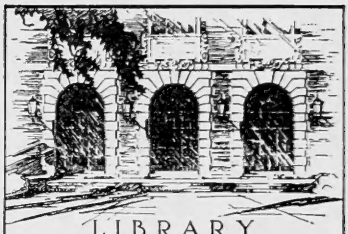

Controlling

PEACH INSECTS

in Illinois

S. C. CHANDLER
W. P. FLINT

ILLINOIS
TURAL HISTORY SURVEY
CIRCULAR 33

STATE OF ILLINOIS
Henry Horner, Governor
DEPARTMENT OF REGISTRATION AND EDUCATION
John J. Hallihan, Director

Controlling PEACH INSECTS *in Illinois*

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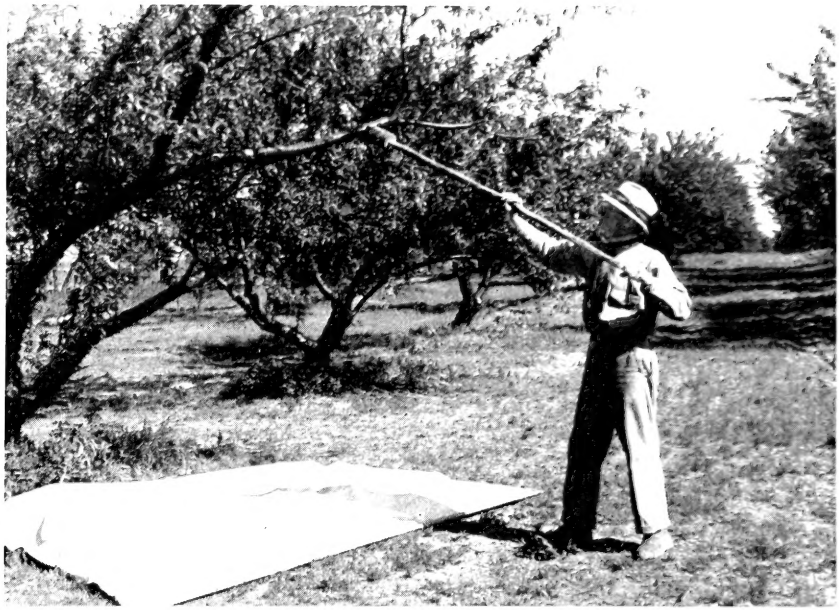
Printed by Authority of the State of Illinois
NATURAL HISTORY SURVEY DIVISION
Theodore H. Frison, Chief

Circular 33 Urbana August 1939

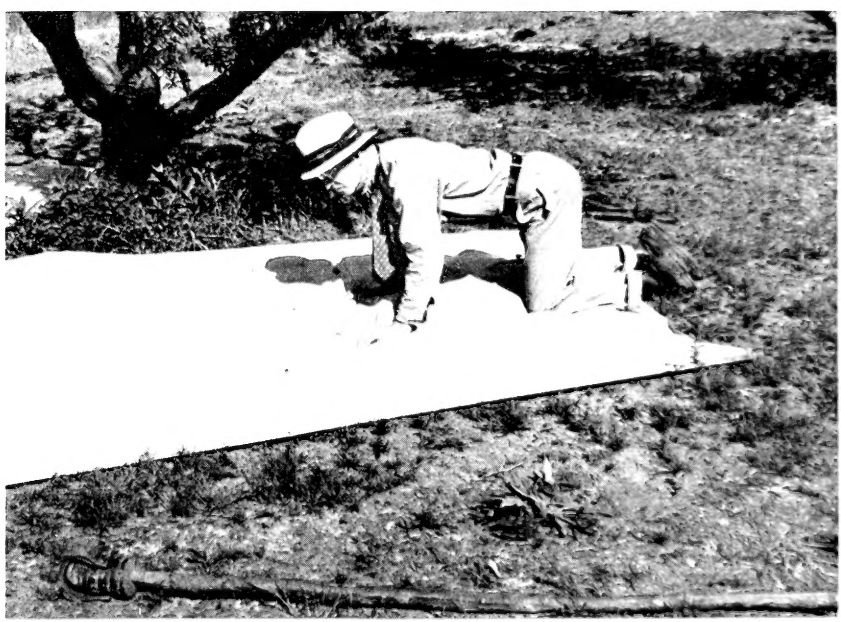
This paper is a contribution from the Section of Economic Entomology

(81805—4M—5-39)

Contents



An Illinois peach grower jarring for plum curculio to determine location and abundance of the insect.



Grower making count of plum curculio to determine abundance on tree which he has jarred.

Part I. Insects Attacking Bark and Trunk of the Peach Tree

SAN JOSÉ SCALE

Aspidiotus perniciosus Comst.

Appearance and type of injury.—A grayish layer of overlapping and very small scales covering the entire bark characterizes a heavy infestation of San José scale. Rubbing the scales between the fingers produces a greasy sensation and appearance, which come from crushing the yellow saclike bodies of the insects beneath the scale covering. A light infestation shows as gray, or nearly black, round specks on the bark; these specks show, when viewed with the aid of a hand lens, a raised, nipple-shaped center. On light colored bark a light infestation is easily detected by a reddish area nearly a quarter inch in diameter around each scale or group of scales.

Under favorable weather conditions scale infestation may increase seriously in a single season. Three seasons showing marked increase of infestation have occurred in the past nine years, as shown by our annual scale surveys. In 1931, 58 per cent of the peach orchards inspected experienced moderate to severe infestations in some part of the orchard, as compared with 31 per cent in 1930. A second increase in this period was from 30 per cent in 1933 to 71 per cent in 1934. The third increase was greater than either of the others, from 22 per cent in 1936 to 72 per cent in 1937. Increases are shown graphically in fig. 1. Two or three years of unrestricted infestation are frequently enough to kill a bearing tree. Even a single year of heavy infestation, combined with the usual effect of winter on the weakened wood, may cause serious results. Fig. 2 shows the effect of the heavy infestation of 1937.

Control.—Before the use of oil sprays began in 1922, San José scale was much more difficult to control on peach than it is today. Now, however, relatively effective control may be had by means of these sprays. Standard commercial lime sulfur, at 1 gallon to 8 gallons of water, will leave 7 to 11 per cent of the insects alive, according to examination of hundreds of thousands of scales in tests conducted in Illinois, whereas oil emulsion or miscible oil sprays at 2 per cent actual oil leave not more than

2 per cent alive. On severe infestation it is advisable to use oil emulsion or miscible oil sprays at 2½ to 3 per cent actual oil. Such sprays usually reduce the number of live scales to less than 1 per cent.

Numerous commercial miscible oils are manufactured, many of which are very efficient when used at the dilutions recommended by the makers.

Combined scale and leaf curl control.—To control leaf curl, as well as scale, plant pathologists in this and other states have found it necessary to add a fungicide, such as Bordeaux mixture,

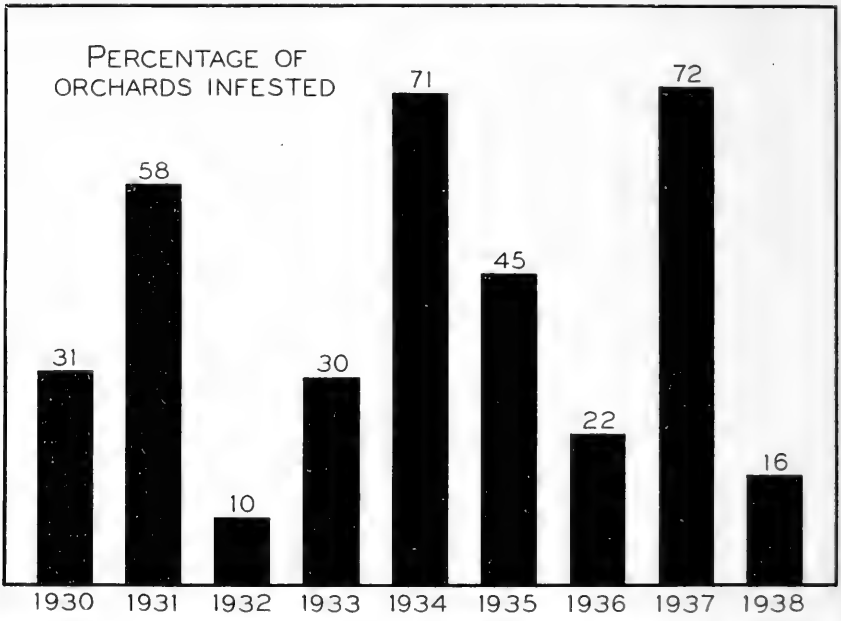


Fig. 1.—Graph showing percentage of peach orchards moderately to severely infested with San José scale as determined by a survey in which 75 to 100 orchards in southern Illinois were inspected in each of the years indicated.

to the oil sprays. A cold-mixed Bordeaux and oil emulsion can be made by emulsifying the oil in the spray tank. The easiest method is as follows:*

To make 100 gallons of cold-mixed emulsion of Bordeaux and oil, put about 25 gallons of water in the spray tank. With

*See also Illinois Agricultural Experiment Station Circular 492, *Directions for Spraying Fruits in Illinois*, prepared by the University of Illinois Department of Horticulture and the Illinois Natural History Survey, March, 1939. May be ordered from the Illinois Natural History Survey.

Fig. 2.—Peach trees showing the effect of a single season's heavy infestation of San José scale and the consequent winter injury. Photograph taken at Anna, May, 1938. Note failure of trees to leaf out and the almost total lack of bud-bearing wood, meaning loss of crop in 1938 and poor prospect for 1939.

the agitator running, sift in 6 pounds of powdered copper sulfate. Put in 4 pounds of hydrated lime previously made into a paste, or, if agitation is sufficient, slowly sift the lime directly into the tank. This is the Bordeaux mixture. Now pour in 2 gallons of oil and run the engine so that for a few minutes the mixture is pumped through the spray gun and back into the tank. This is the cold-mixed oil emulsion. Add additional water to make 100 gallons. A somewhat better suspension of the Bordeaux is obtained if about half the copper sulfate and lime is placed in the tank before the oil is added and the remainder later while the tank is being filled.

An oil injector* can easily be inserted somewhere along the intake pipe of the spray machine, fig. 3. With this injector, a better and more stable cold-mixed emulsion can be made than that pumped through the spray gun. The Bordeaux needed for peach leaf curl control may be used as an emulsifier. Table 1 gives results of tests with sprays mixed by the injector method.

*Described in Illinois Agricultural Experiment Station Circular 492 and more fully in a special mimeographed sheet.

In recent years several tar distillate oils containing a fungicide have been put on the market. The fungicide has cresylic acid or similar material as a base. In our tests to date these oils used at 5 per cent strength show excellent kill of scale. According

Fig. 3.—Mixing spray material by the injector method.

to Dr. H. W. Anderson of the University of Illinois Department of Horticulture, the oils give almost complete control of leaf curl. As yet they are much more expensive than oil emulsion plus Bordeaux.

The use of DN (2, 4 dinitro 6 cyclohexylphenol or dinitro-ortho-cyclohexylphenol) in petroleum oil solutions has been suggested and tested in a number of states. Tests with this material were made in 1937. They showed that the petroleum oil solution with DN (4 per cent) used as dormant sprays for control of San José scale was effective to such an extent that 1 per cent of oil with DN produced a kill equal to that produced by 2 or 2½ per cent of oil without DN. In one of two orchards the oil with DN resulted in such a killing back of the bud-bearing wood that much of the crop was lost. Light injury occurred in the other orchard. Tests are in progress to determine the fungicidal value of DN for control of leaf curl. In 1939 no injury resulted from applications at 1⅛ per cent strength.

The liquid lime sulfur at 1 gallon to 7 or 8 gallons of water, which was the standard spray material for the scale before 1922, has the advantage of being a fungicide and a control for peach leaf curl as well as for light to moderate infestations of San José scale. It may be applied either in fall or in the spring before the buds swell much. Spring applications have proved somewhat more effective. It is more expensive than the oil sprays in common use.

Life history.—Only the partly-grown San José scales live through the winter. Varying temperatures of the winter months are often a deciding factor in the following year's infestation. Mortality ranges from practically nothing to 98 per cent, according to the severity of the weather; 20 degrees below zero Fahrenheit will kill 90 to 95 per cent of the scales.

When sap begins to flow in spring the overwintering scales resume development and become fully grown by the time the shucks are being pushed off the peaches. At this time the male scales emerge as tiny, yellow, two-winged insects. The female, who never moves from under her protective waxy covering, is fertilized by the male soon after his emergence and shortly thereafter gives birth to young.

Table 1.—Control of San José scale on peach by oil emulsified by injector method. Heaton Orchard, New Burnside, March, 1938. One thousand scales examined from each plot.

Plot No.	Oil	Emulsifier	Per Cent of Scales Alive	Efficiency of Oil Emulsion*
1	*Diamond Paraffin Oil* 2½%..	3-2-100 Bordeaux	0.5	98.7
2	*Diamond Paraffin Oil* 2½%..	6-4-100 Bordeaux	0.3	99.2
3	*Diamond Paraffin Oil* 2½%..	Soy flour 2½-100	0.3	99.2
4	Commercial miscible oil 2½%	None	0.3	99.2
5	Check.....		38.1	...

*Based on survival of San José scale in the check.

The young have six legs and are active crawlers; in appearance they resemble yellow mites. It is during this active stage, lasting not more than a day or two for each individual, that scales are spread from tree to tree. Larger insects and birds accidentally transport the scales, but most of the spread results from the action of the wind. On finding a place to their liking the crawlers pierce the bark with their threadlike mouthparts and begin sucking the sap. Shortly afterward they shed their skins, lose their antennae and legs, and become to all appearances

mere yellow sacs. They exude a waxy substance at first white, then gray, which hardens and forms the scale covering their bodies.

The number of broods in a year depends upon temperature and latitude. Two broods in a year are ordinarily found in northern Illinois and as many as six in the extreme southern end of the state. During mild fall weather, crawling young have frequently been observed as late as the middle of November, and in the exceptionally mild autumn of 1931 crawlers were observed at Carbondale on December 17.

PEACH BORER*

Conopia exitiosa (Say)

Appearance and type of injury.—Masses of exuded gum and frass at the base of a tree usually betray the presence of this insect, figs. 4 and 5. Examination of the trunk, for several inches above and below the groundline, of trees so marked, usually reveals the white wormlike borers working in brown areas of the bark or outer wood.

Fig. 4.—Above, larva of peach borer, natural size.

Fig. 5.—Left, adult female of peach borer, natural size.

The cheapest and most effective method of controlling the peach borer is by the use of paradichlorobenzene, commonly called PDB, or of ethylene dichloride emulsion.

Control by PDB.—From one-half to 2 ounces of PDB crystals should be used to a tree, according to its age and size. A

*For a more detailed account of the peach borer, see Illinois Natural History Survey Circular 31, *The Peach Tree Borers of Illinois*, by S. C. Chandler, February, 1939.

quarter ounce is sufficient for trees one full year old, and three-quarters of an ounce is the correct amount for trees three to five years old. The amount for trees more than five years old depends upon the circumference of the tree. Tests conducted at

Fig. 6.—Application of PDB for control of the peach borer. Left, the ring of PDB around the trunk on leveled ground. The PDB should not be allowed to touch the bark, or injury to the tree may result. Right, the mound around the base of the treated tree.

Centralia with 15-year old trees demonstrated that 2 ounces per tree are required to kill borers on trees having circumferences of about 40 inches.

In applying PDB, spread a ring of it around the base of the tree trunk not closer than 1 inch nor more than 3 inches away from it, fig. 6. Cover the PDB with four or five spadesful of earth and tamp the earth a little with the back of the spade. It is not necessary to remove growths of grass and weeds if they do not interfere with the correct placing of the PDB around the tree.

In sandy soils it is sometimes advisable to pull the mounds from the trees two or three weeks after treatment, but in all our southern Illinois tests this practice has not been found necessary. However, the mounds should be leveled off by the first week of the following July, when the moths begin to lay their eggs. If the mounds are left the moths will lay higher on the tree trunk, making control more difficult.

The PDB treatment may be applied either in spring or fall. Tests conducted in southern Illinois for eight years under proper conditions of soil temperature gave an average kill of 83.4 per cent in the spring and 94.2 per cent in the fall. In spring it is necessary to wait until the ground temperature is about 60 degrees Fahrenheit, usually about May 1 in southern Illinois, before applying the PDB.

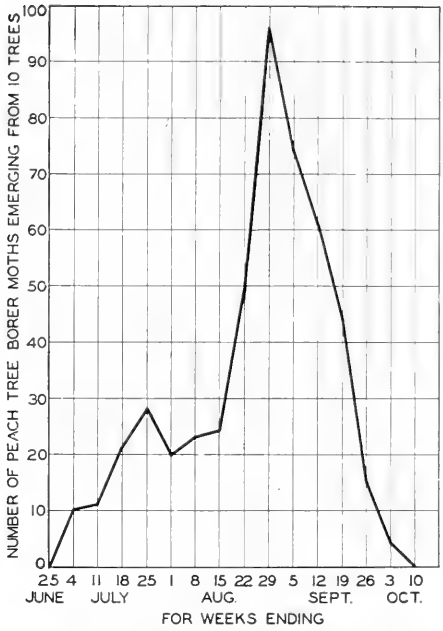


Fig. 7.—Graph illustrating composite records of peach borer emergence in orchards near Carbondale, 1924-29.

Fall treatment should be applied within a month after the moths cease emerging. The peak of emergence for southern Illinois occurs between August 29 and September 15, according to a five-year record tabulated by the Natural History Survey, fig. 7. In the southern end of the state, PDB should be applied from September 25 to October 15, in the Centralia-Olney-Flora district between September 20 and October 5, and in central Illinois from September 15 to October 1. A three-week period after these dates usually occurs during which the soil temperature is high enough to afford maximum results from the treatment.

Growers who prefer to apply PDB in liquid rather than solid form may dissolve the crystals in oil in the proportion of 2 pounds of the crystals to 1 gallon of commercial miscible oil, such as *Dendrol* or *Scalecide*, and dilute the mixture with water to make 4 gallons. This dilution gives 1 ounce of PDB in each pint of the mixture. The oil with the PDB may be sprayed or poured at the base of the tree at the rate of one-fourth pint of liquid per tree for 2-year trees, one-half pint for 5-year trees and 1 pint for 10-year trees.

In a number of tests conducted under field conditions, the liquid treatment was found to be faster but somewhat more expensive than the crystal treatment. Both treatments with PDB are discussed in greater detail in Circular 31.* Larger quantities or concentrations than those recommended should not be used, or injury to trees may result.

Control by ethylene dichloride emulsion.—Ethylene dichloride may be applied at the rate of one-fourth pint of 15 per cent

**The Peach Tree Borers of Illinois*, by S. C. Chandler, Illinois Natural History Survey Circular 31, February, 1939.

emulsion to a 2-year tree, one-half pint of 15 per cent emulsion to a 4-year tree and one-half pint of 20 per cent emulsion to a 10-year tree. This liquid has given effective control of peach borers at temperatures not high enough for good control by PDB. It is discussed in greater detail in Circular 31.

Life history.—The peach borer hibernates in the inner bark of the tree near the ground line as a partly grown larva, resuming its feeding and growth in the spring. This larva or borer is white and it has a brown head. When full grown it attains a length of about 1 inch, fig. 4. Upon reaching maturity it spins a cocoon of silk, covered with dirt, frass and gum, in its burrow in the tree or in the soil close by. In this it spends the pupal stage. Worms of all sizes are found in the trees in spring and, as indicated by the emergence chart, fig. 7, feeding goes on over a long period.

In flight, the peach borer moths, especially the females, look like wasps. The females lay large numbers of eggs on the tree trunks and in cracks in the soil within a few inches of the tree. The peach borer produces one brood a year.

LESSER PEACH BORER†

Synanthedon pictipes (G. & R.)

Appearance and type of injury.—The lesser peach borer is prevalent in Illinois orchards but causes less damage than the peach borer. The larvae and work of the lesser peach borer greatly resemble those of the peach borer except that the minor pest usually attacks the upper part of the trunk and the large branches, fig. 8. Usually the lesser peach borer enters weakened trees or injured areas in trees.

Control.—The best control is to keep the trees in healthy growing condition and to avoid mechanical injuries.

Five seasons of tests in Illinois with PDB dissolved in miscible oil at the rate of 2 pounds of PDB to 1 gallon of oil and the solution diluted with water to make 2 gallons (2 ounces of PDB in 1 pint of mixture) averaged 86.7 per cent kill of the lesser peach borer when the mixture was painted on the affected areas.

A control measure has been developed in Georgia by the U. S. Department of Agriculture, Bureau of Entomology and Plant Quarantine. This measure consists of painting *the affected*

†For a more detailed account of the lesser peach borer, see Illinois Natural History Survey Circular 31, *The Peach Tree Borers of Illinois.*

areas only with a PDB solution, 1 pound of PDB in 2 quarts of cottonseed oil emulsified with fish-oil soap, and the emulsion diluted with water to make 2 gallons.*

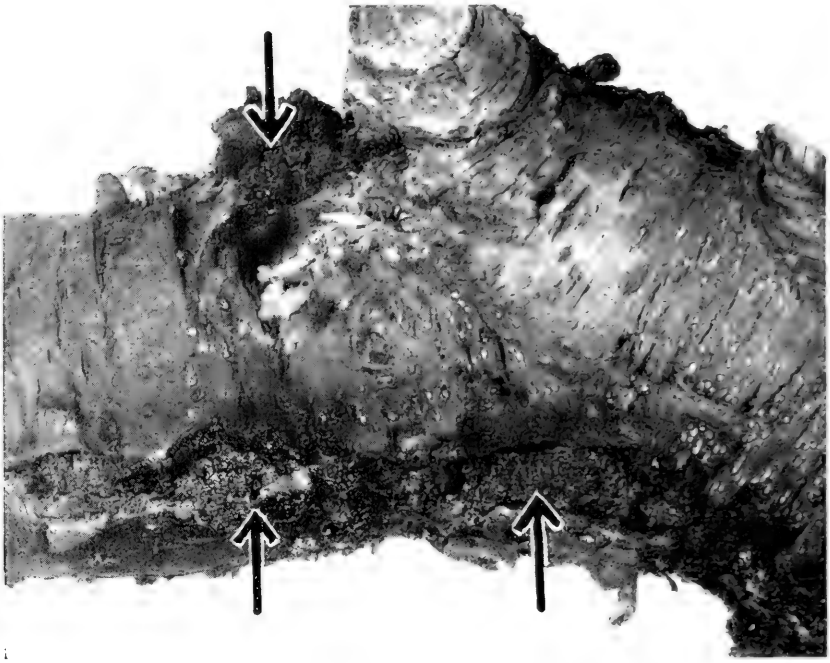


Fig. 8.—Injury caused by lesser peach borer.

Life History.—The appearance, except for its smaller size, and the life history of this insect are almost identical with those of the peach borer.

SHOT-HOLE BORER AND PEACH BARK BEETLE

Scolytus rugulosus Ratz.
Phthorophloeus liminaris (Harr.)

Appearance and type of injury.—These two bark beetles attack the trunk and branches of peach trees. A characteristically injured branch looks as if it had been hit with a charge of shot, showing many small, round holes, with dots of gum exuding.

**Insects Attacking the Peach in the South and How to Control Them*, by O. I. Snapp, U. S. Department of Agriculture Farmers' Bulletin 1557, May, 1928.

Control.—As the beetles attack chiefly weak or injured trees or branches, the best method of control is to keep the trees in good condition. A little extra cultivation or application of fertilizer may accomplish this. All peach prunings and diseased trees should be removed and burned during the dormant season.

Tests were conducted for three seasons with PDB in a miscible oil, *Dendrol*, at the strength recommended for the lesser peach borer, 2 ounces of PDB in 1 pint of diluted emulsion. The mixture was made with 2 pounds of PDB dissolved in 1 gallon of *Dendrol* and the solution diluted with water to make a total of 2 gallons. This mixture was painted on the affected areas of the trees. Over 98 per cent of the beetles of the shot-hole borer were killed, but only 17 per cent of the grubs. It appears necessary to treat when beetles have first attacked and before they

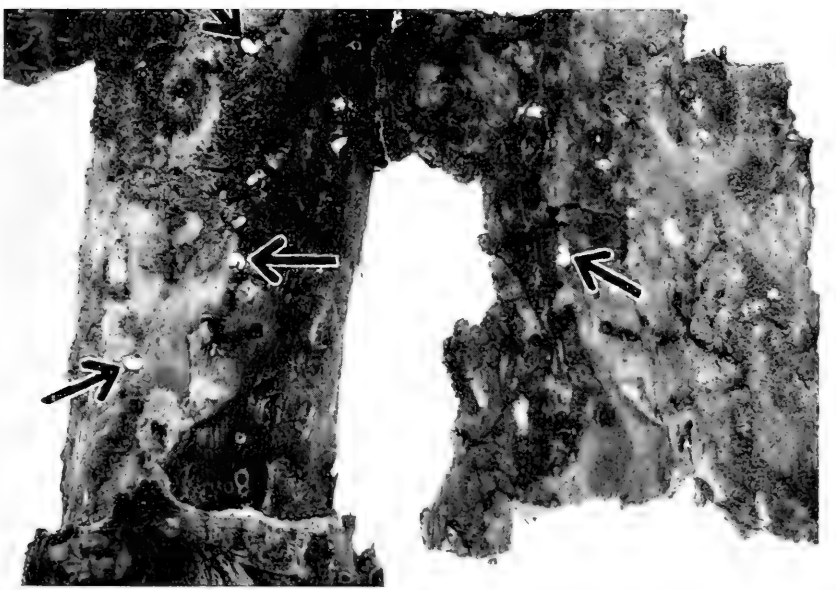


Fig. 9.—Branch of peach tree infested with bark beetles; the bark has been pulled off to show the white grubs in position.

have laid eggs. Our studies have not yet shown the optimum times for treatment. In 1938, in the southern end of the state, the first week in October was favorable, most of the insects then being in the adult stage.

Life history.—The beetles are brownish-black insects about a tenth of an inch long. The larvae are tiny pink-white footless

grubs, which make a series of tunnels just beneath the bark, fig. 9. At least two generations occur each year in southern Illinois.

TERRAPIN SCALE

Lecanium nigrofasciatum Perg.

Appearance and type of injury.—This brown, hemispherical scale, less than one-eighth inch across, is occasionally found covering twigs and small branches of peach trees in southern

Fig. 10.—Terrapin scale adults on peach twigs. About six times life size.*

Illinois, fig. 10. In summer, leaves and fruit may be covered with sticky honeydew on which grows a sooty black fungus.

Control.—Oil sprays having a strength of at least 4 per cent actual oil applied to the dormant tree are effective for control of this scale. Either miscible oils or oil emulsions, if used at a strength of 4 per cent, are satisfactory. Lime sulfur sprays will not control terrapin scale, usually of little importance.

Life history.—Fertilized females on the bark of small branches and twigs carry the scale over the winter. The females resume feeding early in spring. In late May or June they produce young, which one or two days after hatching crawl from under the females to the leaves, where they feed for a month, when the males mature as two-winged insects and mate with the females, dying soon after. The females continue feeding until cold weather.

*Illustration courtesy U. S. Department of Agriculture, Bureau of Entomology and Plant Quarantine.

Part II. Insects Attacking Twigs, Foliage and Fruit of the Peach Tree

ORIENTAL FRUIT MOTH

Grapholitha molesta (Busck)

Appearance and type of injury.—The first indication of injury by oriental fruit moth is usually the wilting of young twigs, caused by the boring of the small worms in terminal shoots, fig. 11. This twig injury has much the same effect as tip pruning, as it causes new growths to be put out below the point of injury: in extreme cases it dwarfs the tree. Injury to the fruit may or may not be seen. When visible, it appears as brown sawdustlike frass mixed with gum and sometimes a few threads of silk exuding from the peach. This frass usually distinguishes oriental fruit moth injury from that of plum curculio, in which only gum exudes. Fruit moth larva feeding inside the peach is a little cleaner than that of curculio and is nearly dry, with some webbing usually present, fig. 12.

The oriental fruit moth is a major pest of peach in Illinois. It was first found in the state in Pulaski County in 1927. By 1929 it had increased in prevalence until as high as 29 per cent infestations were found in fruit. Since then the infestation on Elbertas, which constitute 88 per cent of all the peaches grown commercially in Illinois, has fluctuated widely because of extremes in heat, cold and drouth, and also because of parasites. The highest average infestation found in our surveys of fruit at harvest was 22 per cent in 1935, with maximums of 50 per cent. The lowest average infestation occurred the next year, 1936, when because of excessive heat and dry weather it fell to only 3.3 per cent. On late varieties, Heath Cling and Krummel's October, it is very common to find the fruit 50 per cent to 80 per cent wormy. The insect is an uncertain and ever present threat to peach growers.

Control by parasites.—Since introduction into the United States in 1912 of parasitic control of oriental fruit moth, notable reductions in infestation have been achieved in several Eastern states. Of the 40 or more parasites attacking the oriental fruit moth, probably the one of greatest importance is a parasite of the larva, *Macrocentrus ancylivorus* Roh. This parasite is not native

to Illinois. Liberations have been made in almost every peach-growing county of the state, with the cooperation of Dr. H. W. Allen of the U. S. Department of Agriculture, Bureau of Ento-

Fig. 11.—Injury to twigs of the peach tree by burrowing larvae of oriental fruit moth.

mology and Plant Quarantine. In Illinois it has required a somewhat longer period than in the East for parasitism to become a factor in control. Table 2 records average infestation, as found in surveys made at harvest, and average parasitism, as reported by Dr. Allen from twig collections sent to him for rearing.

It will be seen that wide fluctuations in infestation occurred in the period 1935 to 1937, inclusive, with little change in parasitism. Parasitism had changed little for three years until an upturn started in 1937. In 1938, a season of very favorable weather for oriental fruit moth increase, the infestation dropped to 3.4 per cent, probably largely the result of the parasitism, which reached an average of 56.8 per cent for southern Illinois, twice that of the previous year and over three times that of the years 1935 and 1936. Several twig collections in 1938 showed 95 to 100 per cent parasitism, and the outlook now seems very favorable.

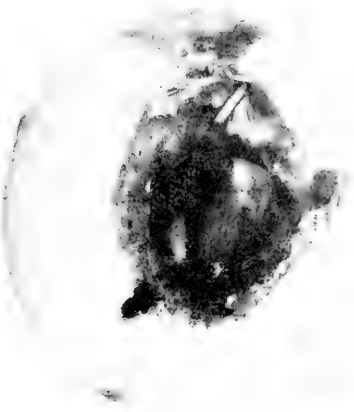


Fig. 12.—Cross section of peach showing injury to the fruit by larvae of oriental fruit moth. Somewhat less than life size.*

Control by sprays and dusts.—Because of the larva's habit of ejecting all the material it bites out in boring into the twigs or fruit, poison applied in the usual way to the surface of the fruit is of no value, and control measures based upon entirely different principles are necessary. To date the two most promising lines of attack are the use of oil dusts and the application of fixed nicotine sprays. No very definite recommendations can yet

*Illustration courtesy Purdue University Agricultural Experiment Station.

be made concerning the fixed nicotine. Our experience over a period of several years leads us to favor the oil dust where the grower is equipped to dust. The most effective period for the application of sprays and dusts is probably the latter part of the season, starting three to four weeks before harvest.

Table 2.—Oriental fruit moth infestation and parasitism in southern Illinois as determined by surveys at harvest and twig collections.

CONDITION	1934	1935	1936	1937	1938
Average per cent of peaches wormy	....	22.1	3.3	12.2	3.4
Average per cent of worms parasitized	20.0	17.7	17.3	28.0	56.8

Dust for oriental fruit moth control during the three weeks before harvest should not contain lead arsenate. Instead, it should be made up according to the following formula:

60 pounds dusting sulfur
35 pounds dusting talc
5 pounds lubricating oil of 80-110 viscosity

Tests during the seasons of 1937 and 1938 indicate that the substitution of talc for the lime formerly used will improve the oil dusts. The ingredients must be thoroughly blended in a dust mixer. Simply stirring the materials together will not make a satisfactory oil dust.

Our first experimental work with oil dusts under conditions of sufficient crop and heavy infestation began in 1929 and resulted in 79 per cent control; this figure is based on check blocks showing 25 per cent infestation. Since then control in our tests has varied from 48 to 97 per cent; such control results in peach crops that are 72 to over 99 per cent free of worms. We believe that if oil dusts are properly applied the grower can normally produce fruit that is 90 to 95 per cent free of oriental fruit moth.

At the present time we believe that one-half to one pound of oil dust should be applied to each mature tree, and that at least four applications should be given, the first starting three weeks before harvest and the last ending within two or three days of the first picking. For best results care must be taken in applying the treatment. The orchardist should apply the dust to both sides of each tree to get full benefit of the operation.

In almost every experiment in which as many as six liquid applications have been given, even in those blocks sprayed only with lead arsenate for curculio, or lime sulfur for peach scab

and brown rot, there has been a marked reduction in oriental fruit moth infestation, compared to infestation in the check plot.

Supplementary control measures.—Several supplementary control measures of little or unknown value are discussed here because of frequent queries about them. In the seasonal order in which the orchardist might undertake them they are as follows:

1. Early cultivation.—This has been a standard recommendation in Eastern states and if any appreciable percentage of our peaches were late varieties it would be worth while in this state. Careful hibernation studies since introduction of the insect into Illinois have shown very few worms carried over the winter in Elberta or Hale orchards, and the proportion of larvae wintering on the ground is insufficient to warrant the expense of cultivation. Especially is this true since cultivation would have to be completed by the time of petal fall, a procedure which if not impossible is often inadvisable in the hill lands of this state.

2. Collection and burning of infested twigs.—This operation has been found of little value under Illinois conditions in reducing infestation, chiefly because of the difficulty of finding all the newly entered twigs in an orchard and because of the entrance into the orchard of moths from other orchards a considerable distance away.

3. Banding.—This is possibly of some value on late maturing varieties, but not on Elbertas or earlier varieties. As high as 150 larvae to a tree have been caught in our banding tests on Krummel's October trees.

4. Use of PDB.—Tests conducted in 1929 showed a kill by PDB of 70 to 90 per cent of the oriental fruit moth larvae hibernating about the base of trees of late varieties. Hibernation studies, however, indicate that not more than 21 per cent of the larvae hibernate in the area reached by the gas, table 3, and because of the small amount of fruit moth hibernation in Elberta orchards this treatment is profitable only for its simultaneous control of the peach borer.

5. Bait trapping.—Adult oriental fruit moths are strongly attracted to certain odors, as revealed by a long series of tests carried on mainly by Yetter and Steiner of the U. S. Department of Agriculture, Bureau of Entomology and Plant Quarantine. Attempts have been made to control the moths by traps made from pails or jars containing scented liquids and hung

Table 3.—Situation of wintering oriental fruit moth larvae in southern Illinois. The figures are percentages based on approximately 1,000 cocoons found in the winters of 1928-29 and 1929-30.

On the ground	40 per cent	
In the trees	60 per cent	
At groundline	5 per cent	Could be reached by PDB
Groundline to 3 inches up trunk	16 per cent	
Three inches above ground to crotch	23 per cent	
In main crotches	5 per cent	
In branches	11 per cent	

on the trees. In two of the larger experiments 30,000 to 50,000 bait jars were used and many hundreds of thousands of moths were caught. While it is possible to catch large numbers of moths in bait pails, it has not yet been demonstrated that bait trapping is profitable from a commercial standpoint.

6. Removal of late maturing peach trees.—Many Elberta and Hale peach orchards contain a few late maturing trees, such as Heath Cling and Krummel's October or late seedlings, which are of very little commercial value to the owner and are left for home use or local trade. Our hibernation studies show 50 to 150 times as many larvae wintering on or under such trees as on or under Elbertas, and it is good policy to remove these late maturing trees, table 4.

7. Removing Hale "buttons".—For the same reason that later maturing varieties of peach become heavily infested, the late crop of small fruit on the Hale variety, called "buttons," is usually infested to a greater extent than is the main crop. Often these late, misshapen fruits are left on the tree, and on two occasions we have noted that infestation was greater the following year in that part of the orchard where these fruits were left than it was where they had been picked. For this reason we advise the removal of these fruits as soon as possible after the regular crop is harvested.

Table 4.—Comparison of early and late varieties of peach trees as hosts of wintering oriental fruit moth larvae, southern Illinois, 1928-29 and 1929-30.

Kind of Trees	Number of Trees Examined	Number of Larvae Found	Location of Larvae
Late maturing trees	14	967	Tree and ground beneath
Elberta	17	6	Tree and ground beneath
Elberta and Hale (Showing post-harvest twig infestation, 75% of tips injured)	40	4	Tree only

8. Avoiding the interplanting of peach and apple.—Where apples and peaches are interplanted the infestation of peaches by oriental fruit moth is, in general, more heavy than in orchards containing only peaches. Interplanting may result also in considerable damage to the apples. This condition is explained by the fact that the apples provide food for late brood larvae, and the peaches furnish food for the first three broods.

Life history.—The oriental fruit moth passes the winter as a full grown larva in a cocoon on some part of the tree or on the ground under the branches. In the winters of 1928-29 and 1929-30, studies were made to determine the percentage of worms hibernating in different situations. Approximately 1,000 larvae were found and their locations recorded, tables 3 and 4.

Larvae of the oriental fruit moth are pinkish yellow, about one-half inch long. They are very active and will drop suspended from a silk thread if disturbed when crawling about. Oriental fruit moth larvae are not to be confused with those of the peach twig borer; the latter are chocolate brown with body segments well defined, giving a ringed appearance.

In the spring, larvae of the oriental fruit moth change to the pupal stage at or before full bloom, and small brown or grayish moths emerge. The eggs are about half the size of a pin head, white and flattened. They are laid chiefly on undersides of leaves near the tips. On hatching, the larvae of the first and second broods bore into the young twigs. Third brood larvae feed largely in the fruit of peach, and fourth and fifth broods occur in the southern part of the state on apple, quince, pear and late varieties of peach.

PEACH TWIG BORER

Anarsia lineatella Zell.

Appearance and type of injury.—The peach twig borer is chiefly a pest of unsprayed orchards. Only once in the past 18 years (1930) has it become abundant in commercial plantings, and then very little damage was done. This borer causes an injury similar to that of the twig-boring oriental fruit moth, but the two pests may be distinguished on at least two counts. The twig borer is active before the oriental fruit moth, we judge from the 1930 infestation, boring into the tough wood of the tree as soon as the first leaves appear, fig. 13; the oriental fruit moth is not active until the trees have new growths 2 to 4 inches long,

when it attacks only the more tender twigs. Unlike the oriental fruit moth, the peach twig borer rarely attacks the fruit.

Control.—Standard dormant peach sprays of sulfur or oils for the control of San José scale are equally effective against the

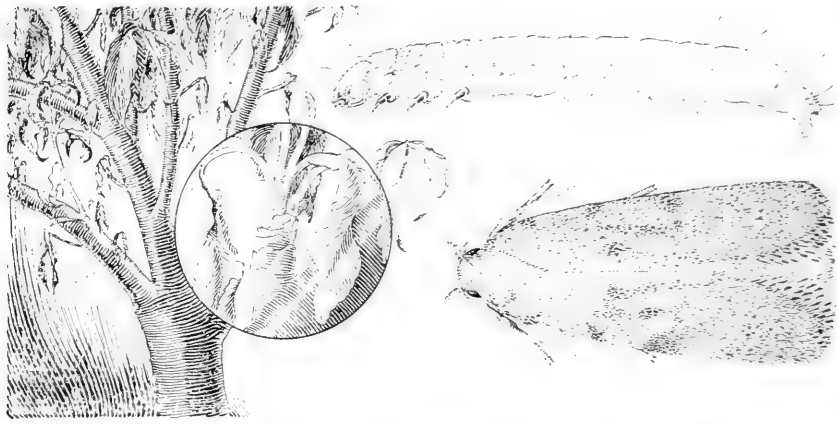


Fig. 13.—The peach twig borer. Eight times life size. Inset, wilting condition of twigs injured by larvae which attack the tender shoots and cause injury resembling that produced by oriental fruit moth.

twig borer. In California, where the insect is more important than in Illinois, orchardists find some advantage in postponing dormant sprays until the buds have reached nearly the pink stage; then they add lead arsenate, 6 pounds to 100 gallons, to the sprays.

Life history.—The partly-grown, reddish-brown larva, one-eighth inch long, passes the winter in a silken case on the trunk of the tree. It is easy to kill in this stage with a lime sulfur or oil spray. The larva leaves this shelter to attack the tree about the time first leaves appear and by its feeding causes the new twigs to wilt and die back to the old growth. The larval form attains a length of one-half inch; segments of the body are well marked. Two generations occur each year in Illinois.

PLUM CURCULIO

Conotrachelus nenuphar (Hbst.)

Appearance and type of injury.—The plum curculio, fig. 14, which attacks cherry, apricot, plum and apple, as well as peach, is one of the most destructive pests of the peach fruit. Fruit

wormy because of curculio is usually evidenced by gum or wax on the outside of the peach. Presence of the insect may be detected by early drop of small peaches, premature ripening, and drop shortly before harvest.

Two other types of injury by this insect are important. Punctures on the fruit made by the insect in feeding and egg laying develop into brown rot, which is always severe when curculio is abundant. Catfacing, the major proportion of which is usually attributed to the tarnished plant bug, is caused in

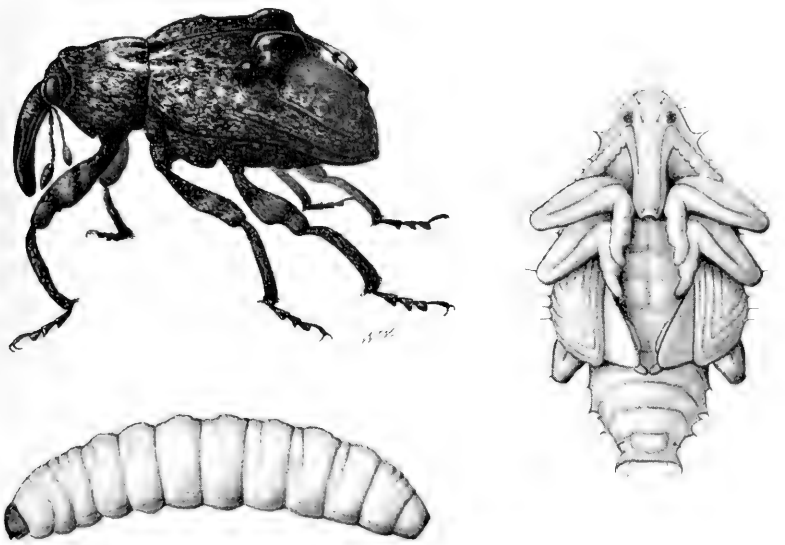


Fig. 14.—The plum curculio. Upper left, adult; below, larva; right, pupa. Nine times life size.

some amount by the plum curculio. This injury appears as scarred places on the fruit where the beetles have fed early in the season, fig. 15.

Control.—The peach grower must rely chiefly on spraying or dusting for control of plum curculio. As he does this work during the growing season principally for control of curculio and the resultant brown rot, this insect adds greatly to his expense.

Illinois Agricultural Experiment Station Circular 492 gives a complete spray schedule, including combination sprays for

both insects and diseases of peach.* For curculio the liquid sprays should contain 3 pounds of lead arsenate, 2 pounds of zinc sulfate and 3 pounds of lime for every 100 gallons of spray, except in the last application when the amount of lead arsenate

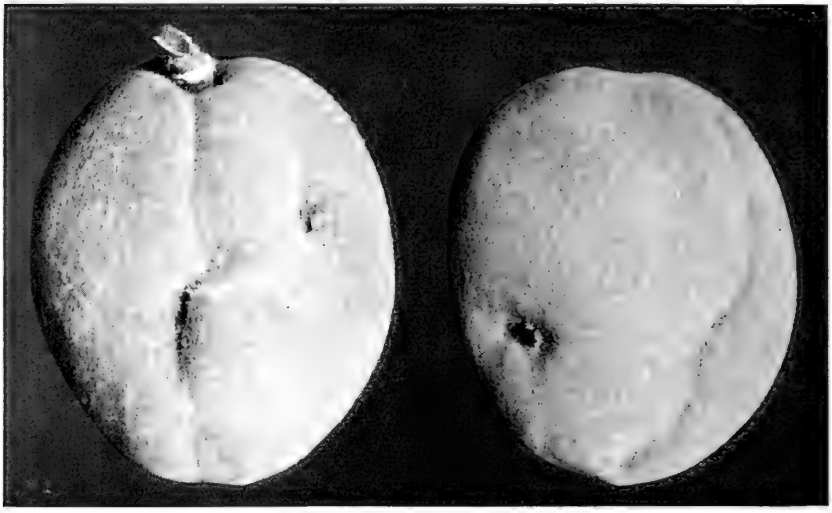


Fig. 15.—Catfacing of peach fruit that has been caused by the adult of the plum curculio.

should be reduced to 2 pounds to prevent possible residue. The dust should contain 10 pounds of lead arsenate in every 100 pounds of dust, except in the last application when the quantity of lead arsenate should be reduced to 5 pounds. The mixtures should ordinarily be applied at the following times during the season, though frequently one or more applications may be omitted:

1.—At that period in shuck fall when most of the shucks are half off the fruit.

2.—Ten days after the first application.

3.—Two to three weeks following the second application.

4.—One month before harvest (usually omitted).

An additional spray is often applied in severe curculio years between sprays 3 and 4 in the above schedule.

To determine the time when curculios are feeding on peaches

**Directions for Spraying Fruits in Illinois*, prepared by the University of Illinois Department of Horticulture and the Illinois Natural History Survey, revised March, 1939. May be ordered from the Illinois Natural History Survey, or Agricultural Experiment Station, Urbana, Illinois.

in southern Illinois, and consequently the best time to spray in that part of the state, a series of jarring collections begun at Carbondale in 1925 has been continued to the present. Natural occurrence of the insect was determined by collections made in unsprayed peach orchards. Ten trees were taken as a unit and jarred every few mornings throughout the season. The curculios were allowed to fall on sheets and were released after being counted so as not to interfere with their natural activities in the orchard. Every season since 1928 sprayed trees have also been jarred. The records, part of which are represented in fig. 16, disclose the following facts:

1.—Shuck fall is early enough for a first application of spray

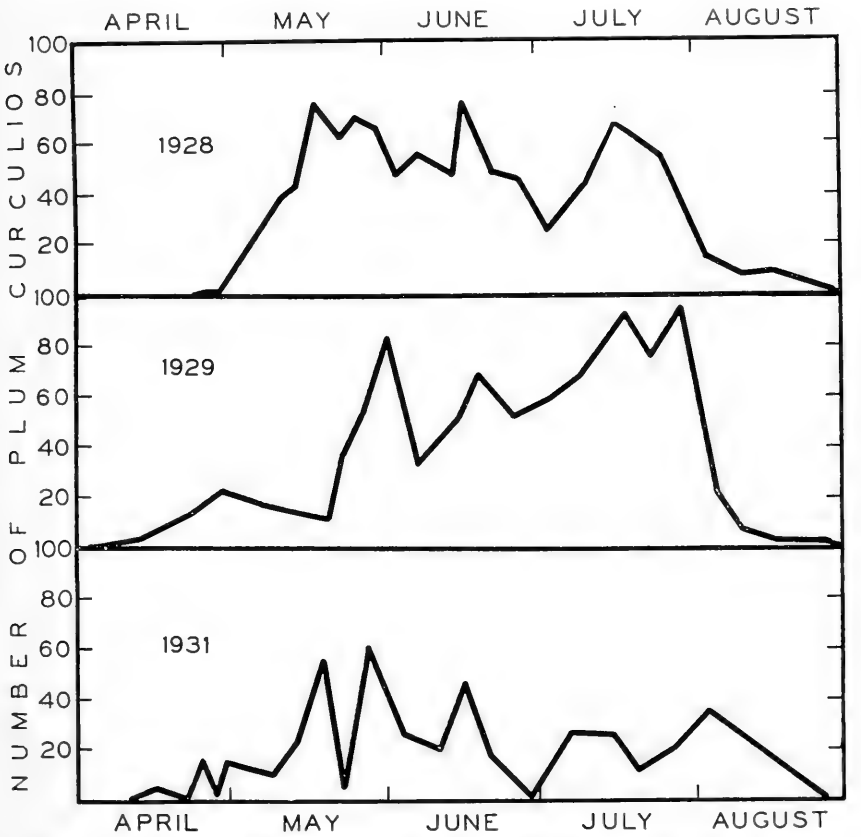


Fig. 16.—Graph of plum curculio occurrence on peach, indicating number of adult curculios jarred from 10 unsprayed peach trees in three southern Illinois orchards on the dates given. In years of light infestation, such as 1931, the first two sprays are normally sufficient.

or dust; a petal fall application thought necessary in some peach-growing sections of the United States has not been of sufficient value to be profitable in Illinois.

2.—Applications at shuck fall and 10 days later are the most important of the season and are all that are needed in years of light curculio infestation.

3.—Late sprays are of great importance in years of heavy curculio infestation, as in 1928 and 1929. Table 5 and fig. 16 indicate the need which arose in 1929 of including lead arsenate in the application one month before harvest. In that year more curculios were found in both sprayed and unsprayed orchards two to four weeks before harvest than at any other time.

4.—Occurrence of curculios on peach practically ceases by harvest, and attempts to poison them after harvest are usually not worth while.

We strongly urge that growers jar for curculio to determine the situation in their own orchards. Usually curculios do not hibernate in the peach orchard, but enter the orchard in the

Table 5.—Comparison of effectiveness of two dusts and one spray for the control of plum curculio on peach in southern Illinois.

			Percentage of Infestation in Treated and Untreated Blocks			
Year	Location	Peaches Examined	1 Oil Dust*	2 Standard Dry Dust**	3 Standard Spray†	4 Check Blocks
1929	Graves Orchard, Pulaski County....	1,000	5.0	10.1	2.3	28.3
1931	Chandler Orchard, Jackson County....	2,000	0.2	0.1	0.1	8.8
1932	Thomas Orchard, Jackson County....	2,000	2.7	...	2.5	24.8
1932	Chandler Orchard, Jackson County....	2,000	4.8	...	7.0	15.8
1933	.....	....	....	...	....	...
1934	.....	....	....	...	....	...
1935	Chandler Orchard, Jackson County....	2,000	1.2	...	0.25	6.4
1936	Hartline Orchard, Union County.....	1,000	0.4	...	....	20.0
1937	Chandler Orchard, Jackson County....	1,000	2.6	...	0.8	8.8
1938	Chandler Orchard, Jackson County....	2,000	4.6	...	3.7	14.1
Average of percentages....			2.68	...	2.38	15.8

*Dust containing 60 pounds dusting sulfur, 25 pounds dusting lime or talc, 10 pounds lead arsenate, 5 pounds lubricating oil of 80-100 viscosity.

**Standard dry dust: 80 pounds sulfur, 10 pounds lead arsenate, 10 pounds lime.

†Standard spray: 3 pounds lead arsenate, 2 pounds zinc sulfate, 3 pounds lime, 100 gallons water.

spring from neighboring woods, brush piles or fence rows. By jarring, the grower may be able to determine the side or sides of his orchard which they are entering. He may be able to concentrate his sprays or dusts around the edges with a considerable

Fig. 17.—Typical injury to peach leaves caused by lead arsenate spray.

saving in cost until his jarring shows him that it is time to apply poison farther in from the edges. Jarring tests in 1938 carried on in cooperation with two growers show that under some situations curculios are at no time during the season found in appreciable numbers in the center of the orchard; a saving in dust of 2,000 pounds and 1,000 pounds, respectively, was effected by these two growers with a resulting infestation of less than 1 per cent. In cases of heavy infestation, jarring may give the grower the warning to continue control measures longer than has been his custom, and the saving may come from cleaner fruit. The frontispiece shows jarring by a grower.

Too much lead arsenate in the sprays will result in arsenical injury to the trees. Roughening of the bark, which is usually

accompanied on the younger twigs by exudation of gum around the axil of the leaf or fruit, may be produced. On foliage the injury may have a shothole appearance, or partial defoliation may result, figs. 17 and 18. Cooperative tests with the Department of Horticulture of the University of Illinois disclose that the use of 2 pounds of zinc sulfate and 3 pounds of hydrated lime to 100 gallons of water greatly reduces injury from lead arsenate, but that injury may occur under certain weather conditions in the face of this precaution. Oil dusts containing 10 per cent lead arsenate cause very little injury even in seasons when liquid sprays burn severely, fig. 19.

Cryolite is a material of potential value as a peach spray, fig. 20. The 1938 results of tests in growers' orchards looked promising. However, some injury from its application occurred in that year. Severe injury to fruit occurred in 1939. No definite recommendations as to the use of cryolite can be made.

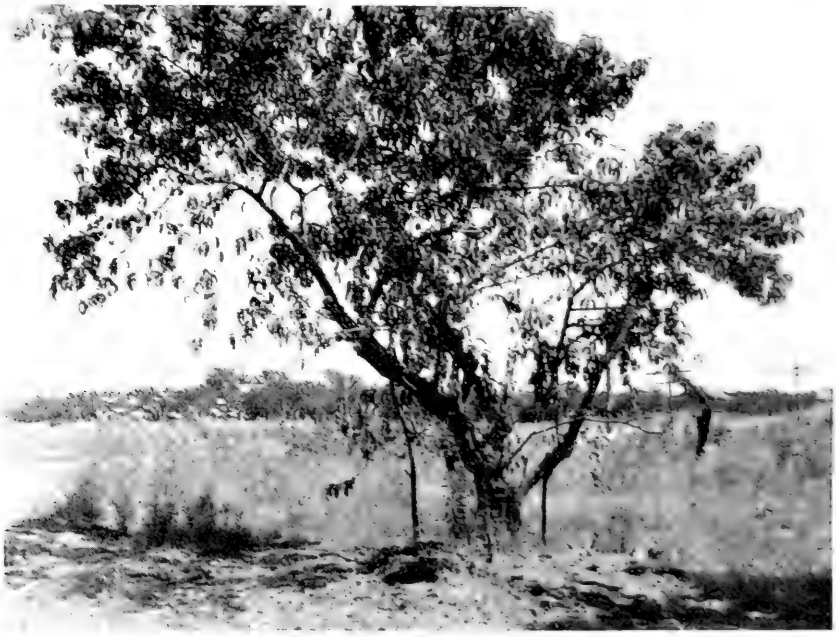


Fig. 18.—Peach tree that during the rainy spring of 1938 received two applications of lead arsenate spray at the rate of 3 pounds of the poison to 100 gallons of water. To each spray were added 2 pounds of zinc sulfate and 3 pounds of lime to each 100 gallons of water. This tree shows heavy defoliation resulting from lead arsenate spray even when the spray has been buffered with zinc sulfate and lime, as compared with little injury on trees treated with oil dust or cryolite, figs. 19 and 20.

Dusts have given fairly satisfactory results where used frequently. However, in our experiments covering years of moderate to severe infestation, dusts used on the regular sched-

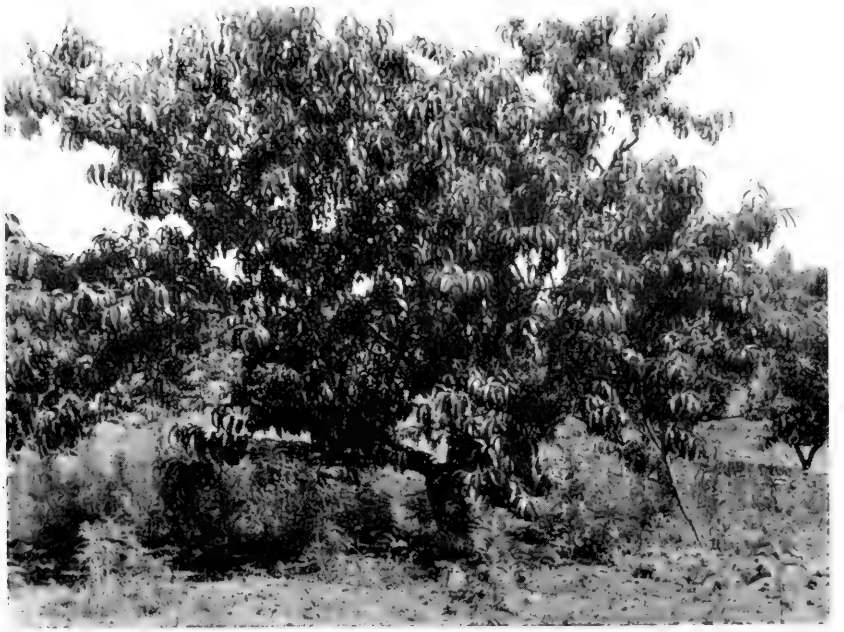


Fig. 19.—Peach tree that during the rainy spring of 1938 received two applications of oil dust containing 10 per cent of lead arsenate. Compare this tree with those in figs. 18 and 20.

ule, in the proportion of 80 pounds sulfur, 10 pounds hydrated lime and 10 pounds lead arsenate, have not given as good results as have sprays.

Oil dusts containing 5 per cent oil by weight, developed in the course of Illinois work on control of oriental fruit moth, have for seven seasons given good control of plum curculio, as shown in table 5.

One of the best dusts for use on peaches for the control of curculio is made by thoroughly mixing the following ingredients:

30 pounds dusting sulfur
30 pounds dusting talc
25 pounds dusting lime
10 pounds lead arsenate
5 pounds lubricating oil of 80-100 viscosity

Supplementary control measures.—The following supplementary control measures are of value.

1. Winter clean-up.—This includes general orchard sanitation.

2. Pick-up of drops.—We have regularly found early drops 50 to 90 per cent wormy; with low labor cost it may be profitable to pick them up when infestation is severe. The first pick-up

Fig. 20.—Peach tree that received two applications of cryolite at the rate of 4 pounds cryolite to 100 gallons of water. Compare this tree with those in figs. 18 and 19.

should be made about one month after bloom, and two or three additional collections at intervals of five or six days. The drop peaches should be burned or buried at least 2 feet deep.

3. Cultivation.—Late spring and early summer cultivation destroys larvae and pupae in their cells in the ground.

Life history.—The adult plum curculio is a dark brown beetle, about one-fourth inch long, with four small humps on its wing covers, fig. 14. Its mouthparts are at the end of a trunklike snout which is nearly a third as long as the body. The adult passes the winter in brush piles, fence rows, the edges of woods and similar situations, and emerges in spring. At or a little

before shuck fall the female cuts a crescent-shaped slit in a young peach or apple, plum or apricot. In the flap thus produced she lays a single egg. A white footless grub hatches from this egg and feeds on the pulp of the fruit. The infested fruit usually drops in the course of two or three weeks; the larva when full grown leaves it to burrow 2 or 3 inches into the ground. Here it makes a cell in which to pass the pupal or resting stage. From pupae the next brood of beetles emerges, beginning the first part of July and continuing into August. The emerging beetles feed on the peaches and then go into hibernation, to reappear the next year. Under favorable circumstances, however, a second brood may occur the same year in southern Illinois. In 1927 a few individuals of a second brood, which began to emerge in August after peach picking, were reared in an insectary. Again in 1933 a few individuals were reared, beetles emerging in September. Meager results of attempts to rear second brood plum curculio seem to indicate that this brood is of little importance in Illinois.

Moisture largely determines the extent of emergence from the pupal stage. Table 6 records results of emergence experiments in which 2,000 to 8,000 wormy drop peaches, or apples, were placed each year in screened cages sunk in the ground

Table 6.—Emergence of plum curculio in cages from drop peaches, eight years, and apples, one year, in southern Illinois.

Year	Wormy Drops in Cages	Number of Plum Curculio Emerged	Percentage of Plum Curculio Emerged
1925	1,700	15	0.9
1926	2,100	13	0.6
1927	2,000	69	3.4
1928	3,000	33	1.1
1929	8,000	564	7.0
1930*	4,000	16	0.4
1931	1,550	35	2.2
1932	2,000	420	21.0
1933	1,600	165	9.0

*Apples. All other years, peaches.

under the branches of orchard trees. The dates and number of beetles emerging were recorded. As the table shows, there was a heavy emergence in the wet year 1929 and a very slight one in the drouth year 1930, with a return to an approximately normal emergence in 1931. The rainfall in 1932, while not excessive, was very evenly distributed during the period most important to the insect. In 1933 excessive rainfall occurred from

early spring until the middle of May; the rest of the year was exceedingly dry. There appeared to be sufficient hold-over effect of the early moisture to allow considerable percentage of emergence.

TARNISHED PLANT BUG

Lygus pratensis (L.)

Appearance and type of injury.—The tarnished plant bug, although considered a minor pest, often damages as much as 10 per cent of the Illinois peach crop. There are few, if any, years in which the insect does not cause blemishes on 2 per cent of all peaches grown in the state. Catfacing is the most common injury inflicted by the bug. This sometimes appears as closed

Fig. 21.—Injury to peach fruit caused by adult tarnished plant bug.

lesions varying from slight dimples to extensive puckered areas, fig. 21. No pubescence develops on the injured places. The damage is worked early in the development of the fruit and it may be localized on a given tree, some branches having no affected fruit, although others may have a large part of their peaches disfigured.

Less important, except in seasons of very light set of fruit, is a second type of damage caused by the tarnished plant bug—death of the tiny fruit shortly after petal fall as a climax to injuries inflicted by the bug's feeding during the period of bloom.

Stopback or dieback is a third injury, important chiefly

to nurserymen. The tarnished plant bug causes a wilting or dying back of new growth when it sucks the sap from the tender terminals. Injury is caused either by the injection into the tree

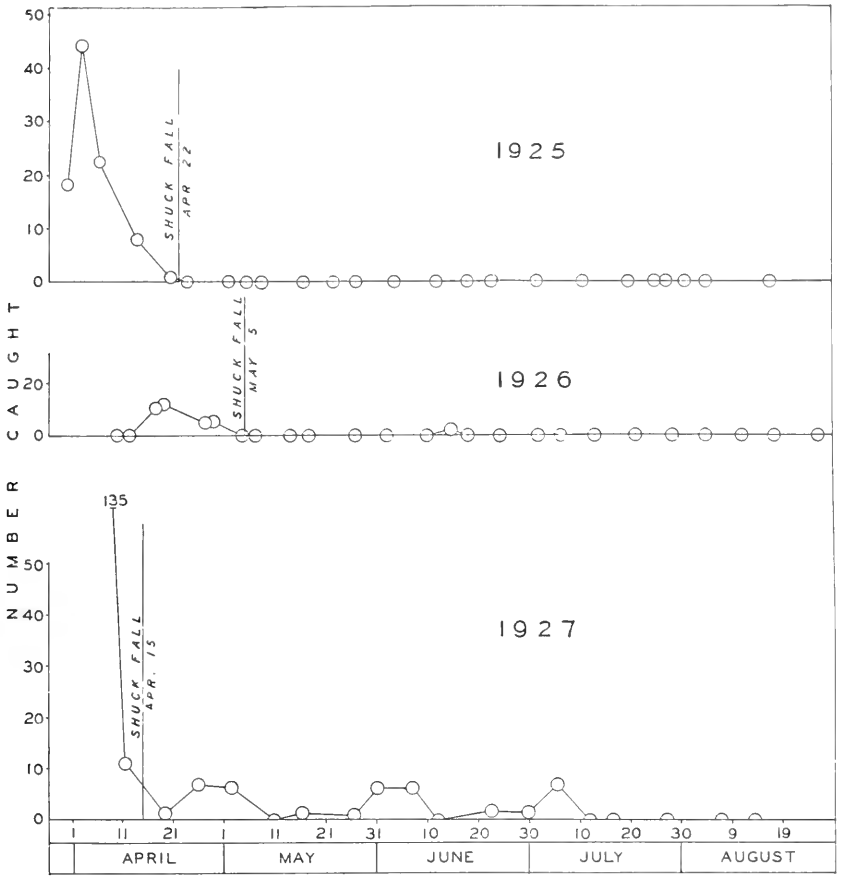


Fig. 22.—Records of tarnished plant bug occurrence. Ten unsprayed trees were jarred between 6 and 7 a. m. over a period of five months in each of the three years given. The records indicate that few to none of the insects remain in the trees after shuck fall.

by the bug of some toxic substance or by a complicated reaction of the tree to the plant bug feeding.

Control.—Although much time has been devoted to elimination of tarnished plant bug in Illinois, Indiana and other states, no satisfactory control measure has been developed. Being a sucking insect, the bug must be hit by a contact poison in order

to be killed. It is very active and hard to hit with any spray or dust. Any possible application of such treatment has to be made very early, immediately after petal fall; nearly all the bugs have left the peaches by shuck fall, as is indicated in fig. 22.

Elimination of weeds in and about the peach orchard may decrease infestation. Observations show a connection between catfacing and the presence of legumes in and close to orchards.

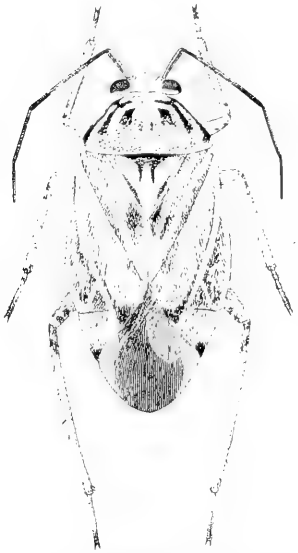


Fig. 23.—Adult tarnished plant bug. Twelve times life size.

While thinning cannot be classed as a control measure, it is a means of reducing losses from catfacing. The injured fruits may easily be detected as the peaches increase in size. Experiments by Dorsey and McMunn* indicate that effective thinning may be done as late as four weeks before harvest. Many growers are now taking advantage of this discovery to eliminate defective fruit.

Life history.—The adult of the tarnished plant bug is a coppery brown insect flecked with darker brown and yellow; it is oval shaped and about a quarter inch long, fig. 23. In Illinois it passes the winter hidden in many kinds of shelter, but it prefers wild parsnip, alfalfa, clover and, most of all, mullein. So greatly is the last plant preferred that we have used the number of bugs found hibernating in it as an index to abundance of the insect.

In early spring the adult becomes active and flies to the peach trees. It leaves them for other crops rather early in the development of the fruit and feeds largely on legumes.

STINK BUGS

Euschistus euschistoides (Voll.) *Euschistus tristigmus* (Say)
Euschistus variolarius (Beauv.) *Euschistus servus* (Say)

Appearance and type of injury.—Two types of injury, catfacing and dimpling, are caused by the stink bug, fig. 24. The green soldier bug, as one kind of stink bug is commonly called,

*Development of Peach Seed in Relation to Thinning, by M. J. Dorsey and R. L. McMunn. American Society of Horticultural Science, 1926, page 402.

Fig. 24.—Injury to fruit by adult of the stink bug. *Euschistus tristigmus* (Say)

specializes in dimpling the fruit, while at least four species are known to cause catfacing in Illinois and Indiana, continuing to produce the injury five or six weeks after petal fall.

Control.—No pratical control measure for this insect is known to exist.

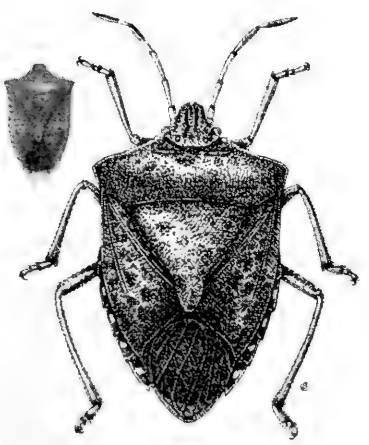


Fig. 25.—Adult of the stink bug. *Euschistus servus* (Say). Inset shows the bug approximately life size.

Life history. — Stink bugs have a modified triangular form about a half inch long and quarter inch wide, fig. 25, and are usually brownish green. They hibernate as adults and first appear on the peach about petal fall. A few species lay small groups of eggs on the peach tree leaves, fig. 26. After the young hatch they cluster about the egg mass for a few days until they molt. Then they leave the peach trees and may be found in large numbers in fields of cowpeas and soybeans. They also feed extensively on weeds, particularly on one of the fleabanes, *Erigeron canadensis*, com-

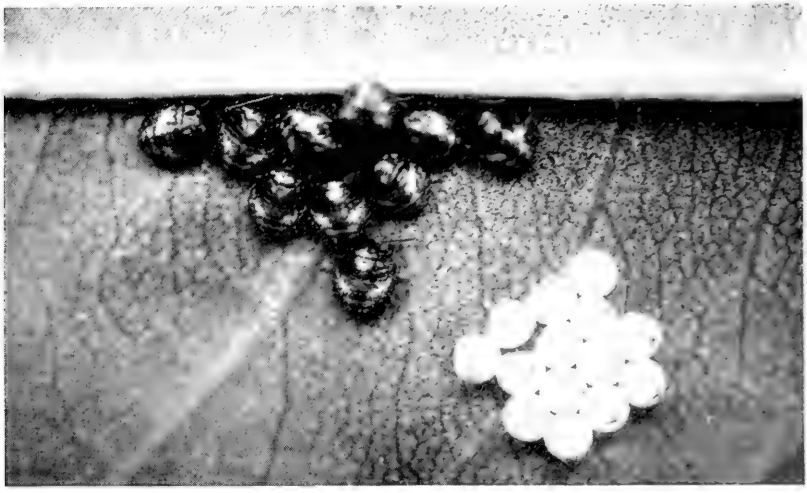


Fig. 26.—Colony of small stink bugs clustered on leaf near egg mass from which they hatched. About six times life size.

monly called butterweed or horseweed. Frequently stink bugs are responsible for the late catface injury which occurs on peaches in southern Illinois.

JAPANESE BEETLE

Popillia japonica Newm.

Appearance and type of injury.—The injury to peach by the Japanese beetle occurs entirely from the feeding of the beetles on the ripe or nearly ripe fruit. The beetles do not feed on the fruit while it is green, but just as it is beginning to ripen they descend upon it. In areas where the insects are abundant they eat almost all the fruit on the trees or break the skin and gouge the fruit in such a way as to render it unmarketable. Clusters of the beetles may be found on the fruit, sometimes 50 or more on a single peach.

Control.—Spraying with the materials ordinarily recommended for the control of curculio is of some value in repelling the Japanese beetle. Anyone seeing an insect of this sort feeding on the peach is urged to send it at once for identification to the chief entomologist, Illinois Natural History Survey, Urbana.

Life history.—The Japanese beetle is a robust, bronze and green beetle about a quarter inch wide and one-third inch long, fig. 27. The wing covers are bronze. The insect has a metallic

green, triangular, shieldlike area just behind the head and four white dots on the tip of the abdomen, which protrudes from under the wing covers. It has been found in most of the states to the east of Illinois and in St. Louis, Missouri, and East St. Louis, Illinois. More than 2,500 of the beetles have been caught in traps in the Chicago region of Illinois during the past four years, but the Japanese beetle has not yet reached the commercial peach-growing counties so far as we know (summer, 1939).

Fig. 27.—Adults of Japanese beetle attacking fruit. Slightly larger than life size.

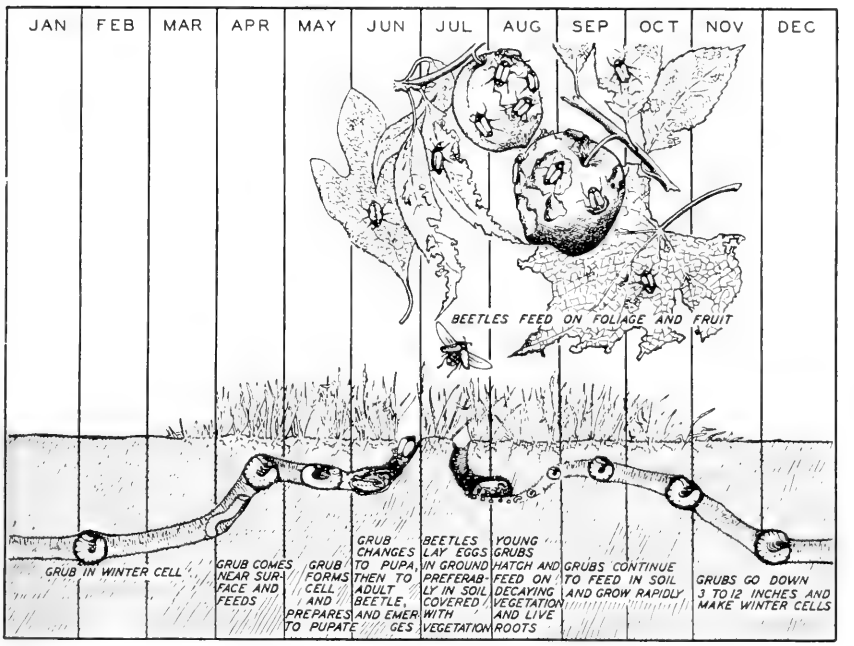


Fig. 28.—Life history of the Japanese beetle.*

The Japanese beetle in most of its range has one complete brood each year, fig. 28. In certain parts of the eastern United States where the soil is wet and cold the beetle may produce only one brood in two years. It passes the winter only in the

*Illustration an adaptation of drawing from the Pennsylvania Department of Plant Industry.

grub stage in a cell several inches deep in the soil. In the spring the grubs feed until late May and then go into the pupal or resting stage, in which they remain for several weeks. In June they start emerging as beetles and continue to emerge through August and in small numbers in September.

The eggs are laid singly in the soil and hatch in about two weeks into small grubs, which feed at first principally on decaying vegetable matter and to some extent on living plant roots. At the start of cool weather the grubs go down in the soil to a depth of 2 to 6 inches and form the protective cells in the soil in which they winter.

GREEN JUNE BEETLE

Cotinis nitida (L.)

Appearance and type of injury.—The green June beetle, as found in southern Illinois, feeds on a wide variety of plants and occasionally attacks peaches just before ripening. The insect eats off the surface of the fruit, usually causing a decaying area to develop. Occasionally it cleans off all flesh clear to the pit.

Fig. 29.—Adult of green June beetle attacking fruit of the peach. Life size.

Fig. 30.—Larva of green June beetle in characteristic position, on its back. One and one-half times life size.*

Control.—As no arsenic spray can be used at the time of attack by this insect, no control other than jarring or hand picking avails. Manure piles in the vicinity of orchards, which may act as breeding places for the insect, should be removed.

Life history.—The beetle is a conspicuous green in color, about three-fourths of an inch long and somewhat flattened, fig. 29. The larva is a dirty-white grub, reaching a length of about 2 inches, which feeds on decaying vegetation and is recognized by the habit of crawling on its back, fig. 30.

*Illustration courtesy U. S. Department of Agriculture, Bureau of Entomology and Plant Quarantine.

COTTON LEAF WORM MOTH

Alabama argillacea (Hbn.)

Appearance and type of injury.—This is the only moth found in Illinois which in the adult stage is capable of puncturing the skin of such fruits as peach, grape and apple. The moth attacks the ripe peaches, chiefly of the late varieties, such as Krummel's October and Heath Cling, on which it may be seen in very large numbers. Although the moths may puncture the skin, they feed extensively through cracks in it, fig. 31. Brown rot usually results from this feeding.

Fig. 31.—The cotton leaf worm moth feeding on fruit. Life size.

Control.—Application of sulfur dust or spray helps to control the brown rot which follows the moth injury, and may have some repelling effect on the moths of the cotton leaf worm.

Life history.—The moth is about 1¼ inches from tip to tip of wing, and is olive tan, with three wavy transverse bars on each front wing. The larva feeds only on the leaves of cotton. It is a subtropical insect and does not winter in Illinois. The cotton leaf worm moth is a strong flier; it frequently travels north into Canada.

APHIDS

Anuraphis persicae-niger (Smith) The Black Peach Aphid
Myzus persicae (Sulz.) The Green Peach Aphid

Appearance and type of injury.—Greenish aphids or plant lice occasionally are found sucking the sap from twigs and new fruit. This is the green peach aphid. Occasionally working in the tree but chiefly on the roots is a brownish colored plant louse, the black peach aphid. The latter insect occasionally causes serious damage to the roots of young trees planted in old peach orchards, sucking the sap and frequently causing the death of the trees.

Control.—Aphids rarely become of sufficient importance in Illinois peach orchards to justify control measures. Those aphids found in the upper part of the tree may be killed by a 40 per cent nicotine sulfate solution, 1 pint to 100 gallons, with 2 pounds

of potash fish oil soap, if the spray is applied thoroughly enough to strike their bodies. No definite control is known for the black peach aphid, as it works on the roots, but if infestation occurs it is advisable to apply one-fourth ounce of PDB per tree, keeping the material away from the trunk, and to increase fertility of the soil to stimulate plant growth. Recent work by the Ohio Agricultural Experiment Station indicates that lack of good growth in young trees may be due not so much to the aphids as to infertility of old peach soil. The Ohio experimenters have found it possible to get good growth of young trees planted in old orchards when new earth has been brought in from the outside and used next to the roots.

GRASSHOPPERS

Melanoplus spp.

Appearance and type of injury.—Occasionally grasshoppers become sufficiently numerous in a peach orchard to cause serious damage by eating the foliage and gnawing the bark from the twigs.

Control.—One of the most effective ways of destroying grasshoppers is by the use of a poison bran bait attractive to them. Effective poisons are described fully in other publications.*

TREE CRICKET

Oecanthus nigricornis Walk.

Appearance and type of injury.—The black-horned tree cricket occasionally causes slight injury to peach by laying rows of eggs in the twigs, 50 to 75 eggs in a row and about 25 to the inch. The twig may die above the series of punctures. Eggs of the tree cricket are pale yellow in color and about one-eighth inch long.

Control.—Control of tree crickets has never been necessary on peach in Illinois. It is probable that ordinary spraying and dusting hold down infestation.

Life history.—Adult tree crickets are very slender green

**Fighting Grasshoppers on Illinois Farms*, by J. H. Bigger, W. P. Flint and M. D. Farrar. University of Illinois College of Agriculture Circular 466, in cooperation with the Illinois Natural History Survey, January, 1937.

Oil Baits for Grasshopper and Armyworm Control, by M. D. Farrar, W. P. Flint and J. H. Bigger. University of Illinois Agricultural Experiment Station Bulletin 442, in cooperation with the Illinois Natural History Survey.

insects with antennae or feelers longer than the body, fig. 32. One generation occurs each year. Eggs are deposited in the fall.

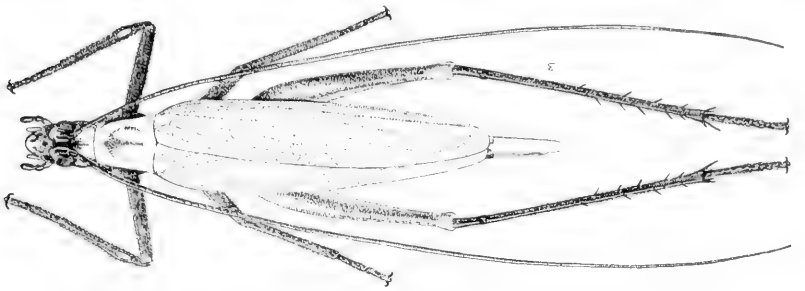


Fig. 32.—Adult female tree cricket. Four times life size.

The insect winters in the egg stage and hatches in spring. The adult male produces chirping notes by rubbing together specially modified parts of the forewings.

PERIODICAL CICADA

Magicicada septendecim (L.)

Appearance and type of injury.—The extent of the damage done to twigs of peach by the 13-year race of the periodical cicada would class this insect with those usually unimportant but occasionally severe. The injury is produced by deep egg-laying cuts, 1 to 4 inches long in the twigs. The cuts sometimes cause the twigs to break off. The injury is more severe in young trees than in those of bearing age. In the latter the weight of the peaches may break the twigs, causing loss of fruit. Infestation is greatest near wooded areas, or where the land was wooded 13 years before, and for this reason is especially heavy in the hill section of southern Illinois.

Control.—The best control measure, if the planting is small and the orchard young, is to cover the trees with cheese cloth. Some agricultural experiment stations, notably that in Michigan, have successfully used a nicotine spray. A good formula for this is as follows:

Nicotine sulfate.....1 quart
Soap (fish oil soap or any good laundry soap).....4 pounds
Water.....100 gallons

The insects must be hit with this spray if they are to be killed.

THRIPS

Frankliniella spp.

Tiny yellow insects called thrips have been generally accused of causing catfacing. Experimental work, field examinations and observations both in this state and in Indiana have proved definitely that catfacing is not caused by thrips.* These insects are often found in large numbers in the peach blossoms, but there is very little evidence of accompanying injury.

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*Some Causes of Catfacing in Peaches, by B. A. Porter, S. C. Chandler and R. F. Sazama. Illinois Natural History Survey Bulletin 17(6):261-75. March, 1928.

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