	62	38	..	81
Danvers Half Long Joseph Harris Seed Co.	55	5	95	..	80	20	..	75
Tendersweet 308 Joseph Harris Seed Co.	68	..	100	..	90	10	..	93
Imperator N180.1 Associated Seed Growers	75	3	97	..	86	14	..	86
Perfection 346 Joseph Harris Seed Co.	45	4	77	13	85	15	..	93
Hutchinson Waltham Field Station	62	..	100	..	81	19	..	75

Sweet Corn

The most important development in sweet corn the past season was the marked increase in the injury from the bacterial wilt known as Stewart's disease. At Mount Carmel, the damage was especially severe. Some varieties showed all of the plants infected and many killed outright. Most varieties were seriously reduced in yield. Some went through the season with no apparent infection. In addition to bacterial wilt, both the corn borer and corn ear worm were unpleasantly prevalent in the early corn at Windsor.

On the light sandy soil at Windsor the first planting was made on May 3, in hills 3 by 2 feet, three stalks to a hill. A good stand resulted.

When the plants were beginning to tassel, counts were made on the number of plants clearly showing injury from bacterial wilt.

At Mount Carmel planting was delayed until May 26. The plants were spaced singly in rows 3½ feet apart and 14 inches in the row, equivalent to hills spaced 3½ by 3½ with three stalks in the hill. At this wide spacing and late planting, the early varieties were somewhat handicapped at Mount Carmel. At Windsor the dry weather during June and July reduced the yields of all varieties, particularly those ripening later.

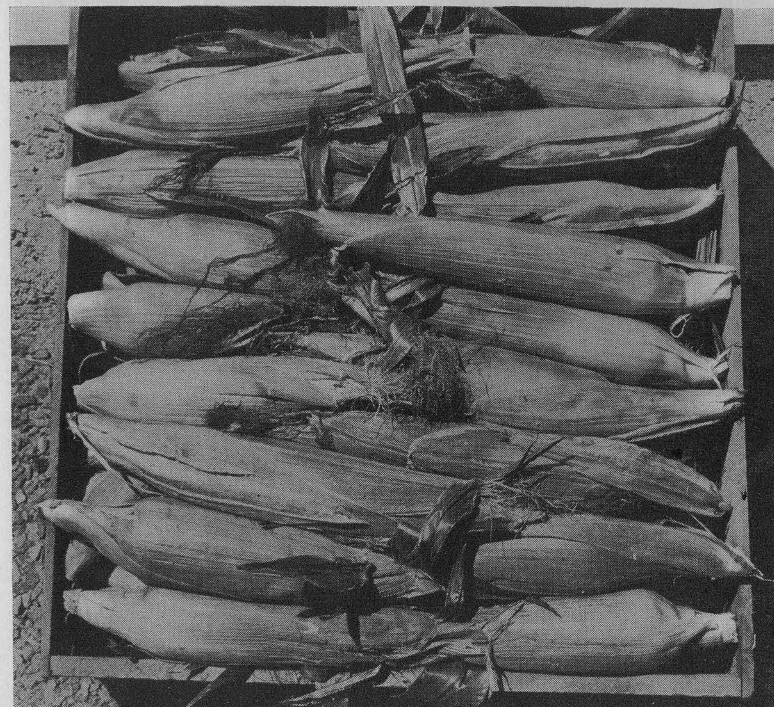

FIGURE 2. Spanish Gold

Spanish Gold was again the first variety to produce marketable ears at the early planting. The first picking was made July 14 at Windsor and the crop was finished by July 17. Golden Early Market was six days later in starting to ripen and was finished on July 22. There was a total of 10,176 marketable ears for the Spanish Gold as compared to 7,769 for the Golden Early Market. The difference was even greater at Mount Carmel where Spanish Gold produced more than twice as many ears.

The marked difference in productiveness was due in a large part to the noticeably greater susceptibility of Golden Early Market to bacterial wilt. It has been the common result in most parts of Connecticut during the past season for this variety to be badly injured. At Mount Carmel, 90.9 per cent of the plants were infected and at Windsor 13.4. Under exactly the same conditions Spanish Gold was much less injured, as shown in Table 4. The chief objection to Spanish Gold is the small size of ears and failure to fill out properly under certain conditions. Some growers have been able to overcome this by growing the plants on very fertile soil. There is a need for a large-eared variety that ripens at about the same time as Spanish Gold, and is more immune to bacterial wilt than Golden Early Market.

FIGURE 3. Top Crossed Spanish Gold resistant to bacterial wilt

Early Yellow Sensation from F. H. Woodruff and Sons is a locally grown corn that in previous trials was much the same as Golden Early Market in size and earliness. This past season it proved to be appreciably more resistant to bacterial wilt at Mount Carmel where the infection was more severe than on our other field. It was not grown at Windsor. At Mount Carmel it produced three times as many ears as Golden Early Market, was equal in stalk growth and in size of ear, and matured at approximately the same time. No record was made on the ripe ears, but the dates of first tassel and first silk were about the same as for Golden Early Market. Although it is by no means immune to the disease, it is worthy of more extended trial.

The Burpee variety is another early sweet corn that in previous tests seemed to have no advantage over other varieties of similar season. During the past season it has been slightly less injured by bacterial wilt than has been Early Yellow Sensation. The Burpee variety is also a little earlier in ripening. In spite of its comparative freedom from bacterial wilt it did not produce as many marketable ears. Our trial was limited, and we can say only that it appears to be worthy of further test.

The first generation cross of Spanish Gold by an inbred strain of Golden Bantam (Indiana 39) has shown the most immunity to bacterial wilt during the past season. (A cross of a variety with an inbred of this kind is called a top cross. A number of these top crosses are being produced at Mount Carmel and other places, and some of them are very promising.)

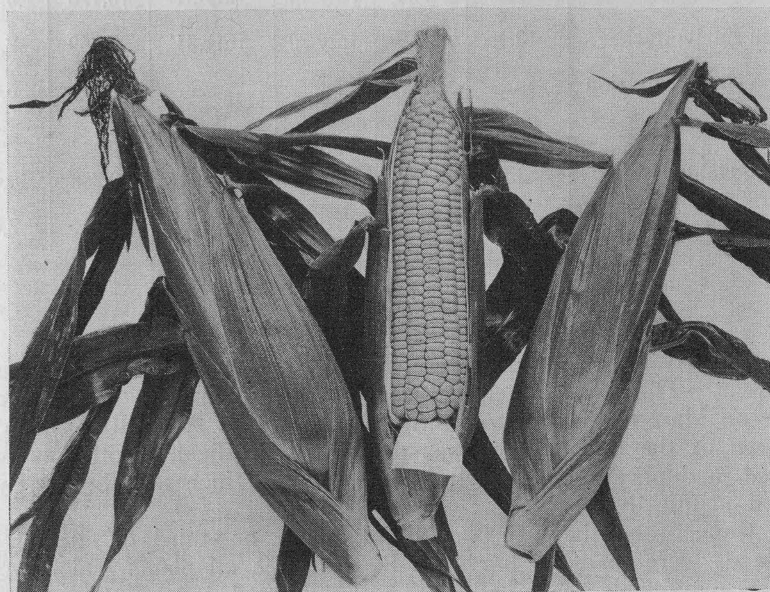

FIGURE 4. Whipple Cross with large well-filled ears grown on vigorous plants free from bacterial wilt

At Mount Carmel no plants of this Top Crossed Spanish Gold were infected. Only a small number was grown so the test is not so reliable as at Windsor where in more than 1,000 plants grown in three different parts of the field, only 3.5 per cent were diseased. The plants made a large and vigorous stalk growth, the ears were mostly 12-rowed, and were well filled. They were somewhat longer than Golden Early Market, but not so thick. More than 10,000 ears per acre of Top Crossed Spanish Gold were produced at both Mount Carmel and at Windsor, compared with 7,000 and 2,000 ears of Golden Early Market. Unfortunately this top cross is about a week later in ripening. Other top crosses with Spanish Gold are being produced that show equal freedom from disease, fully as large an ear, and early maturity. Some of these will be available for testing in 1934.

TABLE 4. SWEET CORN AT WINDSOR AND MOUNT CARMEL

Variety	Percentage bacterial wilt		Date of first picking		Number ears per acre	
	Windsor	Mt. Carmel	Windsor	Mt. Carmel	Windsor	Mt. Carmel
Spanish Gold	5.8	20.0	July 14	July 31	10,176	4,741
Golden Early Market	13.4	90.9	July 20	July 31	7,769	2,134
Early Yellow Sensation	...	35.7	......	......	......	6,519
Burpee	...	26.7	......	......	......	4,741
Spanish Gold x Ind. 39	3.5	0	July 27	August 5	10,258	10,668
Tendergold	...	55.2	......	August 8	......	7,408

Lettuce

Sixteen strains of lettuce were grown from both plants and seeds this year. The transplanted lettuce was started in flats in the greenhouse on March 10 and set directly in the field on April 10. On April 11, seed of the same strains was planted in the field. Both lots were planted in duplicate and spaced 14 inches by 14 inches. The lots were treated identically.

By June 5, on the transplanted lot, about one-third to one-half of the heads were ready to harvest. By June 19, all plants which would produce marketable heads had done so. The seeded lots were not ready to harvest until about June 30. Because the weather conditions this year were not as favorable for lettuce as last year, the percentage of marketable heads was much lower for every strain planted.

In the transplanted lots, New York 12 W.S. from Waldo Rhonert Seed Company, and New York 12 209.1 from Pieters Wheeler Seed Company, were highest in the percentage of marketable heads.

In the seeded lots, New York 4-820 from Pieters Wheeler Seed Company was highest in the percentage of marketable heads, and New York 12 W.S. from Waldo Rhonert Seed Company was second. New York 4-820 from Pieters Wheeler Seed Company was the only strain to produce a significantly larger percentage of marketable heads in the seeded lot than in the transplanted lot.

The highest yielding strain last year was New York 12 T297.5 from the Associated Seed Growers. Ninety-nine per cent of the transplanted plants and 92 per cent of the seeded plants produced marketable heads, while this year 80 per cent of the transplanted, and 53 per cent of the seeded plants, produced marketable heads.

We are trying to find a strain of lettuce of the New York type that will come to a satisfactory head during the last part of June and the first part of July. It is at this period that native head lettuce brings the highest price.

TABLE 5. LETTUCE

Variety			Percentage marketable heads	
			Transplanted	Seeded
New York	12 W.S.	Waldo Rhonert Seed Co.	85	62
New York	209.1	Pieters Wheeler Seed Co.	85	42
New York	T297.5	Associated Seed Growers	80	53
Imperial	D	U. S. Dept. Agriculture	79	55
New York	O.F.X	Pieters Wheeler Seed Co.	74	61
New York	56	Pieters Wheeler Seed Co.	73	50
New York	4051	Pieters Wheeler Seed Co.	60	22
New York	690x	Pieters Wheeler Seed Co.	58	37
New York	1-235	F. H. Woodruff and Sons	58	46
New York	4 D1x	Pieters Wheeler Seed Co.	55	33
New York	D296.1	Associated Seed Growers	50	46
New York	4-820	Pieters Wheeler Seed Co.	50	67
New York	514	Pieters Wheeler Seed Co.	47	50
New York	515	Pieters Wheeler Seed Co.	47	52
New York	831	Pieters Wheeler Seed Co.	47	49
New York	Select	Pieters Wheeler Seed Co.	37	29

Potatoes

Two new varieties of white potatoes originated by the United States Department of Agriculture at Presque Isle, Maine, were grown in comparison with Green Mountain at Windsor and Mount Carmel. Both of these potatoes resemble the Irish Cobbler in shape of tuber. Their growing season is longer, however, and in yield both compare favorably with late varieties. The outstanding features of these new potatoes, Katahdin and Chippewa, are their resistance to some of the virus diseases and the uniformity in size and shape of the tubers, which are round and smooth with shallow eyes.

The accompanying table shows the yields and grading percentage in comparison with Green Mountain.

Both Katahdin and Chippewa seem to be somewhat more susceptible to late blight than Green Mountain. The vines died earlier and probably for that reason the two new varieties did not compare so well in total yield. The proportion of first grade tubers was noticeably higher. Both varieties bake well and are firmer than Green Mountain when boiled. They produce an attractive crop and are worth trying by Connecticut potato growers. So far there seems to be little choice between the two new varieties. Chippewa in the Green Mountain territory has usually given the larger yields.

TABLE 6. POTATOES

Variety	Yield in bushels per acre		Percent No. 1
	Mt. Carmel	Windsor	Mt. Carmel
Green Mountain	430	378	84.4
Chippewa	408	...	91.2
Katahdin	387	266	93.8

Sweet Potatoes

The sweet potato has been considered as a crop to be grown on some of the land that formerly has been used for tobacco in this state. The results of the past season indicate that well developed roots and good yields can be obtained on the sandy soil characteristic of the Windsor farm. However, as stated before, the past season was above the average in mean temperature during the principal growing months and the rainfall was below the usual expectation. Both factors are favorable to this crop. Frost also held off until after October 7, when the roots were dug. In consequence of these factors, as good results as were obtained last year may not be repeated for some time.

Five varieties of distinct type were grown. Plants of some varieties were started from roots bedded in sand in electrically heated hot beds. The roots were started April 15 and the plants were pulled and set in the field early in June. Part of the plants were purchased in the south. They arrived in good condition and were set in the field with very little loss. It will probably be more satisfactory to buy the plants rather than the seed roots to grow plants from, provided healthy plants can be obtained.

The plants were set on top of ridges, 3 feet between the rows and the plants about 18 inches apart in the rows.

The varieties grown and the notes taken at the time they were dug are as follows.

Porto Rico
: Red outside, yellow inside color. Mostly large roots, varying from long and slender to round and chunky. Yielded 291 bushels per acre.

Maryland Golden
: Yellow outside, dark yellow inside color. Roots smooth, tapering, ranging in size from small to large. Prominent veins on many roots. Very attractive on account of color. Yielded 249 bushels per acre.

Nancy Hall
: Light pinkish yellow outside, bright yellow with pinkish streaks inside color. Roots blunt pointed, medium to large in size, chunky, ribbed, variable in size and shape. Yield not recorded.

Big Stem Jersey
: Light yellow outside, light yellow with some pinkish yellow inside color. Medium to small in size, short, blunt pointed, chunky, smooth. Yielded 235 bushels per acre.

Yellow Jersey
: Light yellow outside, light yellow inside color. Roots mostly medium in size, smooth. Tapering gradually at both ends. Most desirable in size and shape but many roots badly discolored at the time of digging. Yielded 312 bushels per acre.

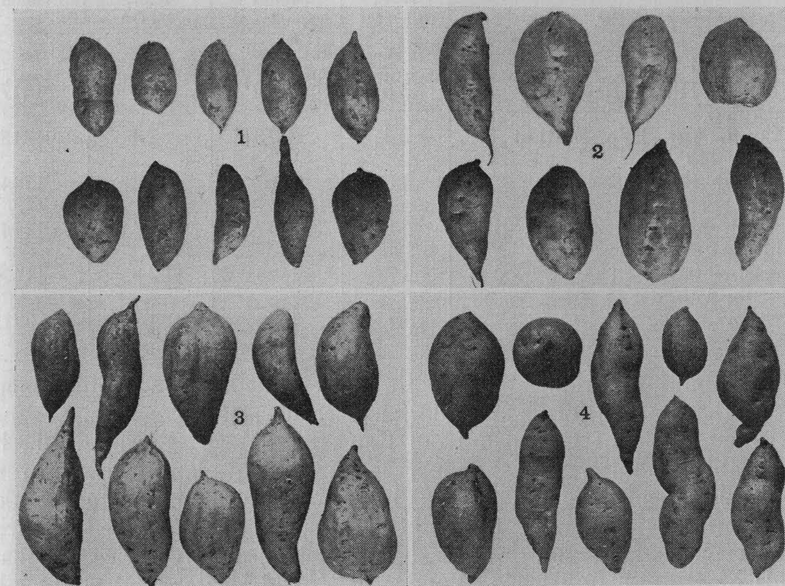

FIGURE 5. Four varieties of sweet potatoes grown at Windsor. (1) Yellow Jersey; (2) Nancy Hall; (3) Maryland Golden; (4) Porto Rico

Peppers

The five peppers grown during the past season represent the best varieties from previous trials, and include early, mid-season and late, yellow and red, thin-walled and thick-walled, and a variety of shapes and variation in smoothness. Bountiful continued to be the most productive pepper in the first part of the picking season, arbitrarily divided at August 1.

This yellowish-green pepper is so variable in shape that it is not suitable for stuffing and will not sell on some markets. It is a tender, well-flavored pepper that is being sold in increasing quantities in some parts of the state.

Early Giant produced a good yield both in the first and second parts of the season. The average weight of individual fruits was heavier in the first part. In color, size and early production, this continues to be the most popular pepper on the market.

TABLE 7. PEPPERS

Variety	Yield to August 1: Average weight of individual fruit, ounces	Yield to August 1: Yield per acre, pounds	Total yield to September 12: Average weight of individual fruit, ounces	Total yield to September 12: Yield per acre, pounds
Harris Early Giant, 443 Joseph Harris Seed Co.	3.6	3289	2.9	14179
Bountiful, 7 Conn. Agr. Exp. Station	2.3	3873	2.1	13156
Oshkosh, 446 Joseph Harris Seed Co.	4.0	1607	3.2	13448
Oshkosh E. C. Swartly, Sterling, Ill.	4.8	2777	3.4	14545
World Beater Associated Seed Growers	3.7	1544	2.9	11430
California Wonder Ferry-Morse Seed Co.	5.1	1544	4.8	10812

The attempt to produce a smooth, thick-walled, large-fruited pepper as attractive as California Wonder, but earlier, still goes on. A new red-fruited strain of Oshkosh from E. C. Swartly of Sterling, Ill., has considerable promise. This pepper is similar in plant growth to the yellow Oshkosh. The fruits are larger, equally smooth and thick-walled, but differ in having the pointed tip somewhat depressed. During the first part of the picking season it yielded nearly twice as many pounds of fruit as California Wonder or World Beater, and appreciably more for the whole season. It was the most productive pepper of the five grown, but had the serious fault of not breaking easily from the plants when picked. The tendency was to adhere to the branch, breaking the plants unless carefully handled. This made harvesting much slower and more difficult.

California Wonder continues to be the heaviest and smoothest pepper available at the present time, but it is surpassed in total yield by World Beater.

Tomatoes

Tomatoes were planted in flats in the greenhouse on March 10. Later they were transplanted to four inch pots and on May 22 set in the field. There they were planted in paired rows with 4 feet in the row, 4 feet between rows, and 6 feet between each pair of rows.

The dry hot weather throughout the latter part of July and the first of August seriously reduced the tomato yields. A large percentage of the fruit of the earlier varieties was unmarketable because of sun scald. The reason for this is that Bonny Best, Clark's Early, and John Baer, all early varieties, have somewhat of an open growth habit which offers less protection from the sun than the later varieties.

Pritchard, a new early type, was the only exception in this early group. This variety has abundant foliage and does not spread out as much as the other types, so the fruit is rather well-protected against sun scald. Of the 12 strains grown this year Pritchard was highest in the production of early fruit and in total yield. It also had the largest fruit at the beginning of the season, and the average weight of individual fruits throughout the season was surpassed only by Clark's Hybrid No. 2. The Pritchard has large, smooth, almost round fruit, but in color it has a yellowish cast, making it less attractive than the Bonny Best.

Last year the Pritchard was fifth in production with a yield of 25 tons to the acre. This year the yield was 21 tons to the acre, a decrease of only 16 per cent. This constancy of production in two widely different seasons indicates its merits and its adaptability to Connecticut conditions.

FIGURE 6. Tomatoes grown by the method of paired-row spacing

The superiority of the Pritchard is apparent when we consider the yields of other varieties for the two seasons. In 1932, Clark's 100 D47.3M from the Associated Seed Growers was the highest yielding variety with a record of 29 tons to the acre. This year it produced only 14 tons to the acre, a decrease of more than 50 per cent.

Clark's Early L 45.6M of Associated Seed Growers was a high yielding variety in 1932 with a yield of 24 tons to the acre. This year it yielded only 16 tons to the acre, a decrease of about 33 per cent.

Marglobe from Ferry-Morse was third in total production. This record was somewhat surprising. Ordinarily Marglobe has not come into bearing until later in the season and usually a large proportion of the crop is still on the vines when frost comes. This year the period of heavy production came between the middle of August and the first part of September.

The difference in yield between the Ferry-Morse strain of Marglobe and the Special Marglobe from F. H. Woodruff and Sons, as shown in Table 8, is significant.

The most uniform variety grown this year was a selection from John Baer. The seed was secured from W. H. Carrier of Glastonbury, who made the original selection several years ago and has continued to save seed from desirable plants. It is remarkably uniform in size, shape and color, smooth, free from cracks, deep red in color, and almost spherical in shape. In yield it is just below Clark's Early and higher than Bonny Best. It is an attractive tomato of high quality.

TABLE 8. TOMATOES

Variety	Yield to August 1		Total yield to September 5	
	Average weight of individual fruit, ounces	Yield per acre, pounds	Average weight of individual fruit, ounces	Yield per acre, pounds
Pritchard Associated Seed Growers	7.1	4287	4.2	42061
Marglobe Ferry-Morse Seed Co.	3.9	1361	3.5	33825
Clark's Early L45.6M Associated Seed Growers	3.7	2382	3.7	31920
John Baer W. H. Carrier	3.6	1905	3.0	30422
Bonny Best, 531 Joseph Harris Seed Co.	3.7	2654	2.8	29674
Bonny Best, 320 F. H. Woodruff and Sons	3.1	1497	2.8	28789
Clark's "100" D47.3M Associated Seed Growers	3.9	1701	3.9	27428
Special Marglobe F. H. Woodruff and Sons	3.5	952	4.0	26883
Clark's Early Hybrid T46.1M Associated Seed Growers	5.5	884	4.1	25522
Clark's "B" L41.1M Associated Seed Growers	3.6	1020	4.0	21575
Clark's Hybrid No. 2, D46.2M Associated Seed Growers	4.6	884	4.5	20690
Greater Baltimore Comstock-Ferre Seed Co.	3.7	408	3.2	13203

Appendix

Source of seed	Address
Associated Seed Growers	New Haven, Conn.
Carrier, W. H.	Glastonbury, Conn.
Comstock-Ferre & Co.	Wethersfield, Conn.
Ferry-Morse Seed Co.	Detroit, Mich.
Harris, Joseph, Seed Co.	Coldwater, N. Y.
Lupton, J. M., and Son	Mattituck, N. Y.
Pieters-Wheeler Seed Co.	Gilroy, Calif.
Rhonert, Waldo, Seed Co.	Gilroy, Calif.
Swartly, E. C.	Sterling, Ill.
Waltham Field Station	Waltham, Mass.
Woodruff, F. H., & Sons	Milford, Conn.

Circular 95 January, 1934

Connecticut Agricultural Experiment Station
New Haven

THE INTERPRETATION OF SOIL TESTS

M. F. MORGAN

Following the announcement of details in regard to Soil Testing Service in Circular 89 of this Station, large numbers of soil samples from fields, orchards, lawns and gardens have been examined for the citizens of the State. The results of these tests have been carefully studied in the light of all available information in regard to cultural methods, fertilizer practices and crop conditions, and data has been compared with results on soils of known fertility requirements. It is now possible to present certain interpretations of soil tests which should prove helpful to those who avail themselves of this service.

Soil Reaction

Soils may be acid (below 7 pH), neutral (7 pH) or basic (above 7 pH) in reaction. Most economic crop plants grow best at reactions between 5.8 and 7.6 pH. A slight acidity is rarely harmful, and is to be expected on the most fertile soils of this state. Medium degrees of acidity (5.0 to 5.8 pH) are desirable for crops troubled with diseases which prefer a less acid condition, as in the cases of potatoes and tobacco. Such crops as corn, timothy, oats, rye and tomatoes do well at medium acidity, if other conditions of fertility are favorable. Moderate liming is necessary for more acid-sensitive crops, such as alfalfa, spinach, lettuce, etc.

Very acid soils (below 5.0 pH) require liberal liming for most crops. Strawberries, blueberries, rhododendron, laurel, and azalea may be grown best on such soils, without lime application. Extreme degrees of acidity (below 4.5 pH) usually prove harmful to such lawn grasses as bent and fescue, which do not require liming on fairly acid soils.

It must be kept in mind that there is a considerable seasonal fluctuation in acidity, and heavily fertilized soils may be as much as one pH unit lower in midsummer than in early spring or late fall. Samples taken at the latter seasons may be more satisfactorily used as an index to the true conditions of the soil.

Ammonium and Nitrate Nitrogen

Nitrogen exists in the soil largely in the form of partially decomposed organic residues containing proteins. Micro-organisms (bacteria and fungi) gradually transform this nitrogen into ammonium compounds. Organic nitrogenous fertilizer materials and leguminous crop residues are more readily thus attacked, due to their high protein content. Some fertilizer materials, such as sulfate of ammonia and ammonium phosphates, add ammonium compounds directly to the soil.

Nitrogen in the form of ammonium compounds may be utilized as such by many plants, especially during their early growth period. Under normal field conditions this form of nitrogen is rapidly converted, first into nitrites, and then into nitrates, by certain species of bacteria. Hence soils rarely show high ammonia tests, unless they have been fertilized with nitrogen in this form during the past few weeks. At other times a high ammonia test is an indication of poor nitrification potentialities in the soil, as a consequence of high acidity, of poor soil aeration due to water-logging, or of some other abnormal factor.

Soils showing high ammonia tests cannot be reliably tested for potassium by the usual simple methods, due to interference of the ammonium ion in the chemical reaction.

Nitrate nitrogen, whether formed in the soil from nitrification of ammonia derived from organic residues and fertilizer materials or directly supplied in the fertilizer (as, for example, nitrate of soda), is rapidly assimilated by the roots of living plants, and is readily lost from the soil by the percolating action of heavy rains. Hence high tests for nitrate nitrogen in field soils are to be expected only when the root system of the crop is not yet fully developed.

High tests indicate a large reserve of readily available nitrogen for the use of the crop as it begins to draw heavily upon the soil. Rapidly growing annual crops require a larger reserve during the early part of their life in the soil, since the gradual processes of nitrogen liberation are rarely sufficiently rapid to meet their requirements during the period of most active growth. Crops with perennial root systems, such as sod grasses, shrubs and trees take up nitrogen through a much longer period of the year, and low nitrate tests do not necessarily indicate a lack of available nitrogen.

Low tests are to be expected at the end of the cropping period, during winter and early spring, and after a period of heavy rainfall. Under such conditions, when all other factors are favorable, the absence of nitrates may not indicate poor availability of soil nitrogen, but the crop is apt to respond to the addition of a readily available nitrogenous fertilizer.

In order to give a reliable indication of the amount of readily available nitrogen in the soil, tests may be made on samples which have been kept in "mellow-moist" condition, in a loosely covered vessel at a temperature of 60° F. or above for several weeks. Low nitrate tests on such samples indicate real nitrogen deficiency in the soil.

Abnormally high nitrate nitrogen tests are occasionally encountered in greenhouse and other intensively fertilized soils, and are an indication of possible injury to the crop due to excessive concentration of the nitrate salts. Such a condition may be corrected by leaching the soils with large amounts of water.

Phosphorus

Phosphorus occurs in unfertilized soils in slowly soluble mineral and organic combinations. It is a component of all mixed fertilizers, and is frequently applied directly as superphosphate.

Under high levels of fertilization, in excess of 800 lbs. per acre per year of fertilizers containing as much as eight per cent of "phosphoric acid", crops remove less phosphorus than is applied to the soil. This element is not leached downward. In soils of only moderate degrees of acidity, applied phosphates remain for long periods in fairly available form. On highly acid soils, containing much active aluminum and iron, more difficultly soluble phosphate compounds are formed with these elements. At low rates of fertilization the phosphorus supplied by the fertilizer results in little or no accumulation, and there may be a net loss when little manure or fertilizer is used. Under such conditions Connecticut soils usually receive no lime, and a high acidity and low phosphorus availability are the rule on most areas of this type.

The phosphorus test indicates the level of more readily available phosphorus in the soil, either native or as a residue from previous applications. There are marked differences in the abilities of various crops to thrive at different degrees of phosphorus availability. Most market garden crops, potatoes, tobacco, and most legumes require the additions of phosphatic fertilizers unless high tests are obtained. Many soils showing only medium tests grow good grass hay, corn, oats and alsike clover with very little phosphorus fertilization when otherwise in a fertile state. Low or very low tests indicate the necessity for proportionally high amounts of "phosphoric acid" in the fertilizer, depending upon the crop grown.

The active phosphorus content of the soil is a fairly stable property, except as affected by recent fertilizer application. Soils which have received direct applications of arsenical materials may give high tests, regardless of their phosphorus content, hence results in such cases are unreliable.

Potassium

Potassium occurs in soils in large amounts in the form of difficultly soluble rock minerals. Their gradual decomposition liberates small quantities of potassium which is loosely combined with colloidal material (clay and humus) capable of being displaced into the soil solution by base exchange reactions. Potassium is also added to the soil in fertilizers containing potash, or as manures or crop residues, and largely goes over into the exchangeable form. Some potassium is removed from the soil by leaching, especially when under cultivation and liberally fertilized.

The active potassium of the soil, capable of nourishing the crop, is that which exist in exchangeable form, or in true solution. This may now be readily determined by the simple soil testing method used by this Station.

Active potassium may be removed from the soil more rapidly than replenished by natural processes, thus tests may be lower at the end of the growing season of a crop with high potash requirements, than after the soil has been fallow or supporting little vegetation for several months. Hence, most reliable tests are obtained in the spring, prior to fertilization.

High potassium tests should be obtained on soils planted to vegetable crops, tobacco and potatoes. Potash fertilization cannot be omitted on such crops, at least for more than one or two seasons, even on soils showing very high potash tests, since the existing favorable conditions cannot long be maintained by natural soil processes.

Legumes and general farm crops, on soils in otherwise favorable degrees of fertility may require little or no potash fertilization when occasional applications of manure are used, if medium or high soil tests are shown. Soils with low and very low tests usually respond to the addition of potash to the soil, either in the form of fertilizer or manure, for most crops and permanent grass sods.

Calcium

Calcium in soils occurs in the form of undecomposed carbonates (in calcareous soils), rock minerals, as exchangeable calcium (absorbed by the soil colloids), and as soluble calcium salts. Acid soils contain no carbonates, and are depleted in exchangeable calcium. However, many soils which show a considerable degree of acidity by pH tests may have a fair amount of exchangeable calcium. This is especially true of soils high in organic matter or active mineral colloids. In many cases the calcium test is a better indication of lime needs than is the pH test.

Soils with high and very high calcium tests contain adequate amounts of calcium for all crops, and usually do not respond to liming, unless a high active aluminum concentration is indicated. Medium calcium tests on soils near the neutral point may be expected on light sandy soils, but on acid soils a need for lime is revealed, for alfalfa, sweet clover, and lime-loving vegetable crops. A low calcium test on soils with a high aluminum test is a certain indication of lime requirement for all except the most acid-tolerant plants such as blueberries, strawberries, or ericaceous shrubs. When a very low test results, lime should be used in liberal amounts for most crops, unless only moderate applications may be made with safety on account of disease factors, as in the case of tobacco and potatoes.

It must be borne in mind that unless all other tests are satisfactory, heavy liming may produce an abnormal soil balance. Thus liming has frequently proven injurious on many sandy soils of the south which are

deficient in other elements, such as magnesium, manganese, potassium or iron.

Magnesium

Magnesium occurs in soils in the form of dolomitic carbonates, unweathered minerals, as exchangeable magnesium, absorbed by the soil colloids and as soluble magnesium salts.

High and very high tests for magnesium are developed from calcareous soils derived from dolomitic limestones and moderately acid soils resulting from the weathering of rocks high in ferro-magnesian minerals. Medium tests are more common on soils of moderate acidity, on calcareous soils from high calcic limestones, or on soils which have been moderately limed with material of dolomitic origin. Low tests are common on acid soils. Some strongly acid soils give very low or negative tests. This is particularly true of sandy soils. In such cases magnesium should be applied. The cheapest form is in dolomitic lime or limestone. On soils giving high calcium and very low magnesium tests, magnesium sulfate (Epsom salts) is to be preferred. Commercial fertilizers are now available which supply magnesium in these forms.

Aluminum

Aluminum occurs in large amounts in all soils, in the form of undecomposed minerals and in the inorganic colloidal material. In neutral, slightly acid or slightly alkaline soils, the element is in inert combinations which have no direct effect upon plant growth. At greater degrees of acidity, aluminum becomes active, capable of combining as soluble salts and thus exerting a toxic effect upon the growth of many plants, especially those which are benefitted by liming when grown on acid soils. A high or very high test is a certain index of an undesirably acid soil, upon which acid sensitive crops are almost certain to fail. A medium test is not so serious, especially with grasses, corn, oats, potatoes, and tobacco. A low or negative test is desirable, except for distinctly acid-tolerant plants.

Manganese

Manganese occurs in small amounts in all soils, chiefly in relatively insoluble combinations. In some calcareous soils and acid soils which have been heavily limed, practically no manganese is present in active forms, and some crops are unable to obtain even the small amounts necessary to meet their requirements. Poor growth and a yellow, chlorotic condition results.

On the other hand, strongly acid soils may contain injurious concentrations of active manganese compounds. Under such conditions liming is a corrective measure.

Manganese is changed by oxidation to less active forms, or may be leached from the soil. Hence tests are of most significance when made just prior to planting or during crop growth. A negative test at such time indicates the desirability of applying manganese. Twenty-five pounds of commercial manganese sulfate per acre is usually adequate to correct any possible deficiency. It is doubtful if manganese is needed if any positive test whatsoever is developed. Medium or moderately low tests are of little significance, except as indicating no manganese deficiency. High or very high tests are undesirable, and indicate a need for lime.

Iron

Iron is an abundant constituent of all soils, existing in the form of iron oxides and many complex mineral combinations. Normally only very small amounts of iron are in active form in the ferric state of oxidation. Under conditions of high acidity, larger amounts are to be found, and under poor drainage conditions, especially in the presence of organic matter, active ferrous iron compounds are developed. Soluble ferrous salts are harmful to plant growth, and are a contributing cause to the infertility of poorly aerated soils.

The presence of very low, yet definite amounts of active iron, as revealed by the test, is desirable for all crops. Higher amounts, on well drained soils, may not be injurious to crops capable of growing under strongly acid conditions. Abnormally high iron tests on poorly drained soils is an indication of an unfavorable condition.

Negative iron tests may occasionally result on heavily limed soils of excessive sandiness. A chlorotic condition of the leaves may develop in such cases, which is controlled by spraying the plants with iron salts. No case of this sort has been encountered in this state.

Other Tests

Occasionally soils which give poor results contain unusual or harmful concentrations of other chemical constituents. Abnormally high tests for chlorine and sodium shows the presence of injurious amounts of common salt. Very high sulfate tests, on soils of unusual acidity, indicate the presence of harmful amounts of sulfuric acid. The presence of more than traces of nitrite nitrogen is likewise injurious, and is occasionally encountered on poorly aerated soils. In all questionable cases these possibilities should be fully investigated.

Other Factors Affecting Crop Growth

Soil testing to determine the nutrient conditions within the soil by means of comparatively simple tests is a comparatively new phase of soil science, and has been made possible by the rapid developments in our chemical knowledge during the present century. It promises to be a valuable contribution to the more intelligent management of the soil, helping to forestall crop failure due to improper fertilization and preventing wasteful use of unnecessary fertilizer ingredients.

However, the best fertilizer and liming practices cannot overcome the injurious effects of deficient or excessive moisture conditions, poor soil tilth, weed competition, improper cultural methods, or insect and plant disease troubles. All these factors must be reasonably favorable to plant growth, else the most thoughtful care in providing favorable nutrient conditions will come to naught.

The form upon which the Soils Department makes its report to persons who have submitted soil samples for analysis is given on the back of this circular.

Connecticut Agricultural Experiment Station

New Haven

Soils Department

REPORT on SOIL TESTS

Name ....

Address ....

.... Date ....

	Sample Designation					
Acidity						
pH						
Concentration of active constituents*..						
Nitrate nitrogen ...						
Ammonia nitrogen..						
Phosphorus........						
Potassium.........						
Calcium						
Magnesium........						
Aluminum						
Manganese........						
Iron						
Other tests........						
....						
....						

* If numbers are given, these represent approximate pounds per acre to plow depth. Letter significance is as follows: T—trace, L—low, M—medium, H—high, V—very, A—acid, N—neutral, B—basic (alkaline).

Remarks ....

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Circular 96 February, 1934

Connecticut Agricultural Experiment Station

New Haven

STEWART'S BACTERIAL WILT ON SWEET CORN

G. P. Clinton and W. Ralph Singleton

SUMMARY

1. Bacterial wilt or Stewart's Disease affects both sweet and field corn. Sweet corn is more seriously affected, and the earlier varieties are more susceptible than the later ones.

2. The disease is caused by a bacterium, *Aplanobacter Stewarti* (E. F. Smith) McCullock, which enters the plant from the seed or *through any broken tissue.*

3. The affected plants appear to be suffering from lack of water. This is actually what is happening, although the soil may be moist. Either the water-conducting vessels are clogged by the bacteria and hence the leaves cannot obtain sufficient water, or the substances formed by these bacteria kill the tissues of the leaves and thus produce the effect of wilting.

4. The bacteria are carried in the seed which may produce diseased plants. This seems to be the primary source of infection, or the means of introduction into an area. Probably the chief means of spread is insects, mainly flea beetles, which carry the bacteria from diseased to healthy plants. The possibility of infection through soil, manure or old stalks needs further confirmation.

5. The use of disease-free seed or disinfected seed does not insure a clean crop, once the wilt is established in a given neighborhood.

6. In Connecticut, where the disease is now quite wide spread, the use of resistant strains and varieties seems to be the chief solution.

In the Station trials, the first early varieties showing some resistance are Early Yellow Sensation, Spanish Gold and Burpee, but none in this season was immune.

In the midseason class, Whipple's is probably the best to grow. Gold Standard or Charlevoix (Ferry Morse Seed Co., Detroit, Michigan) gave good results in the 1933 trials. Whipple crosses bred by the Station are now available. They are quite resistant.

Of the later maturing varieties, Golden Cross Bantam is resistant and of good quality. In general, the later varieties are not so susceptible.

7. In the trials conducted by the Station, varieties developed in regions where there is no bacterial wilt have shown little or no resistance to the disease. On the other hand, varieties developed in regions where the disease is prevalent have, by natural selection, acquired some resistance to the disease and produced a more satisfactory crop here. Therefore it seems best to secure seed from areas where bacterial wilt is present. Such varieties will probably have some resistance to the disease.

8. By inoculation tests it is possible to isolate strains immune to bacterial wilt. The Station is making every effort to breed resistant strains suitable to Connecticut conditions and market demands.

STEWART'S DISEASE; CAUSE AND CONTROL

Stewart's disease or bacterial wilt affects both sweet and field corn, but causes most serious injury to sweet corn. It was first described from Long Island by F. C. Stewart of the Geneva Station, New York, in 1897. The next year E. F. Smith of the U. S. Department of Agriculture gave a specific name to the bacterial organism that causes the trouble—*Aplanobacter Stewarti.*

The trouble is characteristic when the young plants are about two feet high, although it often can be seen when they are only six inches

FIGURE 7. Inoculation trials with susceptible Whipple inbred. Pot at right not inoculated; pot at left inoculated with bacterial wilt.

high. The plants affected appear to be suffering from lack of water even though the soil may be moist. It shows first by a wilting of the older leaves and, if the injury is serious, the plants look almost as though frosted. Apparently the water-conducting vessels are clogged by the bacteria or else the substances formed by the bacteria kill the tissues of the leaves and this produces the effect of wilting. Usually there is no external evidence of any exudation or of a fruiting state of a fungus to indicate the cause of the trouble. Except for the wilted and dried up greenish leaves, the injury in younger plants is shown only by an internal reddish-brown discoloration or dead area at the base of the stem just above the hypocotyl that springs from the seed. If the stem is cut lengthwise this discoloration is disclosed. If it is cut crosswise at this same place, one can see the yellowish (or occasionally whitish) ooze of bacteria issuing from the cut bundles.

When young plants are very badly affected they make little further growth and finally die. The young plants and even older ones very often rot off at the base so that they are easily pulled from the ground. Less seriously injured plants make a longer growth with more or less wilting and death of the leaves, but may fail to make tassels or ears. Some infected plants even reach maturity, but often with small or imperfect ears.

Since its discovery, Stewart's disease has been found in most of the states where sweet corn is grown commercially and, especially in the last few years, has proved a serious pest. Apparently the disease has not been as injurious in northern states as in those farther south, although the trouble was not uncommon in the Ontario province of Canada in 1932. In Maine it was not conspicuous in 1932, but it was found in several of the New England states farther south.

Occurrence in Connecticut

It is only recently that Stewart's disease has been a serious menace to corn in Connecticut. However, there is little doubt that we found this disease, on Golden Bantam late in July, 1919, although it was not definitely identified at the time. That year fields in Woodmont and Milford injured by the Fusarium root rot were being investigated. Notes made indicated the presence of bacteria, as well as Fusarium, in the rotted bases of the large stalks, and it was a question which was the primary cause of the injury. If examination had been made earlier, the cause of the trouble would have been more easily and definitely identified. In 1921, Rand and Cash, of the U. S. Department of Agriculture, definitely reported the trouble from this State. However, it was not until 1932 and 1933 that the trouble caused sudden and serious loss in Connecticut. In June of 1932 a market gardener of New Haven called our attention to a serious wilt and drying-up of his sweet corn. Examination showed the bacterial disease, and for the first time we obtained cultures of the organism for infection tests.

The fact that this disease varies in different years and places indicates that certain seasons are more favorable for its development and spread than others. If the germs carry over at all in the soil or in the manure, the type of winter may have something to do with the severity of the infections. The mild winters of 1931 and 1932 would have favored this. On this theory the severe cold period in late December, 1933 should decrease infection in the coming season, particularly if the snow mulch did not lessen the freezing effect in the soil.

A wet spring at the time of planting the corn may augment the seriousness of this trouble, especially if followed by hot, dry weather later on that favors loss of water by the plants. In 1932, for example, it was difficult in some cases to tell whether the injury to corn was drought injury or that caused by the wilt of Stewart's disease.

How the Disease is Spread

There seems to be no question that the bacteria are carried by the seed. Seed treatment has not proved so effective as it was once thought to be, so it is probably also true that the bacteria are carried more internally than externally.

Some think that seed infection is the only, or at least the chief, manner in which the bacteria carry over from year to year. There is reason to believe, however, that the germs may occasionally be carried in the soil, or in manure when it is applied in the spring and especially when it comes from animals, particularly hogs, that have been fed with corn or corn stalks that came from diseased plants. This statement is based on observation of a farm where the same seed was used for certain of the fields but where different fertilizers were used. Hog manure was used in some of the fields. In these fields the trouble was unusually conspicuous. In one field, however, where chemical fertilizers were used there was little trouble.

Rand and Cash (U. S. D. A. Tech. Bull. No. 362, May 1933) showed that insects, especially certain species of flea beetles, carry the germs from infected plants to healthy ones during the growing season. They believe that these insects are the chief source of the summer spread of the trouble, and insect inoculation would seem to be a good explanation of the difference, as shown by their experiments, between outbreaks in the District of Columbia and in Maine on plants grown from the same seed.

Infection Experiments

Greenhouse Experiment. The experimental work began in 1933. In early spring a greenhouse test was made on about 70 rows of seedlings, each row containing 20 seedlings of inbred corn from the same ear. Water containing pure cultures of the bacteria isolated from infected corn was sprayed on these seedlings. The plants were sprayed three times during a period of ten days. Usually before each spraying, half of the plants were pricked several times with a needle. The results of this experiment showed that of the 1,050 pricked plants 935, or 90 per cent became infected, while of the 918 unpricked plants only 55, or 6 per cent showed infection. This experiment seems to corroborate Rand and Cash's statement that injury by insects carrying the germs causes the spread of the disease.

Field Experiments. Field experiments on several phases of the problem were conducted at the Mount Carmel farm, with the following objectives: (a) to compare the effect of spraying the bacteria on pricked and unpricked plants, as in the greenhouse experiment; (b) to determine the value of seed disinfectants; (c) to test the possibility of infection from infected plant material in the soil; (d) to compare the susceptibility of ten standard varieties of sweet corn.

The plants were grown in six different rows. Each of the ten varieties was planted in the same order in each row, so that each row had about

1000 seeds. One row was kept as a check, but each of the other five was given a different treatment.

The results were recorded in two ways; first, the percentage of plants infected was determined (a slightly infected plant was counted the same as one killed when young); second, the effect of infection was determined by assigning different percentages to each plant according to its condition, as follows: a perfectly healthy plant was assigned 0 per cent; a slightly infected one 30 per cent; a moderately infected one 50 per cent; a badly infected one 80 per cent; a dead or nearly dead one 100 per cent. The determinations were made by both the external

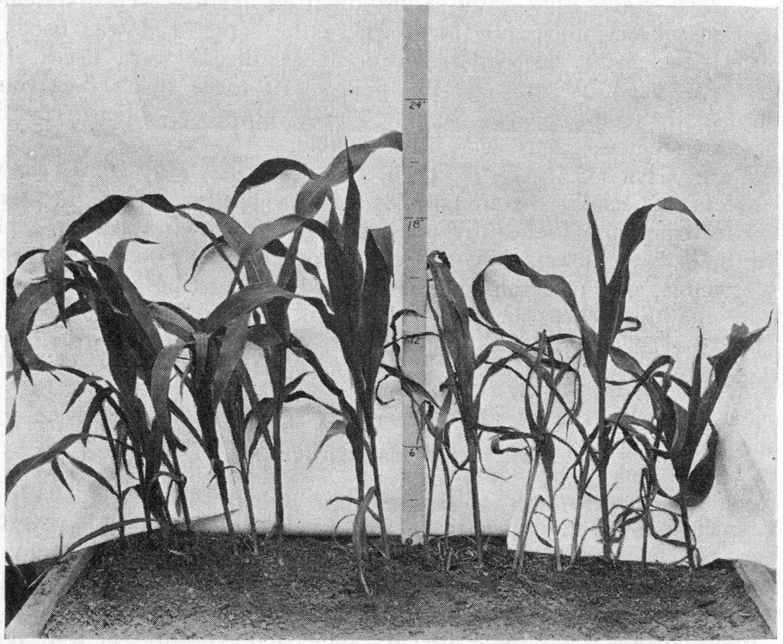

FIGURE 8. Inoculation trials in greenhouse. Spanish Gold inbred. Plants at left sprayed with bacteria, not pricked; plants at right sprayed with bacteria, pricked with needle before spraying.

and internal appearance of each plant. The examination was made in July after many of the plants had made their full growth but before they had tasseled. While these two types of measurement showed the same general results, the percentage of the number of plants affected was of course larger in each case than the percentage showing the degree of injury.

The treatments and the results of the several experiments are as follows:

(a) Half of the plants of each variety in one row were pricked before they were sprayed with water containing the bacteria. The effect of pricking the leaves was not as marked as in the greenhouse experiment. The pricked plants showed 40 per cent injury, as against 38 per cent for the unpricked—not a significant difference. It is fair to assume that this experiment was upset by some other factor—probably the transmission of the trouble to all the plants by insect inoculation, such as Rand and Cash describe.

(b) Three of the rows were planted with seed which had been treated with a disinfectant. The seed in each of these rows was treated with a different disinfectant, as follows: (1) Seed treated with corrosive sublimate, 1 to 1000, by soaking for 15 minutes; (2) seed dusted with Semesan; (3) seed treated with formalin, 2 per cent, by soaking for 15 minutes.

The percentage, first, of the total number of plants infected and, second, the percentage showing the degree of injury on the various rows is given in the following table:

	Seed treated with corrosive sublimate	Seed treated with Semesan	Seed treated with formalin	Check—no treatment
	%	%	%	%
1. Total number of plants infected	52	61	67	64
2. Degree of injury	22	27	33	29

There was, as the table shows, very little difference in the results from these treatments. The amount of injury in the corrosive sublimate row was least, 22 per cent, as compared with the other rows, Semesan, 27 per cent, control row, 29 per cent, and formalin, 33 per cent. There was some injury to the row treated with formalin from the formalin itself, which may have caused part of the injury that was laid to the wilt. This difference in the relative amount of injury was not sufficient to recommend seed treatment as an effective measure of control. If, however, seed treatment is used as an extra precautionary measure, the corrosive sublimate treatment would seem to be the best.

(c) In a fifth row, ground and dried infected plant tissues were planted with the seed. The infected material had been kept indoors during the winter. Moreover, so little was used that this row was not expected to show any great difference from the other rows. It showed slightly less injury, 26 per cent, than the check row, 29 per cent. All of the other rows except that in which the seed had been treated with corrosive sublimate showed more injury. This result, as well as other observations elsewhere, indicates that corn will not escape infection when planted in land not recently in corn.

(d) As to the relative susceptibility of the ten varieties, this experiment showed that, in the order of their maturity, the earlier varieties were more seriously affected than the later varieties. This result tallies with general observations made in the fields over the State. Yet certain varieties stood up better than others. The strain that stood up best in this test was Golden Cross Bantam, which showed only 5 per cent injury; next was Whipple's Yellow, 11 per cent injury; Spanish Gold, 13 per cent; and Red Green, 14 per cent. These varieties also showed the smallest percentages as to the number of plants infected. Golden Gem was the least resistant of the varieties tried. It showed 64 per cent injury, and 95 per cent of the plants were affected.

Apparently the most effective method of combatting Stewart's disease is to plant only those strains which are least affected by it. The results of plant breeding experiments and additional information on resistant strains are given in the next section.

One grower, however, successfully fought the infection by planting his seed rather thickly in the rows and then hoeing out plants as soon as they showed symptoms of the trouble. In this way he got a fair stand of plants that came to maturity. Of course, in case the disease does not appear, this method entails unnecessary work in thinning out the stands.

BREEDING RESISTANT STRAINS

With a view to finding varieties resistant to bacterial wilt, 81 samples of early yellow and white sweet corn were tested in 1933 on the Station's farm in Mount Carmel. This list included most of the standard varieties grown in this section as well as new varieties or crosses recently introduced. In most cases only one row of each sample was grown. The rows were 21 feet long. The results based on this area are subject to considerable chance variation, and different samples of the same variety might show large deviations. However, important differences between varieties should be apparent and promising varieties will be tested more thoroughly another year.

Before bacterial wilt became widespread in Connecticut there were several varieties that met the need of growers who desired a first early sweet corn. Probably the two most widely grown commercially were Golden Early Market and Golden Sunshine. Both of these have proved to be highly susceptible to bacterial wilt and this now makes their use questionable. Sunshine is a little more resistant than Golden Early Market. In our trials we had Golden Early Market from five seedsmen. No lot produced more than 2000 ears per acre. One lot of Sunshine yielded twice this amount, but even so, the crop was unprofitable.

Judging by the prevalence of the disease on susceptible plants, it seems likely that all plants were inoculated with the disease. This is plausible in view of the fact that the disease is spread by insects, mainly flea beetles. The plants that escaped the disease were almost certainly resistant. It is interesting to note that the varieties found most susceptible had been produced in regions where wilt was unknown and hence had no opportunity to develop resistance. Seed of varieties such as Golden Gem

and Golden Early Market had been grown on the Pacific coast where wilt has not occurred. Therefore, the seed was free of infection, yet these varieties were the most seriously affected with the disease. Another experiment showing that plants from disease-free seed may become infected was conducted last summer. In trying to secure early inbreds we decided to grow again some of Lord's Early Yellow. The only seed

FIGURE 9. Susceptible strain of Whipple in center. Indiana 39 and resistant Whipple inbreds on either side.

we had was produced in 1929 when there was no wilt. Hence the seed was free of disease. Of 20 plants grown, 16 were badly diseased at the time the notes were taken and no ears were obtained from the other four plants. In other words, this lot was between 75 and 100 per cent infected.

On the whole, varieties developed where wilt has been prevalent are more resistant to the disease. It therefore seems wiser to obtain seed from regions where there has been wilt for a long time. The chances are better of getting a resistant variety.

Varieties Partially Resistant

In our trials there were a few first early varieties that showed some resistance to bacterial wilt. Both Early Yellow Sensation and Early Golden produced sizeable ears and gave a fair yield—7000 ears per acre. Spanish Gold produced the same amount of marketable ears, and was five to seven days earlier than the two varieties previously mentioned, but the ears were somewhat smaller. For the home garden, or for the gardener who has a market for the first early corn with medium-sized ears, Spanish Gold is still to be considered. For the general market gardener, the ears of Spanish Gold are probably too small. Burpee produced 5,000 ears per acre and was as early as Golden Early Market. The ears are about the same size as those of Golden Early Market.

In the midseason class, Whipple's Early Yellow is probably the best variety to grow. It is fairly resistant to the disease and produces a good yield of large marketable ears (average of five samples more than 7000 marketable ears to the acre). In this same season, Charlevoix or Gold Standard (Ferry-Morse Seed Co., Detroit, Michigan) was exceptionally free from the disease (94 per cent healthy plants) and gave a good yield of 8000 marketable ears to the acre. The ears are a little smaller than those of Whipple.

Eight-rowed Golden Bantam

The varieties of Golden Bantam differed considerably. Some produced no marketable ears at all. Two samples, Reeves' Golden Bantam from K. C. Livermore, Honeoye Fall, N. Y., and Golden Bantam from Grand Junction Seed Company, Grand Junction, Colo., gave good yields of 9,000 and 11,000 marketable ears respectively. These samples seemed true Golden Bantams, mostly eight-rowed, with an occasional 10-rowed ear. Another sample, Stevens' Golden Bantam from Gunson & Co., Rochester, N. Y., gave a remarkable yield of 14,000 ears, but the ears varied in row number of eight to sixteen and would probably not pass for a true Golden Bantam. The quality of these samples was not tested. Three samples of Barden's Wonder Bantam were tested. They all produced from 10,000 to 13,000 marketable ears which had good flavor and were judged quite tender. Some persons who tested them judged Wonder Bantam equal to Golden Cross Bantam in quality and flavor. Wonder Bantam had predominately eight rows, although in two samples there was an occasional ear with ten rows. Where an eight-rowed Bantam is desired, these varieties are well worth considering. We do not know the quality of the canned product.

Promising Hybrids

Golden Cross Bantam is well known for its high quality and resistance to bacterial wilt. It produced the largest number of marketable ears, 15,000, of all varieties or crosses tested. It is a little late for the first early or midseason crop and some new hybrids have been developed to meet the need of the earlier growers. Tendergold is about in the Whipple season or perhaps a little earlier. It has good quality and some resistance to bacterial wilt, although it is not immune. It produced 7,000 and 8,000 marketable ears to the acre. This cross is thought to be a top cross of Sunshine by Indiana 39.

One of our own top crosses, Spanish Gold by 482-2 (a Whipple inbred) was just as early as Golden Early Market, produced one large ear to the stalk, and was almost immune to bacterial wilt. It produced 94 per cent of healthy plants in comparison with 0 to 13 per cent for Golden Early Market and gave a yield of 9,000 marketable ears per

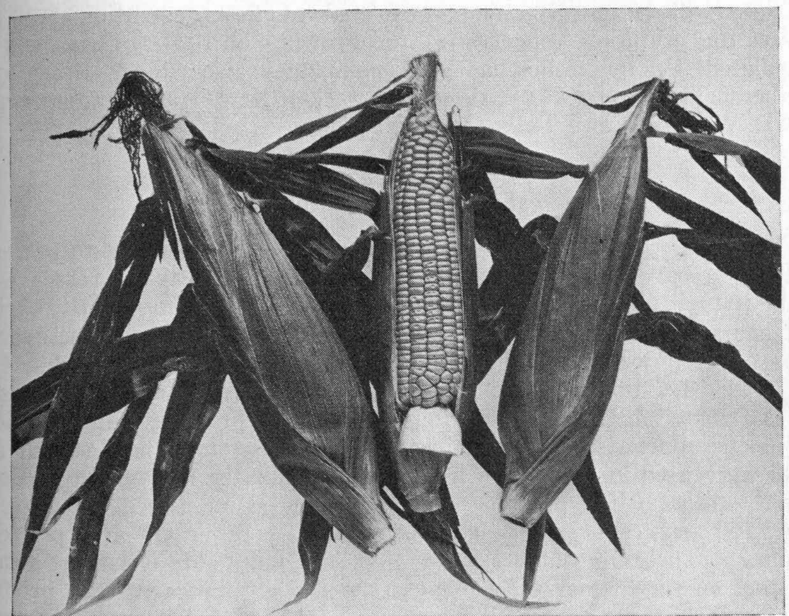

FIGURE 10. Whipple Cross grown at Windsor and Mount Carmel showed no injury from bacterial wilt.

acre. The highest yield of Golden Early Market was 2,000. There will be seed of this new top cross for distribution in the spring of 1935.

Another top cross that gave a better yield, although a little later, was Spanish Gold by Indiana 39. It produced an average of 10,000 ears to the acre. It is in the same season as Early Yellow Sensation and Early Golden. There is a limited supply of seed for distribution in 1934 by the Associated Seed Growers, New Haven, Conn.

An Inbred as a Variety

Indiana 39, an inbred produced by the Indiana Station and used as one of the parents of Golden Cross Bantam, has been put out as a commercial variety under the name of Purdue Bantam. It is an unusual inbred which retained considerable vigor upon selfing. It gave a good yield, 11,000, of medium-sized ears. This variety was not tested for quality.

Whipple Cross

A large number of crosses of inbred strains of Whipple's Yellow sweet corn are being tested for adaptability and for resistance to bacterial wilt. Some of these have been entirely free from disease symptoms both at Mount Carmel and at Windsor. At the same time they have produced large well-filled ears on practically every stalk, and these all ripened very nearly at the same time.

There will be small amounts of seed of first generation Whipple crosses and Whipple top crosses, for growing in 1934. These will be distributed by the following seed companies: Comstock, Ferre Co., Wethersfield, Conn.; F. S. Platt Seed Co., New Haven, Conn.; and F. H. Woodruff and Sons, Milford, Conn.

First Early Variety

There is a particular need for a first early variety resistant to bacterial wilt. We have already begun work on such a variety. Crosses were made last year which in a short time should give a first early variety that has a large ear and is highly resistant to the disease. Three generations of corn were grown in 1933, two in the greenhouse and one in the field. By this method of growing three generations in a season, we can materially reduce the time required to produce a new variety. By inoculation tests it was possible to isolate resistant inbred strains and these were used in crossing to get resistance for the new variety. Some inbred strains when pricked and inoculated, as described on page 29 were 100 per cent susceptible, and others were nearly 100 per cent immune. These inoculation tests give promise of isolating strains resistant to the disease. By obtaining resistant inbreds we can produce new types of corn that will be immune or highly resistant to bacterial wilt. This seems at present to be the most feasible method of controlling the disease.

Circular 97 February, 1934

Connecticut Agricultural Experiment Station
New Haven

FLEAS AND THEIR CONTROL

B. H. Walden

Fleas are familiar insects to anyone owning pet animals. They are small, brown, wingless insects with piercing and sucking mouth parts. The body is much flattened at the sides and is provided with stiff bristles slanting towards the rear, which probably prevent back slipping and aid the thin bodied insect to pass rapidly among the hairs of its host.

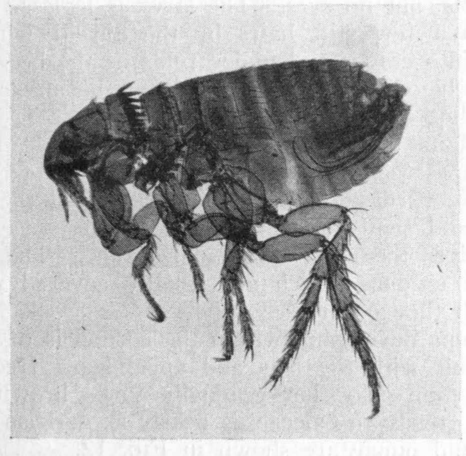

FIGURE 11. Dog flea, male. Enlarged about 24 times.

Cats and dogs are nearly always infested with fleas. In Connecticut the most common species on both animals is the dog flea, *Ctenocephalus canis* Curtis. The cat flea, *Ctenocephalus felis* Bouché, has been reported from Connecticut, but the species is much more prevalent in the south where it is as abundant on dogs as it is on cats. Both species readily attack human beings, and are frequently found on rats, skunks and other warm blooded mammals. These two insects appear so much alike that some authorities consider that the cat flea is only a variety of the dog flea. Whether one or the other is present is of minor importance to the animal or its owner, as the habits of the two fleas are very similar and the method of control is the same. Although only the adult form is found on animals, fleas pass through four stages in their development, the egg, larva, pupa and adult. The life cycle of the dog flea from egg to adult, in warm weather and with other favorable conditions, may be completed in from two weeks to twenty days, but in cool weather it may require more than four weeks. The adults are comparatively long lived, especially in cool, moist climates. Dog fleas when fed have been kept alive for 234 days and without food for 58 days. The adult dog flea is shown in FIG. 11.

Life History and Habits

Egg. The egg of the dog flea is from .5 to .57 mm. or about 1/40 of an inch in length, elongate oval in shape and pearly white in color. The eggs are usually deposited among the hairs of the host but are not attached and are readily shaken off wherever the animal may go. Naturally the greatest numbers are found in the animal's bedding.

Larva. The white worm-like larva hatches from the egg in two to four days. The body has thirteen segments, a well developed head with biting mouth parts, but no eyes. The larva is legless, but each segment is provided with a few stiff hairs by the aid of which it is able to quickly wriggle into cracks and under folds of the bedding. The larvae feed upon dried blood or bits of skin from the animal or any organic material in the lint and dust in cracks and crevices. Under the most favorable conditions they may become full grown in seven or eight days, while cool weather and other factors may extend the larval stage to more than twenty days. When fully developed they are about 3.25 mm. in length, and semi-transparent, but the presence of blood in the digestive tract gives them a reddish appearance. The larvae then spin thin, white, oval cocoons which are usually covered with particles of the dirt in which they occur.

Pupa. The pupa developing within the cocoon is of the same general shape as the adult with the legs and appendages free. At first it is of a yellowish white color but gradually turns brown, and in five to seven days, when ready to emerge, is nearly as dark as the adult. Eggs, larvae, cocoons and pupae are shown in FIG. 12.

Other Kinds of Fleas

There are about 500 species of fleas known from different parts of the world, many of which are only found in tropical countries, and others only where their individual hosts occur. Twenty-six species have been listed from New York State and at least as many different kinds probably will be found in Connecticut. Many of the wild mammals

harbor one or more species and a few have been taken on some of the larger birds.

The **human flea,** *Pulex irritans* Linn., occurs all over the world and is a persistent species where it becomes established. It is especially active at night and besides attacking man, its natural host, it may live on cats, dogs, rats and other mammals.

Rat fleas. In addition to many species of fleas that may occur on rats, there are several species of which rats are the natural hosts. The common species in this section is the European rat flea, *Ceratophyllus fasciatus* Bosc. The Indian rat flea, *Xenopsylla cheopis* Rothsch., has been distributed by rats in ships to all the seaports in the warmer parts of the world and is one of the most abundant fleas in our southern ports. This species has been taken in New York City, but it has not become

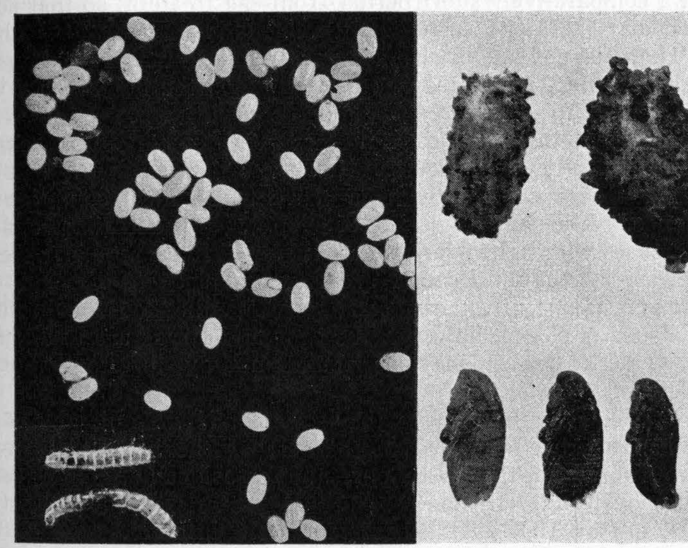

FIGURE 12. Dog flea. Eggs at left, larvae lower left, cocoons upper right, pupae lower right. Enlarged eight times.

established in sections where there are long periods of freezing weather. The Indian rat flea readily attacks man and is of great economic significance because it has been one of the principal agencies in transmitting bubonic plague from infected rats to human beings. Human fleas, as well as cat and dog fleas if they have been feeding on affected rats, may also carry the plague.

The **European hen flea,** *Ceratophyllus gallinae* Schr., is widely distributed throughout the United States and has been found in Connecticut. In neglected poultry houses this insect may become very abundant, and not only reduce the egg production but cause the fowls to lose weight and even kill them in extreme cases. The hen flea bites human beings and may be carried into the dwelling on the clothing.

Infestations in Houses

Each year we receive reports that persons returning from vacations to their homes, which have been closed for part of the summer, find the house over-run with fleas. They ask how to get rid of them. In some cases the owner is very careful to inform us that these are sand fleas. There is a species known as the sand flea in tropical or sub-tropical countries, but sand fleas do not occur in this section. Even after admitting that they have either a cat or dog or both, it may be difficult for the owners to accept the fact that it is the common dog flea that is present in their house.

How can the fleas develop in such numbers when there has been no animal in the house for them to live on? The adults of many insect species die and are replaced by another generation, but fleas are long lived, with a comparatively short period from egg to adult, so that several generations may develop, each adding its numbers to those already present. There is no data at hand regarding the number of eggs laid by a female dog flea, but it may be as prolific as the human flea which has been observed to lay over one hundred fertile eggs.

It is well known that fleas can find sufficient food in the cracks and crevices in apparently clean houses. Old houses with floors that have wide cracks and are covered with carpets furnish ideal conditions for their existence. The larva will not develop when much disturbed, and in modern houses with tight floors, where rugs which are regularly cleaned, especially with a vacuum cleaner, are used in place of carpets, there is little danger of an infestation starting while the house is occupied. When the house is closed, however, the eggs and larvae are undisturbed, and even modern houses may be found heavily infested upon the owners' return.

The infestation may be only in the basement if the animal has slept there and has not been allowed in the rest of the house, but usually one or two rooms on the first floor, and occasionally the entire first floor, is also over-run. In one case brought to our attention last summer both floors as well as the basement were infested.

It is possible that many of these outbreaks may start from the animal's infested bedding. A short time ago the bed of a dog was examined. It was an old Morris chair cushion with a large piece of artificial leather folded over it. The dog had been bathed the preceding week and appeared to have only a few fleas on him. On his bed there was a little sand and some scattered hairs, which were shaken onto a piece of paper and brought to the laboratory. Upon examination so many eggs were found that the material was weighed and the eggs counted. The material, largely sand, weighed .3 of a gram and contained 293 eggs. Any one who keeps animals in the house might easily overlook this bedding when closing the house for the summer, but it should by all means be removed and cleaned so as to kill any stage of the fleas that may be in it.

Treatment of Infested Houses

The owner, of course, wishes to rid the house of fleas as soon as possible. Fumigating with hydrocyanic acid gas or with calcium cyanide will readily kill the fleas, but these are not safe materials for everyone to use, and the expense of hiring the fumigating done does not appeal to the average individual just returned from his vacation.

Burning sulfur, at the rate of 3–4 pounds to each 1000 cubic feet of space is also effective, but there is a certain fire hazard in using it. In fumigating with sulfur, the sulfur should be put in a metal container which is set on top of bricks placed in a large pan partly filled with water. Although sulfur may be used in a basement, it is objectional in living quarters because it may bleach wall paper and draperies, and tarnish metal objects and fixtures.

In 1909 the late Dr. Henry Skinner published a note in the Journal of Economic Entomology (Vol. 2, p. 192) regarding the use of flake naphthalene in ridding a house of fleas. He took one room at a time, scattered on the floor 5 pounds of flake naphthalene and closed it for 24 hours. He states that it proved to be a perfect remedy, and very inexpensive because the napthalene could be swept up and transferred to other rooms. We have been advising the use of this material as it is safe, effective, and cheap. One objection is the odor, another that the fumes are irritating to the eyes and air passages. In one case this summer the owner discovered the infestation in his house before his family returned. He purchased sufficient flake naphthalene to treat the whole house. Part of it was scattered over the floors and the rest was spread out thin on pieces of burlap placed on top of the radiators. A strong fire was built in the boiler, raising the temperature of the rooms to about 100° F. The house was left closed for four days. When the naphthalene was cleaned up, only about one-third of the original bulk remained. It is needless to say that there were no live fleas in the house after this treatment. While it probably was not necessary to raise the room temperature in average summer weather, a high temperature should make the treatment more effective if one wishes to fumigate with naphthalene during the cool weather.

Ridding the Animal of Fleas

Of course the animal is directly responsible for bringing most of the fleas into the house. Therefore keeping the house pets free of fleas is attacking the problem at its source.

One of the most effective methods of ridding the dog of fleas is to wash him with a three per cent solution of creolin or four tablespoonfuls to a gallon of warm water. This not only kills the fleas but heals scratches and leaves the hair in good condition. With cats which have a more tender skin, a two per cent solution should be used. Soap flakes, two ounces to a gallon of water, can be used if creolin is not available, but the soap should be rinsed off with clear water.

Thoroughly dusting the animal with fresh pyrethrum or one of the prepared flea powders, working the material well into the hair, will kill or stupefy the fleas. It is well to have the animal on a blanket or sheet so that the fleas that drop off can be gathered up and burned.

Occasionally in the summer when the animals are kept outside near the house, swarms of fleas appear in the grass and may be brought into the house by people walking over it. This past summer such an infestation was destroyed by thoroughly spraying the grass area with nicotine sulfate, one part to four hundred parts of water, (two teaspoonfuls to one gallon of water).

It is said that oil of pennyroyal will repel fleas and if one has to be where fleas are plentiful, a little of the oil applied to the ankles will aid in keeping them off.

Controlling the Hen Flea

Where poultry houses become infested with the hen flea, the birds should be removed and the house thoroughly cleaned. Bury the droppings and burn all litter. All parts of the interior should be sprayed with Phinotus disinfectant using one part to ten parts of water. The ground around the house, where the litter was burned and the droppings buried, should also be sprayed. The hens as they are returned to the house should be immersed in a solution of one part of the disinfectant to 60 parts of water.

Connecticut Agricultural Experiment Station
New Haven

LATE BLIGHT OF TOMATOES

A. A. Dunlap

During the seasons of 1932 and 1933 a blight of tomatoes caused extensive damage to the late crop throughout Connecticut. More than forty years ago, in 1890, this blight was once observed in the state by Thaxter*. Since that time, the late blight on tomatoes had never been recorded in Connecticut until 1928. Even from 1928 to 1932 the disease appeared only occasionally in this state. In other states including New York, Virginia, Texas, and California, however, epidemics of this blight, lasting from one to six years, have been reported since 1919.

The late blight of tomatoes is caused by a downy-mildew fungus, *Phytophthora infestans*. Apparently this organism is the same as or is very closely related to the fungus causing the late blight of potatoes. In Connecticut the disease has occurred on tomatoes in seasons when the potato crop has not been seriously affected. In other states, it has been reported occasionally as occurring on tomatoes and potatoes at the same time. According to Ramsey and Bailey,† the amount of damage caused by tomato late blight is dependent upon weather conditions, the disease being most destructive in periods of wet weather when the nights are cool and the days are only moderately warm.

In Connecticut this blight has not been found until the first of September, so only the late crops of tomatoes have been affected. Apparently all varieties, if planted late enough to have an abundance of green foliage in September, are susceptible. The late-blight disease makes its first appearance on the older leaves which are on or near the ground. Infected spots on the leaves are irregular in shape, with a dark, water-soaked appearance. The fungus appears on the under surface of the diseased leaves as a whitish mildew, bearing the spores which spread the disease. If the weather is favorable for the fungus, the entire foliage of the plant is eventually invaded, causing the leaves to become darkened and drooping, resembling the effects of a frost.

*Thaxter, R. Diseases of Tomatoes. Conn. Agr. Exp. Sta. Rpt. **1890**:95-96. 1891.
†Ramsey C. B., and Alice Allen Bailey. Tomato Late-Blight Rot, a Serious Transit and Market Disease. U. S. D. A. Circular 169. July, 1931.

Shortly after the foliage has become blighted the disease has been found to appear on the tomato fruits of all sizes as a brownish area with an uneven surface. If the fruit is young a soft rot usually follows infection. In older fruits the diseased areas may stay firm, while the remainder of the fruit ripens normally. Since the fruit does not show signs of the blight until several days after infection has taken place, considerable loss may occur during storage or shipment.

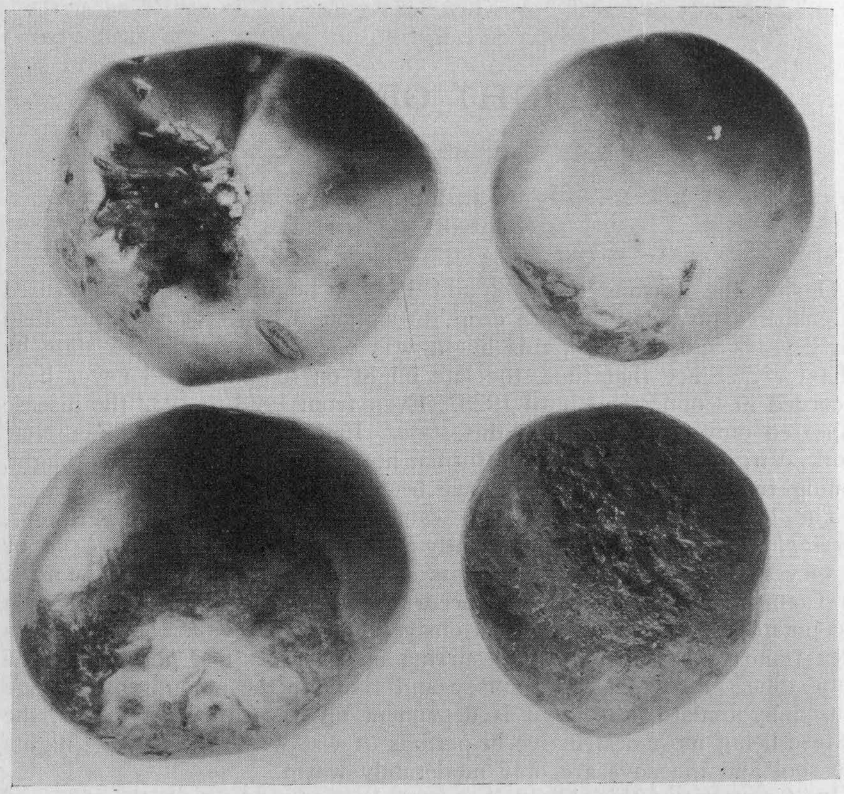

FIGURE 13. Tomato fruits showing lesions of late blight

Control

Preventive measures against late blight of tomatoes have not yet been systematically undertaken by Connecticut growers. In some cases a fair control of the disease has been obtained by one or two spray applications, while in others no benefit has been received from late spraying after the blight has become widespread in the field.

At the Experimental Farm, Mount Carmel, in 1933, the most satisfactory control of this disease was obtained by thorough spraying with 4-4-50 Bordeaux mixture (4 lbs. copper sulfate, 4 lbs. hydrated lime, 50 gals. water). Application of copper-lime dust (1 part monohydrated

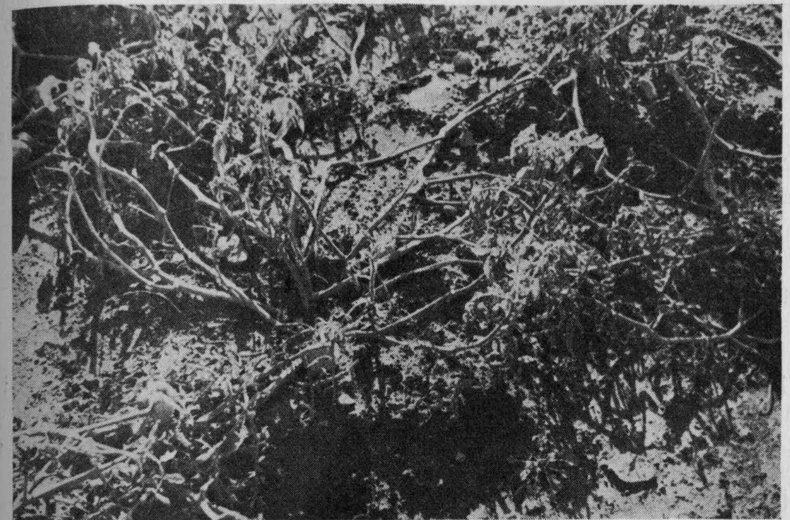

FIGURE 14. Unsprayed tomato plant, photographed September 25, 1933, showing defoliation by late blight. All fruits showing blight infection were removed

FIGURE 15. Photograph of tomato plant which had received Bordeaux spray, taken on same date as above. Note healthy condition of foliage and abundance of healthy fruits

copper sulfate thoroughly mixed with 4 parts of hydrated lime) gave fair control of the disease. The following table shows the results of these two treatments upon late plantings of Bonny Best, Marglobe and Stone varieties of tomatoes in comparison with an untreated plot.

Treatment	Yield of Tomatoes, lbs. per Plot		Number of Blighted Fruits per Plot
	Ripe	Green	
Check (untreated)	57	0	1846
Copper-Lime Dust	173	168	186
Bordeaux Spray	204	295	7

The ripe fruits listed above were gathered during the season as they became mature, while the green fruits were harvested at the time of the first frost on October 12. The blighted fruits were removed from the vines and counted as soon as they showed blight infection.

Since late blight has become prevalent in Connecticut during the past two seasons, it would seem advisable for growers to undertake control measures if the certainty of a profitable crop of late tomatoes is to be assured. It is recommended that the plants be sprayed with 4–4–50 or 5–5–50 Bordeaux mixture, at least four times during the season. From 100 to 200 gallons of spray per acre should be used at each application and care should be taken to secure thorough coverage of both the upper and lower leaf surfaces. The first application should be made before the plants fall over on the ground. It is possible that the second spray need not be applied until the last week in August or the first week in September. Other spray applications should follow as frequently as is necessary to maintain a coverage of Bordeaux mixture on most of the foliage up to the time of the last harvesting of the fruit.

If copper-lime dust is to be used, it should be applied more frequently than is necessary in the case of Bordeaux spray. From 30 to 40 pounds per acre of the dust should be used for each application and the dusting should be done while the plants are wet.

Although the residue from Bordeaux spray on the tomato fruits is not poisonous, it may prove objectionable in marketing. Less frequent spraying after the fruits have reached a medium size would result in less residue on the tomatoes, but too few sprays might give poor control of the disease. It is also possible that 1–1½–50 Burgundy mixture (1 lb. copper sulfate, 1½ lbs. sodium carbonate, 50 gals. water) may be used in place of the Bordeaux mixture in the later spray applications. Burgundy mixture leaves no noticeable spray residue. However, we have made no experiments with this material for the control of tomato late blight. There is also less residue from copper-lime dust than from Bordeaux mixture.

There are no indications that the late blight fungus is carried by the tomato seed; therefore seed treatment is not recommended.

Circular 99 March, 1934

Connecticut Agricultural Experiment Station
New Haven

CONTROL OF THE PLUM CURCULIO ON FRUIT TREES

Philip Garman

The plum curculio[1] is one of the most serious pests in Connecticut fruit orchards. It infests plums, peaches, pears, cherries and apples but damages plums and apples more than any others. The greatest commercial injury is done to apples, because of the relative size and value of that crop. Plums, and particularly peaches, frequently set enough fruit so that injury from curculios and subsequent fruit drop amounts to little more than a

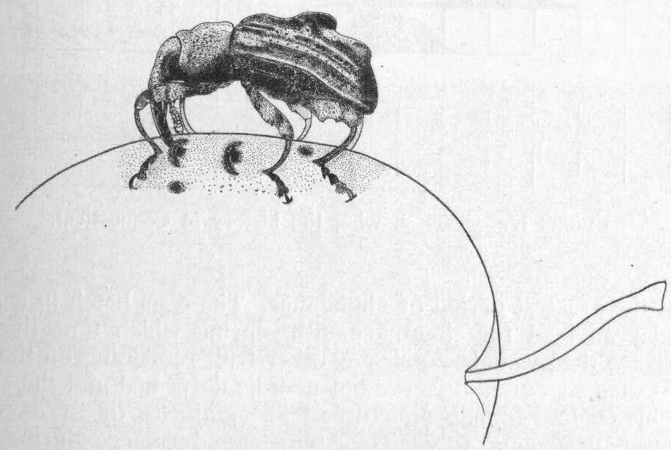

FIGURE 16. Side view of adult curculio, greatly enlarged, with feeding and egg punctures.

natural thinning. If there is a light set of either peaches or plums, then curculio control becomes important in order to save the crop. Pears and cherries are not usually injured severely.

[1] *Conotrachelus nenuphar* Hbst.

Life History

Curculios pass the winter as adult beetles, hiding away in fence rows, stone walls or margins of woodlands or thickets. They begin to emerge in spring after a few warm days when the temperature reaches 60° F. If the season has been dry previously, a warm rain may bring them out in large numbers. They seek plums, apples and peaches, feeding on leaves and petals of the flowers until the fruit is set. Then they begin to feed and lay eggs on the young fruit. The majority do not reach apples, however, until after the fruit is about one-fourth inch in diameter and the greatest numbers are present 7 to 14 days after the petals have fallen. Peak egg laying

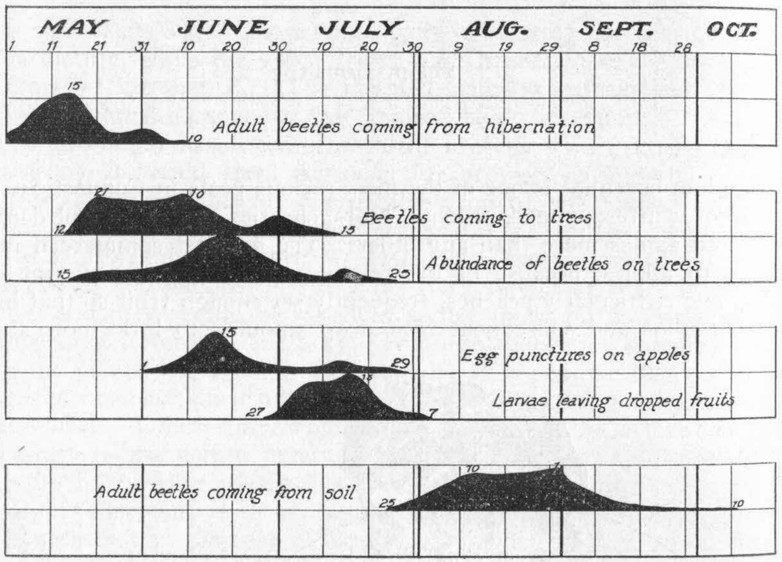

FIGURE 17. Chart showing life history in Connecticut.

occurs at the greatest period of abundance. The eggs hatch in a few days and the larvae feed for about a month, during which time the infested fruit drops to the ground. Apples or other fruit remaining on the tree are rarely infested by curculio larvae but may be deformed and the sale value lowered by feeding or egg punctures. The majority of the larvae leave the fallen fruit during July. They pupate and emerge during August. Adults emerging from the soil soon seek winter quarters in Connecticut, but do some feeding on the fruit in the fall before hibernating.

The eggs are well protected from sprays because they are embedded in the tissues of the fruit. Larvae are likewise impossible to reach by spraying. After leaving the fruit and entering the soil, cultivation under the trees destroys them as well as the pupae into which they transform. Collection and destruction of early drop fruits serves the same purpose.

The adult beetles may be poisoned by sprays and this method of control has superseded all others in Connecticut. In severe infestations, however, destruction of beetles in winter quarters, and prevention of breeding cen-

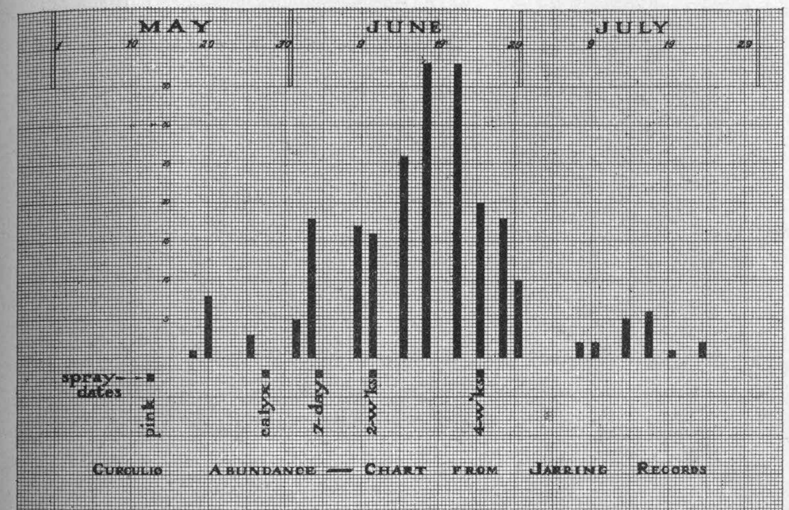

FIGURE 18. Chart from jarring records, showing periods when curculios are most abundant. Spray dates in relation to abundance are also given.

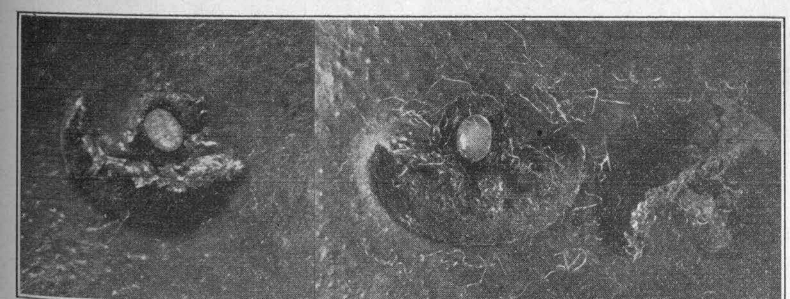

FIGURE 19. Eggs and egg punctures. The crescent-shaped scar is typical of curculio. No other apple insect makes such a scar.

ters in neglected apple or other trees surrounding the orchard should also be considered of value.

Parasitic or other enemies of the curculio are not numerous in Connecticut at the present time.

Sprays for Control

Many materials have been used to kill the adult beetles. In general, nicotine, pyrethrum, and rotenone preparations are ineffective. The arseni-

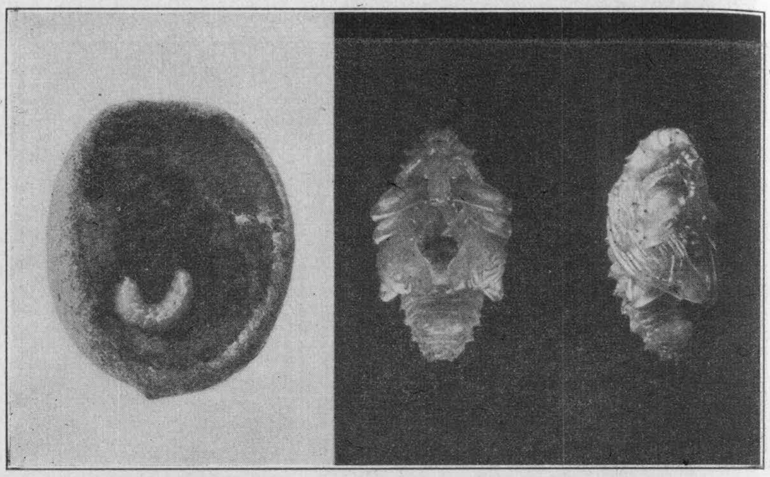

FIGURE 20. Curculio larva in peach (left) and curculio pupae (right). The pupae are very delicate and easily destroyed by cultivation.

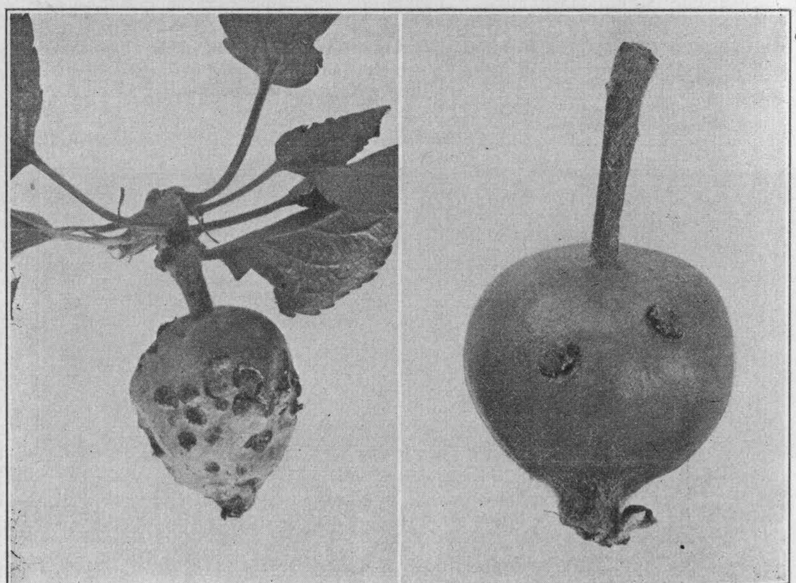

FIGURE 21. Egg scars (right) and severe injury to young fruit.

cals are mainly relied upon, and of these, standard acid lead arsenate (sold by most concerns simply as lead arsenate) is the most effective. Calcium arsenate, and the fluorine compounds such as barium fluosilicate, and syn-

thetic cryolite, have been shown to have considerable killing power for the curculio, but they cannot be generally recommended at this time to take the place of lead arsenate. More experimental work with them is needed.

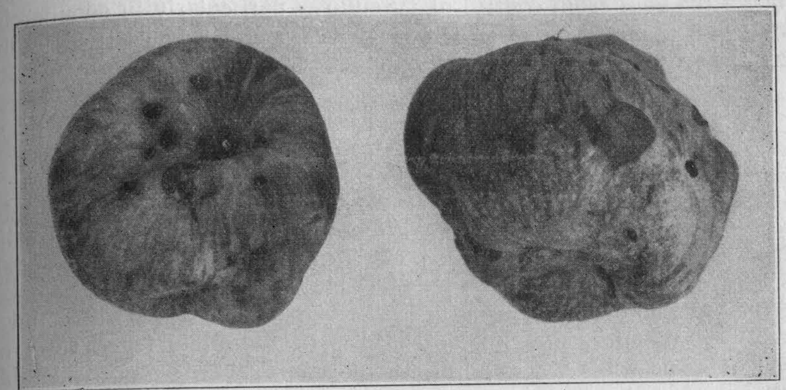

FIGURE 22. Deformed fruit at harvest time resulting from severe curculio injury.

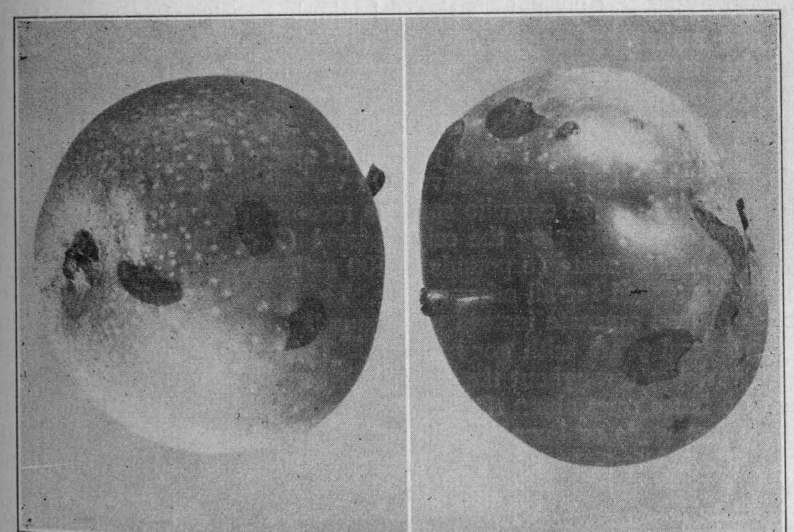

FIGURE 23. Curculio egg scars expanded from growth of the apple. The eggs were probably crushed in this fruit so that it did not become wormy and drop.

There are various ways of increasing the killing power of the poison used. Adhesive properties of lead arsenate may be augmented by the addition of fish or linseed oil, or the dosage may be increased from the usual 3 pounds to 100 gallons, to 4 or 5 pounds. The value of these measures is disputed but it is believed that the use of stickers such as fish or linseed oil is of benefit in Connecticut, especially since the spray is held on the fruit at critical times, or during rainy periods.

For peaches, the danger of spray burn from the use of lead arsenate may offset the gain from control of curculio — particularly in commercial orchards. In order to avoid such burn, zinc sulfate may be used in the spray mixture or a large excess of lime added.

Supplementary Measures

Wild and neglected apple trees near commercial orchards should be removed or sprayed. It is not known exactly how far the adult curculio will travel, but the greatest danger probably is from trees within one-half mile. The problem cannot be handled easily if trees lie on neighboring property. State and Federal agencies have been engaged (1934) in removal of such trees about commercial orchards. Burning out fence rows or removal of stone walls where adult curculios hibernate is of considerable benefit.

Recommendations

APPLES: Spray at least three times, beginning with calyx or petal fall spray, and make applications once each week or once in 10 days. If the weather is cool, ten days between sprays will suffice, if warm (75° or above) not more than 7 days should be allowed.

Use lead arsenate, 3 pounds to 100 gallons. The special curculio spray consisting of 10 pounds of lime, 4 pounds of arsenate of lead and 1 quart of fish or linseed oil is very effective. On varieties affected by scab, such as McIntosh, the special curculio spray is recommended only in the treatment immediately following the calyx period (7 or 10 days later). On this variety lead arsenate (3 pounds to 100 gallons) with the usual fungicide is recommended for all other sprays. The special curculio spray with 3 pounds of lead arsenate instead of 4 pounds has been used experimentally for several years with good results. This may be applied to non-scabbing varieties throughout the season without additional fungicide.

Clean up fence rows about the orchard, removing brush and burning it. Remove stone walls or burn over in order to destroy climbing vines or other shelter. Attend to neglected trees near the orchard having them removed or sprayed wherever possible.

PEACHES: It is not generally necessary to spray peaches for curculio in Connecticut. When the trees are heavily infested or if for any reason the crop is light, and it is desired to prevent as much damage from curculios as possible, the trees may be sprayed with lead arsenate, 3 pounds to 100 gallons, with 4 pounds of zinc sulfate, 4 pounds of hydrated lime and a wettable sulfur in each 100 gallons. Apply as the shucks are pushing off the young fruit and again 10 to 14 days later.

PLUMS: Spray with lead arsenate, 2 pounds, hydrated lime, 4 pounds, and a wettable sulfur in each 100 gallons when the fruits are the size of peas or when the first crescent shaped egg punctures appear. Repeat 10 to 14 days later.

PEARS: Spray with lead arsenate, 3 pounds, and a wettable sulfur[1] in each 100 gallons. Apply at calyx period and again 10 to 14 days later.

CHERRIES: Spray with 3 pounds of arsenate of lead plus a wettable sulfur in each 100 gallons. Apply directly after petal fall and again two weeks later.

FIGURE 24. Neglected apple tree growing under ideal conditions for curculio development. Trees such as this are a decided menace if near a commercial orchard, not only because of curculios but of other insects as well.

Methods of Spraying

Thorough coverage of all parts of the tree is essential in control of curculios. It is immaterial how this is accomplished, but it should be realized that much depends on the thoroughness of applications. Use enough material to cover all parts of the tree without over-spraying so that the sprays are wasted. Timeliness of application is also very important. The fruit must be well covered with spray when curculios are most abundant and active.

[1]Flotation sulfur, New Jersey dry-mix or any of the commercial products. Lime sulfur should not be used.

Connecticut Agricultural Experiment Station

New Haven

SUBSTITUTES FOR LEAD ARSENATE ON FRUITS AND VEGETABLES IN CONNECTICUT

Philip Garman and Neely Turner

In their efforts to protect crops from injury and destruction by insects and plant diseases, growers have been making more and more use in recent years of protective sprays and dusts. At the same time there has been increasing agitation on the part of consumers and, in turn, of governmental authorities lest substances harmful to man remain on the harvested fruit or vegetable.

Lead arsenate, the most universally employed stomach poison for the control of insects, is also poisonous to man if taken in large enough doses. Both lead and arsenic are sufficiently dangerous poisons to warrant measures to insure their removal whenever they occur on food products in injurious amounts. Lead is considered more dangerous than arsenic, due to its cumulative effect.

The United States Department of Agriculture and various experiment stations have studied this problem for many years. The Secretary of Agriculture has fixed limits as to the amount of various poisons allowed to be present on food products sold interstate. These restrictions are known as tolerances and correspond in general with restrictions placed by foreign nations governing exported fruit. Tolerances set by Federal and State authorities are necessarily low, but are subject to revision as more is learned of the effect of these materials on humans.

The problem facing the grower, if he is to avoid the necessity of removing residue before marketing, is that of, (1) securing insecticides that are less poisonous, or, (2) of employing materials that disappear from the fruit or vegetable through decomposition or evaporation, (3) allowing sufficient time between spraying and harvest for natural removal of residues by rainfall. There are a few insecticides that are harmless to man.

For several years and particularly in 1933, experiment stations have given increasing attention to this problem, testing spraying and dusting materials that are less poisonous than those now commonly used, or regulating their use so that there will be no harmful residue. New experiments have been undertaken in regions where none have been conducted before. The situation in Connecticut is not so serious as in some other states because of the more abundant normal rainfall which removes deleterious substances before the crop is harvested. Nevertheless experiments are in progress to help solve the problem as it applies to Connecticut conditions, and some of the results are reported herein.

In the meantime the grower should put his product in first class marketable condition from the standpoint of residue as well as from any other standpoint. And, regardless of what insecticides are used, it would seem to be good policy for the consumer to wash all fruits and vegetables before eating them. Many harmless carriers or insecticides resemble the poisonous ingredients and the two materials are difficult to distinguish by superficial inspection. Washing will make doubly sure that no poisonous substance is consumed.

Materials Tested

The insecticides that have been prepared as substitutes for lead arsenate are listed below. Many investigators are studying these materials, and, with the exception of one, nicotine bentonite, they have been tested at this Station.

(1) Non-lead arsenicals such as
- calcium arsenate
- magnesium arsenate
- manganese arsenate
- paris green
- zinc arsenate

(2) Fluorine compounds
- barium fluosilicate
- calcium fluosilicate
- cryolite (synthetic)
- potassium fluosilicate
- sodium fluosilicate

(3) Nicotine preparations
- nicotine bentonite
- nicotine-oil combination
- nicotine sulfate
- nicotine tannate

(4) Rotenone preparations
- dusts from derris
- sprays containing rotenone from extracted derris or other plant containing rotenone

(5) Pyrethrum preparations
- dusts with sulfur or other carrier
- sprays used mainly with soaps

(6) Hellebore, ground root of swamp hellebore or itchweed from Europe

Of the non-lead arsenical poisons, calcium arsenate has been tested extensively for fruits, especially apples, and found to be nearly but not quite as effective as lead arsenate for Connecticut conditions. The danger of spray burn to fruit and foliage is considerable and wherever calcium arsenate is used it should be combined with 6 to 8 pounds of lime. Where a fungicide is needed with calcium arsenate, a wettable sulfur is used in preference to lime-sulfur. Calcium arsenate is useful for the control of certain vegetable insects, such as potato and cucumber beetles.

Manganese arsenate, zinc arsenate, magnesium arsenate, and paris green are not recommended for fruits. Magnesium arsenate has been successful and is recommended for the control of the Mexican bean beetle. More experiments with manganese and zinc arsenates are needed.

Barium fluosilicate and cryolite (synthetic) are promising insecticides but need further testing in Connecticut. Other fluosilicates such as sodium and potassium cannot be recommended. Barium fluosilicate has been useful in the control of vegetable insects.

Nicotine preparations are valuable mainly in contact sprays or dusts for aphids, leafhoppers and other sucking insects. Their use has been advocated to take the place of arsenical poisons but in general their killing power is considerably less. Nicotine tannate, nicotine bentonite and nicotine-oil combinations are reported to be successful for control of codling moth. Nicotine is poisonous to man but volatilizes fairly rapidly in the open air. Either pure or in the form of a sulfate, when used as a dust or spray it is probably not dangerous if about three days elapse between the time of application and the consumption of fruit or vegetable.

Rotenone preparations made from cubé or derris are promising both as stomach and contact poisons. However, it is believed that they cannot be generally recommended at the present time for fruit insects because of expense and ineffectiveness against certain important pests. They are much more valuable against vegetable insects and have the decided advantage over arsenical poisons of disappearing from the plants after a short time. A week is probably sufficient time for this to take place.

Pyrethrum preparations have no value as stomach poisons, but kill many insects by contact. Certain combinations are being developed which will be helpful in insect control, but they cannot be recommended for arsenical substitutes because of cost and ineffectiveness for certain insects. Pyrethrum sprays are harmless to man. Hellebore is a mild stomach poison, useful mainly against currant worms. It is considered harmless to man because it loses strength rapidly in the open air.

Specific Suggestions

Fruits

APPLES. The main problem in fruit culture is concerned with residue of poisons on harvested apples. The amount remaining at picking time varies with the season, but with normal rainfall, there is little danger of amounts remaining that exceed the tolerance. On early fruit such as Gravenstein, or Duchess or Astrachan, it is well to omit lead arsenate sprays after the second cover spray (that is on the maggot sprays), and either dust or spray with calcium arsenate or dust with lead arsenate. Dust leaves much less residue at picking time than spray. For late varieties there is much less danger, but at least two months should be allowed between the last spray and the picking date. Obviously there will be certain years when spray removal will be advisable because of scanty rainfall, but for average years this will not be necessary in Connecticut with the present tolerance.

CURRANTS and GOOSEBERRIES. Lead arsenate may be applied when worms first appear. Fresh hellebore (dust or spray) should be used if applications are needed near picking time, or derris dusts or rotenone sprays applied allowing at least one week before picking the fruit. Drift from spraying or dusting fruits or vegetables nearby should be avoided.

GRAPES. Lead arsenate may be applied as needed.

PEACHES. No arsenical spray should be applied after the middle of June. Lead arsenate, lime and zinc sulfate are recommended for early sprays if an arsenical poison is needed, (lead arsenate, 3 pounds, zinc sulfate, 4 pounds, lime, 4 pounds, water, 100 gallons).

PEARS. Lead arsenate may be used as needed.

PLUMS and CHERRIES. Lead arsenate, lime and a wettable sulfur may be used. Apply not later than the middle of June. This is for curculio control.

RASPBERRIES and STRAWBERRIES. Lead arsenate may be used until the fruit sets. If applications are needed later, use rotenone or pyrethrum sprays or derris dusts. Avoid drift from spraying or dusting nearby fruits or vegetables.

Vegetables

BEANS. Green and lima beans may be sprayed or dusted with magnesium arsenate, barium fluosilicate or copper-lime-calcium arsenate dust until the pods form. After the pods form a pyrethrum dust containing 25 per cent pure flowers, or a .6 per cent rotenone dust, should be used to control the Mexican bean beetle.

CABBAGE, CAULIFLOWER, BROCCOLI. On account of the large surface area of such vegetables as cabbage, broccoli and cauliflower, no poisonous insecticides should be used except when the plants are young. For control of cabbage worms, pyrethrum or rotenone (derris) dusts should be used. A pyrethrum dust containing 50 per cent pure ground pyrethrum flowers and 50 per cent inert carrier will control cabbage worms if it is applied while the worms are small. From 10 to 16 pounds of dust to the acre is necessary, depending on the size of the plants. A .6 per cent rotenone dust may be used in the same manner.

CELERY. Pyrethrum or rotenone dusts should always be used on celery, rather than arsenical materials.

LEAFY VEGETABLES. No arsenical poisons should be applied to beets, turnips, lettuce, spinach, Swiss chard, New Zealand spinach, or any other crop if the leaves are to be used for human consumption. Care should be taken not to allow spray or dust applied to other crops to drift and settle on these crops. If insecticides are needed, use nicotine, rotenone, or pyrethrum and wash the leaves thoroughly before cooking.

POTATOES. Calcium or lead arsenate may be used on potatoes at any time.

SQUASH, CUCUMBERS, MELONS. Calcium arsenate is safe when applied to control the striped cucumber beetle early in the season. It should not be used after the fruit forms. Arsenate of lead may be applied to Hubbard squash for control of the squash vine borer, because the fruits are just forming at that time.

TOMATOES usually require no arsenical spray, but if one is necessary it should be applied before the tomatoes set on the vines.

Circular 101 April, 1934

Connecticut Agricultural Experiment Station
New Haven

CONTROL OF APPLE MAGGOT

PHILIP GARMAN

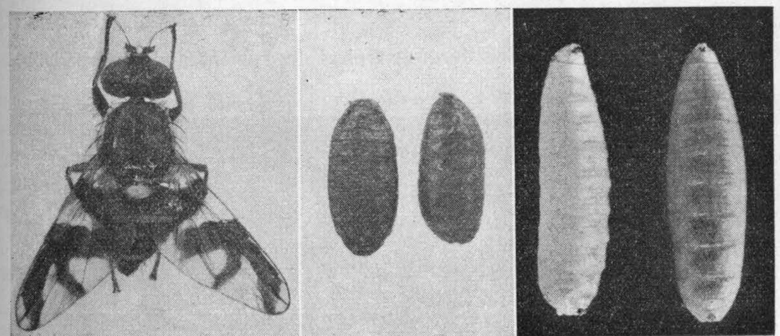

FIGURE 25. Apple maggots, puparia and adult fly, (five times enlarged). Left, fly; middle, puparia; right, maggots.

The apple maggot, *Rhagoletis pomonella* Walsh, infests many kinds of apples, particularly sweet, subacid and early fall varieties. Early Harvest, Sweet Bough, Wealthy and Northern Spy are examples of heavily infested varieties. Red Astrachan is sometimes heavily infested. Gravenstein is moderately or severely infested. Baldwin, Ben Davis, McIntosh, Greening and Wolf River are examples of moderate to lightly infested varieties, but McIntosh may be heavily infested if interplanted with early varieties subject to attack. Delicious is often more severely injured than other late fall varieties. Infested fruit usually drops to the ground and in general is worthless from a commercial standpoint. Figures 26 and 27 show infested apples. The fly, maggots and puparia are shown in Figure 25.

Life History

The individual life history consumes a full year, or in some cases more than one year. Flies emerge in June or July, feed for ten days or so, mate and then begin to lay eggs in the fruit. Maggots develop during late summer and fall and as they mature, leave the fallen fruit and enter the soil

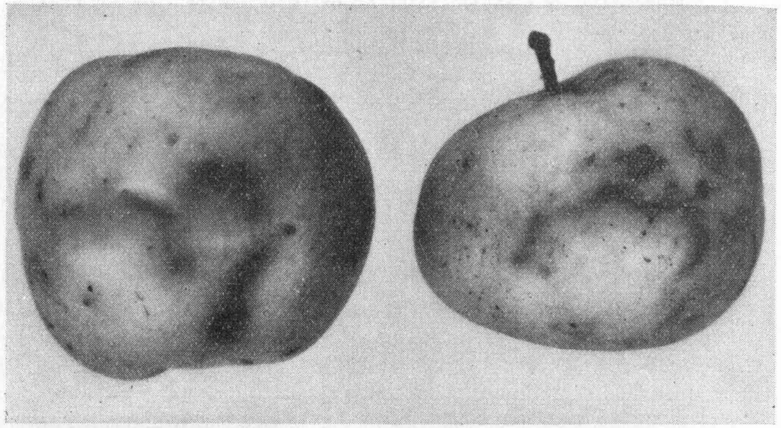

FIGURE 26. Infested apples showing typical depressions and "railroads."

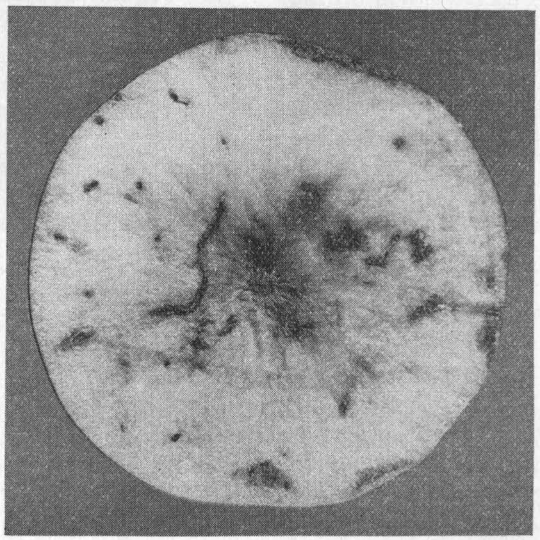

FIGURE 27. Cross section of an infested apple.

where they transform into hard-shelled brown puparia. They remain in this stage until the adults emerge the following year. A small percentage carry over until the second summer, or in more northerly localities until

the third to the sixth year. The percentage remaining for periods longer than one year is, however, relatively small.

During the summer season the majority of the flies emerge from the soil in July. The work of Porter indicates that in the Wallingford district the majority emerge the latter part of July (Figure 28) although maggots breeding in early varieties may produce flies that emerge earlier in the year as shown in Figure 28. Research workers have indicated that maggot flies will also emerge earlier from sandy soils than from heavy loams. It is advisable to have some means of knowing definitely when flies emerge in the orchard if sprays are to be timed correctly. Traps (Figures 29 and 30) are convenient for this purpose and should be placed under the trees where infested fruit naturally falls. They should be filled with maggoty apples in early fall and the apples removed after the maggots have left them to enter the soil.

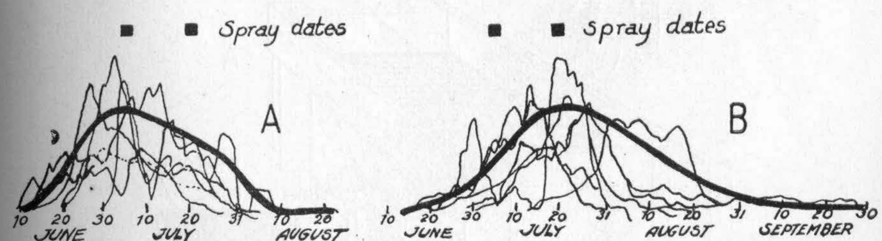

FIGURE 28. Chart of emergence of apple maggot flies at Wallingford, Connecticut, from data by Porter. A. Emergence from early or summer apples. B. Emergence from fall or winter varieties.

The extent of flight as determined by Phipps of Maine, indicates that the majority of the flies do not travel more than 300 yards. It is probable, however, that they sometimes travel much greater distances.

Control Measures

Maggot flies obtain food and moisture from the surface of the fruit and leaves and for this reason stomach poisons are used to kill them.

At present arsenical stomach poisons are generally employed for maggot control. Both calcium and lead arsenate have been used successfully and lead arsenate dust is reported to be effective. Other poisons tried so far have not proved satisfactory although some are promising.

Spray or dusting operations should include bearing trees whether they contain a crop of apples or not, because of the habits of the flies, which feed on the foliage of non-bearing as well as bearing trees.

Maggot infested apples or apples in which maggots are just beginning to work may be saved by placing in cold storage for a month before using or sending to market. This destroys young maggots and eggs.

Where severe infestations occur it is advisable to remove or spray neglected trees near the commercial orchard, and collect and destroy windfalls of heavily infested varieties. Collected fruits may be buried in a trench with two feet of closely tamped soil above, or if it is necessary to dispose of large quantities they may be dumped in a concrete or dirt pit and covered with crank case oil in late fall or early spring. The number of flies emerging from the soil the following summer can be appreciably reduced by these measures.

The main difficulty in successful maggot control is to prevent spray residue accumulation on the fruit, and yet to apply enough poison to control the insect.

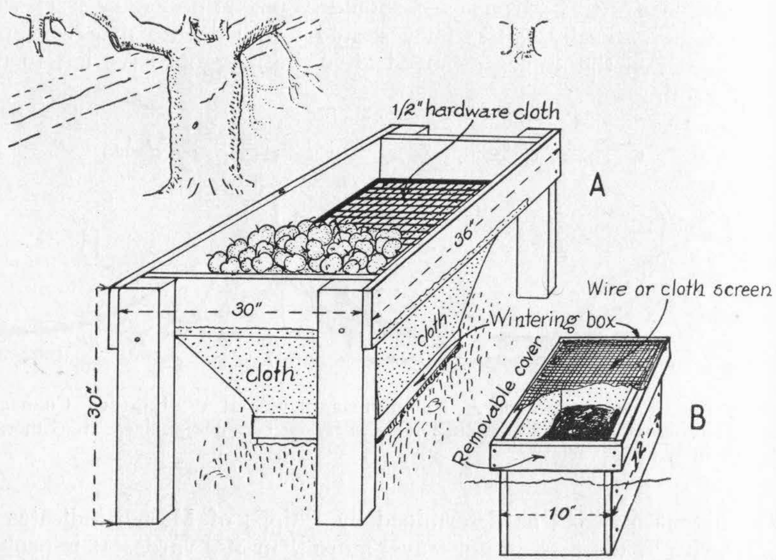

FIGURE 29. Phipps maggot trap. Larvae leaving apples in tray pass through the hardware cloth and into the wintering box (A). The stand with apples should be removed after frost and the over-wintering box (B) provided with a 14 - 16 mesh screen about June 1. Trap slightly modified from the original.

Recommendations for Connecticut

Sprays and dusts

FOR SUMMER AND EARLY FALL VARIETIES: Dust with 90 - 10 lime calcium arsenate dust; or 80 - 10 - 10 sulfur-lime-lead arsenate dust. Apply during the first week in July and again about July 20. The second application can probably be omitted in cases of light infestations. Calcium arsenate lime spray (2 pounds calcium arsenate, 6 to 8 pounds hydrated lime[1] and 100 gallons water) may be used on varieties that ripen late enough to allow two months between the last spray and the picking dates.

[1]Fresh high calcium hydrated lime (calcium oxide 75 to 80 per cent and not over 5 per cent magnesium oxide) finely ground and free from grit.

FOR LATE FALL AND WINTER VARIETIES: Spray with lead arsenate, 3 pounds to 100 gallons, the first week in July and again about July 20. If the infestation is severe, a third application may be needed about the first of August, but this is not usually necessary. In light infestations a single application during early July (July 6 to 10) is sufficient to obtain control. At least two months should be allowed between the last spray and picking dates. Sulfur-lime-lead arsenate dust (80 - 10 - 10) may be substituted for the August spray application, and is preferable in dry seasons. If spray is used, the amount of lead arsenate should be reduced to 2 pounds to each 100 gallons. A fungicide is commonly combined with lead arsenate for control of fungous diseases, and for this purpose lime sulfur or a wettable sulfur should be used. With calcium arsenate only wettable sulfurs should be employed.

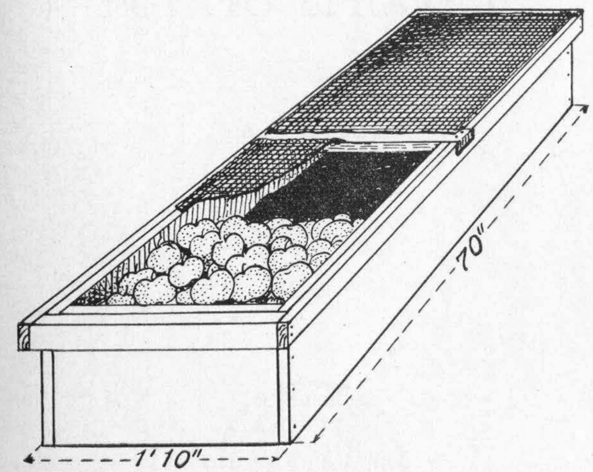

FIGURE 30. A convenient type of ground cage with tight telescope cover. The cover should be left off until June, and the apples removed in late fall.

Supplementary Measures

Attend to all neglected apple trees within 300 yards of the orchard and either spray or remove them. Removal is the surest remedy if it can be done.

If fruit appears to be infested at harvest, place immediately in cold storage and hold at least one month before using.

Collect windfalls of early varieties and destroy them. In order to be successful, this measure should be repeated several times a week and is applicable mainly to heavy infestations or to small plantings where a few trees are involved.

Circular 102 May, 1934

POTATO SPRAYING

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POTATO SPRAYING

The spraying of late potatoes with Bordeaux mixture has become a recognized necessity in Connecticut if profitable yields are to be obtained. With early potatoes, although spraying for disease is usually not necessary, preventive treatment against flea beetles has been found desirable for best results.

Earlier experiments[1] conducted by this Station from 1902 to 1914 showed an average increase in yield of 38 bushels per acre by spraying with 4–4–50 Bordeaux mixture. The average yield from unsprayed plants during this 13-year period was 115 bushels per acre; therefore spraying increased the yield by 33 per cent. During certain years, when late blight was prevalent, the yield was increased by 100 bushels of potatoes per acre. Recently, further experiments have been conducted at the Experimental Farm, Mount Carmel, which show much larger crop gains in blight-free years than those previously recorded. At the same time additional data have been collected in regard to strength of spray, optimum pressure for spraying, and insect control.

Foliage Diseases of the Potato

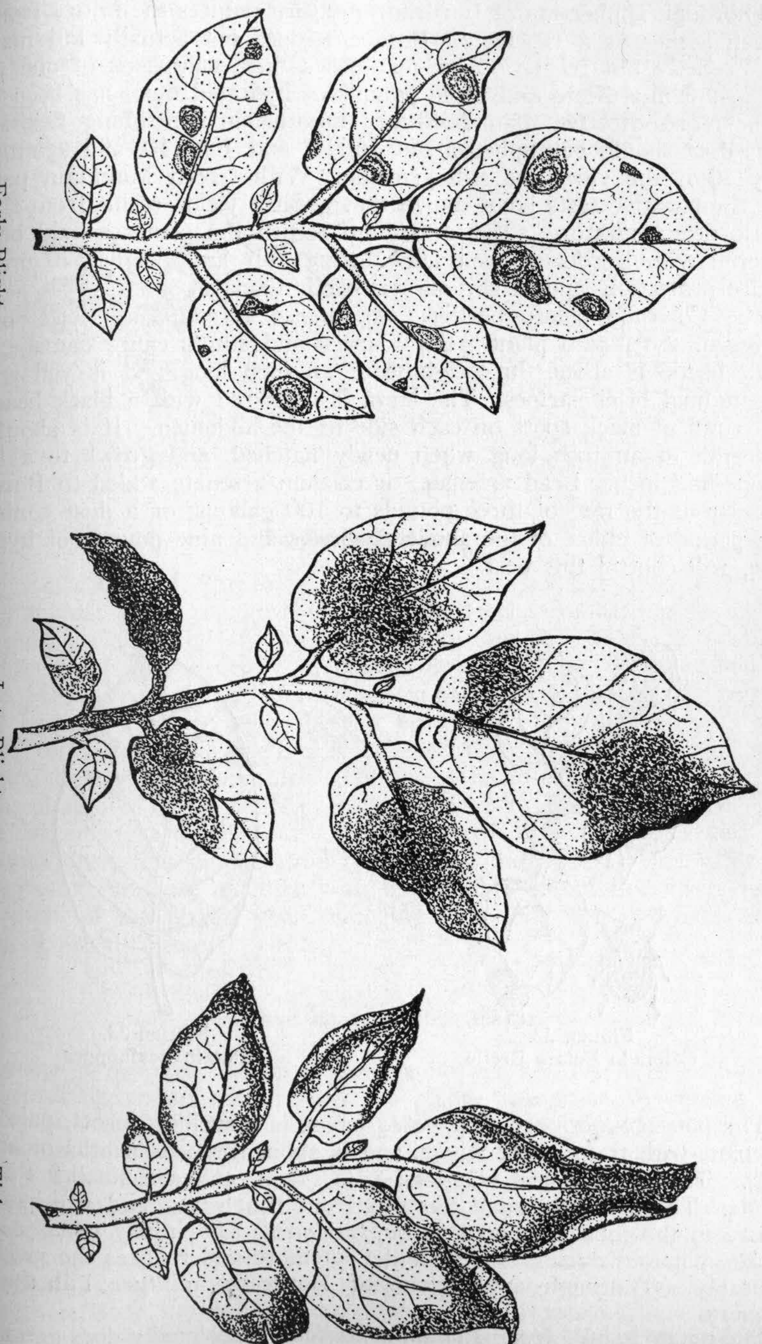
Spraying with Bordeaux mixture prevents two important diseases of potatoes, the early and late blights. Late blight, *Phytophthora infestans,* is by far the more serious of the two. Sometimes this disease appears early in July and in periods of wet weather it may spread rapidly over an entire field. It begins as large, watersoaked leaf-spots on the under surfaces of which a fine, whitish mildew may frequently be seen. The fungus may finally destroy the foliage entirely leaving the potato plants blackened and wilted. When the tops are blighted, tuber infection usually follows. This in turn results in a rot of the potatoes with serious losses in crop yield.

The injury caused by early blight, *Alternaria solani,* is less extensive than that by late blight. This fungus is confined to irregular brown spots marked with concentric rings on the leaves, which diminish the amount of healthy leaf surface. If the blight becomes serious some defoliation may take place. In Connecticut early blight is usually present every year whereas late blight is prevalent only during bad blight years after extended periods of rainy or foggy weather.

Potato Insects

The potato flea-beetle, *Epitrix cucumeris,* is a black, jumping insect about one-sixteenth of an inch long, which chews small, round holes in the leaves. There is one generation a year in Connecticut. The adult emerges from hibernation and attacks potato plants soon after they appear above ground. Eggs are deposited during the latter part of May and throughout June. The larvae feed on potato roots and tubers and emerge as adults in July and August.

[1]Conn. Agr. Expt. Sta., Rept. of the Station Botanist, pp. 471–487. 1915.



Early Blight

Late Blight

Tipburn

FIGURE 31. Leaf Diseases of Potatoes

Thorough application of Bordeaux mixture reduces the injury from this insect, acting as a repellent. Bordeaux does not actually kill many of the beetles. On Irish Cobbler potatoes a dust, composed of one pound of barium fluosilicate and three pounds of hydrated lime, has been found to be more effective than Bordeaux mixture in controlling flea-beetles. This dust should be applied about June 1 and June 10, and again about July 10 if the vines are still growing. With Green Mountain potatoes our comparative tests have shown that greater yields result from the use of Bordeaux mixture. For maximum return the plants should be kept covered with Bordeaux, especially during July and August, in order to insure protection against serious flea-beetle damage.

The Colorado potato beetle, *Leptinotarsa decemlineata,* feeds on the leaves of the potato plant. Both larvae and adults cause damage. The adult beetle is about three-eighths of an inch long and is yellow with longitudinal black stripes. The larva is dark red with a black head and two rows of black spots on each side of the abdomen. It is about one-sixteenth of an inch long when newly hatched, and grows to a length of one-half inch. Lead arsenate, or calcium arsenate added to Bordeaux mixture at the rate of three pounds to 100 gallons, or a dust containing one pound of either of the above arsenates and nine pounds of hydrated lime, will control this pest.

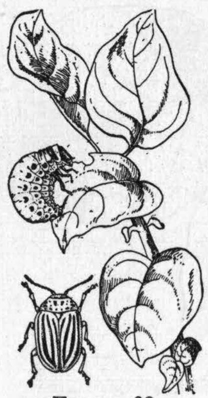


FIGURE 32.
Colorado Potato Beetle

FIGURE 33.
Potato Leafhopper

The potato leafhopper, *Empoasca fabae,* is a sucking insect, pale green in color, with transparent wings, and is about three-sixteenths of an inch long. The nymphs are wingless, pale green, and are smaller than the adults. These insects suck the sap from the leaves and cause serious injury to the foliage, known as *hopper-burn.* The injury usually occurs on late potatoes during August and September and reduces the yield considerably. Thorough applications of Bordeaux mixture kill the leafhoppers.

The potato aphid, *Macrosiphum solanifolii,* occasionally does great harm to the potato crop by sucking sap from the leaves and terminal shoots.

This insect does not cause serious damage every year, but occasionally there is a severe outbreak. A thorough application of 4 per cent nicotine dust, applied under a canvas dragged behind the duster, usually controls these plant lice. The dusting should be done on a hot day. The addition of one part of 40 per cent nicotine sulfate solution to 800 parts of the regular Bordeaux spray is also effective in controlling potato aphids.

FIGURE 34.
Potato Aphid

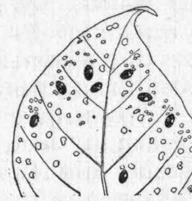


FIGURE 35.
Potato Flea Beetle

Tip-burn of Potato

The application of Bordeaux mixture to potatoes has other desirable effects, at least in the region of Connecticut, besides combatting the above mentioned diseases and insects. During certain dry years tip-burn of potatoes, which is frequently mistaken for late blight, has resulted in serious losses in this state. There are apparently two types of tip-burn of the leaves. One, recognized by a browning of the leaf margin and upward rolling of the leaf edge, is believed to be caused by bright sunlight and lack of soil moisture. The other is an injury caused by the feeding punctures of the leafhopper, and is usually noticeable at the ends of the larger veins of the leaf. Prevention of these tip-burns and the additional protection against unfavorable conditions of climate afforded by Bordeaux mixture, together with its possible stimulative effect upon the growth of the potato plant, combine to extend the growing period and consequently increase yields.

Time and Frequency of Sprays

In order to prevent excessive damage by the flea beetle, it is well to begin spraying potatoes soon after the plants appear above ground. In our experiments with late potatoes, planted May 15, good results have been obtained by commencing to spray with Bordeaux mixture about the first of July. Earlier plantings might require somewhat earlier spraying. By making successive applications of Bordeaux every week or ten days, the potato foliage may be maintained in a healthy, active condition until the growing season is over and thus larger yields obtained. We have found that a smaller number of sprays per season are necessary when the work is done thoroughly, and that 8–8–50 Bordeaux mixture lasts longer on the plants than 4–4–50 mixture. An experiment conducted in 1932 showed that plants sprayed only four times with 8–8–50 Bordeaux yielded 29 bushels of potatoes per acre more than others sprayed seven times with the 4–4–50 mixture. Under normal conditions, from six to ten applications of spray should be made per season, depending upon the growth of the plants, weather conditions, and thoroughness of spraying.

Pressure, Amount of Spray, Concentration and Coverage

Our experiments seem to show that the best coverage has been obtained by the use of a double strength spray, applied at a fairly high pressure (350 to 400 pounds per square inch) and at a rate of 200 or more gallons per acre. Smaller amounts are used in spraying younger plants. This treatment has been found to require the least number of applications in order to maintain good coverage throughout the season.

Complete coverage of the plant with Bordeaux mixture is the important, desirable aim in potato spraying. It seems that the means of securing this coverage are less important than the complete coverage itself. Our experiments have shown an average difference in yield of 18 bushels per acre between plots sprayed at a pressure of 400 pounds per square inch and plots sprayed at 200 pounds when 4–4–50 Bordeaux mixture was used. With 8–8–50 Bordeaux, this difference between low and high spraying pressures has amounted to only 10 bushels per acre. However, greater care and more time were necessary in securing good coverage with the lower than with the higher pressure. Likewise, four spray-nozzles to the row and larger amounts of spray material secured more thorough coverage by reaching all of the foliage.

Results of Recent Experiments at this Station

The results of experiments conducted with late potatoes at Mount Carmel, over a three-year period from 1931 to 1933, have shown Bordeaux mixture to produce profitable increases in yield each year. The 8–8–50 Bordeaux (8 pounds of copper sulfate, 8 pounds of hydrated lime and 50 gallons of water) increased the yields more than the weaker 4–4–50 mixture.

Year	*Yield—Bushels Marketable Tubers per Acre*			
	Check (untreated)	Copper lime dust	Bordeaux mixture 4–4–50	Bordeaux mixture 8–8–50
1931	225	279	318	343
1932	113	235	219	295
1933	74	99	165	257
Average	137	204	234	298

We have been unable to secure consistent increases in the yield of potatoes by use of copper-lime dust. In 1932 this dust, applied twice as frequently as the spray applications, produced yields which were only comparable with the poorest ones obtained from the regular applications of 4–4–50 Bordeaux mixture. The data upon yields from the use of the stronger and weaker spray mixtures and also from the use of copper-lime dust are shown in the table above.

Tubers from the plants sprayed with Bordeaux mixture were much larger than those from the unsprayed or dusted plots, as is shown by the following numbers of tubers necessary to make 100 pounds in weight: untreated, 342; copper-lime dust, 345; 4–4–50 Bordeaux, 250; 8–8–50 Bordeaux, 246.

In 1933, one field of potatoes containing both Irish Cobbler and Green Mountain varieties, on land different from that used in the above experiments, was sprayed with 6–6–50 Bordeaux mixture. Here the early variety in unsprayed plots produced 128 bushels per acre while the sprayed plants produced 252 bushels. With the late variety, the spray treatment increased the yield from 196 to 457 bushels per acre. In the latter case, the percentage increase of the 6–6–50 spray treatment will be found to be intermediate between the 4–4–50 and 8–8–50 results recorded in the above table for this year.

Tests were made in 1931 with a 12–12–50 Bordeaux mixture, but the yield with this spray was only six bushels per acre more than that with the 8–8–50 Bordeaux.

At Windsor, an experiment carried out in 1933 with late potatoes on land previously planted with tobacco gave results similar to those obtained at Mount Carmel. The yields of potatoes from this plot, showing the variations between the different spraying and dusting treatments, are listed in the following table. In this experiment the lead arsenate and fish oil spray, and the barium fluosilicate dust, both gave good control of the potato flea beetles. Therefore, the increases in yield of 40 and 51 bushels of first grade potatoes per acre respectively for these two

Treatment	*Yield—Bushels per acre* Firsts	Seconds	Increase over untreated Firsts
Untreated	176	23	
Lead arsenate fish oil spray	216	13	40
Copper-lime dust	225	16	49
Barium fluosilicate dust	227	16	51
4–4–50 Bordeaux spray	376	12	200
8–8–50 Bordeaux spray	404	7	228

treatments probably show the approximate amount of damage caused by the flea beetle. The much larger increases in yield obtained by the Bordeaux sprays show the greater amount of benefit resulting from the additional control of leafhoppers and diseases, and the general beneficial effects of the Bordeaux mixture.

Preparation of Bordeaux Mixture

Bordeaux mixture is prepared by mixing solutions of lime and copper sulfate. Freshly slaked stone lime is probably the best for this purpose. Fresh hydrated lime is entirely satisfactory, however, and is widely used because of its convenience. Hydrated lime for Bordeaux mixture must be fresh, very fine and of high quality. The ordinary crystalline copper sulfate, (bluestone or blue vitriol), is usually used in preparing Bordeaux mixture. Monohydrated copper sulfate, (copper snow), has been advocated. It dissolves more quickly, but it is too expensive for general use. Ordinary copper sulfate can be dissolved in cold water in about two hours by placing the required amount in a burlap bag and hanging it just in contact with the surface of the water in a wooden tank or barrel. The combined action of the air and water acting simultaneously on the copper sulfate crystals makes them pass into solution readily.

In making Bordeaux mixture, the two dilute materials may be mixed in the spray tank, or one of these materials may be diluted in the tank and the other ingredient added in a concentrated solution, with the agitator in operation. Strong agitation during the mixing process aids in making a better Bordeaux mixture. Laboratory tests have shown that addition of concentrated copper sulfate (1 pound in 1 gallon of water) to diluted lime (1 pound in 6 to 12 gallons of water) produces a Bordeaux mixture which stays in suspension longer than that produced by other methods. However, this method is only slightly superior to that of adding dilute lime (1 pound in 3 to 6 gallons of water) to dilute copper sulfate (1 pound in 3 to 6 gallons of water).

The use of 4–4–50 Bordeaux mixture has been found to produce satisfactory yields of potatoes. However, in our experiments, 6–6–50 and 8–8–50 Bordeaux have always increased the yields more than enough to pay for the additional amounts of materials necessary to strengthen the spray solution.

Circular 103 July, 1934

Connecticut Agricultural Experiment Station

New Haven

LAW AND REGULATIONS CONCERNING THE INSPECTION AND SHIPMENT OF NURSERY STOCK IN CONNECTICUT*

W. E. BRITTON, STATE ENTOMOLOGIST

The present law governing the inspection and transportation of nursery stock was enacted in 1925, and published as Chapter 265, Public Acts of 1925. In the revision of the General Statutes of 1930, this law appears in slightly different form in Sections 2135 to 2140, inclusive, as follows:

Sec. 2135. Certificate of inspection of imported nursery stock. All nursery stock shipped into this state shall bear on each package a certificate that the contents of such package have been inspected by a state or government officer and that such contents appear free from all dangerous insects and diseases. If nursery stock shall have been brought into the state without such a certificate, the express, freight or other transportation company or person shall, before delivering shipment to consignee, notify the state entomologist of the facts, giving name and address of consignee, origin of shipment and approximate number of cars, boxes or packages and probable date of delivery to the consignee. The state entomologist may cause the inspection and, if infested, the treatment of the stock. No person, firm or corporation shall unpack any woody field-grown nursery or florists' stock brought into this state from foreign countries except in the presence of an inspector unless given permission to do so by the state entomologist or one of his assistants. If such stock shall be found infested with any dangerous pests, the state entomologist may order it treated. Any person violating any of the provisions of this section shall be fined not more than fifty dollars. No provision of section 6132 shall be construed to apply to any bale, box, package or

*Revision of Bulletin of Immediate Information No. 50, 1925.

load or to the contents thereof, which shall be transported into this state from outside the state, provided the same shall be labeled in such a manner as to indicate the place from which it shall have been transported and shall be accompanied by the certificate prescribed by this section.

Sec. 2136. Nursery stock; powers of State Entomologist. The state entomologist or his assistants shall, upon application, inspect at least once each year all nurseries at which woody field-grown hardy trees and plants shall be grown for sale or shipment; may inspect any nursery stock when dug, before shipment or at destination; may inspect nurseries at any time for the purpose of controlling plant pests or to ascertain whether such pests exist in nurseries; may prescribe forms for registration, certificates and permits and may make rules and regulations regarding time and methods of inspection; may destroy or treat or order the destruction or treatment of, and prohibit the movement of, plants infested with dangerous pests, may coöperate with agents of the United States department of agriculture in the inspection of nurseries and control of plant pests; may, at reasonable times, enter any public or private grounds in performance of his duties under the provisions of this section and sections 2137 and 2138. In case orders shall be issued for the destruction or treatment of infested plants, the owner, manager or agent of the nursery shall, within a reasonable time from the date of such order, destroy such plants as shall be ordered destroyed and make such treatment within the time specified in the order or be subject to the penalty provided in section 2140.

Sec. 2137. Nurserymen and dealers to register. All nurserymen shall register with the state entomologist each year, on or before July first, and make application for inspection, and furnish such data on such blanks as the state entomologist shall prescribe and furnish. In case a nurseryman shall fail to make such application on or before July first, he shall pay to the state entomologist the cost of such inspection. All firms, stores and individuals who shall sell but shall not grow nursery stock shall be classed as dealers, and shall, each year, on or before March first, register with the state entomologist, giving the chief sources of their nursery stock and such data as he may require, on such forms as he may prescribe and furnish, and the state entomologist may issue a permit allowing such dealer to sell such nursery stock. Each nursery outside the state, before shipping nursery stock into the state, shall file with the state entomologist a copy of a valid inspection certificate and the state entomologist may issue a permit allowing such nursery to ship stock into the state. The state entomologist shall keep a record of all money received as costs for inspection, and such money shall be deposited with the state treasurer.

Sec. 2138. Nursery certificate. Uninspected stock. The state entomologist shall issue to regular nurseries certificates, valid until the first day of August following the date of issue and covering the stock inspected and such other stock as shall have been received under valid certificates of inspection and may issue temporary permits covering certain portions thereof, and permits to dealers. All such certificates and permits may be revoked for cause. Nursery stock which shall not have been inspected or stock from a nursery not holding a valid certificate of inspection shall not be sold or transported, and transportation companies shall refuse to accept any shipment not bearing such certificate or some form of permit issued by the state entomologist, and all nurserymen shall furnish a certificate, and all dealers a permit, to accompany each package of stock sold or transported, but no provision of section 2136, 2137 or 2138 shall prevent or render liable any person or firm transporting stock from one field or property to another field or property belonging to or operated by such person or firm when such stock is not to be immediately sold or offered for sale and when such transportation shall not violate any established federal or state embargo or quarantine regulations.

Sec. 2139. Nursery and nursery stock defined. For the purposes of sections 2136, 2137 and 2138, any place at which hardy trees, shrubs and vines shall be propagated or grown out of doors for commercial purposes shall be considered a nursery, and such stock shall be regarded as nursery stock. Hardy herbaceous perennial plants, including strawberry plants, may be subject to the same provisions regarding inspection and pest control, if, in the opinion of the state entomologist, it shall be desirable to control the movement of such plants. Florists' ordinary plants, unless woody and field-grown, shall not be included.

Sec. 2140. Penalty. Appeal. Any person who shall interfere with the state entomologist or his assistant in the performance of his duties under the provisions of sections 2136, 2137 and 2138, or any person, firm or corporation who shall violate any of the provisions thereof, shall be fined not more than fifty dollars. Any person aggrieved by any order issued under the provisions of sections 2136, 2137 and 2138 may appeal to the superior court, or to any judge thereof if said court shall not be in session, and said court or such judge may grant such relief or issue such order or judgment in the premises as to equity may appertain.

Registration

All persons who grow nursery stock for sale or shipment are required to register with the State Entomologist each year before July 1. The annual inspection of nurseries begins in July and nurseries in existence the preceding year must bear the cost of inspection if they fail to register before July 1.

All persons who buy and sell but do not grow nursery stock are also required to register with the State Entomologist and receive a dealer's permit. No inspection is required, but a dealer is supposed to handle only stock procured from regular nurseries holding certificates.

Inspection and Pest Control

In July, after the nurseries have registered, the inspection force examines the nurseries by groups to avoid unnecessary travel, beginning with those that request early attention. In case pests are found, directions for eradicating or controlling them are given by the inspector or sent from the office, and the owner or manager is expected to carry them out promptly and to notify this office when completed. Pests must be eradicated before a certificate can be issued.

Nursery Certificates

The original certificate issued by the State Entomologist under Section 2138, is to be kept in the nurseryman's possession, and is not to be attached to any package of nursery stock. It applies to the whole nursery which has been inspected and to such purchased stock as has been received from other nurseries under the certificate of a state or government officer. If any stock is received from outside the state unaccompanied by such a certificate, the State Entomologist should be notified at once so that it may be inspected.

An exact transcript of the certificate including number and date may be printed on labels or tags for shipping and must be attached to each package sent out of the nursery. An additional statement, made by the owner, that the stock has been fumigated will be required in some states.

The law now requires that the inspection certificate be attached to every package shipped to points both within the State of Connecticut and outside. Please see that a copy always accompanies each sale whether shipped by freight, express, mail, automobile or whether carried away by the purchaser.

After the date of expiration, which is a part of each certificate, the document becomes invalid and should not be attached to any box, bale or package. The nurseryman has no right to change the date or any other portion of the certificate.

The improper use or abuse of a certificate will not be tolerated, and the certificate may be revoked for cause.

Duplicate copies of certificates for filing in other states will be furnished on request of the nurseryman.

Dealer's Permits

The original permit issued by the State Entomologist under Section 2137, should be kept in the dealer's possession and is not to be attached to any package or shipment of nursery stock, though copies may be made for this purpose. These may be typewritten or printed and a copy must go with each separate sale from stores, and with each shipment or package of nursery stock transported. This copy must be an exact transcript, and must include number, date of issue and of expiration. After the expiration date, the permit becomes invalid and should not be used. The dealer has no right to alter the date or any other portion of the permit. This permit may be revoked for improper use or abuse, and for not complying with the law.

Shipper's Permits

The shipper's permit is issued to nurserymen in other states who file applications and duplicate signed copies of their state inspection certificates. The original permit should be kept, and a copy (typed or printed) together with a copy of the inspection certificate of the state in which the nursery is situated should accompany each shipment into Connecticut.

Package Certificates

Occasionally individuals and firms not in the nursery business wish to ship a few trees or shrubs but cannot do so without inspection certificates. If such materials can be inspected by our men on their usual trips without extra travel and expense, this will be done on request, as an accommodation. Other inspections may be arranged by special appointment, or plants can be sent to the Station with address and postage for forwarding, and here they will be examined and sent along.

The U. S. Postal Laws and Regulations, Section 467, Paragraph 2, governs the mailing of plants and plant products, and reads as follows:

"Nursery stock, including all field-grown florists' stock, trees, shrubs, vines, cuttings, grafts, scions, buds, fruit pits and other seeds of fruit and ornamental trees or shrubs, and other plants and plant products for propagation, except field, vegetable and flower seeds, bedding plants and other herbaceous plants, bulbs and roots, may be admitted to the mails only when accompanied with a certificate from a State or Government inspector to the effect that the nursery or premises from which such nursery stock is shipped has been inspected within a year and found free from injurious insects and plant diseases, and the parcel containing such nursery stock is plainly marked to show the nature of the contents and the name and address of the sender."

Such materials may be mailed without certificate to any Agricultural Experiment Station or to the United States Department of Agriculture. Florists' plants (not woody, field-grown) and vegetable or other annual herbaceous plants do not require certificates but must be plainly marked as to contents, origin and destination. Package certificates apply only to the contents of the packages on which they are placed, and the contents of which have been examined.

Quarantines

Both State and Federal quarantines prohibit the movement of nursery stock and forest products from the area quarantined on account of the gipsy moth to any point outside of that area, without inspection and special certificate. State and Federal quarantines prohibit the shipment of willow and poplar outside of the area quarantined on account of the satin moth and no inspection will be made or certificates issued.

Shipments to points outside the area covered by the Federal Japanese beetle quarantine must bear special certificates. On account of the European corn borer, quarantines have been established by about 31 states, and certain susceptible plants grown in the infested area of the northeastern and middle western states must be certified if they are to be shipped into states protected by state quarantines.

Federal inspectors will be stationed at convenient points to cover the quarantined area of the State. Applications for such inspections may be made to the nearest Federal inspector or to the following:

J. Peter Johnson, Deputy in Charge of Federal Quarantines in Connecticut,

W. E. Britton, State Entomologist, In Charge of State Quarantine and Inspection Service,
Agricultural Experiment Station,
New Haven, Conn.

Circular 104 July 1934

Connecticut Agricultural Experiment Station

New Haven

QUARANTINE MEASURES RESTRICTING SHIPMENTS OF CONNECTICUT PLANTS, 1934

W. E. BRITTON

The shipment out of Connecticut of nursery stock, florist's plants and forest products is now regulated by six different Federal quarantines, as follows:

Gipsy moth	Federal quarantine No.	45	(Conn. No. 18)		Federal and State quarantines coincide
Satin moth	" " "	53	(" " 32)		
Japanese beetle	" " "	48	(no State quarantine)		
White pine blister rust	" " "	63	" " "		Federal quarantine covers entire State
Barberry-grain black stem rust	" " "	38	" " "		
Narcissus bulb fly and eelworm	" " "	62	" " "		

In all except the satin moth and barberry-grain stem rust quarantines, special certificates are required on shipments going outside the quarantined areas. These two exceptions are absolute embargoes for certain kinds of plants.

In addition to the quarantines mentioned above, many State quarantines on account of the European corn borer prevent the shipment of certain kinds of plants from the infested states to points outside, unless certified. The Federal corn borer quarantine has been revoked but Federal and State inspectors are authorized to make inspections and issue certificates

Gipsy Moth

There has been no recent change in the gipsy moth quarantine. The restricted area includes all of Windham, New London, Hartford, Tolland and Middlesex Counties; the towns of Colebrook, Winchester, Barkhamsted, Torrington, New Hartford, Harwinton, Thomaston and Plymouth in Litchfield County, and the towns of Waterbury, Wolcott, Meriden, North Haven, North Branford, Branford, Guilford and Madison in New Haven County. Woody field-grown nursery stock and forest products from the quarantined area must be inspected and certified before they can be shipped outside the area. Quarantined areas in other states include all of Rhode Island, all of Massachusetts except Berkshire County, all of Vermont except the barrier zone of about two tiers of towns along the western border, all of New Hampshire except the northern third of Coos County, and the southwestern third of Maine.

Japanese Beetle

The area quarantined on account of the Japanese beetle now includes all of New England except Maine and the northern half of New Hampshire and Vermont; all of New Jersey, Delaware and the District of Columbia; the southeastern third of New York; all of Pennsylvania except six counties in the extreme northwestern corner, and portions of Maryland and Virginia.

Inspectors

The following inspectors are authorized to make inspections and issue certificates on account of the gipsy moth, the Japanese beetle and the European corn borer. In general, application for inspection should be sent in advance to the nearest inspector.

W. J. Ahearn, Box 63, telephone 4388, Westerly, R. I.
M. J. Anderson, 38 Main St., telephone 1613, Middletown, Conn.
W. W. Eells, Box 363, Sta. A, telephone 4482, Manchester, Conn.
F. L. Fall, 313 Montauk Ave., telephone 2-2333, New London, Conn.
J. F. Keough, 54 Moulton Court, telephone 1395, Willimantic, Conn.
W. H. Shinkwin, Box 260, telephone 46, Westfield, Mass.—(covers town of Enfield, Conn.)
J. P. Johnson, Agr. Expt. Station, telephone 5-5078, New Haven, Conn.

Satin Moth

The quarantined area includes the whole of Hartford, Tolland, Windham, New London and Middlesex Counties; all of New Haven County except Oxford, Middlebury and Southbury; Stratford and Bridgeport in Fairfield County; and Torrington, New Hartford, Harwinton, Thomaston, Plymouth and Watertown in Litchfield County. Quarantined territory in other states includes all of Rhode Island; the southern half of Maine; the southern two-thirds of New Hampshire; and one row of towns along the Connecticut River through Windham, Windsor and Orange Counties in Vermont.

Poplar and willow trees, or parts thereof capable of propagation, if grown within the quarantined area shall not be allowed to move out of that area. Permits may be issued for poplar and willow trees that are brought into the area after October 1, and shipped before April 30 of the following year.

Barberry-grain Stem Rust

The common barberry and its horticultural varieties and certain other uncommon species of *Berberis* and *Mahonia* are prohibited by Federal Quarantine No. 38, from being shipped into Colorado, Illinois, Indiana, Iowa, Michigan, Minnesota, Montana, Nebraska, North Dakota, Ohio, South Dakota, Wisconsin and Wyoming. The movement of Japanese barberry is not restricted.

Narcissus Bulb Fly and Eelworm

Federal Quarantine No. 62, as amended, provides that all varieties of narcissus bulbs may be shipped into other states only after inspection in the field, after digging, and certification. Requests for inspection should be made before May 1, so that a field inspection is possible when the plants are in bloom.

Apply to W. E. Britton, State Entomologist, Agr. Expt. Station, telephone 5-6192, New Haven, Conn.

White Pine Blister Rust

In order that five-leaf pines may be grown in blister rust free areas, Connecticut has legally established control areas around twelve nurseries in the following localities: Avon, Barkhamsted, Bristol, Cheshire, Cromwell, Deep River, Ridgefield, Southport, Wallingford, Waterford, West Hartford and Woodmont.

Five-leaf pines and *Ribes* may be shipped into Connecticut from the other New England States and New York only after obtaining control area permits (Federal Form 415). Five-leaf pines may be shipped out of the New York-New England area only when grown from seed in an area declared officially to be free from *Ribes*.

Five-leaf pines may be shipped at any time of the year if accompanied by a control area permit (Form 415).

The European black currant is outlawed and no permits will be issued for that species.

Red, white and mountain currants and gooseberries may be moved interstate (or shipped from place to place in Connecticut—a state regulation) only between September 20 and May 15, and in compliance with the following regulations:

1. Plants must be dormant, or they must be dipped just before shipping in lime-sulfur mixture (32° Baumé, one part in eight parts water—dilute test 4, 5 Baumé).
2. Containers shall be plainly marked to show that they contain *Ribes*, name and address of consignor and consignee, State certificate of inspection and control area permit (Form 415).

For control area permits apply to State Horticulturist, Augusta, Me.; Director, Division of Plant Pest Control, State House, Boston, Mass.; State Nursery Inspector, Durham, N. H.; State Entomologist, Providence, R. I.; Director, Bureau of Plant Industry, Albany, N. Y.

For control area permits in Connecticut give name and address of consignee, with number of plants and name of each variety, and apply to W. E. Britton, State Entomologist, Agricultural Experiment Station, New Haven; telephone 5-6192.

For inspections of *Ribes* and pines to determine blister rust conditions, and for the establishment of *Ribes* free areas, apply to J. E. Riley, Jr., in charge of Blister Rust Control, Agricultural Experiment Station, New Haven; telephone 5-6192.

European Corn Borer

The Federal corn borer quarantine was repealed in 1932. Since then, 31 states have established quarantines prohibiting the usual host plants from entering those states from the infested area. Most of these host plants are rarely shipped by nurserymen. Hardy chrysanthemums and hollyhocks are handled by nurserymen, and if accompanied by special certificates showing freedom from infestation, may be shipped into the following states:

Arizona	Kansas	Oregon
Arkansas	Kentucky	South Carolina
California	Louisiana	South Dakota
Colorado	Michigan	Tennessee
Florida	Mississippi	Texas
Georgia	Missouri	Utah
Idaho	Nebraska	Virginia
Illinois	Nevada	Washington
Indiana	New Mexico	Wisconsin
Iowa	Ohio	Wyoming
	Oklahoma	

Connecticut Agricultural Experiment Station
New Haven

REGULATIONS CONCERNING TRANSPORTATION OF NURSERY STOCK IN THE UNITED STATES AND CANADA

Compiled by
W. E. BRITTON, State Entomologist

At the present time nearly every state in the Union has laws or regulations in regard to the inspection, certification and transportation of nursery stock. These all have one object in view, namely, the control of plant pests. But conditions are not uniform throughout the United States, and each state has established such requirements as seem to give it the best protection, with the result that there are many different regulations.

This situation assumes a serious aspect to the nurserymen who may wish to fill orders received from 18 or 20 or more different states. In order to tabulate and bring together these varying regulations in convenient form for the use of Connecticut nurserymen, this bulletin has been prepared. It should be understood that it presents only a brief digest in each case, and if any points are not clear, the nurseryman should write to the officer in charge of inspection in that state for more information.

In addition to the various state laws and regulations, there are several Federal quarantines regulating the shipment of nursery stock. A digest of these has been included in this bulletin, together with the regulations of the District of Columbia and of the Dominion of Canada.

FEDERAL QUARANTINES

The following Federal quarantines concern the shipment of nursery stock:

White pine blister rust. Quarantine No. 63 regulates the interstate movement throughout the United States of five-leaf pines and currant and gooseberry plants. The infected states and district are designated as Connecticut, Idaho, Iowa, Maine, Maryland, Massachusetts, Michigan, Minnesota, Montana, New Hampshire, New Jersey, New York, Ohio, Oregon, Pennsylvania, Rhode Island, Vermont, Virginia, Washington, West Virginia, Wisconsin and the District of Columbia.

Pine Shipments

These regulations require a Federal pine-shipping permit for the shipment or transportation of five-leaf pines from any infected state or district; except that in the case of shipments to or between the states of Connecticut, Maine, Massachusetts, New Hampshire, New York, Rhode Island and Vermont, a control-area permit secured from the proper officer of the state of destination may, until further notice, be substituted for the Federal pine-shipping permit.

Pine-shipping permits are issued for pines grown from seed in a nursery which is protected from blister-rust infection by a Ribes-free zone around the premises.

Valid state nursery inspection certificates are also required as to all interstate movement of five-leaf pines in the United States.

Currant and Gooseberry Shipments

The interstate movement of European black-currant, *Ribes nigrum,* plants is prohibited except to and between the states of Alabama, Arkansas, Florida, Kansas, Louisiana, Mississippi, Missouri, Nebraska, North Dakota, Oklahoma, South Dakota and Texas.

Currant and gooseberry plants shipped from any infected state or district must be either dormant and defoliated or else dipped in lime-sulfur solution (4.5°B.) *immediately before shipment.* The solution is prepared by diluting 1 part of commercial concentrated lime-sulfur solution of 32 degrees B. with 8 parts of water.

A control-area permit must be secured from the state of destination for shipments of currant and gooseberry plants into those states which have legally established areas in which the growing of currant and gooseberry plants is prohibited. Such states are Connecticut, Idaho, Maine, Massachusetts, Michigan, New Hampshire, New York, Rhode Island and Vermont.

Narcissus bulbs. Quarantine No. 62 provides that all varieties of narcissus bulbs may be shipped interstate only after inspection (and treatment if found infested) and certification in the state where grown. Each crate, box, or other container must bear a Federal shipping certificate authorizing interstate movement and such certificate shall remain and continue as a condition of any reshipment of such bulbs in original containers. "Certified narcissus bulbs taken from crates or other original containers for reshipment interstate in smaller lots shall have securely attached to each container a tag or label signed by the shipper thereof reading as follows: 'The undersigned certifies that the narcissus bulbs contained herein were taken from a shipment of narcissus bulbs certified by the Bureau of Plant Quarantine, under Notice of Quarantine No. 62.' "

Black stem rust of grains. Quarantine No. 38, as revised effective August 1, 1931, prohibits the movement of any plants (or parts of plants capable of propagation) of the genus *Berberis* (barberry) or of the genera *Mahonia* or *Mahoberberis* (*Mahonias,* hollygrapes, holly barberries, or Oregon grapes) into any of the protected states, unless a permit shall have been issued therefor by the United States Department of Agriculture, except that no restrictions are placed on the shipment of Japanese barberry (*Berberis thunbergii*) or any of its horticultural varieties. The protected states are: Colorado, Illinois, Indiana, Iowa, Michigan, Minnesota, Montana, Nebraska, North Dakota, Ohio, South Dakota, Wisconsin and Wyoming.

Permits are issued to nurseries which grow only those species of *Berberis* and *Mahonia* which are immune or resistant to black stem rust infection.

Gypsy moth and brown-tail moth. Quarantine No. 45 regulates the interstate shipment of all nursery stock, forest products, Christmas trees and Christmas greens and greenery, such as holly and laurel, stone and quarry products from the infested area in the New England States, and from the generally infested to the lightly infested areas within those states. Nursery stock must be inspected and certified by Federal inspectors.

Japanese beetle. Quarantine No. 48 (revised) regulates the interstate movement of all nursery stock and other materials including soil from the regulated areas to or through outside points. The regulated areas include the entire states of Connecticut, Delaware, Massachusetts, New Jersey and Rhode Island, the District of Columbia, and parts of the states of Maine, Maryland, New Hampshire, New York, Pennsylvania, Vermont, Virginia and West Virginia.

Satin moth. Quarantine No. 53, as revised, prohibits the interstate shipment from the infested areas in Maine, Massachusetts, New Hampshire, Rhode Island, Vermont, Connecticut and Washington to outside points, of all species and varieties of willow and poplar trees or parts thereof capable of propagation. Federal permits may, however, be issued for the interstate movement of poplar and willow trees or parts thereof from the regulated area on the following conditions: Trees must have originated outside of the regulated area; taken within that area they must be kept entirely removed from other poplar and willow trees, and so segregated as to be easily identified, and so placed that in the judgment of the inspector no infestation can be transmitted. Such permits are issued only for the period from October 1 to April 30.

Woodgate rust. Quarantine No. 65 prohibits the interstate movement from the regulated area in the state of New York of trees, branches, limbs, or twigs of Scotch pine, Canary Island pine, slash pine, Japanese red pine, Corsican pine, stone pine, western yellow pine, Monterey pine, loblolly pine, or Jersey pine, or of any variety thereof, or of any species or variety of hard pine hereafter found to be susceptible to the Woodgate rust.

For further information regarding Federal quarantines and regulations address: Bureau of Plant Quarantine, U. S. Department of Agriculture, Washington, D. C.

District of Columbia

Each package of nursery stock (all woody plants including such greenhouse-grown plants as palms and roses) entering the District of Columbia, must bear a valid certificate of inspection, and must be marked with the nature of the contents and with the name and address of both the consignor and consignee. Herbaceous perennial plants, bulbs and roots are required to be marked with the name and address of the consignor and the consignee and with the nature of the contents, but certification in advance is not required. There are no restrictions on the shipment into the District of Columbia of annual plants, cut flowers, evergreen branches or trees without roots and other portions of plants without roots and free from soil and not intended for propagation, except that compliance with any special plant quarantines or other restrictive orders which may be applicable to such plants is required.

Bureau of Plant Quarantine, Washington, D. C.

Postal Regulations Regarding Nursery Stock Shipped by Parcel Post

The United States Postal Laws and Regulations, Section 595, paragraph 2, governing the mailing of plants and plant products, reads as follows:

"Nursery stock, including all field-grown florists' stock, trees, shrubs, vines, cuttings, grafts, scions, buds, fruit pits, and other seeds of fruit and ornamental trees or shrubs, and other plants and plant products for propagation, except field, vegetable and flower seeds, bedding plants and other herbaceous plants, bulbs, and roots, may be admitted to the mails only when accompanied with a certificate from a State or Government inspector to the effect that the nursery or premises from which such nursery stock is shipped has been inspected within a year and found free from injurious insects and plant diseases, and the parcel containing such nursery stock is plainly marked to show the nature of the contents and the name and address of the sender."

DOMINION OF CANADA

Nursery stock and all plants for ornamental purposes, propagation or cropping, (seeds and seed potatoes excepted), from the United States, can enter Canada only after permits (and official labels, if to be sent by mail) have been procured by the importer from the Secretary, Destructive Insect and Pest Act Advisory Board, Ottawa, Canada. Applications must specify the quantity, kind, value, origin and destination of stock, the name and address of consignor and consignee, and whether the stock is to be shipped by mail or otherwise. The importer will furnish the permit number to

the shipper, and this number must be on every container, together with a certificate of inspection issued at the time of packing. The original permit must accompany the way-bill with copy on containers. It must be signed by an authorized official of the state or country where the stock originated, contain the name and address of both consignor and consignee, and a declaration of kind and quantity of the stock. The following are designated as ports of importation:

Halifax, N. S.	Toronto, Ont. (Parcel Post only)
Saint John, N. B.	Windsor, Ont.
Montreal, P. Q.	Winnipeg, Man.
Ottawa, Ont.	Estevan, Sask.
Niagara Falls, Ont.	Vancouver, B. C.

Regulations *prohibit the importation* of conifers from New England; all five-leaf pines; chestnut (*Castanea dentata*) and chinquapin (*Castanea pumila*), including hybrids and horticultural varieties; all currants and gooseberries, except commercial varieties of gooseberries and red and white currants to be cultivated for their edible fruits only; European buckthorn and all varieties of rust barberry (*Berberis vulgaris*); all varieties of Corylus into British Columbia from the states of Montana, Wyoming, Colorado, New Mexico, and all other states eastward; all peach nursery stock and peach fruit pits or seeds for propagating purposes into British Columbia from the states of Wisconsin, Illinois, Missouri, Arkansas and Texas and all other states eastward; tobacco seed from all states, elms from all states and living insects (except honey bees) from all states unless a special permit has been secured.

Regulations *restrict importations as follows*: Potatoes from California must have a special fumigation certificate; potatoes from Pennsylvania, West Virginia and Maryland, special certificate of origin; nursery stock except conifers and forest products, etc. from New England, special certificate covering freedom from brown-tail and gipsy moth. During the period June to December certain cut flowers or plants from the corn borer infested states must have a special certificate covering freedom from European corn borer; shell corn throughout the year from corn borer infested states, a special certificate covering freedom from corn borer; peach and nectarine trees or roots from all states, a special certificate declaring nursery of origin, and district within one mile of the nursery, to be free from phony peach disease, and further that the trees themselves are free from peach borer.

Leonard S. McLaine, Secretary, Destructive Insect and Pest Act, Advisory Board, Department of Agriculture, Ottawa, Canada.

STATE REGULATIONS

Filing of Certificates in Other States

In order to ship nursery stock into the following states, it is necessary to file duplicate inspection certificates:

Alabama	Maryland	Ohio
Arkansas	Massachusetts	Oklahoma
Connecticut	Michigan	Pennsylvania
Florida	Minnesota	South Carolina
Georgia	Mississippi	South Dakota
Idaho	Missouri	Tennessee
Illinois	Nebraska	Texas
Indiana	New Mexico	Virginia
Iowa	New York	Wisconsin
Kentucky	North Carolina	Wyoming
Louisiana	North Dakota	

Filing of Bonds

Bonds are required in the following states:

Arkansas	$1,000.00	Montana	$1,000.00
Georgia	1,000.00	Oklahoma	1,000.00
Idaho	2,000.00		

Tennessee requires a bond of $5,000 where trees are planted by outside nurserymen under contract to prune and spray for a period of years.

Payment of Fees

The payment of fees is required for registration in certain states, as follows:

State	Registration fee	Agent's fee
Alabama	$10.00	$1.00
	(Dealers)—$10.00	
Arkansas	5.00	1.00
Georgia	5.00	1.00
Idaho	15.00	1.00
Indiana	1.00	1.00
Kentucky	5.00	5.00
Maine	5.00	
Michigan	5.00	1.00
Missouri	5.00	
Montana	25.00[1]	
Nebraska		1.00

State	Registration fee	Agent's fee
New Mexico	$5.00	
Ohio	5.00	$1.00
Oklahoma	5.00	
Oregon	15.00	1.00
South Dakota	10.00	1.00
Texas	5.00	
Utah	10.00	
Virginia	10.00	1.00
Washington	5.00	1.00
	(Dealers)—15.00	
West Virginia	20.00	
Wyoming	15.00	

Fumigation

All deciduous nursery stock subject to the attack of San José scale must be fumigated with hydrocyanic acid gas and labeled with a certificate or affidavit stating that this has been done, before it will be allowed to enter the states of Florida[2] and Tennessee.

[1]Covering all Montana agents. Agents for unlicensed nurseries must pay annual fee of $25 and file bond of $1,000. Inspection fees, $10 per car lot, smaller lots in proportion. Unlicensed nurseries, 10 per cent of invoice price, with minimum of 50 cents per package.

[2]Fumigate all host plants of San José scale with hydrocyanic acid gas, at the standard dosage, or thoroughly scrub in a solution of fish oil soap at a dilution of one pound of soap to three gallons of water immediately before shipment into Florida. Such stock entering Michigan must bear certificate of fumigation.

State Quarantines on Account of European Corn Borer

Since the repeal of the European corn borer quarantine in 1932, 31 states have established quarantine regulations for protection against this insect. Prohibited or restricted articles are: corn, broomcorn, sorghums, Sudan grass (debris, cobs and parts of plants except clean shelled corn and seeds), aster, chrysanthemum, gladiolus, dahlia (cut flowers or entire plants except bulbs or tubers without stems), beans in the pod, beets with tops, rhubarb, celery, oat and rye straw, cosmos, zinnia, hollyhock (cut flowers or entire plants).

This class of plants and plant material is rarely shipped by nurserymen with the exception of hardy chrysanthemums and hollyhocks. Special certificates showing freedom from infestation are necessary for these if they are to be shipped into the following states:

Arizona	Kansas	Oregon
Arkansas	Kentucky	South Carolina
California	Louisiana	South Dakota
Colorado	Michigan	Tennessee
Florida	Mississippi	Texas
Georgia	Missouri	Utah
Idaho	Nebraska	Virginia
Illinois	Nevada	Washington
Indiana	New Mexico	Wisconsin
Iowa	Ohio	Wyoming
	Oklahoma	

State Tags

State tags are required and will be furnished at the shippers' expense, by the following states:

Alabama	Mississippi	Texas[1]
Arkansas	New Mexico	Virginia
Florida	North Carolina	West Virginia
Georgia	South Carolina	Wisconsin
Louisiana		Wyoming

Special Inspection and Certification of Raspberry Plants

In an attempt to control mosaic and allied diseases of raspberry plants, certain states require two summer inspections, one in June, and the other a month later, and after all mosaic plants discovered at the first inspection have been removed. If the plants are then free from mosaic diseases, a certificate to that effect may be granted. The following states require this special inspection and certification for shipping raspberry plants:

Kansas	Minnesota	Vermont
Michigan	New York	Wisconsin
	North Dakota	

Requirements of Various States

Alabama. Nurserymen in other states wishing to ship stock into Alabama must obtain an Alabama license by filing a signed copy of inspection certificate, with fee of $10. Each package of nursery stock

[1]Texas requires tags showing an exact copy of the Texas permit but the shipper must have them printed from the original certificate.

entering the state must bear an Alabama tag, which is furnished at cost. Dealers must register, file list of all nurseries from which they purchase stock, pay fee of $10 and obtain a dealer's certificate. An agent's certificate (cost $1.00) must be obtained through the principal for each agent selling nursery stock in Alabama. Nursery stock infested with San José scale, new peach scale, woolly aphis, brown-tail moth, gipsy moth, crown gall, black knot, citrus canker, peach yellows, pear blight, apple blotch, root nematode, peach borer, grape phylloxera or nut grass, must not be sold in Alabama.

B. P. LIVINGSTON, Chief, Division of Plant Industry, Montgomery, Ala.

Arizona. All nursery stock and plant products entering Arizona through the United States mails or transported in any manner shall be prominently labeled, showing (a) name and address of consignor; (b) name and address of consignee; (c) certificate of inspection; (d) locality where grown, and (e) contents of shipment. Common carriers shall not deliver to consignee any shipment of nursery stock or plant products until inspected by the State Entomologist or his agent and a certificate of release issued in each case to the common carrier and to the consignee. Postmasters are required to forward all parcels of nursery stock or plant products to the nearest Post Office Inspection Station, and cannot forward from these stations to point of destination any parcel of nursery stock or plant products unless accompanied by an inspected plant shipment tag.

Quarantines prohibit the entrance of: Peach, nectarine or apricot trees or cuttings, grafts, scions, buds or pits, or trees budded or grafted upon peach stock from Massachusetts, Rhode Island, Connecticut, New York, New Jersey, Pennsylvania, Delaware, Maryland, Virginia, Ohio, Indiana, Michigan, Illinois, West Virginia, Tennessee, North Carolina, Arkansas, Nevada, Florida, Mississippi, Kentucky, and Ontario, Canada, and any other section in which peach yellows or rosette are known to exist; peach, nectarine, almond, apricot, plum, cherry, chokecherry, quince, pear, and apple trees or plants or parts thereof including the fresh fruits, and all barrels, boxes, baskets or other containers that have been used to hold the same from the states of Alabama, Arkansas, Connecticut, Delaware, Florida, Georgia, Indiana, Louisiana, Maryland, Mississippi, North Carolina, New Jersey, New York, Ohio, Pennsylvania, South Carolina, Tennessee, Texas, Virginia, West Virginia, and the District of Columbia on account of the Oriental fruit moth; pecan, hickory and Japanese walnut trees, cuttings, grafts, scions and buds from all outside sources, with the exception of California, on account of the pecan nut insect pests.

D. C. GEORGE, State Entomologist, Box 2006, Phoenix, Ariz.

Arkansas. In order to ship nursery stock into Arkansas, it is necessary (1) to file a nursery inspection certificate and pay a fee of $1.00, and (2) every shipment into the state must bear a copy of the permit purchased of the chief inspector. (Price two cents each.)

Out-of-state nurserymen having agents or representatives soliciting orders, or doing other nursery business in Arkansas, must (1) file a bond of $1,000, (2) pay $5.00 for a license to do business in the state, and (3) pay $1.00 for a license for each agent in the state.

Quarantines prohibit entrance of chestnut trees from Iowa, Nebraska, and all states east of the Mississippi River.

P. H. MILLAR, Chief Inspector, Little Rock, Ark.

California. All shipments of nursery stock, plants, seeds, and similar material into the state of California must be marked in a conspicuous manner and place with the name and address of the shipper, the name and address of the consignee, and a statement of the contents of each package; also the name of the country, state, or territory where the contents were grown.

Of several state quarantines, the following are of interest to shippers to California:

Quarantine Order No. 1 (new series) prohibits the entry into California of citrus fruits, all varieties and species of citrus plants and parts thereof, including buds and scions.

Quarantine Order No. 2 (new series) prohibits the entry into California of all chestnut and chinquapin trees, plants, grafts, cuttings, or scions thereof from all states and districts east of and including the states of Montana, Wyoming, Colorado, and New Mexico, on account of chestnut bark disease.

Quarantine Proclamation No. 3 (new series) prohibits the entry into California of all varieties and species, including the flowering forms of peach, nectarine, almond, apricot, plum, cherry, chokecherry, quince, pear, and apple trees and plants, and fresh fruits thereof, from the states of New York, Connecticut, New Jersey, Ohio, Pennsylvania, Maryland, Delaware, Kentucky, West Virginia, Virginia, Tennessee, North Carolina, South Carolina, Florida, Georgia, Alabama, Mississippi, Louisiana, Arkansas, Texas, Indiana, Illinois, Missouri, Kansas and the District of Columbia; also states of Massachusetts, Michigan, Rhode Island, and Province of Ontario, Canada, on account of the Oriental fruit moth.[1]

Quarantine Order No. 4 (new series) prohibits the entry into California of all trees, plants, grafts, cuttings, or scions of all species and varieties of the cultivated filbert or hazelnut and American wild hazel (*Corylus americana*) from all states and districts east of and including the states of Montana, Wyoming, Colorado, and New Mexico, on account of Eastern filbert blight.

Quarantine Proclamation No. 11 (new series) prohibits the entry into California of peach, nectarine, almond, plum or apricot trees or cuttings, grafts, scions, buds, or pits of such trees; or any trees budded or grafted upon peach stock or roots that have been in a district where the disease known as contagious peach rosette is known to exist. The states known to be infected are as follows: Massachusetts, Connecticut, Rhode Island, New York, New Jersey, Delaware, Maryland, Pennsylvania, West Virginia, Virginia, North Carolina, Tennessee, Kentucky, Mississippi, Ohio, Michigan, Illinois, Indiana, Arkansas, Florida, South Carolina, Georgia, Alabama, Oklahoma, District of Columbia, and the Province of Ontario in Canada.

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[1]Budwood or scions of the above material admissible into California from the area under quarantine only for the period between November 1 and March 1 inclusive, and the importer must first obtain a permit from the California Director of Agriculture.

Quarantine Order No. 12 (new series) prohibits the entry into California of all varieties and species of hickory, pecan, and walnut trees (*Hicoria* sp. and *Juglans* sp.) and parts thereof, including grafts, cuttings or scions from all states east of and including the states of Montana, Wyoming, Colorado, and New Mexico, on account of the pecan leaf case-bearer and the pecan nut case-bearer.[1]

Quarantine Order No. 14 (new series) prohibits the entry into California of all hop sets, hop roots, and hop cuttings from all states and districts in the United States.

Quarantine Order No. 15 (new series—revised) prohibits the entry into California of susceptible plants from the region infested by the European corn borer unless accompanied by a certificate signed by an inspector of the Bureau of Plant Quarantine of the U. S. Department of Agriculture.

Quarantine Circular No. 6 (new series) provides that grapevines or cuttings will be admitted if free from Phylloxera, subject to hot water treatment upon arrival.

A. C. Fleury, Chief, Bureau of Plant Quarantine, Sacramento, Calif.

Colorado. Each package of nursery stock entering the state must bear a certificate of inspection signed by a duly authorized inspector in the state from which it was shipped. On arrival, shipments are turned over to the County Inspector, who, in turn, if they pass inspection, releases them to the consignee.

Quarantines prohibit the entrance of the common barberry.

George M. List, State Entomologist, Fort Collins, Colo.

Connecticut. Nurseries are inspected annually and nurserymen and dealers must register; nurserymen receive registration and inspection certificates, and dealers receive permits. Out-of-state nurserymen must make application and file signed copies of their valid inspection certificates and receive permits before shipping stock into the state. All stock entering the state must be accompanied by both certificate and permit, and all stock transported within the state must be accompanied by either a certificate or by a permit, and transportation companies are subject to prosecution for accepting shipments without valid certificates or permits. Nursery stock imported from foreign countries must be held unopened until inspector arrives. Inspectors have authority to inspect any stock at destination.

Quarantines regulate the shipment of all nursery stock and forest products, on account of the gipsy moth and satin moth.

W. E. Britton, State Entomologist, New Haven, Conn.

Delaware. Each shipment of nursery stock entering the state must be accompanied by a copy of the nursery inspection certificate, and all stock must conform to the Federal rules and regulations.

Ralph C. Wilson, Secretary, State Board of Agriculture, Dover, Del.

Florida. Each nurseryman shall (1) file with the Nursery Inspector, Gainesville, Florida, a copy of his certificate of inspection, personally signed

[1]Budwood and scions admitted from quarantined area on permit of the Director of Agriculture.

by the proper official of his state, and make application for permit tags on a form supplied by the Nursery Inspector; (2) secure Florida permit tags (price list furnished); (3) attach one, and only one, Florida permit tag to each package, box or bundle of woody perennials, including palms,[1] shipped into Florida. In club orders, one permit tag should be attached to each individual order, and one permit tag attached to the package containing the individual orders; (4) each permit tag is serially numbered. An invoice showing the name and address of consignor, name and address of consignee, kind and amount of nursery stock in the shipment, and number of the permit tag attached to the shipment, should be mailed the Nursery Inspector, Gainesville, on the day the shipment is made. An invoice is required for each individual order in a club order and also for the package containing the individual orders; (5) return all spoiled or mutilated permit tags to the Nursery Inspector for cancellation; (6) return all unused permit tags when the same become void; (7) fumigate all host plants of San José scale with hydrocyanic acid gas, at the standard dosage, or thoroughly scrub in a solution of fish oil soap at a dilution of one pound of soap to three gallons of water, immediately before shipment into Florida. (8) Plants showing root knot, hairy root, crown gall, or any especially injurious insect or disease will not be permitted entry into the state of Florida. (9) All citrus trees and parts thereof are prohibited entry into the state of Florida from all other states and countries.

Nursery Inspector, State Plant Board, Gainesville, Fla.

Georgia. Each nurseryman, dealer, agent, salesman or solicitor selling or offering nursery stock for sale must (1) Secure license. Fee for nurserymen and dealers, \$5.00; agents, \$1.00. Agent's license furnished only upon request of nursery represented. (2) File affidavit agreeing to observe regulations, to cull out visibly affected stock, and to fumigate with hydrocyanic acid gas. (3) Furnish bond of \$1,000 and maintain for three years as guarantee that all stock sold will be true to all selling claims, name, variety, etc. Surety bond required except from incorporated firms. (4) Purchase Georgia certificate tags and attach one, together with tag of state of origin, to each package, crate, or bundle shipped. Tags furnished only in multiples of 100; first 100, \$2.00. (5) Return tag invoice stubs showing name and address of consignee and quantity and kind of plants, not later than end of week during which shipment was made.

Nursery stock includes all woody perennials, both open and house grown, and strawberries. Does not include herbaceous plants, roots thereof, and bulbs. Soft-bodied plant certificates for this latter class of stock, obtainable at 35 cents a hundred when order is accompanied by duplicate certificate, will expedite movement, since all stock not accompanied by Georgia certificate is held for terminal inspection.

Stock from areas infested with Japanese camphor scale prohibited.

Stock from areas under Federal Quarantine admitted only in strict accordance with Federal regulations.

M. S. Yeomans, State Entomologist, Atlanta, Ga.

[1]Soft bodied herbaceous plants are not classed as nursery stock.

Idaho. No person, firm or corporation shall import or sell nursery stock by agents within the state without first applying to the Department of Agriculture, filing a bond of $2,000 and obtaining an annual license by paying a fee of $15.00. All shipments into the state must show name of shipper, locality where grown, variety of nursery stock and an official certificate of fumigation from the state where the stock was grown. Imported trees are fumigated before distribution, and all nursery stock shipped into the state must be inspected upon arrival at the expense of the consignee. Each nursery firm doing business in the state must annually pay an additional $1.00 for each agent. Duplicate certificates should be filed.

State quarantines exclude the entrance of all five-leaf pine, currant, gooseberry, peach, nectarine, prune, almond or other trees worked on peach stock and all pits, cuttings, buds or scions grown in a district where peach yellows or other detrimental diseases exist.

Permits for entry must be secured from the Bureau of Plant Industry and accompany the shipment before any currants or gooseberries can be shipped into the state. The eight northern counties are designated as a blister rust control area from which currants, gooseberries and five-leaf pines are excluded.

W. H. Wicks, Director, Bureau of Plant Industry, Boise, Idaho.

Illinois. Outside nurserymen and dealers in nursery stock wishing to ship nursery stock into Illinois or to solicit business through agents in Illinois, are required to send to the office of the Chief Plant Inspector a duplicate copy of their certificate of inspection personally signed by their State Inspector. Those employing agents are required to apply to the Chief Plant Inspector for a permit to employ agents in Illinois and for a permit for each agent so employed before he engages in the business of soliciting orders for nursery stock. All agent's permits must be renewed annually after July 1. All outside nurseries are required to file a complete list of all agents in this state after that date.

All nursery stock entering the state must bear a valid State or Federal certificate of inspection, the names and addresses of the consignor and the consignee, and a statement of the nature of the stock.

Transportation companies receiving stock without certificate of inspection must report the fact to the Department of Agriculture and must either return the stock to the consignor, hold it for instructions, or send it to the Department of Agriculture for inspection. Any person receiving nursery stock without certificate in this state is required to notify the Department of Agriculture and not to use the stock nor let it pass from his possession until it has been inspected or released by the Department of Agriculture and expenses incurred paid.

A state quarantine prohibits shipment into Illinois of all species and varieties of the genus Castanea from the New England States, Alabama, Delaware, Georgia, Indiana, Iowa, Kentucky, Maryland, New Jersey, New York, North Carolina, Ohio, Pennsylvania, South Carolina, Tennessee, Virginia and West Virginia.

Stock shipped into Illinois in violation of a State or a Federal quarantine is destroyed or returned to the consignor or otherwise disposed of at the discretion of the Department.

P. A. Glenn, Chief Plant Inspector, Division of Plant Industry, Urbana, Illinois.

Indiana. Nursery stock entering or shipped within the state must bear an official inspection certificate and give the names of both the consignor and the consignee. All out-of-state nurseries must file with the State Entomologist a copy of their valid inspection certificate before shipping stock into the state. Nurseries having agents in Indiana must pay a fee of $1.00 to obtain a license before shipping. Each dealer and agent selling or soliciting sales of nursery stock in Indiana must pay $1.00 and obtain a license from the State Entomologist.

Frank N. Wallace, State Entomologist, Department of Conservation, Indianapolis, Indiana.

Iowa. Copy of inspection certificate must be filed with and approved by the State Entomologist, and must accompany each shipment of nursery stock into the state.

Quarantine against the European corn borer prohibits all the usual host plants entering the state from the infested areas, unless accompanied by a certificate of inspection showing freedom from the pest.

Carl J. Drake, State Entomologist, Ames, Iowa.

Kansas. Nurseries are inspected annually and all certificates expire on January 1 following date of issue. Nursery stock from other states must be accompanied by a recognized certificate of inspection, and may be inspected in transit or at destination. If found infested, stock may be returned to consignor at his expense, treated or otherwise disposed of, as the inspector may direct.

Nurserymen both within or outside the state who sell nursery stock at retail through agents in Kansas shall file a list of such agents with addresses; said agents shall carry with them at all times credentials of appointment from the nurseries which they represent and copies of inspection certificates issued to said nurseries.

All raspberry plants entering the state must be certified as being free from all diseases of the virus type, except so-called "mild mosaic" of black and purple raspberries, after two inspections the preceding growing season, with an interval of 30 days between inspections. Duplicate certificates of other states must be filed.

Charles A. Scott, Secretary, Entomological Commission, Topeka, Kansas.

Kentucky. Kentucky nurseries are inspected annually and certificates are issued when stock is found free of dangerous pests. All nurserymen, resident or non-resident, must file credentials at this office annually, and if in good standing receive a permit on payment of a fee of $5.00.

Agents and dealers must file credentials annually, including names of "nurseries, nurserymen, or persons represented," and on payment of a fee of $5.00 are issued a permit. Agents while soliciting orders must carry their permits to show prospective buyers, county officials, or agents of the State Entomologist, on demand. Quarantines are provided for.

W. A. PRICE, State Entomologist, Lexington, Ky.

Louisiana. Before shipping nursery stock into Louisiana, application must be made to the Entomologist for permit, by filing copy of valid certificate and order for certificate tags, accompanied by money to pay for them (price on application). The Louisiana tag and the inspection certificate of the state where the stock was grown must both accompany each shipment. The invoice stub of each permit tag must be filed with the Entomologist once a week, showing the number and varieties of plants shipped.

W. E. ANDERSON, State Entomologist, Department of Agriculture, Baton Rouge, La.

Maine. All individuals or firms selling or soliciting sales of nursery stock that they have not grown shall annually obtain a license from the State Horticulturist by paying a fee of $5.00. All stock entering the state shall bear on each box or package a valid inspection certificate; such stock may be inspected at destination and if found infested with dangerous pests may be destroyed or returned to the consignor.

STANLEY L. PAINTER, State Horticulturist, Augusta, Me.

Maryland. Nurseries are inspected twice each year. Nursery stock coming from blocks that show evidence of San José scale must be hand-inspected to eliminate visibly infested stock. Shipments entering the state must bear certificates of inspection, besides names of consignor and consignee. A duplicate certificate should be filed with the State Entomologist.

Maryland has quarantines designed to protect the state against the Japanese beetle, gipsy moth, white pine blister rust and potato wart. These regulations are similar to the Federal quarantines and are administered in coöperation with the Federal authorities.

ERNEST N. CORY, State Entomologist, College Park, Md.

Massachusetts. All growers and agents who sell nursery stock for delivery within the state must have a grower's certificate or an agent's license, and a copy of such certificate or license must accompany each car, box or package of stock shipped or delivered. Agents must apply to Director, Division of Plant Pest Control, Boston, Mass., and file list of nursery firms from which they purchase stock before receiving agent's license. Authority is granted to inspect at destination all stock entering the state, and if found infested it may be destroyed, treated, or returned to the consignor at his expense.

Quarantines prohibit Ribes from entering the state except under permit.

R. H. ALLEN, Director, Division of Plant Pest Control, 136 State House, Boston, Mass.

Michigan. All nurseries are inspected annually. Each out-of-state nurseryman who sells in Michigan through personal representatives must

file a certified copy of his original certificate, and pay a fee of $5.00 to obtain a license permitting him to ship stock into the state, and each representative must have an agent's permit, for which there is a fee of $1.00. Each shipment must bear an exact copy of the inspection certificate issued in the state from which the stock was shipped, names and addresses of both consignor and consignee, and a statement showing the general nature of the contents. Out-of-state nurserymen wishing to sell nursery stock in Michigan through catalogue must file copies of their original certificates of inspection.

The law and quarantine regulations prohibit the entrance of all barberries subject to the attack of black stem rust of grains; all chestnut trees; all trees and plants from areas infested by the Japanese beetle and European corn borer, except in compliance with Federal regulations; all raspberries unless bearing certificates that the plants have been properly inspected for virus diseases, as under Rules and Regulations No. 273. Currants and gooseberries shipped into Michigan must be accompanied by a control area permit issued by the Commissioner of Agriculture.

E. C. MANDENBERG, In Charge of Orchard and Nursery Inspection, Department of Agriculture, Lansing, Mich.

Minnesota. All shipments must be accompanied by a valid certificate of inspection on the outside of each package. A copy of this certificate must be filed with the State Inspector before nursery stock is shipped into the state. No filing fee is required. A license is not required for agents or salesmen.

Minnesota Quarantine No. 5 prohibits the entry of alfalfa hay and other hay of all kinds and cereal straw if grown or stored in the state of Utah and certain portions of the states of Idaho, Colorado, Nevada, California, Oregon, and Wyoming, on account of the alfalfa weevil.

Minnesota Quarantine No. 6 requires that all raspberry plants shipped into Minnesota must be accompanied by a valid certificate showing that the plants have been inspected and found apparently free from mosaic and other virus diseases. A special affidavit signed by the shipper may be accepted in lieu of such certificate on each package.

The term "nursery stock" includes all wild and cultivated trees, shrubs, perennial vines, small fruit plants, perennial roots, rhizomes, herbaceous perennials, cuttings, buds, grafts and scions for or capable of propagation. A certificate of inspection is not required for greenhouse or house-grown plants, bedding plants, herbaceous annuals, vegetable plants, bulbs, corms and tubers.

All nursery stock for shipment into Minnesota must comply with the requirements of quarantines promulgated by the Federal Bureau of Plant Quarantine.

A. G. RUGGLES, State Entomologist, University Farm, St. Paul, Minn.

Mississippi. Each package of nursery stock shipped into Mississippi must have attached to it a Mississippi permit. Also, there must be a statement on each shipment showing the name and address of the consignor. The permits may be obtained at actual cost from the State Plant Board, at State College, Mississippi, after a satisfactory certificate of inspection issued by the duly authorized state official has been filed. The manager of the nursery must sign and file with the Plant Board an agreement with reference to complying with the Mississippi law in shipping nursery stock.

All plants capable of defoliation must be defoliated. Plants infected with root knot (caused by nematodes), crown gall, or showing any insect pest or disease or marking thereof, must not be shipped into Mississippi.

The term "nursery stock" covers palms and woody perennials, including budwood and scions.

Sweet potatoes and sweet potato plants are not considered as nursery stock, but a special potato permit is required. Shipments from areas known to be infested with the sweet potato weevil are prohibited.

In order to prevent the introduction into the state of Mississippi of the European corn borer, the movement into Mississippi of the usual host plants from the infested area is prohibited unless the plants are inspected by a duly authorized state or Federal inspector and certified to be free from the European corn borer.

Each agent representing a nursery is required to register with and obtain an agent's certificate from the Plant Board before selling, delivering, or taking orders for nursery stock in Mississippi. Stock shipped to nursery agents for delivery in Mississippi must be packed in individual packages, and each of these accompanied by a Mississippi permit.

Each permit has an invoice stub attached. On using a Mississippi permit, the nurseryman must mail to the Plant Board, State College, Mississippi, the invoice stub from that permit showing the name and address of the consignee and an itemized list of plants in the shipment. Mutilated, spoiled, and unused permits must be returned to the Plant Board. All permits remaining on hand at the close of the season must be returned by September 1.

A circular explaining the requirements in more detail will be sent on request.

R. P. Colmer, Acting Chief Inspector, State College, Miss.

Missouri. Outside nurseries must file necessary papers including certificate and apply for a permit certificate which will be issued on payment of a $5.00 fee. All agents or salesmen must apply for agent's certificate. Each package of nursery stock entering the state must bear the names of both consignor and consignee, statement of contents, and a certificate showing that the stock therein contained has been inspected where grown by a duly authorized inspector and found to be apparently free from dangerously injurious insect pests and plant diseases. Transportation companies are not permitted to deliver nursery stock unless so labeled.

J. Carl Dawson, Plant Officer, Jefferson City, Mo.

Montana. All nursery stock entering the state must be unpacked and inspected at one of the following designated quarantine stations: Billings, Butte, Miles City, Missoula, Glendive, Great Falls, Hamilton, and Kalispell. All shipments entering the state are subject to inspection with fees as follows: Licensed nurseries, car lots, $10, smaller lots proportionate with minimum fee of 25 cents per package; unlicensed nurseries, 10 per

cent of invoice price shipment with minimum of 50 cents per package. Notice of shipment including list of stock and names of transportation company, consignor and consignee must be sent to the Chief, Division of Horticulture, Missoula, Mont., five days before shipment.

Nurserymen are required to pay an annual fee of $25 and file a bond of $1,000 in favor of the state of Montana; this includes licenses for all Montana agents. Agents for unlicensed nurseries must pay an annual fee of $25 and file bonds of $1,000.

Quarantines prohibit the entrance of the common barberry, black currant, five-leaf pine, currant and gooseberry plants, and black locust.

George L. Knight, Chief, Division of Horticulture, Missoula, Mont.

Nebraska. Non-resident nurserymen, dealers, or other persons wishing to ship nursery stock into Nebraska must file a duplicate certified copy of their original certificate with the State Department of Agriculture. If this certificate is approved by the Department of Agriculture, they will be issued a permit allowing them to ship nursery stock into this state during the period that such original certificate issued by the state in which they reside or are doing business, is in force. No fee is charged for the non-resident dealer's or nurseryman's permit. Each shipment of nursery stock coming into the state must be plainly and legibly marked in a conspicuous place with a statement showing: (a) The name and address of the consignor; (b) the name and address of the consignee; (c) the general nature of the contents; (d) the name of locality where grown; and (e) a certificate of inspection from the proper official of the state, territory, district or country from which it was shipped. All agents selling nursery stock or soliciting orders for nursery stock for any nurseryman or dealer located either within or without the state of Nebraska shall be required to secure and carry an agent's permit. The fee for this permit is $1.00.

Any prohibited insect pest or plant disease, plant product or other substance or thing, brought into the state in violation of any regulation of the State Department of Agriculture or any Federal quarantine, shall at the expense of the owner be either destroyed, returned to the consignor, or otherwise disposed of as the Department of Agriculture may direct.

D. F. Felton, Director; L. M. Gates, Entomologist, State Department of Agriculture and Inspection, Lincoln, Neb.

Nevada. All nursery stock entering the state must bear on each car, bale, or package a copy of a valid official inspection certificate, and names of consignor and consignee. Transportation companies shall not deliver nursery stock lacking such certificate.

Quarantine prohibits entry of any fruit trees, and fresh fruits and their boxes or containers, from any states infested by the Oriental fruit moth.

George G. Schweis, Director, Division of Plant Industry, 7 Cladianos Building, Reno, Nev.

New Hampshire. All nursery stock entering this state must bear on each container a copy of a valid inspection certificate.

Quarantines prohibit the entrance of currants or gooseberries into any part of the state, except an area in the northernmost part of the state, beginning with the towns of Stratford, Odell, Millsfield and Errol; require permit for importation of any five-leaf pines, and special certificate from state of origin, in accordance with Federal regulations; prohibit entry of plants susceptible to attack by the gipsy moth, the brown-tail moth, and the satin moth from infested regions into uninfested territory, except with proper certificate.

W. C. O'Kane, Deputy Commissioner of Agriculture, Durham, N. H.

New Jersey. Shipments into the state must be accompanied by a certificate of inspection of current date, or copy thereof, attached to each car or parcel, together with a statement from the shipper that the stock therein is a part of the stock inspected, and stating whether such stock has been fumigated with hydrocyanic gas. It shall be the duty of all carriers to refuse for transportation within the state all stock not accompanied by a certificate of inspection. All stock coming into the state may be detained for examination, wherever found, by the Chief of the Bureau of Plant Industry, and if found to be infested with any insects or plant diseases, injurious or liable to become so, will be destroyed.

It shall be the duty of every nurseryman, or other person who imports plant material of any kind from without the state, and every transportation company or other carrier for hire that brings plant material from without the state for delivery to any person, persons, firm, or corporation within the state, to notify the Chief of the Bureau of Plant Industry of such shipment prior to, or within 24 hours after, its arrival. Such notice shall state the kind, the quantity of plant material, the name and address of the shipper, the date of shipment, and if from a foreign country, the name of the country or district in which the shipment originated, the port of entry, and the approximate date of arrival at said port. If the Bureau Chief has any reason to suspect the presence of a dangerous pest, he may order the examination of every package of such material, in transit or at the point of delivery, and shall not authorize its acceptance or delivery until he is satisfied that no dangerous pest is present.

Harry B. Weiss, Chief, Bureau of Plant Industry, State Department of Agriculture, Trenton, N. J.

New Mexico. Nurserymen in other states desiring to ship nursery stock into New Mexico must each file a copy of their certificate of inspection signed with pen by the proper official, with a filing fee of $5.00, and secure a permit-certificate bearing the facsimile signature of the Deputy Inspector, which must accompany each shipment of nursery stock into the state. Tags may be purchased at the following prices:

50 tags	$1.00	200 tags	$2.00
100 tags	1.25	500 tags	4.25

The following quarantines affect the shipment of nursery stock: Quarantine No. 7, white pines and Ribes; Quarantine No. 8, nursery stock, farm products, and forage crops; Quarantine No. 9, plants susceptible to infestation by the European corn borer.

R. F. Crawford, Plant Quarantine and Regulatory Office, State College, N. M.

New York. Nursery stock cannot enter the state or be moved within the state unless a valid certificate is attached issued by the New York State Department of Agriculture and Markets, or by the state in which the shipment originated. Transportation companies and all persons bringing nursery stock into the state from other states, must send notice to the Department of Agriculture and Markets. Blanks will be furnished for such notices. An exact copy of the certificate must be attached to each package sent by mail. Stock received from abroad or from other states unaccompanied by a valid certificate of inspection must not be unpacked or distributed until after inspection or release by the Department of Agriculture and Markets.

Quarantines prohibit the entrance of five-leaf pine trees into the state except when such shipments comply with Federal Quarantine 63; also of Christmas trees and woody greens from New England except from those areas lightly or not infested by gipsy moth (Federal certificates must accompany shipments from the lightly infested area); of raspberry plants unless apparently free from mosaic diseases and so certified after two inspections and the removal of all diseased plants, as is practiced in New York State. Currants and gooseberries cannot be grown in certain pine-growing areas of the state and permits must be obtained to ship them into the state. Name and address of consignee must be given in application.

B. D. Van Buren, Director, Bureau of Plant Industry, Department of Agriculture and Markets, Albany, N. Y.

North Carolina. Nursery stock may enter the state only when shipments bear North Carolina official permit tags, which will be supplied at cost on request, and the filing of a duplicate inspection certificate.

Quarantines prohibit the entrance of five-leaf pines and Ribes except in accordance with Federal regulations.

R. W. Leiby, Entomologist, State Department of Agriculture, Raleigh, N. C.

North Dakota. Shipments of nursery stock into the state must bear a certificate of inspection showing that the stock has been inspected and found free of injurious insects and plant diseases. Copy of said certificate must be filed with the office of the State Entomologist of the North Dakota Experiment Station, State College Station, Fargo, North Dakota. Raspberry plants coming from other states must be inspected and certified as being free from virus and other diseases.

Director, North Dakota Experiment Station, State College Station, Fargo, N. D.

Ohio. Out-of-state nurserymen must file copies of their inspection certificates and obtain an Ohio certificate permitting them to solicit orders for nursery stock. Each dealer within or without the state shall obtain annually a dealer's certificate, by furnishing an affidavit that he will buy and sell only inspected stock and will maintain with the Secretary of Agriculture a list of all sources from which he obtains nursery stock. Each affidavit shall be accompanied by a fee of $5.00. Each agent soliciting orders for nursery stock shall file annually a statement that he will sell only inspected stock, and pay a fee of $1.00. He shall carry an agent's certificate and a copy of the certificate held by his principal.

Each shipment entering the state shall be accompanied by a tag or poster giving an exact copy of the valid certificate of inspection. Altered certificates are prohibited.

W. W. Ellenwood, Chief, Division of Plant Industry, Department of Agriculture, Columbus, Ohio.

Oklahoma. Nursery stock entering the state must bear on each package of shipment an inspection certificate. Nurserymen must each file a duplicate copy of their valid inspection certificate, and furnish a surety bond of $1,000 in favor of the State Board of Agriculture. A permit will be issued on payment of the fee of $5.00, and a copy of this permit must be attached to all shipments entering the State of Oklahoma.

Peach and nectarine trees or any tree or shrub budded or grafted on peach or nectarine roots, will not be permitted to enter the state unless accompanied by a state certificate showing that (1) the stock was grown in a county in which no phony peach disease has been found, or (2) that the nursery and its environs within a mile have been inspected and no phony peach disease found, and (3) that each plant has been hand inspected after digging and found free of infestation by the peach borer.

All dealers within or outside the state must attach to each package of each shipment a copy of the dealer's certificate issued to them by the Board of Agriculture.

R. E. Montgomery, State Nursery Inspector, Oklahoma City, Okla.

Oregon. Shipments of nursery stock entering the state must be plainly marked, with names and addresses of both consignor and consignee, name of state, territory where grown, and nature of contents. All shipments are inspected. Nurserymen's licenses are required *only* of nurserymen who have agents or an office in said state. The fee is $15.00 for nurserymen and $1.00 for each agent.

Quarantines prohibit entrance of all hazel and filbert trees, all chestnut and chinquapin trees or cuttings or scions of said nut trees from eastern states. All species and varieties, including the flowering forms of peach, almond, nectarine, apricot, plum, cherry, quince, pear, and apple trees or parts thereof from eastern states are prohibited. Grapevines may be admitted if certified that they were grown and shipped from sections free from Phylloxera. Raspberry plants from eastern states are prohibited.

Charles A. Cole, Chief, Division of Plant Industry, Department of Agriculture, Salem, Oregon.

Pennsylvania. Each nurseryman from outside of the state must file with the Director of the Bureau of Plant Industry a duplicate copy of his valid inspection certificate, signed in person by the state inspection official in charge, and supply a statement giving the exact acreage of nursery stock he is growing, as well as the acreage being grown for him under contract. Upon compliance with these regulations a certificate is issued that must be received before stock is shipped into the state. Dealers are granted certificates on application and receipt of a statement from each that he will buy stock only from nurseries holding valid certificates of inspection. Agents soliciting for the sale of nursery stock in the state must obtain and carry agent's duplicate certificates. All shipments of nursery stock entering the state will be rejected unless accompanied by certificates of inspection.

R. H. Bell, Director, Bureau of Plant Industry, Harrisburg, Pa.

Rhode Island. All stock entering the state must bear a valid official certificate of inspection, but is subject to further inspection and may be destroyed or returned to the consignor if found infested. Agents must obtain agent's licenses, on stating where they expect to purchase their stock.

Five-leaf pines and Ribes can be shipped into the state or planted in certain parts of the state only on permission. Planting of black currant and flowering currant is prohibited.

A. E. Stene, State Entomologist, State House, Providence, R. I.

South Carolina. Each package of nursery stock entering the state must bear a permit tag of the South Carolina State Crop Pest Commission, which may be obtained at cost by filing a duplicate certificate of inspection and fumigation.

Quarantines prohibit the entrance of five-leaf pines, currants, gooseberries and all host plants of the European corn borer except when shipped in conformity with Federal regulations. Citrus stock is allowed to enter only by special permit. Fumigation of host plants of San José scale is required.

Peach and nectarine trees and all other stock budded or grafted on peach or nectarine roots, will not be permitted to enter the state unless accompanied by a state certificate showing that (1) the stock was grown in a county in which no phony peach disease has been found, or (2) that the nursery and its environs within a mile have been inspected and no phony peach disease found, and (3) that each plant has been hand inspected after digging and found free of infestation by the peach borer.

South Carolina State Crop Pest Commission, Clemson College, S. C.

South Dakota. Out-of-state dealers may obtain certificates permitting them to solicit and fill orders in the state, by filing with the Secretary of Agriculture a certified copy of their official inspection certificates and by paying a fee of $10.00 each. All agents shall likewise obtain and carry agent's certificates bearing copies of the certificates held by their principals, and paying fees of $1.00 each.

Quarantines prohibit the entrance of all five-leaf pines and Ribes, of all poplars and willows from areas infested by the satin moth, all host plants of the European corn borer.

C. A. Russell, Secretary of Agriculture, Pierre, S. D.; R. W. Vance, Nursery Inspector, Pierre, S. D.

Tennessee. Out-of-state nurseries must file duplicate inspection certificates and the following agreement regarding fumigation:

"We, the undersigned, agree to fumigate with hydrocyanic acid gas, according to the required strength, all nursery stock subject to attack from San José scale and other dangerous insect pests. We also agree to attach a fumigation tag to each and every shipment going into the State of Tennessee."

Every shipment must bear a valid inspection certificate and a fumigation tag, and failure to comply with these requirements subjects the stock to confiscation.

Nursery agents and dealers must file sworn statements on official Tennessee blanks, which will be supplied. Each agent operating in Tennessee, and each dealer or jobber, is required to secure a license.

Nurserymen selling trees under contract to prune and spray the same for a period of years are required to take out a bond of $5,000 before selling trees under such special contract.

State quarantines prohibit the entrance of all varieties of barberry, except *Berberis thunbergii.* Other restrictions apply to the Japanese beetle, the European corn borer, gipsy moth, sweet potato weevil and pink bollworm of cotton. Peach and pecan seedlings are allowed entrance only by special permit for experimental purposes.

G. M. Bentley, State Entomologist and Plant Pathologist, Knoxville, Tenn.

Texas. No nursery or floral stock can be shipped into Texas until a duplicate certificate of inspection issued by the state in which the stock was grown has first been filed with the Commissioner of Agriculture and a fee of $5 paid to obtain a permit or license. Applications are to be made on forms which require a notice of all shipments, and applicants must agree to comply with all Texas regulations. Permits are issued annually and expire August 31 of each year.

Dealers are classed as nurserymen and are required to take out permits. Agents or dealers operating in Texas for nurserymen in other states must show credentials from firms that they represent. Greenhouses and greenhouse plants as well as nurseries are included for inspection under the Texas law.

Quarantine No. 71 regulates entry of plants susceptible to infestation by European corn borer.

J. M. Del Curto, Chief Entomologist, Department of Agriculture, Austin, Texas.

Utah. No person shall engage or continue in the business of selling within the state or of importing into the state, any nursery stock without first having obtained a license. License fee $10. All nurseries are inspected annually, and infested stock must be destroyed or otherwise treated as determined by the inspector. A certificate must be attached to each package, box, bale or car lot shipment. Nursery stock from other states must be held for inspection and release by Utah inspectors before distribution.

State quarantines prohibit the shipment of all fruit trees and their flowering varieties from the eastern and middle United States on account of the Oriental fruit moth; all pecan, Japanese walnut and hickory trees from all states except California, on account of the pecan case bearer.

Earl Hutchins, Agricultural Inspector, State Board of Agriculture, Salt Lake City, Utah.

Vermont. All nursery stock entering the state must bear valid official inspection certificates and the names and post office addresses of both consignor and consignee.

Quarantines restrict the free movement of out-of-state shipments of uncertified raspberry plants on account of mosaic, leaf roll and rosette, hosts of the European corn borer, and all uninspected and non-nursery grown trees and forest products on account of the gipsy and brown-tail moths.

M. B. Cummings, State Nursery Inspector, Burlington, Vt.

Virginia. Nursery stock shipped into Virginia must have attached to each package an official tag purchased from the State Entomologist. Tag prices forwarded upon request.

Registration is required annually; all registrations expire on August 31. Registration fee $10.00 for principals; duplicates for each agent, $1.00. Make checks payable to Treasurer, State of Virginia, and mail to State Entomologist. Duplicate nursery inspection certificate must be filed with application for registration.

Nursery stock under the Virginia regulations includes trees, shrubs and vines, bush fruits, grapevines whether cultivated, native or wild, buds, scions and cuttings from such plants. Strawberry plants are also included as nursery stock and the same is true of narcissus bulbs. Roses and other woody plants that are greenhouse grown, but that are sold for outside planting, are considered nursery stock. Greenhouse plants, unless woody and field grown, are not included as nursery stock and inspection certificates are not required. The same is true of perennials and herbaceous plants.

Japanese beetle quarantine in effect, which is similar to Federal Quarantine No. 48.

Sweet potato weevil quarantine: Sweet potato plants or parts thereof, morning glory vines, cuttings, tubers, and slips are prohibited from the following states: Texas, Louisiana, Mississippi, Alabama, Georgia, and Florida, unless each package bears a certificate from proper state official certifying that contents originated in an area that is free from the sweet potato weevil and is itself uninfested by this weevil. A similar requirement regulates the shipment into Virginia of sweet potatoes intended for food and originating in the states enumerated.

European corn borer quarantine: Chrysanthemum and hollyhock plants from the infested area may be admitted if the container has attached to it a certificate of an authorized inspector of the state of origin or of a Federal inspector certifying that the contents have been inspected and found to be free from the European corn borer.

Any susceptible plants are subject to destruction or return to the point of origin, at the discretion of the State Entomologist, if they enter the state in violation of the quarantine.

G. T. French, State Entomologist, Department of Agriculture and Immigration, Room 1112 State Office Building, Richmond, Va.

Washington. No person, firm or corporation shall sell, solicit sales, or distribute nursery stock except berry plants, without first obtaining a license to do so from the Director of Agriculture. The license fee is $5.00 for nurserymen who grow all the stock they sell, $15 for other nurserymen, dealers, brokers and landscape architects, and $1.00 for agents, salesmen and solicitors. All licenses expire July 1. All nursery stock entering the state shall have contents, names and addresses of consignor and consignee, and name of state, territory, or country where the stock was grown, plainly marked on each car, box, bale or package. The state is divided into eleven horticultural districts with an inspector-at-large in charge of each district. Notice must be sent to one of these inspectors of any shipments arriving without the proper license certificate or labels, and the said inspectors are authorized to inspect such shipments and charge such fees as may be fixed by the Director of Agriculture.

Quarantines prohibit the entrance of five-leaf pines, currants, gooseberries, chestnut, chinquapin, hazel, filbert, and carriers of the European corn borer, peach yellows, and Oriental fruit moth.

J. O. Griner, Supervisor of Horticulture, Olympia, Wash.

West Virginia. All nursery stock entering the state must bear a valid certificate of inspection and a West Virginia permit tag. No nursery stock shall be sold, offered for sale or delivered, without first obtaining from the Commissioner of Agriculture a certificate of registration; annual fee, $20.

W. E. Rumsey, State Entomologist, Morgantown, W. Va.

Wisconsin. Each out-of-state nurseryman must file a valid certificate of inspection and obtain a state license before shipping stock into the state. Each car, or package, must bear certificate tags. Each agent selling nursery stock in the state must carry an agent's duplicate certificate bearing the same number and date as that of his principal. No fees are charged except for resident nurserymen.

Quarantines prohibit entrance of all five-leaf pines and all barberry bushes, except Japanese barberry, and host plants of European corn borer from infested areas; nursery stock from gipsy moth infested areas except under Federal certificate; cranberry plants; raspberry plants unless certified to a special inspection for virus diseases.

E. L. Chambers, State Entomologist, Madison, Wis.

Wyoming. Each out-of-state nurseryman must file a valid certificate of inspection and deposit a fee of $15 and receive a license valid until the following July 1. Authorized shipping tags are furnished at cost, and carriers are forbidden to deliver unless each shipment bears such a tag.

Quarantines prohibit entrance of all five-leaf pines, currants and gooseberries.

C. L. Corkins, State Entomologist, State Department of Agriculture, Cheyenne, Wyo.

OFFICERS IN CHARGE OF INSPECTION AND QUARANTINE SERVICE

Alabama ....B. P. Livingston, Chief, Division of Plant Industry, Montgomery, Ala.
Arizona ....D. C. George, State Entomologist, Phoenix, Ariz.
Arkansas ....P. H. Millar, Chief Inspector, Little Rock, Ark.
California ....A. C. Fleury, Chief Quarantine Officer, Sacramento, Cal.
Colorado ....George M. List, State Entomologist, Fort Collins, Colo.
Connecticut ......W. E. Britton, State Entomologist, New Haven, Conn.
Delaware ....Ralph C. Wilson, Secretary, State Board of Agriculture, Dover, Del.
Florida ....Nursery Inspector, State Plant Board, Gainesville, Fla.
Georgia ....M. S. Yeomans, State Entomologist, Atlanta, Ga.
Idaho ....W. H. Wicks, Director, Bureau of Plant Industry, Boise, Idaho.
Illinois ....P. A. Glenn, Chief Plant Inspector, Division of Plant Industry, Urbana, Ill.
Indiana ....Frank N. Wallace, State Entomologist, Indianapolis, Ind.
Iowa ....Carl J. Drake, State Entomologist, Ames, Iowa.
Kansas ....Charles A. Scott, Secretary, Entomological Commission, Topeka, Kans.
Kentucky ....W. A. Price, State Entomologist, Lexington, Ky.
Louisiana ....W. E. Anderson, State Entomologist, Baton Rouge, La.
Maine ....Stanley L. Painter, State Horticulturist, Augusta, Me.
Maryland ....E. N. Cory, State Entomologist, College Park, Md.
Massachusetts ....R. H. Allen, Director, Division of Plant Pest Control, State House, Boston, Mass.
Michigan ....E. C. Mandenberg, In Charge of Orchard and Nursery Inspection, Department of Agriculture, Lansing, Mich.
Minnesota ....A. G. Ruggles, State Entomologist, University Farm, St. Paul, Minn.
Mississippi ....R. P. Colmer, Acting Chief Inspector, State College, Miss.
Missouri ....J. Carl Dawson, Plant Officer, Jefferson City, Mo.
Montana ....George L. Knight, Chief, Division of Horticulture, Missoula, Mont.
Nebraska ....D. F. Felton, Director; L. M. Gates, Entomologist, State Department of Agriculture and Inspection, Lincoln, Nebr.
Nevada ....George G. Schweis, Director, Division of Plant Industry, 7 Cladianos Building, Reno, Nev.
New Hampshire ..W. C. O'Kane, Deputy Commissioner of Agriculture, Durham, N. H.
New Jersey ......Harry B. Weiss, Chief, Bureau of Plant Industry, State Department of Agriculture, Trenton, N. J.
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