Station Bulletin 513 April 1952

Control of Western Peach Tree Borer *in Northeastern Oregon*

Earl Brown

Agricultural Experiment Station
Oregon State College
Corvallis

FOREWORD

The Western Peach Tree Borer has long been a serious pest of plums, peaches, and cherries in Oregon. It attacks and kills healthy young trees and greatly devitalizes older plantings.

Large acreages of plums, peaches, and cherries are grown on rocky soils in the Milton-Freewater area. The western peach tree borer is not successfully controlled by the standard paradichlorobenzene crystal method on rocky, gravelly soils. Such soils do not hold the gas long enough to kill the borers. This bulletin presents new methods of controlling the borer in trees planted on rocky soils. Trees from two to three years old can now be treated successfully for borer control without danger of injury from the insecticide.

F. E. Price

Dean and Director

Control of

Western Peach Tree Borer[1]

in Northeastern Oregon

EARL BROWN[2]
Research Assistant

THE western peach tree borer, *Sanninoidea exitiosa grafei* (Hy. Ed.)[3], has been one of the worst pests of peach, prune, and cherry trees in the northeastern section of Oregon for many years. It is present in almost every orchard where its hosts are grown.

The borer damage can readily be detected by gum and sawdust-like frass at the base of its host tree. The damage caused at this stage is usually a girdling or partial girdling of the trunk at the ground level where it feeds on the soft inner bark or the cambium layer. This feeding cuts off movement of water and food materials to the upper part of the tree and eventually results in the complete or partial killing of the host.

Experimental work included in this bulletin was done in the Milton-Freewater area in Umatilla County. It is the uppermost part of the Walla Walla Valley. Large acreages of land are irrigated from the Walla Walla River and small streams throughout the area. Additional irrigation is supplied by pumping from wells in the valley floor.

The main farm crops are fruits and vegetables. About 25,000 tons of prunes, 1,500 tons of cherries, 1,500 tons of apples, and 1,500 tons of tomatoes are shipped by railroad from the area annually. The cobbly and gravelly loam soil covering most of the area warms up early in the spring and crops mature earlier than in other areas of the Northwest where similar crops are grown. Early shipments of fresh fruits and vegetables are made from the area to many parts of the United States and Canada.

The average annual temperature for the area is 52.8° F. Temperatures of 100° F. are common during July, while temperatures as low as —20° F. occasionally occur during January and February. Fourteen inches of rainfall is normal. These factors, coupled with an average annual frost-free period of approximately 200 days, make fruit and vegetable production favorable.

Information compiled in this bulletin on the control of the western peach tree borer is intended to show a portion of the work

[1]The common name "western peach tree borer" was adopted for this insect by the American Association of Economic Entomology in February, 1950 (Jour. Econ. Ent. 43: 117-138).

[2]This work was done under the leadership of S. C. Jones, Associate Entomologist, Oregon Agricultural Experiment Station, Corvallis, Oregon.

[3]Order Lepidoptera, Family Aegeriidae.

done in the Milton-Freewater area and to make this information available to the fruit growers concerned.

History and Hosts Attacked

The western peach tree borer has been under observation by members of the Oregon Agricultural Experiment Station for nearly fifty years. Entomologists on the Pacific Coast have been attempting to find a suitable control of this pest since 1902. The western peach tree borer is a native species which infested wild prunes and cherries long before its present host trees were planted in this region.[1]

The western peach tree borer is strictly a western species and is found in Oregon, California, Washington, Nevada, and British Columbia. Its long list of hosts includes the peach, prune, cherry, western choke cherry, plum, apricot, almond, and other members of the genus *Prunus*.[2]

Description of Life Cycle Stages and Habits

The adult male

The adult male is a dark steel-blue, clear-winged moth with a wing expanse of 1.25 inches (Figure 1). Its over-all length from

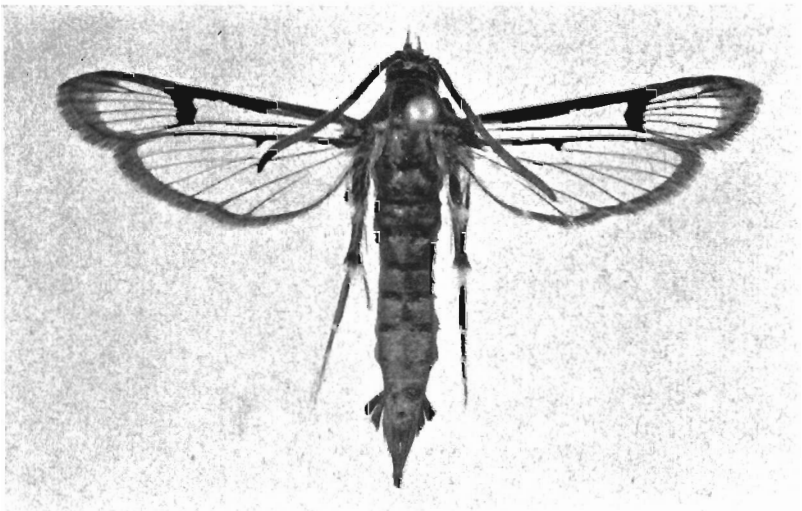

Figure 1. Adult male moth with wings and legs exposed to show identifying characteristics.

[1]F. H. Lathrop and A. B. Black, Third Crop Pest and Hort. Rept., 1915-1920. Oregon Experiment Station, p. 59, 1921.
[2]E. O. Essig, Insects of Western North America, p. 723, 1926.

the front part of the head to the tip of its abdomen is about 0.75 inch. The front and rear wings are both entirely transparent, possessing dark, narrow veins bordered by a fringe of dark hairs on the rear portion, and a wider dark strip on the fore portion. The abdomen is a very dark, slender, shiny color with the exception of tufts of yellow hair on the rear underneath portion of the thorax of some males. The tip of the abdomen terminates in a sharp point. The most striking feature of the male is the presence of yellow tufts of hair on the legs that are not present on the female.

The adult female

The adult female, like the male, is a dark steel-blue moth with a wing expanse of 1.0 to 1.25 inches (Figure 2). Its over-all length from the front part of its head to the tip of its abdomen is about 0.75 inch. The front wing of the female, unlike the front wing of the male, is almost entirely covered with dark scales. The rear wing is transparent, as in the male, and possesses an almost identical vein pattern to that found in the male. The most striking difference between the male and the female is the presence of an orange band around the abdomen, covering the fourth abdominal segment of the female. The yellow tufts of hair on the thorax and legs of the male are absent on the female.

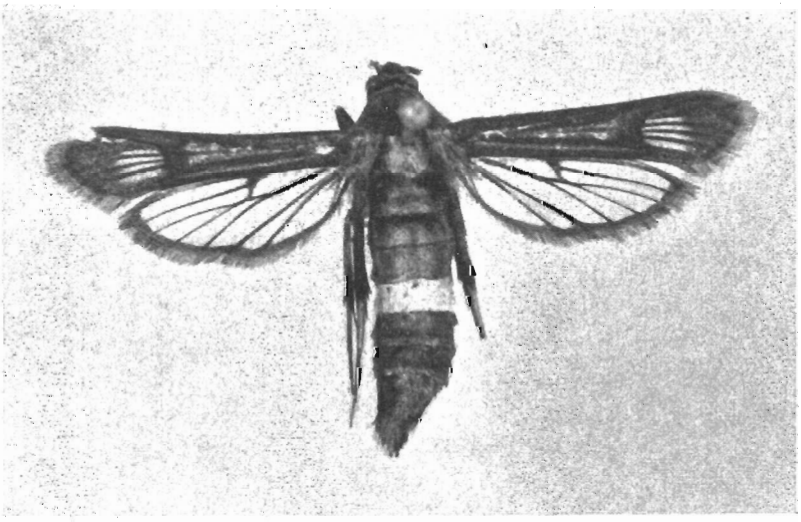

Figure 2. Adult female moth with wings and abdomen exposed to show identifying characteristics.

Both the male and the female can be found resting on the leaves and trunks of its host trees or flying in the orchards during July and August. When in flight they appear as dark-colored wasps darting back and forth through the orchard. They are easily disturbed and are difficult to catch.

The egg

The individual egg is a tiny flattened disk-shaped object with a reddish-brown color. Each egg measures about 1/50th of an inch in length. Most of the eggs are found on the trunk. Hatched eggs are marked by the presence of an emergence hole at the end of the egg case. These eggs also have a much lighter brown appearance than unhatched eggs. Since the female glues each individual egg to the trunk, leaf (Figure 3), or other object upon deposition, the empty egg shells from previous years can sometimes be found on the trunk. The largest number of eggs will be found during August and September.

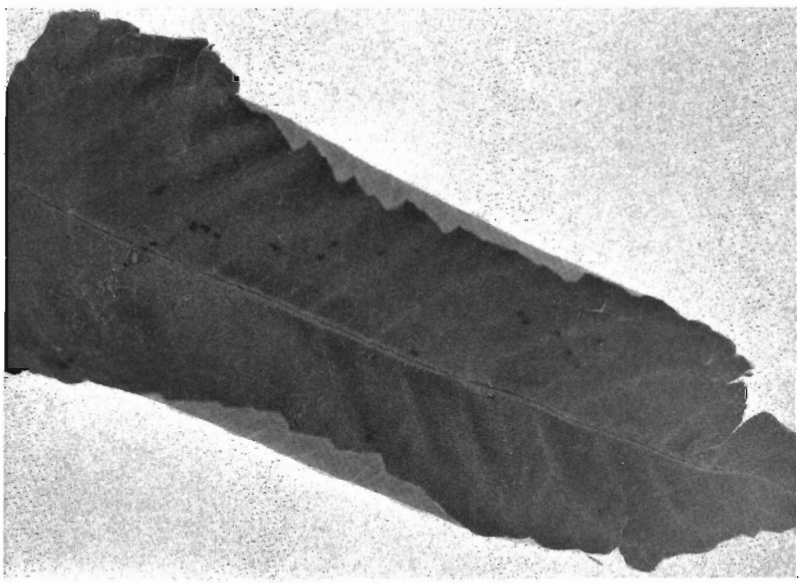

Figure 3. Eggs placed on leaf by female moth.

The larva or borer

The larva is a grublike "worm," pale yellow or white in color with a dark brown head (Figure 4). When the larva first emerges from the egg, it is so small that it cannot be readily seen with the

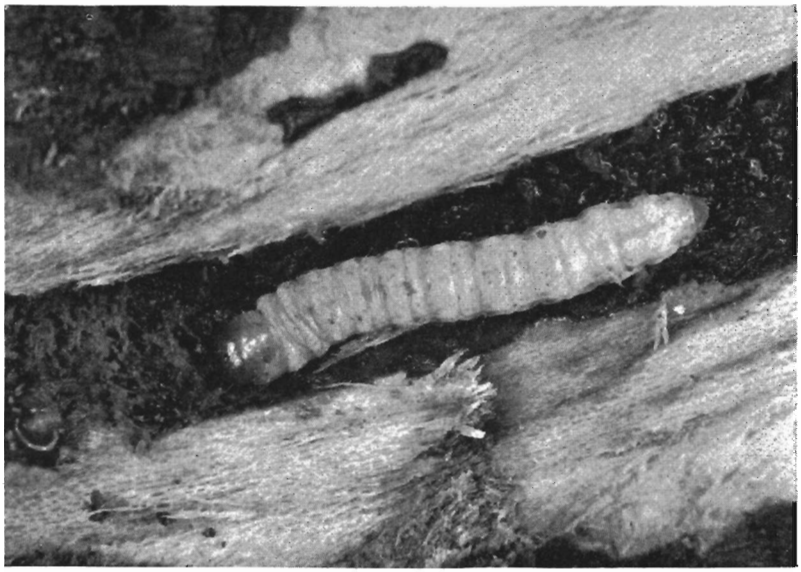

Figure 4. Immature larvae exposed to show feeding gallery in trunk of prune tree.

naked eye. When fully developed, the larva is approximately 1.25 inches long. The young borer can be found in the outer layers of the bark of its host. As it grows, it bores into the inner bark and cambium area. Most of its tunnelling will be marked by frass and gum at the base of the tree, or higher up if the borer is working upward in the tree. Borers are present in trees during any month of the year. The least number of borers will be found during July.

The average number of borers found per tree depends upon the individual orchard. It is not uncommon to find two or three borers per tree. As many as sixty-six have been taken from a single prune tree about six inches in diameter. Trees one and two inches in diameter are often girdled by one or two borers. On the other hand, twenty-five or thirty borers will not completely girdle a tree six or eight inches in diameter, since many of the tunnels are made up and down the trunk. Heavily infested trees are so devitalized that the leaves have a definite yellow, rolled appearance. The fruit set is reduced on these trees.

The pupa or transformation stage

After the larva has fully matured, it spins a silken cocoon (Figure 5). It incorporates particles of frass and bark into the cocoon,

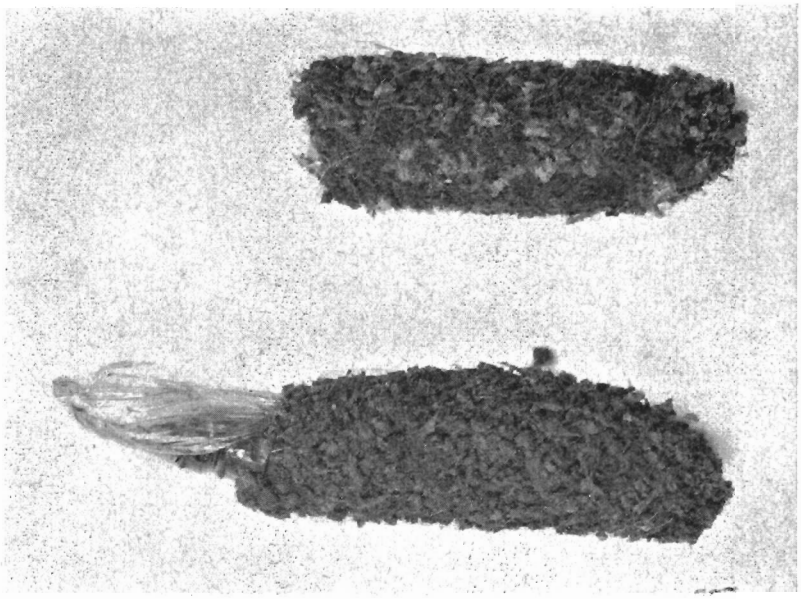

Figure 5. *Top:* Cocoon prior to moth emergence. *Bottom:* Cocoon with empty pupal skin protruding from cocoon.

making a dark brown, capsulelike structure. Within this cocoon it changes to a pupa about 0.75 inch long. On the back of the pupa are short, stout spines that enable the pupa to push itself from the cocoon before it is ready to emerge as a moth. Usually the cocoon can be found in the entrance to a tunnel or further back under the bark inside of the tunnel. Often the cocoon will be found in the frass and jellylike substance at the base of the tree, especially if the larva has been working far down in the roots where the emerging adult is not accessible to the ground surface upon emergence. As the moth emerges from the cocoon about one-half inch of empty pupal skin is left sticking from its end (Figure 5). This is what the orchardist will find late in the summer and early fall upon examination of tree trunks at the ground level.

Life History

The peach and prune root borer overwinters in its tunnel in the host tree as a larva within a hibernating cell. In the early spring, as the weather warms up, feeding is resumed. As the borer becomes fully developed it makes its cocoon in a suitable place and transforms

to a pupa. The first cocoons are usually found the latter part of May. During June four weeks is usually required for transformation from the larva to the adult; but later, during July and August, two and one-half to three weeks is spent in the transformation stage.

The adults begin emerging the latter part of June or the first of July in the Milton-Freewater area. The earliest emergence recorded was the 11th of June in that area. The peak of emergence of adult moths usually occurs the latter part of July or the first of August. A few stragglers emerge later in August, after the peak has been reached. These cease to emerge near the end of August or the first part of September.

Immediately after emergence, the adults begin laying eggs. Each female lays from 400 to 700 eggs. They are laid singly or in masses of sixteen or more eggs. These eggs hatch in about ten days and the young borers immediately bore into the tree and commence feeding.

The young borers that enter the trees during July and the first part of August feed greedily during the autumn months. They remain dormant during the winter months. Feeding is resumed early the next spring. A single year is required for their development. On the other hand, larvae hatching from eggs laid the latter part of August or the first part of September do not reach maturity until early the second year. The adults from these larvae usually emerge the latter part of June of the second year. Larvae of all sizes are present in tree trunks at all times of the year (Figure 4). This is due to the long egg-laying period of the adults and the variation of development due to weather conditions.

Control of the Root Borer

Summer control experiments

Experimental work was initiated in the Milton-Freewater area in 1948. Concentrated organic insecticides have been tested for root borer larvae control prior to their entering the tree. Applications of these materials to tree trunks prior to egg hatching have given satisfactory control.

Single tree plots were used in experimental orchards in 1948 and 1949. The number of trees per replication was increased during 1950 and 1951. Results obtained from these experiments showed definite indications of control. Results of these experiments are shown in Tables 1 and 2. The insecticides were applied with a 100-gallon power-driven sprayer operated at sixty to eighty pounds pressure. The trees were sprayed from at least three angles distributed

Table 1. 1950 Experimental Results Showing Data from Two Experiments Carried on Against the Root Borer Infesting Four-Year-Old Prune Trees.

Experiment number	Material	Pounds/ 100 gallons water	Date of application	Number replications	Number trees per replication	Total trees examined	Number trees without borers	Average number borers found per tree[1]
1	50% WP DDT	8	July 13 August 11	6	4	23	8	1.98
	15% WP Parathion	8	July 13 August 11	6	4	23	10	.96
	15% WP Parathion	4	July 13 August 11	6	4	23	5	3.20
	50% WP DDT	8	July 13	6	4	23	10	2.68
	15% WP Parathion	8	July 13	6	4	23	6	2.93
	50% WP DDT	8	August 11	6	4	24	4	5.13
	15% WP Parathion	8	August 11	6	4	21	4	3.06
	No treatment	....	.....	6	4	23	1	15.98[2]
2	50% WP DDT	8	July 19	2	15	18	11	.88
	50% WP DDT	6	July 19	2	15	21	12	1.19
	50% WP DDT	4	July 19	2	15	18	3	3.66
	No treatment	....	.....	2	15	22	1	11.27[2]

[1]The possibility that large borers were remaining in trees for more than one year was not given careful consideration during 1949 and 1950, and borers that may have been in trees prior to treatment were not kept separate during 1950 sampling.

[2]The difference between check and treatment was highly significant, but there was no significant difference between treatments.

Table 2. 1951 Experimental Results Showing Data from Two Experiments Carried on Against the Root Borer Infesting Six-Year-Old Prune Trees.

Experiment number	Material	Pounds/ 100 gallons water	Date of application	Number replications	Number trees per replication	Total trees checked	Number trees without borers	Average number borers found per tree
1	50% DDT WP	8	July 16 August 15	4	25	17	6	3.94[1]
	50% DDT WP	6	July 16 August 15	4	25	18	3	6.56
	No treatment	0	.....	4	25	15	0	24.53[2]
	50% DDT WP plus 1 qt. summer oil	8	July 16 August 15	4	25	17	8	1.58[1]
	50% DDT WP plus 1 qt. summer oil	6	July 16 August 15	4	25	17	5	3.23
2	50% DDT WP	8	July 18	3	40	37	13	2.16[1]
	15% Parathion WP	8	July 18	3	40	42	5	4.26
	No treatment	0	.....	3	40	41	0	12.65[2]
	50% DDT WP	8	July 18 August 16	3	40	43	18	1.44[1]
	15% Parathion WP	8	July 18 August 16	3	40	49	18	2.36[1]

[1]The borers taken from these treatments were large and for the most part were individuals that had remained in the trees during the summer of 1951 and thus were not killed from the treatment. No dead borers were found, thus the author feels that none of the treatments killed any large borers already in the tree when materials were applied.

[2]The difference between check and treatment was highly significant, but there was no significant difference between treatments.

Table 3. 1950 Fumigation Trials Using Ethylene and Propylene Dichloride to Control the Root Borer on Six-Year-Old Prune Trees. (Applied September 25.)

Material[1]	Method of application	Number trees treated and checked	Live borers	Dead borers	Per cent control
Propylene dichloride	Sprayed on trunks at 80 pounds pressure	5	5	26	83.9
Propylene dichloride	Poured around base against the trunk	5	2	28	93.3
Propylene dichloride	Poured in ring around base and mounded	5	1	36	97.3
Ethylene dichloride	Sprayed on trunks at 80 pounds pressure	5	8	29	78.4
Ethylene dichloride	Poured around base against the trunk	5	9	23	71.9
Ethylene dichloride	Poured in ring around base and mounded	5	3	18	85.7
No treatment		5	38	0	00.0[2]

[1]The strength of emulsion and the directions for mixing described in Table 4 as prescribed for six-year-old trees were those used in this experiment.
[2]The difference between check and treatment was highly significant, but there was no significant difference between treatments.

evenly around the tree. This method assured complete coverage of the trunk, from the first branches to the ground. The ground around the base of the tree was also sprayed. The amount applied per tree depended on its size. Trees one to three inches in diameter required from one-half to three-fourths of a pint per tree. Those four to six inches in diameter required from one to one and one-fourth pints per tree.

The trees in the plots were checked by removing and counting all borers in each tree. This was usually done during October and November, after all of the eggs on the test trees had hatched, and the borers were large enough to find and count.

All the live trees in each plot were checked in the 1950 experiments. The size of the plots was increased in 1951. The borers in the buffer rows around each plot were not counted.

Table 2 gives results obtained from summer treatments of DDT and Parathion for peach tree borer control in 1951.

Fall and spring control experiments

Ethylene and propylene dichloride were tested for peach tree borer control in the Milton-Freewater area in 1949 and 1950. Excellent control of the borer was obtained with these materials.

Results obtained from ethylene and propylene dichloride are tabulated in Table 3. Trees as uniformly infested as possible were selected for testing these materials. Single tree plots were used. Other similar experiments showed similar results. All trees in these experiments were checked one to two months after treatments were applied. The borers were removed and classified dead or alive and recorded for each individual tree.

Discussion of Results

The control of the western peach tree borer has been a serious problem in Oregon since 1890. Some of the early methods of control were as follows:

- Flooding the base of the trees for larval control.
- Mechanical barriers and sticky material placed on the tree trunks to prevent the larvae from entering the trees or killing the moths before they lay their eggs.
- Removing the larvae from the tree.

All these methods were unsatisfactory.

The use of paradichlorobenzene was first discovered in 1919 by E. B. Blakeslee[1], when he prescribed the treatment to kill the borers within the tree. This method of control was very effective and in many areas it is still being recommended and used as a control measure. In the Milton-Freewater area the rocky condition of the soil limits its use.

During 1939 work by the Entomology Department, Oregon Agricultural Experiment Station, in the Willamette Valley and later work during 1949 and 1950 in the Milton-Freewater area showed that ethylene or propylene dichloride as a fumigant can be used against this pest in Oregon. However, it is not satisfactory for use on trees younger than four years old, because it is very toxic to the tender tissues of these trees. Before trees reach the age when ethylene or propylene dichloride can safely be applied many are killed or are severely damaged by borer feeding.

The use of concentrated organic insecticides to control the larvae before entering the trees has been under extensive experimental study since 1948 in the Milton-Freewater area. The results of these experiments are shown in Tables 1 and 2. The reduction of severe injury and killing can be accomplished by this method, providing effective insecticides are used and that timing and proper methods of application are employed. It is especially helpful in controlling larvae infesting nursery stock before the young trees are shipped to growers. The danger of killing or injuring trees with poisonous gases is eliminated. This is very important in young orchard plantings.

The fact that a few borers remain in the tree trunks two years before they are fully developed presents some problems. However, if controls are applied for two or more years in succession this trouble can be avoided. If young trees are treated annually after they are planted until they are eight or nine years old, it is likely no future borer problem will result. This is not true of the gas treatment, since some injury is done each year by borers feeding before control measures are taken (thus making possible entry through previous wounds in much older trees). Borers that enter high up on the trunk are killed with this method of control, where gas forming materials fail to give control.

The cost of applying concentrated DDT or parathion is less than one-third as expensive as the propylene or ethylene dichloride treatment. Orchardists applying parathion should follow the manufacturer's precautions in handling the material.

[1]E. O. Essig, Insects of Western North America, 1926, p. 724.

Recommendations

Summer control methods

As a result of recent experimental work in the Milton-Freewater area, the western peach tree borer can now be controlled by summer spraying with DDT or parathion. Careful studies have shown that severe infestation of fifteen to twenty-five borers per tree can be controlled by spraying properly. Two applications of either 50% DDT, 8 pounds, or 15% parathion, 8 pounds wettable powder to 100 gallons of water, give excellent control. The time of application is important and may vary from year to year depending upon the life history of the root borer in the area. In the Milton-Freewater area, the best controls have been obtained when the first application was applied between the 10th and the 15th of July, followed by a second application applied between the 10th and the 15th of August (Figure 6). If one application is made it should be applied the 15th of July.

The amount of spray material per tree will vary with the size of the trees being treated. Trees one to three inches in diameter require about one-half to three-fourths of a pint per tree, while those four to six inches in diameter require about one to one and one-fourth pints per tree.

The following method of applying concentrated insecticides to tree trunks is recommended:

Remove all weeds and trash from the immediate area of the tree trunk to be sprayed in order to make the application of the insecticide easier.

Fill the spray tank about one-third full of water and, with the agitator running, mix the required amount of the insecticide to be used; then add water to make the desired concentration. It is important that the agitator is running during spraying and that the insecticide is kept in suspension. If no agitator is available, the material should be constantly stirred so that it does not settle in the bottom of the sprayer. Agitation is important where such a heavy concentration of the insecticide is being used.

Apply the insecticide to the tree trunk using sixty to eighty pounds pressure. Higher pressure should be avoided.

Cover the trunk thoroughly from the ground surface to the first limbs and allow the insecticide to puddle at the base of the tree on the soil. This can be accomplished by two downward and upward strokes with the spray gun from about three evenly distributed locations around each tree trunk.

The application of spray materials with an orchard-type sprayer is preferred. However, a hand sprayer can be used effectively on small plantings, providing the required amount of spray is applied to each tree.

Fall or spring control method

Ethylene and propylene dichloride are fumigants designed to kill the peach and prune root borer by fumigation after they become established in the trees. Since paradichlorobenzene failed to control

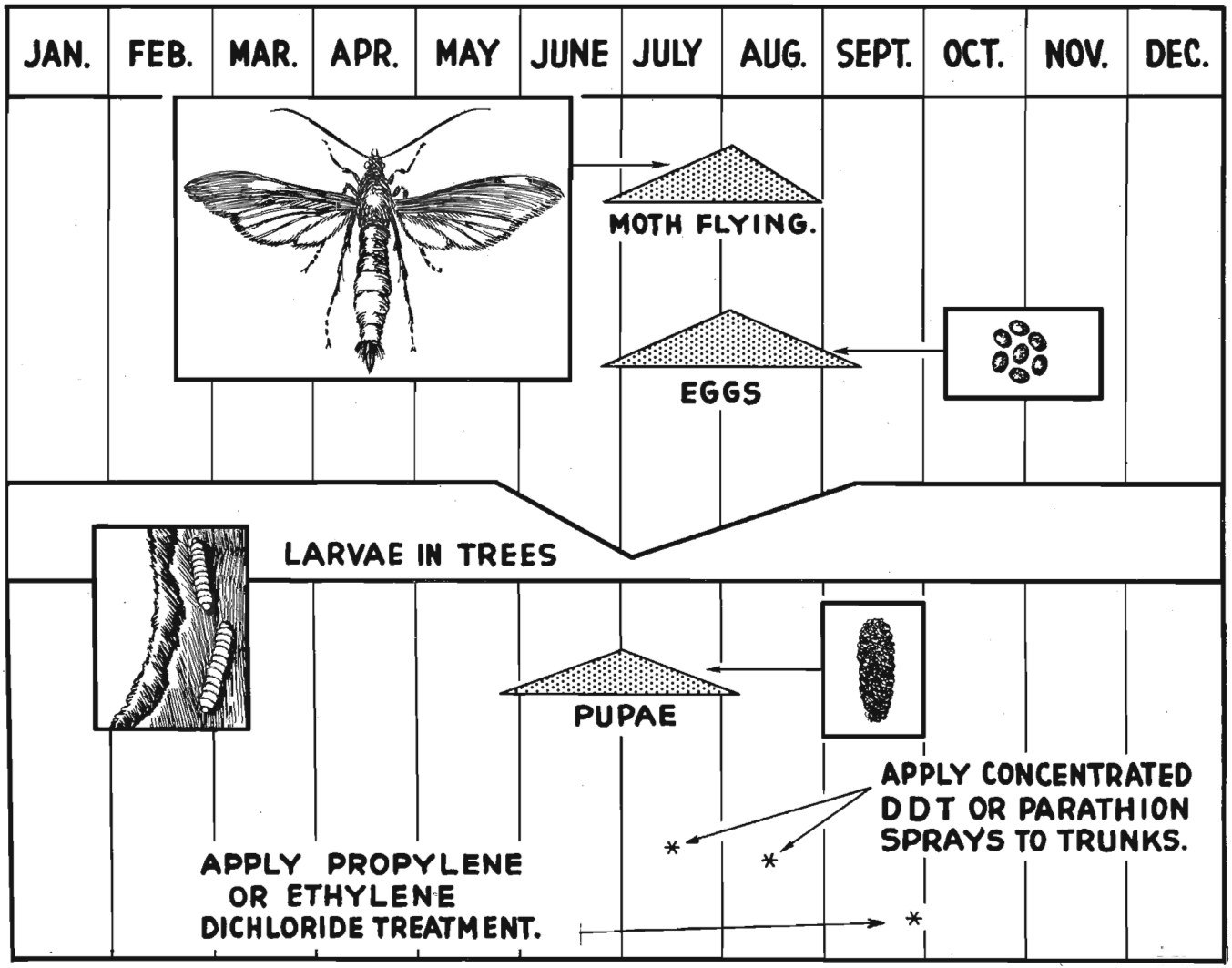

Figure 6. Western peach tree borer life history and treatment chart for the Milton-Freewater area.

the insects in rocky soils, many orchardists in desperation used ethylene or propylene dichloride emulsions for borer control before experiments with these materials could be performed in the Milton-Freewater area. Many growers obtained excellent results, but some experienced injury to their trees. This was especially the case where these materials were applied to young trees.

Ethylene and propylene dichloride as fall and spring treatments gave excellent control of the pest without injury to the trees (Table 3). It was found that either of these materials must be properly emulsified and diluted. Trees can be severely injured by using unstable emulsions or by using emulsions with improper agitation during application. Improper agitation may result in the emulsion "breaking" or "separating." This results in the application of pure ethylene or propylene dichloride on the trees and causes serious injury.

The grower may purchase commercial emulsified ethylene or propylene dichloride emulsion, but he should insist on properly emulsified materials. The following table shows emulsions that can be prepared by the grower with a minimum amount of effort and can be used with a reasonable degree of safety if certain precautions are taken :[1]

Age of trees	Strength of emulsion	Amount per tree
6 years and older..	25% emulsion—3 gallons of water plus 2 ounces of Tergitol 7, plus 1 gallon of either ethylene or propylene dichloride	One-half pint
4 to 5 years old	20% emulsion—4 gallons of water plus 2 ounces of Tergitol 7, plus 1 gallon of either ethylene or propylene dichloride	One-half pint
3 years old[1]	15% emulsion—5½ gallons of water plus 2 ounces of Tergitol 7, plus 1 gallon of either ethylene or propylene dichloride	One-half pint
2 years old	15% emulsion (same as for 3 years old)	One-fourth pint
1 year old	7½% emulsion—12½ gallons of water plus 2 ounces of Tergitol 7, plus 1 gallon of either ethylene or propylene dichloride	One-eighth pint

[1]It is not recommended that trees younger than four years old be treated with these materials; however, growers may wish to use this material, and suggestions for concentrations of emulsions for use on younger trees are given here.

Directions for Mixing. Measure out the required amount of water for the strength of the solution indicated for the age of the trees to be treated. Add Tergitol 7 to the water and stir constantly. Finally pour the measured amount of ethylene or propylene dichloride slowly in the water and stir thoroughly. Mix only one day's supply at a time.

Methods of Application. The material can be applied in the fall or in the spring after the ground begins to warm up. Ethylene and propylene dichloride were applied in experimental tests as follows: (1) Spray the emulsion on the tree trunk at eighty pounds pressure. (2) Pour the emulsion around and against the trunk of the tree at its base. (3) Pour the emulsion in a ring around the base of the tree and mound the tree trunk in a cone to avoid the escape of gas.

Effective control can be expected with either ethylene or propylene dichloride emulsion. The grower doing the treating should remember that the amount applied to each tree must be exactly that amount called for in this table.

Fall treatments, applied during September, are preferred, as spring treatments give the borers a chance to do more damage. Spring treatments should be applied during early April.

Conclusions

The peach and prune root borer is a very troublesome pest, attacking peach, prune, cherry, and other stone fruit trees in the Milton-Freewater area. The rocky condition of the soil has rendered the paradichlorobenzene crystal treatment ineffective as a control measure.

The use of ethylene or propylene dichloride has been very successful in controlling this pest, both in the Milton-Freewater area and other areas of the state. Stable emulsions, plus careful handling during application, are important factors in its success. It is important to consider the age of trees to be treated. Trees under four years of age can be killed or severely damaged with these materials.

The application of concentrated DDT or parathion for peach tree borer is the most promising and practical method of control. DDT and parathion controlled the borer equally well. The latter, however, is more expensive and dangerous to handle. Successive yearly applications are needed to control borers requiring two years to complete their life cycle. Annual applications to newly planted trees will keep infestations of trees eight years old and older at a minimum.