Control of Peach Twig Borer Subject of Continuing Research By University Entomologists

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Use of DDT is Experimental

The use of DDT on fruit trees has resulted in a rapid build-up of red spiders in many cases. This hazard should be considered a serious one.

DDT has certain advantages over basic lead arsenate when used against the peach twig borer but there is not sufficient data at present to recommend that DDT be entirely substituted for the basic lead arsenate.

If DDT is used in the control of the peach twig borer this season, it should be regarded as experimental.

Standard Recommendations

The standard recommendations which have proven to be the best over a period of years are given here:

Jacket spray. This spray should be applied immediately after the petals fall and is particularly desirable on apricots, plums, nectarines and peaches.

Basic lead of arsenate....3 to 4 lbs.
Spreader or sticker..⅓ lb, or 1 qt.
Water..............................100 gallons

If the basic lead arsenate is used with Bordeaux mixture or wettable sulfur, no spreader is necessary.

May spray. The time of application, from May 5th to 25th, varies from year to year. It is best correlated with the first wilted growing shoots especially on young trees. There may be as much as a month variation in successive years in the appearance of the first larval brood which causes the wilt injury and no average date for applying this first spray can be established beforehand.

Powdered spreaders should be used and so-called "deposit builders" or oils should be avoided in this spray.

Where mixed varieties of peaches occur, all trees must be sprayed. The jacket spray and the following May spray are necessary in peach growing districts where the twig borer is always a potential threat.

Use the basic lead arsenate at the same strength as in the first or jacket spray.

Mid-summer treatment. In the following treatments substitutes for the basic lead arsenate spray must be used to avoid poisonous residue. The 70-30 dust—70 per cent sulfur and 30 per cent lead arsenate—is widely used on peaches. On mature trees, 50 pounds per acre is necessary to get adequate protection.

On plums, spraying with rotenone powder—three to five pounds depending on the strength of the rotenone—or about six pounds of fixed nicotine—fused—powder of about a five per cent strength per 100 gallons of water may be used with very satisfactory results. Each variety must be sprayed as it ripens.

All of these fruits should be treated as soon as any small "stem worms" are observed on the first fruits to turn color.

Two Special Cases

Pre-bloom spray. In the Southern San Joaquin Valley, the twig borer caterpillars emerge from dormancy earlier than in other localities and best success has been had by applying the basic lead arsenate spray to the trees before bloom instead of the jacket stage. A sticker or "deposit builder" is very desirable to use at this time.

Dormant treatment. During the period 1940-42 experiments were made with a large number of spray formulae in the winter in an attempt to control the worms during hibernation. DDT and many other new materials were unavailable at that time and of the materials tested, the best formula was found to be:

Dinitro-o-cresylate
30%........................1½ to 2 quarts
(1:200 or 1:300)
or Dinitro powder....................1 lb.
Medium oil emulsion....2 to 3 gals.
(About 80 vis. and 80 U.R.)
Water ....100 gals.

This formula on prunes, plums, and almonds may be used especially where aphis eggs, scale, and brown almond mite infestations occur and dormant sprays are necessary, but should not be used on peaches and nectarines.

To obtain the best results apply after January 15th and up to the early green-bud stage.

Problems Still Unsolved

There is no satisfactory control known for the adult moths. Burlap and other types of banding for the larvae and pupae are not practical or effective on large trees.

Natural control by means of parasites is unpredictable, although in some seasons the parasites eliminate over 90 per cent of the caterpillars, chiefly during the winter.

Cultural methods, such as immediate burning of prunings, and destruction of fallen fruit in severe outbreaks have been tried but under normal conditions, it is questionable whether they aid in reducing local infestations.

Stanley F. Bailey is Associate Professor of Entomology and Associate Entomologist in the Experiment Station, Davis.

A detailed report giving more complete information concerning the parasites, the seasonal cycle, and experimental data on chemical control will be published as an Experiment Station Bulletin when completed. An announcement of its publication will be made at that time.

Peach Twig Borer

The peach twig borer is an annual pest on peaches, nectarines, plums, apricots, and almonds and, like many pests, causes irregular but severe outbreaks.

It derives its common name "twig borer" from its habit of burrowing into the terminal shoots of green twigs of its host plants in the spring and early summer.

Permanent injury is not serious except on young trees which are sometimes badly deformed if no control measures are followed. Later in the season the worms attack the ripening fruit causing considerable loss, especially in the Northern San Joaquin and Sacramento valleys.

Hibernation of the minute larvae occurs on the trees in a cell beneath the surface of the bark, particularly in the crotches of the two-year-old wood, where they remain dormant from October to the following March.

Feeding activity starts about the time the buds begin to swell and a gradual migration takes place to the growing points during March. Emergence begins a week or two earlier in the central and southern portions of the San Joaquin Valley.

After maturing, the caterpillars, which are chocolate-colored and about one-fourth inch in length, migrate downward to the rough bark of the tree trunk and to the litter beneath the tree. In these places the worms pupate and transform to the adult stage.

The small, grey, inconspicuous moths rest on the undersides of the large limbs and lay their eggs on the young leaves and fruit.

The four principal broods or larval feeding periods are normally: (1) March, (2) May 5-25, (3) July 1-20, and (4) an irregular over-lapping brood extending from about August 15 to September 15.

With each successive brood there is a greater increase in number and more over-lapping of the different stages in the life cycle of the insect. These conditions make control increasing difficult.

Control Of Insect Pests By Means Of Disease Agents

Edward A. Steinhaus

Biological warfare against certain insect pests by means of disease agents is a relatively unexplored method of insect control.

That insects may suffer from disease just as do human beings has long been known, and today it is hoped that agriculture may profit by this fact.

In the past, most of the attempts to use microorganisms to control insect outbreaks have met with little success due largely to a lack of information concerning the way in which disease-producing organisms infect insects and cause epidemics among them. Some attempts to use this means of control have been very successful. An example of the latter is the use of the so-called "milky diseases" to aid in the control of the Japanese beetle in northeastern United States.

Investigations Undertaken

In an effort to investigate the fundamental factors involved in the diseases which afflict insects, to develop methods by which such diseases may be used in the control of insects, and to make these methods available to California agriculture, the College of Agriculture and the Experiment Station at the University of California have undertaken several projects to investigate the possibilities offered. For this purpose a laboratory of insect pathology has been established on the Berkeley campus as part of the Division of Biological Control.

A great deal of fundamental biological work will have to precede the actual field use of microbial methods of control, but there is justification for hope that once such relatively inexpensive methods are perfected they will serve to benefit the farmers of the state immensely.

Several types of microorganisms are being investigated as to their potential control capabilities. These include bacteria, fungi, viruses, and protoza. Epidemics caused by these microorganisms occur frequently among insects in nature. Such diseases are very destructive to insects but are harmless to man, animals and plants. These epidemics are frequently of paramount importance in saving the crops from destructive insects. Natural outbreaks of disease often occur rather late in the season after the insects have already wrought considerable damage. One objective of the studies underway is to devise means by which the diseases may be prompted to bring about their beneficial effects earlier in the season.

Epidemics Studied

One of the most spectacular of these natural epidemics in California is the so-called "wilt" disease which destroys the caterpillars of the alfalfa butterfly.

The affected caterpillars become sluggish in movement, lose their appetites and soon die, frequently hanging from their food plant as dark, limp, fragil larvae. When handled or picked up their skin almost invariably breaks open, liberating a characteristic fluid consisting of the liquefied body contents of the insect.

This disease is caused by a submicroscopic virus which spreads rapidly among the insects when the optimun conditions for its development prevail. Current investigations are concerned with the nature of these factors and with means of propagating the virus in large quantities for field distribution.

Similar virus diseases occur in the yellow-striped armyworm and in the larvae of the California oak moth, both of which are also being studied by the University.

The possibility of combatting the insects named in the preceding paragraph by means of certain protozoan diseases is also being investigated. The protozoa concerned are of the group known as microsporidia, and it is hoped that the proper distribution of the spores of these organisms may, under the right conditions, enable infection of the insects to take place on such a large scale that the insect population will be substantially reduced.

Experiments Under Way

Experiments are under way to find microbial agents which will infect insect pests other than those mentioned such as certain species of citrus scale insects.

Although the potentialities of the microbial method of control are great, much fundamental research followed by extensive field trials, will be necessary before a true picture of its practical possibilities can be had. The successful use of such methods depends on the development of procedures for the proper handling and distribution of the disease producing organisms under conditions which will promote their effectiveness against the insect pests susceptible to them.

Edward A. Steinhaus is Assistant Professor of Bacteriology and Assistant Insect Pathologist in the Experiment Station.

Unnecessary Irrigation Added Expense In Prune Production Shown By 13-year Investigation

(Continued from page 1)

able moisture at all times, and for considerable periods, the amount was relatively high in the available range.

The **B** treatments were reduced to about the permanent wilting percentage several times each year, ranging in length from a few days to several weeks during the harvest period.

The **C** treatment, while kept moist in the early part of the season, was reduced to the permanent wilting percentage and remained there for several months in the latter part of the season.

Thus, by way of contrast, the **B** treatment reached the permanent wilting percentage several times for short periods each year. The **C** treatment reached this moisture content and remained there for a long period.

Growth of Trees

The growth of trees as indicated by the average cross-section areas of the trunks was recorded. For two years the differential irrigation treatment had comparatively little effect on the growth of the trees. Thereafter the trees in the **A** treatment were the largest, with those in **B** and **C** in that order.

The slopes of the recorded growth curves indicated that the **A** treatment slowly increased its size over the **B**, while both **A** and **B** increased over **C** somewhat more rapidly. The short periods the trees in treatment **B** were without readily available moisture probably resulted in smaller trees than in treatment **A**.

The tendency for alternate bearing was indicated by the rapid or slow increase in the cross-section area, particularly during the past five or six years.

The trees under treatment **A** are somewhat larger than those in **B**, as measured by the cross-section areas, but the tops of the trees do not show so much difference in size.

Amounts of Water, Costs and Yields of Prunes During a 13-Year Period
Costs Figured on 1945 Basis

1	2	3	4	5	6	7	8
Treatment	Av. no. of irrigations per year	Total Amt. Water in Acre Inches	Av. Amt. Per acre Per year	Av. Amt. per Irrigation, Acre Inches	Total Wt. Dried Fruit in Tons	Total Cost of Irrigation	Total Income
A	4.5	445	34.2	7.5	46.9	$818.80	$7504
B	3.1	315	24.2	7.9	46.6	579.60	7456
C	2.2	220	16.9	7.6	41.0	404.80	6560

Column 2 gives the average number of irrigations necessary to maintain the soil moisture. Columns 3, 4, and 5 give the total amounts of water applied, the average yearly amounts, and the average amount for each irrigation in acre inches per acre. Column 6 gives the average cumulative yields of the dried fruit. The total cost of preparing the land for irrigating, water, and the application of water are given in column 7. The last column gives the gross returns per acre for the 13-year period.

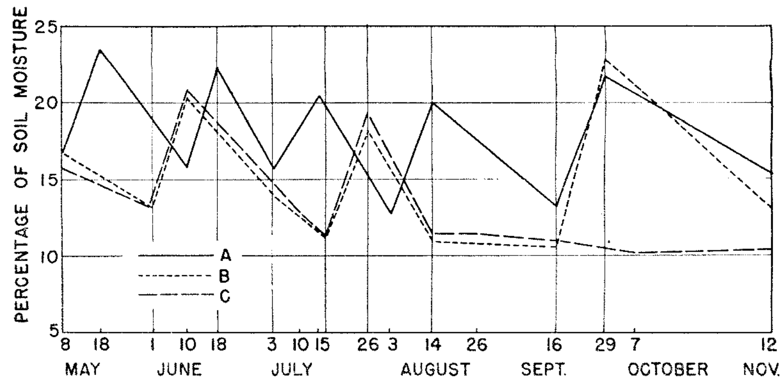
Yields

The average cumulative yields, in tons per acre of fresh fruit, indicated that treatments **A** and **B** yielded approximately equal crops. All treatments produced substantially equal yields for six years after differential irrigation treatments began.

In 1939 the yield from treatment **C** fell below those of **A** and **B**, and it has remained there since that time.

The quality of the dried product, as measured by specific gravities, and drying ratios, was essentially equal for all three treatments.

In sizes, treatment **C**, in addition to producing less fruit than the other two, produced a slightly smaller proportion of large sizes and a larger proportion of small prunes than either **A** or **B**.



Soil-moisture contents of the top three feet in the orchard during a typical season.

Treatment **A** returned $48 more per acre than treatment **B**, but it cost $239.20 more to irrigate this treatment, showing that the extra water and labor were not profitable. In a similar way treatment **B** returned $896 more than **C**, while additional expense for irrigating was only $174.80.

Conclusions

The only advantage gained by the trees in treatment **A** was a slight increase in size of tree as measured by the cross-section areas. Ordinarily the larger trees would be expected to produce the larger crops. This was not true during the 13-year period.

The sizes of fruit in the **A** treatment were not materially increased. This treatment produced about six per cent more large fruit and about the same percentage less small fruit than the **B** treatment. The difference in sizes is not enough to compen-

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HAROLD ELLIS..............................Director, Agricultural Information
W. G. WILDE..Editor

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