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FRONTIERS

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FALL ISSUE

CONNECTICUT AGRICULTURAL EXPERIMENT STATION, NEW HAVEN

Dr. Herbert L. Everett holding hybrid ear produced on pollen sterile seed parent plant. Since tassels on this plant produce no pollen, the laborious chore of detasseling is omitted.

New Corn Plant Keeps Its Tassels In Hybridization Process

by Donald F. Jones[1]

At the Mt. Carmel Experimental Farm this past season, one of the spots attracting the most visitors was a field in which two apparently identical plots of hybrid field corn were growing, facing each other across a narrow roadway. Standing in the road, and glancing first to the right, then to the left, the visitor could see little visual evidence that the corn plants differed enormously. Each seemed to be merely an exceptionally tall, hardy, productive variety of field corn.

In a way the visitor would be right. On each side of the roadway, the same new Connecticut Station-developed variety of field corn was growing. But the big, yellow ears adorning the stalks on one side were produced in a vastly different way from those on the other.

A clue to this would be the one observable difference in the two plots of corn, twin-like in all other respects. On one plot, the tassels on all plants were absent in three rows, then there'd be a row with the tassels intact, then another three rows of tasselless plants, and so on. On the other plot, *all* of the plants had retained their tassels.

If the visitor knew how hybrid corn is produced, he'd realize that the plot with the alternating three tasselless and one tasseled row represented the standard way of making hybrid corn. Part of this process is the removal of the tassels from the seed parent plant before any pollen is shed. This is done so that the resulting seed is fertilized only by the pollen parent, thus insuring trueness to type. Otherwise, the careful breeding which goes into the making of a hybrid would be ruined.

Eliminates Detasseling

The all-tasseled plot represents a new procedure which promises to revolutionize the hybrid seed corn industry, by eliminating the necessity of detasseling. For the seed parent of the big, hybrid ears in that plot is a new corn plant, normal in all respects, except that it produces no pollen on its tassels.

In the huge crossing fields of the mid-West where seed for the nation's hybrid corn is produced, detasseling is a laborious chore. To remove all tassels before any pollen is produced requires a crew of tassel pullers going over the field every day, or every other day.

Obviously, a plant that produces no pollen on its tassels to begin with and so makes the chore of detasseling unnecessary is a boon to the hybrid seed corn producer. Even more important than its saving in labor and time, is the fact that its use results in less injury to the corn plant and, consequently, in higher yields.

Pulling tassels often results in removal or injury of one or more leaves and this loss of leaf area regularly reduces yields appreciably. Breaking the tassel from the stalk exposes injured tissue in which smut infection frequently gains a foothold and this infection further reduces yields. The use of the pollenless plant solves the problem of reduced yields from this cause.

The new type of corn is unable to produce pollen because of something geneticists call a "pollen sterile characteristic"—a factor that occurs in the cytoplasm of the plants. Its antecedents were obtained from Dr. P. C. Mangelsdorf, formerly a member of the Station staff, who discovered the corn growing in Texas. In these plants, the rare pollen sterile characteristic appeared naturally.

Sterile Character Reproduced

The Texas corn was valueless in itself for the production of hybrids. But it was found that by crossing and backcrossing for several generations, the sterile characteristic could be reproduced in any inbred strain of corn. Thus, the new process can be used in the production of any hybrid, using a sterile inbred as one of the two seed parent inbreds. Investigations continue to make certain the extent to which the expense and labor of detasseling can be done away with. If they fulfil their early promise, the new method of seed production promises to be as revolutionary as the double cross method was originally.

[1] Dr. Jones is head of the Genetics Department.

Left, usual method of producing hybrid corn with alternating tasseled and tasselless rows.

Right, new method, by which all the tassels can be left on.

What's Under The Trees?

by Herbert A. Lunt[1]

If I had the job of managing a large tract of woodland, the first thing I would want to see is the forest type map, and the second, the soil map. Both kinds of maps are essential to modern timber management and if either were missing, I would want to prepare the missing one at the earliest opportunity.

Broadly speaking, in this country very few forest tracts have been mapped for soils. Fortunately, there is a growing recognition of the importance of the soil beneath the trees and the role it plays in determining the character of the stand and its yield in lumber or cordwood. This may seem to be a mis-statement, considering the fact that, where rainfall is adequate, trees survive in almost any situation, including some of our roughest and rockiest land where there is little or no soil.

Survival Not Enough

But the key word here is *survive*. There's a vast difference between mere survival and satisfactory growth. Where cordwood, fence posts, ties or lumber is to be the fruit of the land, something better is needed than bare rock with a few crevices for root anchorage.

Like any farm crop, trees need moisture and plant food from the soil. And like many crops, forest stands need to be weeded and thinned if growth of crop trees is to be maintained at a maximum.

Unlike most farm crops, tree roots remain in the soil year after year, and the rate of demand for plant food during any one season of the year is rather low. Further, the amount of removal from the land is infinitely less (in undisturbed stands). Because of these facts, the rate of natural liberation of available plant food is usually ample in the forest. Hence, fertilizers are not ordinarily needed, even on soils considered to be very poor by farming standards.

However, the more favorable the moisture supply and the higher the rate of plant food liberation—other factors being equal, and taking into account the differences in the requirements of various species—the better the quality of the stand and/or the more rapid the growth. Both moisture supply and plant food liberation are tied in with properties of the soil.

Moisture Most Important

Our work here at the Connecticut Station, which was one of the first to begin research on forest soils, has shown that in most instances soil moisture is the factor of first importance. Moisture relations may be indicated by the soil type. For example, Merrimac loamy sand is a drier soil than Merrimac fine sandy loam or Brookfield loam, and Leicester loam soils are wetter than Gloucester loam.

In some instances moisture conditions vary within a given soil type because of topographic position. For example, trees growing on a sandy soil with a water table averaging five feet deep will grow faster than they would on the same kind of soil but where the water table is 15 or 20 feet deep. Likewise, the middle or lower portion of a long slope or the north side of a hill will usually have better moisture conditions and trees are likely to grow faster than those on the upper portion of the slope or on the south side of a hill, although a soil map may show the same soil in all of the situations cited. This fact is indicative of some of the complications involved in determining the relationships between soils and tree growth.

One of the most striking effects of soil texture and moisture supply came to light recently when it was found that a five-year-old planting of white pine on Hartford sandy loam was growing 27 per cent faster than an identical planting on Merrimac loamy sand not more than 350 feet away. The increase with Norway spruce was even greater—nearly 90 per cent. Here the difference was not one of soil series as such—Hartford vs. Merrimac—but rather that of soil texture and moisture supply. The substratum of the Hartford sandy loam was considerably more moist and tree roots had penetrated to a greater depth than on the block of Merrimac loamy sand.

Our studies have shown that the soil in the woods is decidedly more loose and porous, contains considerably more organic matter and has a *much higher water-holding capacity* than cultivated soils. Direct comparisons in nine separate locations in south-central Connecticut revealed that the top soil in the forest, exclusive of forest litter, contained 48 per cent more nitrogen than the top soil of tilled soils, and was able to hold 40 per cent more water. Further, the forest soils were about 22 per cent lighter, indicating a larger amount of air space.

Available Nutrients

So far as available nutrients are concerned — especially phosphorus, potassium and calcium — farm soils are usually better stocked as a result of fertilizer treatments; but in comparison with permanent pasture soils, forest soils generally have the advantage.

When one takes into consideration the deposition of litter and humus usually present in undisturbed forests, the favorable condition of woodland soils is further enhanced.

Unfortunately, man has not yet found a practical, economically feasible way to maintain the highly desirable condition of good forest soil under our modern system of farming.

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[1] Dr. Lunt is a soil scientist, specializing in forest soils.

Analyses of Foods a

by Rich

L. G. Keirstead is checking the temperature controls of the Soxhlet extraction apparatus used in the examination of various materials for DDT, parathion and other insecticides.

Each year thousands of samples of foods, drugs, cosmetics, vitamin D milk, and commercial feeds, fertilizers, insecticides and fungicides come into the laboratories of the Station's Department of Analytical Chemistry for analysis to see that they meet lawful standards. Today the scope of the Department's work touches the life of every resident of the State, directly or indirectly.

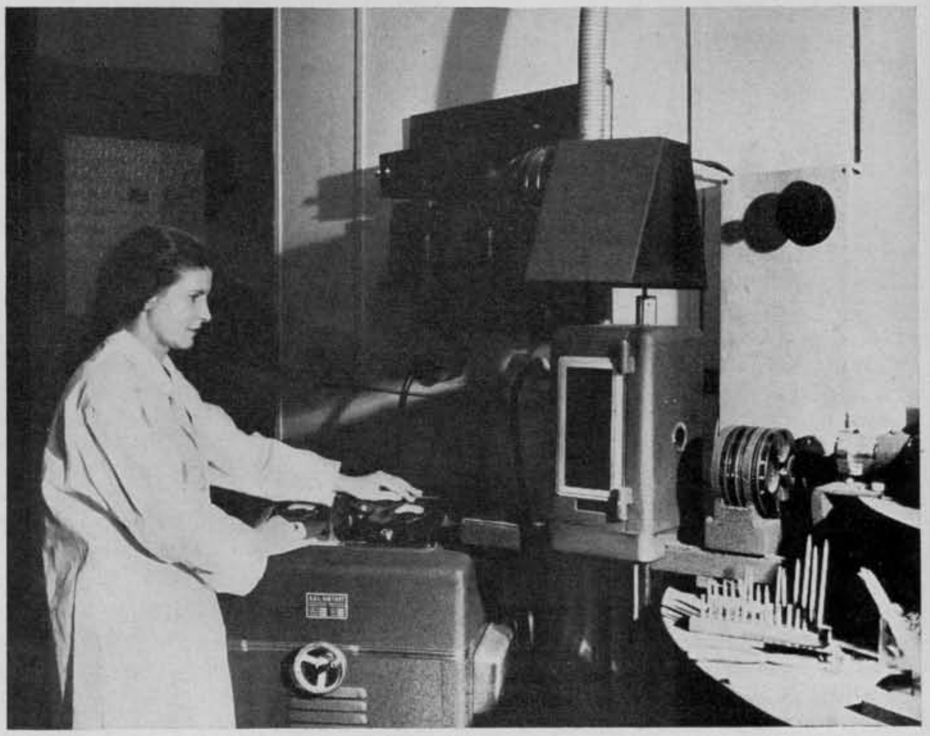
This, however, was not always so. At first, the laboratory concerned itself only with examinations of fertilizers and similar materials for the benefit of the Connecticut farmer. However, with the passage of the years, various acts of the legislature resulted in laws which broadened the Department's work to include all of the products mentioned above.

Food is undoubtedly the item that interests most people most directly. Department reports on foods and drugs, now issued for 52 years, indicate that, on the whole, the housewife usually receives foods well up to standard when she buys from her Connecticut grocer's shelves. Adulteration or misbranding are the two main suspicions on which samples are submitted. By careful chemical analysis and other precision methods, the Department makes sure that no foreign substances or substances forbidden by law stay in food sold to Connecticut consumers and that claims made on the package are fulfilled in the contents.

Drugs Also Tested

Drugs are also on the list of items subject to analysis by law but they are not so prone to violation because regulations concerning them are very strict. Surveys of those compounded by pharmacists and of those manufactured by pharmaceutical firms are conducted annually to see if they comply with the law. Fortunately for the health of its residents, drugs sold in Connecticut are seldom adulterated or misbranded. And, fortunately, too, today "cure-all" remedies are a thing of the past.

A phase of the Department's work always of interest to visitors is the use of the animal laboratory in the Department of Biochemistry for the assay of vitamin D milk and poultry feed supplements such as codliver oil. They are surprised to learn that the vitamin D milk that they know is good for their children is tested for its vitamin D content by feeding it to albino rats. The growth response of the rats, covering a period of seven days, is used as a measure of the potency of the vitamin. For assaying vitamin oils, Leghorn chicks are fed a standard poultry feed mixed with the oil for a 21-day period. To protect the purchaser, vitamin D milk and poultry feed supplements must be sold under guarantees of potency and such biological assays continue to reveal that most guarantees are met satisfactorily.

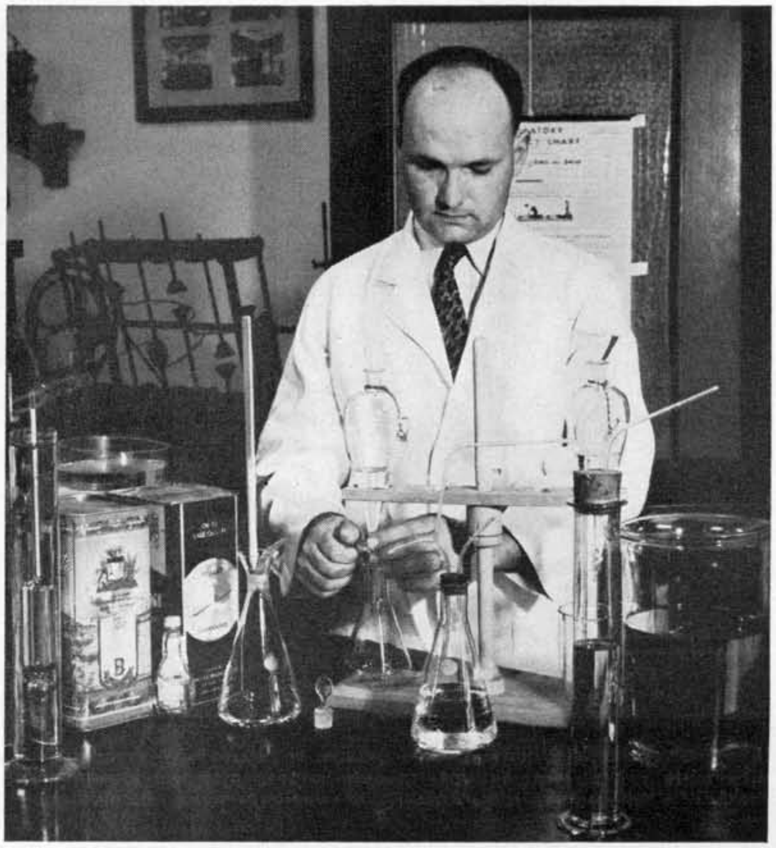


The spectrograph annually accounts for thousands of analyses of different materials for their metallic constituents. Here, Miss Helen Kocaba is turning on the electric current which flows through the electrode containing the sample.

d Feeds Protect Public

T. Merwin[1]

The cover picture shows Mr. Richard R. Nicols, Station agent, sampling a bag of feed with his "trier", with which he withdraws portions from several bags and carefully mixes them for chemical analysis. The Station is authorized to collect annually a sample of each commercial brand of feed and fertilizer sold in Connecticut. All such commercial brands must be registered according to law and must be analyzed to see if they comply with the guaranties under which they are sold. This means that each year well over a thousand samples must be examined, totaling in all nearly 10,000 separate analyses.

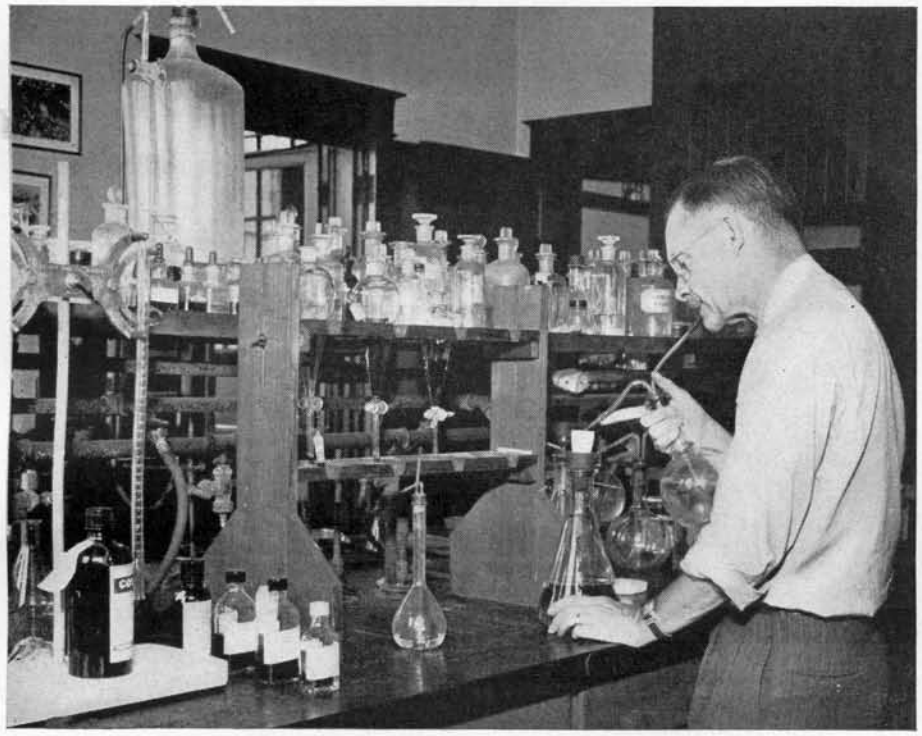


Alphonse Wickrowski is making a separation of squalene, one of the components found in greater amount in olive than in any other edible vegetable oil. A low squalene value indicates little or no olive oil in blends.

Poisoned Animals

A little-known feature of the Department's work deals with the examination of biological specimens from domestic animals and poultry for poisonous substances, such as pasture plants containing harmful alkaloids, and metals such as arsenic, antimony, lead and zinc. In a recent year nearly 50 per cent of the materials examined proved to have sufficient amounts of poisonous substances to cause death.

In much of the poison work the spectrograph installed in December, 1945, has been used to detect the kind and approximate quantity of metals present in the materials examined. Each metal has its own spectrum in the invisible ultra-violet range of light rays. When it is burned in an electrode of the spectrograph, the metal emits light at wavelengths characteristic of that metal only, and so produces an identifying pattern on a photographic film. The relative intensities of the light lines on the film make possible a quantitative estimation of the amount of metal present. In this way, poisonous amounts of lead, zinc, mercury and other metals have been easily and quickly detected. The spectrograph is used extensively for analysis of many materials and to date has accounted for more than 20,000 determinations.



Prescriptions, standard drugs, and other pharmaceutical preparations are carefully assayed for their ingredients and the quantities of each. Mr. Merwin is shown using a suction flask for rapid filtration and washing of certain drug components.

The Department of Analytical Chemistry has the distinction of being the oldest of those comprising the Experiment Station, for it came into being in July, 1875. For nearly 75 years it has functioned, not only in the interest of agriculture, but in the interest of the general consumer as well. Its services have been a great deterrent to those who would defraud the public.

[1] Mr. Merwin is an analytical chemist.

From the Director

The contributions which Connecticut has made to industry are known to society at large. The equally significant contributions that the State has made to agriculture are known to fewer people.

Connecticut has made six fundamental contributions to the world's agriculture: In the 18th century, the first law on public control of crop pests, and the first book on agriculture in America; in the 19th century, the first courses in college teaching of agriculture, and the first Agricultural Experiment Station; and in the 20th century, the first practical hybrid corn and the co-discovery of the first vitamin in food.

These six contributions follow an interesting pattern. The first law on the control of pests showed an early interest in agriculture on the part of the legislators in the State. Jared Eliot, Yale graduate, minister and experimenter, published his "Essay on Husbandry" in several parts, finishing it in 1761. He stimulated interest in agriculture among the people.

This interest grew by means of agricultural societies and finally flowered at Yale in the late 1840's in the establishment of the first courses in college teaching of agriculture as distinct from farm schools. The elevation of agriculture to the college level increased the interest of the people in agriculture and provided college-trained practitioners.

College-trained farmers had the background to understand and support a new movement that was gathering speed—a movement to set up a research laboratory to "put science to work for agriculture".

The accomplishments of this research laboratory are being recorded in this century. Hybrid corn and vitamins are significant examples.

JGHorsfall

CROPS IN CIRCLES FOR RESEARCH

by Saul Rich [1]

Crops growing in spiral rows! This sight never fails to mystify visitors to our Mt. Carmel Farm.

Many times our answers to the always asked "Why are they planted in spirals?" do not satisfy visitors. Most visitors are used to seeing experimental plots laid out in conventional straight rows. Our answers become more clear, however, when one understands the purpose of the particular plots. The spiral plots are mainly used for testing the ability of chemicals to protect plants against diseases in the field. These chemicals have passed extensive laboratory and greenhouse trials before they appear at Mt. Carmel for their "acid test". Here the chemical either passes and is adopted by a commercial concern for extensive development, or the chemical is found lacking and is discarded.

Field Testing Slow and Tedious

Testing spray chemicals in the field is a slow and tedious process. The spiral design and its associated equipment and methods slowly evolved as one answer to the problem of getting a maximum of information with a minimum outlay of time and space. The design is based on the geometric principle that any given area is most compact—has the smallest boundary—within a circle. The spiral, of course, is confined within a circular area, and has the added advantage of continuity in planting and cultivation.

Each spiral has at its center pipes for water and drainage, so that it is not necessary to move the pumping apparatus after the sprayer is moved into position over the pipes and connected to them. The rotatable, horizontal boom mounted on the sprayer holds most of the spray hose above the plots. The sprayer has twin tanks so that while the spray-man walking through the spiral is spraying from one tank, the man at the center is mixing the next material in the other tank. When the spray-man finishes applying one material, he is back at his starting point and ready to begin his next cycle.

This compact operation has eliminated much drudgery for us, and by so doing has improved the speed, efficiency and volume in carrying out our objective: testing chemicals as plant protectants.

[1] Dr. Rich is a plant pathologist.

Planting crops in spirals saves time and effort in experimental plots. These are used for testing chemicals for their disease-combating abilities. Spray tank remains stationary in center while spray boom holding hose rotates over the plot.

MIST BLOWERS

by Roger B. Friend and Samuel F. Potts[1]

Roderick A. Spencer, one of the designers of the small mist blower shown here, uses the wheelbarrow model for spraying an orchard tree. The model is not adapted to general orchard use but can be used for treating a few small trees.

A MIST blower is a spraying machine which uses a stream of air to carry the spray in the form of minute droplets to the object to be sprayed. The spray material is in a much more concentrated form than that used in the more orthodox hydraulic sprayers, but the small drop size permits the use of such concentrates without injury to plants, provided the plant is not oversprayed. Even kerosene and fuel oil solutions are usually safe, particularly on most trees and shrubs. Not only does the small droplet size provide for safety but it also give a good distribution of the spray material.

This Experiment Station has collaborated with the Division of Forest Insects, Bureau of Entomology and Plant Quarantine of the U. S. Department of Agriculture in the development of mist blowers during the last five years. The machine was developed to fill the need for more efficient application of insecticides to shade and forest trees, but results have been so promising that wider uses are being developed. Most of the machines used in shade tree work today are modifications of the larger model described by Potts and Friend in 1946. A small model has been quite widely used for a variety of purposes.

A great advantage of a mist blower over other spraying equipment lies in the small quantity of material used. If you wish to spray an elm tree 65 feet high with DDT to control cankerworms, a hydraulic sprayer applying a suspension of one pound of actual DDT per 100 gallons would use approximately 15 gallons. This means about 3 ounces of actual DDT. A 12 per cent solution of DDT in kerosene-xylene (about one pound per gallon) applied by mist blower would achieve the same results by using between one pint and one quart.

There are on the market at the present time many makes and sizes of mist blowers, but all are devised to apply small quantities of concentrated insecticides. The particular designs of fans, nozzles, pumps and engines differ but the important feature is the proper delivery of air and insecticide through their respective orifices. The size of blower to use depends on what is being sprayed and for what purpose. For example, the small machine shown is suitable for treating a few rather large orchard trees but does not have the capacity needed for commercial orchards. It may also be used in gardens, barns, warehouses, for mosquito control around dwellings and other such purposes. The large model is very efficient in treating shade and forest trees and large areas for mosquito control. It is not quite suitable for orchard use because the air blast is too severe on the lower branches of the trees and there is not sufficient coverage in the top center of the crown. For this purpose other types of air orifices and less air speed are required. At the present time there is some indication that the "Speed Sprayer" can be modified to apply concentrated insecticides at low volume per acre, it then being a type of mist blower.

Mist blowers are very useful for a number of purposes and when properly used give excellent results. For other purposes they are still experimental machines, and in some cases they cannot, as yet, be used efficiently.

[1] Dr. Friend is Head of the Entomology Department. Mr. Potts is an entomologist with the Division of Forest Insects, Bureau of Entomology and Plant Quarantine, U. S. Department of Agriculture.

Large mist blower, successfully used for spraying shade and forest trees. This type is also well adapted to treating large areas for mosquito control.

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List of New Station Publications

BULLETINS

529. Connecticut Volume Tables for Plantation-Grown Red Pine, *Pinus resinosa,* Solander.
531. An Evaluation of Chemotherapy and Vector Control by Insecticides for Combating Dutch Elm Disease.
532. Hybrid Field Corn.

CIRCULARS

169. How Good Lawns Grow.
170. Poison Ivy and Its Eradication.
171. Control of Common Household Insects.
172. Control of Termites in Buildings.

SPECIAL CIRCULAR

The Law Concerning Concentrated Commercial Feeding Stuffs and Regulations Pertaining Thereto.

NUCLEAR RADIATIONS SERVE AGRICULTURE

by A. E. Dimond [1]

Atomic energy may be a blessing or a curse to man. In the newspapers we read almost daily about how our statesmen are trying to control its undesirable uses. More rarely do we hear about how radioisotopes, a product of atomic energy work, are being used to answer the questions that researchers ask of nature.

AEC Contract

Recently, the Station signed a contract with the Atomic Energy Commission under which we will explore the possible uses of atomic energy for plant disease control. A part of this work will be done in our own laboratories and a part will be done with the facilities of Brookhaven National Laboratory and of Yale University, and with the cooperation of their personnel.

Two kinds of experiments, both employing radioisotopes, will be carried on in this work. The first are "tracer" experiments. If an ordinary chemical element, such as phosphorus, is placed in an atomic pile for a few days, it becomes radioactive, which makes it very useful in experimental work. Because it behaves chemically exactly like ordinary phosphorus does, it will enter into all the chemical reactions which normal phosphorus will. Because it is radioactive, it can be detected with electronic equipment at levels far below those a chemist can detect.

By using radiophosphorus, we can tell just where phosphorus goes in a plant and how it behaves. Such experiments are called tracer experiments. Radioactive tracer experiments will be used in the present study to determine where a material goes in the plant so it may be used most effectively in fighting plant diseases.

Another type of experiment uses radioisotopes merely as a source of nuclear radiation. In cancer therapy X-rays and radium have been used for many years. Recently radiocobalt, made in the atomic pile, is being used as a cheaper source of radiation for cancer therapy. Some of our own experiments will be of this type, with the radiation itself used for therapy of plant diseases.

Study Several Diseases

Several kinds of diseases will be studied under the contract. Already experiments are under way on Fusarium wilt of tomato. In addition, Dutch elm disease, also caused by a vascular invading fungus, will be studied. Other diseases caused by fungi may become of interest, since it may develop that fungi causing leaf spots, such as apple scab, respond to treatment more definitely. In addition, diseases caused by bacteria and by the viruses will come under scrutiny.

What we learn from these studies, whether directly or indirectly applicable to practical disease control, will provide more information so that basic science can be used in agricultural practice.

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[1] Dr. Dimond is Assistant Chief, Plant Pathology Department.

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