CIRCULAR 174 JANUARY, 1950

Control of
THE STRAWBERRY ROOT WEEVIL IN NURSERY PLANTINGS

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The strawberry root weevil, *Brachyrhinus ovatus* (L.), is not only a pest of strawberries in the United States and Canada but is also known to destroy a wide variety of other host plants both in this country and in Europe.[2] It is most troublesome, however, to conifers, especially hemlock and American arbor vitae, in nurseries. Plantings of Japanese yew,[3] *Taxus cuspidata*, at times are heavily infested. Specimen trees in ornamental settings are also seriously injured.

Injury to conifers by the weevil is of two kinds: damage to the root system by the larvae and to the foliage and stems by the adults. Small hemlock trees, especially in newly transplanted blocks, are very often killed as a result of root feeding by the larvae. The roots may be stripped of root hairs and the larger anchor roots are sometimes girdled or denuded of bark.

Adult feeding on hemlock foliage is relatively unimportant. Occasionally small crescent-shaped areas are eaten out of the leaves; however, this is not especially noticeable even when the weevil population is heavy. Girdling of hemlock twigs has not been observed in nurseries in Connecticut, and reports from other areas are that this type of injury may occur but is seldom serious.

Arbor vitae, on the other hand, rarely, if ever, suffers seriously from larval injury to the root system. Here, injury results from girdling of twigs by the adults. Terminals in the upper part of the trees are affected, resulting in a yellowing and ultimate dying back of the foliage, more serious in globe varieties. Tender new growth may be devoured by the weevils in late spring. Foliage injury causes the development of unsightly plants during the summer and autumn. Damaged trees are for the most part unsalable, unless sheared and allowed to stand in the nursery blocks for a season or two to recover. Partially girdled twigs may callous over, leaving an obvious gall-like formation where the damage occurred.

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[1] Entomology Department.
[2] Gambrell, F. L., 1938. Jour. Econ. Ent., Vol. 31, No. 1, pp. 107-113.
[3] Whitcomb, W. D., 1931. Amer. Nurseryman 39 (11) June.

Adult of the strawberry root weevil (enlarged 8 times).

LIFE HISTORY

The strawberry root weevil overwinters primarily in the larval stage, although occasionally as a pupa or adult. The last stage may be encountered in the field throughout the entire year. In the usual season, however, it is most abundant from the middle of June to early August. Overwintering adults take shelter in trash, fence rows, under stones and beneath injured trees. They become active in early spring when the weather is warm. It may be the middle of May, however, before the twigs of arbor vitae are girdled to any extent.

Weevils transforming to the adult stage in late spring begin to appear in the soil during the early part of June but may not emerge to feed on foliage immediately. Soon, however, they appear in the trees in ever-increasing numbers where they feed for four or five weeks.

After an adult has emerged, egg laying does not begin for 10 days to two weeks or more. Eggs occur in the soil throughout the summer. Late emerging adults may lay eggs during early fall.

Under favorable temperature and moisture conditions, eggs hatch in a week to 10 days. The larvae feed until cool weather compels them to move downward in the soil to a depth of 6 to 14 inches. With the onset of milder weather in early spring they work upward again, feeding on the roots of the trees as they go. When the feeding period is completed in late May, the larvae are usually in the center of the root system within an inch or two of the surface of the ground.

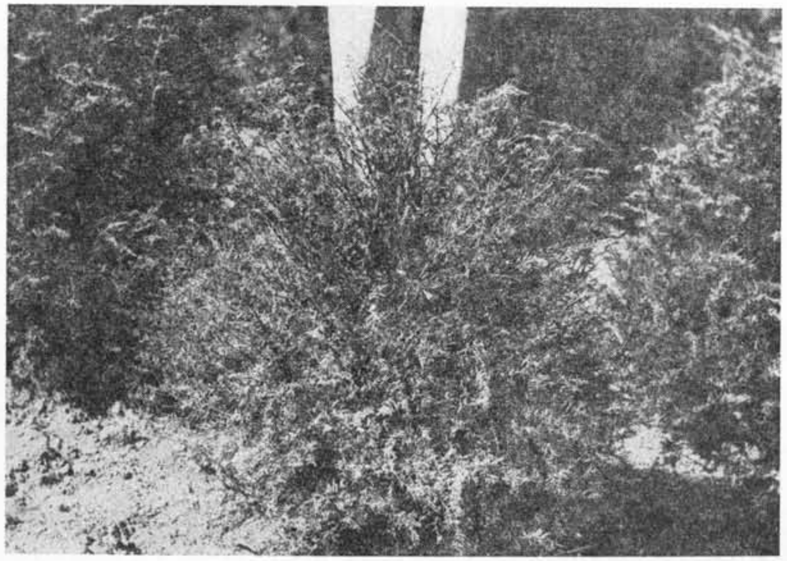
CONTROL

Since the latter part of the last century, considerable work has been done on this continent in developing methods for the control of the strawberry root weevil in strawberry plantings and to a limited extent in nurseries. Some of the earliest as well as more recently developed methods of controlling larvae include soil fumigation, flooding, cultural practices, barriers, crop rotation, contact and stomach poisons. Spraying, trapping, dusting and the use of poison baits were also employed to destroy the adults. The success of the methods has varied considerably. Most of the insecticides, however, achieved a fairly high degree of control when applied under favorable conditions.

Experiments with New Insecticides

Following requests by nurserymen for assistance in solving the strawberry root weevil problem in hemlock and arbor vitae plantings, we explored the possibility of using some of the insecticides developed in post-war years. Obviously, the many new ones provided a wealth of material from which to choose. Three chemicals exhibiting insecticidal properties of a high order of efficiency were selected for experimental purposes.

Parathion,[1] an organic phosphate; benzene hexachloride,[2] containing 6



Injury to hemlock tree showing effect of root feeding by the strawberry root weevil.

[1] Thiophos.
[2] "Lexone 50W".

per cent of the gamma isomer, and Chlordane[1] were chosen as perhaps the most likely ones to destroy Brachyrhinus larvae in the soil. All three possess fumigating powers in addition to contact and stomach poison action.

The management of one of the largest nurseries in Connecticut granted the use of hemlock and arbor vitae plantings for extensive research on the subject.

A three-quarter acre block of 12 to 15 year-old hemlock trees was selected from among many similar sized areas for the work. The planting was rather centrally located in the nursery, the trees were remarkably uniform in size, and the Brachyrhinus infestation throughout the block was quite high (25 to 48 larvae per tree). The area was divided into three equal parts of one-quarter acre each. The treatments were applied on May 25, 1949, a clear, mild, rather windy day.

One one-quarter-acre section containing 30 rows of trees was treated with 50 pounds of 5 per cent Chlordane dust mixed with 75 pounds of fertilizer[2] as a diluent to increase the volume of material and thereby achieve more even distribution of the toxicant. This provided 10 pounds of actual chemical per acre.

A similar section of the block was treated with 17 pounds of benzene hexachloride (6 per cent gamma isomer) diluted with 100 pounds of fertilizer. The actual amount of technical toxicant used per acre in this instance was 4.08 pounds of gamma isomer.

The third and last section was treated with 200 pounds of 1.5 per cent parathion dust, achieving a 12 pound level of actual insecticide per acre. No fertilizer was used in this treatment. There were check areas on all four sides of the experimental block.

An "Iron Age" lime-fertilizer distributor was used to apply the treatments to the cultivated soil between the rows of trees. Immediately following the applications a horse-drawn "winged" cultivator was employed to turn a part of the insecticides plus a minimum of soil towards the base of the trees. Thus, all of the ground area under the trees as well as the exposed soil between them was covered with the toxicants. Furthermore, the mechanical action of the cultivator worked most of the insecticides into the soil to a depth of an inch or so.

The first six weeks following treatments were very dry. On May 26, 1949, 0.11 inches of rain fell on the treated plots. There was no further rainfall (with the exception of 0.01 inches on June 16 and 0.02 inches on June 19) until July 6. The mean temperature during this period was 5°F. above normal and the sky was clear virtually the entire time. As a result, the soil around the roots of the trees was not penetrated to any extent by the insecticides; instead they appeared to remain about where they had been placed.

[1] **Synklor.**
[2] **Milorganite.**

Experimental Results

When the area was examined on June 10, a large number of dead and dying adult weevils were found in the plots treated with Chlordane and benzene hexachloride, both on the ground around the base of the trees and in the rows between them. None but live, normally active weevils were seen in the block where parathion had been applied.

An examination of the earth around the roots of a seriously injured tree in the Chlordane plot revealed six live pupae and two live adults. In the benzene hexachloride plot there were 13 live pupae in the center of the root system of a badly injured tree. A dying tree in an adjoining check plot was examined. Eighteen live pupae, one live adult and one live larva were found.

It would seem that, although drought prevented any considerable penetration of the insecticides, Chlordane and benzene hexachloride destroyed the weevils as they came to the surface after transforming to the adult stage. The fumigating action of the insecticides in this case did not appear to have taken place.

What happened in the parathion plot is largely conjecture. As a result of long, extremely hot, dry weather, the toxicant (which normally breaks down and disappears quite rapidly when exposed to sunlight) probably lost its lethal action before the adult weevils began to emerge. This would in part account for the complete absence of dead weevils and the presence of many live ones on the ground and in the trees where the insecticide was used.

It was obvious by June 17 that remarkable control of the weevil had been obtained through the use of low dosages of Chlordane and benzene hexachloride. As far as could be determined, all weevils present were killed. Trees in the Chlordane and benzene hexachloride treated plots were shaken violently but no adult weevils could be found. Thousands of dead weevils were found on the ground.

A few live adults were seen in the trees in the adjacent check blocks and also in the plot treated with parathion. Furthermore, on June 17 no dead weevils were found on the ground in the check or parathion plots.

Following the successful control of the weevil in the Chlordane and benzene hexachloride experimental blocks, the owners of the nursery treated with Chlordane all other sections where the strawberry root weevil might occur, including the previously treated parathion plot.

Repeated examinations of the experimental plots during the second half of June were reassuring in the belief that there was no survival of Brachyrhinus. Dying weevils were found on the ground throughout this period but none was seen in the trees. During July and early August no live weevils could be found and the injured hemlock trees appeared to be recovering.

Many trees with yellowish foliage (resulting from early season injury) but also with new green tips an inch or so long were pulled up for examination during the first two weeks in September from areas treated with Chlordane by the management. No eggs or larvae of the strawberry root weevil could be found and new rootlets were developing rapidly. Trees injured only slightly during the months prior to treatment recovered more quickly. By autumn they displayed rich, deep green foliage.

On September 27, 24 stunted, off-color trees injured during the late season of 1948 and in the spring of 1949 were removed for examination, half from the Chlordane and half from the benzene hexachloride blocks. Brachyrhinus larvae could not be found and the trees showed evidence of recovering. In addition, the root system and surrounding soil of 40 healthy hemlock trees in these blocks were examined before mid-October but no weevil larvae or eggs could be found.

CONCLUSIONS

Experiments described above, using Chlordane and benzene hexachloride, and large scale applications of the former insecticide show that control of the strawberry root weevil in hemlock and arbor vitae plantings in nurseries is practicable.

Owing to the fact that the weevil is unable to fly and must migrate on foot or be carried into the nursery artificially, reinfestation will probably be very slow. Moreover, because the residual action of Chlordane and benzene hexachloride lasts for several years, it may reasonably be expected that one treatment will be effective for several seasons. Booster treatments at about three-year intervals using perhaps one-quarter to one-half of the original dosage should prevent strawberry root weevil reestablishment permanently

Benzene hexachloride should not be used in soil where food plants are grown or where the ground may in the future be converted to the culture of plants for this purpose. The chemical imparts a disagreeable odor and taste which can be eliminated only at great expense, if at all. It may be acquired by plants years after a treatment has been made.