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CONTROL of PEACH INSECTS

By
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A. DE CAPRIO

THE CONNECTICUT AGRICULTURAL
EXPERIMENT STATION

NEW HAVEN CONNECTICUT

CONTROL

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The Connecticut Agricultural
Experiment Station
New Haven

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by Philip Garman, W. T. Brigham and A. de Caprio

INTRODUCTION

Control of peach insects has in general become much easier during the past decade. Up to 1941 or 1942, the only usable insecticide for leaf-eating and fruit-infesting insects was arsenate of lead. Continued use of arsenate of lead in this climate, however, resulted in ever-increasing bark and leaf injury so that the life of the peach tree was shortened and the quality of the fruit impaired. Parasites were used for fruit moth control in the 1930's. While satisfactory in some years, control with parasites tended to be erratic and allowed more damage from the fruit moth than was consistent with good peach culture.

Beginning with the discovery of DDT, conditions began to change. DDT was of considerable help in control of the Oriental fruit moth but proved unsatisfactory for curculio. Also, its use increased the populations of various mites. Methoxychlor and chlordane proved effective enough against curculio so that for the first time it was not necessary to use arsenate of lead. Parathion and related phosphates have given relief from most insects that infest Connecticut peach orchards, and still other organic insecticides and miticides are on the way.

With the newer insecticides, however, all is not clear sailing. Off-flavor has been produced occasionally, insects may become resistant to the insecticides, and the problem of objectionable residues is not yet completely solved. The phosphates disappear rapidly from fruit and foliage after spraying, but are so toxic to the spray crew that some orchardists refuse to use them. All these problems are undergoing intensive research in industry and agriculture so that whatever spray materials we suggest may be superseded in the near future by others of better properties.

A trend towards simplification is to be seen in the production of "all-purpose" mixes designed for use by home owners or in small orchards. Some, but not all of these, are suitable for peaches, plums and cherries, as well as apples, pears, grapes and quinces. They represent a distinct advance in spray mixtures since they contain both insecticide and fungicide, packaged in a single container.

In this publication, as in Bulletin 552 on apple insects, as much life history and seasonal data is included as could be obtained. Thorough perusal of the literature on peach insects has enabled us to collect many scattered facts with respect to the activities of the different pests. These should be helpful in deciding how to control them. Results of our tests to control each insect will be found in the text. In addition, a pictorial chart with dates of spray applications (page 56) brings all of this information together in abbreviated form for quick reference.

PLUM CURCULIO

Conotrachelus nenuphar (Hbst.)

Description

The eggs are ovoid, and laid in semicircular slits. The larva has a brown head and legless abdomen, which is white to yellowish in color. The adult is a small brown snout beetle with two humps or elevations.

Damage

Feeding of adult curculios leaves punctures in the immature fruit. Eggs are laid in crescent-shaped cuts in the young peach, and the larvae feed within. Unless controlled, severe infestations may destroy the crop.

Life History

There is only one generation a year in Connecticut. Beetles pass the winter in or near the orchard, emerge near bloom, and remain for a month or six weeks, feeding and laying eggs as the fruit reaches proper size. Maximum activity occurs just after the shucks push off the young peach. After completing development in the fruit, the larvae emerge, drop to the ground and pupate near the surface.

Factors Affecting Abundance

Temperatures influence curculio activity greatly, first in bringing beetles from hibernation and second in promoting egg laying. Mean temperatures above 70° F. or maximum temperatures of 75° F. or above over a considerable length of time, will produce severe damage from curculios.

Woodlands or stone fences near an orchard provide ideal hibernating quarters.

Predators and Parasites

About 16 in all are known to occur in North America. At least 12 of these have been found in Connecticut, including the important species, *Triaspis curculionis* F. and *Anaphoidea conotracheli* G. In addition to parasites, ants, ground beetles, lacewing flies, thrips, birds and moles destroy curculios.

Control Measures

Older methods for peaches included jarring the trees, cultivation to destroy larvae and pupae in the soil, spraying with lead arsenate, and burning over woodland and fence rows to destroy hibernating beetles.

Recently, sprays of parathion, chlordane and methoxychlor have proven more effective than arsenate of lead and less injurious to the tree. Aldrin and dieldrin have also been used successfully. Dieldrin appears to be fully as efficient as parathion, chlordane or methoxychlor. Benzene hexachloride has been tried, but the orginal sprays made with this chemical impaired flavor in the canned product, and benzene hexachloride is now seldom used in Connecticut. Both DDT and DDD (TDE) are ineffective.

In our tests, excellent control has resulted from the use of methoxychlor, 3 pounds to 100 gallons, applied as the shucks push off and repeated 10 and 20 days later. If the season is very warm and there is much rain, these may be repeated 7, 14 and 21 days later. Parathion 15 per cent, 1 to 2 pounds to 100 gallons, was also used on essentially the same schedule.

Tables 1 and 2 give some of our results.

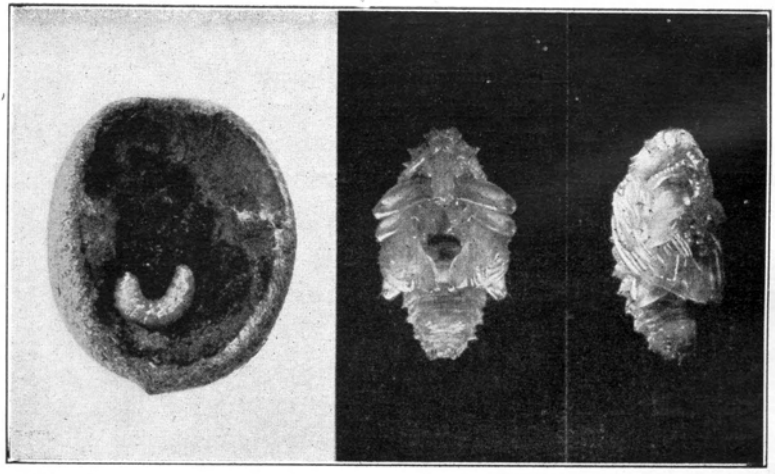

Figure 1. Curculio larva in peach (left) and curculio pupae (right).

TABLE 1.

Curculio Control. Mount Carmel. 1951.

Treatment	Chemicals	Beetles per tree (sum of 3 counts)	Drops per cent curculio	Tinned per cent curculio	Harvested	
					per cent curculio	per cent fruit moth
1	Fungicide only	15	45.2	14.8	8.9	50.6
2	Methoxychlor	2	4.8	.47	5.1	20.7
3	Aldrin	2	8.1	1.8	3.5	53.8
4	Chlordane, DDT	2	4.1	1.4	5.0	9.7
5	Malathion	2	21.1	4.9	13.8	27.6

PEACHES—SCHEDULE OF TREATMENTS

1. Sulfur 5 lbs. to 100 gallons—May 15, 25.
   Ziram *(Zerlate)* 1½ lbs. to 100—June 12, 28; July 11, 27.

2. Same fungicides as No. 1.
   Methoxychlor *(Marlate)* 3 lbs. to 100, May 15, 25; June 12, 28; July 11, 27.

3. Same fungicides as No. 1.
   Aldrin 1½ lbs. to 100—May 15, 25; June 12, 28; July 11, 27.

4. Same fungicides as No. 1.
   Chlordane 3 lbs. to 100—May 15, 25; June 12.
   DDT June 28; July 11, 27.

5. Same fungicides as No. 1.
   Malathion 2 lbs. to 100—May 15, 25; June 12, 28; July 11, 27.

TABLE 2.

Curculio Control On Peaches and Amount of Brown Rot Following Control of Oriental Fruit Moth. Mount Carmel. 1948.

Treatment	Curculio beetles per tree	Early drops per tree	Per cent curculio			Per cent brown rot	
			Drops	Thinned	Harvested	DDT or parathion for Oriental fruit moth	Parasite treated[1]
Parathion 1 to 1½ lbs. Sulfur paste 8 lbs.—100 gals.	.6	30	10.8	10.85	15.34	4.00 (Parathion)	....
Chlordane 2 lbs. (50%) Sulfur paste 8 lbs.—100 gals.	.5	274	64.4	13.34	24.19	5.94 (DDT)	22.02
Toxaphene 3 lbs. (25%) Sulfur paste 8 lbs.—100 gals.	3.0	320	88.3	6.90	19.10	1.63 (DDT)	18.24
Benzene hexachloride[2] 2 lbs. (12% gamma) Sulfur paste 8 lbs.—100 gals.	7.7	45	28.7	21.12	28.41	9.50 (DDT)	13.48
Basic lead arsenate 4 lbs. Lime 4 lbs. Sulfur paste 8 lbs.—100 gals.	8.6	193	81.8	2.04	27.55	4.23 (DDT)	2.67
Lime 6 lbs. Sulfur paste 8 lbs.—100 gals.	8.3	241	83.8	20.64	40.28	0.48 (DDT)	49.35

[1] No midsummer fungicide or insecticide.

[2] Partially deodorized—from gamma isomer.

Spray dates: For curculio—June 1, 11, and 20; for Oriental fruit moth—July 6 and 20, and August 3. Application at 500-600 lbs. pressure broom and single shade tree gun—all from tank.

NOTE: No foliage or fruit injury from parathion, chlordane, benzene hexachloride, or toxaphene.

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ORIENTAL FRUIT MOTH

Grapholitha molesta (Busck)

Description

The larva is white to pink (sometimes greenish) with a black head, pink when mature. The moth is small (about 1/4 inch long), and black with inconspicuous streaks along the wing margins. Moths are rarely seen except in storages or in bait pails. The egg is flat, white and delicately sculptured, and is laid on the underside of leaves or occasionally on new growth of twigs.

Damage

Damage (wormy or injured fruit) may vary from less than 5 per cent to more than 90 per cent of the crop. Worminess is not always apparent from external examination. Early fruit infestation results in unsightly scars which exude gum and make the mature peach practically worthless. Damage to the twigs by the first or second generation is not usually serious except that it tends to produce a bushy tree instead of one of normal growth.

Life History

The larvae pass the winter in small cocoons beneath bark scales or on the ground. Pupation takes place in late spring and the moths are on the wing about June 1. Normally it requires about one month to complete a generation so that the second flight of moths occurs in early July, the third in August. If the season is warm, a partial fourth may appear in September (Figure 8). No definite cycles of abundance have developed, but our observations between 1930 and 1951 indicate a trend towards an approximate 10-year cycle. Years of unusual abundance were 1929, 1937-1938 and 1951.

Factors Affecting Abundance

Hot humid weather, heavy fertilization or abundant rain, all of which promote rank twig growth, are favorable to the fruit moth. If the twigs begin to harden before the second generation completes larval development, many larvae cannot mature and the third and fourth generations may be small. Likewise, if temperatures reach 60° F. or below during July, many larvae go into hibernation which also results in

a smaller third generation. Cool sundown temperatures (below 70° F.) during August may cut down the size of the brood still more because fewer eggs are laid.

The effect of sprays such as DDT or other chlorinated compounds on parasites has not been fully determined, but it is known that many parasites survive these treatments, as shown in Table 3.

Since sprays are required late in the season to control this pest, it is necessary to avoid insecticides that leave a residue toxic to humans. Parathion or the related phosphates are apparently unobjectionable since they are rapidly dissipated.

Predators and Parasites

There are many native parasites and a large number of new ones were introduced in the 1930's and early 1940's. The Experiment Station liberated in Connecticut nearly 2 million *Trichogramma* sp., 326,000 *Macrocentrus ancylivorus* Roh., 14,000 *Ascogaster* sp., 82,000 *Bassus diversus* Meus., 188,000 *Dioctes* sp. (now *Inareolata*) and 17,000 *Orgilus* species. Many of these were supplied by the Bureau of Entomology and Plant Quarantine of the U. S. Department of Agriculture. In addition, a fair number of other species were also liberated. (In this connection refer to Allen, Holloway and Haeussler, 1940). The most effective parasite to date has been *Macrocentrus ancylivorus*, which strangely enough survives treatments with DDT and may be becoming resistant. *Glypta rufiscutellaris* Cress. and *Trichogramma minutum* Riley have been important, but it is not known how well they will survive treatment with the insecticides now in use.

The trend of parasitism (prior to 1950) during the years of widest fluctuation seemed to follow the trend of moth population or degree of infestation as shown in Figure 8.

Of the parasites introduced from abroad, only *Bassus diversus* appears to have become established (Allen and Yetter, 1949).

Control Measures

From introduction of the fruit moth about 1920 until the discovery of DDT, there were no very effective spray controls. From 1930 to 1942, the growers depended on *Macrocentrus* or other parasites, whose production and liberation were sponsored jointly by the Connecticut Pomological Society and the Experiment Station. In 1948, sprays were

finally determined to be more efficient than parasite liberations (Table 4) and further distribution of parasites was abandoned. To date, DDT or parathion have given the best control in our experiments. From experiments in this and other states, it looks as if EPN were also quite efficient. Chlordane and aldrin seem to have little effect. Methoxychlor provides partial control, as indicated by our 1951 experiments. It gave very poor results in 1952.

Parathion kills the moths as shown in bait pail catches given in Table 3. In this respect it is superior to DDT and makes it possible to so reduce fruit moth populations by early season sprays that they do not recover during the current year.

DDT plus a miticide used during June, July and early August gives good control; if sprays are needed later than August 1, methoxychlor may be used. In the early season, methoxychlor has controlled curculio and may be combined with DDT or chlordane-DDT mixtures for the fruit moth. For those prepared to use parathion, this insecticide may be more effective than any other. In midseason, DDT, 2 pounds 50 per cent to 100 gallons (plus miticide), or 1½ pounds 15 per cent parathion to 100 gallons has given good results.

Timing has been very important in application of sprays to control the fruit moth. Use of bait pails and counts of moths caught have been used to determine when sprays are needed (see reference to W. T. Brigham, p. 17).

TABLE 3.

Oriental Fruit Moth Control. Mount Carmel. 1948. Collection Summary.

Treatment	Moth collection in bait pails Av. per pail				No. eggs collected in one hour on:								No. larvae collected on:		Per cent parasitism of larvae collected on:		Per cent clean fruit at harvest
	June	July	Aug.	Sept.	June 1	July		August				Sept. 11	July		July		
						8	15	4	14	18	26		23	30	23	30	
DDT	4.3	20.6	3.1	3.0	0	4	1	0	0	1	8	12	16	2	37	50	93.7
Parasites	2.6	26.6	7.2	7.5	12	6	3	24	4	3	8	28	43	10	82	60	80.3
Parathion	3.0	6.0	.5	8.7	0	0	0	0	0	0	6	4	14	1	57	0	96.8

TABLE 4.

Oriental Fruit Moth Control On Elberta Peaches. Mount Carmel. 1948.

Treatment	Total fruits per tree	Per cent infested
DDT sprays		
July 6, 20, Aug. 3	600-800	3.70
DDT (50%) 2 lbs.	400-600	7.20
Ziram 2 lbs.	200-400	6.46
water 100 gals.	100-200	8.00
	below 100	20.00
Parathion sprays		
July 6, 20, Aug. 3	600-800	3.60
Parathion (25%) 1 lb.	400-600	3.67
Ziram 2 lbs.	200-400	4.23
water 100 gals.		
Parasite liberations		
July 12, 23, 28, 30	600-800	17.84
3000 males, 3000 females	400-600	15.97
	200-400	23.70
	100-200	24.81
	below 100	53.43

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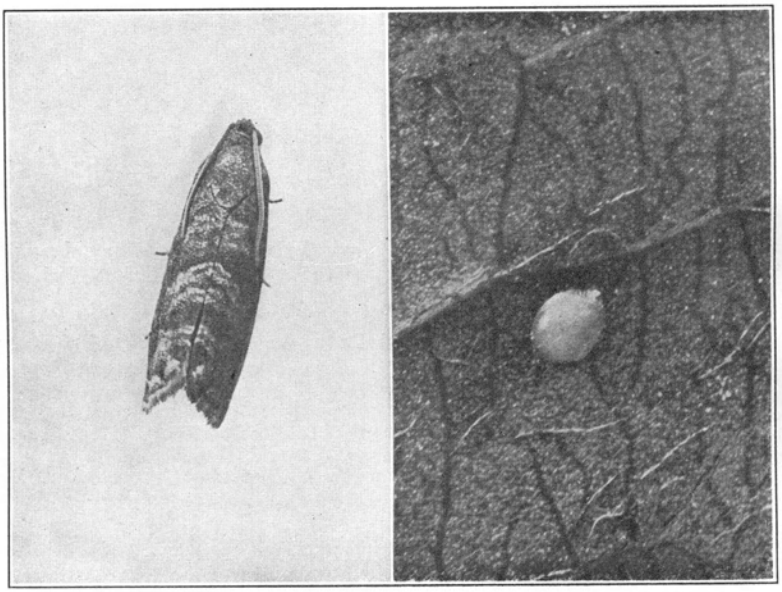

Figure 2. Left, adult Oriental fruit moth, enlarged six times; right, egg, enlarged eighteen times.

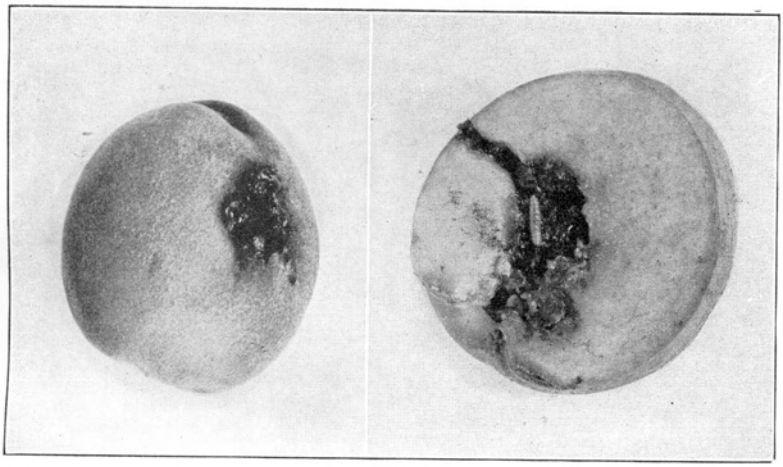

Figure 3. Left, peach with nearly full grown larva of Oriental fruit moth; right, exterior marks of infestation.

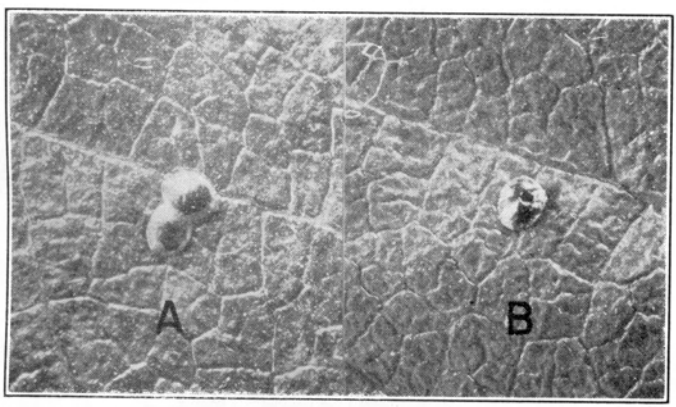

Figure 4. Left, eggs of Oriental fruit moth parasitized by *Trichogramma;* right, egg from which parasite has emerged.

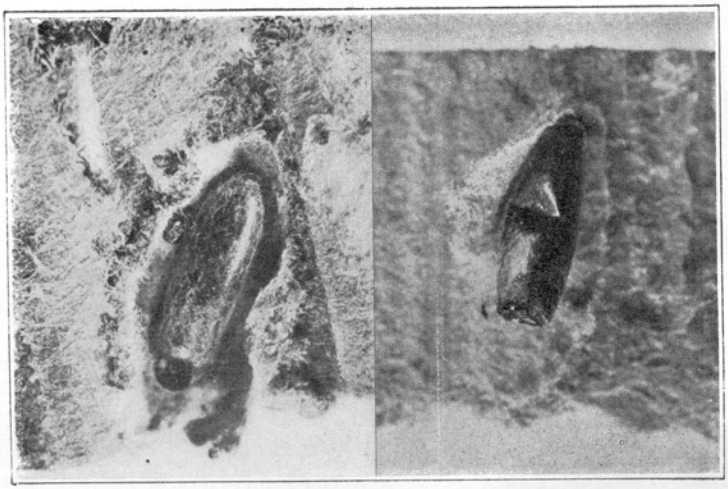

Figure 5. Cocoons of *Macrocentrus ancylivora* Rohwer.

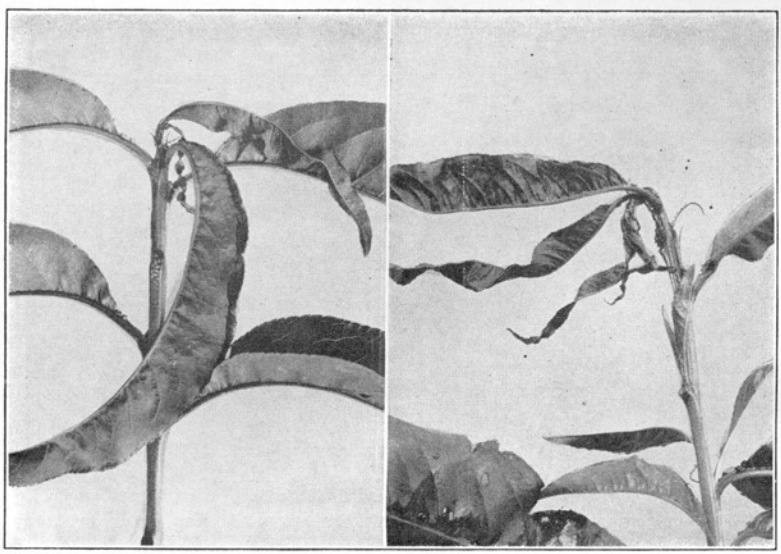

Figure 6. Twig injury by Oriental fruit moth.

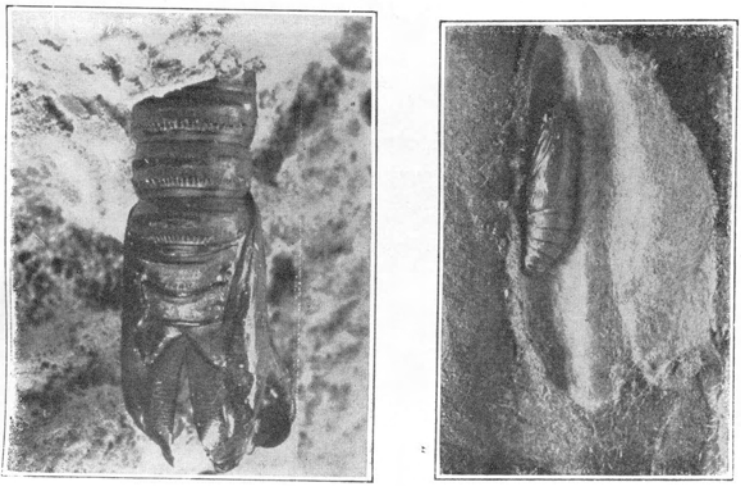

Figure 7. Left, Oriental fruit moth, pupa in cocoon under bark, enlarged four times; right, protruding pupal skin from which adult has emerged, enlarged ten times.

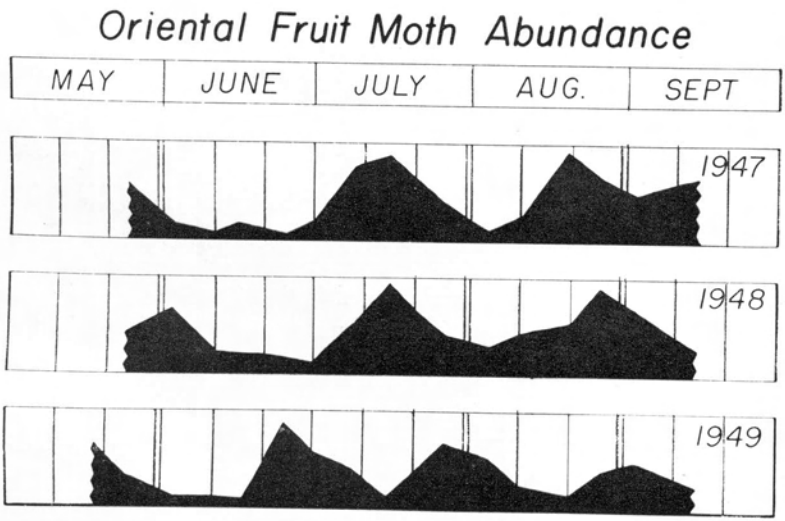

Figure 8. Chart showing Oriental fruit moth abundance in Connecticut.

PLUM LEAFHOPPER

Macropsis trimaculata (Fitch)

Description

This is a small blunt-nosed inconspicuous leafhopper, usually brown with three lighter spots in a row along each side. The total length is about 1/6 inch.

Damage

While these leafhoppers occur mostly on plums, they are important to peach growers because they transmit peach yellows and little peach and may cause severe losses wherever peaches are within their flight range. Thus, in spite of their general scarcity on peaches, they may be considered as one of the more important enemies.

Life History

Winter is passed in the egg stage and hatching takes place in late May or early June. Nymphs are present on plums in the vicinity of Yonkers, New York (Hartzel, 1937), from the last of May until the last of June. Adults appear about June 15 and may be found until slightly after August 15. Eggs are laid, beginning about June 15, and remain in the twigs over winter. These dates may be slightly early for Connecticut. The critical period for peaches in Connecticut would seem to be when adults are active and moving from plum to peach or from about June 15 until after the middle of August.

Factors Affecting Abundance

Nearness of plums to the peach orchard is the most important factor. It suggests the inadvisability of mixing plums and peaches or planting the two near one another.

Predators and Parasites

No parasites or enemies are known.

Control Measures

Removal of wild plums within a mile has been suggested (Manns, 1942). Spraying of peaches and plums with DDT, parathion or some

other suitable contact spray should be beneficial. Every effort should be made to eliminate the plum leafhopper from commercial orchards.

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Factors Affecting Abundance

Damp weather is said to decrease the number of tarnished plant bugs. The type of weeds may be important. Reports from other states indicate that tarnished plant bugs prefer sweet clover, or weeds of the composite family, such as daisy fleabane. Venables and Waddell (1943) observed that white Dutch clover provided a better cover (attracted fewer plant bugs) than red clover or alfalfa.

Predators and Parasites

Very little is known of the predators or parasites.

Control Measures

Until recently, chemical controls generally failed to give relief. The chief reliance was upon sanitary measures and removal of weeds in the vicinity, as well as treatment of nearby oaks and hickories and removal of the latter when possible. Sprays or dusts of nicotine, pyrethrum and sulfur, or combinations, were found useful in some localities. Modern insecticides have made control of this insect much easier. Applied at the rate of 2 pounds to 100 gallons, 50 per cent DDT has given control. This spray is usually applied about the time petals fall[1] and repeated June 10 to 15. Parathion, applied on the same schedule, has also given good results. The usual rate is 1½ pounds 15 per cent parathion to 100 gallons. The value of methoxychlor and chlordane is not yet fully established, but these materials have been promising for control of the tarnished plant bug on vegetables.

Destruction of weeds by mowing helps reduce the number of plant bugs. However, if weeds are allowed to grow, they should not be cut just prior to peach harvest, since this forces the plant bugs to seek food elsewhere, and damage to the fruit may result. Oaks or hickories within 200 yards of the peach orchard may be removed, or sprayed once about June 1.

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[1] Some authorities suggest full bloom applications, but until the problem of control becomes more acute in Connecticut than it is now, application at that time would be unwise.

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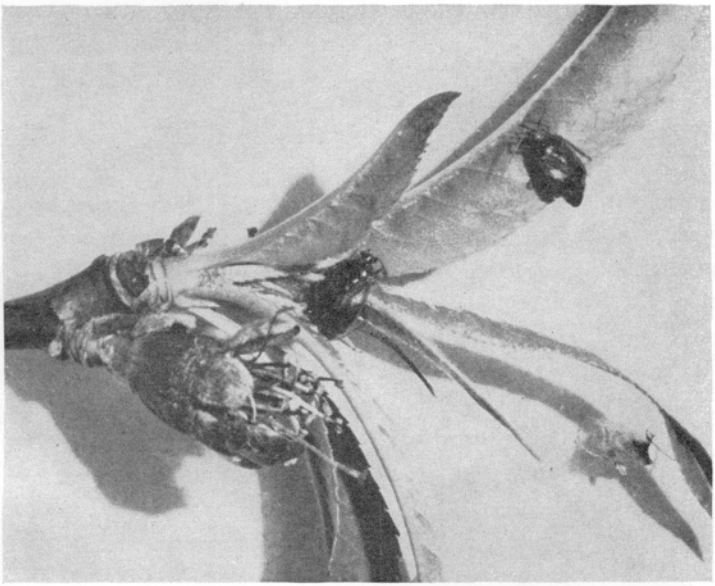

Figure 9. Tarnished plant bug. Mature bugs on peach shoot; petal fall period.

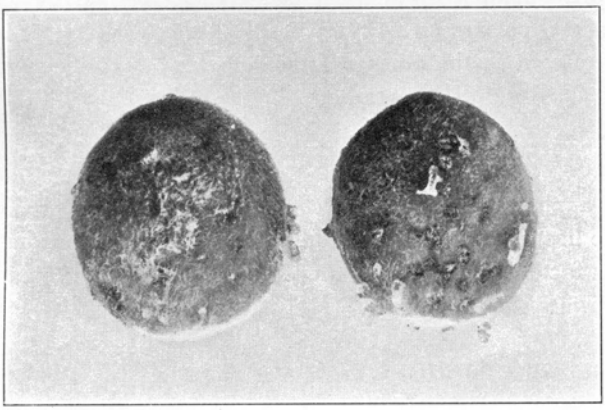

Figure 10. Peaches injured by oak plant bugs, natural size.

PEACH TREE BORER

Sanninoidea exitiosa (Say)

Description

The larva is a creamy to yellowish borer with a brown head. The adult female is a clear-winged moth (front wings are cloudy), having a black abdomen with a bright orange band. Larvae of these insects work at ground level and may usually be detected by masses of gum coming from the bark, frequently containing conspicuous "sawdust" excrement of the borer.

Damage

The damage is severe unless controlled, and whole orchards may be killed outright. Partial girdling lowers production and impairs fruit quality. It is of utmost importance to control the peach borer in Connecticut orchards.

Life History

This is a one-generation insect, passing the winter as a mature larva at or below the ground level. Eggs are laid in August or September and the young enter trees through cracks in the bark and remain in their galleries over winter. They continue to feed in the spring until June, when pupation occurs. The larva leaves its burrow just before pupation and constructs a brown or blackish cocoon at ground level. Adults are seen in the orchard from late June until September. Eggs are laid shortly after emergence.

Factors Affecting Abundance

Weather apparently does not affect the peach tree borer in Connecticut. Alternate host trees such as wild black cherry in the immediate vicinity may be a factor. Also, any abandoned peach planting near a producing orchard is a serious menace.

Predators and Parasites

About 10 parasites of the peach tree borer are known in North America. So far none of them appears too important. Peairs in 1941 mentioned *Microbracon sanninoidea* Gahan and the egg parasite *Telenomus quaintancei* Girault.

Control Measures

Older methods consisted mostly of worming by hand in spring and fall, or treatment with paradichlorobenzene, ethylene dichloride emulsion or propylene dichloride emulsion. The latter method consists of levelling the soil around each tree; removing gum, sticks, sod, and stone; applying a definite amount of the chemical, and hilling up with loose soil to a height of about six inches. With paradichlorobenzene, a ring of crystals about one inch wide and about one inch from the trunk is made on the levelled soil before hilling. A full grown tree requires one ounce, smaller trees proportionately less. When ethylene dichloride or propylene dichloride is used, the emulsion is poured on the trunk around the base after levelling, the same as for paradichlorobenzene. Hilling is done as before. Treatments are usually made during the first part of September in Connecticut and the hills are frequently left over winter, then removed in spring. Manufacturer's recommendations should be followed for doses of ethylene and propylene dichlorides.

Recently, sprays of DDT or parathion applied to the trunk during July or August have been found effective. These may be applied during one or more of the regular sprays and require much less labor than hand worming or the hilling method. Furthermore, they kill the larvae before any damage is done. Dosages for 50 per cent DDT are the same as required for regular sprays or, if the infestation is severe, up to 4 pounds per 100 gallons may be used—preferably as a separate spray directed at the trunk with a single gun. Use of parathion in a complete schedule probably will eliminate the moths before egg-laying begins and observations in commercial orchards indicate that very little trouble is being experienced wherever parathion is so used.

For the home orchard, the simplest method is to throw a handful of 5 or 10 per cent DDT dust around the base of the tree on trunk and ground.

In commercial orchards, the trunks at ground level to about 1 foot above may be treated with 10 per cent DDT dust or a spray of 50 per cent wettable powder diluted 4 pounds to 100 gallons. Parathion spray may be used in the same manner diluting 1½ pounds 15 per cent powder to 100 gallons. Treatment has been necessary about July 1, August 1 and September 1.

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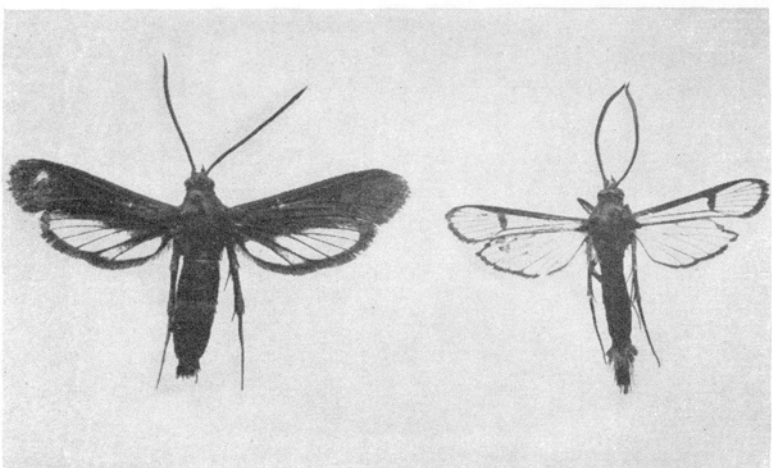

Figure 11. Peach tree borer moths. Left, female; right, male.

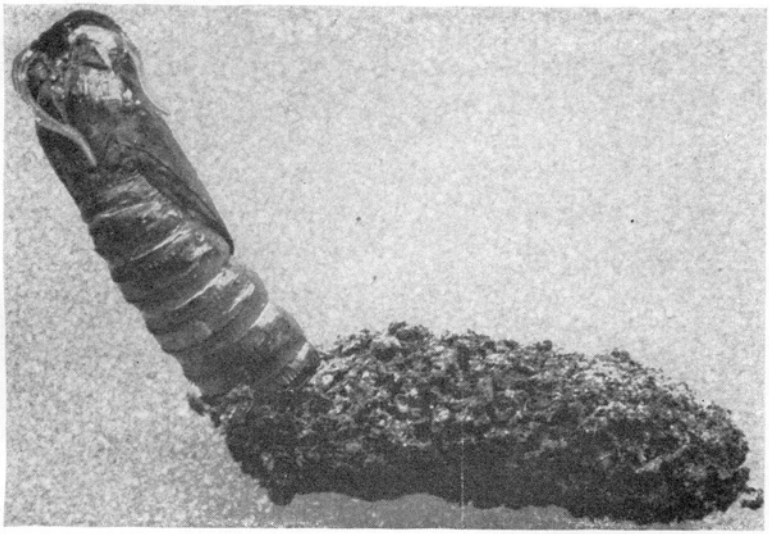

Figure 12. Peach tree borer cocoon and protruding pupa case.

Figure 13. Peach tree borer damage at base of tree.

Of the newer sprays, only parathion has given favorable results. Three or four applications may be needed in a season, according to Smith (1950). The dilution has been 1½ pounds 15 per cent wettable powder to 100 gallons, applied about mid-June and repeated July 1 and 15. Necessary cuts may be painted with a protectant, such as asphalt paint, or white lead and linseed oil without turpentine. Asphalt paints with naphtha light fraction solvents may injure the bark. Most satisfactory are asphalt paints which can be diluted with water and contain no solvents.

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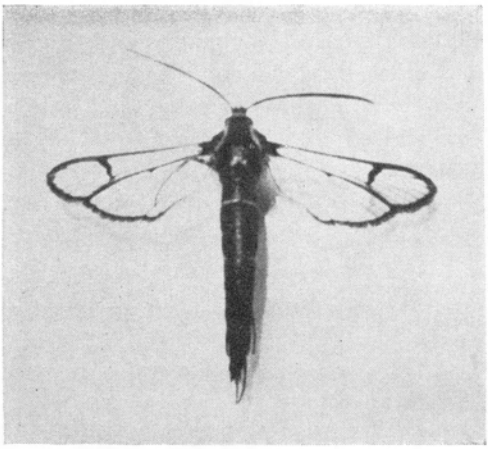

Figure 14. Lesser peach tree borer, female moth.

Figure 15. Lesser peach tree borer injury with larva exposed.

SHOT-HOLE BORER[1]

Scolytus rugulosus (Ratz.)

Description

The larva is a small white grub with a reddish head, which works just beneath the bark, producing a somewhat complicated (centipede-like) series of galleries. The most conspicuous evidence of the insect's presence is the appearance of many circular exit holes in the bark that look as if they were made by a shot gun. In some cases masses of gum exude from the points of feeding and may cover the side of a branch or trunk. The beetle itself is a small brown insect about 1/10 inch long.

Damage

Trees are damaged by feeding of the adult female at it makes its galleries, or by the larvae feeding underneath the bark. After emergence, the beetles feed in the crotches of small twigs. They may attack any nearby tree, and feeding is not limited to peaches at this time.

Life History

There are two generations a year. The insects pass the winter as larvae within their galleries. Beetles emerge in spring, burrow into the tree and lay eggs in their galleries. Larvae emerging from these eggs complete their development in August or September, pupate and emerge. The beetles then re-enter the tree to lay eggs and start a second generation.

Factors Affecting Abundance

The effect of weather on shot-hole borers is not known, but is certainly not often a serious deterrent. The main predisposing factor concerned with outbreaks of this borer is lack of tree vigor. Trees weakened by any cause are readily attacked. Trees in low land or other unfavorable situations or trees damaged by animals or insects, such as the peach tree borer, are subject to infestation.

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[1] A second species *Phthorophloeus liminaris* (Harr.) is known to damage peach trees, but is not yet recorded from Connecticut.

Predators and Parasites

Cheiropachys colon L. is said to be able to reduce infestations (Peairs, 1941). *Cheiropachys obscuripes* Brues, *Brachystes* sp., *Eurytoma* sp. and *Spathius canadensis* Ashm. occur in Canada.

Control Measures

Older methods consisted mainly of keeping trees in good vigor. Removal of infested trees as soon as they become a menace, pruning off diseased branches, burning infested trees and avoidance of untreated woodpiles near the orchard were all useful, and still are. White wash applied to the trunk was thought to be beneficial.

Sprays of DDT and parathion or combinations thereof have been mentioned recently as effective in destroying the beetles before they can penetrate the bark. To be effective, this measure would probably have to be applied in spring and again in late summer or fall, possibly after harvest.

If sanitary measures do not work, the trees may be sprayed with 50 per cent DDT wettable powder, 2 pounds to 100 gallons, or 1½ pounds 15 per cent parathion, or a combination of the two, 1 pound parathion and 1 pound DDT to 100 gallons, applied about June 1 and again August 1.

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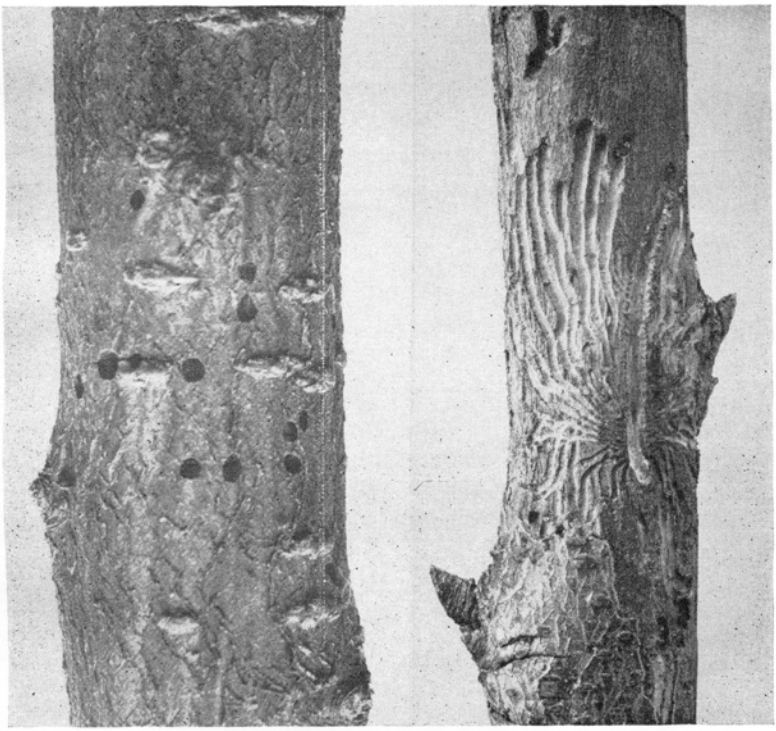

Figure 16. Shot-hole borer damage.

JAPANESE BEETLE

Popillia japonica Newm.

Description

The larva is a small white grub feeding in lawns or turf areas. The beetle is the only stage damaging fruit. It is a green beetle with bronze wing covers and white spots on the abdomen below the wing covers.

Damage

The principal damage produced by the Japanese beetle is from feeding on foliage and fruit. Partial defoliation may occur, but the worst injury is from feeding on the peaches themselves which results in both a direct loss and an indirect loss from brown rot.

Life History

Beetles lay eggs in lawn or turf areas during July, August and September. The grubs remain in the soil over winter, descending below the root level to escape the cold. They continue to feed the following spring and pupate in late spring. Beetles begin to emerge in late June and peak oviposition usually occurs about August 1. Damage to fruit occurs mostly from mid-July to September.

Factors Affecting Abundance

Drought conditions are unfavorable—a year following a dry year may produce fewer beetles in turf areas and hence fewer are present in the orchard.

Predators and Parasites

Many parasites have been introduced including several species of *Tiphia* and the fly, *Centeter*. Besides these, there is the disease *Bacillus popilliae* Dutky which has been distributed extensively in Connecticut. In addition, skunks, moles, blackbirds, starlings and crows feed on the grubs in the soil. (For fuller discussion, see Station Bulletin 552 on apples.)

Control Measures

Lead arsenate was standard for controlling the Japanese beetle until the discovery of DDT. Traps were tried but were generally discontinued after DDT became available.

Since then several new compounds have proven effective, of which a few may be mentioned. DDT, chlordane, and especially methoxychlor, are efficient and protect over a fairly long period. The phosphates, parathion, EPN and TEPP, have not been very effective on peaches.

Spray when beetles appear, using DDT, 2 pounds 50 per cent per 100 gallons, or methoxychlor, 3 pounds to 100. For late season, near harvest, methoxychlor has been preferred to DDT.

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[1] For a more complete list, see Conn. Agr. Exp. Sta. Bul. 552.

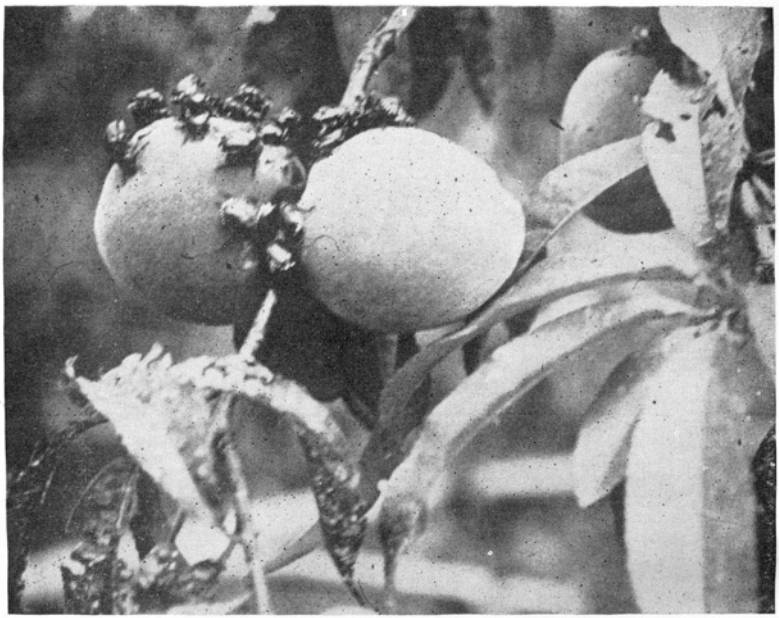

Figure 17. Japanese beetle feeding on peaches.

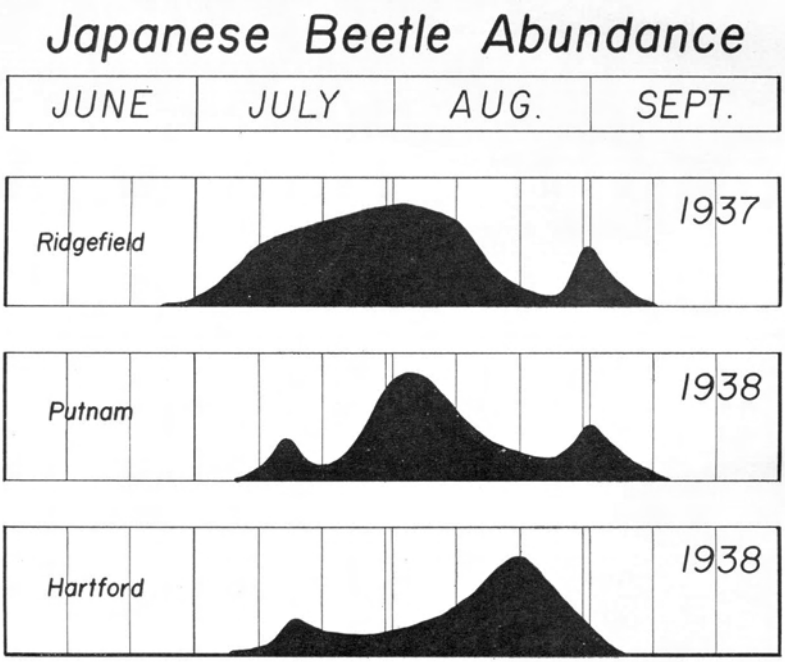

Figure 18. Chart showing Japanese beetle abundance in Connecticut.

ROSE CHAFER

Macrodactylus subspinosus (F.)

Description

The adults are slender brown or yellowish beetles with long spiny legs, most abundant in June.

Damage

As the name implies, this insect is especially injurious to roses. Next in importance in its menu are grapes, and much of the literature is devoted to it as a pest of vineyards. It also does considerable damage to peaches at times, feeding on fruit and destroying it.

Life History

The insect has a one-year cycle. The beetles appear about June 10 to 12 and begin feeding, continuing for about a month. After feeding, the beetles return to turf or waste areas to lay eggs. The larvae live on the roots of grasses and weeds.

Factors Affecting Abundance

Little or no information is available on the effect of weather or temperature on the rose chafer. Beetles prefer sandy waste areas for egg laying. If the orchard is in sandy soil, clean cultivation to keep down weeds on which the larvae feed is important. Some authors state that beetles will lay eggs only in sandy soil, but it is not always clear what percentage of sand a soil must have. Probably what is meant is a coarse sandy soil readily discernible without close examination or analysis.

Predators and Parasites

In spite of the prominence of this insect in the Northeast, very few parasites are recorded. This does not mean that the rose chafer has no enemies.

Control Measures

Before the discovery of DDT, the only control was to spray with lead arsenate which, as stated above, injures peach trees severely in this locality. Some authors favored addition of molasses to improve attractiveness of the lead arsenate, but the practice was not widespread. Orchard sanitation was also stressed.

DDT has been shown to be effective against the rose chafer and it seems probable that related materials such as methoxychlor would also give

good control. Two pounds of 50 per cent DDT in 100 gallons of water may be used when the beetles appear and repeated as needed. It may be necessary to spray three or four times when infestations are severe.

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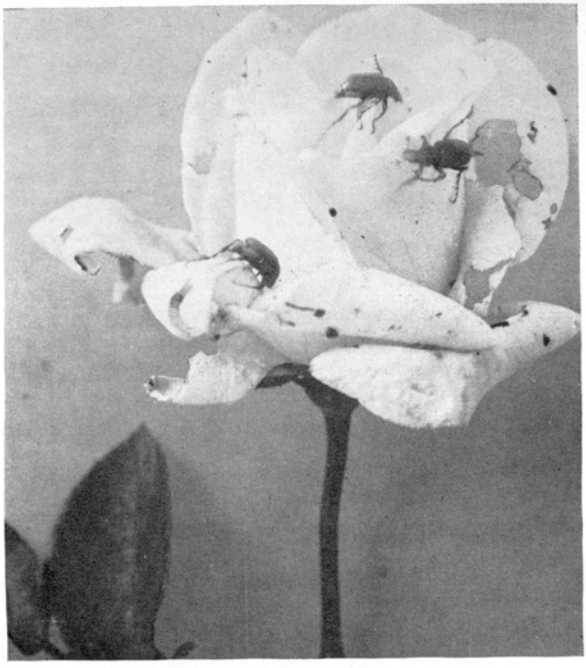

Figure 19. Rose chafer beetles on rose.

TWO-SPOTTED SPIDER MITE

Tetranychus bimaculatus (Harvey)

Description

These are minute creatures slightly less than ½ millimeter, or 1/50 of an inch long. The common form seen in midsummer is flesh colored with a dark spot on each side (Figure 21). Hibernating females seen under bark scales or other quarters are slightly pinkish. Seen with a magnifier, the eggs are minute spherical pearls.

Damage

Feeding along the midrib of the leaves results in removal of chlorophyll, and the leaf may then turn yellow and drop (Figure 20). The type of feeding is different from the European red mite which is more general over the leaf.

Life History

The winter is passed as an adult female under bark scales or on the ground. The pest moves to foliage as soon as the leaves are of sufficient size, and generations occur in rapid succession. More than three generations may sometimes be passed on ground cover such as weeds and grasses before moving into the trees. In Connecticut the peak abundance on the trees is not reached until August or September, about one month later than the European red mite.

Factors Affecting Abundance

Weed infestations within the orchard are a menace, since droughts or dry weather may force the mites up into the trees at any time. Sprays such as DDT, sulfur and possibly others may react unfavorably on predators and encourage outbreaks.

Predators and Parasites

There are many predators, but no parasites are known for the two-spotted mite. Lady beetles, thrips, other mites and certain Neuroptera or lacewing flies generally keep infestations at a low point. (For more complete information, see Station Bulletin 552.)

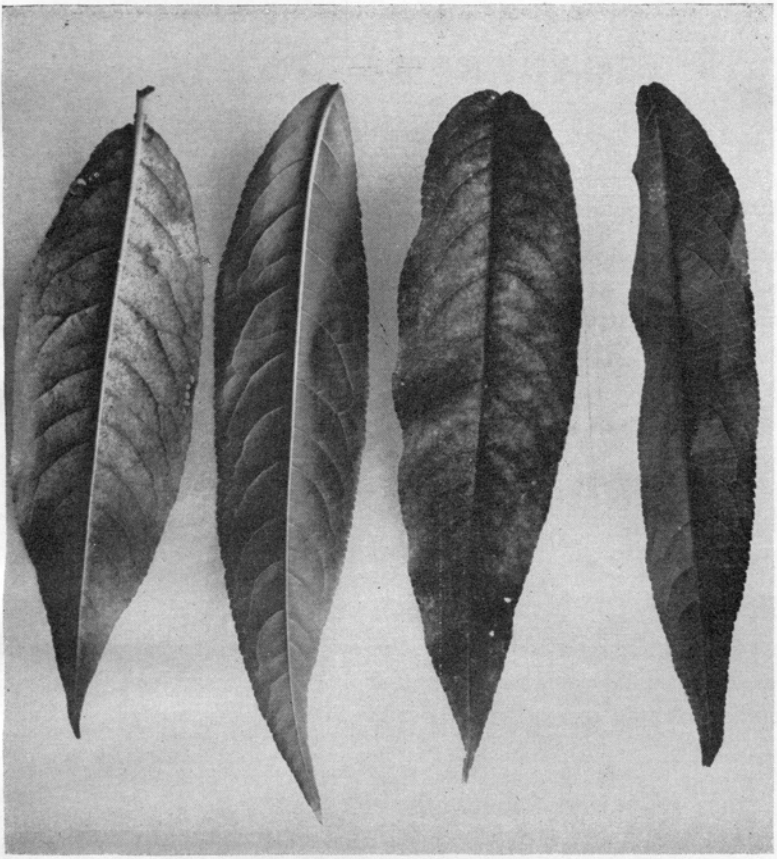

Figure 20. Damage to peach leaves from the two-spotted mite. First and third leaf from the left uninjured.

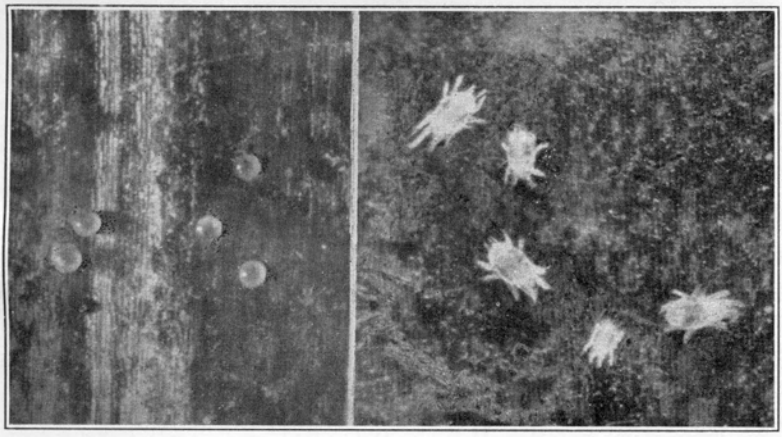

Figure 21. Two-spotted mite. Left, eggs; right, mites.

EUROPEAN RED MITE

Paratetranychus pilosus (C. & F.)

Description

Adult females of this mite are approximately the same size as the two-spotted mite, but they are velvety red with white dorsal spots. The eggs are brown (summer) to red (winter) and possess a delicate dorsal seta or hair which can only be seen with considerable magnification.

Damage

Feeding of the European red mite on peach leaves produces a fine over-all mottling (Figure 23), and the leaf may take on a grayish hue when mites are numerous. Defoliation may occur the same as for the two-spotted mite.

Life History

In general the winter is passed in the egg stage on the twigs and bark. Hatching usually commences about May 1 and generations follow one another in rapid succession. (For more detailed information, see Bulletin 552.)

Factors Affecting Abundance

Dry hot seasons seem to favor infestations of this mite, and peaches interplanted with apples may be heavily attacked. DDT and sulfur sprays may increase the build-up of European red mites through destruction of predators.

Predators and Parasites

Predators attacking the European red mite are about the same as those listed for the two-spotted mite.

Control Measures

Formerly, few or no controls for either this or the two-spotted mite were needed on peaches. Dormant oils were used in some orchards. Since the use of organic insecticides such as DDT, controls have been needed more frequently. To overcome mite build-up, *Aramite*, parathion, TEPP, EPN or *Ovotran* have been used.

A dormant spray is usually not required for this pest on peaches in Connecticut.

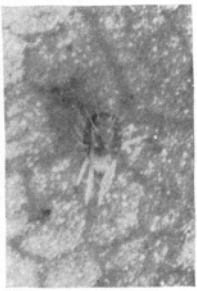

Figure 22. European red mite, adult female.

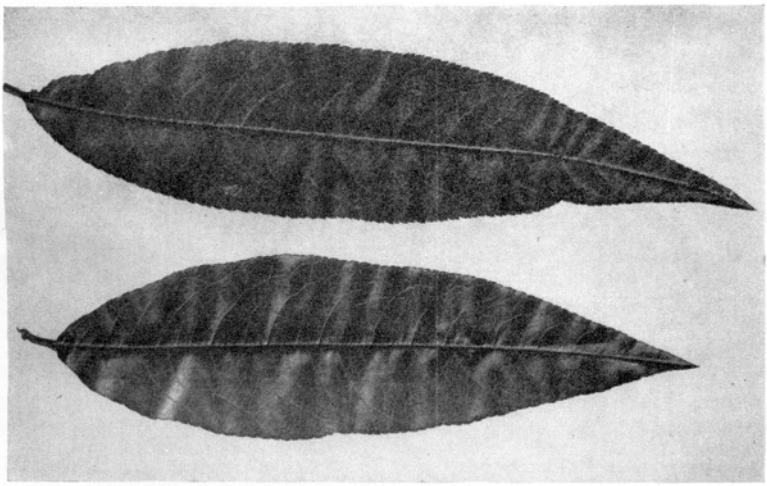

Figure 23. Injury to peach leaves by the European red mite. Upper leaf injured, lower leaf normal.

GREEN PEACH APHID

Myzus persicae (Sulz.)

Description

These smooth, green, sucking insects are often abundant on new growth. Their presence may be first apparent on curled leaves, the first to unfold. This insect has innumerable hosts, but is most frequently mentioned in literature as a pest of spinach.

Damage

Damage is so minor in Connecticut that few orchardists find control measures necessary. However, the green peach aphid is said to be a vector of one of the peach viruses, hence it may be important to control the pest whenever it does appear. Also, the peach is apparently a necessary intermediate host on which the aphid gets a start before moving to vegetables. Consequently, if vegetables are grown nearby, its destruction on peaches becomes very important.

Life History

Winter is passed as a black shiny egg from which young aphids hatch as soon as the tree begins to grow in spring. As already indicated, the sojourn on peaches is relatively short, after which the pest moves on to other hosts.

Factors Affecting Abundance

Cool, moist or rainy weather, which causes rapid twig growth, is favorable. Heavy fertilization would give the same result. Vegetables, weeds or other hosts in the immediate vicinity may encourage the population so that more aphids migrate to the peach in the fall to lay eggs.

Predators and Parasites

Three internal parasites are known from North America, *Aphelinus semiflavus* How., *Aphidius phorodontis* Ashm. and *Praon simulans* Prov. So far only the last two have been recorded from Connecticut. Lady beetles of various species are important, especially *Hippodamia convergens* Guer. and *Coccinella transversoguttata* Fabr. Besides these, lacewing flies and syrphus fly larvae are often abundant in Connecticut orchards.

Control Measures

Nicotine sulfate mixed with soap or other spreader was the standard control for a long time. At present, this spray has been replaced by the organic phosphates, such as parathion, TEPP, EPN or malathion.

One of the following aphicides may be applied, if aphids are abundant during bloom or shortly after:

1. Nicotine sulfate (40 per cent), 1 pint to 100 gallons plus soap or spreader.
2. Parathion, ½ to 1 pound 15 per cent in 100 gallons.
3. EPN at manufacturer's recommendation.
4. TEPP, ½ pint 20 per cent or ¼ pint 40 per cent in 100 gallons.

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SAN JOSE SCALE

Aspidiotus perniciosus Comst.

FORBES SCALE

Aspidiotus forbesi Johns.[1]

Description

These two scales are very much alike in habits and general appearance. The female scales are nearly circular in outline, the males elongated. The main difference between the two species is in the central portion of the scale which, in Forbes scale, is orange-red; in San Jose scale, pale yellow. San Jose scale is much more abundant.

Damage

Damage may be severe, with branches or trees killed outright. Many peach orchards were destroyed by these scales before controls were perfected (Figure 24).

Life History

There are three generations a year of the San Jose scale; Forbes scale probably has the same number. Crawlers, therefore, appear at different periods, the more critical for spray controls occurring in May or early June and again in September. Distribution from one part of the tree to another is by means of this crawler stage, while the scales move from one tree to another on the feet of birds or other animals.

Factors Affecting Abundance

Cold limits are not known for either scale, but there are probably no temperatures in Connecticut during the winter low enough to kill them. There is some evidence that continued use of DDT tends to keep populations at a high level, possibly through destruction of natural enemies.

Predators and Parasites

One of the most effective enemies of the San Jose scale is the internal parasite *Prospaltella perniciosus* Tower. Known in Connecticut since

[1] Formerly called cherry scale.

the early 1920's, this parasite has been largely responsible for reducing the status of the San Jose scale to that of a minor pest. A total of 29 different species of internal parasites of the San Jose scale has been recorded from North America, but only one parasite of Forbes scale (*Prospaltella forbesi* Johns.). In addition, there are a number of lady beetles, lacewing flies and syrphus fly predators which are usually abundant in Connecticut.

Control Measures

Lime sulfur (8 to 10 gallons to 100) was perhaps the first remedy for scale in Connecticut. Extensive spraying of orchards was necessary prior to 1920 to prevent destruction of the trees. Oils have been found equally efficient, though in general a little more injurious to the peach tree. Since 1920, spraying for San Jose scale has gradually declined. Recently, sprays of parathion, 1½ pounds 15 per cent to 100 gallons, have been found effective, which eliminates the necessity for dormant sprays. What the final result of these treatments will be, however, remains to be seen, especially in view of the rather general use of other organic sprays which destroy parasites and predators.

If the scales become abundant, either lime sulfur or dormant oil may be applied during April, or parathion at the strength given above.

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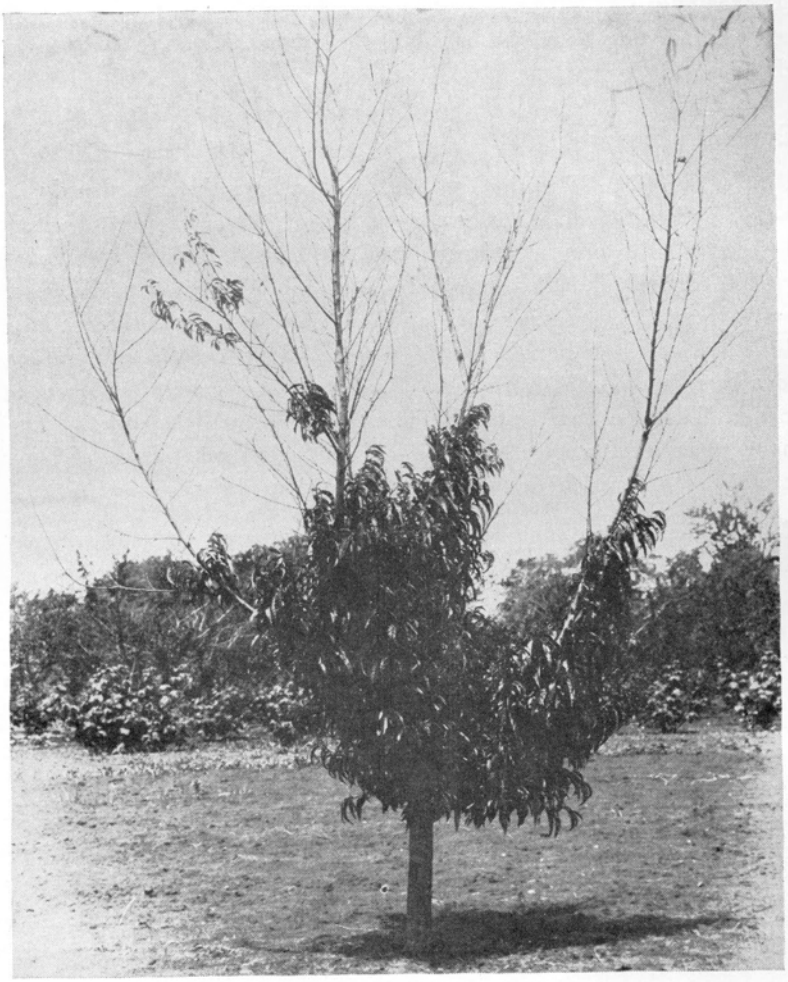

Figure 24. Peach tree partly killed by the San Jose scale.

TERRAPIN SCALE

Lecanium nigrofasciatum Perg.

EUROPEAN FRUIT LECANIUM

Lecanium corni Bouché

Description

Both are small dark brown convex scales, similar in general appearance. Variations in structure of the insects living on different plants have caused some confusion among entomologists who have given different names to the same scale.

Damage

We have yet to see serious damage to peaches in Connecticut from either the terrapin scale or European fruit lecanium. The terrapin scale often becomes a serious pest farther south. Damage consists of injured branches or twigs where the insects have fed.

Life History

There is one generation a year for both species, the crawler or mobile stage occurring in June and July, or considerably later than that of the San Jose scale.

Factors Affecting Abundance

Circumstantial evidence (Asquith, 1949) indicates that outbreaks of the fruit tree lecanium follow DDT sprays.

Predators and Parasites

At least 19 internal parasites have been found in North America. Of these, *Anagrus armatus* Ash., the egg parasite, occurs in the Northeast. *Aphycus rileyi* Timb., *Coccophagus lecanii* (Fitch) and *Pachyneuron altiscuta* How. may also be found here.

Control Measures

Lime sulfur and dormant oils have been the standard spray controls for a long time. Recently, high paraffinic oils have proven more success-

ful than the older types. Best results have been obtained when there is at least 2 per cent oil in the final mixture, and when the mixture is applied with a gun, providing a forceful stream rather than a mist.

Parathion at 1½ to 3 pounds per 100 gallons has also been found useful. There are some indications, however, that parathion may increase rather than decrease the abundance of lecanium scales, through destruction of parasites. To be most effective, applications should be timed to follow closely hatching of the eggs.

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MISCELLANEOUS INSECTS ATTACKING PEACHES IN CONNECTICUT

The following list covers some of the less common insects that feed on peach trees in Connecticut. It is impossible to give all of them here.

Pest	Description and activity	Control
Canker worms *Alsophila pometaria* (Harr.) *Paleacrita vernata* (Peck)	Green or black loopers eating holes in leaves in late April or in May.	Methoxychlor, or parathion or related phosphates.
Black peach aphid *Anuraphis persicae-niger* (Smith) Clover mite	Black plant lice on leaves, also on roots.	Parathion, TEPP, malathion, etc., or nicotine sulfate.
Bryobia practiosa Koch	Small brown mites on leaves in midsummer.	*Aramite,* or organic phosphates.
Cottony peach scale *Pulvinaria amygdali* Ckll.	Brown convex scale, secreting white cottony masses.	Dormant oil or ½ lb. 15 per cent parathion to 100 gals.
Periodical cicada *Magicicada septendecim* (L.)	Red marked cicadas with distinct "w" on wings. Next brood will appear in 1962.	TEPP is reported to kill these insects.
Red-banded leaf roller *Argyrotaenia velutinana* (Wlkr.)	Green caterpillars with green heads. Feed on surface of fruit or on foliage.	DDD (TDE) at 2-3 pounds per 100 gals.
Sawfly *Pamphilus persicum* MacG.	Skeletonizes the leaves. Little damage reported in Connecticut since 1911.	Methoxychlor 3 lbs. per 100 gals. suggested.
Scurfy scale *Chionaspis furfura* (Fitch)	White scale. See Bul. 552.	Parathion in regular sprays.
Tent caterpillars Eastern, *Malacosoma americana* (F.) Forest, *Malacosoma disstria* Hbn.	Tents or masses of caterpillars before or during bloom.	Methoxychlor 3 lbs. to 100 gals. prebloom spray.
Peach twig borer *Anarsia lineatella* Zell.	Bores in twigs like Oriental fruit moth. Brown larva instead of white or pink.	No controls needed in Connecticut.

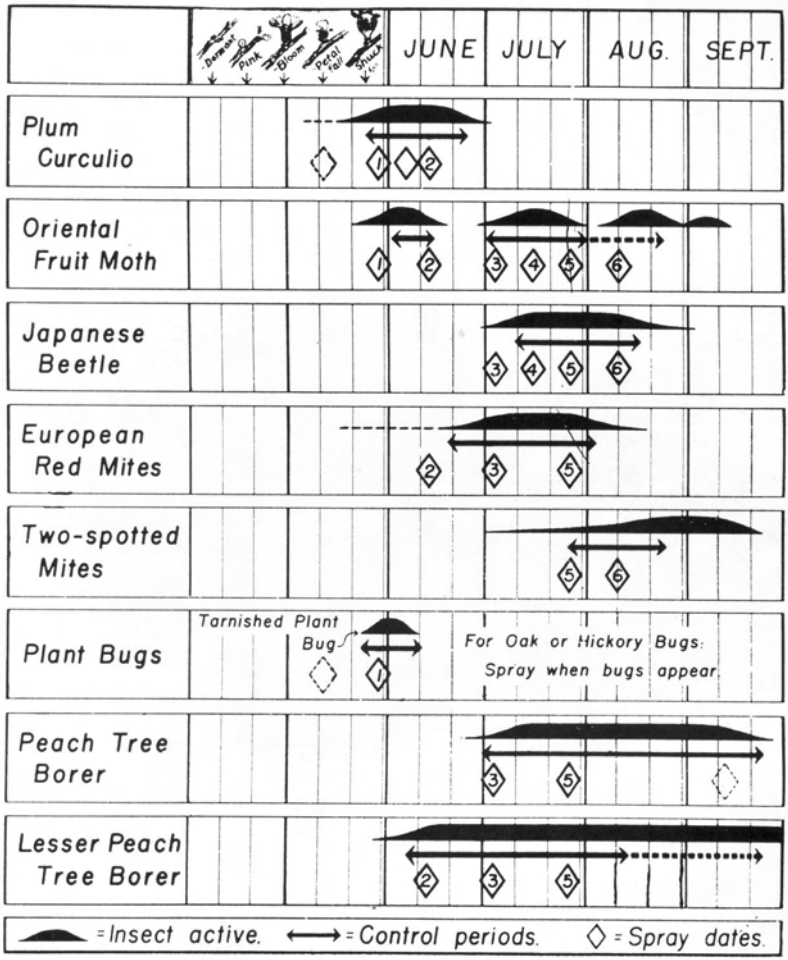

Figure 25. Spray chart for peach insects.

EXPLANATION OF SPRAY CHART

Periods of insect activity as well as times when protection is needed are shown by heavy lines with arrows. In addition, normal spray dates are given (diamonds with numbers) and a few dates when controls may be needed if the insect becomes abundant (diamonds without numbers).

The normal spray schedule may be carried out by using the following materials (amounts are for 100 gallons).

1. 50% methoxychlor 3 lbs. or 15% parathion 1½ lbs.; wettable sulfur 4 to 8 lbs.

2. 50% methoxychlor 3 lbs. or 15% parathion 1½ lbs.; wettable sulfur 4 to 8 lbs.

3. 50% DDT (or equiv. 75%) 2 lbs. or 15% parathion 1½ lbs.; wettable sulfur 4 lbs. or *Ziram* 2 lbs. If DDT is used, include a miticide.

4. 50% DDT (or equiv. 75%) 2 lbs. or 15% parathion 1½ lbs.; wettable sulfur 4 lbs. or *Ziram* 2 lbs. If DDT is used, include a miticide.

5. 50% DDT (or equiv. 75%) 2 lbs. or 15% parathion 1½ lbs.; wettable sulfur 4 lbs. or *Ziram* 2 lbs. If DDT is used, include a miticide.

6. 50% DDT (or equiv. 75%) 2 lbs. or 15% parathion 1½ lbs.; wettable sulfur 4 lbs. or *Ziram* 2 lbs. If DDT is used, include a miticide.

   (*No. 6 is usually omitted on early varieties* ripening by mid-August or before.)

Early treatment for plant bugs may be with the same materials as No. 1. For lesser peach tree borers, Nos. 2, 3 and 4 should contain parathion, to date the only effective insecticide for that insect.

Treatment in September for peach borers is paradichlorobenzene or similar material.

Captan is becoming increasingly popular as a fungicide, in place of the ones indicated.

Figure 26. Early peach bud stages of development. a. Dormant. b. Delayed dormant. c. Pink bud. d. Full bloom. e. Petal fall. f. Shuck split. g. Shuck off.

NOTES ON SPRAY MATERIALS FOR PEACHES

Chlorinated Hydrocarbons

DDT. One of the most effective materials against Oriental fruit moth, but not so satisfactory for plum curculio. Also good for plant bugs. Dilution 2 pounds of 50% wettable powder per 100 gallons.

DDD (or TDE). Used against red-banded leaf roller, but only rarely needed on peaches. Dilution 2 to 3 pounds (50%) in 100 gallons.

Chlordane. Effective against curculio, but of little or no value for Oriental fruit moth. Dilution 2 pounds (50%) in 100 gallons. Used early in the season (to first cover) but avoid in late season application.

Benzene hexachloride. Reported effective against aphids, but not as good as several other compounds against curculio. Some danger of off-flavor in fruit sprayed with it; especially from late sprays in July or August.

Toxaphene. Reported successful under some conditions, but not much used in Connecticut today.

Methoxychlor. Very effective against curculio; of value for late sprays because of its low poison hazard. Not very good for Oriental fruit moth. Dilution 3 pounds (50%) in 100 gallons.

Dieldrin. Very effective against curculio. Its long residual property makes its use doubtful for late sprays. Suggested dilution 1 to 2 pounds (25%) in 100 gallons.

Aldrin. Reasonably effective against curculio, but of little or no value for Oriental fruit moth. Volatile and disappears rapidly. Suggested dilution 1 to 2 pounds (25%) in 100 gallons.

Phosphates

Parathion. One of the most effective all-around insecticides yet devised. Very useful for peach sprays except for Japanese beetles. Dilution 1 to 2 pounds (15%) in 100 gallons.

TEPP. Used mostly against aphids and mites; of little value for curculio.

EPN. Similar to parathion in action on peach insects—fully as good.

Malathion. Useful mainly against mites and aphids. Much less toxic to the operator than the three above.

The following precautions on phosphate insecticides, prepared by the Extension Service of the University of Connecticut, are reprinted here for the convenience of peach growers.

WARNING ON PHOSPHATE INSECTICIDES

Phosphorus compounds such as parathion, TEPP, HETP, EPN and others are nerve poisons and highly toxic to humans. They are extremely hazardous if swallowed, inhaled or absorbed through the skin.

Symptoms of poisoning

Headache, chest pain, blurred vision, pinpoint pupils, salivation, sweating, nausea, vomiting, diarrhea and cramps. Headaches, nausea and blurred vision are the most important.

Precautions

1. Treat phosphate insecticides with respect—don't get careless.
2. Wear a U.S.D.A. accepted respirator, avoid breathing fumes or dust. Open bags with a knife and empty well *inside* the spray tank.
3. Wear rubber gloves—avoid contaminating the hands and food or "smokes." Wash hands and face with soap and water after spraying.
4. Wear washable clothing and hat—wash after one day's use.
5. Take a bath each day after working with phosphate insecticides.
6. Burn paper containers. Sweep up spillage and bury.
7. Avoid spray drift into neighboring fields where there are livestock.
8. Get a doctor's prescription and keep a supply of atropine, the antidote, on hand (1/100 grain tablets).
9. Avoid going into an orchard to thin or prune less than two weeks after an application of parathion or similar phosphate insecticide.
10. Do not use phosphate insecticides in the home orchard.

If symptoms appear:

Quit spraying at the first sign of dizziness or persistent headache. Change clothes and take a bath.

For a sick stomach, induce vomiting. Swallow warm salt water and repeat until water shows clear.

Call a doctor. Ask him to administer the atropine, preferably by injection.

If poison is swallowed, make patient vomit by giving warm salty or soapy water.

If symptoms include blurred vision or pinpoint pupils, don't wait for the doctor, give two atropine tablets at once.

Remove label from package or bag and have ready for doctor when he arrives. It may give him useful information.

Fungicides

Lime sulfur, liquid. Devised as a scalecide, it continues to be used as a dormant fungicide for peach leaf curl. For leaf curl, 6 gallons standard strength is commonly used, for scale, 9 gallons in 100 gallons water. If the material has stood for a number of years, it is probably weakened and a stronger dose may be necessary.

Lime sulfur, liquid or dry, is useful only on dormant trees as it will kill peach foliage.

Lime sulfur, dry. Liquid lime sulfur is now difficult to obtain, but the dry form is still available. Usual dose for dormant sprays is 12 pounds to 100 gallons, for summer sprays 6 pounds.

Wettable sulfur. Dry wettable sulfurs are much safer for peach trees than either form of lime sulfur. Since the preparations vary, it is necessary to follow the manufacturer's directions for dilution. Of little use as an insecticide, wettable sulfur may be of some value during hot weather as a control for two-spotted mites. Drip from the trees onto the soil tends to produce an acid condition which must be corrected by applications of lime.

Ziram (*Zerlate; Zimate*). Zinc dimethyldithiocarbamate. A fungicide useful on peaches but having no known insecticidal properties.

Captan (*SR-406; Orthocide 406*). *N*-tricholoromethylthio tetrahydrophthalimide. This fungicide has appeared on the market within the last two or three years and is becoming popular very rapidly. To date, it has not been shown to have insecticidal properties.

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