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FRONTIERS of Plant Science

The tobacco "patent" of the Connecticut Valley, typified by this field of Broadleaf in South Windsor, faces what is perhaps its greatest challenge in 300 years. For a report on how researchers help meet this challenge, see page 4.

The CONNECTICUT AGRICULTURAL EXPERIMENT STATION · New Haven

Do We Need to Cultivate?

by C. L. W. Swanson and H. G. M. Jacobson . . . *Department of Soils*

WHAT DOES cultivation do to the soil? We know that we cultivate to kill weeds; after the weeds are killed, is there any further need for cultivation?

Is over-cultivation harmful to soils?

Does cultivation with tractors compact soils?

If chemical weed killers are used, do we need to cultivate?

Some of the answers to questions like these come from experiments set up at the Mt. Carmel Experimental Farm 8 years ago. Corn was the test crop used, for it responds quickly to changes in environment. All of the plots were fertilized the same. Differences observed are thus attributed to physical differences in the soils.

Comparisons were made with regular tractor cultivation, 2,4-D and one cultivation, and flame- or 2,4-D-killing of weeds with no cultivation. The three cropping systems used to obtain differences in organic matter levels in the soil were a corn-oats-clover rotation (excellent), a corn-sunflower rotation (fair), and continuous corn (poor).

Cultivation Breaks Soil Crust

It soon became apparent that cultivation under some conditions is beneficial. Hard rains sometimes pack the soil surface. On drying by a hot sun, this packed surface is baked into a hard crust. Under these conditions, soils can't breathe. Air can neither get in or out. When this air seal is broken, plants recover quickly.

In 1949, for example, soils on uncultivated 2,4-D plots were sealed by crusting. On breaking of the crust by one cultivation at third cultivation time, the nitrate nitrogen in the plow layer went up from 88 to 101 pounds per acre.

Seventy-eight per cent more force was required to penetrate the soil in the 2,4-D plots than in the cultivated ones. Breaking of the crust produced a 16 bushel greater corn yield compared with plots treated only with 2,4-D for weed control.

Value of Organic Matter Shown

Years ago, when soils in the Corn Belt had been farmed only a few years, an experiment showed that cultivation was needed only for the control of weeds. These soils were high in organic matter and in good physical condition. Soils can be brought back to these favorable conditions. Our experiment shows that if organic matter in soils is brought to a high level, the physical condition of soils is improved, and cultivation under some conditions may not be necessary. Soils in continuous corn and flamed, but without additions of organic matter, gave the most compact soil and lowest corn yields. Adding 20 tons of manure per acre on the corn and turning under a red clover crop every 3 years produced the best soil structure and highest corn yields on the cultivated plots.

More surprising but of no less interest, this 3-year rotation gave the same corn yield (103 bushels) whether the weeds were killed by flaming or by cultivation. This compared with 84 bushels per acre for the continuous corn soils.

Soil structure-wise, the corn-oats-clover soils were considerably better than the continuous corn soils. Neither had been cultivated, but the rotation soils had an average of 13 per cent lower bulk density, required 116 per cent less force to penetrate the soil 3⅜ inches, had 60 per cent greater non-capillary porosity, and had 11 per cent more organic matter.

On a practical basis these data indicate that if weeds are controlled by chemical or other means, there is little need for cultivation. Cultivation may be necessary in some years to break surface crusts.

Soil Compaction by Tractors

Running over the land by tractors in plowing, discing, harrowing, and cultivating for row crops during a growing season can be bad for our soils.

Thousands of penetrometer measurements made on soils under cultivation in Connecticut show that tractor traffic produces at least three distinct and varying degrees of compact layers or zones in soils. These compaction layers are shown diagrammatically below.

Seedbed and cultivation treatments after plowing loosen the upper 3 to 4 inches of the plow layer. In this secondary tillage zone the soils are loose, friable, and well aerated.

In the secondary tillage sole below, the soil has been compacted by seedbed preparation: it has been relatively undisturbed after plowing except for compaction. Cultivation tends to compact the soil, rearranging the soil particles so that there are fewer large pores.

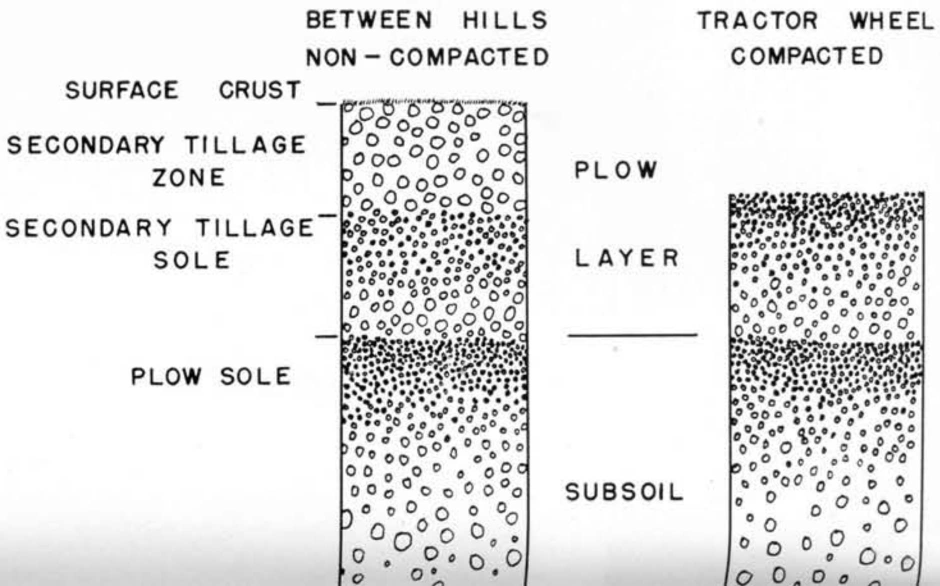
In plowing, the rear tractor wheel runs in the furrow, packing the furrow bottom. The plow share may also pack the soils. Penetrometer measurements show the plow sole to be about 50 to 75 per cent harder than the subsoil below.

One way of breaking up the plow sole is with deep-rooted legumes. In the clover plots, for example, percolation was 62 per cent better than in the continuous corn. The plow sole may also be broken up mechanically with a subsoiling apparatus. Research on this is in progress.

The diagram shows the effect of tractor wheels in packing soils in row crops after three cultivations. *Here the secondary tillage zone is compressed and eliminated by* the tractor wheel. Penetration of corn roots was restricted somewhat by this compact layer, but was not of enough consequence to reduce corn yields measurably.

Our research shows that for highest yields, cultivation should be reduced to the minimum. But first, the soils must be kept high in organic matter and in good structure so that surface crusting and compaction will be minimized.

Many measurements made on Connecticut soils under cultivation show distinct compaction layers. Plow sole in tractor-wheel compacted soils may be about 50 to 75 per cent harder than the underlying subsoil. One way of breaking this plow sole mechanically is shown on page 4.



We Need New Ways to Fight Insects

by R. L. Beard . . . *Department of Entomology*

EACH YEAR most of the skirmishes and battles against insect pests are successfully waged, but at great total cost. Some battles are lost, however, and the long war continues with no end in sight. The issue is clear-cut: some insects like the same things we do—the food we eat, the houses we live in, the clothes we wear, or the ornamental plants we admire. Other insects directly affect our health and comfort. Many insects, however, are not in competition with us and we have no real quarrel with them. So we fight specialized conflicts against relatively few species of insects, whose individual members are legion. We have recently come to realize that a generalized attack, made possible by the development of outstanding insecticides, has accentuated several problems, among which is the development of resistance to insecticides.

These difficulties are sometimes used as arguments against any use of insecticides. With all their shortcomings, however, insecticides have been generally the most satisfactory means of combating insect pests. Insecticide problems have resulted largely, apart from downright carelessness, from unwise use—unwise in the sense that we do not appreciate, or we do not have, information on *proper* use.

Many Studies Needed

In self-defense we must round-out our knowledge with more long-range experimentation. This must include investigations in insect physiology and how insect populations rise and fall and how they are affected by control practices. Studies of these must be made from many points of view in many laboratories.

Few time-tested examples give direction to this long-range experimentation. One chemical insecticide, however, is time-tested—not for 10 years like DDT, or even 100 years like pyrethrum—but for probably millions of years. This chemical is the venom of a tiny braconid wasp, (previously discussed in Frontiers, Vol. III No. 2) which paralyzes and kills a certain few insects. No resistance to this chemical is evident in the insects attacked by the wasp. Although this chemical is an impractical insecticide as we use insecticides, it suggests lines of needed research. The efficiency of this venom lies in a combination of three properties: it is extremely poisonous; its effect is limited to a few insect species; it is applied in a way that permits no survivors.

We Seek Selective Killers

We now have many chemicals that are very effective against insects, but are so highly toxic to other animals, including man, as to be hazardous to use. A few such chemicals are so dangerous that their possible application as insecticides was never publicized. The braconid venom suggests that chemical substances may be highly poisonous to insects but have no effect on many other animals. Why is this so? It has long been known that insects' heart action and breathing systems are different from ours. But much remains to be learned about how they do operate. New knowledge of the function of insect nerves may give a clue to the use of an insect nerve poison that is not a human nerve poison, too. Studies of insect nutrition show now and then some small differences in enzyme activity or vitamin requirements. Hormones and other chemical materials are being found that affect insect growth, development, and reproduction, but have no effect on humans. These differences point the way to possibly vulnerable systems in insects against which chemicals may be directed with full safety to humans.

Just as these physiological differences between man and insects are discovered with continued study, more subtle differences appear among insect species. Thus the venom from one species of braconid wasp will paralyze and kill larvae of both the wax moth and the European corn borer, whereas venom from a closely related species of wasp will kill the wax moth larva but have no effect on the corn borer. Some differences in the nerve-muscle physiology between the wax moth larva and the corn borer make this possible. A full knowledge of such differences would help us attack our insect competitors without killing our insect allies.

No insect victim of the braconid wasp survives because it receives from the wasp's sting a dose of venom far in excess of that required to cause death. The chemical is placed inside the insect, and there is no escape. To be sure we can accomplish the same thing with a fly swatter and the "two-blocks-of-wood" technique—getting one insect at a time—but there is more involved than this.

Mrs. Eugenia Grabicki, Department of Entomology technician, takes care of the cultures of the milkweed bug, one of the test insects used in the long-range research at the Station on development of resistance in insects.

Our Control is Imperfect

In our control practices, some insects survive because they luckily escape any poison; others get less than a killing dose; still others survive because their defenses overcome the effect of the poison before it kills. Among these last two groups are the individuals which may be responsible for the development of resistance. To what extent we can insure "no survivors" by improving methods of insecticide application is not known. "Lucky escape" insects are not likely to contribute to resistance development. Perhaps we can tolerate more lucky escapes if we can insure that no insects survive after actual contact with the insecticide.

Many of these studies must be undertaken with patience, for successful application of the information may be in the distant future. Our long-range experimentation here may not help win the battles against insects in 1956, but it may disclose effective new strategies for our long war against insect enemies. Effective new weapons or old weapons used more wisely could dramatically affect the outcome.

Tobacco Researchers Look Ahead

by Gordon S. Taylor . . . *Tobacco Laboratory, Windsor*

CIGAR TOBACCO from the Connecticut Valley has long commanded a premium price for premium quality. Ever since the early settlers grew more tobacco than they needed, cigar makers have steadily preferred our leaf for cigar binder and wrapper. In recent years they paid growers $27,000,000 annually for Connecticut's share of the Valley crop, thus making tobacco rank third in agricultural income for Connecticut.

Now, change is in the air. The cigar trade as a whole has been caught in the price squeeze. New ideas are being tried everywhere to cut costs and improve sales.

One of these ideas is a synthetic binder to replace natural leaf. In brief, ground-up tobacco is put together again as a sheet material that handles and smells like tobacco but can be made into any desired shape or size. This eliminates a worker on the cigar-making machine and, more critical for the Valley, uses drastically less raw tobacco to bind the same number of cigars.

Future is Uncertain

When we look ahead toward research of the future we immediately find two big "if's." First, substantially less tobacco will be needed from all natural binder-leaf areas, including Connecticut, if the new binder is accepted by smokers, and manufacturers use it freely. So far it has been accepted. Secondly, if the distinctive qualities that made our natural leaf better than others are not important in the synthetic binders, then we must compete evenly with other areas which presently grow tobacco for half our costs. This is still undecided and is crucial.

What are these distinctive qualities which have been aptly described as our Valley "patent"? In short they are good taste, smooth burn, uniform color, and elasticity with good physical strength. Ability to grow this kind of tobacco comes largely from our soil type and climate, but it has taken continuous research on fertilizers, curing, pest control, farming practices, and plant breeding to maintain this "patent."

Tobacco Research Began in 1892

This Station began research on tobacco in 1892. It was then recognized that while immediate problems needed immediate attention, additional basic information on plant growth and pest behavior would be extremely useful in solving future problems. This philosophy has been in the Connecticut Station tradition ever since.

When Sumatra threatened to take away our cigar wrapper trade, we copied Sumatra's climate by using cloth houses covering 6,000 acres of land. Certainly this was a revolutionary idea for the year 1900. This took know-how of plant behavior, plus just plain trying it. The once-proud wrapper from Havana Seed grown in the open soon disappeared, but a $30,000,000 shade wrapper industry took its place.

Outbreaks of insects and diseases have also threatened to eliminate tobacco from the Valley but research, both basic and applied, has tamed them enough to live with.

Now synthetic binders threaten to eliminate the market for our "patent" leaf and we ask ourselves: How do we face this problem? Actually, like Janus, we must look two ways at once. First, we assume that the process will not extinguish the market for Connecticut tobacco. So we continue our present research program designed to increase the return a grower can realize from his tobacco acreage with natural binder leaf. Second, we add a new research approach, assuming that tobacco produced in the Valley will be used mainly in the synthetic binder product.

In the first program, research on soil structure is one of the most promising new fields. Tractor culture has led to shallower tillage plus compaction of the soil below the cultivated depth. Tobacco roots penetrate this compacted layer poorly, causing shallow rooting and inefficient use of potential growing space. Special machinery designed at the Tobacco Laboratory has broken up this layer, added fertilizers at deep levels, and prevented repacking by the tractor wheel. Root studies as reported by Dr. deRoo in the last issue of "Frontiers" show that tobacco roots go much deeper after such treatments. Roots of various fall cover crops may help to prevent the loosened soil from repacking. Results so far have shown improved quality and yield of tobacco with improved rooting depth and deep fertilization. The study is continuing, and several years may be necessary to fully correct soil compaction troubles.

Plant breeding also strives to produce better quality tobacco at less cost. An important aim is to bring in disease resistance while maintaining or improving quality standards. Wild relatives of tobacco have supplied resistance to mosaic disease, wildfire, black root rot, and blue mold. It is difficult, however, to obtain uniform varieties that have both a high degree of resistance and superior quality. Hundreds of lines are grown each year with strict selections for uniformity of quality, yield, and resistance.

Seek Other Properties

Properties other than disease resistance are also sought by Dr. Seaward A. Sand, our tobacco geneticist. Among them are male sterility, which would allow simple production of a hybrid similar to present-day corn, indeterminate growth habit which produces many more leaves on a plant before flowering begins, and leaf characteristics to provide shade wrapper quality when grown outdoors.

In the latter study, plants were irradiated to increase variations. Desirable qualities other than those aimed for may also come from the treated plants.

Tobacco diseases can often be controlled with chemical fungicides where disease resistance has not been developed. For instance, a standard practice for control of wildfire has been copper fungicides sprayed on the seedbeds. Recently the antibiotic

This subsoiler, developed at the Tobacco Laboratory, breaks up the compacted soil layer below the plow level, prevents repacking by the tractor wheel, and places fertilizer deep.

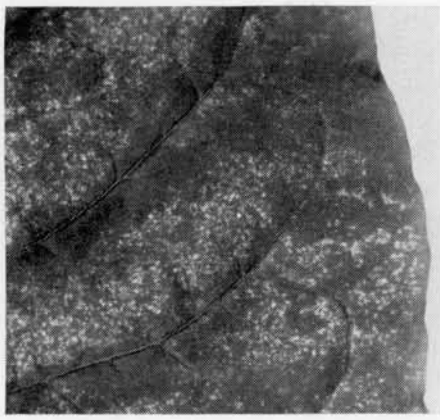
streptomycin has proved superior to copper for wildfire control. Streptomycin used on young seedbed plants will also control the serious disease known as blue mold. Unfortunately this antibiotic does not control another disease, called bed rot, which kills patches of larger plants. For this reason zineb or ferbam, which control both blue mold and bed rot, are still most effective for late spraying on seedbeds. In tests last year a newer member of the dithiocarbamate family, maneb, successfully controlled blue mold and did not injure tobacco when used at eight times the normal concentration. Easily applied compounds for killing weeds and soil-borne diseases in seedbeds looked promising in tests last year but need further study as to their safety for tobacco plants.

Insect Studies Continue

Insects on tobacco may kill transplanted seedlings, retard growth by damaging plant leaves, or destroy large leaf areas on nearly mature plants. A steady development of new insecticides has given the grower a chance to select the compound best suited to his situation. Evaluating these compounds is part of our program on tobacco research. These evaluations often require increased knowledge of a particular insect's life history. For example, larvae of the seed corn maggot tunnel into stems of newly set tobacco only over a short period of time, which apparently depends on the season and soil characteristics. In order to apply chemicals for control we must know when the insect will be there. Dr. James B. Kring, our tobacco entomologist, therefore, studies the biology of insects along with trials of new compounds.

Recent findings for control of other insects have shown that endrin is effective against cutworms, aphids, thrips, and hornworms. Another new compound, dieldrin, will control cutworms and flea beetles. Growers now have toxaphene, heptachlor, endrin, and dieldrin as choices for cutworm control.

Cause of weather fleck, a new disease of shade tobacco, remains unknown. Development of new varieties may finally overcome trouble.



One project of considerable interest is an attempt to produce wrapper-quality tobacco without using the very expensive shade tent. This would allow many more growers to produce the higher priced wrapper tobacco. Shaded leaves grow differently from those grown in the sun. This difference is desirable. We are now asking just what are these differences in measurable terms and how nearly can we reproduce them with experimental treatments. The chemical and physical differences studied so far by Dr. Milton L. Zucker, one of our plant physiologists, tell us that water economy may be more important than reduced sunlight in producing wrapper quality. Thus irrigation studies are needed.

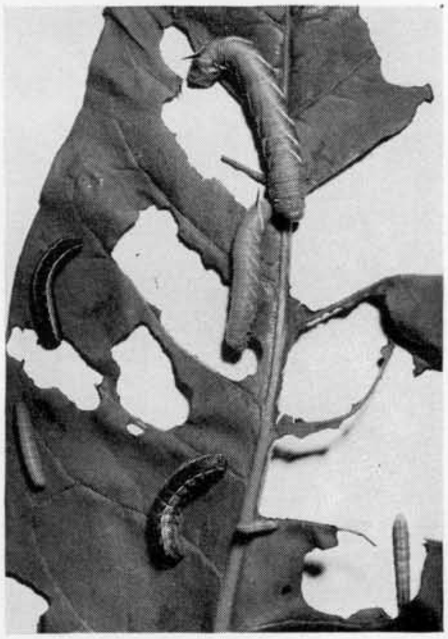
Study Curing Environment

One of the most important considerations in tobacco culture is proper curing of the leaves after they are grown. Rapidly dried cigar tobacco is unsmokable. Many chemical and physical changes must occur as the leaf slowly dies and dries out. These changes have been studied for years but only recently in conjunction with carefully controlled variations in the curing environment.

Using air-conditioned cabinets, Dr. A. Boyd Pack, another of our plant physiologists, found with shade tobacco that color changes were related more closely to rate of water loss than they were to time or temperature of curing. The relationship did not vary with position of the leaf on the stalk. This now tells us that color may best be regulated by controlling the actual drying rate of curing leaves rather than by setting up arbitrary temperatures and relative humidities. In practice, this means that different curing seasons may require different temperatures and humidities to maintain the proper drying rate.

Much other work is going on, such as sucker control treatments and studies of irrigation, nematode control, fertilizer, new varieties and minor diseases, all of which may eventually help the grower produce better quality natural binder at a greater profit.

Facing now in the other direction, we will assume that the synthetic binder will eventually be used on 80 per cent of the cigars made. This means that drastic cost cutting is necessary if the Connecticut Valley is to compete successfully for the synthetic market.



Effective control of insect pests of tobacco calls for careful studies of each insect's life history, and repeated trials of new materials.

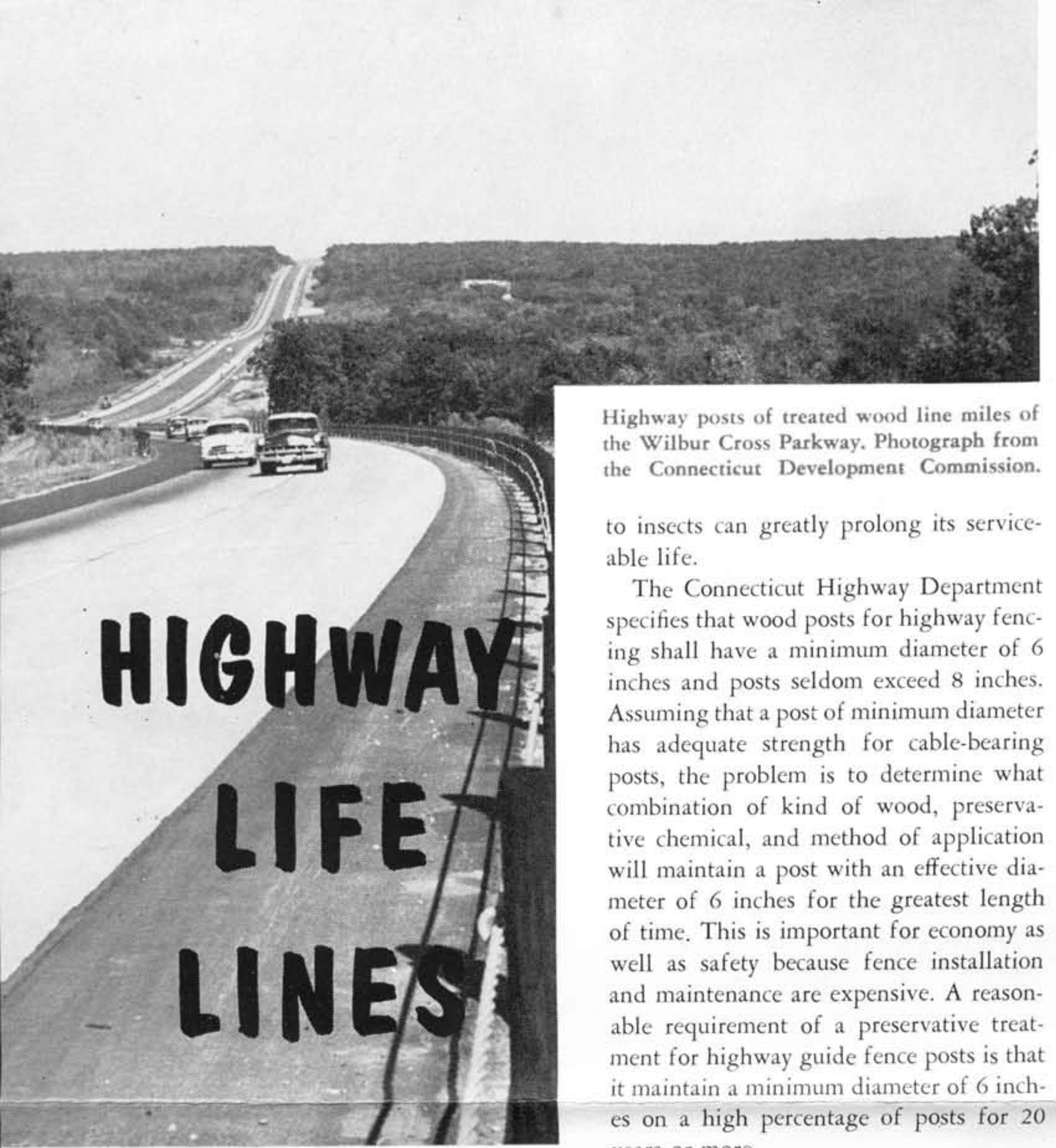
Labor is the largest cost item for tobacco growers. Harvesting requires the most labor. Since tobacco used in synthetic binders must be ground up anyway, it would seem possible to harvest tobacco with an ensilage cutter and dry it with hay dryers. First, however, we must discover a short cut to the curing processes and produce a good smoking product. This is where plant biochemists and physiologists are helping us.

Need More Facts on Flavor and Aroma

Preliminary results have shown promise of success with certain chemical treatments, but we need to know more about enzymes, bacteria, and chemical composition, particularly as they relate to flavor and aroma development. New sciences such as gas chromatography will help us with this problem.

In addition to drastic changes in harvest methods we are studying all other cultural procedures as well as changing the plant genetically, for ways to chop at costs per pound wherever we can.

In looking ahead then, we see not so much a change in our research but rather additions to it, enlisting all of the know-how available. In short, it means more work for all of us, but with promise of deep satisfaction in keeping our Tobacco Valley in Connecticut.



Highway posts of treated wood line miles of the Wilbur Cross Parkway. Photograph from the Connecticut Development Commission.

HIGHWAY LIFE LINES

by Henry W. Hicock
Department of Forestry

THE MOTORIST is probably as safe on Connecticut's highways as on any highway in the country. One reason for this is that any stretch of roadway appreciably above the surrounding terrain is provided with a guide railing or fence consisting of steel cables borne on wood posts. These wood posts have certain advantages over posts of concrete or steel. Wood has a high strength-weight ratio, gives to some extent on impact, and is relatively inexpensive and easy to install. When a fence is hit by a motor vehicle, the vehicle usually stays on the roadway and frequently the only damage to the fence is the upsetting, without breakage, of one or more posts. These can be reset and the fence is again in working order. Steel and concrete posts, on the other hand, are often bent or shattered and must be replaced.

Wood is at a disadvantage because it deteriorates with time. Application of chemicals toxic to fungi causing decay and to insects can greatly prolong its serviceable life.

The Connecticut Highway Department specifies that wood posts for highway fencing shall have a minimum diameter of 6 inches and posts seldom exceed 8 inches. Assuming that a post of minimum diameter has adequate strength for cable-bearing posts, the problem is to determine what combination of kind of wood, preservative chemical, and method of application will maintain a post with an effective diameter of 6 inches for the greatest length of time. This is important for economy as well as safety because fence installation and maintenance are expensive. A reasonable requirement of a preservative treatment for highway guide fence posts is that it maintain a minimum diameter of 6 inches on a high percentage of posts for 20 years or more.

Study Began in 1940

As a basis for evaluating treatments, this Station and the State Highway Department began a cooperative survey of highway posts in 1940. Since then some 8,500 posts have been under observation, involving nine kinds of wood, six preservative chemicals, and six methods of preservative application. Detailed results of the survey are given in Circular 196 of this Station. This article briefly summarizes those results. For this purpose methods of preservative application are divided into two broad categories: (a) Those which apply the chemical to the surface of the wood without appreciable penetration, and (b) those which force the toxic chemical into the wood to considerable depth.

Superficial treatments using several preservatives were totally inadequate for nondurable woods used in highway fencing. With the exception of locust, highly durable with or without treatment, posts so treated began to fail at ground line within 5 years and almost all had become unserviceable within 10 years.

Treatments to impregnate the wood in depth were more successful. These are discussed below under several headings.

Treatment with hot creosote *under pressure* at the rate of 6 lbs. per cubic foot gave excellent protection to red and southern yellow pine posts, which were in nearly perfect condition after 15 years in the ground. Hardwood posts given the same treatment were in a less satisfactory condition after 15 years. Ring-porous oaks were in better condition than diffuse-porous maples and birch.

Oak and maple posts *pressure-treated* with Wolman salts were in essentially the same condition after 15 years as the same woods pressure-treated with creosote. There was some evidence of deterioration caused by the salt in addition to that caused by organisms.

Untreated Tops Soon Show Decay

Open-tank treatment of the butts only of hardwood and pitch pine posts by immersion in hot creosote for several hours and then allowing the posts to cool in the solution was a complete failure because the untreated tops began to decay after only 5 years. The condition of hardwood posts given a full-length open-tank treatment with creosote compared quite favorably after 15 years with that of the same woods given a pressure treatment with creosote. These two treatments demonstrate that in Connecticut, and regions with comparable climate, it is fully as necessary to treat the tops of posts as to treat the butts.

Posts of red pine *cold-soaked* in a solution of pentachlorophenol in furnace oil for 2 to 4 days were in excellent condition after 5 years.

Red pine posts *barrel-treated* with zinc chloride were in excellent condition after 8 years.

Pressure Treatment now Standard

For greater safety and economy the State Highway Department has now adopted the policy of using pine posts, pressure-treated with creosote at the rate of 8 lbs. per cubic foot, for cable fencing on virtually all roads with heavy traffic. It has completely abandoned the use of posts given only a superficial treatment. Along other roads and also for property fences along highways, the use of posts treated by one of the other impregnation methods is permissible, but all such posts must have full-length treatment.

Safeguarding Your Plant-food Dollars

FERTILIZER ANALYSIS since the 1850's

by H. J. Fisher . . . *Department of Analytical Chemistry*

THE NEED for analysis of fertilizers was the reason for establishment in 1875 of The Connecticut Agricultural Experiment Station, first in this country. The series of events that led to this foundation began in the 1850's with a series of articles in the Connecticut Homestead by Professor Samuel W. Johnson of Yale.

He recognized as fraud such practices as the sale of New Haven Harbor mud as fertilizer. To expose these practices, he analyzed commercial fertilizers then being sold, calculated the dollars-and-cents value of their plant-food ingredients, and published the results. He did this at first on his own responsibility. In 1857, he was appointed chemist to the State Agricultural Society and continued his work under its auspices until 1866, when the new State Board of Agriculture took over.

Dr. Johnson's studies in Germany had given him firsthand knowledge of agricultural experiment stations there, and he saw the need of such institutions in this country to advance the scientific study of agriculture. A proposal by a committee of the Board of Agriculture to the Legislature in 1874, that it found such a station, failed of passage for money reasons. Almost immediately thereafter, Orange Judd of Middletown offered the free use of laboratories at Wesleyan University if the State would appropriate $700 a quarter for two years for salaries of an experiment station staff. Purpose of the new station was "for the analysis of commericial fertilizers alone." The legislature accepted this offer, and the station came into being at Middletown under Dr. W. O. Atwater in 1875.

89,000 Tons a Year

About 89,000 tons of fertilizer are spread on Connecticut fields each year. The pattern here differs from that in any other state in one respect: the large-scale use of natural vegetable products like cottonseed meal. Almost 12,000 tons of vegetable meals are used on Connecticut Valley tobacco fields, where they have until recently been considered indispensable for production of top-grade tobacco. As a source of nitrogen, vegetable meals are much more expensive than are man-made products like sulphate of ammonia.

The Connecticut home gardener can get information on the plant-food needs of his soil by following sampling instructions available from the Department of Soils at this Station.

During its two years at Middletown, the Station's work was principally analysis of commercial fertilizers. Removal to New Haven in 1877 brought no neglect of fertilizer analysis, and painstaking attention to this work continues, even though Station research has branched out into many other paths.

1869 Law Called for Analysis

The first State fertilizer law, passed in 1869, antedated the Station. That law required "commercial manures" to carry "a true analysis or specification of the chemical elements and their several amounts contained therein." The secretary of the Board of Agriculture was authorized to "procure the analysis of any fertilizer offered for sale in this state, and to prosecute any persons who violate the provisions of this act."

All costs of analysis were borne by the State. Curiously enough, in 1881, the manufacturers themselves suggested that costs be met by manufacturers' registration fees. Faced with this situation in other states, Connecticut manufacturers felt that out-of-state competitors should not invade this State scot-free.

At their instigation, the law passed in 1882 required payment of a $10 analysis fee "for each of the fertilizer ingredients contained or claimed to exist in said fertilizer." Since 1883, every commercial fertilizer sold in the State has been registered.

Two of the manufacturers who registered in 1883 are still registering 73 years later, Rogers and Hubbard of Middletown and M. L. Shoemaker, Philadelphia, Pa.

In 1919 an amendment to the 1882 law imposed a 6-cent tonnage tax in addition to the analysis fees, and restricted the declared elements to nitrogen, phosphoric acid, and potash.

A 1949 amendment took care of the minor elements whose importance had been shown in later years.

Owen Nolan analyzes nitrogen content of fertilizers, one of nine separate determinations made on complete mixed plant-food samples.

Operation of the fertilizer laws begins with the manufacturers, who file brand names and guaranties of all the fertilizers they intend to offer for sale in this State during the year. Then R. Richard Nichols, Station inspector, takes samples from the stocks of fertilizer dealers.

In the laboratory, these samples are numbered, ground, and analyzed. Analysis of fertilizers and animal feeds takes practically the full time of three chemists. At least nine separate determinations are made on each complete mixed fertilizer (one containing nitrogen, phosphoric acid, and potash): Total nitrogen, ammonia nitrogen, nitrate nitrogen, insoluble nitrogen, availability of the insoluble nitrogen (by two methods), total and citrate-soluble phosphoric acid, and water-soluble potash. Analysis is also made for magnesium, boron, copper, and other minor elements

(*Continued on page* 8)

Virgil Churchill, sampling agent for 44 years—more than half the time this Station has analyzed fertilizers—traveled Connecticut byways in a wide variety of conveyances during his long period of service from 1897 to 1941.

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FERTILIZER ANALYSIS

(*Continued from page* 7)

when the fertilizer carries guaranties of such elements.

Where possible, methods used are those of the Association of Official Agricultural Chemists of North America. By law in most states, these methods are recognized as authoritative. Analysis is by chemical methods, or by the flame photometer, as efficiency and accuracy dictate.

Beauty Treatment for Lawns

Custom application to lawns of diluted fertilizer solutions, sprayed from oil trucks, became a part of the Connecticut fertilizer picture in 1955. Samples analyzed by the Station showed that these mixtures were usually made accurately, and that the customer got what he bought in 1955. The customer, of course, puts his own value on the "convenience" he is purchasing in addition to fertilizer.

Manufacturers receive results of these analyses on completion, and once a year a published report is issued which constitutes a public record. This publication of results, rather than court prosecution, is relied upon to keep up the quality of fertilizers in this State. Proof that this system works lies in the fact that year after year 88 per cent of all guaranties are found to have been met.

As in the past 81 years, the Station will continue in the future to guard the fertilizer supply of Connecticut buyers.

From the Director

Occasionally, we must all stand aside and take a new look at our old problems. And we at the Station have stood aside and taken a new look at our organizational scheme. Our present organization for research covers most of the problems in plant science. We concern ourselves with soil problems in the soils department, with plant growth problems in the biochemistry and other departments. We deal with the plant and its pests in the departments of entomology and plant pathology. We deal with the problems of plant reproduction and breeding in the genetics department, and with many of the problems of the forest in the forestry department.

The oldest problem in agriculture is the weather. The early chapters of Genesis bespeak it. The scribe tells of how the east wind blew and smote the crops with blasting and mildew.

We at the Station have not neglected the weather exactly, but we have not treated it with the respect that it requires. We have done research on the relation of climate to the distribution of forest trees, to the destructiveness of insects and diseases. We have studied the effect of weather on tobacco curing, and many other problems.

In taking a new look at our research, we have decided to do something about the weather. We are establishing a new Department of Agricultural Climatology under the able leadership of Dr. Paul E. Waggoner, who has been interested in weather ever since he was an undergraduate student at the University of Chicago.

The establishment of a Department of Climatology will enable us to maintain our staff tradition: top specialists in all significant basic sciences that underlie agricultural practice. As far as we know, this will be the second full-fledged Department of Climatology in an American Experiment Station. New Jersey has one that they call Meteorology. Iowa has a Climatology Section of the Agronomy Department.

James G. Horsfall

New Publications

The publications listed below, and a List of Available Publications, are free to residents of Connecticut who apply for them, and to others as editions permit. Address requests to Publications, The Connecticut Agricultural Experiment Station, Box 1106, New Haven 4, Connecticut.

Forestry and Wood Utilization

C 196 Highway Post Survey, a 1956 Progress Report

Insect Pests

C 197 The Forage Insect Problem

Report on Inspections

B 596 *Food and Drug Products, 1953*
B 597 Commercial Fertilizers, 1955

Special Circular

The European Chafer Quarantine

Although not new, the following publications may also be of interest.

Insect Pests

C 188 Ants as Pests

Lawns and Turf

C 190 Lawns

Tobacco

B 564 Growing Tobacco in Connecticut

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