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REPORT OF THE DIRECTOR

For the Year Ending

October 31, 1935



Connecticut
Agricultural Experiment Station
New Haven

CONNECTICUT AGRICULTURAL EXPERIMENT STATION

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CONTENTS

TRIBUTE TO LAFAYETTE BENEDICT MENDEL	164
INTRODUCTORY STATEMENT	165
INVESTIGATIONS OF PARTICULAR INTEREST TO THE PUBLIC	
The Public Becomes Termite-Conscious	167
United Front Holds Dutch Elm Disease	167
New Corn and Peppers Developed	168
System for Testing Seed Value Devised	169
Soil Surveys for Land Use Planning	169
PROGRESS OF THE STATION'S WORK	
Analytical Chemistry	171
Adulteration and Mislabeling of Foods and Drugs	171
Testing Vitamin D Milk	171
Biochemistry	
Chemistry of the Tobacco Plant	172
Glutamine in Tomato Plants	173
Protein Investigations	173
Nutrition Investigations	173
Botany	
Further Experiments on Late Blight	174
Sand-Culture Controls Damping-Off of Seedlings	175
"X" Disease of Peach	176
Spraying to Control Fruit Diseases	177
Entomology	
Spray Tests for Foliage Burn	179
Control of the Oriental Fruit Moth	179
Removing Spray Residue from Fruit	180
Date of Planting and Corn Borer Infestations	182
Elimination of the Mosquito Nuisance	182
New Insect Pests Discovered	183
Forestry	
Treatment of Native Woods for Posts	184
Federal Aid in Blister Rust Control	185
Plant Breeding	
Vegetables for Connecticut	186
Breeding Experiments Bearing on Evolution	187
Soils	
Experiments on Magnesium-deficient Soil	188
Fertilizing Vegetable Crops	189
Forest Lysimeters	191
TOBACCO SUBSTATION	
Testing Substitutes for Cottonseed Fertilizers	192
Tobacco Diseases in 1935	194
Insect Pests of Tobacco Studied	195
Improved Strain of Shade Tobacco	196
THE LIBRARY	196
PUBLICATIONS	197
PROJECTS ACTIVE IN 1935-36	199
WHAT THE STATION CAN DO	202

REPORT OF THE DIRECTOR

FOR THE YEAR ENDING, OCTOBER 31

1935

LAFAYETTE BENEDICT MENDEL

THE STATION suffered a great loss in the death of Dr. Lafayette B. Mendel on December 9, 1935. The following resolution was adopted by the Staff:

Always interested in this Station, Dr. Mendel was for many years, and up to the time of his death, an active participant in its work in the capacity of Research Associate in the Department of Biochemistry.

His high ideals, profound knowledge, broad vision, and his sympathetic understanding and friendliness, have been of inestimable value to the Department with which he was associated and to the Station as a whole. The notable contributions to our knowledge of the fundamentals of animal and human nutrition that have come from this Department have brought lasting credit to the Station; and their value has been greatly enhanced by the scientific and scholarly attainments of this esteemed co-worker.

In recording our bereavement in the loss of a loyal friend and colleague, we acknowledge the debt we owe him for the example of his life and service and for the inspiration of his friendship.

We take pride in the fact that his great reputation as an investigator in the field of nutrition was in large measure founded upon the work carried on for many years in collaboration with the late Doctor Thomas B. Osborne at this Station.

To the Board of Control of the Connecticut Agricultural Station:

A FORMAL REPORT of your Board to the Governor of the State is made annually. This, however, is not distributed with the bulletins, and does not reach the public. Therefore it has been the custom to issue this brief summary of the year's work.

Sixty years ago, the founders of the Station, in formulating the charter, stated its purpose in these words, "to conduct scientific investigations and experiments . . . for the general benefit and improvement of agriculture and kindred interests of the State of Connecticut". Thus the primary function of the Station is scientific research. It performs many other services for the people of Connecticut — the analysis of fertilizers, feeds, foods, drugs and soils, the inspection of nurseries, the control of plant pests and the like; it serves the State as a scientific laboratory furnishing information on a variety of matters. But all this is dependent on the research program conducted by highly trained scientists who are authorities in their several fields.

In the beginning, the research and service was limited to fertilizers and a few other matters strictly agricultural. From time to time new duties have been added, until today all residents of the State are served directly or indirectly. For illustration may be mentioned the research on vitamins, on the food value of milk, on clothes moths, on termites, on fertilizing shade trees, or the Dutch elm disease.

Supervision of Relief Projects In common with some other state institutions and departments, the Station has been called on to supervise "Relief" projects. During the past year there were five of these for the control of pests: Mosquito, gypsy moth, pine shoot moth, pine blister rust and elm disease. As many as 1500 men were employed at certain seasons and excellent progress made. Naturally this has added greatly to the work of the staff and to some extent hampered the regular program. Also the expense of administration, so-called "sponsor's contribution", has depleted our funds, since no special provision was made by the Legislature except for the Dutch elm disease.

Field Days in 1935 During the year the Station has held four field days at the Mount Carmel farm and at the market garden plots at Windsor. In addition, at the request of vegetable growers, the last Saturday of each summer month was designated "open house" at Windsor, so that any one who cared to look at the vegetable breeding or fertilizer experiments might find a member of the staff to guide him about the plots and explain the work.

A field day devoted entirely to sweet corn was held on August 15 at **Mount Carmel**. Not only did the plant breeders exhibit outstanding early and mid-season crosses of corn, and point out the effects of tillering in reducing yield, but the entomologists demonstrated spraying for control of the European corn borer. Interest among growers in this first Corn Field Day warrants its addition to the regular activities on the station calendar.

**Staff Addresses
Special
Groups**

Members of the staff have addressed fruit and vegetable growers, garden clubs, architects, scientific organizations and other specialized groups on subjects of particular interest to them. Exhibits were organized in connection with the National Grange Convention at Hartford in November and the celebration of the State Tercentenary at Litchfield in July. Special articles were written for newspapers and magazines bringing some phases of the station's work to the attention of the public, and bulletins and circulars were published as listed on page 197.

**Members of
Staff Honored**

A number of honors were conferred on staff members in recognition of their achievements. Governor Cross appointed Director Slate chairman of the State Planning Board after that body had been created by the General Assembly in May. The Board had been in existence for a year under authority of the Governor's executive order.

Dr. Jones was elected president of the Genetics Society of America and also gave the Spragg Lectures at Michigan State College.

On August 1, Dr. Clinton's name was added to Connecticut's hall of fame of men and women who have made outstanding contributions to agriculture and rural life. Each year since 1924, this honorary recognition has been conferred on two or three citizens at the celebration of Farmers' Week at Connecticut State College, Storrs. As the pamphlet reviewing Dr. Clinton's eminent botanical services states: "The purpose of this award is not to single out 'best' farmers. Neither is it primarily to confer distinction upon an individual, but rather to present to the people of Connecticut, urban as well as rural, an idea of the dignity, the importance and the permanence of Connecticut farming."

As chairman of the State Committee on Dutch Elm Disease, Mr. Filley represents Connecticut at regional meetings.

Investigations of Particular Interest to the Public

**The Public Be-
comes Termite-
Conscious**

The people of Connecticut are gradually becoming termite-conscious as they realize that these subterranean insects may cause serious damage to their homes. During 1935 the State Entomologist received 111 requests for examination of infested buildings. These represent a 300 per cent increase over the infestations reported in 1934 and by no means exhaust the trouble throughout the State. Numerous letters from all sections indicate an awareness of the outbreak.

In each case where examination of property was made, records were kept of the type of structure, points of entry of the termites, and the estimated amount of damage. In addition to these data, members of the entomology department kept colonies of termites in the laboratory to observe their social habits, and studied all available publications on the subject. As a result of their findings, a station bulletin will be ready for distribution in the spring of 1936.

Meanwhile recommendations on repairs of old buildings and on the proper termite-proof construction of new buildings were drawn up and sent out in mimeographed form. A member of the department also wrote an article for the newspapers of the State and made a number of talks before groups of architects and contractors.

**United Front
Holds Dutch
Elm Disease**

Another problem that absorbs the interest of our citizens is the Dutch elm disease. While the number of cases in Connecticut mounted from 57 to 133 in the past season, no new areas of infection have been discovered and the outlook for control is brighter than it was a year ago.

This trouble first appeared here in the autumn of 1933 and its history in European countries and in New York and New Jersey caused immediate alarm. Members of the forestry department organized a survey of elms of the State and cooperated with the Federal Government in searching for and destroying diseased trees. The botanists made cultures of specimens sent to the Station and studied the disease in the field and in the laboratory. And the entomologists took up investigations of the habits of insect carriers of the fungus. During the past year, newspaper articles and Station Circular 106 found wide circulation, and frequently members of the staff were called upon to address groups of interested persons.

Stringent efforts to check the spread of the disease began early in 1935 with the establishment of two control areas. One includes twenty towns in Fairfield and two in New Haven counties; and the other, four towns each in New London and Middlesex counties. Within these zones, agents of the U. S. Department of Agriculture are authorized to act for the Experiment Station in locating and destroying infected trees, or dead and dying trees which might breed beetles known to be carriers. In the summer, laboratory cultures confirmed the disease in 75 elms and these trees were destroyed. A sanitation program resulted in the removal of more than 95,000 dead and dying elms in the control areas.

Outside the territory under federal supervision, work was carried on through an emergency appropriation of \$25,000 made by the General Assembly in May. Using six crews of two men each, the Station made a survey of elms. Most of the towns were covered three times and approx-

imately 618,000 trees were inspected. Of these, 4,750 appeared to have disease symptoms, and 281 specimens were sent to the botanical laboratory for culture. No infection was found. It would, therefore, seem probable that the disease is at present confined to the southwestern corner of the State, with an isolated infection at Old Lyme, where every effort has been made to stamp it out.

The Station also supervised an FERA program employing 350 men in 60 towns to prune all elms, and to remove dead and dying trees. This work is being continued under the WPA and should materially reduce the bark beetle population and thus help to control the spread of the disease.

Meanwhile entomologists at the Station are studying the life stages of the native elm bark beetle, noting particularly the characteristics distinguishing this species from the closely related European beetle, which is known to carry the Dutch elm disease. Hibernation studies are now in progress and it has recently been discovered that adults as well as larvae can winter over. The beetles construct special tunnels for this purpose. Evidence seems to indicate that beetles escaped from the single diseased tree the previous year were responsible for the new cases at Old Lyme last season. In examining elms for unusual symptoms, the Botanist observed two forms of infection present in Connecticut: The first acts quickly, killing the cambium of the victim and then the leaves; the second kills the tree gradually, the fungus spreading down the length of the stem from the infected wood in the twigs to the roots.

On the whole, the year ends with a note of cheer, as data indicate that the Dutch elm disease is making slow progress in Connecticut.

New Corn and Peppers Developed for Connecticut

Breeding vegetables especially suited to Connecticut conditions has been a major project of the plant breeding department in recent years. Several experiments reached partial fruition in 1935 when a new sweet pepper and several improved varieties of sweet corn were introduced to the growers.

Spancross C2, was the best first early hybrid sweet corn in the tests at the Mount Carmel farm where not only Station varieties, but those in commercial production, are tried out. It was three to five days later than Golden Early Market, but surpassed this popular corn in yield and quality. It produced 12,000 marketable ears to the acre, as against 6,500 for Golden Early Market. Spancross C2 has the additional advantage of being quite resistant to bacterial wilt and smut, while the earlier corn is susceptible.

Other hybrid varieties that were outstanding in these tests and are being recommended to Connecticut growers in the coming year are: Marcross C6 and Spancross P39 for the early types; and Whipcrosses C6.2, C7.2, P39 and C2.P39, for midseason sweet corn.

Connecticut hybrid sweet corn was raised in 22 states in 1935 and excellent reports came from all sections. Its record is especially high in New England where Spancross C2 outdistanced many popular commercial varieties.

Since 1922, when Dr. Jones first introduced the idea of inbreeding and crossing maize, the acreage of hybrid corn, both in Connecticut and throughout the United States, has increased with astonishing rapidity. It

was estimated that about 30,000 acres of hybrid sweet and field corn were raised in 1932. In the past season the land devoted to crossed sweet corn alone amounted approximately to between 300,000 and 500,000 acres.

A sweet pepper named Windsor-A, producing approximately 25 per cent more fruit than the average commercial variety, is the first of a new series to be brought forward for Connecticut. It is an early, thick-walled Ruby King type that was developed by the breeders in their search for these characteristics in the California Wonder type. Windsor-A results from crossing two peppers with widely differing qualities. One parent was California Wonder, a late, green, large, thick-walled variety; and the other was Bountiful, an early, productive, rough, thin-walled pepper. Bountiful originated at the Experiment Station in 1926.

New System for Testing Seed Values

In 1935 the General Assembly revised the seed law to require a label declaring the contents of each brand of mixed lawn seed sold in the State. Based on this law, the seed laboratory drew up a system by which buyers and dealers may know the money value of each pound of mixed seed, and the comparative values of different brands of seed, regardless of price.

Certain declared contents in every pound of lawn seed are useless for growing lawns. The sum of these is termed "dockage". Subtracting the total percentage of dockage from 100 gives an index value to the seed. Mixtures with the smallest amount of dockage, hence with the highest index figure, give the best return for the money spent.

Actual money value of seed may be calculated in the same manner. For example, consider a number of brands of seed at 50 cents a pound. One label shows a dockage of 10 per cent; another 25 per cent; and still another, 50 per cent. Obviously, the man who buys the first brand is getting 45 cents worth of seed useful for his purposes, while the purchaser of the second is getting 37 cents worth, and the third, 25 cents worth. Correspondingly, the index for these successively is 90, 75 and 50.

The object is to raise the standard of mixed seed sold in the State by educating dealers and public to demand the better grades.

Soil Surveys for Land Use Planning

During the spring and summer of 1935, the soils department made a revised map of soil and land cover conditions of the State, as related to the production planning phase of the Agricultural Adjustment Administration. This work was done in cooperation with the Bureau of Agricultural Economics of the Department of Agriculture and was conducted along the following lines.

1. Aeroplane survey mosaic maps, made by the State Planning Board, of each of the topographic survey quadrangles, were obtained on the same scale as the topographic sheets (1/62,500). These maps give a bird's eye picture of the distribution of fields and forests. They also show urban or village areas, road network and drainage pattern in more accurate location than represented on the old topographic maps. The photographs have been hand-colored with distinctive tints marking the various classes of present land use. It

2. A classification was prepared in order to represent characteristics that would operate to limit or favor the use of land for various crops, or for pasture. The following factors were recognized in the "land type" designation: topography; stoniness; sand and clay content (texture); drainage; sub-soil conditions with respect to sand, gravel or "hardpan"; calcareous rocks in the parent material.

3. The general outlines of the above "land types" for each of the topographic survey quadrangles were drawn on a transparent sheet of "viscaloid". These may be used as "overlays", either on the photographic land cover sheets or on the topographic maps.

The new map was based on that presented in Station Bulletin 320, but extensive additional field work was done in 1935, which has resulted in a much more accurate knowledge of the boundaries of these soil groups.

The above studies have provided basic soil and land use data that can be of great help in evaluating the physical background for future adjustments in the agricultural policy of the State. They also enable the staff of the Experiment Station to ascertain at a glance the prevailing soil and other physical land characteristics of any area in question, without resorting either to expensive additional travel for personal inspection or to the questionable practice of relying on the written or oral description of an untrained observer.

The foregoing surveys will also be used as the basis for the publication of land use and soil maps, at the scale of the present large state highway wall maps (one-half inch per mile) as time and funds are available. They do not provide the degree of precision required to represent accurately the many important variations in soil that occur from field to field. Therefore they will not reduce the desirability of undertaking a detailed state soil survey, as suggested in the report of the Director for last year. A proposal to provide funds for this work by legislative action was not supported because of the restricted state income.

The major projects of the several departments are reviewed briefly in the following pages. A complete list of current projects will be found on page 199; and a list of services the Station is best equipped to render, on page 202.

Progress of the Station's Work

ANALYTICAL CHEMISTRY

Adulteration and Mislabeling of Foods and Drugs A feature of the year's work in food and drug control was the inspection of olive oil and other edible vegetable oils for adulteration and misbranding. The survey was carried on at the same time as similar investigations by control officials of neighboring states and of the Federal Government. One of the chief objects was to stop the practice of marketing domestic edible oils, such as corn, peanut and cottonseed, in containers so closely resembling those used for imported olive oils that purchasers were deceived. An extreme case of this kind was an instance of cottonseed oil marketed in cans that were counterfeits of those of a well known brand of imported olive oil. The proper authorities have taken steps to correct this abuse. No objection is taken to the sale of edible oils by their rightful names.

The recurrence of another illegal practice was detected in the substitution of saccharin for sugar in sweet pickles. Also a number of samples of butter were examined and found to be oleomargarine. It developed, however, that all of this "butter" was marketed through the activities of a ring operating in several states and which was finally broken up by federal authorities.

Inspectors from the Dairy and Food Commissioner's department made a survey of orchards for apples bearing poison spray residue in excess of tolerance. Few instances of noticeable excesses of arsenic or lead were found.

In all, the Food and Drug Report, Bulletin 373, contains the analyses of 1800 samples of foods, drugs and miscellaneous materials, a discussion of the station role in food and drug control, findings on oils marketed in the State, and a supplement, Analyses of Common Foods, described below.

Analyses of Common Foods The new analyses of common foods includes the decision of the American Medical Association on so-called special diabetic foods, interprets the terms used in the tables, and gives the chemical content of commonly used fresh and canned foods from cereal to fruits and beverages. It is a compilation from station records and from analyses of leading nutritionists and chemists.

Milk Tested for Vitamin D Content Vitamin D milk as an aid in prophylaxis of rickets in infants and children has become a commercial article of considerable importance. As a problem of food control, this article presents some difficulties because there are no chemical methods for evaluating the vitamin D content, and bioassays are time-consuming and expensive. The Milk Regulation Board, however, requested the Dairy and Food Commissioner to undertake the inspection of this commodity. The Commissioner then requested the aid of the analytical laboratory of the Station in pursuing the project. It was decided to handle the inspection and control on the same basis as that of other food products and an additional appropriation under the food and drug statute was granted for this purpose. This seemed the logical procedure and the work is going on satisfactorily on this plan.

Other department work included the analyses of 100 samples of tobacco for ash constituent for the soils department and Tobacco Substation and the checking of 2500 pieces of Babcock glassware and certification, if found correct. Various members of the staff have collaborated with the Association of Official Agricultural Chemists on studies of analytical methods for foods and drugs; and Dr. Bailey has continued to serve on the council on pharmacy and chemistry and on the committee on foods of the American Medical Association.

Fertilizers Inspected A summary of the regular annual inspection of fertilizers for 1935 is given in Bulletin 377, published in October. During the year, 325 brands were registered. This number is about the same as in 1934, but is more than 100 less than the 1930 registrations. Fewer than 2 per cent of the samples examined showed commercial deficiencies in excess of \$1.00 per ton. Nearly 80 per cent substantially met or exceeded the guaranteed amounts of plant food.

So far as could be judged by the usual laboratory methods, the quality of the carriers of organic nitrogen in the samples analyzed was satisfactory.

Anticipating a change in the official method for determining potash in mixed goods, the proposed method was employed in all cases where a deficiency was found by the usual tests. Failure to recover all the potash put into the mixture has been a criticism of the official method for a long time, and the proposed method gives more satisfactory results.

1451 Samples of Feeds Examined For the year 1934, the total number of samples of feeding stuffs and related materials examined was 1461. Of these, 820 were for purposes of official inspection, 519 were analyses made for the Storrs Station, and the remainder were from miscellaneous sources.

Prior to 1918, fodder analyses, including official samples collected for inspection purposes, totaled 300 to 400 samples each year. Since that time, collaboration with the Storrs Station in its investigational program, and compulsory registration of commercial feeding stuffs after 1925, have greatly increased the volume of work required of this department. Eighty-seven per cent of the official inspection samples examined in the year substantially met or exceeded the guaranteed items of nutrients indicated by the labels. Summary of the work is given in Bulletin 370.

BIOCHEMISTRY

Chemistry of the Tobacco Plant The department of biochemistry has continued the intensive chemical study of the tobacco plant and has recently published the fifth report on these investigations, "Chemical Changes that Occur During Growth". This bulletin describes the progressive changes in the composition of the plant that take place throughout the season.

Particular interest attaches to the data for malic, citric, and oxalic acids as this is the first time that methods have been applied throughout the life of a growing plant whereby accurate and trustworthy determinations of these substances can be secured. The three acids maintain a nearly constant ratio to one another in the leaves, notwithstanding the fact that the total quantity of organic acid increases some 400 per cent in the interval between 40 to 75 days of age and then sharply decreases

owing to translocation from the leaves to other parts of the plant. It is clear that the metabolism of each of these acids, and of oxalic acid as well, is closely related. Oxalic acid, usually regarded as an end-product of metabolism, shares proportionately with the others in the chemical changes that occur.

The growth of the plant as a whole can be roughly divided into three periods. The first is that in which the seedling establishes itself in the soil; the second, the period of rapid growth, roughly from the thirtieth to the seventy-fifth day; and finally, the period of reproduction characterized by changes associated with the setting of seed. In this last stage the most striking phenomena are the translocation of nitrogenous and of non-nitrogenous substances to the seedpods, where protein and fatty materials rapidly accumulate. Approximately one-fifth of the organic solids, and one-third of the nitrogen of the plant, are ultimately located in the fruit.

Further study of analytical methods applicable to plant tissues has resulted in substantial improvements in those for determining ammonia and amide nitrogen.

Glutamine in Tomato Plants Much attention has been devoted to the amide nitrogen of the tobacco, as well as of the beet and tomato plants. The tomato, in particular, has been found to store large quantities of glutamine in the stem when the plant is grown upon culture solutions that provide nitrogen exclusively in the form of ammonium salts. On nitrate cultures, the glutamine content of the plants is not strikingly high. These results are interpreted to mean that glutamine is used by the tomato plant as a detoxifying substance against ammonia, the synthesis being regulated by a mechanism called into play by the slightest increase in the level of free ammonia present in the tissues.

Protein Investigations Although the amide glutamine is chiefly regarded as a product of plant metabolism, it is an amino acid which undoubtedly forms a part of the structure of most, if not all, proteins. As indicated last year, a great deal of attention has been given to this extremely rare and little known substance. A method whereby it can be conveniently obtained in quantity from beet root tissue has been developed, and a detailed study of certain of its properties has been made.

The basic amino acids of human skin have been determined in order to see how closely the composition of this tissue approaches that found typical of numerous keratins in this laboratory and elsewhere in recent years. The results suggest that the process of keratinization is progressive in the tissue. A keratin of typical composition is doubtless present in at least one layer, but the over-all composition of the several layers does not correspond closely to that of keratin as illustrated by such tissues as horn or hair.

Nutrition Investigations The Osborne-Mendel strain of rats is unique in its ability to make unusually rapid growth, and therefore most of the problems under investigation here have to do with the nutritional needs of rapidly growing animals. A new salt mixture has been devised for inclusion in artificial diets that seems better adapted to these animals than the one formerly used, and an extensive study is being made of its suitability under various experimental condi-

tions. Data on the time required for animals to increase from 60 to 200 grams in body weight are recorded and, in addition, the percentage of ash in the bones is determined. This latter criterion has been found to be an indication of the nutritive efficiency of the salt mixture that is extraordinarily sensitive to change in the diet, and has furnished an admirable means to control the composition of the mixture and the level at which the inorganic salts should be fed.

The stock ration fed to the breeding animals was modified a few years ago to include a higher proportion of proteins and accessory food substances. The change has resulted in a marked increase in rate of growth of the young animals and in the reproductive performance of the breeders. A study of the effect of pregnancy upon the store of mineral elements in the mother has revealed a significant decrease in the bone ash as the result of one pregnancy and lactation, but the loss is not sufficient to constitute a serious drain on the skeletal system.

The extensive investigation of reproduction of the albino rat, that has been carried out for several years in our laboratory under the supervision of Professors Arthur H. Smith and William E. Anderson of Yale University, has been continued, and data referring to six complete generations have now been collected. The observation that there was a tendency towards lower weaning weights at the end of the fourth generation was mentioned last year. In three of the experimental groups, the later generations have shown an unmistakable increase in weaning weight, again emphasizing the necessity of careful control in experiments of this character.

Closely allied to the general problem of rapid growth is the study we have undertaken in collaboration with Dr. L. G. Rowntree of the Philadelphia Institute for Medical Research. Certain animals of our colony receive daily injections of thymus extract and the effect is observed. Although we have not noted the striking rapidity of development he has reported, nevertheless young rats, nursed by mothers that receive the extract, tend to increase in weight more rapidly than our normal stock animals.

In cooperation with the department of analytical chemistry we have recently begun to conduct bioassays of the vitamin D milk produced in the State.

BOTANY

Research in Vegetable Diseases

Research on vegetable diseases was carried on in laboratory, greenhouse and field. The Botanist experimented further on the late blight of potatoes and tomatoes. Final greenhouse experiments were made in the control of damping-off and the sand culture of seedlings. And the following diseases were studied at the farm: Leaf blight and tip burn of potatoes, club root of cabbage and cauliflower, and downy mildew of cucumbers and muskmelons.

Further Experi- ments On Late Blight of Tomato

Further research on the late blight of tomatoes and potatoes was carried on by the Station Botanist. The object is to find how the infection carries over the winter outdoors. In contrast to its recent prevalence,

Phytophthora infestans was found in only three potato and two tomato fields in 1935, and no infection appeared in places where diseased plants grew the previous season.

In one case, the infection apparently spread from a potato field to an adjacent tomato patch but no reason was determined for its occurrence elsewhere. At Milford, the blight was found on potatoes July 8, about the earliest in our experience, yet it did not spread to other fields, probably because of the later dry weather. In fact, it appeared in the three tomato fields much later than in 1934. This lateness and its scarcity are also explained by the very dry weather of late summer and autumn. Experiments were carried out with infected tomatoes kept outdoors over winter, and with soil that had been exposed to infection the previous season.

So far the results indicate that oospores of *Phytophthora infestans* are not produced in the rotted tomatoes left outdoors over winter. This leaves two possible sources of infection: One from potato fields, where it is known to take place from the mycelial infected tubers planted in the spring and producing conidia; and the other from infected seeds of tomatoes. To date no seed has been found, either in the field or in laboratory experiments, producing conidia even when taken from badly infected tomatoes with plenty of mycelium in the placenta. Never has growth in culture been obtained from mycelial infected tomatoes after the end of October.

Attempts also failed to find a wild host that might harbor the infection in winter and infect tomatoes the following season.

Sand Culture Controls Damping-Off of Seedlings

Damping-off of seedlings in greenhouses has been one of the problems of vegetable growers, florists and nurserymen for many years. Soil-inhabiting fungi known as *Rhizoctonia* and *Pythium* affect both the pre-sprouting and early seedling stages of growth. Several methods of controlling the disease have been used with varying degrees of success. Autoclaving the soil, the most effective of these, entails considerable time and expense and too frequently causes poor germination of seed.

For three years the botanical department has compared raising seeds in washed sand with the accepted systems of soil culture. Many of the commonly grown flowers and vegetables of the State have been used in these trials, which have been carried on at all seasons under differing light conditions and temperatures in the Station greenhouse. Not only was the sand culture easier and less expensive than any of the soil culture methods followed, but it proved superior in the following ways: It controlled damping-off as well as, if not better than, any of the other methods used. It produced consistently a larger number of healthy seedlings of a uniform size and with stronger root systems. It provided a means of regulating the final size of the seedlings. Frequently medium-sized seedlings with firm stems and roots are more easily handled and withstand the shock of transplanting better than large, fleshy plants. By regulating the amount of plant food supplied in the sand before planting seed, it was found that size could be controlled.

In brief, the sand culture method used here was: Wash any kind of sand thoroughly in several changes of hot water. Place it in clean flats or crocks two to three inches deep. Sprinkle it with a nutrient solution

of saltpeter, one-half teaspoonful to one small cup of water for each square foot of sand surface. Drill or sow the seed, with care not to cover too deeply. Water the plants once or twice a day to keep the sand thoroughly moist.

A full description of the method will be published in Bulletin 380 in March, 1936.

**Bordeaux
Increased
Potato Yield**

With potatoes, the results were in general comparable to those of previous years. The highest yield for this season was again obtained with 8-8-50 Bordeaux spray, and dusting with copper-lime dust still proved inferior.

The relative increase in yields from plots sprayed with 6-6-50 Bordeaux as compared with 4-4-50, was greater than that from using an 8-8-50 mixture as compared with 6-6-50. Plots sprayed as early as June 13 showed no definite increase in yield over those first sprayed on July 11. Using a 6-6-50 mixture, plots sprayed at a pressure of 400 pounds yielded 13 more bushels per acre than similar plots sprayed at 200 pounds pressure. The dryness of the fields in which the experiments were conducted resulted in premature death of the plants and relatively low yields of potatoes.

**Blight Resistant
Variety Scores**

A blight-resistant variety of potato from the U. S. Department of Agriculture (44-488) was found highly resistant to drought and tip burn. Unsprayed plants of this strain produced 184 bushels of potatoes per acre, as compared with 85 bushels produced by unsprayed, certified Green Mountain variety in an adjoining plot.

The use of hydrated lime (two tons per acre) and of calcium cyanamid (one-half ton per acre) reduced club root of cauliflower and cabbages. The soil was treated first, then the plants were set, and finally soil from another field containing the club root organism was scattered over the surface of the plots. Plants in adjoining plots received no inoculation and were free from disease at harvest. Non-treated plots which received the inoculum showed 75 per cent diseased plants. Both the lime and the cyanamid treatments reduced the amount of infection to from 5 to 15 per cent.

**Slip-Seeding
Sweet Potatoes
Found Practical**

Tests at the farm in 1935 showed that slip seeding of sweet potatoes, a method that furnishes an important control of the most serious diseases of the plant, may be successfully practiced in Connecticut. Plants were set in the field on May 31. Cuttings taken from these vines on July 25 were planted immediately and took root readily. By October they developed roots that were sufficiently large to be stored for use as seed next spring. With the increase in the acreage of sweet potatoes in the State, this method of producing seed from plants which are known to be healthy is valuable.

**Further Investi-
gations of "X"
Disease of Peach**

While evident progress was made in the investigations of the "X" disease of peach, there still remains much to be definitely determined.

Exact records were kept on all the plots mapped in 1933 and 1934 and on one additional plot. For the most part, the disease did not spread rapidly during the past season, although there were increases up to 25 per cent of the trees in a few young orchards. In

two places where diseased trees were taken out in the autumn of 1934, there were very few new cases in 1935. In several others the disease was controlled for one season in from 50 to 100 per cent of the cases where affected branches were cut off. The past season's work indicates that the trouble is more likely caused by a virus than by a fungus, and that it is brought into the orchard by a wild host.

Healthy trees budded with diseased cuttings in 1934 showed a larger per cent of disease than did those budded in 1933. Half of those with "X" disease in 1935 were trees in which the buds did not take, and it was sprouts from the seedling stock that were affected.

Some preliminary work was done on treatment with zinc sulphate as a control measure. This material was put on the soil around the trees at the rate of four to ten ounces per tree for four-year-old trees, and also smaller amounts were put into holes bored into the trunks or large branches. The zinc sulphate was readily absorbed by the trees. When put on the soil it was not injurious, but when inserted into small trees there was considerable defoliation on certain parts, although the injury apparently was not permanent. The results of these treatments were not very striking although the progress of the disease seemed to be checked in a few instances. If chemical treatments are to yield results, we are of the opinion that they should be made earlier in the season.

A search for possible sources of infection brought the chokecherry under suspicion. In sections of the State where the peach disease occurs, these wild trees showed a peculiar, mosaic-like condition of the foliage, not unlike the appearance of peach leaves affected by "X" disease. They were found commonly associated with diseased peaches in the several orchards as well as at long distances from peach trees, precluding the assumption that the cherry trees might have been infected by the peaches. Although this connection between the two is largely theoretical at the present time, it seems a promising clue. Much cross budding was done this fall between peaches and chokecherries to make further determinations along this line.

The removal of all diseased trees as soon as possible after discovery of the trouble, appears at present to be the most feasible method of control. Cutting off single branches may be recommended in some cases.

**Chestnut
Blight**

Check-up on the chestnuts planted in five places in the State in past years, shows the presence of the blight in a few cases. Some saplings at Racebrook Golf Course have grown to a height of six to seven feet, the tallest of those set out, but those at Rainbow show the highest percentage of survivals. A few supposedly resistant varieties are growing at the Mt. Carmel farm.

At Lebanon the oldest living chestnut in Connecticut is still surviving but its years are numbered. Cultures of the blight have been kept growing in the laboratory for 15 to 20 years. Inoculation tests seem to indicate that they are not so virulent as the three-year old cultures.

**Spraying to
Control Fruit
Diseases**

The apple spraying program for control of insect and disease pests at the Mt. Carmel farm followed the same lines as last year and results continued to show that the arsenate of lead, lime and oil combination is

an effective fungicide for the control of sooty blotch and for scab on all varieties except McIntosh. The same treatment produced a high percentage of insect-free fruits. This project is carried on in cooperation with the entomology department.

Some special spraying at Mt. Carmel was done on Wealthy, for the control of cedar rust, using lime-sulfur and Bordeaux mixture. Both these materials were combined with a water-proof casein glue and a sulfonated phenol as spreaders and stickers, these latter materials proving very satisfactory in that capacity. Unfortunately cedar rust infection was not heavy even on the check trees, and the data obtained were not striking. The Bordeaux mixture caused severe burning and defoliation and will be discarded in future experiments.

In a Wealthy orchard in Southington, the owner used lime-sulfur spray with casein glue for a spreader and as long as the trees were kept covered with spray practically no infection of cedar rust occurred. Owing to pressure of other work, one of the later sprays was omitted just previous to a heavy discharge of spores. The unprotected foliage became heavily infected at that time. The fruit, however, was practically clean throughout the season. These two experiments are by no means conclusive but indicate that, with a little more experience, a schedule for the control of cedar rust may be recommended.

Testing Control of Gray Mold on Strawberries

An attempt to check gray mold (*Botrytis* sp.) on Premium strawberries was conducted in Cheshire. Plots were sprayed with Bordeaux mixture previous to picking time, and with ammoniacal solution of copper carbonate, a very finely ground sulfur and red copper oxide, during the picking season. Of these materials the sulfur gave the best results. Unfortunately it leaves an excess of visible residue on the fruit which makes it impractical for use. The other materials gave a certain amount of control but not enough to be entirely successful. From observations it appears that clearing the beds of old foliage and rubbish, as well as spraying, is necessary to obtain good commercial control.

Seed Analysis

Seed analysis work increased considerably in the past year, both on samples collected by the Commissioner of Agriculture and on those sent in by purchasers. Purity tests have been made on 150 samples of unmixed seed, and 100 samples of lawn mixtures from the Commissioner's office, as well as on numerous others submitted by residents of the State.

Disease Survey

About the usual number of plant diseases and injuries was reported this year by members of the department. There were no really new fungi causing them but some fungi, reported previously, appeared on new hosts. These are as follows: On kale, powdery mildew, *Erysiphe Polygoni*; on Austrian pine, leaf rust, *Peridermium acicolum*; on Japanese quince, crown gall, *Bacterium tumefaciens*; on coleus, wilt, *Verticillium* sps.; on *Gypsophila alba*, damping-off, *Pythium debaryanum*; on zinnia, leaf spot, *Alternaria* sp. as a possible cause; on clarkia (*Phlox subulata*, *Potentilla canadensis*) crown rot, *Sclerotium Delphini*.

Besides these, new hosts for other troubles were: mosaic, (virus), of elm; yellows, (virus) of carrot; and leaf blackening of chrysanthemums,

a nematode trouble, *Aphelenchoides Fragariae*. An unusual spotting of ripe peppers that started internally and finally showed on the surface was also reported to be serious in one case. As no indication of bacteria or fungi was found, it seemed to be a physiological trouble, much like Baldwin spot of apples, possibly due to dry weather conditions. Other previously reported troubles that were either rare or unusually severe were: *Aphanomyces Raphani*, black spot of radish (rare); *Bacterium tumefaciens*, crown gall of sweet pea (rare); *Caeoma Abietiscanadensis*, rust of hemlocks (common); *Peridermium acicolum*, leaf rust, common on red pine but rare on *Pinus Banksiana*; cracking of celery (rare); *Merulius lachrymans*, dry rot of house (rare); *Peridermium balsameum* rust of balsam fir (rare); *Phoma Anthemi*, on dill, (reported only once before). On the other hand, the following troubles, bad last year, were infrequent in 1935: Anthracnose of sycamore, black spot of elm, mildew of rose and lilac and late blight of tomatoes.

ENTOMOLOGY

Work of the entomologists in connection with the termite outbreak and investigations of elm bark beetles, carriers of Dutch elm disease, is discussed in the opening section of this report.

Among the major projects of the department are continued efforts to control the Oriental fruit moth that has been a costly foe of Connecticut farmers who produce peaches and quinces.

Spray Tests for Foliage Burn

For the second consecutive year, freezing winter weather killed the peach buds at the Mount Carmel farm. In the absence of fruit, spray tests were confined to foliage. A study of 13 brands of lead arsenate in respect to their ability to scorch foliage has led to the conclusion that both the amount and rapidity of burn are closely correlated with the amount of water soluble arsenic, expressed as As_2O_5 . Results of the 1935 experiments confirmed these findings. There was a marked difference in the amount of both spotting and leaf fall caused by samples containing the lowest and the highest quantities of water soluble arsenic, in spite of the fact that this ingredient tested well within the limits allowed by federal authorities for commercial preparations. It was evident that even small amounts present in some lots were enough to cause injury when used without protective agents.

Control of the Oriental Fruit Moth

As in previous years, both foreign and domestic parasites of the Oriental fruit moth were reared in the station laboratories. After these insects have been released, it is customary to visit the orchards the following seasons to see whether they have succeeded in establishing themselves. Owing to the light crop of peaches in 1934, and the general decline of the fruit moth infestation this year, recovery of parasites was not extensive. However, *Trichogramma* showed great activity early in the season, and *Macrocentrus* were also found in many orchards. So far none of the recently introduced foreign parasites have been seen the year after their liberation, but it is hoped that some will become established in spite of the scarcity of the fruit moth at present.

In 1935, five different parasites were bred at the Station and released in orchards in the following numbers: *Bassus diversus*, a parthenogenetic Japanese parasite, 5,199; *Diocles molestae* of Korean origin, 1,200; *Macrocentrus ancylivorus*, of which large numbers have been reared here previously, 6,462; *Perisierola angulata*, an Australian Betlylid wasp, 7,850; and 11,000,000 *Trichogramma*, purchased by grower of Connecticut. Of these the *Macrocentrus* and *Trichogramma* are on a "service" basis and are reared and distributed in cooperation with the Connecticut Pomological Society. The others are still in the experimental age.

Substitutes for Lead Arsenate Lead arsenate continued to hold first place for controlling insect pests when compared with other sprays used in apple orchards. However, materials such as lime, talc and sulfur were found to have possibilities in curbing the apple maggot; and cryolite, which is much inferior to lead arsenate as a general spray, also gave promise of controlling this insect.

The number of eggs deposited by laboratory-bred flies of the maggot was curtailed by the presence of lime. In the field also, lime-glue sprays proved successful, noticeably reducing the amount of infested fruit in two orchards. In comparison with lead arsenate sprays, however, the lime treatment was not so effective, and derris used in the Mount Carmel tests was in every way inferior.

Removing Spray Residue from Fruit Fruit with excess residue of lead may be made safe for market by washing in a dilute solution of hydrochloric acid, according to tests made in cooperation with the analytical chemistry department at the Station during the summer. A dry August left spray residue on a few of our apples above the tolerance permitted by the U. S. Government. It was found that immersion for one or two minutes in a 1.5 per cent acid bath (4 1/5 gallons of 32 per cent hydrochloric acid to 100 gallons of water) brought the lead residue within tolerance. Lead in excess of .04 grams to one pound of fruit required heating the acid, or some other means, to condition the apples for market.

Experiments with Oil Sprays Oil sprays with tar and lubricating oils were tested for control of the European red mite, rosy aphid and fruit tree leaf roller. Both laboratory and field experiments indicated that emulsions made with tar distillates were effective in combating the rosy aphid, thus confirming the work of others in this line. Tank mix summer oils with nicotine sulfate added were used in two different pear orchards against the pear psylla. Good control was secured, but even in unsprayed trees the development of this pest did not come up to expectations.

European Pine Shoot Moth Besides taking active part with the forestry department in measures to suppress the European pine shoot moth, enemy of red pine, entomologists studied the biology and made further tests of spray control. Whereas three sprays of lead arsenate and fish oil were formerly recommended for infestations on red pine, two sprays were found effective in 1935. Lead arsenate with 10 per cent igepon (a fatty acid amide derivative made by condensing oleic acid with tannine) as a spreader, looks promising and will be tried in future experiments. Results this year gave 79 per cent control, as

against 88 per cent with lead arsenate and fish oil, but the spreading quality of the former spray appeared better. In one plantation *Hyssopus thymus* Girault, the most common parasite, parasitized 8 to 12 per cent of the larvae of the pine shoot moth in the spring.

Control of the Potato Flea Beetle Tests of sprays and dusts to control the potato flea beetle on green mountain potatoes were made in cooperation with the botany department. A combination of two dusts applied in June, using one part of barium fluosilicate to three of hydrated lime, followed by 6-6-50 Bordeaux mixture applied four times during July, produced as good a yield as six applications of Bordeaux mixture. However, there was no indication this year that the combination treatments were any more effective than the spray alone. Therefore the experiments will be continued.

Spotted Cloth Attacked By Clothes Moths Two series of tests were made to determine the reaction of clothes moth larvae to soiled spots on clothing. In the first, various types of cloth were spotted with brown gravy. In eight out of twelve cases, the moths damaged the soiled places; and in two out of eight, no injury occurred except on the spots. In the second test, fresh milk, cod liver oil, corn oil, lard and honey were applied to different pieces of the same cloth. The moths damaged the milk spots and honey spots but did not eat the other material.

Spruce Gall Aphid Studied Investigations of relations of spruce gall aphid to host trees have shown that the survival of the spring generation is absolutely dependent on the previous existence of the hibernating generation on the particular twig involved. That is, if the hibernating stem mother has not affected the developing shoot in the early spring, that shoot will not later support a colony of the gall-forming generation.

Control of the Asiatic Beetle Eighteen of 33 lawns examined in the past season were infested by the Asiatic beetle, grubs of which eat the grass roots and thus injure lawns. Although there has been no official attempt to control this insect, information regarding the lead arsenate treatment for prevention and control has been given on request. As described in Station Circular 62 and Bulletin 344, three pounds of lead arsenate are applied to each 100 square feet of lawn, either by raking it into the top two inches of earth for a new lawn, or by sprinkling it evenly in a water solution.

Control of the Japanese Beetle During the past summer Japanese beetles were found in larger numbers in many communities, but especially in old centers of infestation: Bridgeport, New Haven, Stamford and Hartford. In Bridgeport, they defoliated many roses, grapevines and Virginia creeper, and dahlias and other flowers were ruined. The Station cooperates with the U. S. Department of Agriculture. Scouting was carried on around classified nurseries and greenhouses and inspections have been made and certificates furnished for the shipment of plants, cut flowers, farm products, soil, sand and manure to points

outside the quarantined area. Altogether, 46,821 such certificates have been issued for nursery, floral stock and farm products, and 598 for soil, sand and manure.

Date of Planting And Corn Borer Infestation Corn was planted at intervals of ten days from April 23 to July 10 to ascertain the relationship between planting dates and European corn borer infestations. Early, mid-season and late corn were used in the experiments and every ear was examined for injury by this pest. The following results obtained cannot be taken as typical because the 1935 season was late.

All ears harvested between July 16 and August 1 were badly infested, regardless of the date of planting. Mid-season and late corn planted in April and early in May, and harvested the first part of August, was only moderately infested. All ears picked after September 1 were also heavily infested. However, corn maturing between August 8 and 23, 1935, was almost entirely free of corn borers.

The results of insecticide tests conducted in cooperation with the U. S. Department of Agriculture, will be published later.

Clean-up Campaigns The first fall clean-up campaign for the control of the corn borer started in October, 1934, and continued through November. Ten inspectors covered about half of the towns in the State urging farmers to plow their corn stubble under and to complete clean-up measures according to legal requirements. A good deal was accomplished.

During the winter the General Assembly amended section 2125 of the general statutes, eliminating the quarantine requirement and changing the final date for proper disposal of stalks and weeds from April 10 to April 25. Five inspectors and one supervisor covered 68 towns in which infestations were heaviest the previous year. During May warrants had to be issued to 57 farmers and many of these were nulled when the fields were cleaned up and costs paid.

Extent of Infestation in Connecticut The federal survey of the corn borer population conducted by the U. S. Bureau of Entomology, points out an increase in Hartford, New Haven and Middlesex counties and a decrease in New London County, in contrast with figures collected during previous years.

Studies of the Corn Ear Worm Recently the corn ear worm, a native pest, has been more widespread than in former years. Investigations carried on at the farm at Mount Carmel show that there are two well-defined generations of this pest each year. In 1935, larvae of the first generation were present from July 23 to August 12. The second generation infested corn maturing during September. In all, 29 ears, or 3.2 per cent of the early corn used in the tests, were infested; while 491 ears, or 31.1 per cent of the later corn, contained ear worms.

Elimination of the Mosquito Nuisance An increased number of requests have come to the Station for investigation of the mosquito nuisance throughout the State. This does not mean that there is an increase in the number of pests, but that residents of the State are aware of the practicability of mosquito control.

Since November, 1933, the Station has been sponsor for statewide mosquito projects under the CWA and FERA. In 1935, ERA labor under Station supervision completed ditching most of the salt marshes. Areas in North Haven and Stratford are yet to be finished, as well as fresh water extensions of the salt marshes and more permanent improvements such as dikes, tide gates and outlets, already under way. Altogether nearly 20,000 acres have now been ditched with more than 2,250,000 linear feet of ditches. Recent work involves 21 towns and affects 750,000 persons, or 47 per cent of the total population of Connecticut.

Relief labor is being used for mosquito control in all except three shore towns and in ten inland towns. It includes surveying, ditching of salt marsh areas and fresh water extensions, building masonry seawalls and sod dikes, tide gates, timber jetties and pipe outlets. In populous districts, fresh water swamps are being ditched, or filled in when ditching is impractical, and improvements made in highway culverts that cause swampy places.

Inspection of Apiaries The State inspection of apiaries is carried on by two men appointed by the State Entomologist, each being responsible for his territory of four counties. This year Mr. W. H. Kelsey of Bristol took the place of Mr. Yates who had served acceptably for 25 years before his retirement. Of the 1,333 apiaries, containing 8,855 colonies, inspected, 84 apiaries and 209 colonies were infested with American foulbrood. None had European foulbrood.

Inspection of Nurseries The number of nurseries in the State decreased by five to 376 in 1935. All of these have been inspected since July 1.

New Insect Pests Discovered in State The European spruce sawfly, *Eiprion polytomum* Hartig, an insect that has defoliated and killed several thousand square miles of spruce forests in Canada, was discovered in Connecticut in October. Investigations revealed that the pest is present in Kent, Litchfield, Middlebury, Orange, West Hartford and West Hartland. It is impossible to predict whether or not it will cause severe damage to the spruce plantations here.

Another discovery in 1935 was a curious and interesting scale, *Matsucoccus matsumurae* Kuw., on pitch pine in Chaplin. This scale is embedded in the tissues of the new growth, but the growth of the preceding year showed scars where it had been present.

Insect Collection Increased A number of new specimens were added to the large insect collection belonging to the entomology department. Among these are beetles and mosquitoes. In all, the insect collection contains more than 60,000 specimens, including 6500 different species, which have been brought together, identified and mounted during the past 40 years.

Studies of elm borers and of insect pests of conifers have added to the information on these subjects. The State Entomologist also has made substantial progress on his manuscript on the *Diptera*, two-winged flies of Connecticut, which will be published as a bulletin of the State Geological and Natural History Survey.

FORESTRY

This has been an unusually busy year in forestry because relief labor requiring close supervision was available for many activities. The Civilian Conservation Corps, the Emergency Relief Administration and the Works Progress Administration have cooperated with us in a number of projects reported below.

Rainbow and Mundy Hollow Last winter a CCC crew from Camp Robinson pruned and cleaned several of the experimental plantations at Rainbow. During the summer, a new CCC camp was established on the Mundy Hollow tract. This was named Camp Britton after the Station Entomologist and its primary purpose is gypsy moth control.

Treatment of Native Woods for Posts Research to find native woods that under treatment will best meet the local demand for fence posts has been continued this year. An open tank creosoting plant was established by the State Forester on the Meshomasic Forest in Portland. Nearly 50,000 posts were treated in the commercial plant and experimental data were secured on about 1000. Most of the work was on oak, red maple, black and yellow birch, all species abundant in Connecticut, and found suitable for posts when given preservative treatment.

Oak is quite readily impregnated to a depth of one-quarter inch at the ground line if immersed in creosote at a temperature of 215°-220°F., for four to six hours, depending on the degree of seasoning. Unless the tops of the posts are to be painted, they should be dipped for five to ten minutes in hot creosote to disinfect cracks or holes which, by forming water pockets, may become breeding spots for rot fungi. Red maple and birch can be impregnated to a depth of one-quarter inch at the ground line with a prolonged hot bath of 12 hours or more but, with this duration of bath, the butts absorb an excess of preservative that serves no useful purpose and very materially increases the cost of treatment. To overcome this difficulty, posts of these species were perforated with a toothed hammer for 6 inches above and 18 inches below the ground line. This made it possible to secure the required penetration with an immersion of four to six hours at 215°-220°F., and without excessive butt absorption.

The treatments described above are for round, seasoned, peeled posts with the sapwood intact and are not applicable to sawed material. The preservative used was Grade I coal tar creosote.

A number of species check severely during seasoning, causing a heavy loss by the culling out of otherwise satisfactory posts. Such checking is negligible in oak and heaviest in red maple and birch. With a view to developing the most practical method of seasoning to prevent this loss, some 2000 posts will be handled experimentally during the coming winter.

Decline in Pine Shoot Moth Population Data on the infestations of the European Pine Shoot Moth in Connecticut indicate that control measures and low temperatures reduced the population considerably during the past two years. The pest is an enemy of red, Scotch and some other varieties of pine. Larvae infest the pine tips, stunt growth and by repeated attacks kill the trees.

In cooperation with the entomologists, this department supervised CCC and FERA crews in a control program from the first of the year until July, 1935. In addition to the area covered in 1934, larger parts of New Haven and Fairfield counties were included. Thus more plantations and a total of 10,221 acres were covered. The table below summarizes the data collected:

PINE SHOOT MOTH INFESTATION IN CONNECTICUT

County	Severity of Infestation (number of plantations)									
	1934					1935				
	None	Light	Medium	Heavy	Total	None	Light	Medium	Heavy	Total
Fairfield	2	6	2	1	11	15	78	33	26	152
New Haven	9	20	10	7	46	16	35	7	1	59
Middlesex	9	30	5	3	47	14	30	1	0	45
New London	33	34	7	3	77	27	33	9	2	71
Litchfield	57	164	36	26	283	134	132	12	0	278
Hartford	20	72	23	9	124	80	38	1	0	119
Tolland	17	64	8	0	89	74	7	1	0	82
Windham	50	20	0	0	70	65	7	1	0	73
Total	197	410	91	49	747	425	360	65	29	879
Total acres in 1935—10,221										

The table shows that there has been an appreciable reduction in moth population in the past two years, more especially in the northern tier of counties than along the shore of Long Island Sound. Undoubtedly the severe winter of 1933-34 accounts for the larger share of the decrease. However, the fact that fewer pests were found in plantations where control work had been done proves the value of artificial measures.

It seems to be demonstrated that the pine shoot moth is quite susceptible to sub-zero temperatures. After introduction into a plantation it takes from three to five years for the insect to build up a population large enough to be harmful. It would, therefore, appear that there is no great danger of this damage reaching epidemic proportions, at least in northern Connecticut where sub-zero temperatures are frequently encountered. Nevertheless serious local outbreaks may occur if control measures are not continued.

Federal Aid in Blister Rust Another project furthered by federal funds in the past year was the control of white pine blister rust. The nature of this disease makes the removal of currant and gooseberry bushes growing within 900 feet of white pine stands the only practical control measure. European black currants are so dangerous in spreading the rust that they are unqualifiedly outlawed wherever they are found in this and in some other states. The following is a summary of the work accomplished by the CCC, FERA and WPA under station supervision:

1. Eradication of wild Ribes, (currants and gooseberries) within infecting distance of white pine stands. A total of over 1,100,000 wild, and 6,783 cultivated Ribes bushes have been removed from approximately 103,000 acres in 61 townships. This includes the rechecking of 275 acres of nursery sanitation zones, from which over 200 wild Ribes were eradicated to insure the production of rust-free, white pine nursery stock.

2. Survey of cultivated *Ribes* with destruction of all European black currants, and removal of other cultivated *Ribes* within 900 feet of white pine. The cultivated *Ribes* survey was carried out in 69 towns where over 165,000 interviews were made. More than 12,000 patches of *Ribes* were located, containing 133,255 bushes; 4,556 European black currant bushes were destroyed and 1,198 other cultivated *Ribes* (located within 900 feet of pine) were removed with the permission of the owners.

3. Pine type maps have been completed in 132 towns of southern and central Connecticut; 29,537 acres of pure pine and pine in mixture with other species were located; more than 2,350,000 acres were examined on which no white pine was found.

A number of new secondary pine infections were discovered in southern Connecticut and infection of *Ribes* was general throughout the State during the past season. These conditions indicate the need for a systematic pine infection survey in southern Connecticut, the results of which would contribute data necessary for determining future control work. It is hoped that this may be completed with the help of WPA labor.

Data on Forests Collected In connection with the various control activities outlined above, much information has been collected regarding existing plantations. The records are more complete than ever before and it is hoped that additional information gathered during the coming year will furnish enough material for a bulletin on forest plantations in Connecticut.

Mounting Demand for Forest Planting Stock The amount of stock for distribution in 1935 was much smaller than in previous years. A total of about 200,000 trees was sold to Connecticut land owners last spring. There is evidence that the demand for forest planting stock is increasing again, but the supply on hand is very low.

PLANT BREEDING

Besides the outstanding Spancross C2, mentioned in the introduction, this department grew a number of new Spancrosses, Marcrosses and Sunshine crosses for the first time in 1935. These resulted from combining inbreds secured from the three early varieties with the Whipple inbreds 2 and 6. Several were much better than Spancross C2 from the standpoint of productivity and earliness, but no seed is available.

Mid-season Sweet Corn Whipcross C6.2, Whipcross C7.2, Whipcross P39 and Whipcross C2.P39 were more productive and much more uniform than the top cross, Whipcross P39. Seed of each of these hybrids is available from commercial seed growers. Other new promising hybrids not yet in commercial production are Stancross C2 (Charlevoix x C2) Stancross P39, Giantcross C2 and Giantcross P39, and Coincross 2 (Gold Coin x Conn. 2).

Vegetable Breeding Windsor-A, the first of a series of peppers especially suited to Connecticut conditions was mentioned in the introduction. Connecticut straightneck squash, an early, high yielding strain, will also be available for distribution in 1936.

This variety was isolated from a cross between Giant Summer Crookneck and a low yielding, straightneck type. Studies on the influence of inbreeding, selection and hybridization of summer squash have been continued.

Lima Beans Seed of a pure line selection of Fordhook bush lima beans, named Connecticut Fordhook, was released for increase in 1935. More seed will be available for trial in 1936. There is a question whether this type has given superior yields for the past four years because of inherent differences or because of the conditions under which it has been grown. This point will be tested further.

Tomatoes Biometrical studies of tomatoes at other experiment stations have indicated that superiority of one variety over another cannot be based on yield alone. To be really superior in yielding performance, one tomato must produce from 37 to 50 per cent more fruit than any other variety. This difference seems large but the results of one year's study at the Mt. Carmel farm seem to bear it out.

High Yielding Strawberries Bred Several of the new hybrid seedling strawberries bred by the Station again produced a higher yield than commercial varieties in trials at the Mt. Carmel Farm in 1935. From our original 9000 seedlings, we now have 100 selections noted as promising in either 1934 or 1935. Fifteen of these were selected in both years. A limited number of plants of these 15 varieties will be sent out for trial in 1936.

Breeding Experiments Bearing on Evolution After 17 generations of continuous inbreeding, sweet corn Connecticut 237 (old number 1-7) was divided and two lines continued from this point on. These lines are called 237 Q1L and 237 Q2L. They are very similar but show a few significant differences. Line 237 Q2L is slightly taller than the other, but the latter produces a much better ear and a greater total grain weight. In 1933 these two lines were crossed, and the F₁ (first generation) hybrids were grown in comparison with the parent lines the following year. The F₁ had an ear very similar to 237 Q1L (the good line) and there was not a significant difference in weight between this parent and the offspring. In height the F₁ plants were intermediate between the two parents. The difference in plant height between the F₁ hybrid and the parent is not significant.

Another inbred Leaming line 243 (old number 1-6) was divided into two lines after inbreeding for 23 generations. These are now 243 W1G and 243 W2G and are to all appearances identical. The grain yield and height are the same. F₁ hybrids from these two lines were no more productive than the parent lines. The height was the same.

Either the inbred 237, after 17 generations of inbreeding, was not completely homozygous for all factors, or there have been mutations in the last 11 years of inbreeding. The question arises whether 23 generations of inbreeding are sufficient to produce complete homozygosity whereas 17 are not; or whether the last 7 years of inbreeding have not allowed sufficient time for mutations to occur, whereas 11 generations have. These questions cannot be answered since two different inbred lines were used in the experiment. Possibly line 237 is more subject to mutations.

Ensilage Corn No ensilage variety trials were grown at the Mt. Carmel farm in 1935. A series of about 400 dent inbreds, secured mostly from Lancaster Sure Crop and West Branch Sweepstakes, were all crossed by the variety Pamunkey, the highest yielder in previous ensilage trials. These hybrids will be grown in comparison with standard varieties in 1936.

SOILS

Soil Testing Increases in Popularity The Universal soil testing system, developed at this Station during the past three years, is a very comprehensive scheme for the diagnosis of chemical soil deficiencies or abnormalities. It is described in detail in Bulletin 372. The speed and simplicity of the technique used in these tests permit the examination of large numbers of soils without great expense, and at no sacrifice to their practical value. Results on more than 4500 samples have been reported by the Station during the current year, the work being divided between the Tobacco Substation and the soils department at New Haven. This represents an increase of approximately 60 per cent over 1934.

Experiments on a Magnesium-deficient Soil During the 1934 field season, an area of one of the fields at the Mt. Carmel farm, planted to corn for the first time after being used in raspberry variety trials, exhibited marked stunting of growth and abnormally chlorotic conditions of the leaves. Diagnosis by chemical soil tests indicated magnesium deficiency, associated with excessive acidity and active aluminum content. This was fully verified by pot experiments conducted during the early months of 1935.

In the spring, both soil and subsoil from this area were thoroughly mixed to provide uniformity and were placed in a series of concrete-walled soil plots. Treatments were planned to give comparisons of magnesium from magnesium sulfate and from dolomitic limestone, on plots adjusted to various levels of acidity by different rates of application of calcium carbonate. Measurements of phosphorus response as affected by degree of acidity were also provided. A crop of spinach, planted 10 days after the initial treatments, failed entirely when magnesium was not provided, even when the acid conditions of the soil were fully corrected by calcium carbonate.

Unsatisfactory growth of spinach was obtained at low pH values, although there was a definite response to magnesium on the unlimed soil. At 4.6 pH, dolomitic limestone was a very effective source of magnesium while at 7.3 pH, it was a complete failure in this respect. The same amount of dolomite was applied in both cases, the adjustment in pH being accomplished by the use of calcium carbonate. On the other hand, dolomitic hydrate and magnesium sulfate were equally effective on the heavily limed soil.

A crop of sweet corn, following the spinach, confirmed the above results, although somewhat better growth was obtained on the unlimed treatments. The absence of magnesium in the treatment, even in the heavily limed plots, produced the same stunting and chlorosis as observed in the field during the previous year. This was corrected by both magnesium

sulfate and dolomitic limestone, on the strongly acid soil, but was not improved by the latter material when used with a heavy application of calcium carbonate. Dolomitic hydrate, on the other hand, was again found to be effective.

Changes in Status of Soil After Nitrogenous Fertilization Four soils of varying physical and chemical characteristics had been under conditions of heavy nitrogenous fertilization, without cropping, in the lysimeter tanks at Windsor for five years previous to May, 1934. In the experiment, separate tanks of each soil had received 200 pounds of nitrogen per acre annually, in the form of nitrate of soda, sulfate of ammonia, urea and cottonseed meal.

In order to ascertain the effects of these treatments with respect to available magnesium and potassium, the soils from each treatment were brought to the greenhouse at New Haven and placed in a series of pots. Turkish tobacco was planted. Treatments provided comparisons of responses to both potassium and magnesium. All of the soils had received annual applications of 200 pounds of potash and 50 pounds of magnesia per acre per year during the five years of lysimeter study.

When two successive crops of tobacco were raised on the four soils, and potassium was omitted, the average decrease in tobacco yield for the four previous nitrogen treatments was: Nitrate of soda, 0.2 per cent; sulfate of ammonia, 31.6 per cent; urea, 15.9 per cent; cottonseed meal, 21.2 per cent.

The omission of magnesium from the treatment resulted in the following decreases in yield, on the same basis as above: Nitrate of soda, 6 per cent; sulfate of ammonia, 13.1 per cent; urea, 10.1 per cent; cottonseed meal, 8.7 per cent.

All treatments under greenhouse conditions supplied nitrogen and phosphorus uniformly, and after removal from the lysimeters, the variable acid conditions resulting from the different nitrogenous fertilizers were corrected by appropriate amounts of calcium carbonate. Thus the effects noted above are to be ascribed to the treatments while in the lysimeters with respect to maintaining or depleting the available potassium and magnesium supply.

A complete fertilizer and lime treatment, including magnesia, failed to equalize fully the differential effects of previous nitrogenous fertilization. Thus the relative yields on the LNPKMg pots averaged as follows: Nitrate of soda, 96.7; sulfate of ammonia, 91.9; urea, 95.2; cottonseed-meal, 100.

The above experiment has confirmed two important points suggested in the lysimeter studies:

1. A considerable portion (approximately 40 per cent) of the potassium added in the fertilizer during the five years of lysimeter measurement has neither leached from the soil nor remained in an available form.
2. Sulfate of ammonia acts to deplete the available magnesium in the soil significantly more than do the other nitrogenous materials used in this investigation.

Fertilizing Vegetable Crops In 1935 there appeared an important variation from results noted the previous five years in vegetable fertilization at the Windsor Substation. Stable manure had formerly produced poorer crops than commercial fertilizer

without manure during the early spring period. This year the opposite was conspicuously exhibited. The manure had been applied in early November, disced into the soil, as usual. Two factors may account for the 1935 results: There was practically no leaching early in the season, thus permitting a greater accumulation of nitrates from the decomposition of the manure. This was accentuated by abnormally high temperature in April and early May. Therefore the nitrogen from the manure was available earlier than usual. On the other hand, the manure treatment helped to provide favorable moisture conditions for shallow-rooted early season crops during weather that was abnormally dry for that time of year.

An experiment in top dressing of the rye cover crop with cyanamid, at the rate of 200 pounds per acre, applied in early March, resulted in almost complete destruction of the rye. This indicates the possibility of injuring growing crops with this material when it is used on sandy soils before the frost is out of the ground.

Fertilizer Requirements of Sweet Potatoes

In 1935 a special series of plots was started in order to study the fertilizer requirements of sweet potatoes under Connecticut conditions. The trials were located on a coarse sandy soil that has proved somewhat too leachy for good results with Havana seed tobacco. In a comparison of several fertilizer ratios, a 2-6-8 applied at the rate of 1200 pounds per acre and broadcast before setting, produced best results. In a rather poor season for sweet potato yields, a crop of 201.2 bushels per acre, of marketable, short stem, Jersey sweets was obtained by this treatment.

Potato Fertilizer Experiments

The fertilizer trials with potatoes on old tobacco land at Windsor were conducted for the third year in 1935. Omission of potash from the treatment, producing no significant decrease in 1933, and showing only slight decrease in the second year, has now reduced the yield by 34.1 bushels below that obtained with 80 pounds of potash in the fertilizer. Phosphoric acid in the formula, at the rate of 40 pounds, gave an increase of 31.5 bushels over the "no phosphorus" treatment. Dolomitic limestone, added to the fertilizer in amounts sufficient to neutralize the theoretical acidity of the treatment, has given 28.5 bushels more potatoes than when the mixture of sulfate of ammonia, ammophos, cottonseed meal and sulfate of potash was used alone. In all cases, the fertilizer was applied in bands two inches to each side, and slightly below, the seed rows. The omission of all fertilizer has given rapidly declining yields during the three years of the trials, the yield in 1935 being only 50 bushels of marketable potatoes. The above yields and treatments are in terms of quantities per acre.

Drainage Losses Under Dolomitic Lime Treatment

In the spring of 1934, a new series of lysimeter studies was started. This involved a comparison between two soils taken from the dolomitic lime series of tobacco experiments at Windsor. One of these was from a plot receiving no lime or magnesia during this experiment, and at a strongly acid reaction (4.9 pH). The other had received applications of dolomitic hydrated lime in 1930 and in 1933, and was at 6.0 pH. On each of these soils the tanks were treated with various nitrogenous fertilizers,

with and without additions of lime, in amounts sufficient to correct the theoretical acidity of the nitrogenous material. There were corresponding treatments on each soil.

An interesting feature of the results of the leachates' analyses during the first year of this experiment is the effect of the previous application of dolomitic material upon the magnesium, calcium and potassium in the drainage water. An increase of 110.9 per cent in magnesium, and decreases of 18.5 per cent in calcium and 49 per cent in potassium, were shown. Thus, despite the large amounts of calcium applied in the dolomitic hydrate as compared with the unlimed soil, less calcium was liberated in soluble form. The same amounts of calcium, magnesium and potassium were supplied in either case while the soils were in the lysimeter tanks, and potassium had been uniformly applied in the previous plot treatments. The tobacco crops grown in the field on the dolomitic treatment had shown corresponding increases in magnesium and decreases in calcium and especially in potassium contents.

It was also significant that the soil which had previously received the dolomitic lime leached less nitrogen, for all corresponding treatments, than did the unlimed soil. Additions of limestone to the fertilizer, in amounts required to prevent increases in acidity from the nitrogenous materials, produced increases in nitrate nitrogen in the drainage water during early summer, but diminished total nitrogen recovery for the first year as a whole. This observation applied to both soils used in the experiment.

Forest Lysimeters

Continuation of the lysimeter studies in a red pine plantation reveals the thoroughness with which tree roots in a closed stand draw upon the soil moisture and plant nutrients. This is shown in the following table which gives a portion of one year's results:

	SOIL AND LITTER	
	NO ROOT COMPETITION	WITH ROOT COMPETITION
Rainfall recover, per cent	88.6	3.7
Nitrogen, pounds per acre	47.7	1.6
Calcium, " " "	42.0	1.9
Potassium, " " "	29.6	0.7

The small amount of plant nutrients collected in the pan type lysimeters (with root competition) is due partly to actual root absorption and partly to the lessened solution effect because of the lower moisture content of the soil.

Complete results will be available when the present experiment is terminated in April, 1936.

Moisture in Forest Soils

The study of moisture in the forest soil during the driest part of the summer was continued this year with samples taken at two depths: 0-5 inches and 12-15 inches. Although the moisture content at the latter depth was usually much less than in the surface 5 inches, the difference is equalized by an accompanying lower moisture equivalent. The net result is that the

relative wetness at both depths is nearly identical. Only in bare soil, or under shallow rooted crops like meadow grass or small nursery stock, did the lower depth contain relatively more available moisture than that of the surface 5 inches.

Tree Survival on Different Soils A new project initiated during the year in cooperation with the State Forestry Department has to do with the survival and subsequent growth of plantings—mostly pine and spruce—made on different soil types in 12 of the state forests. The study is expected to yield some valuable information on the suitability of the various soils for reforestation purposes.

Soil Improvement in Natural Oak Stands Over a considerable area in the eastern part of the State, and in limited areas elsewhere, are poor soils supporting slow-growing, open, unprofitable stands of scarlet and chestnut oak and a heavy ground cover of huckleberry and blueberry bushes. In the belief that the ground cover is detrimental to both the soil and the trees, this department, in cooperation with the State Forestry Department, has set aside plots for various treatments. The object is to determine what practices may bring about more favorable growing conditions, not only for the present stand of oaks, but for underplantings that may be made.

TOBACCO SUBSTATION

Testing Seed for Germination Seed with a low percentage of germination is expensive to the grower. It makes the "stand" in the beds too thin and the plants do not develop into a shape suitable for setting by machine. Valuable bed space is wasted and the grower must incur the expense of purchasing plants elsewhere. To avoid this, a large proportion of Connecticut growers have the seed tested each year before sowing, a service rendered gratis by the Tobacco Substation. If the test shows the germination too low, the grower obtains good seed from some other source.

Hundreds of tests made during the past 12 years have led to some interesting observations. Seed produced in certain seasons is characterized throughout by high germination, while at other times all lots are poor. Almost invariably, seed germinates better the second year, rather than the first, after maturity. High testing seed in general shows very little diminution in germinative capacity up to five years; after that the percentage usually falls gradually, although occasionally there is excellent germination at 10 years. We have found cases of a small percentage of germination at 20 years.

As seed gets older, it germinates more slowly. New seed takes three or four days; old seed, seven to ten days at laboratory temperature and much longer in the cold soil of early spring. When seed germinates too slowly, even though the percentage is satisfactory, it is often disappointing to the grower because of the long wait before it comes up in the beds. This may result in poor stands and delayed setting.

Testing Substitutes for Cottonseed Fertilizers For a generation or more, the standard organic base material for tobacco fertilizer mixtures has been cottonseed meal, an expensive source of nitrogen. More money is spent for this than for any other fert-

ilizer material for tobacco. Most growers believe that a good crop cannot be raised without it and this dependence on the cottonseed crop puts them at a disadvantage when the price is high. There is a possible place for other organic materials that will grow just as good tobacco and to which the grower may turn when cottonseed meal is expensive.

Certain organics such as castor pomace, linseed meal, or fish meal have been tested in the past and are used to some extent as supplements, but have not been considered desirable as substitutes for cottonseed. Three years ago we began experiments with corn gluten meal and in 1935 with soy bean meal as possible substitutes. Both of these have come on the market in recent years and are becoming more plentiful. They are usually less expensive as sources of nitrogen. Both have given promising results in field tests. It is too early, however, to draw any conclusions.

Soil Nitrate Production A number of field plots were fertilized with different nitrogenous materials at the rate of 200 pounds nitrogen to the acre, and others with varying quantities of nitrogen. In order to compare the capacity of each material to furnish an adequate store of nitrate for growth of tobacco, the amount of nitrate produced in the soil is measured at weekly intervals during the growing season.

The general level of soil nitrates in 1935 was the lowest of the four years studied. Heavy rains throughout June, with 2.30 inches on the 29th, prevented the accumulation of nitrates during the early part of the growing season. This was followed by high precipitation in July, with the result that the nitrate supply after the middle of that month could not keep pace with the demands of the plants and nitrogen starvation occurred. During the last three weeks the crop was in the field, the average amount of nitrogen on all "vegetable organic" plots (cottonseed, linseed, corn gluten and soy bean meals, and castor pomace) was 12 pounds per acre; on the "animal organic" plots (fish meal and Peruvian guano), 11 pounds; and on the inorganics (nitrate of soda, sulfate of ammonia, urea, calnitro and cyanamid) 15 pounds, with individual plot readings as low as one pound per acre.

For the present season, studies on nitrate production with varying applications of nitrogen showed that 200 pounds of fertilizer nitrogen per acre were inadequate to maintain a satisfactory level, but 250 pounds were fully as good as larger amounts. Previous results have indicated that 200 pounds were sufficient.

Soil Testing Service The service of testing soils for tobacco growers was introduced in 1925. At that time only the reaction of the soil was determined. It enabled the grower to avoid fields too nearly alkaline, these being subject to black rootrot, or to add lime to the fields that were too acid. This test was also used to aid in selection of new fields for growing tobacco.

Since the introduction of the Universal system of soil testing in 1932, the testing service has been extended to include examination and analysis of the soils as a guide to fertilizer needs. Considerable saving to the growers may result from the test for phosphorus, since this element has a tendency to accumulate in the soil and was formerly used in excess of annual needs on the tobacco fields in the Connecticut Valley. The mag-

nesium content in the soil has an important bearing on the burning qualities of the tobacco leaf. This test has been worked out to such a degree that suitable quantities of magnesia compounds may be recommended for various soils with fair accuracy. Of equal importance is the estimation of the need for readily available calcium and potassium as a basis for fertilizer recommendations. It is important to obtain a proper balance in the soil among the three bases mentioned. Tobacco soils in this Valley need a standard application of nitrogenous fertilizers annually. The test for nitrogen, however, is valuable after a leaching rain, to find out whether or not a side dressing is needed.

In addition, the soil testing service aids in the diagnosis of malnutrition troubles in a growing field. In such cases, besides the tests mentioned, estimations of active iron, manganese and aluminum are often employed.

The ever increasing call for soil testing service (about 3000 samples were handled last year) together with favorable reports from the growers may be taken as a criterion of the reliability of the testing system.

Wildfire Increases After the serious outbreak of wildfire in the early "twenties", the disease became less and less prevalent with each succeeding year until it had practically disappeared from the Valley in 1934. No cases were observed in seedbeds in 1935 but in the late summer it appeared again in two or three localities and in some cases the fields were seriously affected at the time of harvesting. This warns of the necessity of continuing the precautionary control methods that were developed and practiced by most of the growers when the disease was more prevalent.

Dead Blossom Leafspot Although not serious here usually, dead blossom leafspot was prevalent in shade tobacco during the latter part of the growing season of 1935 and was therefore made the subject of a more thorough investigation than it had previously received. Falling blossoms lodge and rot on the leaves. In wet weather these are surrounded by dead brown spots, frequently an inch or more in diameter and the leaves are rendered worthless for cigar wrappers. A more serious loss, however, is incurred in the curing shed where affected leaves serve as centers from which the rot passes to others. One leaf may thus cause the ruin of an entire lath of leaves. The symptoms then are exactly like those of pole rot.

Examination of the decayed blossom on the leaves showed sporulating fungi of several species, the most common of which were *Alternaria tenuis* and *Botrytis cinerea*. When microscopic examinations were made and cultures taken from the margins of the dead leaf spots, only one fungus, *Alternaria tenuis*, was found to be universally present. It is apparent that this species, which ordinarily is only saprophytic, is able to develop parasitic properties under these conditions. In view of the causal relation that we know this fungus bears to pole rot, the spread of infection in the curing shed is to be expected. No control measures seem practical except the throwing out of affected leaves at the time they are strung on the lath.

Pythium Rot of Transplants Common This is another disease that became prevalent in 1935 and necessitated considerable restocking of plants early in the season. Plants affected die within a week or two after they are transplanted into the field. The

stalk decays with a black, mushy, soft rot, and frequently the bases of the leaves are similarly affected. Then the entire plant falls over and dies.

The unusually wet transplanting season of 1935 undoubtedly aggravated the disease. No study of the trouble has been attempted previously in this State. Microscopic examination and culture isolations showed the affected tissues to be filled with fungous mycelia of the species *Pythium debaryanum*. Whether this fungus is on the plants when they are taken from the beds or comes from the soil in the field was not determined. It was observed that well-hardened plants of the later "pullings" were not so susceptible, a fact that offers a suggestion for control. This appears to be the same disease that has been known in Sumatra since 1917 under the Dutch name of "Stengelverbranding". In that Island, however, several other species of *Pythium* have been connected with it.

Causes of Pole Rot Investigated Pole rot causes more damage, is less successfully controlled and less understood than any other disease of tobacco in the State. It rots the leaves in the curing shed after the grower has invested his time and money in producing them. At the very beginning of our studies we are confronted with the unsolved question of whether one organism or several operates to cause the trouble; whether this is one disease or a group of diseases. An investigation was started last year with the object of learning more about the causal agents as a necessary preliminary to a more rational practice in control.

Judging from symptoms, there are three types of pole rot: Freckle rot, web rot and vein rot. A considerable number of species of fungi and bacteria occur on leaves affected by these but not all of them have a causal relation. Up to the present, work has concentrated on the first type, "freckle rot", characterized by aggregations of small, reddish brown to black spots on the leaf blades, reminding one in size, shape, color and distribution of the freckles on the face. No spores are produced on these spots but microscopic investigation and pure culture isolations from a large number of very young ones show that only one fungus is universally present. This fungus, *Alternaria tenuis* Nees, is undoubtedly the primary causal agent of this type of pole rot in Connecticut. Other fungi and bacteria, however, may play an important part in the other types.

Insect Pests of Tobacco Studied Studies of insect pests of tobacco continued for the sixth summer in 1935, and Station Bulletin 379, on the results of investigations, is soon to be published.

The tobacco budworm, a southern species, usually not serious in Connecticut, is becoming a little more prevalent here each season. In control experiments, begun in 1935, satisfactory results were obtained by dropping a pinch of a mixture of corn meal and arsenate of lead in each bud.

The potato flea beetle caused great injury to tobacco in 1935, as in previous years. Again the most lasting control was obtained with barium fluosilicate. Dusts containing rotenone and pyrethrum also killed the insects but the effectiveness of the materials was not so lasting. Certain strains of tobacco appear to be less attractive to the flea beetle than others. Thus it was observed that when some experimental strains of Havana Seed were being grown in rows side by side, the leaves of one strain were so badly punctured that they were worthless, while those on an adjacent

row were practically free from injury. This suggests the possibility of control through strain selection. In this connection it is of interest to note that the best of the new rootrot resistant strains, No. 211, was the most resistant to flea beetle.

Good control of thrips was obtained by spraying with "Ku-Ba-Tox" diluted 1 to 400 in water, or with "Cubor", 2 pounds to 50 gallons of water.

Life history studies on wire worms are being continued and special study of the species of cutworms affecting tobacco has been made. There are at least five different kinds that injure the crop in Connecticut.

A Better Strain of Shade Tobacco Among the strains of shade tobacco which have been developed by selection at the Windsor Station, the D strain has met with most favor with shade growers. For the first time this year, it has been raised commercially in larger than one-acre plots. It gives a higher yield, has more uniformity, and thinner leaves higher up on the stalk than the common types.

Weather Records More complete weather records will be obtained at this Station with the installation of instruments for measurement of maximum and minimum temperature and relative humidity. A shelter of approved United States Weather Bureau type has been built to house these instruments and it will also contain a hygrothermograph, which will give a continuous record of temperature and relative humidity. The record of rainfall, which has been kept for several years, will be continued. Wind velocity, wind direction, and sunshine duration indicators, with their appropriate recorders, may be added later.

THE LIBRARY

During the year ended October 31, 1935, the Station Library has had approximately the following number of additions:

U. S. Department of Agriculture bulletins and reports.....	1056
State Agricultural Experiment Station publications	1229
Scientific and agricultural domestic and foreign journals (separates)...	2632
Single books purchased.....	65
Total	4982

The library subscribes to 85 sets of scientific journals. It receives in exchange for its own publications about 24 sets of domestic farm journals and 24 sets of foreign agricultural journals.

The total number of cloth- and paper-bound volumes on hand is now about 22,000. Most of the United States Department of Agriculture and State Experiment Station publications, as well as journals, are received in pamphlet form and are not included in the volume count until bound.

PUBLICATIONS

Bulletins of the Station

- REPORT OF COMMERCIAL FERTILIZERS FOR 1934. E. M. Bailey. No. 365.
 REPORT OF THE DIRECTOR FOR THE YEAR ENDING OCTOBER 31, 1933. No. 366.
 TOBACCO SUBSTATION AT WINDSOR. Report for 1934. P. J. Anderson, T. R. Swanback and O. E. Street. No. 367
 CONNECTICUT STATE ENTOMOLOGIST. 34th Report, 1934. W. E. Britton. No. 368.
 INSECT PESTS OF ELMS IN CONNECTICUT. W. E. Britton and R. B. Friend. No. 369.
 COMMERCIAL FEEDING STUFFS. Report on Inspection, 1934. E. M. Bailey. No. 370
 FURTHER EXPERIMENTS ON MEXICAN BEAN BEETLE CONTROL. Neely Turner and Roger B. Friend. No. 371.
 THE UNIVERSAL SOIL TESTING SYSTEM. M. F. Morgan. No. 372.
 REPORT ON FOOD PRODUCTS AND DRUGS, FOR 1934. E. M. Bailey. No. 373.
 ANALYSES OF COMMON FOODS. E. M. Bailey. Supplement of No. 373.
 CHEMICAL INVESTIGATIONS OF THE TOBACCO PLANT. V. CHEMICAL CHANGES THAT OCCUR DURING GROWTH. H. B. Vickery, G. W. Pucher, C. S. Leavenworth and A. J. Wakeman. No. 374.
 THE GYPSY MOTH. W. E. Britton. No. 375.
 THE IMPROVEMENT OF NATURALLY CROSS-POLLINATED PLANTS BY SELECTION IN SELF-FERTILIZED LINES. II. THE TESTING AND UTILIZATION OF INBRED STRAINS OF CORN. D. F. Jones and W. R. Singleton. No. 376.
 DUTCH ELM DISEASE IN CONNECTICUT. K. Palmer. Circular No. 106.

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PROJECTS ACTIVE IN 1935-36

Analytical Chemistry

1. Inspection of fertilizers.
2. Inspection of feeding stuffs.
3. Inspection of food 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.
9. Biological tests of Vitamin D milk.

Biochemistry

1. Cell chemistry.
 - a. A detailed examination of the constituents of plant cells, in particular those of leaf tissues. The further development of methods for the determination of the different forms of nitrogen extracts of such tissues.
 - b. An investigation of the constituents of the tobacco plant with special reference to the changes that occur during growth and curing.
 - e. The metabolism of the organic acids in plants.
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.
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, in particular the mineral salts, to growth.
 - c. A study of reproduction in the Osborne-Mendel strain of white rats.
 - d. An investigation of the effect of extracts of the thymus gland on the rate of growth of the offspring.

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.
27. Investigations of elm diseases.
28. Studies on the identification of apple varieties by seed characters.
30. Investigations on the diseases of vegetable crops and their control.
31. Investigation of a new peach trouble ("X" disease).

Control and Service

12. Seed testing. (In cooperation with the Commissioner of Agriculture.)
25. Spray service. (With the Extension Service, Connecticut State College.)

Entomology

3. Spraying and dusting experiments on apples and peaches. (See also Botany, No. 8.)
9. Insect survey of Connecticut.
17. Studies on the control of the Oriental fruit moth.
28. Investigations on oil sprays.
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.
34. Tests of methods to control 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.
38. The relation of rate of growth and pruning methods to the recovery of white pine to weevil injury. (In cooperation with the U. S. Dept. Agr.)
39. The Carpenter ant as a pest of telephone poles.
40. Studies of sprays and parasites for the control of the European corn borer. (In cooperation with the U. S. Dept. Agr.)
41. Studies on the corn ear worm. (In cooperation with the U. S. Dept. Agr.)
42. The biology and control of termites.
43. The spruce gall aphid.
44. A native elm bark beetle, *Hylurgopinus rufipes* Eich.

Control and Service

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

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 Quassipaig 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.
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.)
14. Studies on extensive control of the white pine weevil.

Control and Service

5. Distribution of forest planting stock. (Under Clarke-McNary Act.)
7. Control of white pine blister rust. (In cooperation with U. S. Dept. Agr.)
15. Control of Dutch elm disease. (In cooperation with U. S. Dept. of 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

2. The physical and chemical characteristics of important soil types in relation to the nutritive response of tobacco and other crops used as indicator plants in greenhouse fertilizer experiments.
3. Nutrient requirements of vegetable crops on important soil types used for market gardening in Connecticut.
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 soils under heavy fertilization as practiced for tobacco and vegetables.
6. Lysimeter studies of the composition of drainage water as affected by the forest floor.
7. Fertilizer experiments with forest species under nursery and woodland conditions.
8. A study of rapid chemical tests for estimating the nutritive status of the soil.
9. The evaluation of various soil factors in terms of land use and types of farming.

Tobacco Substation

1. Fertilizer experiments—various sources and rates of nitrogen, phosphoric acid, potash, lime and magnesia.
4. Tobacco nutrition studies—the role of nitrogen, sulfur, potassium, phosphorus, calcium, manganese, boron, magnesium and other elements.
5. Improvement of Havana seed tobacco by selection. (In cooperation with U. S. Dept. Agr.)
6. Improvement of Broadleaf tobacco.
7. Improvement of Cuban shade tobacco.
13. Preservative treatment of shade tent poles. (See Forestry, No. 12.)
17. Investigations in the curing of tobacco.
19. Diseases of tobacco.
20. A study of insects that attack the tobacco plant. (See also Entomology, No. 30.)
22. Experiments on the irrigation of tobacco.
23. Studies on the rate of growth of tobacco.
24. The effect of harvesting tobacco at different stages of maturity.

WHAT THE STATION CAN DO

Each mail brings to the Station requests for information and service, the range of subjects being almost without limit. Every effort is made to comply with these requests, even though they are outside the fields under investigation. This is one of the purposes for which the library is maintained. However, some of the letters request help that requires an intimate knowledge of live stock management and the like and others ask us to make laboratory determinations for which we do not have the equipment or staff. Therefore it is helpful to publish from time to time a list of the subjects on which we are best equipped to furnish information and the kinds of samples we can accept.

The Station can furnish information on:

- Fertilizers and fertilization.
- Soils and their management.
- The chemical composition of foods, drugs, insecticides and fungicides.
- Insect pests of plants and their control.
- Fungous and other diseases of plants and their control.
- Sprays and spraying.
- Fruits and fruit management.
- Weeds and their control.
- Forestry—all phases.
- Care of shade trees, all phases.
- Plant breeding.
- Lawns, establishment and care.
- Bees.
- Mosquito elimination.
- Tobacco.
- Vegetables, especially varieties and strains.

Samples and specimens that can be analyzed, tested or identified:

- Fertilizers.
- Feeding stuffs.
- Foods and drugs.
- Milk—except for bacterial count.
- Seeds.
- Weeds and other plants.
- Insects.
- Diseased and injured plants.
- Soils.

The Station does not furnish information on:

- Live stock feeding and management, including poultry.
- Animal diseases.
- Household management.
- Clothing.
- Farm management.
- Markets and marketing.

Requests for information on these subjects should be sent to the Connecticut State College, Storrs.

The Station cannot make analyses and examinations of:

- Drinking water—apply to the State Board of Health, Hartford.
- Milk for bacterial content—apply to the Dairy and Food Commissioner, Hartford.

Sick or dead poultry should be sent to the Animal Diseases Laboratory, Agricultural Experiment Station, Storrs.

All of which is respectfully submitted.

WILLIAM L. SLATE,

Director.