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THIRTY-NINTH REPORT

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State Entomologist

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WILTON EVERETT BRITTON

September 18, 1868—February 15, 1939

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WILTON EVERETT BRITTON

Roger B. Friend

Doctor Wilton Everett Britton, State Entomologist of Connecticut and Entomologist of the Agricultural Experiment Station at New Haven, died February 15, 1939, in his seventy-first year. He had been a member of the staff of the Agricultural Experiment Station since 1894 and State Entomologist since the office was established in 1901. During his long and useful career he exemplified that devotion to his profession and to the welfare of his State that characterizes a public servant of the highest calibre.

Dr. Britton descended from a line of New England ancestors going back to James Britton who, at the age of 27, arrived in America on the *Increase* April 15, 1635. Probably he came from London, and he lived for a time in Charlestown, Massachusetts. The succeeding generations of the family, dwelling in eastern Massachusetts, southern Maine, and southern New Hampshire, were presumably typical of that class which formed the backbone of the population, a race of farmers, sailors, mechanics, small merchants, and, when wars were afoot, soldiers. Dr. Britton's father, Benjamin Howard Britton, was born at North Easton, Massachusetts, in 1833 and died at Gilsum, New Hampshire, in 1899. In 1861 he married Emily Eliza Wright, whose great grandfather had come from Hartford, Connecticut, and died at Keene, New Hampshire, in 1812.

Dr. Britton was born at Marlboro, Massachusetts, September 18, 1868. His family moved to a farm in Gilsum, New Hampshire. There, in a distinctly rural environment, the impress of which lasted throughout his life, Dr. Britton spent his early years. He attended the local schools and worked on the farm, raising the crops, caring for livestock, lumbering, making maple sugar, etc. Life was a bit rigorous, but conducive to integrity, industry, frugality, and independence of thought and action. He enjoyed it. Later he attended the New Hampshire College of Agriculture and Mechanic Arts at Hanover (now the University of New Hampshire at Durham), from which he received the degree of Bachelor of Science in 1893. If later performance is any criterion, he must have been a good student. The year following graduation was spent at Cornell University studying under L. H. Bailey. Apparently at that time Dr. Britton's main interests lay in the field of horticulture.

In 1894 the opportunity came to obtain a position as horticulturist at the Connecticut Agricultural Experiment Station at New Haven. Both student and professor evidently believed this position offered great promise professionally, for Dr. Britton once told the writer that Bailey advised him to take the job even if he received no salary. The advice was followed, although salary there was—fifty dollars a month. This inclination to disregard remuneration when offered an opportunity to work in his field was quite characteristic. While at the Agricultural Experiment Station he continued graduate study in the Department of Botany at Yale University and received the degree of Doctor of Philosophy from that institution in 1903.

During his tenure as horticulturist, Dr. Britton collaborated with the Station chemist, Dr. E. H. Jenkins, in fertilizer investigations, worked with "forcing-house" crops, conducted experiments in grafting nut trees, and began his entomological career. The reports of the Experiment Station during this period indicate that his work was carefully done and of such high quality that the confidence of his superiors became firmly established.

Dr. Britton's interest in entomology dates back to his boyhood days. The economic aspect of the science was early impressed on him by long hours spent in the hot summer sun knocking Colorado potato beetles off the plants into a can. While at college he made a collection of insects and built a fine cabinet with eighteen glass-topped drawers to house it. This was the foundation of the present collection at the Experiment Station, and the cabinet is still in use. At this time he also wrote an article entitled "The Horn Fly", which was published in the New Hampshire College Monthly in 1893. While working in horticulture, his attention was drawn to insect pests of cultivated plants and he considered them well worth investigating. In the report of the Experiment Station for the year 1894, a short article entitled "Notes on Some Leaf Miners" (pp. 143-146) bears his signature. This describes the life cycle and habits of *Odontocera dorsalis* Loew (*Cerodontha femoralis* Meigen), the habits of which had been unknown up to that time, on corn, and *Phytomyza aquilegiae* Hardy, not previously known to have occurred in this country, on columbine. At this time the Station mycologist, Dr. Sturgis, was interested in insect pests and contributed articles on the subject to the Station reports.

Dr. Britton gradually swung to entomology, emphasizing this phase of his work increasingly each year. His horticultural and botanical training stood him in good stead, and he never fully relinquished his interest in these fields. Even during the latter part of his life he remained the Station authority on the identity of native plants and horticultural varieties. In the Station Report for 1895, he published short articles on several insects, including one on the greenhouse whitefly, and, in collaboration with Sturgis, an article on the San José scale. These two last were the first of a number of contributions to our knowledge of whiteflies and scale insects. Also in 1895 appeared Station Bulletin 121 on the elm leaf beetle, by Britton, Sturgis, Jenkins and Johnson. Dr. Britton later became a widely known authority on insects affecting trees. In the Report for 1896 the section entitled "Insect Notes" was written by Dr. Britton, who had apparently by this time assumed the entomological work of the Station. The Report for the following year states: "The necessary Entomological work of the Station, such as the determination of species of insects sent for identification, experiments in the destruction of insect pests, and the efficiency of various insecticides, has also been done by Mr. Britton". In this Report, and those of the next few years, the work of the horticulturist is briefly noted by the Board of Control under the title of "Horticultural and Entomological Work". Apparently the die was cast, and Dr. Britton decided to devote much of his time to entomology.

From 1897 to 1901, while still carrying on horticultural investigations, Dr. Britton gave increasing attention to entomological problems. He published bulletins and short articles on fruit, garden, greenhouse, and shade tree pests. The nursery inspection work began in 1898 when eleven nurseries were examined and eight certificates issued. Other states were demanding inspection certificates on nursery stock shipped into their territory, so inspection of Connecticut nurseries became necessary. At this time the San José scale was a notorious pest of fruit trees, and in 1899 the Station Board of Control formally adopted regulations regarding nursery inspection. In the Report of the Station for 1900 the following statement occurs: "More than fifty insects have been sent in by farmers for identification. These have been in every case named and all available information given as to their habits and, where necessary, as to the best way of destroying them..... The facilities of the department have been greatly increased by the addition of a microscope and accessories and by fitting up a new office and laboratory for Mr. Britton." In 1900 appeared Bulletin 131, "Protection of Shade Trees", by Jenkins, Britton, Graves, and Blake, a report by the committee to the Mayor of New Haven.

At the January Session for 1901, the General Assembly passed "An Act Concerning Insect Pests" which required the Board of Control of the Agricultural Experiment Station to appoint a State Entomologist to serve during the pleasure of the Board and to be responsible to it. He was to receive no compensation other than his salary as a member of the Station staff. In July, 1901, Dr. Britton was appointed and received the title of Entomologist of the Station as well as that of State Entomologist, although he continued his horticultural work for several years. Apparently this Act of the General Assembly was the result of the desire of nurserymen and orchardists to be protected against insect pests. The Connecticut Pomological Society was particularly active in the matter. The Act provided for general duties of the State Entomologist, including nursery inspection, inspection of other premises, investigations, publication of bulletins, etc., and an appropriation of $3,000 a year for two years. One of Dr. Britton's first purchases was "an excellent photographic outfit". This camera is now used by the Entomology Department for making enlargements, and the lens is still used for regular photographic work.

The State Entomologist undertook his duties with energetic enthusiasm. He not only met various situations as they arose, but, prophetically, anticipated future problems and was prepared for emergencies. The demands on his office increased as time went on, and the high quality of service rendered the people of the State engendered confidence in the work. With the increase of personnel to the staff and a multiplication of tasks, including research, control, quarantine, publication, and the manifold activities involved in keeping track of insect pests and informing the people of the State about them, Dr. Britton's work gradually shifted in emphasis from research to administration. In Connecticut the State Entomologist is also Entomologist of the Agricultural Experiment Station, and hence directs the research and also administers all regulatory phases of entomology, an ideal arrangement for a small state.

Some conception of the work carried on by the Entomologist and his staff may be obtained by briefly reviewing the succession of insect pests which received attention during Dr. Britton's term of office. The presence of these pests necessitated a series of investigations of their life cycles, habits, relations to the environment, economic importance, and frequently large scale control operations and the enforcement of quarantines and other regulations.

During the first few years, the San José scale was a major problem in orchards and nurseries. In 1903 the salt marsh mosquito nuisance received some attention, and the investigations conducted gradually led to the organization of a state-wide marsh drainage program and the maintenance of such areas free of mosquito breeding centers. The inhabitants of shore towns have benefited materially by this work. In 1906 the gypsy moth was discovered at Stonington, and vigorous measures were undertaken to suppress it. Gypsy moth suppression is an important part of the work of the Entomologist today. The remarkably small amount of injury by this insect to the forests of the State reflects the efficiency of the gypsy moth control program. In 1909 the General Assembly, as a result of agitation by the Connecticut Beekeepers' Association, passed an apiary inspection law and placed the inspection service under the State Entomologist. European foul brood was then the most important disease of bees in the State, and the apiary inspection was an attempt to reduce the infection of this as well as other diseases. In August, 1915, *Diprion simile*, a European sawfly injurious to pines, was discovered in New Haven, its first appearance in the United States. Its biology was investigated at once and control measures developed. The laws pertaining to gypsy moth control and mosquito elimination first became effective in 1915. In 1918 the Oriental fruit moth was found in Connecticut. This insect became definitely injurious to the peach crop in 1923 and since then has caused tremendous loss to the peach industry. Efforts to develop a practical means of controlling it have involved a long series of insecticide and parasite investigations. The present work in the biological control of insect pests carried out at the Experiment Station is an outgrowth of fruit moth investigations.

Two interesting fruit tree pests were discovered in the State in 1920, the European red mite and the apple and thorn skeletonizer, both immigrants from Europe. The red mite is still seriously injurious to apple and pear orchards unless artificially controlled and has been a subject of intense study. The skeletonizer was very abundant for a few years but is not common in orchards at present.

The impetus to the study of insects affecting lawns and similar grasslands was furnished by the discovery of the Asiatic beetle in the western part of New Haven in 1922. This was the first time it had been found in the United States. A vigorous attempt to eradicate the insect failed, but in the course of the next few years suitable control measures were developed.

In 1923 the European corn borer was found in Groton and Niantic. Suppressive measures were undertaken in coöperation with the Federal Bureau of Entomology, and quarantine lines were drawn. Although the dispersion of the insect was retarded for a few years, the entire State has since become well infested. Laws relating to the destruction of borer-containing material were enacted and are still in force. At present insecticidal control measures are being developed.

Several other pests of more or less importance have appeared in the State since the corn borer arrived. In 1924 the birch leaf-mining sawfly, of European origin, was discovered, the first definite record for the country, although injured birch leaves had been noticed the previous year. A study of its biology, economic importance, and control was undertaken with the result that ornamental birches can be protected. The Japanese beetle arrived in 1926. In spite of the enforcement of federal and state quarantine regulations, the insect spread over the State in a few years, although at present it is injuriously abundant in only a few towns and cities. Particular attention is being given to the parasites and diseases of this notorious pest. In 1929 the Mexican bean beetle was found in southwestern Connecticut, and two years later it was everywhere abundant. Insecticidal and cultural control methods were soon found which were applicable to Connecticut conditions. The Dutch elm disease had reached Connecticut in 1933, and investigation of the elm bark beetles transmitting this disease was begun at once. The felted beech scale and the European spruce sawfly, both potentially serious pests of forest trees, were found in the State in 1934 and 1935 respectively. Neither has caused much injury to date, but both are being watched.

During all this period the insect collection of the Station was steadily built up. It now contains about 7,000 species of Connecticut insects, the total specimens numbering over 100,000. This collection is of inestimable value to the work of the Entomology Department and is frequently used by entomologists from all parts of the country.

Dr. Britton's professional interest in entomological work involved several fields of activity. From 1901 to 1905 he lectured in forest entomology at the School of Forestry of Yale University. From 1910 to 1929 he was Associate Editor of the *Journal of Economic Entomology*. In 1911 appeared the first of a series of taxonomic bulletins entitled "Guide to the Insects of Connecticut", prepared under his direction and published by the Connecticut Geological and Natural History Survey. This first volume contained "Part I, General Introduction" by Dr. Britton, and "Part II, Euplexoptera and Orthoptera of Connecticut" by B. H. Walden, a member of his staff. "Part III, The Hymenoptera or Wasp-like Insects of Connecticut", which appeared in 1916, was compiled by H. L. Viereck, a member of his staff, in collaboration with other authors. Dr. Britton wrote the sections on Coccidae and Aleyrodidae in "Part IV, The Hemiptera or Sucking Insects of Connecticut", published in 1923. Another staff member, Dr. Philip Garman, wrote "Part V, The Odonata or Dragonflies of Connecticut". Dr. Britton wrote the "Check-List of the Insects of Connecticut", published in 1920 as Bulletin 31 of the Survey, and its "First Supplement", published in 1938 as Bulletin 60. The latter bulletin also contained the "Check-List of the Spiders of Connecticut" by another of the staff, Dr. B. J. Kaston. At present a continuation of this series, the Diptera, is being prepared for publication. From 1925 until his death, Dr. Britton was Superintendent of the Survey, part of the time, during an economic stringency when the General Assembly eliminated the appropriation for its support, serving without salary.

Dr. Britton served on the Board of Governors of the Crop Protection Institute from 1922 to 1924. He was for many years a member of the Eastern Plant Board and its Chairman in 1936. Since the formation of the Connecticut Tree Protection Examining Board in 1919 he acted as chairman until his death. The Board held institutes for the instruction of tree workers for a few years, and this led to the formation of the Connecticut Tree Protective Association in 1922. In 1924 a Shade Tree Conference, with Dr. Britton as Chairman, was held in Stamford, Connecticut. This soon became national in scope, and the fifth conference in Brooklyn, N. Y., in 1929 became the Fifth National Shade Tree Conference. For many years Dr. Britton also served on the National Malaria Committee.

By his associates in science and in agricultural work, Dr. Britton was highly esteemed. He was a member of the American Association of Economic Entomologists and its president in 1909, a fellow of the American Association for the Advancement of Science and of the Entomological Society of America, a member of the Connecticut Botanical Society, Sigma Xi and Phi Kappa Phi. In 1930 the University of New Hampshire conferred upon him the honorary degree of Doctor of Science. In 1936 the Connecticut State College awarded him Honorary Recognition as a leader in agriculture and rural life. He belonged to many agricultural organizations in the State.

Dr. Britton was interested in civic affairs and an ardent patriot. He was the first president of the Edgewood Civic Association, in 1908, and again held this office in 1920. He organized and served as director and president of the Donald G. Mitchell Library in Westville. From 1912 on he was a director of the Young Men's Institute of New Haven and from 1925 to 1932 he served on the Board of Directors of the New Haven Public Library. From April, 1917, to December, 1920, he was a member of the Second Company, Governor's Foot Guard. During the World War he was chairman of the Committee on Food of the New Haven War Bureau.

The list of Dr. Britton's publications is too long to include here. He wrote about 541 scientific bulletins and shorter articles on horticultural, botanical and entomological subjects, and over 41 other articles on various matters. Among his outstanding contributions to entomology, the series "Guide to the Insects of Connecticut" has been mentioned. His annual reports of the State Entomologist, 38 in number, are unsurpassed in both text and illustration. They cover all phases of work in economic entomology in the State. He wrote the "Plant Pest Handbook, I. Insects", an outstanding experiment station publication. A facile writer, his publications exhibit meticulous care in preparation.

A man's accomplishments depend on his personal qualities. Dr. Britton adhered to sound principles in his personal affairs and his relations to members of his staff and other associates in his profession, as well as to his community. Although inherently conservative and personally rigidly adherent to an ethical code which demanded honesty, integrity and candor, he was at the same time liberal in his judgment, tolerant in his decisions, disinterested and generous. To the members of his staff he was always stimulating. Interested in every phase of their activities and demanding intelligent application to the task at hand, faithful performance, loyalty, and devotion to the public welfare, at the same time he neither interfered unduly in their work nor evaded responsibility for their acts. He was excessively careful in giving them credit for whatever they accomplished. Those outside the Experiment Station with whom the State Entomologist coöperated in many phases of entomological work found him an ideal associate, and the community in which he lived benefited by his presence. In spite of his manifold tasks and remarkable productivity, he took the oscillations of fortune philosophically, confident of the outcome.

unperturbed, saved from fretfulness by a serene disposition and a sense of humor.

Dr. Britton became ill in the summer of 1938 and before winter it was obvious that an operation would be necessary. Although he realized the seriousness of his condition, he calmly kept at his work while following the advice of his physician. The operation failed to clear up the trouble. Ultimately, unable to care for himself, he went to a hospital in New Haven. The members of his staff kept him in touch with affairs at his office, and his interest in the work continued as long as he was able to carry on a conversation. Although he must have suffered intensely at times, he never complained of physical discomfort. His own personal future did not appear to concern him greatly; the inevitable was beyond his control. Gradually weakening, he finally sank into a coma and died.

He was buried in Surry, New Hampshire, in the grave beside his wife, Bertha Madeline Perkins, whom he had married in 1895 and who died in 1938. There were no children.

CONNECTICUT STATE ENTOMOLOGIST

THIRTY-NINTH REPORT

1939

R. B. Friend

INTRODUCTION

Doctor Wilton Everett Britton, State Entomologist of Connecticut since the office was established in 1901, died February 15, 1939. A brief biographical sketch of Dr. Britton is included in this report.

The staff was augmented this year by the appointment of Raimon L. Beard, who received the degree of Doctor of Philosophy from Yale University in June. Doctor Beard has been a temporary employe of the Station for several summers, giving particular attention to the squash bug. He will continue to work with vegetable crop pests.

In its research work the staff has continued to devote most of its time to a group of major insect pests affecting fruit orchards, vegetable crops, grasslands, and shade and forest trees. The biology of these pests has been studied and efficient means of controlling them sought by the use of insecticides, parasites, cultural practices, etc. Among those investigated, particular attention was given to the apple maggot, European red mite, Oriental fruit moth, red-banded leaf roller, Japanese beetle, a native scarabaeid (*Cyclocephala borealis*) affecting lawns, chinch bug, European corn borer, squash pests, potato flea beetle, white pine weevil, European pine shoot moth, European elm bark beetle, and rodents. The progress made in these investigations is indicated in the following pages of this Report and in the bulletins and scientific papers published by the staff, a list of which is to be found at the end of this bulletin. The coöperation of the Federal Bureau of Entomology and Plant Quarantine in various entomological problems, and of the Federal Bureau of Biological Survey in rodent control, is gratefully acknowledged.

In addition to research work, members of the staff are constantly requested by citizens of the State to investigate pest outbreaks and injury on farms, in home vegetable and flower gardens, in forests and on estates, in homes and public buildings, etc. These requests, which involve anything from rabbits, rats, and mice to insects and organisms in drinking water, receive immediate attention either by mail or personal visits, and information on control is given the persons concerned. Most of the pests are insects affecting plants, household insects and termites. The effect of the hurricane on trees and shrubs along the shore of the sound has been investigated and the results summarized in this Report.

The State Entomologist is responsible for the inspection of nurseries and apiaries, the enforcement of insect quarantines, and the control of the gypsy moth, all of which are reported in the following pages. Mosquito control on salt marshes is now carried out under the direction of a Board of Mosquito Control of which the Director of this Station is at present Chairman. This work is also reviewed.

INSECT RECORD FOR 1939

CERTAIN species of insect pests were unusually abundant and injurious in 1939 or deserve mention for some other reason. One of the most important features of the season was the great increase in abundance and injuriousness of the Japanese beetle (*Popillia japonica* Newm.). This insect attained the status of a serious pest of ornamental trees and shrubs and of grapevines in parts of Fairfield, Hartford and New Haven counties, and the larvae injured grassland in these as well as in some other parts of the State. In the vicinity of Windsor, beetles were observed feeding on tobacco leaves.

The gypsy moth (*Porthetria dispar* L.) increased in abundance in the Granby-Simsbury area; trees on 2500 to 3000 acres were completely defoliated. A small but heavy infestation, in which trees on about one acre were stripped of leaves, was found on the Southbury-Roxbury line.

The fall webworm (*Hyphantria cunea* Drury) was quite abundant over most of the State, perhaps more so in Fairfield and New Haven counties than elsewhere.

The European elm bark beetle (*Scolytus multistriatus* Marsh.) was more abundant than usual in New Haven County and has spread eastward somewhat into the towns along the Connecticut River south of Hartford.

The locust leaf miner (*Chalepus dorsalis* Thunb.) was quite abundant in Middlesex and New London counties and badly injured the foliage of many black locust trees.

The walnut caterpillar (*Datana integerrima* G. & R.) stripped the foliage from many black walnut, butternut, and shagbark hickory trees late in the summer.

In northwestern Connecticut the elm flea beetle (*Altica ulmi* Woods) has been abundant during the last two years. In 1939 the foliage of some elms in this region was severely injured.

The elm spanworm (*Ennomos subsignarius* Hübn.) outbreak in Monroe, where trees on about 250 acres of forest were defoliated in 1938, declined noticeably in 1939.

The forest tent caterpillar (*Malacosoma disstria* Hübn.) was less abundant in western Connecticut than in previous years. The outbreak appears to be definitely declining.

The first generation of the Oriental fruit moth (*Grapholitha molesta* Busck) was unusually abundant in June in Fairfield and New Haven counties and was quite abundant throughout the State. Egg parasitism by *Trichogramma*, as well as larval parasitism, was high. The second generation was less numerous and the fruit in general was less heavily infested than in 1938.

The plum curculio (*Conotrachelus nenuphar* Hbst.) was seriously injurious to apples, peaches, and cherries in New Haven County. This insect was more conspicuous than usual.

The apple maggot (*Rhagoletis pomonella* Walsh) was unusually abundant over much of the State late in the summer. The European red mite (*Paratetranychus pilosus* C. & F.), another pest of apples, was less injurious than usual in New Haven County.

The rose chafer (*Macrodactylus subspinosus* Fabr.), which is a rather omnivorous feeder, injured peach trees and Siberian elms in New Haven and Middlesex counties.

The rosy apple aphid (*Anuraphis roseus* Baker) was not as injurious as usual in orchards, because of an unfavorable season.

The European corn borer (*Pyrausta nubilalis* Hübn.) reached the highest population density ever recorded in Connecticut. In early sweet corn in New Haven County the number of first generation larvae averaged about 20 per cornstalk. Many fields of sweet corn were a total failure. Another corn pest, the corn ear worm (*Heliothis obsoleta* Fabr.) was abundant late in the summer in southern Connecticut. About seven acres of early sweet corn in Southbury were severely damaged by a species of thrips. In East Haven a 12-acre field of corn suffered severely from armyworms (*Cirphis unipuncta* Haw.).

The cabbage maggot (*Hylemyia brassicae* Bouché) was abundant, the injury in untreated fields of cabbage, cauliflower and broccoli ranging up to an almost total loss.

Early potato fields were severely injured by the flea beetle (*Epitrix cucumeris* Harr.) and the aphid (*Macrosiphum solanifolii* Ashm.). The aphid was particularly injurious in Fairfield County, and, on late potatoes, in the Connecticut River Valley. The potato leafhopper (*Empoasca fabae* Harr.) was more abundant than in 1938 and tipburn was common.

Squash and melons suffered from the attack of the striped cucumber beetle (*Diabrotica vittata* Fabr.), and the squash borer (*Melittia satyriniformis* Hübn.) was locally injurious to squash.

The spinach leaf miner (*Pegomyia hyoscyami* Panz.) severely injured early beets in some fields.

The Mexican bean beetle (*Epilachna varivestris* Muls.) was not very serious throughout the State, although a few fields were heavily infested.

The wireworm (*Limonius agonus* Say) was more abundant in tobacco fields than in 1938, but less abundant in potato fields.

The European earwig (*Forficula auricularia* L.) was first found in Connecticut in the western part of New Haven in 1938. During 1939 it was discovered in several adjacent yards.

The harlequin cabbage bug (*Murgantia histrionica* Hahn) was found at Mt. Carmel where three specimens were collected. This is the first record of this southern pest in Connecticut since 1910.

Chinch bugs (*Blissus hirtus* Montcl.) were quite injurious to lawns late in the summer. The dry weather apparently favored their increase.

The Oriental beetle (*Anomala orientalis* Waterhouse) caused the usual amount of injury to untreated lawns in the towns of Greenwich, Stamford and New Haven.

The Asiatic garden beetle (*Autoserica castanea* Arr.) was somewhat more abundant in grasslands in southwestern Connecticut than usual. A field of corn in Westport was badly injured.

During the year the office received, by mail or messenger, 568 specimens about which information was requested. They have been grouped in economic categories and are listed below:

Specimens Received—1939

Fruit pests	35
Field, vegetable, and truck crop pests	24
Forest and shade tree pests	169
Pests of shrubs and vines	24
Flower and greenhouse pests	34
Household and stored food products pests	78
Timber and wood products pests	61
Soil and grassland inhabiting pests	61
Insects annoying man and domesticated animals	16
Parasitic and predaceous insects	17
Miscellaneous	49
	568

This list does not in any way indicate the economic significance of the groups of pests, but does reflect the importance of a part of the work of the Department and the value of its collection of Connecticut insects, to which specimens may be referred for identification. Termites (or materials injured by them) head the list of insects, with 38 specimens received. Termites are very injurious to houses and other wooden structures and the public's interest in them is keen. The next on the list is the cicada killer, a wasp which preys on cicadas, 16 specimens. The burrows of this large, beautiful insect are very conspicuous in lawns in the late summer. It is an interesting species, but not a serious pest. The carpenter ant, often mistaken by the public for a termite, holds third place with 11 specimens received. This insect is injurious to structural wood and to trees. Eight specimens of each of the following were received: fleas, Oriental beetle grubs, and black carpet beetles. Fleas are pests of both man and his pets, the dog and cat, and the pets are usually responsible for infestations. Oriental beetle grubs kill lawn grass. The carpet beetle injures woolen clothing, rugs, etc. Five or six specimens of each of the following arrived: the plum curculio, a pest of fruit; the elm flea beetle; the hickory tussock caterpillar; the rose chafer, an omnivorous feeder on foliage and flowers; the German roach, a household pest; the Indian meal moth, a pest of cereals, flour, etc.; and the Chinese praying mantid, a very large insect which preys upon grasshoppers, caterpillars, etc.

CONFERENCE OF CONNECTICUT ENTOMOLOGISTS

At the invitation of Professor J. A. Manter, who made all arrangements for the meeting, the sixteenth annual conference of Connecticut entomologists was held at the Community House, University of Connecticut, Storrs, on Friday, October 27, 1939. Doctor R. B. Friend was appointed chairman and 90 persons were present. Luncheon was served at the university grill. Unfortunately President Jorgensen could not be present, but Professor H. D. Newton, Dean of the Department of Arts and Sciences, welcomed the group on behalf of the University. Mr. A. F. Burgess was unable to attend and Mr. S. S. Crossman from his office took his place. The program was arranged in three sections: the first, a discussion of the European corn borer, led by Mr. Neely Turner; the second, a consideration of the Japanese beetle, led by Mr. J. P. Johnson, and the third on the gypsy moth with Mr. John T. Ashworth leading. The program planned was as follows:

Greeting, President A. N. Jorgensen, Storrs, Conn.

The European Corn Borer

- The Status of the Insect in Connecticut. Neely Turner, New Haven, Conn.
- Experiments with Dust Insecticides in 1939. C. H. Batchelder, New Haven, Conn.
- Biological Strains of the European Corn Borer. K. D. Arbuthnot, New Haven, Conn.

Dr. W. E. Britton. E. P. Felt, Stamford, Conn.

The Japanese Beetle

- The Status of the Insect in Connecticut. J. P. Johnson, New Haven, Conn.
- Nematode Parasites of the Japanese Beetle. H. B. Girth, White Horse, N. J.
- Bacterial Diseases of the Japanese Beetle. C. H. Hadley, Moorestown, N. J.

Moving Pictures of Insect Life. J. A. Manter, Storrs, Conn.

Connecticut Wildlife Problems. R. P. Hunter, Hartford, Conn.

The Gypsy Moth

- The Gypsy Moth Problem in Connecticut. J. T. Ashworth, Danielson, Conn.
- Federal Gypsy Moth Control Work. A. F. Burgess, Greenfield, Mass.
- The Parasites of the Gypsy Moth. R. C. Brown, New Haven, Conn.

INSPECTION OF NURSERIES, 1939

M. P. Zappe

The annual inspection of nurseries started on July 1, 1939, as required by Section 2136 of the General Statutes. The writer, assisted by Messrs. A. F. Clark, W. T. Rowe and R. J. Walker, inspected all the larger nurseries during the months of July and August. The smaller ones were inspected during September, and all regular work was completed by the end of that month. Several of the nurseries were inspected a second time to check on the eradication of pests.

As a whole the nurseries were in better condition than in 1938. The business had improved slightly, and consequently nurserymen took a little better care of their stock. A few nurseries, however, are still somewhat neglected.

Altogether, 96 different insect pests and 52 plant diseases were found in nurseries in 1939, most of them, however, of minor or no importance. San José scale is very scarce at the present time. Spruce gall aphids were much less abundant than usual, especially in the hurricane area. European pine shoot moth was a little less abundant than in 1938. Pine leaf scale, on the contrary, was much more prevalent than last year. Poplar canker is becoming less abundant, perhaps because some of the nurseries have ceased growing Lombardy poplars. The presence of "X" disease of peach in Connecticut has made necessary stringent regulations for the growing of peach nursery stock. Nurserymen growing peach trees have received copies of these regulations.

Some of the more important pests that may be carried on nursery stock, with the number of nurseries infested by each for the past 10 years, are shown in the following table:

Table 1. Ten-Year Record of Certain Nursery Pests

Pest	1930	1931	1932	1933	1934	1935	1936	1937	1938	1939
Oyster-shell scale	86	73	68	78	104	93	87	84	53	49
San José scale	8	11	10	13	19	17	11	8	2	1
Spruce gall aphids[1]	99	124	141	231	244	285	337	306	312	216
White pine weevil	66	74	70	61	67	98	82	101	97	93
Pine leaf scale	10	20	26	46	66	42	72	60	25	50
European pine shoot moth	17	32	77	137	120	121	108	128	130	110
Poplar canker	35	23	40	34	39	28	28	26	20	14
Pine blister rust	7	13	12	11	7	2	0	4	5	3
Nurseries uninfested	18	32	24	22	21	16	26	25	32	19
Number of nurseries	302	327	351	362	381	373	380	377	402	399

[1] Includes both *Adelges abietis* and *A. cooleyi*.

Number and Size of Nurseries

The list of nurserymen for 1939 contains 399 names, a decrease of three since 1938. A classification of nurseries by size is given in the following table:

Area	Number	Percentage
50 acres or more	18	5
10 acres to 49 acres	44	11
5 acres to 9 acres	33	8
2 acres to 4 acres	96	24
1 acre or less	208	52
	399	100

Of the 399 nurseries listed for 1939, 10 new nurseries were registered and inspected before the spring shipping season and again in late summer. These are marked "(2)" after the name, because each was inspected twice and granted two certificates during the year.

Seven nurserymen failed to register before July 1, 1939, and, as provided in Section 2137 of the General Statutes, were charged for the cost of inspection, a minimum fee of $5.00 in each case. All but two have paid, and $25.00 has been turned over to the Treasurer of the Station to be sent to the State Treasury.

The area of Connecticut nurseries receiving certificates in 1939 is 4,833 acres, a decrease of 198 acres since 1938. Altogether 30 new nurseries have been added, and 33 have discontinued operations either temporarily or permanently since last year. Some of these registered, others did not; but only a few notified this office of their change. Consequently the inspector visited most of them before learning that they were out of the business. A few nurseries listed in 1938 are on the 1939 list under different names, thus changing the alphabetical arrangement. The nursery firms receiving certificates for 1939 are as follows:

Connecticut Nursery Firms Certified in 1939

Name of firm	Address	Acreage	Certificate number
Ackerman, H. S.	West Hartford	4	4417
Adamcyk, Frank	Deep River	1	4724
Adamec Evergreen Nursery, George	East Haven	1	4757
Aldrich, Edward	Guilford	1	4489
Aldrich, Miss Inie E.	Plymouth	1	4637
Allara, Dima	Hamden	1	4628
Allen, Henry L.	Pawcatuck	1	4737
Amato, Rose	Cromwell	2	4725
American Nursery & Tree Expert Co.	Rockfall	40	4472
Andover Gardens	Andover	1	4446
Anstett Nursery, Louis	Norfolk	2	4480
Artistree Nursery	Branford	3	4490
Austin, Jr., Irving M.	Greenwich	2	4823
Backiel, Adolf	Southport	1	4632
Bailey's Nursery, Ralph	West Cornwall	1	4661
Bakhmeteff, Boris A.	Brookfield	10	4654
Baldwin, Linus	Middletown	1	4747
Banak Nurseries	New Britain	4	4618
Banigan, R. D.	Danielson	4	4502
Barnes Bros. Nursery Co., The	Yalesville	200	4686
Barton Nursery	Hamden	1	4695
Beach, Roy G.	Forestville	1	4652
Beattie, W. H.	New Haven	1	4714
Bedford Gardens	Plainville	1	4549
Bedini, Vincent	Ridgefield	3	4741
Beers, Herbert P.	Southport	1	4801

CONNECTICUT NURSERY FIRMS CERTIFIED IN 1939—(Continued)

Name of firm	Address	Acreage	Certificate number
Beran Landscape Developers & Florists (2)	New London	1	4467
Berg, Fred	Stamford	4	4418
Berkshire Gate Nurseries	Danbury	1	4454
Bertolf Brothers	Old Greenwich	40	4698
Biehler, Mrs. Augusta	Plainville	1	4552
Binnenkade's Nursery	New London	1	4414
Blue Hills Nurseries, Inc.	Avon	30	4464
Boggini Nursery, L.	Manchester	1	4588
Bollerer, F. G., Anderson Ave. Nursery	West Haven	1	4680
Bonnie Brook Gardens	Rowayton	2	4807
Booy, H. W.	Yalesville	4	4521
Boschen, George E.	West Haven	1	4797
Brack Nursery	New Milford	3	4635
Brainard Nursery & Seed Co.	Thompsonville	14	4655
Branford Nurseries	Branford	6	4766
Bretschneider, A.	Danielson	1	4456
Bridgeport Hydraulic Co.	Bridgeport	15	4419
Brimfield Gardens Nursery	Wethersfield	8	4503
Bristol Nurseries, Inc.	Bristol	65	4497
Brooklawn Conservatories	Bridgeport	1	4476
Brooklawn Nursery	Bridgeport	1	4722
Brooks, H. P.	West Haven	1	4562
Brookside Nurseries	Darien	5	4670
Brouwer Nursery, Jack	New London	6	4677
Brouwer's Nurseries	New London	25	4631
Brouwer's Nurseries, Peter	New London	4	4479
Buell's Greenhouse	Guilford	1	4814
Burke the Florist	Rockville	1	4667
Burnett's Corners Farm, The	Groton	2	4649
Burnside Avenue Greenhouse & Nursery	East Hartford	4	4657
Burr, Morris L.	Westport	1	4522
Burr & Co., C. R.	Manchester	500	4681
Burwell Seed Co., E. E.	New Haven	1	4794
Byram Nursery	East Port Chester	1	4738
Candlewood Nursery	Danbury	1	4742
Cannavo, Tony	Winsted	1	4457
Cardarelli, E. J.	Cromwell	5	4505
Cascio Nursery, The Peter	West Hartford	15	4420
Centerbrook Nursery & Tree Expert Co.(2)	Centerbrook	1	4484
Charlie's Stand	East Hartford	1	4511
Cherry Hill Nursery, Inc.	Rockfall	5	4449
Chiapperini & Sons, Michele	Groton	2	4466
Child's Gardens	Kent	1	4461
Chippendale Nurseries, Inc.	Old Lyme	2	4743
Choate School, The	Wallingford	4	4693
Chudy, Peter	Danbury	1	4592
City Line Florist	Bridgeport	1	4530
Clark, Arthur H.	Yalesville	1	4816
Cleary's Gardens	Bethel	1	4770
Clinton Nurseries	Clinton	60	4493
Clyne Nursery & Florist	Milldale	1	4668
Coley, H. W.	Westport	1	4643
Conine Nursery Co., Inc.	Stratford	75	4610
Conn. Agr. Expt. Station (W. O. Filley, Forester)	New Haven	2	4753

CONNECTICUT NURSERY FIRMS CERTIFIED IN 1939—(Continued)

Name of firm	Address	Acreage	Certificate number
Connecticut Forestry Nurseries	Deep River	15	4599
Conn. State Forestry Department	Hartford	8	4688
Conn. State Highway Department	Hartford	18	4581
Connecticut Valley Nurseries	Manchester	39	4689
Cooke, C. W. (2)	Branford	1	4664
Corrigan's West Haven Nursery	West Haven	1	4627
Cronamere Alpine Nurseries, Inc.	Greens Farms	7	4496
Cylkowski, B.	Simsbury	2	4810
Daisy Hill Gardens	Derby	1	4598
Damen, Peter J.	East Haven	2	4509
Daniel, Joseph (2)	Bridgeport	1	4576
Daybreak Nurseries	Westport	3	4758
DeBaise, Pasquale	Wallingford	2	4648
DeMars Nursery	Winsted	1	4768
DesPierre, Lawrence	Hamden	1	4713
Dewey, V. E.	Groton	2	4790
Dietrich Nursery, Benjamin	Greenwich	4	4746
Dillon, Thomas	Greenwich	1	4525
Dingwall, Joseph N.	West Haven	1	4482
Dixon, Harry	Stamford	2	4421
Doane, David F.	Haddam	1	4719
Donovan, Daniel	Talcottville	1	4506
Donovan, John N.	Rocky Hill	3	4775
Drenckhahn, Ernest J.	Cos Cob	10	4625
Dudley, Grace W.	Guilford	1	4796
Dunlap's Dollar Evergreens	Cromwell	3	4751
Dunn, John	Danbury	1	4817
Eager, Edward M.	Bridgeport	1	4563
East Haven Nursery	East Haven	1	4611
Edgewood Nurseries	New Haven	1	4777
Elfgren Nurseries	East Killingly	3	4646
Elliott, Jessie M.	Litchfield	1	4802
Ellmer, Karl	Cannondale	5	4460
Ellsworth Nursery	Newington	1	4514
Elmgren Nursery	Cromwell	1	4500
Elm Grove Cemetery Association	Mystic	1	4453
Evergreen Nursery Co., The	Wilton	30	4422
Fairlawn Nursery	West Hartford	2	4508
Fairway Gardens	Woodmont	1	4558
Ferchau, Hugo, Post Road Florist	Milford	1	4748
Ferruci, Joseph (2)	Bridgeport	1	4765
Flower City Rose Co.	Manchester	23	4684
Follett Nursery	Westport	10	4673
Fountain Nurseries	Farmington	10	4516
Foxon Park Nursery	East Haven	1	4560
Frank & MacArthur	Ansonia	1	4701
Fraser's Nurseries & Dahlia Gardens	Willimantic	3	4520
Frede, Wm. Frederick	Danbury	1	4542
Freitag, John G.	New Haven	1	4703
Galligan, Clarence W.	New Haven	1	4749
Garden of Romance, The	Old Saybrook	3	4633
Gardner's Nurseries	Rocky Hill	300	4595
Geduldig's Florist & Nurseryman	Norwich	7	4569
Georges Hill Nursery	Southbury	1	4609
German, Peter B.	Fairfield	1	4692
Giana, John F.	Kensington	1	4473
Giant Valley Nursery	Mount Carmel	1	4733

CONNECTICUT NURSERY FIRMS CERTIFIED IN 1939—(Continued)

Name of firm	Address	Acreage	Certificate number
Glastonbury Gardens	Glastonbury	4	4615
Glenbrook Greenhouses	Glenbrook	1	4669
Glen Terrace Nurseries	Hamden	70	4601
Glenwood Nurseries	Clinton	2	4634
Godfrey, George R., Stratfield Nursery	Bridgeport	50	4736
Godfrey Tree Expert Co. & Garden Shop	Fairfield	1	4416
Golden Hill Nurseries	Shelton	3	4756
Goodwin Nurseries	Bloomfield	7	4541
Goshen Nurseries	Goshen	6	4718
Gosnell, Evelyn	Westport	1	4795
Great Pond Nursery	Simsbury	1	4423
Green Acre Farms, Inc.	Waterford	1	4734
Grillo, N.	Milldale	1	4785
Gunn, Mrs. Charles	Kent	1	4803
Haas, Florist	Milford	1	4486
Hall, Henry A. L.	West Haven	1	4596
Hamden Nursery	Hamden	1	4507
Hansen's Florist & Nursery	Fairfield	5	4564
Hansen's Garden	Newington	3	4617
Happy Days Farm	Norwalk	10	4510
Hearn, Thomas H.	Washington	3	4597
Heath & Co.	Manchester	15	4682
Henninger, Christ.	New Britain	1	4726
Hettinger, Joseph O.	Manchester	1	4707
Hildebrand's Nursery	Norwich	1	4580
Hilding Bros.	Amston	1	4715
Hillcrest Gardens	Woodbridge	4	4638
Hilliard, H. J.	Sound View	1	4424
Hilltop Nurseries	Orange	1	4425
Hinckley Hill Nurseries	Stonington	1	4459
Hiti Nurseries	Pomfret Centre	11	4612
Hoffmann's Nursery	Hartford	2	4499
Hofmann, William T.	Cromwell	2	4533
Holcomb's Evergreen Nursery	Winsted	6	4656
Holdridge & Sons, S. E.	Norwich	3	4653
Hope St. Nursery	Springdale	1	4793
Horan, J. F.	Hartford	1	4662
Horan, Kieran W.	West Hartford	1	4784
Horowitz, Ben	East Hampton	1	4621
Hosking, James S.	Watertown	1	4426
Hotchkiss, H. L.	North Haven	1	4526
Hotchkiss, Sr., Wallace M.	Norfolk	1	4427
Houston's Nurseries	Mansfield Depot	5	4608
Hoyt, Charles E.	Bethel	40	4535
Hoyt's Sons Co., Inc., Stephen	New Canaan	500	4513
Hurlburt Nursery	Hamden	1	4729
Hutt, Robert F.	Glastonbury	3	4568
Hyatt, Thaddeus	Stamford	10	4798
Iles, Jr., Harry (2)	Ridgefield	1	4781
Isselee's Sons, Inc., Charles	Darien	5	4428
Jennings, Sereno G.	Southport	2	4571
Johnson, Lincoln	Stamford	15	4546
Johnson, Tom	Stratford	1	4788
Joyosa Gardens	Cornwall Bridge	1	4728

Connecticut Nursery Firms Certified in 1939—(Continued)

Name of firm	Address	Acreage	Certificate number
Kateley, Milton M.	East River	1	4448
Kauser, Alice	Norwalk	1	4791
Kelley & Son, James J.	New Canaan	6	4495
Kellner, Arthur H.	Norwalk	1	4771
Kennedy, Wellington	Greenwich	20	4813
Keser's Sons, Inc., Otto	Portland	1	4732
Key Rock Gardens	Newtown	2	4659
Knobling, Edmund	Danbury	3	4678
Lanedale Farm Nurseries	New Canaan	10	4470
Langstroth Nurseries	Danbury	6	4469
La Pari, V.	Trumbull	2	4815
Laviola, Cosmo	New Haven	1	4616
Lawrence Greenhouses	Branford	1	4780
Leghorn's Evergreen Nursery	Cromwell	40	4630
Lemmon, Robert S.	New Canaan	1	4429
Lewis & Valentine Landscape Corporation	Darien	9	4604
Lewis Gardening Service	Kensington	1	4606
Linley & Case (2)	Ridgefield	1	4764
Lovely Garden (2)	Unionville	1	4570
Lowescroft Gardens	Manchester	1	4498
Luce, Mrs. Charles L.	Newington	1	4720
Luckey, Ada Mae	Greens Farms	1	4557
Luckner, Jr., William	Stepney	1	4626
Lynch, Mrs. John H.	Ridgefield	3	4709
Maplewood Nursery Co.	Norwich	2	4786
Marigold Farm	New Canaan	20	4666
Marlboro Gardens	East Hampton	2	4705
Mather Homestead	Darien	1	4462
Mayapple Nursery	Stamford	1	4672
McCarthy, John P.	Danbury	2	4575
McConville's Greenhouses & Nurseries	Manchester	2	4487
McDermott, E. F.	Windsor	1	4760
Meier, A. R.	West Hartford	1	4430
Melville Nurseries	Bridgeport	1	4518
Merwin Lane Nursery	East Norwalk	3	4524
Meyer Nursery, Ludwig	Bridgeport	5	4512
Middeleer	Darien	10	4593
Milford Nursery	Milford	2	4658
Millane Nurseries & Tree Experts, Inc.	Cromwell	100	4431
Mill River Nursery	Fairfield	8	4478
Millstone Garden	Terryville	1	4623
Minge, G. H.	Rocky Hill	1	4534
Moore Hill Nurseries	Waterford	1	4578
Moraio Brothers	Old Greenwich	5	4745
Morgan, Everett E.	Pawcatuck	1	4809
Morgan & Sons, Wm. F.	North Stonington	2	4702
Morrison, George	Yalesville	1	4819
Mountain Grove Cemetery Assn., The	Bridgeport	1	4548
Mount Airy Gardens	Stamford	1	4577
Mount Carmel Nursery	Mount Carmel	1	4783
Munro, Edward A.	New Haven	1	4474
New England Water Lily Gardens	Manchester	1	4566
New Era Seed Company	Clinton	1	4492
New Haven Park Commission	New Haven	10	4614
New Haven Park Dept., Bureau of Trees	New Haven	7	4432

Connecticut Nursery Firms Certified in 1939—(Continued)

Name of firm	Address	Acreage	Certificate number
Newington Gardens & Nurseries	Newington Junction	1	4463
New London Cemetery Association	New London	1	4545
New London County Nurseries	New London	5	4679
Newton's Nursery	West Granby	1	4451
Newtown Gardens	Newtown	1	4763
New York, New Haven & Hartford Railroad	Stamford	4	4651
Niantic Bouquet Shop	Niantic	1	4769
North-Eastern Forestry Co., The	Cheshire	96	4433
North Greenwich Nursery	Greenwich	1	4584
North Street Gardens	Milford	1	4694
Northville Gardens	New Milford	1	4731
Norwalk Perennial Garden	Norwalk	4	4613
Nyveldt's Nursery	New London	2	4554
Oakland Nurseries	Manchester	20	4683
Oldfield Nursery	Stratford	1	4755
Old Orchard Nursery	Norwalk	2	4485
Outpost Nurseries, Inc.	Ridgefield	700	4434
Ouwerkerk, Dirk K.	Yalesville	10	4435
Over-the-Garden-Wall	West Hartford	3	4636
Oxoboxo Nursery	Montville	2	4711
Palmieri Nursery & Florist	New Haven	1	4536
Park Place Nurseries	Marion	2	4723
Parker, Mrs. Elizabeth	Bridgeport	3	4821
Partrick Nursery	Sandy Hook	1	4740
Pendleton's Flower Gardens	Norwich	2	4488
Peschko, Robert	Danbury	1	4586
Pestretto, Frank	West Hartford	1	4773
Pestretto, Salvatore	Hartford	1	4792
Peterson's Flower Shop	West Hartford	1	4663
Pflomm, Charles W.	Bridgeport	1	4603
Pierson, Inc., A. N.	Cromwell	300	4481
Pinchbeck Bros., Inc.	Ridgefield	10	4610
Pine Hirst Gardens	Guilford	1	4494
Pine Plains Greenhouses	Norwich	2	4629
Platt, Kenneth M. & Norman E.	Milford	1	4455
Polen, Romuald	Southport	2	4550
Polish Orphanage Farm	New Britain	1	4594
Pomeroy Nurseries	New Milford	1	4555
Prospect Nurseries, Inc.	Cromwell	30	4531
Q Gardens Farm	Milford	1	4779
Rabinak Flower Farm	Deep River	3	4587
Race Brook Gardens	Orange	1	4436
Reliable Nursery, The	East Hartford	2	4642
Rengerman's Garden	Granby	1	4706
Reveley Landscaping Service, The	Clinton	2	4547
Reynolds' Farms	South Norwalk	1	4716
Richmond, Gordon L.	New Milford	15	4515
Ridgewood Nurseries	Milford	1	4754
Riese, F. K.	Watertown	1	4676
Riverside Farm	Milford	1	4582
Robinson Estate, Seymour N.	West Hartford	2	4691
Rockacres Nursery	Stamford	2	4824
Rockfall Nursery Co., The	Rockfall	4	4447
Rolf, Mrs. Fred H.	Guilford	1	4475
Rose Hill Nursery	Gildersleeve	3	4708
Russell Street Perennial Garden	Manchester	1	4645

Connecticut Nursery Firms Certified in 1939—(Continued)

Name of firm	Address	Acreage	Certificate number
Sage Brothers	Woodbury	1	4556
Sakson's Nursery	Greenwich	1	4622
Sandelli Greenhouses	New Britain	1	4710
Sasco Hill Nursery	Southport	1	4674
Savanella Brothers Nursery	Torrington	2	4437
Scarano Nursery, Alphonse	Groton	1	4690
Schaeffer, Peter	Ledyard	1	4787
Schleichert Nursery	Bridgeport	4	4517
Schneider, Adolf	Milford	1	4583
Schuller, John	Higganum	2	4528
Schulze, Edward E.	Bethel	1	4744
Scott's Nurseries	Bloomfield	10	4675
Scotty's Landscape Service	Woodbury	1	4644
Sears, Roebuck & Company	Manchester	10	4685
Seltsam's Pequonnock Gardens	Bridgeport	1	4620
Seymour Gardens, Prudence	New Milford	1	4468
Sharon Valley Nursery	Sharon	1	4639
Silver City Nursery	Meriden	5	4762
Silver Lane Nursery	East Hartford	1	4818
Simonsen, H. C.	Plainville	3	4699
Sipocz Arrowhead Farm	Fairfield	1	4477
Soltes Nursery, M. J.	Shelton	2	4445
Southbury Nursery, The	Southbury	4	4523
Southington Nursery	Southington	15	4532
Southport Nursery	Southport	35	4491
South Wilton Nurseries	Wilton	9	4696
Spring Nurseries	Forestville	1	4438
Stack, Garrett M.	Guilford	1	4782
Stafford Conservatories	Stafford Springs	1	4721
Standish, Norman S.	Hanover	1	4529
Stannard, Julia	Wilton	2	4799
State Street Nursery	Hamden	4	4752
Steck, Charles A.	Newtown	20	4539
Steck Nursery	Bethel	4	4647
Steele's Nurseries, Charles	Greenwich	2	4750
Stocking, Milton C.	Simsbury	1	4565
Strayer, Paul	Stratford	1	4415
Sunny Valley Nursery	New Milford	15	4551
Sunridge Nurseries	Greenwich	55	4730
Sun Rise Nursery	North Haven	1	4624
Swendson, Hans	Cheshire	1	4605
Sylvan Greenhouse & Nursery	Bridgeport	2	4800
Taylor, Walter G.	Wallingford	1	4687
Tennett, Norman E.	Danielson	2	4812
Thomson Co., The W. W.	West Hartford	3	4439
Tobin, Daniel J.	Ridgefield	2	4573
Tollgate Nursery	Avon	1	4537
Torizzo, P. A.	West Hartford	5	4660
Tow Path Gardens, Inc.	Hartford	5	4641
Tracy, B. Hammond	Yalesville	1	4590
Triangle Nursery	Yalesville	2	4440
Twin Pines Gardens	New Milford	1	4501
University of Connecticut (S. P. Hollister)	Storrs	2	4444
Valentine, William	Pomfret Center	1	4553
Valley View Nursery	Southington	1	4504
van der Bom, Mrs. F.	Bethel	5	4665

CONNECTICUT NURSERY FIRMS CERTIFIED IN 1939—(Concluded)

Name of firm	Address	Acreage	Certificate number
Vanderbrook & Son, C. L.	Manchester	50	4441
Van Horn & Harrington	Suffield	1	4700
Van Wilgen, William	Branford	1	4778
Van Wilgen Nurseries	Branford	22	4607
Vasileff Nurseries	Greenwich	5	4671
Verkade's Nurseries	New London	60	4585
Vernick's Nurseries & Landscape Service	Bridgeport	2	4774
Wagner, William H.	Woodbury	1	4820
Wallace Nursery	Wallingford	4	4650
Wallingford Nurseries of Barnes Nursery & Orchard Co.	Wallingford	60	4543
Ward & Son, J. F.	Windsor	1	4452
Watertown Nurseries	Watertown	1	4739
Wayside Garden (2)	Canton	1	4825
Wayside Nursery	Naugatuck	2	4717
Weinberger, William	Ridgefield	1	4574
West Cornwall Nurseries	West Cornwall	1	4567
Westerly Nurseries	Pawcatuck	3	4465
West Mystic Gardens	West Mystic	1	4519
Westover Trading Corp.	Stamford	1	4759
Westville Nurseries	New Haven	2	4761
Wethersfield Nursery	Wethersfield	3	4712
Wheeler, Charles B.	Stonington	1	4591
Whipple, Earle G.	Danielson	1	4514
White Memorial Foundation	Bantam	12	4776
Whittemore Co., J. H	Naugatuck	3	4442
Wildflower Nursery, The	Brookfield	1	4772
Wild's Nursery, Henry	Norwalk	30	4471
Willow Gardens	Darien	1	4697
Willson, Stewart H	Thompsonville	1	4561
Wilridge Nurseries	Ridgefield	5	4589
Wilson, M. L.	Litchfield	5	4704
Wilson Nurseries, C. E.	Manchester	1	4806
Wilson Landscape Co., The	Hartford	1	4811
Woodbourne Cultural Nurseries, Inc. (2)	Manchester	100	4579
Woodbridge Nurseries	New Haven	12	4540
Woodcrythe Nursery (W. S. Sloan)	New Canaan	1	4572
Wyllie, David	North Haven	1	4559
Yale University School of Forestry Nursery	New Haven	1	4443
Yale University Landscape Department	New Haven	5	4527
Young's Nurseries	Wilton	3	4767
Zack Co., H. J.	Deep River	10	4600
Total	**399 nurseries**	**4,833 acres**	

The cost of inspecting these nurseries in 1939, including certain additional visits to make sure that the pests had been eradicated, was approximately $1,735.76, exclusive of traveling expenses.

Other Kinds of Certificates Issued

During 1939, 135 duplicate certificates were issued to Connecticut nurserymen, to be filed in other states. Altogether 97 dealers' permits were issued to registered dealers who do not grow the nursery stock that they sell. Shippers' permits to the number of 173 were issued to nurserymen in other states, who wish to ship stock into Connecticut. Also, 1,696 parcels of nursery stock were inspected and certified for shipment to accommodate individuals.

There were also issued 190 miscellaneous certificates and special permits, 195 blister rust control area permits, 1,204 corn borer certificates, and 2,535 certificates for packages of shelled corn and other seeds, many of which were consigned to foreign countries.

Inspection of Imported Nursery Stock

Foreign nursery stock enters the United States at designated ports of entry under permits issued by the Federal Bureau of Entomology and Plant Quarantine and is released for transit to destination points, where it is examined by state inspectors. Importation permits are granted for rose stocks only. These are used almost entirely by florists for grafting purposes. Although the number of shipments of nursery stock entering Connecticut from foreign countries in 1938-1939 was the same as the preceding year, the number of cases and plants was smaller, possibly because of increased domestic production on the West Coast. Thirteen shipments containing 37 cases and 276,400 rose plants, all of which were for propagation purposes, were imported. Of these plants 265,600 were *Rosa manetti* and 10,800 were *Rosa multiflora*. These plants were all imported by four commercial rose growers who received 124,100, 91,500, 50,000 and 10,800 respectively. They came from the following sources:

Country	No. shipments	No. plants
Holland	12	236,400
England	1	40,000

The time required to inspect this rose stock was equivalent to eight days' work for one man and this, together with the travel (815 miles) and other necessary expenses, amounted to a cost of approximately $125.75. Reports of the results of inspection of the 13 shipments were sent to the Federal Bureau of Entomology and Plant Quarantine.

Results of Inspection

Of the 13 shipments inspected, two, or 15 percent, were found infested with larvae of a sawfly, *Emphytus cinctus* Linn., which enter the pith of the cut stems of the rose plants seeking a place to pupate. Three shipments, or 23 percent, were infected with crown gall, a bacterial disease.

In addition to the rose stocks mentioned above, the following miscellaneous plants and seeds entered Connecticut after federal inspection at ports of entry. These were not inspected in Connecticut:

3,550 pounds of seeds
1,167 rose bushes
234 dahlia plants
20 tubes of orchid seedlings
4,547 orchid plants
12 Ficus cuttings
5 Prunus trees
18,753 gladiolus bulbs
1,495 perennial plants
4 palms
167 miscellaneous bulbs and rhizomes
3 cactus plants
350 azalea plants

INSPECTION OF APIARIES, 1939

R. B. Friend

In 1939, Mr. H. W. Coley of Westport inspected bees in Fairfield, New Haven, Middlesex and New London counties, and Mr. W. H. Kelsey of Bristol inspected in the counties of Litchfield, Hartford, Tolland and Windham. Only two colonies were found infected with sacbrood, and the percentage of American foul brood was slightly smaller than in 1938. Mr. Kelsey reported a heavy winter loss of bees in the four northern counties.

Altogether, 1,627 apiaries containing 8,936 colonies were inspected. These averaged 5.5 colonies per apiary as against 6.7 in 1938. There were 147 colonies in 83 apiaries infected with American foul brood; 20 of these apiaries were inspected twice.

The total cost of inspection in 1939 was $1,826.60.

Table 2. Thirty Year Record of Apiary Inspection in Connecticut

Year	Number apiaries	Number colonies	Averago No. colonies per apiary	Average cost of inspection per apiary	Average cost of inspection per colony
1910	208	1,595	7.6	$2.10	.28
1911	162	1,571	9.7	1.99	.21
1912	153	1,431	9.3	1.96	.21
1913	189	1,500	7.9	1.63	.21
1914	463	3,882	8.38	1.62	.19
1915	494	4,241	8.58	1.51	.175
1916	467	3,898	8.34	1.61	.19
1917	473	4,506	9.52	1.58	.166
1918	395	3,047	7.8	1.97	.25
1919	723	6,070	11.2	2.45	.29
1920	762	4,797	6.5	2.565	.41
1921	751	6,972	9.2	2.638	.24
1922	797	8,007	10.04	2.60	.257
1923	725	6,802	9.38	2.55	.27
1924	953	8,929	9.4	2.42	.25
1925	766	8,257	10.7	2.45	.22
1926	814	7,923	9.7	2.35	.24
1927	803	8,133	10.1	2.37	.234
1928	852	8,023	9.41	2.12	.225
1929	990	9,559	9.55	2.19	.227
1930	1,059	10,335	9.76	2.01	.206
1931	1,232	10,678	8.66	1.83	.212
1932	1,397	11,459	8.2	1.60	.195
1933	1,342	10,927	8.1	1.69	.208
1934	1,429	7,128	4.98	1.40	.28
1935	1,333	8,855	6.64	1.556	.234
1936	1,438	9,278	6.45	1.429	.221
1937	1,437	10,253	7.1	1.28	.18
1938	1,609	10,705	6.7	1.18	.177
1939	1,627	8,936	5.5	1.12	.204

Table 2 shows the number of apiaries and colonies inspected, the average number of colonies per apiary and the average cost of inspecting each apiary and colony for each year since inspection began in 1910.

In 1939 apiaries were inspected in 156 towns. Inspections were made in the following nine towns not visited in 1938:

Fairfield County: Easton, Redding, Shelton; *New Haven County:* Ansonia, Guilford; *Hartford County:* Enfield; *Tolland County:* Union, Willington; *Windham County:* Sterling.

In 1939 American foul brood was discovered in the following 48 towns:

Fairfield County: Bethel, Danbury, Fairfield, Greenwich, New Canaan, Newtown, Shelton, Stamford, Trumbull; *New Haven County:* Branford, Meriden, Middlebury, Milford, New Haven, North Branford, Waterbury, Woodbridge; *Middlesex County:* Westbrook; *New London County:* East Lyme; *Litchfield County:* Bethlehem, Harwinton, Litchfield, New Milford, Plymouth, Salisbury, Sharon, Warren, Washington, Winchester, Woodbury; *Hartford County:* Avon, Berlin, Bristol, Burlington, Canton, East Hartford, East Windsor, Granby, Hartford, New Britain, Plainville, Southington, West Hartford, Windsor; *Tolland County:* Coventry, Mansfield, Vernon; *Windham County:* Windham.

Statistics of Inspection

The statistics of apiary inspection are shown below.

TABLE 3. INSPECTION OF APIARIES, 1939

County	Number of towns	Apiaries		Colonies	
		Inspected	Diseased (Am.f.b.)	Inspected	Diseased (Am.f.b.)
Fairfield[1]	22	153	15	1,222	19
New Haven[1,2]	21	115	10	815	20
Middlesex	15	86	1	840	5
New London[1]	19	121	1	965	1
Litchfield[1]	24	318	24	1,570	40
Hartford[1]	29	547	27	2,529	56
Tolland[1]	13	164	4	515	5
Windham	13	123	1	480	1
	156	1,627	83	8,936	147

[1] Fairfield County, one apiary inspected twice; New Haven County, one apiary inspected twice; New London County, one apiary inspected twice; Litchfield County, 17 apiaries inspected twice; Hartford County, 24 apiaries inspected twice; Tolland County, three apiaries inspected twice.

[2] New Haven County, two colonies sacbrood.

SUMMARY OF INSPECTION

	Apiaries	Colonies
Inspected, 1939	1,627	8,936
Infected with American foul brood	83	147
Percentage infected	5.1	1.6
Colonies treated		21
Colonies destroyed		126
Average number of colonies per apiary		5.5
Average cost of inspection	1.12	.204
Total cost of inspection for 1939	$1,826.60	

Financial Statement

January 1, 1939—December 31, 1939

Disbursements

January 1 to June 30, 1939:		
Salaries	$474.00	
Travel (outlying investigations)	308.25	$782.25
July 1 to December 31, 1939:		
Salaries	$618.00	
Travel (outlying investigations)	426.35	
		1,044.35
Total disbursements for 1939		$1,826.60

Registration of Bees

Section 2129 of the General Statutes provides: That each beekeeper shall register his bees on or before October 1 of each year with the town clerk of the town in which the bees are kept; and that each town clerk, on or before December 1, shall report to the State Entomologist whether or not any bees have been registered, and if so, shall send a list of the names and number of colonies belonging to each. In 1939, 1,627 apiaries containing 8,936 colonies were inspected. However, only 861 apiaries and 4,881 colonies were registered. After checking the registrations and inspections, and deducting duplications, the following figures were obtained, showing that at least this number of apiaries and colonies were kept in Connecticut in 1939:

	Apiaries	Colonies
Inspected	1,627	8,936
Registered but not inspected	324	1,563
	1,951	10,499

REPORT ON CONTROL OF THE GYPSY MOTH, 1938-1939[1]

J. T. Ashworth and O. B. Cooke

During the 1938-1939 scouting season, the gypsy moth control work was carried on as it has been in past years. Trees were examined in the open and in woodlands during the fall, winter and early spring for egg-masses, which were creosoted when found. In the spring infestations were sprayed with a mixture of lead arsenate and water, with fish oil added when a sticker was required, and during the summer months infested areas were patrolled to detect gypsy moth larvae (caterpillars). Such work, in one form or another, was performed in 75 towns in Connecticut with the coöperation of the Bureau of Entomology and Plant Quarantine of the United States Department of Agriculture and the Civilian Conservation Corps. This coöperation is greatly appreciated, and the writers here express their gratitude to Mr. A. F. Burgess, who has general supervision of gypsy and brown-tail moth control for the Bureau of Entomology and Plant Quarantine; Mr. H. L. Blaisdell, in charge of field work under

[1] This report covers the field work from July 1, 1938, to June 30, 1939, *not* the calendar year 1939.

Mr. Burgess; Mr. S. S. Crossman, under whose direction gypsy moth control work was carried on in the various C.C.C. camps in the central part of Connecticut; and to Mr. A. F. Hawes, State Forester, who has general supervision of the C.C.C. camps.

New Equipment

In June it was necessary to replace 500 feet of spray hose that was worn out. The usual number of small wrenches and other tools that had worn out or broken were also replaced.

Control Operations

Following is a brief report for the past year of gypsy moth control operations carried on by the different agencies.

Work Performed by State Men

The regular state gypsy moth crews operated in Windham, New London, Tolland, Hartford and Litchfield counties.

Windham County: Scouting work was performed in the towns of Brooklyn, Killingly, Pomfret, and Putnam, gypsy moth infestations being found in all these towns. Infestations in the towns of Brooklyn, Killingly and Putnam were visited during the larval season and caterpillars were found at all points. No spraying was carried on in this county.

New London County: Scouting work was performed in the towns of Bozrah, Colchester, East Lyme, Groton, Lebanon, Lyme, Montville, Norwich, Preston, Salem, and Stonington. Infestations were found in all the towns visited with the exception of Bozrah, Lyme, and Salem. During the larval season the towns of Colchester, East Lyme, Groton, Lebanon, Montville, New London, North Stonington, Norwich, Preston, Stonington and Waterford were visited and caterpillars were found at all points visited except in East Lyme, Norwich, and Waterford.

Tolland County: State crews performed scouting work in the towns of Andover, Bolton, Columbia, Coventry, and Vernon, all of which were infested. During the larval season, the towns of Andover, Bolton, Coventry, Somers, Stafford, and Union were patrolled and caterpillars were found at points visited in Somers, Stafford, and Union. No spraying was done in this county.

Hartford County: The following towns were scouted in this county: East Granby, Granby, Hartland, Suffield, and Windsor and infestations were found in all. During the larval season, known infestations in the towns of Burlington and Enfield were visited, caterpillars being taken in each place. It was in Hartford County that, during the 1937-1938 scouting season, a large gypsy moth infestation was discovered covering an area of about 600 acres in the southern part of Granby, the northeast corner of Canton, and the northwest section of Simsbury. During the 1938-1939 scouting season state and C.C.C. crews destroyed 7,236,186 egg-clusters in this infestation. Because of the size and location of the infested area and the enormous number of egg-clusters present, we decided to forego spraying in other sections of the State. By concentrating operations here we made an attempt to reduce the gypsy moth population and to prevent the dispersion of young larvae by wind as much as possible. Just prior to the spraying season a project was set up and the work placed in charge of Mr. LaBelle of the state force. A survey of the area indicated that at least five power spraying machines, operating two shifts a day, would be required to complete the project in the time available. This called for 75 men each shift to operate the machines efficiently. The situation was taken care of through the loan of three power spraying machines and the necessary spray hose from the U. S. Bureau of Entomology and Plant Quarantine and the use of C.C.C. details furnished from Camps Robinson and White, located in the vicinity of the infestation. On the recommendation of Mr. Hawes, most of the lead arsenate used on this project was furnished by the C.C.C. Spraying was started May 27, 1939, and continued through July 1, 1939, at which time the advanced stage of the larvae made further spraying impractical. Approximately 1,562 acres of woodland were sprayed, using 22.5 tons of arsenate of lead.

Litchfield County: State crews performed control work in six towns in this county, namely: Barkhamsted, Colebrook, Harwinton, New Hartford, Torrington, and Winchester. Scouting work was performed in the towns of Barkhamsted, Harwinton, New Hartford, Torrington, and Winchester, and infestations were found in all except Torrington. During the larval season the town of Colebrook was patrolled, and caterpillars were found at points visited.

State men scouted 374 miles of roadside and 13,595 acres of open and wooded country, destroyed 426,941 egg-clusters and 19,494 larvae and pupae.

Work Performed by C.C.C. Men

During the past year, details of men from the various C.C.C. camps located in the central and eastern sections of the State were engaged in gypsy moth control work in the form of woodland scouting, cleaning and cutting out infested areas, banding and patrolling for caterpillars. The details from the C.C.C. camps in the eastern section of the State were unable to perform the same amount of control work that they had accomplished in years past, because, immediately after the hurricane on September 21, 1938, all the gypsy moth crews were put on emergency fire hazard work. This continued until the end of the year. The details in the camps in the central part of the State continued with gypsy moth work, with a greatly curtailed schedule, throughout the entire year. These various C.C.C. details scouted 5,673 acres of woodland and 21 miles of roadside, cleaned and removed the underbrush from 551 acres of woodland and destroyed approximately 7,824,665 egg-clusters. This includes the work accomplished in the Granby-Canton-Simsbury infestation previously mentioned. Previous to the larval season, they banded 154,299 trees in infested areas and during the larval season patrolled these banded trees, destroying 27,200 larvae and pupae.

WPA Work Performed

The Federal Bureau of Entomology and Plant Quarantine, with headquarters at Greenfield, Mass., again carried on a gypsy moth control project in this State, using funds provided by the Works Progress Administration. As usual, the work of this agency was confined to the western part of Connecticut in what is known as the "Barrier Zone", a strip of land extending from Long Island Sound to the Canadian Border, with the eastern boundary passing through the western part of Connecticut. This Barrier Zone was established in an endeavor to stop the spread of the gypsy moth to the west. WPA crews worked in 21 towns in Fairfield, Litchfield, and New Haven counties. During the past season these men scouted 805 miles of roadside and 185,082 acres of open and wooded country, and destroyed 9,034 egg-clusters and 6,457 larvae and pupae. They applied 272,248 bands to trees in and around infested areas previous to the larval season and during the spraying season sprayed 29 infestations in 10 towns in Litchfield County, using 106,202 pounds of lead arsenate.

Scouting for Brown-Tail Moth

There was no brown-tail moth scouting project carried on in Connecticut during the 1938-1939 season.

FINANCIAL STATEMENT
July 1, 1938—June 30, 1939

RECEIPTS	
Appropriation year ending June 30, 1939	$44,880.00
DISBURSEMENTS	
Personal Services:	
Salaries	$39,011.55
Supplies and Materials:	
Stationery and office supplies	2.62
Insecticides	156.00
Gasoline	1,022.98
Auto oil and grease	45.67
Chemicals	.50
Lumber and small hardware	2.99
Other supplies (miscellaneous)	22.28
Communication Service:	
Telephone	47.81
Postage	15.00
Transportation of Materials:	
Freight, express and parcel post	.67
Heat and Light:	
Fuel	21.86
Electricity	15.36
Contingent Expenses:	
Insurance	409.83
Equipment:	
Tools, machinery and appliances (new)	385.89
Tools, machinery and appliances (repairs)	53.25
Automobiles (repairs)	488.85
Buildings and Land:	
Rent of storehouse and office space	420.00
Total Disbursements	$42,123.11
Balance on hand, July 1, 1939	2,756.89[1]
	$44,880.00

[1] Reverted to State Treasury.

TABLE 4. STATISTICS OF INFESTATIONS, 1938-1939

Town	Infestations found	Egg-clusters creosoted	Number colonies sprayed	Lbs. lead used	Larvae, pupae crushed	Bands applied	Miles scouted	Acres scouted	Acres cleaned
Windham County									
Brooklyn[1]	2	141	0	0	160	0	0	26	0
Killingly[1]	2	1,437	0	0	67	0	0	178	0
Pomfret[1]	1	2,332	0	0	0	0	0	12	0
Putnam[1]	1	33	0	0	210	0	0	5	0
Sterling[2]	12	263	0	0	0	0	0	654	0
Woodstock[3]	6	121,491	0	0	0	0	2	78	3
	24	125,697	0	0	437	0	2	953	3
New London County									
Bozrah[1]	0	0	0	0	0	0	0	375	0
Colchester[1]	6	972	0	0	49	0	31	701	0
East Lyme[1]	2	77	0	0	0	0	64	3,971	0
Groton[1]	2	310	0	0	977	0	1	0	0
Lebanon[1]	10	3,228	0	0	1,096	0	0	2,810	0
Lyme[1]	0	0	0	0	0	0	79	500	0
Montville[1]	4	84	0	0	6	0	0	204	0
New London[1]	0	0	0	0	548	0	0	0	0
North Stonington[2]	7	786	0	0	14	0	0	69	0
Norwich[1]	1	1	0	0	0	0	0	9	0
Preston[1]	5	1,110	0	0	97	0	0	49	0
Salem[1]	0	0	0	0	0	0	3	55	0
Stonington[1]	5	1,498	0	0	1,694	0	4	0	0
Waterford[1]	0	0	0	0	0	0	0	0	0
	42	8,066	0	0	4,481	0	182	8,743	0

Footnotes at end of Table.

TABLE 4. STATISTICS OF INFESTATIONS, 1938-1939—Continued

Town	Infestations found	Egg-clusters creosoted	Number colonies sprayed	Lbs. lead used	Larvae, pupae crushed	Bands applied	Miles scouted	Acres scouted	Acres cleaned
Tolland County									
Andover[1]	4	124	0	0	0	0	0	499	0
Bolton[1]	3	14	0	0	0	0	0	137	0
Columbia[1]	1	871	0	0	0	0	0	16	0
Coventry[1]	8	75	0	0	0	0	0	385	0
Somers[1]	0	0	0	0	1,882	0	0	0	0
Stafford[4]	2	1,798	0	0	1,396	0	0	13	0
Union[4]	1	113,322	0	0	3,744	0	0	26	0
Vernon[1]	4	24	0	0	0	0	0	197	0
	23	116,228	0	0	7,022	0	0	1,273	0
Middlesex County									
Durham[2]	0	0	0	0	336	5,093	0	18	1
Haddam[2]	1	2	0	0	641	14,461	1	787	0
Middlefield[2]	0	0	0	0	87	5,304	0	0	0
Middletown[2]	2	85	0	0	1,805	26,948	0	32	20
	3	87	0	0	2,869	51,806	1	837	21
Hartford County									
Berlin[2]	1	4	0	0	680	9,399	0	73	2
Burlington[1]	0	0	0	0	69	0	0	0	0
Canton[2]	1	228,208	0	0	0	0	0	19	14
East Granby[1]	12	1,040	0	0	1,428	0	12	146	0
Enfield[1]	0	0	0	0	191	0	0	0	0
Granby[4]	7	7,236,186	1	40,434	3,015	0	36	571	387
Hartland[4]	8	93	0	0	10,292	23,754	1	561	0

TABLE 4. STATISTICS OF INFESTATIONS, 1938-1939—Continued

Town	Infestations found	Egg-clusters creosoted	Number colonies sprayed	Lbs. lead used	Larvae, pupae crushed	Bands applied	Miles scouted	Acres scouted	Acres cleaned
Hartford County—Continued									
New Britain[2]	0	0	0	0	117	2,547	11	825	74
Simsbury[2]	1	524,924	1	3,860	0	0	0	83	33
Suffield[1]	160	5,176	0	0	1,879	0	113	677	0
Wethersfield[2]	0	0	0	0	266	3,031	0	0	0
Windsor[1]	1	2	0	0	0	0	0	10	0
	191	7,995,633	2	44,294	17,937	38,731	173	2,965	510
New Haven County									
Branford[2]	0	0	0	0	1,057	1,175	0	0	0
East Haven[3]	0	0	0	0	0	0	58	8,069	0
Guilford[2]	0	0	0	0	855	7,455	0	17	10
Meriden[2]	1	22	0	0	3,391	9,393	0	10	10
New Haven[3]	0	0	0	0	0	0	210	14,260	0
North Branford[2]	0	0	0	0	0	0	8	2,891	0
Southbury[3]	1*	0	0	0	0	2,695	0	0	0
Wallingford[3]	0	0	0	0	0	0	0	183	0
Wolcott[3]	1	264	0	0	0	0	0	181	22
	3	286	0	0	5,306	20,718	276	25,611	42

TABLE 4. STATISTICS OF INFESTATIONS, 1938-1939—Concluded

Town	Infestations found	Egg-clusters creosoted	Number colonies sprayed	Lbs. lead used	Larvae, pupae crushed	Bands applied	Miles scouted	Acres scouted	Acres cleaned
Litchfield County									
Barkhamsted[4]	11	5,741	0	0	7,131	37,968	15	334	0
Bethlehem[3]	1	3	1	900	0	0	57	12,700	0
Canaan[3]	30	3,933	6	41,967	5,945	128,068	39	19,600	23
Colebrook[4]	0	0	0	0	12	1,452	3	267	0
Cornwall[3]	14	1,746	2	10,594	91	33,756	28	11,539	7
Goshen[3]	9	167	0	0	0	23,673	48	17,433	0
Harwinton[1]	4	56	0	0	672	0	4	640	0
Kent[3]	1	2	0	0	0	400	3	1,618	0
Litchfield[3]	15	872	4	6,052	96	16,152	42	15,193	35
Morris[3]	14	183	6	5,341	0	5,784	48	13,032	16
New Hartford[4]	1	6	0	0	714	10,763	0	0	0
Norfolk[3]	11	392	1	7,109	104	18,911	27	11,604	0
North Canaan[3]	7	207	0	0	0	8,377	31	10,130	6
Salisbury[3]	6	218	1	5,585	89	14,804	39	12,745	0
Sharon[3]	1	31	1	2,399	2	125	3	1,726	0
Torrington[4]	0	0	0	0	0	1,033	0	18	0
Warren[3]	6	813	4	17,695	130	13,669	24	7,831	21
Washington[3]	8	203	3	8,560	0	5,834	47	10,280	0
Watertown[3]	0	0	0	0	0	0	89	16,083	0
Winchester[4]	5	70	0	0	113	3,922	7	320	0
	144	14,643	29	106,202	15,099	324,691	551	163,093	108
Fairfield County									
Bridgeport[3]	0	0	0	0	0	0	9	565	0
Stratford[3]	0	0	0	0	0	0	3	310	0
	0	0	0	0	0	0	12	875	0

SUMMARY OF STATISTICS, 1938-1939

County	No. of towns	Infestations found	Egg-clusters creosoted	Number colonies sprayed	Lbs. lead used	Larvae, pupae crushed	Bands applied	Miles scouted	Acres scouted	Acres cleaned
Windham	6	24	125,697	0	0	437	0	2	953	3
New London	14	42	8,066	0	0	4,481	0	182	8,743	0
Tolland	8	23	116,228	0	0	7,022	0	0	1,273	0
Middlesex	4	3	87	0	0	2,869	51,806	1	837	21
Hartford	12	191	7,995,633	2	44,294	17,937	38,731	173	2,965	510
New Haven	9	3	286	0	0	5,306	20,718	276	25,611	42
Litchfield	20	144	14,643	29	106,202	15,099	324,691	554	163,093	108
Fairfield	2	0	0	0	0	0	0	12	875	0
	75	430	8,260,640	31	150,496	53,151	435,946	1,200	204,350	684

[1] Conn. State work
[2] C.C.C. work
[3] U.S.D.A. work
[4] State and C.C.C. work

*Larval infestation (Southbury)

THE JAPANESE BEETLE, 1939

J. Peter Johnson

Quarantine Activities

Since 1926, when the Japanese beetle was first found in Connecticut at Stamford, the Department of Entomology of the Connecticut Agricultural Experiment Station has coöperated with the United States Department of Agriculture, Bureau of Entomology and Plant Quarantine, in conducting the Japanese beetle quarantine in this State. This includes seasonal scouting of certain nursery and greenhouse properties and their sources of sand, soil and manure for classification purposes; the inspection and certification of all articles included in the quarantine regulations; and miscellaneous tasks necessary to the quarantine.

Mr. H. N. Bartley, in charge of the federal Japanese beetle office, Boston, Massachusetts, supervises all the Japanese beetle quarantine activities in areas coinciding with the gypsy moth quarantine area. In Connecticut this comprises Hartford, Middlesex, New London, Tolland, Windham counties and a few towns in the eastern parts of Litchfield and New Haven counties, while the remaining portions of the State are supervised from the New Haven office at the Experiment Station.

Scouting

Scouting has been conducted yearly and the procedure followed during the summer of 1939 to determine whether or not adult beetles were present on classified properties was similar to that of preceding years. Four crews, each consisting of one foreman and two scouts, reported for work on July 10. Three of them received one day of schooling in the methods of scouting in addition to general instructions. The fourth crew, made up of experienced men, was given instructions and immediately assigned to its territory. The crews followed a prepared itinerary and were stationed at Derby, Hartford, Middletown and Storrs, central locations in their respective districts.

They scouted 56 nursery, greenhouse, or other similar establishments, and their subdivisions, a total of 110 units, three to five times. The minimum distance examined around each establishment was 500 feet. A total of 663 adult beetles was found on 34 of the 65 nursery and greenhouse properties scouted. The crews also scouted the premises of 116 dealers in sand, soil and manure and found 448 beetles on 37 of these. A total of 1,111 beetles were found on the property of scouted establishments, resulting in 11 changes in classification and 24 dropping their classified status under the quarantine regulations.

Inspection and Certification

The district inspectors responsible for inspection and certification of quarantined materials were located as follows:

Location	No. of Inspectors
New Haven	2
[1]Manchester	1
[1]Middletown	1
[1]Westerly, R. I.	1
Total	5

The total number of plants inspected and certified for shipment to other states and foreign countries was 6,334,633.

The number and kinds of certificates issued are shown in the following table:

TABLE 5. CERTIFICATES ISSUED*

Kind	Farm Products	Cut Flowers	Nursery and Ornamental Stock	Sand Soil	Manure	Total
"A"	16	12	36,780	0	0	36,808
"B"	0	0	6,799	4	13	6,816
Total	16	12	43,579	4	13	43,624

* For the calendar year 1939.

As in past seasons, the district inspectors were able to make the necessary farm products quarantine inspections in addition to their regular duties. These were few in number and consisted of the following packages: apples 1, beans 15, corn 6, cut flowers 12.

Control Activities

The control activities in Connecticut are confined to a general survey of the beetle conditions over the entire State, investigation of insecticides for controlling the insect and natural control by use of parasites. The parasite work is carried on in coöperation with the Japanese beetle research laboratories of the United States Department of Agriculture.

Adult Japanese beetles were found in Berlin, Bolton, Cheshire, Cromwell, East Windsor, Ellington and Newington for the first time. Eighty towns are now known to be infested and there are probably many others that have not come to our attention.

Prevailing dry weather in late June and July delayed the emergence of the adult beetles from the soil. The first one was found on June 22. Usually great numbers appear near the end of the first week in July but in 1939 the hard, dry soil held them back a week or more. Then, instead of a general emergence over a short period of two or three weeks, beetles continued to appear until early in August. The adult population was more uniform than usual over the entire season, from the second week in July until the middle of August, although there were exceptions to this in

[1] The district inspectors in Manchester, Middletown and Westerly, R. I., were under the supervision of the Federal Japanese Beetle Office, Boston, Mass.

localized areas. A general increase in population was noted in all areas of infestation. Natural spread from local centers of infestation was more noticeable and apparently general. Scouts reported more beetles found in suburban and rural sections than in previous years. The last adult beetle in the season of 1939 was found on October 10.

Adult beetle feeding occurred on apple, cherry, elm, horsechestnut, linden, mountain ash, Norway maple, pin oak, plum, sassafras, and Schwedleri maple trees as well as grapevines and many ornamental shrubs, vines and plants. The skeletonized foliage was more apparent in the late season than in midseason. General feeding took place in Branford, Bridgeport, Darien, Danbury, East Haven, Fairfield, Greenwich, Hamden, Hartford, New Canaan, New Haven, New London, Norwalk, Putnam, Ridgefield, Stamford and Stratford. In some towns it was confined to localized areas and in others was very general. Restricted feeding occurred on some of the more favorite host plants in a few of the towns adjoining those already mentioned.

The grubs of this insect damaged or destroyed upwards of 2,000 or more acres of turf in parks, golf courses and lawns. This estimate, in the opinion of the writer, is very conservative. Many acres of turf have been protected by the application of lead arsenate during the past season.

The checking of recommended sprays and the development of new materials is carried on with the coöperation of Dr. Philip Garman. Among the sprays tested, lead arsenate is the most satisfactory from a general standpoint. It should be used with a good sticking agent such as wheat flour, fish oil or any of the desirable proprietary agents. Derris (containing at least 4 percent rotenone) with rosin residue must be used weekly to give protection to the foliage. Tetramethyl thiuram disulfide and rosin residue gave promise as a repellent. Derris and tetramethyl thiuram disulfide leave very little visual spray residue and may be used where white discoloration is undesirable. Two proprietary sprays containing 4 percent rotenone were used and compared favorably with the derris spray mentioned above.

During May, 1939, twenty-five colonies of *Tiphia vernalis* Roh., a parasite of the larvae of the Japanese beetle, were released in infested areas in Bridgeport, Devon, East Hartford, East Portchester, Fairfield, Fair Haven, Greenwich, Hartford, Meriden, Montowese, New London, Ridgefield, Waterbury, West Haven and Wilson. Since 1937, 75 colonies of parasites have been released in the State, including releases in Branford, Danbury, New Haven, Norwalk, Norwich, Putnam, Stamford and Westport.

The causal organism of a bacterial disease, known as the milky disease, of the Japanese beetle larvae was isolated in 1933 by workers in the United States Department of Agriculture after considerable study and effort. The bacterium appears to be effective when distributed in areas of heavy grub infestation in New Jersey, reducing the number of grubs appreciably after two feeding seasons, but experimental results to date do not warrant general use by the public. A laboratory method has been devised to propagate the bacterium in quantity. Experimental plots have been established in Bridgeport and New Haven to observe its true value in relation to the control of the Japanese beetle in Connecticut.

MOSQUITO CONTROL WORK IN CONNECTICUT, 1939

R. C. Botsford

As in past years maintenance of state-accepted salt marsh areas for mosquito control continued from about April 1 to the middle of September. The state appropriation for this work for the fiscal year was $12,000.00. The regular average crew of nine men patrolled the areas as rapidly as possible in order to discover any potential breeding places which might have developed during the previous winter. As soon as discovered, the worst of these were corrected, while those in fair condition were passed by until time permitted attending to them.

Many small broods of mosquitoes developed in scattered areas, and a limited quantity of light fuel oil was sprayed on the surface of the water to destroy the larvae and pupae. At Grove Beach in Clinton a large brood had developed to the pupal stage in the ditches which had become stagnant due to lack of water circulation. These ditches were oiled immediately to prevent emergence, and the tide gates were opened to create a circulation of water. Although this occurred twice during the season, no mosquito nuisance was evident. Since this experience, all tide gates have been equipped with an adjustment so that they can be kept from closing tightly. Enough water is permitted to pass through to create the necessary circulation to prevent mosquito breeding.

Mosquito control work under the Work Projects Administration continued in coöperation with towns where labor and materials were made available. Although the Station sponsored many projects in name, no actual Station funds were available to cover their obligation as sponsor. In all cases the local town became co-sponsor and provided the stipulated requirements.

All federal aid mosquito projects on state-maintained areas were carried on in complete coöperation and with the approval of the Station. Projects on salt marsh areas which in the future may be accepted for state maintenance were given attention. All completed projects have so far functioned to the satisfaction of the Station.

The following résumé of W.P.A. federal aid mosquito control projects is a continuation of last year's report showing work completed and new work in progress. Many of these projects are town sponsored and may be rated as flood control and sanitation projects with mosquito control as secondary:

Ansonia: Cleaning Beaver Brook; completed.
Colony Street, draining swamp and walling up ditch. Town sponsored.

Branford: Stony Creek Dike; completed. Here an old stone dike needing frequent and expensive repairs was replaced by a modern earthen dike and concrete tide gate emplacement. Station sponsored.

East Hartford: Pewter Pot Brook; Station sponsored by request; completed.
Panzy's Pond, correcting drainage. Station sponsored by request.

Fairfield: Ash Creek Park and Meadowbrook drainage; completed.
Pine Creek Bridge. All town sponsored.

Groton: Benham Road and Warren Street, draining swamp. Town sponsored.

Guilford: Great Harbor Dike, rebuilding dike damaged by hurricane. Station sponsored.

Hamden: Fairview Avenue, draining swamp and laying pipe. Town sponsored.

Madison: Madison Yacht Club Marsh, outlet under construction. Town sponsored.
Tuxis Pond, improving drainage. Town sponsored.

New Britain: Piper Brook and Bass Brook, corrective work. Town sponsored.

New Haven: West River, Wilmot Brook and Lawncrest Brook; corrective work. Town sponsored.
East Shore Meadows, improving outlet. Town sponsored.

North Haven: Blakeslee Road, swamp drainage. Station sponsored, by request.

Norwalk: Lockwood Lane, swamp drainage. Town sponsored.

Plymouth: Pequabuck River, corrective work. Town sponsored.

Southington: Holcomb School Swamp; completed. Town sponsored.

Stratford: Great Dike repairs abandoned.
Sniffens Meadow, new outlet. Town sponsored.
Bruce Brook, new bridge and corrective work. Town sponsored.

West Haven: Berkshire Division, swamp drainage. Town sponsored.

Westport: Town Dump Swamp, swamp drainage. Town sponsored.

Following is a complete list of proposed projects included in a 1939 state-wide application by the Experiment Station. These have been approved by the U. S. Biological Survey and federal funds have been designated to cover the share of cost borne by the W.P.A. Some of these are already in various stages of operation and many incorporate important improvements to state-maintained areas. This list is subject to change.

List of Project Sites Included Under the 1939 Project Application

Branford	Branford River	Repair tide gate
	Sunset Beach	Install tide gate
	Bullard's Meadow	Install tide gate
	Oppel's Creek	Install tide gate
	[1]Stony Creek	Complete present project
	[2]Stony Creek Center	Clean culverts
	Sybil Creek	Rebuild tide gate
Clinton	Indian River	Install tide gate
	Point Beach	Dig outlet through dunes
[2]**East Hartford**	[1]Pitkin Street	Install outlet
East Haven	Caroline Creek	Install tide gate and jetties
	Meadow Mere	Install tide gate
Fairfield	Casco Brook	Install timber jetties: replace stone culvert with pipe.
[2]**Glastonbury**	Hubbard Brook & Sycamore Street	Install culverts and correct stream bed.
	Glastonbury Meadows	Install outlet
Groton	Route No. 215	Install tide gate and outlet
	Groton Long Point	Lower culverts; correct drainage

Guilford	[1]Great Harbor	Repair dike; install jetties
	Guilford Sluice Tide Gate	Install tide gate
	Leete's Island Quarry	Install tide gate
	Vineyard Point	Install tide gate
[2]**Hamden**	Church Street	Drain pond
	Oregon Avenue Dump	Low spot to be filled
	Pot Hole North of Skiff Street	Low area to be filled
	Whitney Ridge Manor	Stream correction
	Waite Street	Stream correction
	Mill River—North of Skiff Street	Drain low area
	Treadwell Street	Fill low area
	Waite & Mather Street	Fill low area
	Morse Street	Ditch low area
	Winchester Dump and Powder Farm	Stream correction
	South of Skiff Street	Drain low area
Madison	Canoe Harbor	Install tide gate
	[2]Country Club Extension	Stream correction
	Hotchkiss Meadow	Install tide gate
	Foot of Harbor Street	Install tide gate
	East of Norma Dee Cottage	Install tide gate
	Overshore	Install tide gate
	[2]Scotland Avenue	Lower culvert
	Foot of Waterbury Avenue	Install tide gate
New Haven	[3]Little River	Install tide gate
	Hemingway Pond	Install tide gate
	Pardee Street	Fill low area
	[2]Parker's Pond	Drain pond
	Strong Street	Install pipe line
New London	[2]Briggs Brook	Stream correction
	[2]Coleman Street	Stream correction
	[2]Dell Avenue & Mahan Street to Sound	Stream correction
	Fort Trumbull & Cotton Gin	Correct drainage
	Ocean Beach	Ditch small salt marsh
	Old Town Mill	Drain low area
	Shaws Cove	Ditching
	Winthrop Cove Project	Drain low area
[2]**North Haven**	Overbrook Road	Stream correction
	Rear of Germains	Correct drainage
Norwalk	Gulf Oil Co.	Install pipe line
Old Lyme	[2]Appleby's Pond	Correct drainage
	Sound View	Install tide gate
	Scott's Pond	Install tide gate
Old Saybrook	Plum Bank	Correct drainage
Stonington	Lord's Point	Install tide gates, outlets, and ditch areas known as 1, 2, 3 and 4.
Stratford	Common Meadows	Install tide gate
	Lighthouse Meadow	Install tide gate
	Lordship Road	Install tide gate
Westbrook	Pochaug River	Fill low area
	Lewis Salt Marsh	Install culvert
	[2]Lewis Swamp	Install tide gate
	Stannard's Beach	Correct drainage
	[2]Westbrook Center	Install culvert and ditch low area.

West Haven	Oyster River	Install tide gate
	[2]Anawan Avenue	Correct drainage
	Cove River	Install tide gate
Westport	[1]Methodist Church Project	Drain low area
	[2]Post Road East of Stage Door Inn	Correct drainage
	Saugatuck Shores	Install outlet
	[2]West Parish & Center Street	Lower culvert
	[2]Peat Swamp	Correct drainage

[1] In operation.

[2] Fresh water work.

[3] Subject to inspection and approval of the U. S. Bureau of Biological Survey.

The following legislation passed the January, 1939, session of the General Assembly and places all state mosquito work under the new Board of Mosquito Control:

"Be it enacted by the Senate and House of Representatives in General Assembly convened:

"The director of the Connecticut Agricultural Experiment Station, the director of the state water commission, the superintendent of the state board of fisheries and game, the commissioner of health and one person appointed for a term of four years by the governor, shall act as a board of mosquito control and shall administer the provisions of sections 2415 and 2416 of the general statutes.

"Sections 2415 and 2416 of the general statutes are amended by striking out the words 'director of the Connecticut Agricultural Experiment Station' wherever they occur and inserting in lieu thereof the words 'board of mosquito control'; by striking out the word 'director' wherever it occurs and inserting in lieu thereof the word 'board' and by striking out the word 'deputies' wherever it occurs and inserting in lieu thereof the word 'agents."

RODENT CONTROL[1]

Howard A. Merrill*

Mouse Control

During the past year (1939) extensive mouse control work has been conducted with satisfactory results in Connecticut with a rodenticide in which zinc phosphide is incorporated. The work was carried out in orchards, nurseries, watershed plantings and other reforestation projects. More than 400 growers in the State coöperated in applying poison baits to control the mice on approximately 18,000 acres. The meadow mouse (*Microtus pennsylvanicus*) control method has been developed to a point at which 90 to 100 percent efficiency may be expected.

As a further help to growers, semi-annual population counts of meadow mice are being made. One is made in the spring about apple blossom time and the other during the early part of September, by trapping all the mice on numerous plots of one acre each. The areas selected are favorable habitats of *Microtus* and comprise those that appear to have a relatively high population judging from observations of trails, nests, and feeding signs. Similar work is being carried on in each of the northeastern states, and by correlating the data we expect to be able to forecast what the population will be and to what extent control measures will be necessary.

[1] U. S. Biological Survey and Connecticut Agricultural Experiment Station co-operating.

* Ass't District Agent, Bureau of Biol. Surv., U. S. D. I.

During the fall of 1938 the meadow mouse population in orchards under observation was very high, about 100 *Microtus* per acre. That probably represented the peak of the mouse fluctuation. In several news letters sent out to the fruit growers and at all meetings the point was emphasized that extensive damage could be expected if control measures were not undertaken. It happened that many growers did not complete poison operations until early winter because of the added work resulting from the hurricane. In those cases a great deal of damage was done prior to poisoning.

Nurserymen and foresters suffered severe losses of conifers and various deciduous trees and shrubs. Mouse damage in these plantings is not usually an annual occurrence. During the peak years of the *Microtus* population fluctuations, however, damage may be expected. It is during such years that we hope to be able to forewarn the growers that added precautions may be necessary, for at such times more than one poisoning may be required, because of the "drift", or reinfestation, of the mice.

The spring population estimation in Connecticut in 1939, made on four well-distributed areas, showed a marked reduction in mouse populations. The counts ranged from 2 to 24 mice per acre in unpoisoned orchard cover. This reduction was noted throughout the northeastern states. The reason for it has not been definitely determined; but, it is felt that climatic conditions may have been an important factor.

In September, 1939, thirty-six *Microtus* were caught in a one-acre orchard plot. Examination of several other orchards had previously been made, and this area gave all appearance of having the highest population.

Pine Mouse Control

Pine mouse (*Pitymys pinetorum*) control is still in the research stage. Results have been effective in certain instances, but have varied with the type of soil, vegetative cover, and the time of poisoning operations. Because pine mice feed both on the surface and underground, the problem is complicated. Areas will be treated during the spring and summer to determine whether or not better results can be obtained at these seasons of the year than in the fall. Different methods of bait application are also being tried. Owing to the heavy sod and soil conditions found in many of the orchards, the probe method has not proved entirely satisfactory, and it is felt necessary to try other means. To determine the rate of drift, or reinfestation, of pine mice into an orchard, a study area has been established in the Hoffmeister orchard at Hamden, Conn., and periodic observations are being made there.

Woodchuck Control

Many fruit growers annually sustain considerable damage to young orchards from woodchucks (*Marmota monax*). Much of this damage is done in the spring, when the woodchucks claw the trunks of the young trees and remove the bark. The woodchucks also burrow under the trees and thus cause excessive aeration of the roots and often upset the tree. (See Figure 1). Mowing machines are frequently damaged when they strike the woodchuck mounds.

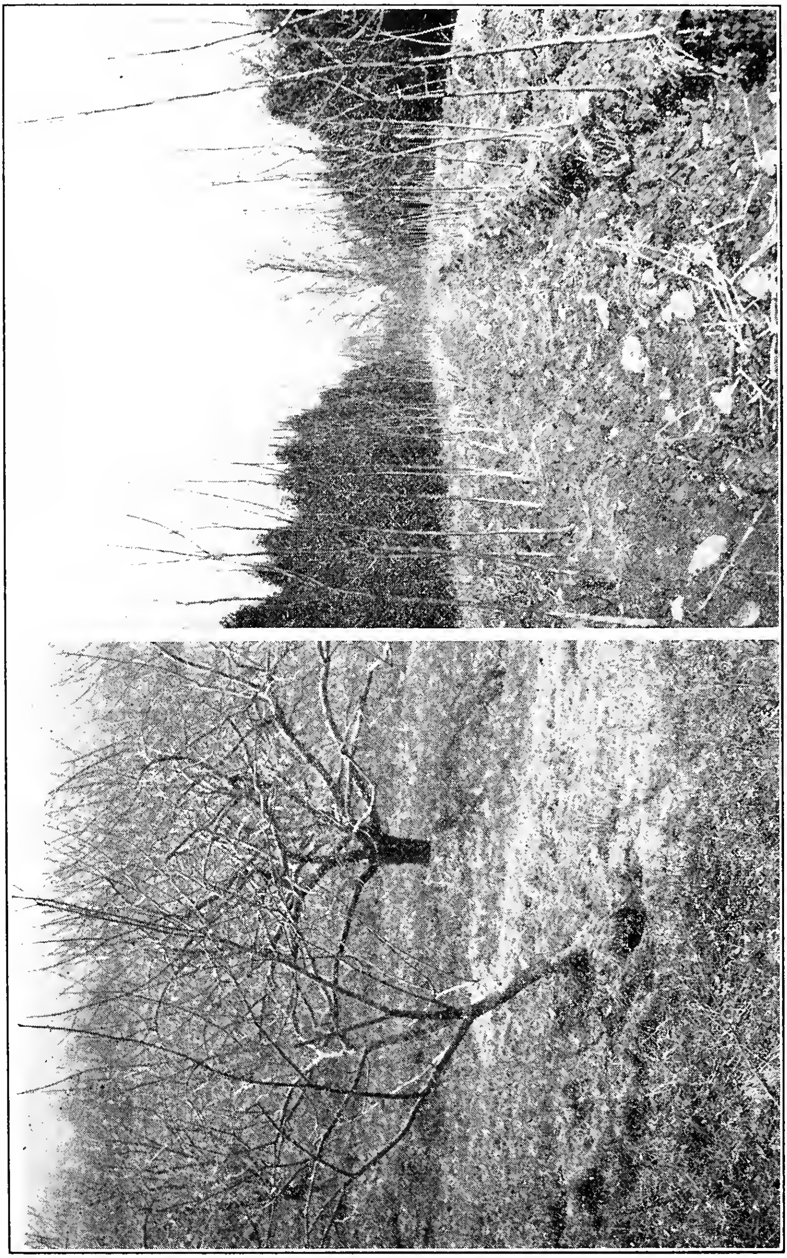

FIGURE 1. Rodent injury to fruit trees. Left: Woodchuck damage in apple orchards, a preventable injury. Right: Typical rabbit damage to apple nursery stock.

Commercial vegetable growers may also suffer serious injury to their crops through the activities of woodchucks.

In woodchuck control it has been the policy not to conduct state or county campaigns. It should be remembered that these animals play an important part in the general wildlife scheme, and usually do not conflict with man's interests. Where they are causing damage, however, they should be controlled. During the past two years research has been conducted to develop a gas cartridge that can be easily handled, is reasonable in cost, and will give effective control. In the spring of 1939, approximately 2,000 of these gas cartridges or "bombs" were used by 50 growers. The results were excellent, and many requests were received from other growers who had learned of their effectiveness. During the coming year we hope to have a larger supply and make them available to all growers upon request.

A Survey of Mammal Damage in Connecticut Nurseries

Numerous complaints pertaining to damage by mice, rabbits, and deer have been received from nurserymen throughout the State. A survey was made to determine the extent of this damage and a considerable amount was discovered in the largest nurseries. In many cases the owners or managers were unaware of the injury until many dollars' worth of valuable stock had been destroyed. The survey was made in 21 of the State's nurseries, including about 3,310 acres, or approximately 65 percent of the total nursery area of Connecticut. Extensive damage, mainly by mice and rabbits, was found in 13 of the 21.

Most of the rabbit injury was caused by the eastern cottontail (*Sylvilagus floridanus mallurus*) and the New England cottontail (*Sylvilagus transitionalis*). However, some damage in the western part of the State was done by the European hare (*Lepus europaeus hybridus*). The greatest amount of rabbit damage was found in nurseries where fruit trees were grown. In seven, a total of 15,750 young fruit trees, valued at \$.75 to \$1.25 each, were injured, with a loss of approximately \$15,000. (See Figure 1). In the 21 nurseries inspected, rabbit damage was found in 11 and the total loss amounted to approximately \$30,000. Plants frequently damaged were: apple (*Malus* v.), pear (*Pyrus* v.), euonymus (deciduous and evergreen), magnolia, Taxus, maples (Norway and sugar), and elms (American and Chinese). Hunting, trapping, and wire guards were used as means of protection but the results were not satisfactory. In many cases the damage occurred within a very short period of time, and no effective control method was available.

It was after this injury was observed and the problems of control discussed with the nurserymen that our interest in the use of repellents was aroused. During the coming year a few experimental tests will be made to determine the feasibility of their use. It will not only be necessary to find a good repellent, but this must be reasonable in cost, easy to apply, and most important of all, it must not in itself injure the tender bark of the nursery stock.

Mouse Injury

Meadow mouse (*Microtus pennsylvanicus*) damage in nurseries is practically as severe as that caused by rabbits. However, unlike the rabbit situation, it is possible to control these pests by methods now available. Insufficient knowledge of control methods on the part of the nurserymen is the main reason for the difficulty.

Clean cultivation is one of the best means of control, but where sod or mulch is used, trail baiting with the Biological Survey Rodenticide gives excellent results. Of the 21 nurseries inspected, mouse damage amounting to approximately $35,000 was found in seven. The principal plants injured were: dogwood (*Cornus* v.), Canadian hemlock (*Tsuga canadensis*), Douglas fir (*Pseudotsuga taxifolia*), Austrian pine (*Pinus nigra*), mugho pine (*Pinus mughus*), yew (*Taxus* v.), Carolina hemlock (*Tsuga caroliniana*), Colorado blue spruce (*Picea pungens glauca*), and Alpine fir (*Abies lasiocarpa*).

Deer Injury

The white-tail deer (*Odocoileus virginianus*) is found to prefer fruit trees in the nurseries as well as in the young orchards. Although other varieties were damaged to a slight extent, fruit trees were most severely attacked. Only one nursery out of the 21 inspected sustained any appreciable damage from deer. In this one, 5,000 apple trees, 400 plum trees, and 50 Ginkgo trees were injured. This amounted to approximately $4,500. The amount of deer damage in nurseries is relatively minor compared to that done in newly developed orchards.

REPORT ON PARASITE WORK FOR 1939

Philip Garman, J. C. Schread, W. T. Brigham and G. R. Smith

Oriental Fruit Moth Parasites

Distribution of parasites and careful parasite studies were continued in 1939. In order to increase our stock and meet demands from peach growers, some parasites were purchased in New Jersey and additional collections were made by Mr. DeCaprio. We received 115 orders and distributed 6,175,000 Trichogramma, 18,944 *Macrocentrus ancylivorus*, 2,087 *Diocles molestae* and 1,241 *Bassus diversus*. A few native species were reared from general collections and placed in orchards where they had not been found previously.

Recovery collections were made in a large number of orchards and careful studies of parasite and fruit moth populations were begun in four. Because of additional help in the laboratory during the summer, much time was spent in peach orchards and considerable data assembled. Condensed results of the first year's work are shown in Table 6. The fruit moth populations are based on egg and twig counts collected on an hourly basis. Survival rates are calculated from the population study to which was applied the reduction brought about by egg, larval and pupal parasitism. In two cases, the "estimated" population was based on comparative records from other orchards but no actual counts were made there. As in previous years, low fruit infestation at harvest seemed to be correlated with the amount of larval parasitism in July, but there were some exceptions noted this year for the first time. Evidently other factors may influence the end results, and it appears probable that population densities of the fruit moth may afford an answer. Thus, if we have a population density of 100 units and parasitism amounting to 90 percent, 10 units of fruit moths will remain, whereas if the population rating is only 20, a parasitism of 50 percent will produce the same result, namely a survival of 10 units.

TABLE 6. CONDENSED RESULTS OF STUDIES ON THE ORIENTAL FRUIT MOTH, 1939

Orchard	Fruit moth population estimates	Relative July survival of fruit moth	Elberta infestation at harvest, %
Bishop 1939	49	2.4	6.0
Rogers	30	2.7	1.0
Bussa	36	4.5	11.2
Peters	18	6.0	8.0
Andrews	89	11.7	22.5
Hanford	200 (est)	23.7	30.3
Platt	125	26.0	31.9
Hurlbutt	100	67.5	25.2
Musante	150	83.9	42.4
Bishop 1938	200 (est)	117	63.4

Recoveries of introduced species were continued and the following were reared from orchard collected twigs.

Species	Maximum survival years	Number of orchards where recovered
Bassus diversus	3	6
Dioctes molestae	1	14
Orgilus longiceps	1	1

Bassus diversus continues to survive in various orchards, but *Dioctes molestae* apparently does not live more than a year in this State. *Orgilus longiceps* was recovered for the first time in New London County.

Japanese Beetle Parasites

Coöperation with the U. S. Bureau of Entomology was continued and assistance was rendered in locating points for liberation of *Tiphia vernalis* colonies throughout the infested area. Twenty-five colonies of this species, each consisting of 100 mated females, were placed in the following towns:

East Portchester	1	Waterbury	1
Greenwich	4	Fair Haven	3
Ridgefield	1	Montowese	1
Fairfield	2	Meriden	1
Bridgeport	4	Hartford	3
Devon	1	East Hartford	1
West Haven	1	New London	1
		Total	25

Tiphia popilliavora recoveries were made at six different localities throughout the State where they had been released in 1937 and 1938. Since there have been 23 liberations of this species in Connecticut, the recoveries indicate that at least 26 percent of them have become established. Twenty-one of the 23 colonizations were scouted this year. Recoveries of *Tiphia vernalis* continue to be made in Bridgeport and New Haven and there are indications that parasitism by the species mentioned is building up rapidly. No systematic scouting program for *vernalis* was carried out in 1939, however.

TESTS OF APPLE SPRAYS

M. P. Zappe and E. M. Stoddard

Tests of various sprays for control of apple pests, both insects and fungous diseases, have been continued as a coöperative project between the departments of Botany and Entomology. The tests were conducted in the Experiment Station orchard at Mount Carmel. The largest number of trees treated were McIntosh and Baldwin, but several Fall Pippin, Wealthy, Gravenstein, Greening, Northern Spy, King, Sutton and Stark were included.

Two types of sprays were used. Those containing sulfurs were applied to scab susceptible varieties and those without sulfur to varieties not particularly susceptible to apple scab. On the scab-resistant varieties the arsenate of lead-lime-fish oil mixture, which has been used several years, again produced a high percentage of good fruit with an excellent finish. No dormant or nicotine sprays have been applied to this plot for several years. The absence of sulfur in these sprays has allowed the red mite and aphid enemies to increase so that it has been unnecessary to apply any special sprays for these pests. Sooty blotch and fruit speck have been satisfactorily controlled with this mixture.

The materials used in these tests and the timing of the applications were selected to give the greatest amount of protection at the least cost. These tests should be of great practical value to fruit growers when there is a surplus of apples and the market price of the fruit is relatively low.

Sulfur Plots

Three different kinds of sulfur sprays were used on plots of McIntosh and Fall Pippin, both of which are susceptible to scab. Applications began with the pink spray May 10, followed by the calyx, 7-day, 14-day and mid-July cover spray. The following materials were used:

1.	Dry lime-sulfur	6 lbs.
	Arsenate of lead	3 "
	Water	100 gals.
2.	Dry flotation sulfur (with and without spreader)	5 lbs.
	Arsenate of lead	3 "
	Water	100 gals.
3.	Magnetic sulfur (with and without spreader)	
	Preblossom	7 lbs.
	Post-blossom	5 "
	Arsenate of lead	3 "
	Water	100 gals.

All the fruit on all plots was examined for insect and fungous injury at harvest time, and all injuries, however slight, were recorded. The percentages of perfect and injured fruit are given in the following table.

TABLE 7. SULFUR PLOTS

	McINTOSH						FALL PIPPIN		
	Flotation sulfur without spreader	Flotation sulfur with spreader	Dry lime-sulfur	Magnetic sulfur without spreader	Magnetic sulfur with spreader	Check—no spray	Flotation sulfur without spreader	Flotation sulfur with spreader	Check—no spray
Good	76.13%	70.39%	75.26%	60.73%	42.83%	4.19%	77.26%	73.51%	2.82%
Curculio	18	21.8	17.65	34.39	55.11	65.55	17.15	23.08	65.85
Codling moth	.01	0	.001	.05	0	1.01	.06	.02	4.36
Other chewing insects	.47	.69	.67	1.72	1.52	2.32	5.01	2.93	36.84
Scab	6.16	5.62	8.59	1.87	1.65	81.87	.52	.9	60.07
Sooty blotch	0	0	0	0	0	0	0	0	32.73

The spreader used in the above plots was an oil emulsion and its inclusion did not result in any better control of insects and diseases. Both flotation and magnetic sulfur gave satisfactory control of apple scab. The dry lime-sulfur plot had a little more scab than either of the other sulfur plots but the difference was not enough to be significant. Curculio injury was too high in all the plots and accounts for the low percentage of perfect fruit. Conditions for curculio damage are very good in our experimental orchard, as adult curculios come from a peach orchard near the apple trees. Weather conditions favored curculios this season and they were more abundant and caused more injury than usual in all orchard sections of Connecticut.

Arsenate of Lead-Lime-Fish Oil Plots

The rest of the orchard, except for the variety Wealthy, was sprayed with the following mixture:

Arsenate of lead	3 lbs.
Hydrated lime	10 "
Fish Oil	1 qt.
Water	100 gals.

The same number of applications were made as in the sulfur plots. Fish oil was omitted from the last application, July 12, because of the danger of excessive spray residue on the fruit at harvest. In order to determine the value of copper sulfate in controlling fruit speck and sooty blotch, two pounds of this material were added to the above mixture in the last application to half the Baldwin and Greening plots.

Table 8. Lead Arsenate-Lime-Fish Oil Plots

	Baldwin	Baldwin Check—no spray	Greening	Greening Check—no spray	King	Northern Spy	Sutton
Good	86.14%	3.65%	86.86%	3.35%	83.75%	90.33%	82.64%
Curculio	12.22	67.1	9.38	80.88	11.47	5.57	10.85
Codling moth	.006	13.84	0	3.45	0	0	.01
Other chewing insects	1.16	14.88	2.35	13.29	1.79	1.01	2.72
Scab	.31	.78	.93	8.86	.56	1.53	.21
Blotch	.33	62.66	.67	76.12	0	1.82	.12
Cedar rust					2.76		4.

This mixture produced a high percentage of good fruit according to our method of scoring. We count all insect or disease blemishes as injured fruit, even though such injury is very slight and would easily pass a commercial grade. Curculio injury was higher than usual. Some of the fruit was scarred but not seriously injured. A mixture of lead arsenate, lime and fish oil has always been a very effective spray on non-scabbing varieties, and this year was no exception. The finish on the harvested fruit from these plots was much better than on the fruit from the lime-sulfur plots. Codling moth damage was hardly noticeable. Although fruit growers in nearby states experience considerable trouble with this pest, Connecticut orchards in general have had no difficulty with the insect in the past. However, we may have an outbreak some time in the future.

Lead Arsenate-Lime-Fish Oil With and Without Copper Sulfate

The following table indicates the effect of adding two pounds of copper sulfate to the last spray, July 12, in reducing fruit speck and sooty blotch (fish oil was omitted from the mixture on this date). Sooty blotch is usually negligible on fruit from trees sprayed throughout the season with a lead arsenate-lime-fish oil mixture, and the addition of copper sulfate did not reduce its incidence enough to pay for the cost of the material.

Table 9. Copper Sulfate Plots

	Baldwin—no copper sulfate	Baldwin—with copper sulfate	Greening—no copper sulfate	Greening—with copper sulfate
Good	82.75%	90.66%	89.62%	85.24%
Curculio	15.05	8.45	6.32	11.21
Codling moth	.01	0	0	0
Other chewing insects	1.58	.6	2.32	2.37
Scab	.41	.2	1.20	.78
Sooty blotch	.45	.16	.76	.63

Wealthy Plots

The variety Wealthy was sprayed with the following mixture, the application dates being the same as in the other plots:

Dry lime-sulfur	6 lbs.
Lead arsenate	3 "
[1]Glue	4 oz.
Water	100 gals.

The results are given in the following table.

[1] "Casco" waterproof glue.

TABLE 10. WEALTHY PLOTS

	Sprayed	Check (no treatment)
Good	72.96%	24.92%
Curculio	12.80	47.65
Codling moth	.07	.56
Other chewing insects	.33	3.05
Scab	.31	3.19
Cedar rust	16.18	42.73

The treatment gave a significant control of cedar rust on the fruit and very satisfactory control on the foliage. The 16 percent of infected apples was not of great importance from the standpoint of the production of a commercial crop, as over 16 percent of the fruit was removed in thinning and the thinnings included a large part of the rusted fruit. The above data include *all* fruit, that removed in thinning as well as that harvested.

CONTINUED EXPERIMENTS ON CONTROL OF THE APPLE MAGGOT

PHILIP GARMAN AND J. F. TOWNSEND

DURING 1939 a series of experiments was begun in an attempt to learn whether or not there are any means of improving rotenone mixtures for use in killing the adult fly. Experiments covering the effect of light, heat and moisture indicated that high temperatures (100 to 105° F.) for three to five days have little effect in reducing the kill (Table 11). Similarly, high humidity had little effect in these tests. Light evidently plays a more important rôle, and the active principles are destroyed in a few days by strong sunlight. It seems probable that ultraviolet rays are not the only ones involved, although they are evidently the most potent, since material exposed under window glass eliminating short waves below 3100 Angstrom units was destroyed. The period necessary for this destruction, however, is much greater than for strong ultraviolet radiation. In view of the efficient behaviour of oil-pyrophyllite dusts containing rotenone during 1938 and 1939, it was decided to try them in the orchard. The main advantage afforded by this combination seems to lie in stability against breakdown in storage and rapid settling on the trees which allows one to make heavy applications without excessive drift away from the point of application. Six months after preparation the dust killed just as rapidly as when freshly prepared. Stabilization against breakdown in strong ultraviolet light, however, appears to be non-existent.

In the course of these tests we also investigated quebracho-fixed nicotine and Genicide dusts, both of which were without effect in killing the fly.

For field work Apothecaries Hall Company of Waterbury prepared 400 pounds of .5 percent rotenone dust (derris containing 4 percent, used as a source of rotenone), to which was added 4 percent white lubricating oil. The carrier was aluminum silicate, known as pyrophyllite. This combination, exposed to bright sunlight (Table 12) in midsummer, retained its effectiveness for 3 hours and for 5.5 hours during an overcast period. Under shaded conditions it was also effective for that length of time. Just how long it remains effective under orchard conditions, especially in the shade, is uncertain.

TABLE 11. LABORATORY CAGE TESTS WITH ROTENONE DUSTS TO SHOW EFFECT OF HEAT AND MOISTURE IN DESTROYING THE ROTENONE OR OTHER ACTIVE PRINCIPLE

Materials used	Treatment after dusting	Mortality	Egg punctures per female
.5% rotenone 4% oil	3 days at 105° F. 30% R.H.	100% in 3 days	0
.5% " 4% "	3 days at 105° F. 80% R.H.	100% in 3 days	0
.5% " 4% "	3 days at 104-5° F. 70-80% R.H.	100% in 4 days	0
.6% " no "	5 days at 104-5° F. 70-80% R.H.	100% in 7-8 days	0
.6% " no oil[1]	....	100% in 6-7 days	0
.6% rotenone no oil	....	100% in 8 days	0
.6% " " "	....	100% in 4 days	0
.5% " —oil	....	100% in 3 days	0
.5% " —oil	....	100% in 5 days	0
Check—no treatment	....	26% in 20 days	26

[1] Sprayed lightly with water after dusting.

In the laboratory tests outlined in tables and text, apples were dusted lightly with the insecticide, after which they were exposed to light and hung in the cages with the adult flies. Apples unexposed to light were hung in the cages directly after treatment. All cages were kept at controlled temperatures and humidity (76° F. and 60—70% R. H.). Flies of both sexes were used in each experiment, the number varying from 20 to 40 individuals.

In addition to laboratory test work, a careful field experiment was made with the oil-impregnated dust mentioned above. The mixture was applied with a power duster to Gravenstein, Delicious, and several other varieties. Results were taken from Gravenstein only. Observations made at frequent intervals after applications indicated rapid destruction of the flies at first but their reappearance was noted after four or five days. The same trees were treated with a similar dust in 1938 but, as already reported (Conn. Agr. Expt. Sta. Bul. 428, p. 72), control was not entirely satisfactory then because of heavy rainfall at critical periods. The rotenone dust used this year is believed to be superior to that used in 1938 because of its property of settling rapidly on the trees and the fact that applications could be made without excessive drift out of the orchard.

Samples were taken of drops and picked apples and both were held for some time before cutting open in order to allow maggot eggs to hatch.

TABLE 12. APPLE MAGGOT CAGE TESTS WITH ROTENONE-BEARING DUSTS SHOWING EFFECT OF VARIOUS EXPOSURES TO LIGHT (IN GREENHOUSE)

	Materials used	Exposure to light	Mortality	Egg punctures per female	Dates of exposure
(1)	.5% rotenone-clay-lampblack-zinc stearate	5 days in greenhouse	45% in 20 days	0	12/17-12/22 '38
	.5% rotenone-clay[1]-oil	5 " " "	57% in 20 days	0	12/17-12/22 '38
	.5% " -clay-oil	5 " " "	78% in 20 days	0	12/17-12/22 '38
	.5% " -clay	5 " " "	37% in 20 days	1	12/17-12/22 '38
(2)	.5% " -clay-oil	4 " " "	100% in 8 days	0	12/21-12/25 '38
	.5% " -lampblack-clay	4 " " "	100% in 13 days	0	12/21-12/25 '38
	.5% " -clay	4 " " "	76% in 20 days	0	12/21-12/25 '38
	.5% " -clay	4 " " "	20% in 20 days	1	12/21-12/25 '38
	.5% " -Nigrosin (black dye)	4 " " "	100% in 17 days	0	12/21-12/25 '38
(3)	.5% " -clay-4% oil	2 " " "	100% in 6 days	0	1/11- 1/13 '39
	.5% " -clay-lampblack-oil	2 " " "	100% in 6 days	0	1/11- 1/13 '39
(4)	Clay only	....	63% in 20 days	0	12/15 '38
	No treatment	....	33% in 20 days	8[2]	12/15 '38
	No treatment	....	29% in 20 days	47	Dec. '38

Notes: All flies kept during experiment at 76° F. 60-70% relative humidity.

(1) Hours sunlight in New Haven Dec. 17 to Dec. 22, 1938—13 hrs. 15 min.
(2) " " " " " Dec. 21 to Dec. 25, 1938—10 hrs. 21 min.
(3) " " " " " Jan. 11 to Jan. 13, 1939—10 hrs. 45 min.

[1] Commercial dust to which oil was added.
[2] Egg puncture count not complete.

TABLE 13. LABORATORY CAGE TESTS WITH OIL-ROTENONE DUSTS FOR CONTROL OF THE APPLE MAGGOT, 1938-1939

Materials used	Exposure to light	Mortality	Egg punctures per female	Dates of exposure
(1) .5% rotenone plus 5% oil	3 hrs. direct sunlight	100% in 16 days	0	July 1939
(2) .5% rotenone plus 4% oil	3 hrs. direct sunlight	100% in 3 days	0	Aug. 1939
(3) .5% rotenone plus 4% oil	5 hrs. partly cloudy day	100% in 3 days	0	July 1939
(4) .5% rotenone plus 4% oil	5½ hrs. in shade	100% in 3 days	0	July 1939
(5) .5% rotenone plus 5% oil	1½ days in greenhouse	100% in 4 days	0	Jan. 1939
(6) .5% rotenone plus 4% oil	4 days in greenhouse	64% in 20 days	0	Dec. 1938
(7) .5% rotenone plus 5% oil	4 days in greenhouse	100% in 6 days	0	Dec. 1938
(8) .5% rotenone plus 5% oil	5 days in greenhouse	78% in 20 days	0	Dec. 1938
(9) .5% rotenone plus 5% oil	5 days in greenhouse	57% in 20 days	8	Jan. 1939
(10) .5% rotenone plus 5% oil	7 days in greenhouse	92% in 20 days	0	Dec. 1938
(11) .5% rotenone plus 5% oil	None	100% in 5 days	0	....
(12) .5% rotenone plus 4% oil	None	100% in 2 days	0	Nov. 1939
(13) .5% rotenone plus 4% oil	None	100% in 3 days	0	Nov. 1939
(14) .5% rotenone plus 4% oil	None	100% in 8 days	0	Nov. 1939
(15) Check—no treatment		29% in 20 days	47	Dec. 1938
(16) Check—no treatment		33% in 20 days	8[1]	Jan. 1939

Notes—4% oil-dust, bearing .5% rotenone prepared by a commercial concern. Other mixtures prepared in the laboratory.

[1] Only partial egg count. Checks were run more frequently than indicated; all appeared to be similar.

While the average for drops in this experiment is fairly high, it does not appear to be higher than for Gravenstein fruit from nearby orchards where trees were sprayed heavily with lead arsenate. Here the drop fruits averaged 28 percent infested and the picked fruit 3 percent, indicating about the same degree of control as obtained with rotenone dust. One to two pounds of dust per tree per application was used, and the trees were dusted each time from both sides. The program for dusted trees is as follows:

(1) Dormant oils for aphis	April 6 and 11
(2) Pink: Lime sulfur and 3 pounds lead arsenate plus spreader and safener in 100 gallons	May 8
(3) Calyx: Same as pink	May 23
(4) First cover: Same as pink	June 2
(5) First maggot: .5% rotenone-oil-pyrophyllite	July 3
(6) 2nd maggot: " " " "	July 11
(7) 3rd maggot: " " " "	July 21
(8) 4th maggot: " " " "	Aug. 2

The apples handled in this experiment were of especially fine quality, being smooth, uniform, and of good color. The treatment did not control European red mite and there was a bad infestation on some of the trees included in the experiment. Results of the count at harvest are given in Table 14. The samples of picked fruit were taken at random to a height of about 9 feet from the ground. Drops were carefully sampled at random. The crop was about the same size as last year.

Progress of the infestation in the test plots during two years of treatment with rotenone dusts is shown in Table 15.

Conclusions

While it appears too early to make specific recommendations concerning the use of rotenone insecticides for control of the apple maggot, it would seem that such materials may have a place late in the season when it is desirable to avoid poisonous residues. They will doubtless be more successful in dry than in wet seasons, and it should be kept in mind that combinations so far prepared lose their potency even in dry weather. They are not known to last more than four or five days on the trees. The extreme rapidity of killing action is in favor of rotenone dusts, as shown by cage tests which frequently give 100 percent knockdowns in 24 hours. Field observations indicate the same rapid destruction of flies in the orchard. Flies coming from unsprayed trees outside the orchard still remain a problem, but there is reason to believe that the chance of eliminating late-comers with rotenone dusts is very good.

Table 14. Apple Maggot Control, 1939
Variety Gravenstein

Tree	No. apples cut open	Number injured by maggots	Number questionable[1]	Percent infested
		PICKED		
1	100	1	4	
2	100	2	2	
3	100	0	3	
4	181	2	1	
5	100	3	0	
6	100	2	0	
7	100	6	0	
	781	16	10	3.3
		DROPS		
1	120	10	6	
2	200	15	2	
3	200	11	6	
4	200	15	12	
5	200	44	22	
6	200	32	26	
7	200	58	23	
	1,320	185	97	21.4

[1]Tunnels few and obscure, doubtfully produced by apple maggots.

Table 15. Apple Maggot Control, 1938-1939
Variety Gravenstein

Treatment	Year	Kind of fruit	Percent injured by maggots
.5% rotenone dust	1938	Drops	37
4 applications	1938	Picked	16
.5% rotenone-oil-pyrophyllite dust	1939	Drops	21
4 applications	1939	Picked	3

CONTINUED STUDY OF STICKERS FOR STANDARD SPRAY MIXTURES

Philip Garman and C. E. Shepard

Work with stickers for orchard sprays was continued in 1939. A series of plots was used in the Burton Orchard at Mount Carmel as well as several rows at the Experiment Station farm. Work with "dynamite" sticker was continued and a new material consisting of bentonite and aluminum acetate was used for the first time. Aluminum acetate has the property of waterproofing spray mixtures and seems to serve as a safener as well as a sticker. Trees sprayed with aluminum acetate-lead arsenate mixture retained practically all their foliage throughout the season. Analysis of fruit at harvest showed considerable residue, especially where July treatments were made, indicating good adhesion. No lime is required in the mixture, aluminum acetate being safe on apple foliage. Further work is planned with this material.

A series of oils, including soybean, Perilla, and fish oil, was compared with aluminum sulfate and a commercial spreader and sticker. In these tests, Table 16, the oils compared favorably, with a slight though probably not significant advantage for Perilla oil. Aluminum sulfate, however, equalled the adhesiveness of the oils for lime-lead arsenate combinations and field observations indicated that it gives less foliage burn in hot weather. A Perilla oil-wettable sulfur combination was also tried with success on Delicious and Astrachan varieties but showed some tendency to drop the foliage of Yellow Transparent. No russetting occurred on apples sprayed with this combination.

A series of oil-sulfur combinations was tried on beans under glass, and it was found that Perilla oil gave less injury than most others.

TABLE 16. LOSS OF ARSENIC WITH DIFFERENT STICKERS

Sticker	Dates of experiment	Percentage lost As_2O_3	Percentage lost Pb.	Rainfall
Perilla oil	June 8—July 8	72	62	4.09 inches
Fish oil	" "	78	62	
Soybean oil	" "	79	69	
Commercial spreader & sticker	" "	83	74	
Aluminum sulfate	" "	75	67	
No sticker	" "	86	75	
Perilla oil	July 11—Aug. 11	35	39	2.14 inches
Fish oil	" "	49	31	
Soybean oil	" "	40	43	
Commercial spreader & sticker	" "	62	51	
Aluminum sulfate	" "	39	28	
No sticker	" "	65	42	

Spray formulae for 100 gallons:

Lime 10 lbs., lead arsenate 3 lbs., plus one of the following stickers

Soybean oil	1 quart
Perilla oil	1 quart
Fish oil	1 quart
Aluminum sulfate	3 lbs.
Commercial spreader & sticker	1 pint

In this series other materials were also added in an attempt to reduce injury, but without success. The quick-drying oils, such as linseed oil and Perilla oil, when combined with sulfur can apparently be used with less danger of foliage burn than non-drying or semi-drying oils. Mineral oils are especially bad in these combinations.

In the field tests, analyses by Mr. Shepard indicated that the arsenate weathered from "dynamite"-sprayed trees at a somewhat slower rate than lime-lead arsenate and Perilla oil, and it appeared possible to place a much heavier load of poison on the foliage and fruit at the time of spraying.

Table 17 shows some of the results outlined above.

In these tests, moderately large Baldwin trees were sprayed with a power sprayer, using about 450 pounds pressure and multiple nozzle rods. Samples were taken at random by punching out 1 square centimeter discs immediately after the spray application. A similar sample was taken one month later, the discs being taken from the same leaves and alongside the holes punched when the first samples were taken.

A comparison of Perilla oil and "dynamite" stickers, as already mentioned, was made on four Baldwin trees at the Experiment Station Farm. The comparative losses at two different periods is as follows.

TABLE 17. SHOWING LOSS OF ARSENIC TRIOXIDE AND LEAD FROM TREES SPRAYED WITH LEAD ARSENATE PLUS "DYNAMITE" STICKER, AND LEAD ARSENATE, LIME AND PERILLA OIL
Figures are micrograms per 100 sq. cm. discs

Sticker	May 26[1]	June 10[1]	Loss	% Loss	Rainfall
	Loss of As_2O_3 in first experiment Amount per 100 discs				
"Dynamite"	1,649	1,195	454	27.5	.32 in.
	1,482	932	550	37.1	
Lime-Perilla oil	932	741	191	20.4	
	980	574	406	41.4	
	Loss of lead in first experiment				
"Dynamite"	3,080	2,080	1,000	32.1	.32 in.
	2,800	1,700	1,100	39.2	
Lime-Perilla oil	1,860	1,200	660	35.4	
	1,760	800	400	22.7	

Sticker	June 23[1]	Aug. 3[1]	Loss	% Loss	Rainfall
	Loss of As_2O_3 in second experiment				
"Dynamite"	1,840	1,171	669	36.3	3.83 in.
	1,625	979	646	39.7	
Lime-Perilla oil	1,028	550	478	46.4	
	884	478	406	45.9	
	Loss of lead in second experiment				
"Dynamite"	3,720	2,390	1,330	35.7	3.83 in.
	3,310	1,955	1,355	40.9	
Lime-Perilla oil	1,028	550	478	46.5	
	884	478	406	45.9	

[1] Dates of analyses.

The figures above indicate fairly consistent losses both of lead and arsenic in the second experiment but lack uniformity in the case of earlier ones. This may be due to inability to obtain an even cover with the earlier treatment. In the second experiment 10 days elapsed between the spray application and first sampling. This probably produced a more even coating than would have been obtained had the sample been taken immediately. It will be noted that the *amount* of both arsenic and lead was much heavier throughout the season on the "dynamite" trees and also the percentage lost between June 23 and August 3 was appreciably less. These facts are reflected in the amount of good fruit at harvest which was nearly 12 percent more on the "dynamite" trees. However, curculio control, Table 18, was only slightly better than on the lime-oil trees, and the difference cannot be considered significant. The main advantage apparently lies in control of such insects as the red-banded leaf roller and others, which accounted for a large part of the difference between the two. As outlined in the 1938 report, better than 90 percent clean fruit was obtained with two sprays of lime-lead arsenate and two of "dynamite"-lead arsenate. The amount of lead arsenate on the fruit in 1938 was considered high, even with the last application as early as June 13. This year, with only three lead arsenate sprays (pink, lead arsenate-oil; calyx and first cover, "dynamite"-lead arsenate) and the last application June 10, there appeared to be no residue problem on Baldwins at harvest. The gap between calyx and first cover sprays was probably too great this year for successful curculio control, though similar conditions prevailed in other orchards where a closer schedule was followed.

Table 18. Harvest Examination of Fruit Sprayed with "Dynamite" Sticker and Lime-Lead Arsenate-Perilla Oil

	Total exam.	% good	% curculio
Lead arsenate and "dynamite" sticker	1,225	75.8	16.3
Lead arsenate, lime, and Perilla oil	758	63.9	17.1

EXPERIMENTS WITH MANGANESE SULFATE AS SAFENER FOR LIME SULFUR-LEAD ARSENATE SPRAY MIXTURES

Philip Garman

Following the introduction of "catalytic" safeners for preventing the well known reaction between lime sulfur and arsenate of lead, experiments were begun in 1937 to determine the possibilities of obtaining a cheap and efficient fungicide-insecticide for summer use on apples—and one reasonably free of spray burn. It is understood that the fungicide requirements of some varieties or strains are much less than of others. Mere reduction of lime sulfur content of the spray, however, does not always reduce spray burn but may even increase it.

The original catalytic safeners contained manganese sulfate, a buffer agent, and some sulfur. Laboratory work with a number of products indicated that one-half pound of soybean flour in 100 gallons was sufficient to afford ample buffer action. Among manganese sulfates used were a number of fertilizer grades as well as the anhydrous products. Some of the fertilizer grades were entirely satisfactory, while one grade containing 10 percent ammonium nitrate served fairly well in orchard tests. The problem then considered was exactly how much manganese sulfate was needed. In the original products, the amount of the manganese sulfate recommended per 100 gallons varied from 4 to 6 ounces. This amount apparently so reduces the fungicidal value of lime sulfur that additional sulfur is needed. It was believed that the manganese sulfate could be cut down to a point where the fungicidal value of lime sulfur would not be impaired and at the same time provide protection from spray burn. Experiments in 1938 on orchard trees indicated that homemade mixtures of soybean flour and manganese sulfate were equal to commercial products. Hence, in 1939, reduction of manganese sulfate was begun, using 2 ounces per 100 gallons with 2 gallons of lime sulfur, and 1 ounce per 100 where 1 gallon was used. These tests were satisfactory on McIntosh during 1939, where the trees were heavily sprayed from both sides. They were also satisfactory for Gravensteins. During 1938, with a more difficult situation from the disease standpoint and larger amounts of manganese sulfate in the mixtures, results were not satisfactory. It is believed that a cheap and suitable spray can be devised containing lime sulfur, manganese sulfate and the usual amount of lead arsenate, but further tests are necessary to demonstrate its efficiency in moist weather. Apparently these sprays must be heavily applied both inside and outside the tree.

CORN BORER INSECTICIDE INVESTIGATIONS[1]

Neely Turner

For the second successive year insecticidal experiments for control of the European corn borer in Connecticut were made to determine the possibility of modifying the standard schedule by eliminating at least one treatment. Marcross corn was planted April 24; corn borer eggs were found May 31 and larvae hatched on June 5. The standard schedule was started June 7, with further applications June 12, 17 and 22. Commercial dual-fixed nicotine dust (3.75 percent nicotine) was used in hand dusters. The plots were four rows wide and 20 feet long, with each treatment applied on six plots replicated at random. The season was dry and only one rain, on June 14, interfered with the schedule. Results were obtained on July 17 by dissecting 10 stalks taken at random from each plot. One hundred plants from untreated plots contained 1,033 larvae. The results are summarized in Table 19.

Applications three days apart were more effective than at longer intervals. There was little difference between dusts applied at four-, five- and six-day intervals. Treatment at weekly intervals was less effective, however. The modified schedules of two and three treatments were not as effective as the standard.

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[1] Tests conducted in co-operation with the Federal Bureau of Entomology and Plant Quarantine, Division of Cereal and Forage Insects.

TABLE 19. SCHEDULE TESTS, FIRST GENERATION

Applications	Dates (June)	% reduction of borers	% No. 1 borer-free ears
1. Three-day intervals	7, 10, 13, 16, 19, 22	75.3	52.6
2. Four-day intervals	7, 11, 15, 19, 23	65.7	46.0
3. Five-day intervals (standard)	7, 12, 17, 22	62.4	48.5
4. Six-day intervals	7, 13, 19, 26	62.4	49.6
5. Seven-day intervals	7, 14, 21	61.5	41.1
6. Three treatments, starting later than standard	9, 14, 19	49.2	31.1
7. Three—first standard omitted	12, 17, 22	54.7	35.4
8. Two treatments—early	7, 14	45.2	26.8
9. Two treatments—late	12, 19	43.9	27.4
10. No treatment	......	...	13.2

Second generation tests were made on Golden Cross Bantam corn planted June 21 and maturing September 6. The plot layout was similar to that used in the first generation. The standard schedule was determined as August 7, 12, 17, 22 and 27. Rainfall was below normal during the month and did not interfere seriously with the schedule. However, the three applications were subjected to 1.05 inches of rain in six showers between the time the schedule was completed and samples were taken. The results are given in Table 20. There were 932 larvae in 100 plants from untreated plots.

TABLE 20. SCHEDULE TESTS, SECOND GENERATION

Applications	Dates (August)	% reduction of borers	% No. 1 borer-free ears
1. Standard	7, 12, 17, 22, 27	58.5	48.5
2. Four—7-day intervals	7, 14, 21, 28	56.7	45.9
3. Four—first standard omitted	12, 17, 22, 27	54.9	42.4
4. Four at weekly intervals starting late	12, 19, 26, Sept. 2	47.9	46.7
5. Three at weekly intervals starting early	7, 14, 21	49.5	35.2
6. No treatment	......	...	19.3

None of the modified schedules was as effective as the standard. This type of test has now been made on four generations in two seasons. The only modification that seems promising is the use of treatments at seven-day intervals, thereby eliminating one application from the standard schedule.

Two tests were made comparing a dual-fixed nicotine dust in which quebracho tannin replaced gallo-tannin, with the standard dust containing gallo-tannin. In both tests the materials were equally effective.

In one test, hand application of dual-fixed nicotine dust was compared with machine application. The power duster was a commercial machine pushed by hand and fitted with four nozzles. Two of these were directed on each row of corn. The results are summarized below, and show that hand dusting was more effective than machine applications.

Comparison of Hand and Machine Dusting

Treatment	% reduction of borers	% No. 1 borer-free ears
Hand	58.5	53.8
Machine	48.9	40.0
No treatment	...	16.7

The 1939 tests were substantially less effective than similar treatments made in 1938. Two facts may contribute to the differences: (1) The 1939 season was dry and in general unfavorable for dusting; and (2) the infestation was heavier in 1939. Regardless of the reasons, the decrease in effectiveness was serious, averaging about 20 percent on the basis of No. 1 borer-free ears.

Three tests were made in commercial cornfields. Two of these were reasonably successful but the third was not satisfactory because many borers had hatched before dusting was started.

EFFECT OF CORN BORERS ON POTATO YIELD

R. L. Beard

In an effort to determine the economic loss incurred by infestation of the European corn borer on potatoes, crop yields for infested and non-infested plants were considered.

Two rows of early market (Irish Cobbler) potatoes were grown for this experiment. To insure as near uniform cultural conditions as possible, paired seed pieces were used, that is, for each hill in one row, a corresponding hill in the other row was planted with seed cut from the same potato. Although the Colorado potato beetle caused injury in both rows, no definite control measures were employed against it. Feeding practically ceased, however, when the first application of Bordeaux mixture was applied. The usual practice of keeping the plants covered with Bordeaux was followed, requiring four treatments. As far as could be observed, the presence of Bordeaux had no effect on the corn borer infestation.

To prevent a natural infestation of corn borers in one row of the potatoes, all plants were examined five times at five-day intervals during the oviposition period of the moth. Wherever found, corn borer eggs were removed. Since the natural infestation was not heavy, it was artificially increased on the second row. This was done by placing on each hill a total of four egg-masses in addition to those already present. Although counts were not made of the eggs placed on each plant, the number approximated 100. Since these were almost on the point of hatching, a maximum infestation should have been attained. Larval mortality is known to be high, however, and the number reaching maturity in the potato stalks was small. Dissections of the plants were not made until the potatoes were dug and by that time the dried condition of the stems and the migration of the larvae made an accurate count of the population of mature larvae impossible. Nevertheless, the maximum number of larvae and/or pupae observed per hill was nine, the average number being 2.4.

The egg-masses on half of the plants were placed at a low level, near the base, whereas the others were placed on the terminal stems of the plants. No difference in infestation was observed which could be attributed to the position of the egg-masses.

A certain amount of migration of corn borer larvae occurred from the infested row to the non-infested row, but not enough to invalidate the experiment.

The potatoes were dug on August 11, the yield being as follows:

Infested row	164 potatoes weighing 55 lbs. 7 oz.
Non-infested row	191 potatoes weighing 54 lbs. 11 oz.

These figures indicate that the non-infested row produced more potatoes, but they were smaller judging by weight. Both rows gave yields of almost identically the same weight, which should be the basis of comparison. The size of the plots was much too small to consider the yield in terms of bushels per acre.

The same procedure was followed on two rows of late (Green Mountain) potatoes, which are susceptible to attack by the second generation of the corn borer. But in spite of the fact that, as before, four egg-masses were placed on each hill in one row, in addition to the natural infestation, so few of the larvae penetrated the plant tissues that the "infested" row contained no more borers than the non-infested row.

The conclusion to be drawn from the experiment on the early potatoes is that an infestation of the European corn borer has no significant effect on yield. This is in line with observations made at the Station's experimental farm at Mount Carmel in 1937 by K. D. Arbuthnot, of the Bureau of Entomology and Plant Quarantine, of the U. S. Department of Agriculture. It is not possible to confirm these experimental results by observations in commercial potato fields because of the absence of borer-free check areas within an infested field. It has been observed, however, that very good yields of potatoes have been obtained from fields with infestations which would be considered severe.

BIOLOGY AND CONTROL OF THE POTATO FLEA BEETLE

Neely Turner

The potato flea beetle (*Epitrix cucumeris* Harris) has been a serious pest of potatoes in Connecticut for many years. It also damages newly set plants of tomatoes and eggplants, and has been seen in injurious numbers on cucumbers and garden beans. As a rule feeding on these plants and seedlings ceases early in the season. Potatoes, however, suffer throughout the season from feeding on the foliage, and in addition the larvae occasionally infest the tubers. In Connecticut "pimply" tubers occur chiefly on early (Irish Cobbler) crops. In 1933, 60 acres of Irish Cobblers growing on light, sandy soil were seriously damaged by larvae.

The biology and control of the potato flea beetle was studied during the period 1931-1937 inclusive. Most of the work on control was done on potatoes, with a few tests on newly set tomato plants.

Seasonal Life History

Over-wintering adults have appeared usually during the last week in May. At that time they have been found feeding on weeds, but as soon as potatoes sprout and tomatoes are set in the field, they migrate to these crops. Eggs are deposited on the surface of the ground around potato plants from late in May until early in July. The larvae feed on the roots of the host plant and sometimes on the young tubers. Pupation occurs from late in June until late in August and emergence from July until late August. Lacroix (5) found that the peak of emergence of adults in Windsor was about the middle of July.

Life History Studies

Eggs obtained in oviposition cages in the insectary hatched in from six to nine days, the majority hatching in seven days. The pupal period was also from six to nine days. On potted plants in an open insectary the total period of development from egg to adult was from 38 to 81 days, with 95 percent requiring from 41 to 55 days.

All the data obtained in both seasonal and life history studies indicate that there is only one complete generation of the potato flea beetle in Connecticut.

Control

Fitch (2) in 1867 suggested the use of inert dusts, such as road dust and lime, as repellents for the potato flea beetle. In 1894 Jones (4) discovered that Bordeaux mixture was an excellent repellent, and since his work was published this material has been the standard. In recent years various workers have conducted experiments in which arsenicals were added to Bordeaux mixture.

In Connecticut there are really four problems involved in controlling the potato flea beetle: (a) prevention of damage to tobacco, (b) protection of seedling vegetables and newly set vegetable plants, (c) control of both adults and larvae on early potatoes, and (d) protection of late potatoes from feeding by adults. Lacroix (6) has reported on the results of experiments on tobacco.

Experiments on vegetable plants. Britton (1) found that tobacco plants could be protected from flea beetles by dipping them in a suspension of arsenate of lead at the rate of one pound in 10 gallons of water. In 1932 tomato plants were dipped in such a mixture, and a second lot dipped in a suspension of one pound barium fluosilicate in 20 gallons of water. Neither treatment was satisfactory. In 1934 a dust of barium fluosilicate, one pound, and lime, 3 pounds, was applied to tomato plants three times at weekly intervals starting June 6. There was much less injury to dusted foliage than to untreated plants. In 1936 and 1937 dust containing .75 percent rotenone (pure ground cubé root mixed with a clay carrier) was used in the same manner. It was moderately effective.

Experiments on early potatoes. Experiments conducted by R. B. Friend in 1928 had shown that arsenate of lead at the rate of 1.5 pounds in 50 gallons of water with one pint of fish oil, was effective in preventing damage by potato flea beetles (unpublished data). Accordingly this material was used in comparison with 4-4-50 Bordeaux mixture in both laboratory and field tests. The following season a dust containing barium fluosilicate, one pound, and hydrated lime, 5 pounds, was tested in the laboratory. The laboratory tests were made by spraying or dusting potted potato plants and caging them with a counted number of flea beetle adults. Results were taken in six days. The tests are summarized in Table 21, and show that Bordeaux mixture protected the foliage but did not kill many flea beetles.

Table 21. Laboratory Tests—Potato Flea Beetle

Year	Material	Percent beetles dead	No. feeding marks on one leaf
1932	Lead arsenate 1.5 lbs., fish oil 1 pint, water 50 gals.	33	183
	Calcium arsenate 1.5 lbs., fish oil 1 pint, water 50 gals.	27	141
	Barium fluosilicate 1.5 lbs., fish oil 1 pint, water 50 gals.	74	49
	Bordeaux mixture 4-4-50	0	50
	No treatment	0	510
1933	Lead arsenate 1.5 lbs., fish oil 1 pint, water 50 gals.	15	
	Bordeaux mixture 5-6-50	26	
	Barium fluosilicate 1 lb., lime 5 lbs. (dust)	89	

Field tests on Irish Cobbler potatoes were made in 1932, 1933 and 1934. All tests were made on latin square blocks of plots, each plot being 5 rows wide and 16 feet long. The following is the record of the experiments:

Year	Date planted	Dates sprayed	Dates harvested
1932	May 2	June 2, 10 & 20	Aug. 8 & 9
1933	May 1	May 26, June 5 & 14, July 1	Aug. 3 & 4
1934	May 2	June 5, 11 & 28, July 9	Aug. 6 & 7

The materials used are given in Table 22. The barium fluosilicate was a commercial preparation (*Dutox*) said to contain 80 percent barium fluosilicate.

Table 22. Materials Used—Field Tests on Early Potatoes

Materials	Years applied
1. Lead arsenate 1.5 lbs., fish oil 1 pint, water 50 gals.	1932, 1933, 1934
2. Calcium arsenate 1.5 lbs., fish oil 1 pint*, water 50 gals.	1932, 1933
3. Barium fluosilicate 1.5 lbs., fish oil 1 pint*, water 50 gals.	1932, 1933
4. Bordeaux mixture 4-4-50	1932, 1933, 1934
5. Barium fluosilicate 1 lb., lime 3 lbs. (dust)	1934

* Fish oil omitted in 1933.

Notes on the condition of plants treated with the various materials were made from time to time during the season. As a rule there was not a great deal of difference in the appearance of the plants until leafhoppers appeared and caused tipburn. When this occurred those sprayed with Bordeaux mixture were in the best condition, with lead arsenate and fish oil a close second. Plants treated with barium fluosilicate as a spray looked much like the untreated plants, and calcium arsenate produced results intermediate between untreated and Bordeaux-treated plants. Likewise those plants treated with barium fluosilicate and calcium arsenate died at the same time as the untreated plants, those sprayed with lead arsenate a few days later, and finally those treated with Bordeaux mixture. In all three seasons the plants treated with Bordeaux mixture died at least 10 days after those sprayed with lead arsenate and fish oil.

The final criterion of results, the yield of potatoes, was obtained by weighing the marketable tubers by rows or plots at digging time. These results are given in Table 23, in which the average yield per 16-foot row is the unit.

Table 23. Average Yield per 16-foot Row—Potato Flea Beetle Control

Treatment	Year		
	1932	1933	1934
Sprays			
Lead arsenate—fish oil	9.26	17.38	14.75
Bordeaux mixture	8.10	16.97	14.28
Calcium arsenate	7.28	14.52	....
Barium fluosilicate	7.04	13.67	....
Untreated check	7.06	14.79	9.77
Dust			
Barium fluosilicate			12.44

The difference between both lead arsenate and Bordeaux mixture yields and the untreated check is significant statistically. However, the slight difference in favor of lead arsenate and fish oil over Bordeaux mixture is not significant. Barium fluosilicate dust was used only one season and was not as effective as the two best spray materials.

Irish Cobbler potatoes are grown in two different sections of Connecticut. In the southern part of the State they are planted early on light, sandy soil and are harvested as early as possible. In the northern section they are grown on heavier soil as an early fall crop, with no particular effort to sell on the early market. As a rule the southern growers dust the crop and the others spray. After completion of these tests one grower in Milford used the barium fluosilicate dust compared with copper-lime dust which had been his standard treatment. The barium fluosilicate dust produced such excellent results that he has adopted it for his entire crop of early potatoes.

As was noted above, vines sprayed with lead arsenate and fish oil matured much earlier than those sprayed with Bordeaux mixture, and the yields were about equal. As a rule, the price of potatoes declines steadily from July 1 until late potatoes are harvested. Early maturity is an advantage in this case and therefore lead arsenate and fish oil should be a more satisfactory spray material than standard Bordeaux mixture.

Experiments on late potatoes. Green Mountain potatoes planted about May 15 and harvested late in September were used in tests in 1933, 1934 and 1936. The plots were random replicates of various sizes. The materials and results of the 1933 tests are listed in Table 24. It was evident that the materials which were so effective on early potatoes were not satisfactory on the late crop. This was due to the fact that neither of the new materials controlled leafhoppers. Bordeaux mixture did control leafhoppers, and was also repellent to flea beetles.

In the same year another test, similar in nature, was made at the Windsor Substation. The results are summarized in Table 25. Here the application of both lead arsenate and fish oil and barium fluosilicate dust increased the yield, but neither was as satisfactory as Bordeaux mixture. Since Bordeaux mixture was a repellent, it was believed necessary to supplement it with some insecticide which would actually kill the flea beetles. The work of Gui (3) had shown that calcium arsenate added to Bordeaux mixture increased its effectiveness in preventing damage by the potato flea beetle. Therefore this combination was included in the 1934 tests.

TABLE 24. 1933 TESTS ON LATE POTATOES

Material	Applied	Yield per plot
Bordeaux mixture 4-4-50	June 5, 14 July 19, 29 Aug. 7, 15	135.5 lbs.
Lead arsenate 1.5 lbs., fish oil 1 pint, water 50 gals.	Same	59.0 lbs.
Barium fluosilicate 1 lb., hydrated lime 3 lbs. (dust)	June 5, 14 July 22, 31 Aug. 8, 15	77.7 lbs.
No treatment		60.5 lbs.

Table 25. 1933 Tests on Potatoes—Windsor

Material	Applied	Yield per 100 feet of row
Bordeaux mixture 8-8-50	May 29 June 8, 19, 30 July 8, 18 Aug. 18	175.5 lbs.
Bordeaux mixture 4-4-50	Same	165.0 lbs.
Lead arsenate 1.5 lbs., fish oil 1 pint, water 50 gals.	Same—except Aug. 18	98.0 lbs.
Barium fluosilicate 1 lb., lime 3 lbs. (dust)	Same—except Aug. 18	94.0 lbs.
No treatment	......	76.5 lbs.

At the same time barium fluosilicate dust was used for two June applications and followed by Bordeaux mixture during July, August and September. The results are given in Table 26.

Table 26. 1934 Tests on Green Mountain Potatoes

Material	Applied	Total yield of plots
Bordeaux mixture 6-6-50	9 times, June 11 to Sept. 14	870 lbs.
Bordeaux mixture 6-6-50, calcium arsenate 1.5 lbs.—50 gals.	Same	749 lbs.
Barium fluosilicate 1 lb., lime 3 lbs. followed by Bordeaux mixture 6-6-50	7 times, July 2 to Sept. 14	917 lbs.
No treatment	......	389 lbs.

In this test the addition of calcium arsenate to Bordeaux mixture was of no value. The combination of dusts and sprays produced excellent results, and was therefore repeated in 1935 and 1936. The results are given in Table 27. In both seasons the combination of dusts followed by Bordeaux mixture produced excellent results, but there was some indication that delayed application of spray was just as effective as the combination or spraying throughout the season.

This project was temporarily discontinued due to the necessity for intensive research on control of the European corn borer. Following publication of results of control experiments for the potato flea beetle on tobacco (6), several tobacco growers who also produced potatoes adopted a combination dusting and spraying program for potatoes. This consisted in the application of a dust containing from .75 percent to 1.0 percent rotenone to potatoes, at least two days before application of Bordeaux mixture spray. The dust was highly effective in killing flea beetles, and therefore prevented migration of beetles from potatoes to tobacco following application of Bordeaux mixture. The expense of the operation was justified by the protection of the tobacco crop rather than by any increase in yield of potatoes.

Table 27. Tests on Green Mountain Potatoes

Material	Applied	Yield, bushels per acre
1935		
Bordeaux mixture 6-6-50	7 times, June 13 to Aug. 15	217
Barium fluosilicate 1 lb., lime 3 lbs., followed by Bordeaux mixture 6-6-50	4 times, July 11 to Aug. 15	212
Bordeaux mixture 6-6-50	4 times, July 11 to Aug. 15	223
No treatment	....	134
1936		
Bordeaux mixture 6-6-50	7 times, June 11 to Aug. 8	214
Barium fluosilicate 1 lb., lime 3 lbs., followed by Bordeaux mixture 6-6-50	June 11 4 times, July 8 to Aug. 9	213
Bordeaux mixture 6-6-50	4 times, July 8 to Aug. 9	191
No treatment	....	152

The possibilities of combination dust and spray treatments or of two types of sprays have not been exhausted. It seems logical to attempt to kill overwintering adults of the potato flea beetle during June in order to avoid large populations in July and August.

Summary

The potato flea beetle overwinters in the adult stage, depositing eggs in June and July. Adults emerge from July until September. There is one complete generation a year in Connecticut.

Seedling and newly set vegetable plants may be protected from flea beetle damage by a dust containing at least .75 percent rotenone.

On early (Irish Cobbler) potatoes a dust containing one pound barium fluosilicate and 3 pounds hydrated lime, or a spray containing 1.5 pounds arsenate of lead and one pint fish oil in 50 gallons of water, were most satisfactory.

On late potatoes (Green Mountain) Bordeaux mixture was necessary for control of leafhoppers. Addition of calcium arsenate was apparently of no value. A combination of dusting and spraying was tested with inconclusive results as regards yield.

Literature Cited

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(5) Lacroix, D. S., 1932: "Tobacco Insects in 1931." Conn. Agr. Expt. Sta., Bul. 335.

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SURVEY OF WIREWORM INJURY TO POTATOES

R. L. Beard

In October, 1939, a preliminary survey of wireworm injury was made in 17 fields of potatoes, chiefly in Tolland County. In each field the extent of wireworm feeding was estimated, soil samples were taken, and the history of the field insofar as possible was recorded.

A satisfactory estimate of wireworm injury to potatoes is difficult to obtain. An estimate based on reports of growers at time of grading is not reliable because of the personal factor involved. Moreover, since the potatoes are not thoroughly cleaned prior to grading, many with superficial feeding scars are overlooked by even the most conscientious graders and will not be noticed by the buyer. This means that the number of potatoes culled because of wireworms is much smaller than the number actually scarred.

In the present survey, the estimate was made by individually brushing and examining several hundred potatoes in each field. All those showing any evidence of wireworm feeding, however superficial, were noted as being infested. This method, too, has its disadvantages. The sampling is time consuming, and since the potato digging is done in a short time, a relatively small number of potatoes can be examined. Even 500 is a very small sample in a field several acres in extent which may yield in excess of 400 bushels per acre. Also, it is difficult to sample the field in a random manner. As potatoes are harvested, the picking crew follows so closely behind the digger that the area of sampling at any one time is limited. Thus, unless considerable time is spent in each location, the entire field cannot be sampled. In recording the samples, units of 100 potatoes were considered. The fact that within a field the infestation in each unit did not vary greatly from the others indicates that in spite of the small size of the sample, a representative estimate was obtained.

The percentage of potatoes showing evidence of wireworm feeding, together with the type of crop grown in each field in previous years, is here tabulated.

TABLE 28. LOCATION, PREVIOUS CROP AND WIREWORM INFESTATION

Number of field	Location	% of potatoes infested	Crop grown on land 1935	1936	1937	1938	1939
1	E. Windsor	2.3	Tobacco..........25 years..............				Potatoes
2	S. Windsor	4.0	Tobacco..................................				Potatoes
3	Somers	8.7		Potatoes	Potatoes	Tobacco	Potatoes
4	Somers	9.6		Tobacco	Potatoes	Potatoes	Potatoes
5	Ellington	13.3	Corn and grass		Potatoes	Potatoes	Potatoes
6	Somers	14.6	Corn or tobacco		Clover sod		Potatoes
7	Ellington	18.0		Potatoes	Clover	Potatoes	Potatoes
8	Ellington	21.0	Potatoes	Tobacco	Potatoes	Potatoes	Potatoes
9	Ellington	22.2		Potatoes	Potatoes	Potatoes	Potatoes
10	E. Windsor	23.5	Potatoes..................9 years................				
11	Somers	25.7		Timothy and clover			Potatoes
12	Somers	27.0	Potatoes	Clover	Clover	Potatoes	Potatoes
13	Somers	31.2	Potatoes	Potatoes	Potatoes	Potatoes	Potatoes
14	Somers	32.3		Potatoes	Tobacco	Tobacco	Potatoes
15	S. Windsor	33.2	Potatoes..................8 years................				
16	Somers	38.0	Weeds	Weeds	Weeds	Weeds	Potatoes
17	Ellington	66.6	Corn and grass		Potatoes	Potatoes	Potatoes

In line with the belief that continued clean cultivation of the land results in an absence of wireworms, the two fields showing least injury had been planted to tobacco for many years prior to 1939. On the other hand, continued planting of land to potatoes, which are considered a cleanly cultivated crop, does not bear this out, so far as the present evidence shows. Otherwise, no conclusions can be drawn from these data relative to the type of crop rotation unfavorable to the wireworm population. Of course, strict comparisons of the fields are not possible because neither the wireworm populations nor the degrees of infestation are known for previous years. As far as can be judged from the statements of potato growers, wireworm injury in 1939 was less than in preceding seasons.

Soil samples were taken from each field and analyzed by the Soils Department of the Experiment Station. No correlation could be observed between the wireworm injury and the physical and chemical nature of the soil.

CONTROL OF SQUASH INSECTS

R. L. Beard

Summer Squash

The chief insects causing damage to summer squash are the striped cucumber beetle (*Diabrotica vittata*), the squash vine borer (*Melittia satyriniformis*), and the common squash bug (*Anasa tristis*).

The cucumber beetle appears in numbers early in June, and young squash plants, if not given protection at this time, may be completely destroyed. Later in the season the beetles, though present, are less abundant, and the squash plants, because of their larger size and greater vigor, are better able to resist the feeding injury. The larvae feed on the roots of the plants and the beetle is instrumental in transmitting the bacterium *Bacillus tracheiphilus*, which is responsible for wilt disease. Many dusts are in common use against the beetle, but most of these have only a repellent action. A derris dust containing .6 percent rotenone is to be recommended over other treatments, for this material serves not only as a repellent, but as both a stomach and a contact poison.

The adult moth of the squash vine borer is in flight during the month of July and eggs are deposited on the basal portions of the squash stems. The borers which hatch from these eggs tunnel into the stems and are frequently responsible for the sudden wilting of an entire plant. On Hubbard squash, nicotine sulfate and lead arsenate have both been employed successfully against the insect, but these insecticides are not desirable for summer squash because of poisonous residues on the fruit.

The squash bug begins to lay eggs the middle of June and, although it continues into September, about 80 percent of the oviposition is completed by mid-July. The young nymphs feed on the leaves and stems of the plants, causing localized injury. Severe injury is seldom caused by the bug except in conjunction with other insects. Although a very concentrated pyrethrum (Pyrocide) dust or spray is effective, the spray is too inconvenient to prepare and the dust is too expensive for common use in controlling the bug.

Thus, although the chemical control of the cucumber beetle is efficient, that of the squash vine borer and the squash bug is not. It is possible, however, to avoid economic loss due to these last two insects by planting two crops of squash in sequence. The time of the plantings should be such that the first crop, receiving the bulk of the infestation, can be destroyed when the second comes into bearing.

During the summer of 1939 this method was demonstrated to be satisfactory. The first planting of squash was made on May 8. This came into bearing the latter part of June, and a prolific yield was maintained throughout July. By the middle of July squash vine borer injury began to appear, and by August production of squash began to taper off. This curtailment was due to no single factor, but to a combination of dry weather, damage caused by the above mentioned insects, powdery mildew, and a leaf spot disease. Two planting dates were tried for the second crop, namely, June 28 and July 5. The latter date proved to be somewhat more satisfactory. Squash from this planting was picked within four days of that from the June 28 planting, and there was less insect damage.

Since the heaviest attack of both the squash bug and vine borer occurs before the middle of July and is directed against the larger plants, only the first crop of squash was severely infested. The squash bug confined its activities to this crop, and the vine borer caused only a negligible amount of injury to the June 28 planting of the second crop.

Not only was the second crop of squash free from insect trouble, but it assured a continued production of squash of good quality. At the time it came into bearing (the second week in August), the old vines of the first planting were coarse and unhealthy, and the fruit, maturing slowly, had a tough appearance. The new plants, on the other hand, were vigorous, clean in appearance, and bore an abundance of tender fruit. Production was curtailed prematurely in September by a severe attack of powdery mildew.

Undoubtedly the optimum planting date for the second crop of squash would vary from year to year with changing weather conditions, but, considering the life histories of the insects in question, July 1 is recommended. This is late enough to preclude the possibility of the young plants attracting an appreciable number of insects from the first planting, and yet early enough for the plants to mature and bear fruit unless the weather conditions are extremely unfavorable.

As soon as the second crop of squash begins to bear, the old vines of the first planting should be destroyed to reduce the insect population.

Hubbard Squash

The insect most destructive to Hubbard squash is the squash vine borer. The cucumber beetle attacks young plants in numbers, but can be controlled easily by dusting, as on summer squash. The squash bug is usually not present on Hubbard squash in sufficient numbers to cause damage.

It has been shown by Friend (Conn. Agr. Expt. Sta., Bul. **328**) that good results in controlling the squash vine borer can be obtained by using nicotine sulfate to kill the eggs or by spraying with lead arsenate and fish oil to kill the young larvae before they enter the stems. The number of inquiries concerning this insect, however, has seemed to justify a further consideration of the problem. Accordingly, in 1939 insecticide experiments were conducted on a small scale.

The treatments employed included lead arsenate and fish oil, Western dynamite spray, and dual-fixed nicotine dust. The Western dynamite spray is lead arsenate prepared as an inverted emulsion with oleic acid and triethanolamine. The lead arsenate in both this spray and with the fish oil was used at the rate of 3 pounds per 100 gallons of water. The dual-fixed nicotine is a dust now in use in controlling the European corn borer. All of these insecticides act as stomach poisons, and to be effective must be present on the stem of the plant at the time the larvae bore their way into the tissue. Since eggs of the vine borer are deposited the last of June and through the month of July, four applications were made at weekly intervals, beginning on July 3. At the end of the growing season, all of the squash produced was picked and weighed, with the following results in yield:

	No. of hills	Average no. squash per hill	Average no. lbs. per hill
Check	8	2.1	6.6
Lead arsenate, fish oil	10	3.4	13.6
Western dynamite spray	8	3.3	14.3
Dual-fixed nicotine dust	8	3.8	14.6

Although a satisfactory evaluation of the treatments cannot be made because of the small size of the plots, all of the treatments resulted in a significant increase in yield over the untreated check plot. The favorable showing of the dual-fixed nicotine dust is promising in view of the greater ease of application of a dust as compared with a spray. The experiment should be repeated, utilizing larger plots, before a definite recommendation of this dust is made.

FURTHER OBSERVATIONS OF THE EFFECT OF SALT WATER SPRAY ON FOLIAGE

M. P. Zappe and E. M. Stoddard[1]

The original observations on salt water spray injury were made shortly after the tropical hurricane which struck New England on September 21, 1938 (Report of the State Entomologist for 1938, p. 103). The information in the present article is based on observations of the same plants during the summer and fall of 1939. Some of the evergreens had made a fair recovery, while others were dead or so badly injured that it was not worthwhile to attempt to grow them for several years in the hope that they would eventually recover. In most cases the most rapidly growing evergreens or the smaller plants made the best recovery, although the smaller plants of hemlock and Chamaecyparis were almost completely killed in the fall of 1938.

In the following table, salt water spray damage was classified into one of the following grades:

"none"—no visible injury was noted.

"slight"—damage was noticeable but not serious, and plants stood the injury fairly well.

"medium"—the injury was very evident and leaves were half burned.

"severe"—the salt spray burned the entire foliage or, in the case of deciduous trees, almost completely defoliated them.

In addition to the 1938 fall observations, further notes were made during 1939 on May 16, June 22 and November 8. The following table gives the results of these observations:

[1] The writers wish to thank Mr. Henry Verkade of New London for assisting in naming some of the horticultural varieties of evergreens and for some of the observations made in his nursery in the town of Waterford, Conn.

TABLE 29. SALT SPRAY DAMAGE TO TREES

Species	Common name	Oct. 13, 1938	May 16, 1939	June 22, 1939	Nov. 8, 1939
Juniperus communis depressa plumosa	Plumed spreading juniper	slight	slight	none	none
" " *hibernica*	Irish juniper	severe	severe	severe	improving
" " *sargenti*	Sargent juniper	slight	none	none	none
" " *suecica*	Swedish juniper	slight	none	none	none
" *chinensis pyramidalis*	Column Chinese juniper	severe	severe	severe	severe
" " *pfitzeriana*	Pfitzer juniper	severe	severe	medium	slight
" *excelsa stricta*	Greek juniper	medium	slight	slight	slight
" *horizontalis*	Creeping juniper	medium	medium	slight	slight
" *littoralis conferta*	Shore juniper	slight	slight	none	none
" *sabina*	Savin juniper	severe	severe	severe	severe
" " *von ehron*	Von Ehron juniper	severe	severe	severe	severe
" *squamata meyeri*	Meyer Juniper	severe	severe	medium	slight
" *virginiana*	Red cedar	severe	severe	medium	medium
" " *glauca*	Silver red cedar	severe	severe	medium	medium
" " *schotti*	Schott red cedar	severe	severe	severe	severe
Pinus densiflora	Japanese red pine	none	none	none	none
" *montana mughus*	Mugho pine	slight	none	none	none
" *nigra*	Austrian pine	slight	none	none	none
" *parviflora glauca*		slight	none	none	none
" *resinosa*	Red pine	slight	none	none	none
" *rigida*	Pitch pine	medium	slight	slight	none
" *strobi*	White pine	severe	severe	old foliage—all off	new foliage—fair
" *sylvestris*	Scotch pine	severe	severe	medium	medium
" *thunbergi*	Japanese black pine	slight	none	none	none
Chamaecyparis obtusa gracilis	Slender Hinoki cypress	none	none	none	none
" " *lycopodioides*	Clubmoss retinospora	medium	slight	slight	slight
" " *nana*	Dwarf Hinoki cypress	slight	slight	none	none
" *pisifera filifera*	Thread cypress	severe	severe	severe	severe
" " " *aurea*	Golden thread cypress	severe	severe	medium	slight
" " *plumosa*	Plume cypress	severe, some dead	severe	severe	severe
" " " *aurea*	Golden plume cypress	severe, some dead	severe	severe	severe
" " *squarrosa*	Moss cypress	severe	severe	severe	medium

TABLE 29. SALT SPRAY DAMAGE TO TREES—Continued

Species	Common name	Oct. 13, 1938	May 16, 1939	June 22, 1939	Nov. 8, 1939
Cupressus macrocarpa crippsi	Cripps cypress	severe	severe	severe	severe
Picea conica glauca	Alberta spruce	none	none	none	none
" *excelsa*	Norway spruce	slight	none	none	none
" *polita*	Tigertail spruce	slight	none	none	none
" *pungens*	Colorado spruce	slight	none	none	none
" " *glauca*	Colorado blue spruce	slight	none	none	none
" " " *kosteri*	Koster blue spruce	slight	none	none	none
Tsuga canadensis	Canada hemlock	severe, some dead, needles off	severe	severe	severe
" " *macrophylla*		slight	slight	slight	slight
" *caroliniana*	Carolina hemlock	severe	severe	severe	severe
" *diversifolia*	Japanese hemlock	medium	slight	slight	slight
Taxus baccata erecta	English yew	slight	none	none	none
" " *oliverini*		slight	slight	slight	none
" *cuspidata*	Japanese yew	medium	medium	slight	slight
" " *capitata*	Upright Japanese yew	severe	severe	medium	medium
" " *nana*	Dwarf Japanese yew	slight	slight	slight	slight
" *media halfieldi*	Hatfield yew	slight	none	none	none
Abies balsamea	Balsam fir	medium	medium	slight	slight
" *concolor*	White fir	medium	slight	slight	slight
" *veitchi*	Veitch fir	slight	slight	none	none
Thuja occidentalis	American arborvitae	severe	severe	medium	slight
" " *batemani*	Bateman arborvitae	severe	dead		
" " *curvinana*		slight	slight	slight	slight
" " *ellwangeriana*	Tom Thumb arborvitae	severe	severe	severe	severe
" " " *reingold*		severe	severe	severe	severe
" " *globosa*	Globe arborvitae	medium	medium	medium	slight
" " *pyramidalis*	American pyramidal arborvitae	medium	medium	slight	slight
" " *rosenthali*	Rosenthal arborvitae	slight	slight	none	none
" " *spiralis*		severe	severe	severe	severe
" " *vervaeneana*	Vervaene arborvitae	slight	slight	none	none
" " *wareana*	Ware arborvitae	medium	slight	slight	slight

TABLE 29. SALT SPRAY DAMAGE TO TREES—Continued

Species	Common name	Oct. 13, 1938	May 16, 1939	June 22, 1939	Nov. 8, 1939
Thuja orientalis	Oriental arborvitae	severe	severe	medium	slight
" " *aurea nana*	Berckmans Golden arborvitae	medium	medium	slight	slight
" " *elegantissima*	Yellow column arborvitae	severe	small plants—medium; large plants—severe	slight	slight
" *plicata (lobbi)*	Giant arborvitae	slight	slight	none	none
Pseudotsuga douglasi	Douglas fir	severe	severe	severe	severe
Sciadopitys verticillata	Umbrella pine	severe	severe	severe	severe
Cryptomeria japonica	Common cryptomeria	none	none	none	none
	BROAD-LEAVED EVERGREENS				
Azaleas	Several horticultural varieties	severe (dead)	severe	medium	slight
Buxus sp.	Boxwood	leaves yellow	yellow	yellow	yellow
Ilex crenata	Japanese holly	severe	severe	medium	slight
" *opaca*	American holly	severe	dead		
Pieris floribunda	Mountain andromeda	severe	dead		
" *japonica*	Japanese andromeda	severe	dead		
Daphne cneorum	Rose daphne	slight	none	none	none
Rhododendrons		severe	50% dead	new growth fair	
	DECIDUOUS PLANTS				
Acer	Maples	severe	many dead twigs	poor thin foliage	
" *palmatum*	Japanese maple	severe	medium	poor growth	
Quercus	Oaks	severe	poor thin foliage		
" *palustris*	Pin oak	severe	poor thin foliage		
Platanus	Sycamores	severe	poor thin foliage		
Liriodendron	Tulip tree	severe	poor thin foliage		
Ulmus pumila	Dwarf Asiatic elm	severe	many dead twigs	foliage thin	
Aesculus	Horsechestnut	slight	none	none	none
Azalea sp. (?)	Azaleas	severe	many dead	improving	
" *schlippenbacki*	Royal azalea	slight	none	none	none

Table 29. Salt Spray Damage to Trees—Concluded

Species	Common name	Oct. 13, 1938	May 16, 1939	June 22, 1939	Nov. 8, 1939
Berberis thunbergi atropurpurea	Red leaf Japanese barberry	medium	fair growth during summer		
Cornus florida rubra	Red flowering dogwood	severe	dead		
Euonymus alatus	Winged euonymus	medium	new growth appears good		
Forsythia sp.	Forsythia	slight	new growth appears good		
Rosa rugosa	Rugosa rose	severe	new growth appears good		
Magnolia sp.	Magnolia	severe	many dead	severe	severe

Although most of the evergreens were more or less injured by the salt spray, the pines and spruces showed less injury than many of the other types. White pine, however, was badly damaged; shortly after the hurricane all the foliage became brown and eventually dropped off. Many of the buds were not killed and the trees leafed out in the spring, although the foliage was weak and rather yellow. White pines in exposed places near the shore front were dead on the windward side the next summer. Most of the junipers were seriously injured except the Greek, Swedish, creeping and shore junipers which made a very good recovery during the following summer. Although all horticultural varieties of Chamaecyparis were injured, the *pisifera* varieties were most seriously affected and many of them, particularly the smaller ones, were actually killed. The *obtusa* varieties were not so seriously affected and made a good recovery. Hemlocks were badly injured. Many were dead or of no value if alive, but the Japanese hemlock was only slightly injured and made a good growth during the next summer. The yews were only slightly damaged and made a good recovery. Arborvitaes were all damaged, some rather seriously, except Rosenthal's and the giant arborvitae, which withstood the hurricane and salt spray much better than the rest. Most of them will outgrow the injury in about two years. Douglas firs lost practically all their foliage and did not recover very much during the first summer after the storm. It is doubtful if they ever will be of any value. The Cryptomeria came through the storm in good shape and showed no particular injury. The broad-leaved evergreens as a group were rather badly damaged, Japanese holly and daphne showing the least injury. The andromedas were severely injured and most of them were dead or worthless by the spring following the hurricane.

The deciduous plants varied considerably in their ability to withstand the wind and salt spray. Many of the trees were entirely defoliated by the storm. Some of them, especially the maples, started new growth in October, 1938, and went into the winter in a weakened condition. During the following summer the foliage was small, scanty, and of poor color. Many of the smaller branches and twigs died, and, in the case of Norway maples, larger branches were also killed. Frequently the bark on the main trunks of the Norway maples split during the winter, and this injury was followed in the summer by the development of Nectria cankers. In some cases this will result in the death of the trees. In New London County these cankers were very common on the maples and may be the cause of serious injury for some time to come. Horsechestnuts were least injured of the deciduous shade trees and appeared in perfect condition the following summer, even though they showed a fall growth and some even blossomed again after the storm. We know of none that were actually uprooted during the hurricane.

Deciduous shrubs lost most of their foliage during the storm, but the following spring leafed out normally in most cases and continued to make a good growth throughout the season. Most of the azaleas (except Schlippenbacki) and magnolias were severely injured, and many of them were dead the following spring.

It is interesting to note that red dogwoods and small hemlocks which were protected during part of the storm by blown down trees and portions of wrecked buildings were not seriously injured and made a good growth the following summer while those left exposed were dead or nearly so.

References to Salt Spray Injury to Trees and Shrubs

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NOTES ON THE SMALLER EUROPEAN ELM BARK BEETLE[1]

Scolytus multistriatus Marsham

Philip Wallace

Observations are reported on the biology of *Scolytus multistriatus* Marsh. as it occurs in Connecticut, with particular reference to its relation to Dutch elm disease. These investigations have been conducted coöperatively by the Entomology and Forestry Departments of this Station.

The spread of Dutch elm disease in the United States is due chiefly to the transmission of the fungus, *Ceratostomella ulmi* (Schwarz) Buisman, by the lesser European elm bark beetle, *Scolytus multistriatus* Marsh. (Collins, C. W. 1938). The adults are known to carry spores of the fungus from diseased elms, and to innoculate healthy elms when feeding on the bark and wood of small twig crotches, or when boring through the bark and attempting to breed in live elm wood. Infection does not take place unless the spores of the fungus are deposited in the vessels of the sapwood, and then only under favorable moisture and temperature conditions.

Early records and geographical distribution. *Scolytus multistriatus* Marsh. is common on elms throughout central Europe and has been known to occur there for many years. The earliest record of this beetle in the United States was made by Chapman (1910). He found *S. multistriatus* at Cambridge, Mass., in 1909, and stated that it undoubtedly had been introduced many years previously. In subsequent years introduction of this European elm bark beetle took place at several Atlantic ports and in several localities in northeastern and midwestern United States, near veneer mills which handled European elm burl logs, along railroads known to have carried such logs, and at points to which other infested elm material was known to have been carried. C. W. Collins (1938) gave a detailed report of the distribution of *S. multistriatus* in the United States. He stated that its occurrence is limited to sections of the following states: New Hampshire, Massachusetts, Connecticut, New York, New Jersey, Pennsylvania, Delaware, Maryland, West Virginia, Ohio, Indiana and Kentucky.

[1] The writer wishes to express his appreciation to the following persons: Mr. W. O. Filley, Station Forester, and Dr. R. B. Friend, under whose guidance these investigations were carried on; Dr. Raimon Beard for assistance in field work and in the preparation of this paper; Mr. B. W. McFarland, who did the photographic work, and agents of the U. S. Department of Agriculture who co-operated in bark beetle trap studies.

The first record of this insect in Connecticut was made in 1932 by Felt, who mentioned its recent discovery in Stamford. Figure 2 is based on a recent survey which indicated that in this State *Scolytus multistriatus* occurs in most of the towns west of the Connecticut River, and in East Hartford, Glastonbury, and Manchester, east of the river. It appears to be increasing in numbers and slowly spreading eastward, but there has been no spread into northeastern Connecticut from the early infestation near Boston. The heaviest infestations occur in Fairfield and lower New Haven counties. The hurricane of September 21, 1938, appears to have had little influence on the distribution of this beetle in Connecticut to date. The

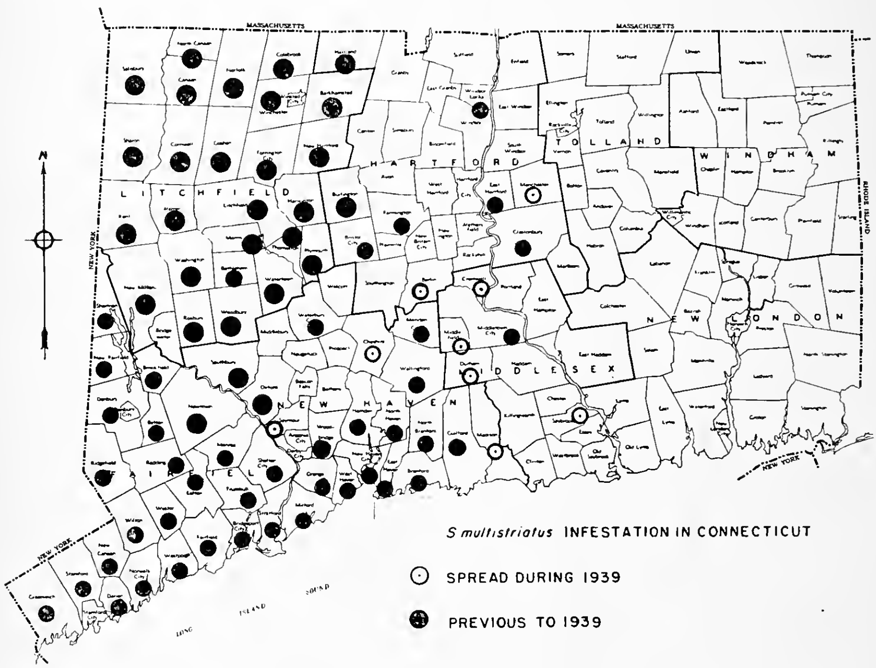

FIGURE 2.

excessively high winds, which might have carried any insect long distances, occurred when the flight season for these beetles was practically terminated, and a clean-up of elm wood in the previously heavily infested towns prevented an increase to outbreak proportions the following season.

Host plants. This insect attacks all the species of elms within its range in this country and is reported to attack practically all the species in Europe. It is not reported from any other host than the genus *Ulmus* in the United States, but in Europe it has been recorded (Escherich, 1923; Nunberg, 1930) from aspen, ash and plum.

Life Cycle

Chapman (1910) gave the first account of the biology of *S. multistriatus* in this country. In 1935 Readio published a more complete account which agrees in most details with the observations here reported. C. W. Collins, *et al.* (1936) made further additions to our knowledge of the biology and habits of this insect.

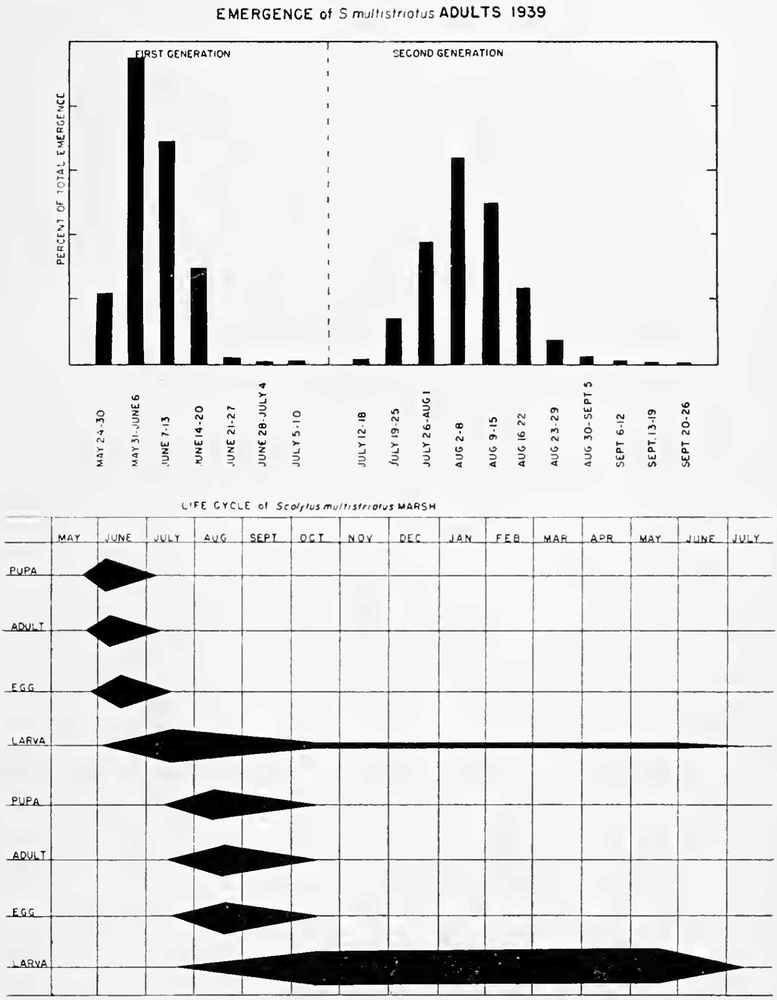

FIGURE 3.

In southern Connecticut the first adults emerge during the latter part of May, when the elm leaves are about two-thirds developed. The record of emergence indicated in Figure 3 was made from infested logs placed in emergence cans from which the beetles were removed daily. These cans were bottomless, placed directly on the soil, covered with two layers of black cloth, and kept in partial shade. Figure 3 diagrammatically represents the life cycle of *S. multistriatus*. In 1939 emergence of the first generation adults began on May 24, was at a peak on June 6, and was complete on July 10, a few days before the second generation adults appeared.

Eggs of the first generation are deposited from one to 10 days after the adults emerge, and were noted from May 27 to July 15. The peak of abundance occurred about June 9, shortly after the peak of adult emergence. The first generation eggs began to hatch and larvae emerged on June 3. Larvae from these eggs were most abundant about July 17. It was observed that about 4 percent of the first generation larvae did not transform the same season but had what may be termed a diapause and hibernated as larvae. This phenomenon was noted by Becker (1937) in the case of *Hylurgopinus rufipes* Eichh.

Pupation of first generation larvae was noted on July 8 and the peak was reached about August 10. Pupae continued to develop throughout the summer until cold temperatures prohibited further activity.

Emergence of second generation adults commenced on July 12, reached the peak of abundance about the middle of August and continued until September 24. However, occasional adults were noted in the field somewhat later than this. Eggs of the second generation appeared on July 15 and were most abundant during the middle of August. Eggs were observed throughout the early fall.

The second generation of larvae commenced to hatch during the third week of July and became more abundant until the eggs were killed by cold in early October. These larvae and a few of the first generation larvae are the only stage of this insect which hibernate. By the middle of October the adults, eggs and pupae are all dead and the larvae are inactive within the bark. As soon as the temperature becomes warm enough in early May, the larvae begin to feed again and complete their development. This period may last until early July. Pupation of the overwintering larvae begins during the middle of May and ends about the first week of July.

There are ordinarily two complete generations of this insect in Connecticut, although often there is one and a partial second, and occasionally only one. It has not been determined whether or not this aberrant behavior of some individuals to produce only one generation is an hereditary characteristic.

Of 1,851 emerging adults, 901 were males and 950 were females, giving a sex ratio of .51, almost an even proportion with no significant difference.

Habits

Feeding of adults. Some of the emerging adults feed for a few days on the bark and wood of healthy elms, usually at small twig crotches. Fransen (1931) stated that this period of feeding lasts from 7 to 10 days. An excellent description of the injuries caused by adults feeding in twig crotches is given by Wolfenbarger and Buchanan (1939). The adults bore into the center or slightly to the side of a twig crotch, excavating a small oval hole, somewhat greater in width than the diameter of the beetle, and slightly greater than the beetle in length. Extensive feeding scars measure 5 mm. in length, 2 mm. in width, and are 1 mm. below the surface, according to C. W. Collins, *et al.* (1936). Sometimes the adults burrow under bark scales at nodes or into depressions left by cladoptosis. When the attack is severe many twigs are completely girdled and hang from the branches like oak twigs attacked by the oak twig girdler, *Oncideres cingulatus* Say. While making the burrow small pieces of bark and frass are thrown out but rarely is any attempt made to construct a brood gallery. It can be assumed that the only purpose of these burrows is for feeding. The investigations of Wolfenbarger and Buchanan (1939) substantiate this hypothesis. They found that newly emerged *S. multistriatus* adults lived a significantly longer time when caged with elm twigs upon which they appeared to feed, than did those without food or water.

Observations in 1939 indicated that only a small percentage of the adults feed on elm twigs at any time. This feeding may occur near the place of emergence or near the place where brood galleries are to be formed. Elm logs infested with *S. multistriatus* larvae were placed in a pile at one end of a row of elms, 10 to 25 feet in height, and a pile of freshly cut elm logs was placed 250 feet away, at the other end of the row. At each 25-foot interval from the infested logs, 1,000 twig crotches were marked for observation. A cursory examination of these crotches was made weekly for evidence of beetle feeding, but none was found until a thorough inspection was made after emergence from the logs was complete. It was previously determined that no other infested elm, nor elm material attractive for beetle breeding, existed within a half-mile radius. The total number of beetles which emerged from these logs, as indicated by the emergence holes, was 2,898. Twig crotch attack was very light and of little consequence more than 25 feet from the place of emergence (Table 30), and no indications of feeding were observed more than 75 feet away from the infested logs. Three feeding scars found 200 to 250 feet distant were presumably attacks at the place of breeding, although no brood galleries of *S. multistriatus* were formed in the fresh elm logs which were used to attract them.

Table 30. Crotch Feeding Near Place of Emergence

Distance from infested logs	Crotches observed	Feeding scars	Percent crotches attacked
0— 25 feet	1,000	13	1.3
25— 50 "	"	3	.3
50—100 "	"	3	.3
100—125 "	"	0	0
125—150 "	"	0	0
150—175 "	"	0	0
175—200 "	"	0	0
200—250 "	"	3	.3
Total	8,000	22	.3

Observations were made at two heavily attacked trap piles to determine the intensity of *S. multistriatus* crotch feeding around attractive breeding material. The elm logs constituting the traps were barked and 4,932 egg galleries found. Assuming there was one male and one female for each gallery, there must have been 9,864 beetles attacking these two trap piles. The density of the egg galleries was 21.1 per square foot of bark surface. This may be considered very close to the maximum density of *S. multistriatus* egg galleries to be found in such breeding material. From a tabulation of the egg galleries made in the logs of 81 trap piles it was found that in only one trap did the average density of egg galleries exceed 20 per square foot, i.e., 27.8.

Table 31 is the record of observations made around these log traps.

TABLE 31. CROTCH FEEDING NEAR PLACE OF ATTACK

	Distance from trap pile in feet	Crotches counted	Feeding scars	% Crotches attacked
Trap	0— 6	638	51	8.0
	6—15	964	17	1.7
No. 12	16—20	608	1	.16
	20—30	241	0	0
Trap	0— 6	209	15	7.1
No. 13	6—15	694	22	3.1
Total		3,354	106	3.1

These observations of feeding at the place of emergence and at the place of attack are obviously not comparable, and furthermore should not be used as a correlation of abundance. The results do indicate that the beetles feed near breeding material as well as near the place of emergence and that feeding is negligible any great distance from either of these locations. This is important from a standpoint of cleaning up breeding material.

In the insectary it has been demonstrated many times that emerging adults do not need to feed on twigs or other material before commencing the brood tunnel. Many adults, when taken directly from emergence cans and caged with a freshly cut log, begin to burrow through the outer bark at once, and occasionally have been observed to excavate as much as 7 mm. of the egg gallery and deposit five eggs within 24 hours after emergence.

It appears that twig crotch feeding is quite variable. The intensity of such feeding either at emergence or attack may depend on weather conditions and other factors beyond our present knowledge or control.

Breeding material and attack. The characteristics which make certain elm wood attractive or unattractive for elm bark beetle breeding are at present not entirely understood. This beetle prefers to breed in dead, dying, or devitalized elm wood, although all such material is not attacked. Trees affected with Dutch elm disease apparently often develop a certain physiological condition which makes them particularly favorable breeding centers. Observations of the intensity of crotch feeding near breeding places indicate that presumably the individual attractiveness of certain trees is an important consideration, as well as the location of the elms in reference to the source of the beetles and to the breeding material itself. The size of the material is not a limiting factor in breeding, for trunks of elms 70 inches in diameter and half-inch twigs have been observed heavily attacked in certain instances. Moreover, we have noted successful emergence from limbs .5 inch in diameter.

If a certain portion of a tree is more heavily attacked than the rest, it can only be assumed that at the time of attack that part was more attractive to the bark beetles seeking breeding places. Observations of an elm, 10 inches D.B.H., which was completely cut off at the base and left standing at the time when beetle flight was at its peak, indicated that for this tree there was no correlation between height from the ground or diameter of the parts (except for branches less than 1 inch in diameter) and severity of attack.

A great abundance of beetles in an area sometimes results in a conspicuous attack on material ordinarily unaffected. We have recently observed an elm in full leaf and apparently healthy, being attacked by *S. multistriatus* adults. This occurred in a heavily infested area, on poor soil, during a period of drought. Attack has also been noted on elms the roots of which were flooded, and in the dead or dying area surrounding a wound or a nectria canker. Occasionally unsuccessful attempts to attack elms are noted in which the flow of sap was so great that it either forced the beetles to back out or killed them *in situ*. Such cases are common in elms, overthrown by the recent hurricane, which still retain many roots in the soil, but at one time were close to death from lack of soil moisture.

The adult, usually the female, chooses a point of attack on a log in suitable condition for breeding, but no attempt is made to start a brood tunnel in such a position that the subsequent larvae will have space to move about and feed. In cages the beetles apparently prefer to start the gallery at the end of a log, and even though infestation is not heavy, parallel egg galleries may be observed as close as 5 mm. apart.

Having chosen a point for attack, the adults at once commence excavating an entrance burrow. It is directed inward, and in vertical logs or trees is situated at the lower end of the egg gallery and directed slightly upward. The entrance burrow extends through the inner bark, usually scoring the xylem. It is slightly over one mm. in diameter, and may be distinguished from an exit hole by its somewhat smaller size, the reddish-brown frass surrounding it, and its general location at the edge of a flake or ridge of bark. A turning or nuptial chamber is then excavated. This is about 3 mm. long and 1.5 mm. wide, and usually meets the egg gallery at an oblique angle. Chamberlain (1939) considered that monogamous species use this chamber for turning only and that mating takes place only once.

Mating. Our observations of mating are restricted to a few pairs of beetles which were noted in copula when taken from emergence cages.

Chapman (1910) stated that copulation first takes place at the entrance to the burrow after two to five days of characteristic behavior, from which time on the male works with the female in egg gallery excavation. He believed they mate several times thereafter. This species is monogamous and a pair constructs only one egg gallery. Observations by C. W. Collins, *et al.* (1936) indicated that whenever the female remains for some time at the gallery entrance, the butting activities of the male are accelerated. Suddenly the male reverses his position and copulates with the female. They immediately re-enter the gallery, the male entering backwards, where coition is presumably consummated.

In order to obtain more information regarding mating, females were taken soon after emergence and caged with logs for breeding. The only time they had an opportunity to be with the males was the few hours between the time they emerged and the time when they were removed from the emergence cages.

As shown in Table 32, these females, without further contact with males, excavated egg galleries of somewhat less than normal length and deposited fewer eggs than normal, but these were of average fertility. This indicates that mating may take place immediately after emergence. It is not apparent whether the shorter galleries and fewer eggs are due to restricted mating or to an overburden of work for the female.

Table 32. Egg Galleries by Females Without Contact with Males after Emergence Cage

	Length mm.	No. Eggs	Eggs hatched
No. 1	21	42	42
2	20	42	39
3	19	33	32
4	10	4	0
5	34	20	17
6	23	10	9
7	11	16	14
Average	19.7	23.8	91.6%
% of Normal	70.0	34.7	95.4

When males alone were caged with logs, in all cases in which the male did not quickly die an egg gallery was excavated in the ordinary manner, but the galleries were short and no egg niches were excised.

The egg gallery. After excavating an entrance burrow and nuptial chamber, the female precedes the male and begins the egg gallery. This is usually constructed parallel with the grain of the wood, although many have been noted at a 45 degree angle with the grain, and occasional galleries run directly across the grain.

The female does most of the actual excavation with the male usually close behind. They both enter head forward. The female pushes the boring dust backwards with the mandibles and fore-tibiae, working it past the body with the legs and by rotating the body. The male, in turn, pushes the dust backwards until it is finally ejected from the entrance burrow. Ordinarily great care is taken not to let frass accumulate in the egg gallery. Usually, the female penetrates to the xylem and constructs a nuptial chamber within 24 hours after attack, but the time required varies considerably. In the extreme cases of seven egg galleries, 24 hours after exposure to attack by beetles direct from emergence, the average length was 5.1 mm. In other instances three or four days are required to penetrate to the cambium.

We were unable to observe the activity of the adults by shaving down the bark and placing a glass plate over the egg gallery, as described by Swaine (1918) for observing *Dendroctonus* beetles. Furthermore, the method of clamping a piece of bark against a glass plate which was used by Kaston (1939) for rearing and observing the larvae of *Hylurgopinus rufipes* is not satisfactory for observing the activities of the adults or larvae of *S. multistriatus* in the egg gallery, because the packing of frass along the gallery and against the glass often obscures their activities.

The observations noted herein were made in the following manner. Adults direct from emergence were placed in a cage with a freshly cut elm log. After 24 hours' exposure to attack, a section of bark about 6 inches square was raised at four places on the log. At each point where an adult had penetrated the bark flap, a designating number was scratched on the inner bark. The bark was then replaced and held down with two wires about the log. In this manner daily observations were readily made on egg gallery construction, oviposition, and hatching. Care must be used not to crush nor disturb the adults when replacing the flap, and it is also important each time to tighten the wires about the flap in order that it may be in close contact with the wood and lose as little moisture as possible.

In the construction of 36 egg galleries observed daily, the average length excavated per day was found to be 3.21 $\pm$ .1 mm.[1] The average length of 311 completed egg galleries was 28.2 $\pm$ 2.1 mm. The maximum was 83 mm. and the minimum 12 mm. It might therefore be assumed that about nine days are required for the construction of an average egg gallery, but a period of cold or wet weather markedly retards activity. However, adults often remain active in the tunnel two or three weeks after attack.

Oviposition. Commencing about 1 mm. from the nuptial chamber, the female cuts out niches on both sides of the gallery wall. These are slightly larger than the egg and under optimum conditions are spaced very closely so that only a thin film of wood fiber separates them. In 197 egg galleries with a total length of 5,471 mm., 13,485 eggs were deposited. The maximum number of eggs deposited in a completed gallery was 227 and the minimum was 17. The average per gallery was 68.5 $\pm$ 1.6. Of these 95.9 percent hatched. The average number of eggs per millimeter, computed from the average number of eggs deposited and the average length of a gallery, was 2.46. Actually the eggs are slightly

[1] Reference is made to the standard error.

closer together than this indicates because the female sometimes does not deposit an egg in every niche nor use all the available space on the sides of the gallery.

The female proceeds backward to the niche, slightly raises the abdomen, and an egg suddenly appears in the space. She immediately gathers some frass and packs the egg in tightly, using the fore-tibiae and mandibles. Usually only a small, shining tip of the egg can be seen from the inner side of the bark, but sometimes the egg is entirely invisible. Only one egg is deposited in a niche, and generally the oviposition lags somewhat behind the egg gallery excavation. The female may cut niches and deposit eggs as fast as the gallery is constructed, but she often goes back after a period of excavation, cuts niches, and deposits an egg in each.

Developmental Stages

The egg. The egg is shining white, subspherical, about .6 mm. by .4 mm. The surface is regular and unsculptured. The eggs cause no protuberances in the gallery for they are packed in flush with the gallery wall. In a few cases it was noted that fertile eggs were deposited within 24 hours after emergence of the adults. In other instances five days were required before oviposition took place. In 45 egg galleries observed, the average time between exposure to attack and oviposition was 2.68 $\pm$ .2 days.

The total number of eggs deposited per tunnel is subject to considerable variation. Unfavorable weather slows down oviposition and diminishes this total. If the sap flow in the bark becomes too great, or if the bark dries out too quickly, the adults may leave or die in the gallery, although the eggs already laid may hatch. Apparently the presence of a male in the gallery has a salutary effect on egg deposition. More than one mating may be necessary to fertilize a large number of eggs, and the male also relieves the female of much of the work in disposing of the frass.

Egg galleries excavated in September are often shorter and contain fewer eggs than those made when high temperatures are more continuous. According to Wadley (unpublished laboratory notes, 1934, ref. Collins *et al.*, 1936) *Scolytus multistriatus* is inert at 45 degrees F., crawls at 52 degrees F., flies at 70 degrees F., and is vigorously active at 85 to 90 degrees F. This may explain the fewer eggs and shorter galleries noted late in the season.

From daily observations of oviposition during warm weather it was found that an average of 3.7 $\pm$ 1.1 eggs were deposited per day. Occasionally no eggs were deposited for a day or more, and the maximum noted was 14 in one day.

The incubation period for the eggs does not vary greatly except under adverse weather conditions, and hatching occurs in surprisingly direct sequence with the time at which the eggs were deposited. From observations of 507 deposited at known dates during August, the average length of the incubation period was found to be 5.1 $\pm$ .5 days. The maximum noted was nine days and the minimum was three days.

About 24 hours before the shell breaks open, the egg loses its shining appearance and shrinks slightly. At this time, if the egg shell is carefully opened, the tiny larva, completely formed, may be removed.

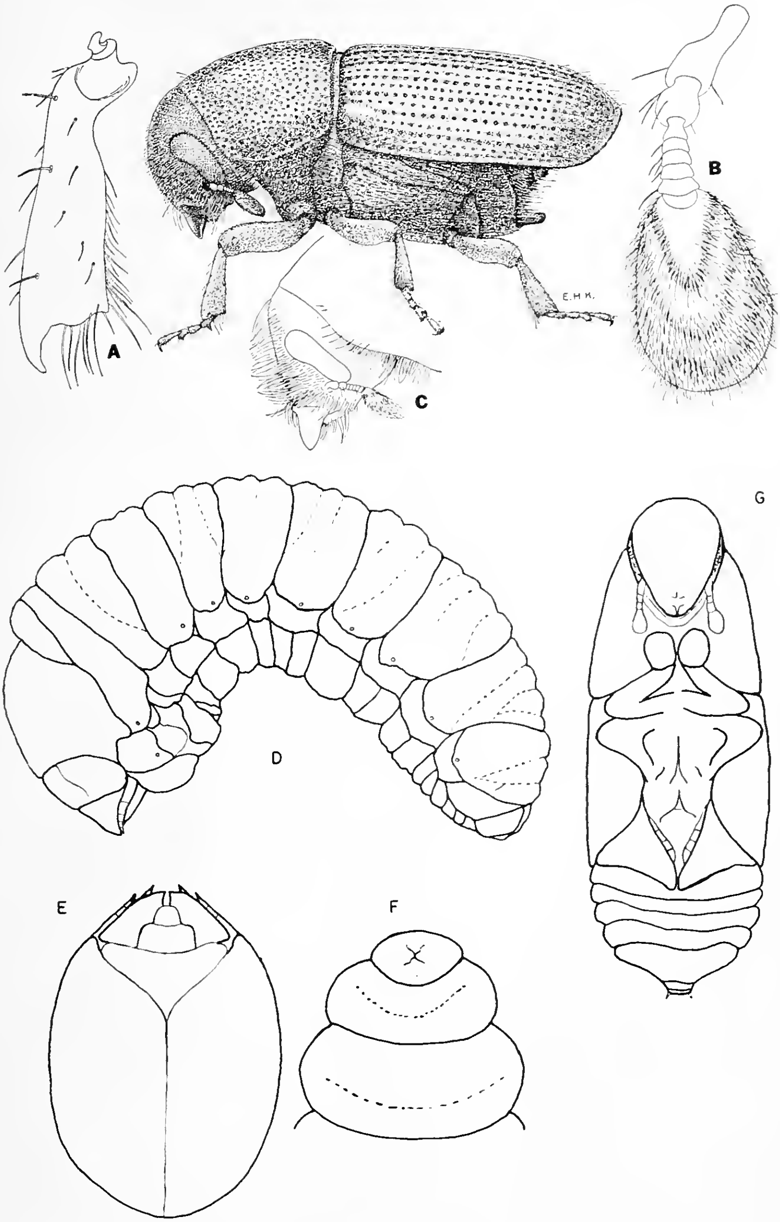

FIGURE 4. Smaller European elm bark beetle: Center above, female, lateral view, about 23 times enlarged. A, left tibia, posterior aspect; B, left antenna, lateral aspect; both enlarged 76 times; C, head of male, lateral aspect, enlarged 23 times; D, larva; E, head capsule, dorsal aspect; F, caudal segments, ventral aspect; G, pupa, ventral aspect.

Larval period. The larva is scolytoid in form, creamy white and 3.5 to 4 mm. in length when fully developed. A fold in the integument, straight across the posterior half of the pronotum and terminating in a puckered depression on each side, readily distinguishes this larva from *Magdalis* sp., in which the fold is distinctly arcuate, and from *H. rufipes* larvae in which the characteristic fold and musculature are not readily discerned. The very sparse pubescence on the venter of the thoracic segments is an additional characteristic by which *S. multistriatus* larvae may be distinguished from other scolytoid larvae found in elm.

When the egg shell breaks open the larva may be seen from the inner surface of the bark, wriggling about within its shell. During the next 24 hours the larva commences to feed and excavates a tunnel at right angles to the egg gallery. The first few millimeters of the larval tunnel are usually excavated entirely within the phloem, and the larva is not then visible. Very shortly the larva cuts entirely through the inner bark, and although the main part of the tunnel is within the bark, the sapwood is lightly scored throughout the length of the larval tunnel. As the larva proceeds, molts, and increases in size, the tunnel is correspondingly larger and may be 2 mm. in width after several ecdyses. Readio (1935) stated that there are five larval molts. The larval tunnel is tightly packed with frass and excrement and occasionally parts of larval exuviae may be found in the mass.

As the larval tunnels are extended they diverge, forming a characteristic fan-shaped pattern. Larvae hatching from eggs at the ends of the gallery usually tunnel with the wood grain, parallel to the egg gallery. Occasionally in a heavily populated area the larval tunnels may cross and recross or two larvae may follow the same tunnel.

The length of larval galleries from which adults have emerged varies greatly. The longest noted was 73 mm. and the shortest was 12 mm. The average length of 454 larval tunnels was found to be 36.5 $\pm$ 1.2 mm.

A short time before the larva pupates, it enlarges the end of the tunnel and constructs a bare cell, continuous with the larval tunnel and often at a right angle to it. This pupal cell is entirely within the bark, not visible from the inner side, and often contiguous to the underside of a flake of outer bark.

Ordinarily these larvae are able to withstand extreme moisture conditions. Many within logs which remained indoors against a steam radiator for two weeks pupated and emerged without apparent ill effects. No detrimental effect on larvae within logs was observed when the logs were submerged for two months in the salt water of an ocean inlet. After submersion for four months, the logs froze in the ice and when removed three weeks later about 50 percent of the larvae were alive and some developed to adults in the laboratory cages. This observation concurs with that of Collins *et al.* (1936), who found that these larvae can withstand two months' submergence in tapwater. Obviously the distribution of this insect may be influenced by the movement of infested logs along inland streams and coastal waters.

Pupal period. The pupa is shining white and bears two distinct appendages on the caudal segments of the abdomen. The duration of the prepupal and pupal stages was determined at 27 degrees C. in an incubator in which an open dish of water was placed to maintain proper humidity. The larva passes through a prepupal period of about 36 hours. During this time it is quiescent and the contents of the alimentary tract are voided. The average duration of the pupal period was 5.0 $\pm$ .6 days. Collins *et al.* (1936) found that the hibernating larvae required two days for the prepupal stage and that the pupal stage lasted 10 days or more under natural conditions during May. Readio (1935) reported a prepupal period of one or two days and a pupal period of five to six days at 27 degrees C. During the latter part of the pupal period the light color of the pupa slowly darkens, so that when transformation is complete the adult is light brown in color.

Emergence of adult. The adult beetle is 2.3 to 3 mm. in length. The pronotum is shining black and finely punctured and the elytra are shining reddish brown, distinctly striate and feebly but densely punctured. A spine projecting from the upper part of the second ventral abdominal segment aids in distinguishing this beetle from many other scolytids. After the adult becomes somewhat hardened, it cuts its way through the outer bark to the surface and crawls about for a short time before flying away to feed or seek a place to breed. The emergence holes are round and slightly larger in diameter than the beetle. The frass from these holes is packed into the pupal cell and does not appear on the outer bark around the holes as it does about entrance burrows.

Flight and Wind Dispersion

No precise observations have been made relative to flight or wind dispersion of these beetles, but the importance of these factors cannot be overlooked. Certain data have been obtained on the movement of insects of similar type and it is reasonable to assume that they may apply in part at least to the movement of *S. multistriatus*.

Felt (1935) stated that the closely related hickory beetle, *Scolytus quadrispinosus* Say, was taken in Albany, N. Y., in 1927, on a roof top 125 feet above the sidewalk, well above adjacent tree tops, and fully three-quarters of a mile from any hickories. At the same location he also recorded taking three species of pine bark beetles, *Ips calligraphus* Germ., *Ips grandicollis* Eichh., and *Ips pini* Say, which must have drifted or flown more than a mile. In the same paper Felt made available data from the Federal Bureau of Entomology, recording the capture from an aeroplane of two species of *Xyleborus* at an elevation of 2,000 feet, another species at 500 feet and four other species of scolytids at 200 feet. The importance of wind drift and air currents in relation to the dispersion of *Scolytus multistriatus* is further emphasized by Felt (1937) from reports of balloons released in southwestern Connecticut, New York and New Jersey. He stated that wind carriage of infected beetles affords the most reasonable explanation of the distribution of Dutch elm disease in the Northeast. However, this work was done before the disease spread southward through southern New Jersey and westward from New Jersey into eastern Pennsylvania. It may well be that natural barriers, availability of breeding material, and climate render insignificant the general effects of the prevailing winds and upper air currents in the distribution of this beetle. Although doubtless wind drift occurs and may be responsible for some outlying infestations, transportation of beetle-containing material appears more significant.

Observations of breeding habits lead us to believe that under ordinary conditions flight of *S. multistriatus* is usually limited to about one-quarter mile. The stimulus for flight is considered to be the desire for suitable breeding material rather than for food, and the beetles appear to be attracted to the nearest suitable elm wood, as observed by Kaston (1939) in the case of the native elm bark beetle, *Hylurgopinus rufipes* Eichh.

Previous to the hurricane of September 21, 1938, the limits of the distribution of *S. multistriatus* in Connecticut were fairly well known. Although there was a heavy infestation around New Haven, North Haven, North Branford and Branford, no evidence of this beetle could be found east of Guilford during a careful survey in the summer of 1938. Much of the hurricane-elm material in these towns and in Guilford was destroyed by the U. S. Department of Agriculture and other agencies, before beetle emergence in July, 1939, but a heavy infestation still existed in Branford and North Branford, if the degree of attack on trap logs may be used as a criterion. After the emergence of the second generation, inspection was made of enormous quantities of elm wood in the towns along the Connecticut shore, east of Guilford, where little effort has been made to destroy it. In this group of towns the only evidence of *S. multistriatus* was a light infestation in Madison, the town adjoining Guilford on the east. This beetle was recorded from Guilford in 1936 and was found there in fairly large numbers in 1937 and 1938, so the abundance of elm-breeding material there during 1939 may have had little significance this season. Occurrence of the beetle this year in Manchester, Durham, Middlefield, Cheshire, Cromwell, Seymour and Berlin appears to be a parallel of the situation in Madison, for our investigations indicate that the spread probably came from adjoining towns. A light infestation in Saybrook is believed to be the direct result of transportation of elm logs from the infested area. Figure 2 indicates the distribution of *S. multistriatus* in Connecticut and the spread in 1939.

During the flight periods in 1939, there was an enormous amount of elm material available throughout Connecticut and much of it was in a suitable condition for breeding at all times. It is probable that the broken, uprooted and dying elms resulting from the hurricane will continue to offer suitable breeding material for these bark beetles for several more years, and that they will eventually spread to every locality in Connecticut where breeding places are maintained. Apparently the normal spread is quite slow, even with an abundance of suitable material present.

Parasites and Predators

The general effect of parasites and predators on *S. multistriatus* is little known. Field observations indicate that in some localized areas certain elm bark beetle enemies are present in great numbers and undoubtedly are important in reducing the beetle population.

Two hymenopterous parasites of *Scolytus multistriatus* are known and both have been taken in Connecticut. *Spathius canadensis* Ashm. has been recovered in large numbers, and *Cheiropachys colon* Linn. has been taken less commonly.

A nematode parasite, *Parasitylenchus scolyti* Oldham, is reported by Oldham (1930) to attack *Scolytus multistriatus* and render as many as 60 percent of the brood sterile.

The clerid, *Enoclerus nigripes* Say, is a common predator as adult and larva upon all stages of *S. multistriatus.* The clerid eggs are deposited in the entrance burrow, whence the larvae make their way throughout the bark beetle egg gallery and larval tunnels, devouring every host egg, larva, and pupa which they are able to reach. The adults are as voracious as the larvae and move rapidly over the surface of an infested log devouring every bark beetle in sight. The clerid attack upon a brood of emerging *S. multistriatus* adults is an astounding procedure to watch.

It is difficult to evaluate the activity of birds in bark beetle control. The downy woodpecker, *Dryobates pubescens medianus* Swain., and the hairy woodpecker, *D. villosus villosus* Linn., are by far the most common bird predators of *S. multistriatus* in Connecticut. A woodpecker has been observed going methodically around a limb of an infested elm, tearing off small strips of bark and devouring the larvae as fast as it could proceed. Woodpeckers have also been observed picking out the adults as they commenced to attack a decadent elm. In certain swamp areas the top limbs of nearly all the infested elms appear to have the bark shredded and a large proportion of the larvae were found to have been destroyed. Although the effect of birds is sometimes locally significant, it is believed that the important species are not numerous enough to exert any appreciable influence on the European elm bark beetle population in general.

The mycelium of an undetermined fungus is often found in association with dead larvae, pupae and adults within the bark, but its significance is unknown.

Bark mites are often numerous within the egg galleries and larval tunnels of *S. multistriatus* but their effect on the brood has not been studied. Rust (1933) found that mites destroy an approximate average of 50 percent of some bark beetle broods, and that 15 to 85 percent of the eggs of *Ips oregoni* Eichh. in ponderosa pine are devoured by predaceous mites.

Survival of Larvae at Low Temperatures

Recent observations on the effect of low temperatures on the survival of larvae of *S. multistriatus* indicated that while most naked larvae die when exposed for a short time to temperatures below −8 degrees F., some survived as low as −70 degrees F. Mortality of larvae contained in logs and exposed for various periods to constant low temperatures shows trends which cannot be strictly correlated with duration or intensity of cold alone. It is believed that winter temperatures in Connecticut are responsible for little mortality of these larvae.

Artificial Control

There is scant information relative to the artificial control of this bark beetle which is based on field tests. The subject has been considered on the basis of what is known of the flight, feeding habits, and life history of the insect.

Destruction of breeding material. The most obvious control measure consists of removing elm material which may provide attractive breeding places for the beetles, and the destruction of infested elm material. Investigations by D. Collins (1938) indicated that there is a definite correlation between the presence of beetle-producing or beetle-attracting wood and the occurrence of twig crotch feeding, and that such feeding is negligible more than 1,000 yards from breeding material. Field observations in Connecticut further support this conclusion, but evidence of crotch feeding has not been found here more than 200 yards from beetle-attracting or -producing wood.

These observations indicate an entirely feasible program for the protection of valuable elms from bark beetle attack and the possible introduction of the Dutch elm disease fungus.

Spraying. Various sprays containing poisons, repellents, and fungicides have been tested at several experimental laboratories. Complete reports are not available, but Felt and Bromley (1938) observed a reduction in intensity and depth of feeding on small potted elms, caged with a large number of beetles, when sprayed with lead arsenate and a sticker. A preliminary report by D. Collins (1938) indicated that in general the feeding on sprayed, caged elms was less than on unsprayed. He further observed that under natural conditions crotch feeding is so erratic that it is difficult to evaluate the results obtained in controlled experiments. It is apparent from the evidence reported that none of the materials tested are likely to give satisfactory control when applied to large elms in the usual manner, even with the current high-pressure spraying equipment.

Chemical treatment of breeding material. Various chemicals were applied to the surface of bark beetle breeding material in an attempt to render it unsuitable for attack. After preliminary tests a light coal-tar creosote oil was selected. Extensive laboratory and field tests indicate that this material, when applied to the bark of elm, may render such logs permanently unattractive for bark beetle breeding. When applied to logs containing bark beetle larvae, the penetrating and killing effects have so far not been entirely satisfactory. In connection with a pruning project during the summer of 1939 in an infested area, the dead and dying wood pruned from about 700 field and woodland elms was treated with creosote. A random inspection of this material in October revealed that there had been no bark beetle attack to any of the treated logs. Creosote was carried in the field in a 12-quart pail and applied with a 4-inch paint brush. This creosote is obtainable from producers of illuminating gas at about 20 cents per gallon in 50-gallon drums, and is known to the trade as "light creosote oil".

The bark from 20 treated logs was burned in a pile about two months after application, and the odor of creosote was hardly noticeable. Apparently there is no reason why logs so treated might not be used for fuel. The application of creosote causes the bark to dry rapidly so that by the time the odor is dissipated to such an extent that it might no longer repel bark beetles, the bark is so dry and loose that it is entirely unsuitable for beetle breeding.

Trap logs. Trap logs have been tested for many years in attempts to reduce the infestation of various species of bark beetles, but the results have generally been obscure or unsatisfactory. Fluctuations in the density of beetle population may be due to factors entirely removed from trapping. Data from observations of 81 trap piles of elm logs placed at various points in southern Connecticut substantiate the conclusion of Martin (1936) that logs in semi-shade are most attractive to *S. multistriatus*. It was also noted that bark beetles seldom breed in the top quadrant of an elm log in any exposure.

Emergence of *Hylurgopinus rufipes* adults from hibernation takes place during late April and early May (Kaston, 1939), before the emergence of *S. multistriatus*. It has been found that trap logs placed during this period often serve as breeding places, not only for the *H. rufipes* adults then in flight, but for those adults often found hibernating at this time in the bark of the trap logs. *S. multistriatus* adults emerging in late May and June were thus excluded from breeding in many trap logs which were placed in April and May because they were already infested with *H. rufipes*.

An indication was desired of the effect of trapping of first generation adults on the subsequent density of population of the second generation. Following a comprehensive trapping program by the U. S. Department of Agriculture for the adults emerging from hibernating *S. multistriatus* larvae, similar traps were placed at two of the previous locations after the first generation emergence was complete and the previous traps had been removed. The number of egg galleries formed per square foot of surface by the second generation was not significantly different from that of the first generation. These observations were limited and may not represent the actual beetle population, but they suggest a factor to be considered—availability of breeding material. Scrutiny of the small quantity of elm bark beetle breeding material in the area indicated that everywhere infestation was close to the maximum, and that under any conditions this material could have accommodated only a small percentage of the emerging adults. It is suggested that the first generation adults which were trapped and destroyed, were a part of those which would have died inevitably from a scarcity of available breeding wood. The density of beetle population within an infested area fluctuates so rapidly due to ecological factors and to the availability of breeding material in particular, that it is believed extensive research should precede the general use of traps to reduce elm bark beetle population.

Summary

S. multistriatus, a native of Europe, was first reported in this country at Boston in 1910. Since that time it is known to have been introduced and become established in many sections of northeastern United States. Figure 2 indicates its distribution in Connecticut.

All species of elms planted in this part of the country are subject to attack, and it is reported from practically all the species of elms in Europe in addition to aspen, ash and plum.

There are ordinarily two complete generations of this insect in Connecticut, although there is often one and a partial second generation and, occasionally, only one complete generation develops. Hibernation takes place in the larval stage only. The first generation adults commence to emerge from hibernating larvae during the latter part of May. Oviposition takes place within a few days. The first generation larvae commence to pupate during the second week of July and second generation adults appear very shortly after the emergence of the first generation is complete, about the middle of July. All stages of the insect may be observed throughout the summer but activity ceases by the first of October.

Some of the adults feed in the twig crotches of healthy elms for a few days shortly after emergence. This feeding may occur near the place of emergence or near the place of attack, and has not been observed more than 200 yards from either of these locations. Many adults do not feed in this manner but go directly to breed. This attack on elm twigs is quite variable and has indicated no correlation with factors other than distance from breeding material.

Mating may occur within a few hours of adult emergence before the beetles move away or at the entrance burrow of the new egg gallery. This species is monogamous, constructs only one egg gallery, and is suspected of mating more than once.

The average length of egg galleries was found to be 28.2 mm. and the average number of eggs deposited per gallery was 68.5. The presence of a male in the gallery appears to stimulate the female to increased egg production. An average of 3.7 eggs were deposited per day in the galleries noted.

The larvae ordinarily are able to withstand extreme moisture conditions.

It is considered that natural barriers, availability of breeding material and climate render insignificant the effects of prevailing winds and upper air currents, in the distribution of this insect. The hurricane of September, 1938, appears to have had little influence on the dispersion of this bark beetle in Connecticut during 1939.

Observations on the effect of low temperatures on survival of the larvae of *S. multistriatus* indicate that the factors of cold intensity and cold duration are responsible for little winter mortality in this State.

Various parasites and predators are noted but they do not appear to exert enough control to be of importance in an outbreak. The controlling factor in an outbreak of these bark beetles is believed to be the availability of breeding material.

The sprays used by various investigators to prevent twig-crotch feeding have so far proved of doubtful value for that purpose.

An easy and cheap method of preventing infestation of elm bark beetle breeding material is the application of light creosote oil to the bark. This has been tested extensively in the field and proven most satisfactory.

Experiments with trap logs to reduce beetle infestation indicate that the density of beetle population fluctuates so rapidly within an area due to ecological factors and to the availability of breeding material in particular that it is believed extensive research should precede the general use of traps.

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MISCELLANEOUS INSECT NOTES

The Crazy Ant in Connecticut. In March, 1939, specimens of *Paratrechina longicornis* Latr. (determined by M. R. Smith) were collected in a New Haven hotel. These ants were found in many parts of the building and were causing much loss by infesting food and some annoyance by appearing in large numbers in guest rooms. They were apparently nesting in cracks behind the woodwork and were controlled by systematic use of poisoned baits.

According to Marlatt, the crazy ant is a tropical species which has been found in large buildings in various parts of the country. In the New Haven building it had been seen for at least a year prior to identification. [NEELY TURNER]

Dermestid Larvae in Composition Board. Specimens of a *Dermestes* larva were received in July from a summer cottage near Hartford. These larvae had bored into the composition board used instead of plaster. Eight or ten holes had been made, and larvae were also found underneath a braided rug. The owner was advised that these larvae had developed on some decaying animal matter, and that they had a habit of boring in soft wood to pupate. It was suggested that a possible source of the trouble was a dead animal underneath the cottage, which had no cellar. Within a few days the owner sent the following information: "Following a suggestion in your letter and also because most of the larvae seemed to be near the fireplace, I poked around the chimney with long-handled brushes. Finally I dislodged a hard object from a narrow shelf just back of the damper, which probably was a squirrel. It must have fallen down, suffocated, and then baked hard by the fire, so that we did not realize it was there. Very likely these pests will soon disappear." [NEELY TURNER]

The House Cricket, *Gryllus domesticus* Linn. A telephone call was received from Dr. Shay of the Health Department, Bridgeport, Conn., requesting information about crickets infesting a home on Birmingham Street in the north end of the city. The home was visited with Dr. Shay and one of his assistants and was found infested from attic to cellar with the house cricket, *Gryllus domesticus* Linn. It was a new house, built less than a year, and was located within a city block of a dump. Soil covered the debris in the dump which was maintained in such a manner as to leave only the latest material temporarily uncovered.

The crickets had been in the house for about two weeks. They had eaten large holes in three dresses, ruining them. More than a hundred that had been killed by a fly swatter were observed. On August 12 a letter was received from a resident of Thorne Street, which is also in the vicinity of the same dump. The writer stated that the neighbors as well as his own family were suffering from an outbreak of crickets in their homes.

It was recommended that a poisoned bran bait be used in each case. The formula follows:

Wheat bran	5 pounds
White arsenic or Paris green	4 ounces
Cheap molasses	1 pint
Water	7 pints
Lemons	1

The bran bait should be scattered thinly around the places where the crickets are found and outdoors around the home. Domestic animals or birds should not be exposed to any quantity of the bait. If the bait is scattered very thinly, little danger exists for animals or birds.

The house cricket was first reported in Connecticut from Shelton in 1918 and only four reports precede the present one in our records. Probably this small outbreak originated in the dump. [J. PETER JOHNSON]

Notes on **Asiatic Garden Beetle** Damage in a Field of Sweet Corn. On July 7, 1939, a letter received from H. E. Baldwin, Westport, Conn., reported injury to sweet corn seedlings. Enclosed with the letter were two adult beetles which were identified as the Asiatic garden beetle, *Autoserica castanea* Arrow. Earlier, when the seedlings were 4 to 6 inches

FIGURE 5. Field of corn in Westport, showing effect of a heavy infestation of the Asiatic garden beetle, *Autoserica castanea* Arrow.

in height, many had turned a reddish color, wilted and died. An examination showed that the roots had been eaten. The field had been used for pasture or hay prior to its use for corn. The land was plowed in the fall and seeded to sweet corn in the spring.

The field was visited about July 10 for observation. As it had not rained for about 10 days, it was possible to see thousands of emergence holes through which the adult beetles had left the ground. Some adult beetles were collected from the soil about the roots of some of the weeds (pussley) in the field. The field was about five acres in size and more than half of the first planting had been destroyed by the grubs earlier in the season. The injury was spotty and irregular with many areas devoid of corn.

On October 23, 1939, 24 diggings one square foot in area and 15 inches in depth were made 100 feet apart in the field. Eight yielded no grubs, and the others yielded from 1 to 11 each. A total of 51 grubs, or an average of 2.1 to one square foot, was found.

As the average number of grubs found per square foot was considered sufficient to injure the 1940 corn crop, it was recommended that the field be plowed and harrowed in the spring when the grubs are just below the surface of the ground. At the time the diggings were made, the grubs were from 6 to 8 inches deep. It was further suggested that the field be harrowed more than normally. [J. PETER JOHNSON]

Results of Trapping **Rose Chafers.** A complaint was received that rose chafers, *Macrodactylus subspinosus* Fabr., were very numerous in a cemetery in New Haven, and considerable feeding was taking place. During the period while the adult beetles were present, from June 12 until early in July, 39 Japanese beetle traps were in operation in the infested portion of the cemetery. These were located throughout the area where the chafers were feeding, to points just beyond the infestation, covering approximately five acres.

The traps were not visited regularly but were emptied and checked at intervals throughout the period. When the last rose chafers disappeared, in early July, all the insects captured were measured. Four quarts of chafers had been caught and one quart of these was counted. It contained approximately 8,000 chafers, so the total catch for the season amounted to 32,000.

Many chafers were not captured in the traps and there seemed to be no decrease in numbers throughout the season. Although traps will catch numbers of rose chafers they cannot be considered as a reliable method of control for this insect. [J. PETER JOHNSON]

The European Earwig. Some notes by B. H. Walden on the occurrence of the European earwig, *Forficula auricularia* Linn., in Connecticut were published in the 1938 report. During the past season a few observations were made in an attempt to learn something about the degree and the extent of the infestation.

Four standard earwig traps as developed by the U. S. Department of Agriculture were placed in the yard in Westville, where the earwigs were originally found, by a representative of the Bureau of Entomology and Plant Quarantine, Division of Forest Insect Investigations. One hundred thirteen of the insects were removed from these traps in one of the periodical checks made during the season.

As the standard earwig traps were not available in quantity, 60 simple traps consisting of 4-inch flower pots filled with excelsior and inverted on stakes 14 inches long were placed on 20 properties in the neighborhood. Three were placed in each yard. The properties were selected on the basis of their location relative to the original infestation. Four sites were trapped in the city block containing the original infestation while two sites were trapped in each of the adjoining blocks, totaling nine blocks in all. Sixty-three earwigs were captured in these traps at six of the locations.

The earwigs were originally found in a back yard on McKinley Avenue. The properties found infested in 1939 were primarily northwest of the 1938 site, toward Barnett Street and Fountain Street. This would indicate that the center of the colony was situated north or west of the place of original discovery. Further trapping in the future will in all probability settle this question.

While making observations to determine whether or not the earwigs were feeding to any extent on flowers or foliage, 16 were taken from four dead dahlia blossoms. One neighbor reported that he captured three or four a day on his dahlias. No feeding of any importance was noted during the observations. [J. PETER JOHNSON]

Bark Beetle Damage to Plantation Pine. In the fall of 1939 it was noticed that a number of pines in the experimental forest plantations of the Connecticut Agricultural Experiment Station at Rainbow were in a dead or dying condition (Figures 6 and 7). A survey was made to determine the identity of the insects causing the injury, the extent of the damage, and the nature of the stands most heavily attacked.

Three of the most extensively infested blocks were examined in detail. These consisted of a planting of pure white pine, one of pure red pine, and a mixed planting of the two. The insects found to be causing primary injury to the trees were bark beetles of the genus *Ips*, and included three species: *Ips pini* Say, *I. grandicollis* Eichh., and *I. calligraphus* Germ. Also present under the bark of red pine were numerous specimens of another bark beetle, *Hypophloeus parallelus* Melsh.

The pure white pine stand was planted in 1902 and spaced 5 by 5 feet. Originally it covered 0.6 of an acre, but most of the stand was destroyed by the hurricane of 1938, and only 179 trees remain. The average diameter is 5 inches and the height is about 40 feet. Of these, five have been killed, while five others are infested and undoubtedly will die. The trees attacked are thus 5.6 percent of the total. In this stand bark beetle damage may be secondary, however, as the trees were drastically exposed and rendered liable to sunscorch and other adverse climatic forces. In addition, some were injured by falling adjacent trees.

The pure red pine stand was planted in 1917, spaced 5 by 5 feet, and includes 0.8 of an acre. The height of these trees is about 27 feet and the average diameter is 4 inches. Of the total of 750 trees, the number attacked by bark beetles is 33, or 4.4 percent. Of these, six are dead and five are dying.

The red and white pines in the mixed stand were planted alternately, 5 by 5 feet apart, in rows 10 feet apart. The white pine has an average diameter of 4.5 inches and a height of 26 feet. The number of trees attacked is 10, or 1.2 percent, and of these three are dead and two are dying. Although the red pines have a thriftier appearance, the number of injured trees is much larger. The height averages 27 feet and the diameter 5.5 inches. In all, 66 trees are infested, or 8.0 percent of the total, and six of these are dead and nine are dying. The dead red pines in this stand have deteriorated rapidly; the bark has fallen from the trunks and the branches, and wind storms have caused many of the infested branches to break off

FIGURE 6. Base of white pine tree killed by Ips bark beetles, showing pitch tubes on trunk and boring dust on ground around trunk.

(Figure 7). Both *Ips pini* and *I. grandicollis* were found in the branches. All three species previously listed were also found hibernating in the organic layer beneath the trees.

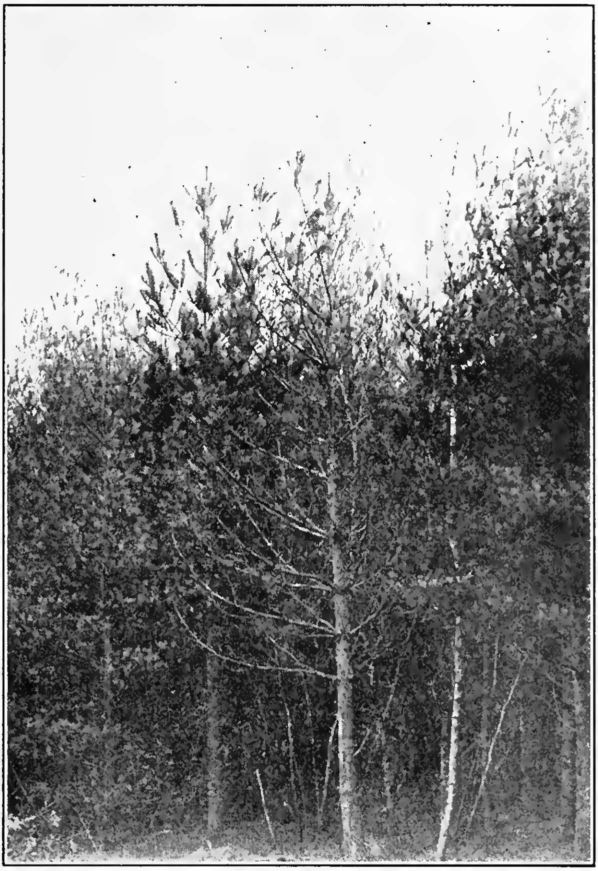

FIGURE 7. Red pine tree about 27 feet high killed by Ips bark beetles.

It has been reported recently that bark beetles have attacked red pine plantations in the Pachaug State Forest in southeastern Connecticut. Specimens taken from these trees have been determined as *Ips pini*. However, many of the trees were also infested by a weevil, *Pissodes approximatus* Hopk. Furthermore, one of the plantings was injured by a fire which occurred in the spring of 1939.

[G. H. PLUMB AND A. DECAPRIO]

Clover Mite in Dwellings. Each summer we receive complaints about clover mites (*Bryobia praetiosa* Koch) entering homes. These pests are of no great economic importance, but when they enter homes in large numbers they become a nuisance to the housewife. They are so small that they can easily gain entrance through screens and under doors and windows.

Most of the recommended methods of control have failed when the mites are present in large numbers. At one house in Branford, where these pests have been troublesome for several summers, the householder applied tree tanglefoot under the lowest course of clapboards all around the house to prevent the mites from crawling up higher and getting in through the screens. This stopped the mites from entering until the tanglefoot had become hardened or bridged over by the bodies of mites. As long as the householder kept the tanglefoot fresh and sticky there was no trouble, but this meant almost daily attention.

As most of the mites were on the south and west sides, the lawn on these sides was covered with a fine sulfur dust for about 15 feet from the house. Shortly after the sulfur dust application it rained for nearly two days, following which mites seemed to be as abundant as before. Another light coating of dust was applied on a warm sunny day. Several hot days followed immediately after the application. The householder reported about two weeks later that the mites were apparently all gone and there was no further trouble with this pest the rest of the summer.

[M. P. Zappe]

Calomycterus setarius Roelofs in Connecticut. This weevil, a native of Japan, was first discovered in Connecticut in the town of Salisbury in 1932. Since then it has been found in the towns of Sharon, Stratford, Fairfield, Westport, and Greenwich.

The largest infestation, in the town of Stratford, covers about one square mile. Adults have been rather abundant here and have been found feeding on Lespedeza, Desmodium and several species of clover. The larvae live in the ground and feed on roots of various plants. The adults are wingless and have the curious habit of crawling up the sides of houses and entering through doors and windows. They appear to prefer houses that are painted white.

The Stratford infestation has apparently not increased in intensity. During the summer of 1939 the adults appeared to be less numerous than they were in 1938. Neither did their host plants show as much feeding injury in 1939 as during the previous year. It was feared that they might become abundant enough to cause economic injury to fields of clover, but this has not yet happened. [M. P. Zappe]

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G. W. Barber, Associate Entomologist, Bureau of Entomology and Plant Quarantine, U.S.D.A.

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SUMMARY OF OFFICE AND INSPECTION WORK

Insects received for identification	568
Nurseries inspected	420
Regular nursery certificates granted (399 nurseries)	409
Duplicate nursery certificates for filing in other states	135
Miscellaneous certificates and special permits granted	190
Nursery dealers' permits issued	97
Shippers' permits issued to nurserymen in other states	173
Blister rust control area permits issued	195
Certification and inspection of occasional shipments	
Parcels of nursery stock	1,696
Corn borer certificates	1,204
Packages of shelled corn and other seeds	2,535
Japanese beetle certificates	
Nursery and floral stock and farm products	41,574
Orchards, gardens, fields and lawns examined[1]	240
Buildings examined for termites, etc.	62
Shipments of imported nursery stock inspected	13
Number of cases	37
Number of plants	276,400
Apiaries inspected	1,627
Colonies inspected	8,936
Apiaries infected with American foul brood	83
Colonies infected with American foul brood	147
Towns covered by gypsy moth scouts	75
Infestations discovered	430
Egg-clusters creosoted	8,260,640
Larvae and pupae killed by hand	53,151
Infestations sprayed	31
Lead arsenate used (pounds)	150,496
Miles of roadside scouted	1,200
Acres of woodland scouted	204,350
Letters written[2]	4,080
Circular letters issued	1,356
Bulletins and circulars mailed	6,067
Packages sent by mail and express	42
Post cards mailed	505
Lectures, papers and addresses at meetings	41

[1] Including 46 calls on vegetable survey.

[2] Including 148 letters written from the gypsy moth office at Danielson.

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