

The Agricultural Experiment Station

OF THE

Colorado Agricultural College

SOME INSECTS AND MITES ATTACKING THE PEACH IN COLORADO

By GEORGE P. WELDON

TWO PLANT LICE OF THE PEACH

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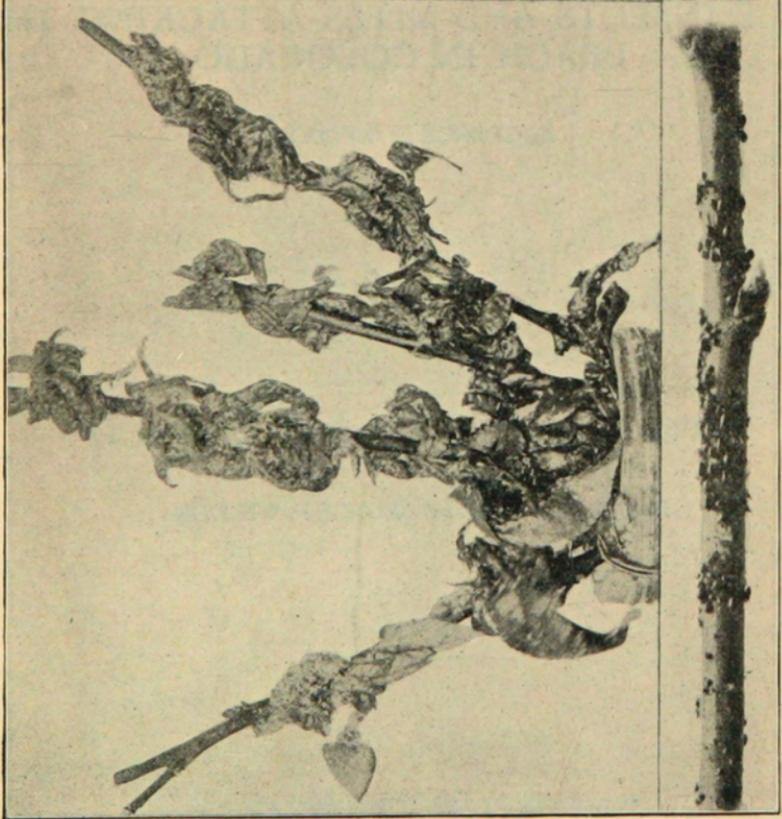


PLATE 1—FIG. 1

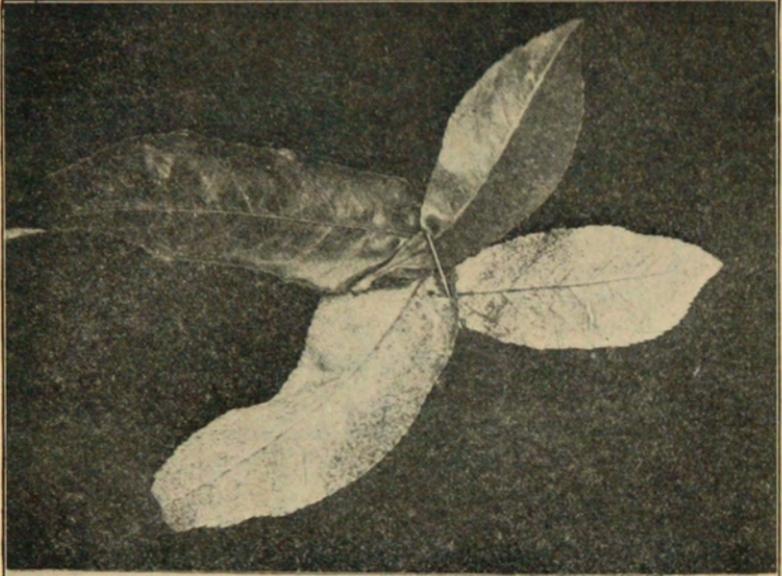


FIG. 2

FIG. 3

PLATE 1—FIGURE 1, Peach leaves curled by green peach louse. FIGURE 2, Black peach aphid on twig early in spring. FIGURE 3 shows one green peach leaf and three faded ones caused by attack of brown mites.

SOME INSECTS AND MITES ATTACKING THE PEACH IN COLORADO

By GEORGE P. WELDON

The peach industry in the western slope region of Colorado is one of much importance, and the need for literature treating of a few insect pests and mites that the peach grower must reckon with, seems to be great enough to justify the publication of this bulletin.

The novice in the business of growing peaches in Colorado very often begins with a mistaken notion that peach trees require no spraying. That notion has probably grown out of the fact that in the early history of orcharding in the State, spraying for the control of insect pests was confined almost entirely to apples. While the spraying of peach trees may not be necessary every season, there are times when certain sprays are necessary in order that destructive pests may be controlled. One who hopes to make a success growing high grade fruit must resort to spraying whenever the prevalence of some insect pest demands it. It would not be wise to lay down set rules for the spraying of peaches, for there are too many factors that may bring about a marked increase or decrease in the numbers of certain pests occurring from season to season. For example, last spring a very severe infestation of the common green peach aphid in the peach growing sections of Colorado, made it necessary that stringent methods of spraying be adopted. The previous spring the occurrence of this pest was very general, but it was not abundant enough in most orchards so that it was necessary to spray for its control. Often a dormant spray of lime and sulphur, or soluble oil is beneficial in orchards where certain pests may be spending the winter. Too much, however, should not be expected of dormant sprays, and while there are insects that they may control very effectively, there are others that will be controlled but partially or not at all. Very often the orchardist who uses a lime and sulfur spray, seems to lose sight of this fact, and because the spray does not meet with his expectations in controlling some certain pest, he condemns it for all of them. As a matter of fact he probably was paid for its use in the destruction of some other pest.

THE PEACH TWIG-BORER (*Anarsia lineatella* Zell)

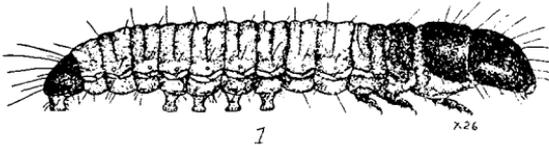
One of the most common enemies of the peach in the United States, is the twig-borer, or "bud worm" as it is sometimes called. Its occurrence has been reported from most of the peach growing states of the Union, both in the East and West.

In Colorado it has been known for a number of years, and while it is not a seriously injurious pest every season, there are seasons when it becomes exceedingly destructive, and is responsible for a great financial loss to those peach growers who do not adopt proper methods of control.

The adult of the twig-borer is a tiny, dark gray moth. It is an Old World species, supposed to have come to us with the peach from Western Asia, and has been known in the United States since 1860.

Kind of Trees Affected.—The twig-borer is principally an enemy of the peach, and usually we hear of it in connection with its damage to this fruit. It may be found, however, on all stone-fruit trees, but shows a decided preference for the peach. In Bulletin 80, of the United States Department of Agriculture, Dr. Marlatt mentions the pear among its list of food plants. The writer has never noted the attack of this insect upon other than stone-fruit trees. Its occurrence on the pear or other pome fruits is probably rare, and might be compared to the occurrence of the codling moth, which is almost exclusively an enemy of the pome fruits, in plums, peaches, or other stone-fruits. While cases of codling moth infesting stone-fruits in any numbers are rare, they were found the past season, so plentiful in Burbank plums of a certain orchard, that they were really doing considerable damage. The twig-borer, during a season of abundance, might occasionally modify its habits to the extent of an occasional attack upon pome fruits, as the codling moth in a season of abundance may modify its habits and occasionally attack stone-fruits.

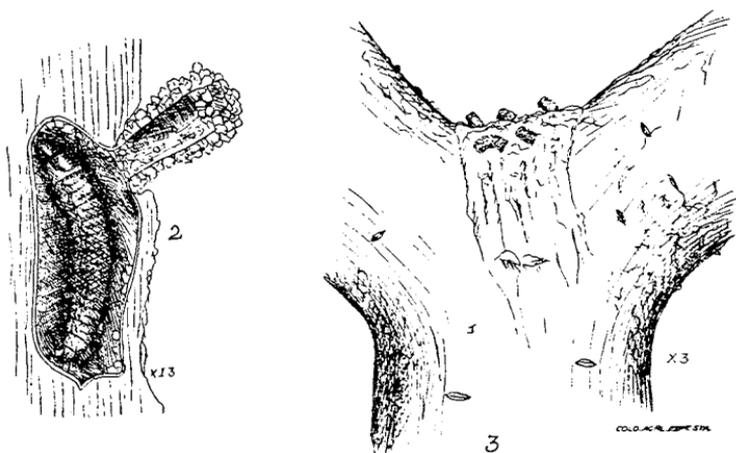
The Larvae and Their Injury.—The larvae, as is shown in Fig. 1, hibernate in little silk-lined chambers constructed within the



bark and very close to its surface. Mr. Warren T. Clarke, in his bulletin, *states that "in the majority of cases they are found just beneath a thin layer of the greener cells, just below the brown bark, while the greater part of the burrow is in the yellowish portion of the cambium." He also states, in connection with the winter burrow within the bark, that: "The position generally chosen on the tree for the purpose is the crotch formed where the new wood joins that of the previous year, though older crotches are occasionally selected." In Colorado I have found them almost entirely in the older crotches and always, when found there, they have been in the brown portion of the bark, just as close to its surface as the hibernacula could be constructed. Occasionally the hibernating cells containing larvae, have been found underneath buds on the new growth of peach trees. Their occurrence in this location does not seem to be at all general.

*Bull. 144, Calif. Exp. Sta.

While hibernating the larvae vary somewhat in size, but are all very small, and their detection is somewhat difficult, except when very close observations are made. The presence of the larvae themselves during the hibernating period, could scarcely be detected were it not for the fact that they construct, at the entrance to their burrows, tiny silken tubes covered on the outside with bits of bark, which were chewed off by the larvae while excavating the hibernacula. These little tubes are shown in the crotch of a tree in Fig. 3, and again one is shown at the entrance to a burrow containing larvae in Fig. 2. The larval cell is also lined with silk, the silken tube being merely a continuation of this cell lining. Throughout the winter months the hibernating larvae remain inactive within this



cell. Apparently no feeding is done after the time that they construct the cells until they leave in the spring, consequently no growth takes place during that time. A hibernating larva, magnified 26 diameters, is shown in Fig. 1. These larvae are exceedingly well protected in their hibernacula, and Mr. Warren T. Clarke's experiments in California show that they are almost impenetrable to even an oil spray during the winter season.

In the spring of the year, about the time the peach trees bloom, the larvae leave their winter quarters and eat into the tips of the twigs, either beginning their work at the extremities or a short distance below, sometimes hollowing them out for usually a distance of less than an inch from where the twig was entered, leaving a mere shell or hollow cylinder of the portion in which they have fed. Again they may merely gouge out the tip of a twig on one side, entering in as far as the pith and then leaving for some other twig. Thus they go from twig to twig, feeding first in one and then in another, until often the tips of a great many branches will be killed back, thereby

checking their growth and more or less injuring the tree. The detection of their work is no difficult matter a short time after they begin feeding, for the leaves of affected twigs soon wilt, as in Fig. 3, and later dry up from the injury done to them.

The injury the first brood larvae do to twigs, while sometimes alarming, is not usually to be compared with the injury to the fruit from the second and third broods. Often this injury to the fruit is extensive enough to render great quantities of it unmarketable, and we have a condition of peaches comparable to that of apples as a result of codling moth attack. The larvae usually enter the fruit from the stem end and may feed entirely within the flesh, but very often they eat their way into the pits. Affected peaches may be detected by an issuance of sap mixed with little pellets from the fruit which have been chewed up by the larvae. This sap hardens on the outside and peaches so effected, are often termed "gummy peaches."

The Pupal Stage.—This stage of the insect is said to last from 6 to 12 days, the first brood remaining pupae for the longest time. This period is passed by the first brood pupae, according to Mr. Clarke, principally in curls of bark on the trunks of trees. They may, however, be found in other places, such as between two peaches which come in contact with each other, under rubbish on the ground, etc. The cocoon which they make is a very flimsy one; in fact, so much so that in reality it should not be termed a cocoon. A few strands of silk are spun by the larvae, and to these strands the pupae is attached by means of hooks at the tip of the abdomen. The second and third brood pupae more often pupate in the suture at stem end of peaches than underneath the bark, and the semblance to cocoons is even less than in the case of the first brood.

The Moth.—The twig-borer moth is a tiny, gray insect, about $\frac{1}{4}$ inch in length and having a wing expanse of about $\frac{1}{2}$ inch. It is quite a beautiful little moth with its dark gray, fringed wings. They are very seldom seen in the orchards by the fruit growers, because of their small size, their close resemblance to projections of the bark and their habit of resting perfectly still during the day time on the trees.

The Egg.—Eggs of this insect were first found by Dr. Marlatt, who kept the moths in confinement and found that they were deposited above the bases of the petioles of the leaves. Mr. Clarke, in California, found the eggs of the first brood in the orchard, in the same location as described by Marlatt. He found, however, that the eggs of the second generation of moths, were laid not on the twigs, but on the fruit and in the edge of the stem end depression; the eggs of the third generation were found in cracks of the bark, or exposed on its surface, just above the crotches formed by the new wood, and on the old wood.

The eggs are pearly white, changing to a deep yellow before hatching. They are quite conspicuous, being about $\frac{2}{3}$ of a millimeter ($\frac{1}{60}$ of an inch) in length by $\frac{1}{2}$ mm. ($\frac{1}{120}$ inch) in breadth.

These observations of the egg and egg-laying habits of the insect, made in California by Mr. Clarke, are very interesting, as they are the first recorded from studies made under the natural conditions of the orchard.

Experiments for Control of the Twig-borer.—The experiments testing different insecticides for the control of this pest, were all conducted in the spring of 1910, and were combined with the green-peach aphid experiments recorded in this bulletin, with the discussion of the latter pest.

The comparative scarcity of twig-borer the past season made it difficult to secure much reliable data from the experiments. Table I was compiled from data gathered in the W. C. Strain orchard at Clifton, and Table III gives general results of all the experiments in both the Strain and Paxson orchards.

TABLE I.

Results attained with different insecticides in controlling the peach twig-borer, in the W. C. Strain orchard at Clifton, Colo.

Insecticide Used	Strength Used	Date Sprayed	Date Examined	Wilted Tips	Trees Examined
Black Leaf	1-30	March 7	April 26	5	3
Black Leaf	1-40	"	"	6	3
Black Leaf	1-50	"	"	3	3
Black Leaf	1-70	"	"	0	1
Black Leaf "40"	1-600	"	"	0	2
Black Leaf "40"	1 800	"	"	7	4
Black Leaf "40"	1-1000	"	"	6	4
Lime and Sulfur	1-10	"	"	0 } 0 }	12
Lime and Sulfur	1-11	"	"	4	2
Soluble Oil	1-20	"	"	16	4
Unsprayed					

While it is not thought that this year's experimental work with twig-borer, would justify the drawing of many conclusions, there were at least some helpful hints gathered in regard to its control. It may be seen from Table I that "Rex" Lime and Sulfur gave perfect results. More trees were sprayed with the "Rex" mixture 1-10 and 1-11, than with any other insecticide, yet in a very careful examination of 12 trees by Mr. Strain and myself, we failed to detect the presence of a single wilted twig because of the work of the borer. On 4 check trees in the same block 16 wilted tips were counted, and on 22 trees sprayed with tobacco preparations and soluble oil, 31 wilted tips in all were counted. One tree sprayed with Black Leaf

1-70 was free from wilted tips, and also 2 trees sprayed with Black Leaf "40" 1-600. The fact that the higher strengths of Black Leaf did no appreciable good, would indicate that it was simply a matter of chance that the one tree sprayed with the weaker strength, indicated good results. Black Leaf "40" 1-600 apparently gave good results, however, because of only two trees having been treated, and because of the scarcity of the twig-borers in the orchard, it would not be wise to draw any definite conclusions without further experiments. The number of trees treated with lime and sulfur and their total freedom from borers, seemed great enough, when compared with the small number of check trees, and other sprayed trees with quite a number of borers, to justify the conclusion that "Rex" lime and sulfur is a perfectly effective spring remedy for this pest. For some unknown reason home prepared lime and sulfur used at the same time as the "Rex" spray, but in another orchard, apparently did little good.

Mr. W. T. Clarke, in Bulletin 144, of the California Experiment Station, at Berkeley, gives some interesting data in regard to sprays applied at different times of the winter and spring, for the control of twig-borer. He found that during the winter season the little larvae, in their hibernating cells, could not be killed either with kerosene emulsion or lime and sulfur. He discovered, however, that the larvae become active in these cells for some time in the spring before emerging, and that during this period of activity the cells are rendered more or less permeable to a spray, and then the larvae can be successfully combated with a contact insecticide. In regard to the effective use of a spring spray of lime and sulfur, Mr. Clarke says:

"The lime-salt-and-sulfur-sprayed trees, when the spraying had been done in the early spring, showed the most satisfactory results of any at the time of examination. On the various station orchards, comprising over 12,000 peach trees, the average number of bud-worms was about one to every ten trees, and this average was maintained on many orchards in the district. Indeed, it was a difficult matter to find the worms in these orchards, and it was only by the closest scrutiny of the trees that they could be located in them. The general condition of these trees was excellent, and a marked absence of 'curl-leaf' was noted.

"An examination of the trees in orchard No. 1, that had been sprayed with the lime salt and sulfur early in February, showed that the attack of bud-worms was severe. On many of the trees from which we cut the worms we found from 5 to 9 to the tree. The general condition of the trees was good and a very small amount of 'curl-leaf' was present."

From this season's experiment at Clifton, from the experience

of the many Colorado orchardists who have used lime and sulfur for the control of this pest, and from the apparent success of this spray in California, we feel justified in recommending it for use in the sections of Colorado where there is injury from twig-borer.

While arsenate of lead was a total disappointment in this season's tests, it has previously been used with good success and is, no doubt, effective when applied at the proper time. E. P. Taylor, in his annual report of the Western Slope Fruit Investigations for 1906, gives some very satisfactory results from the use of 5 pounds of arsenate of lead to 50 gallons of water, applied on April 14, at which time the majority of the blossom buds showed their pink tips. Commenting upon the results of his experimental work, he wrote: "It may be said that arsenate of lead, applied in the spring at the time the buds of the peach are beginning to open, will control the peach twig-borer as effectively and cheaply as the lime and sulfur wash, up to this time the most universally used."

THE PEACH TREE-BORER (*Sanninoidea exitiosa*)

Colorado peach growers are fortunate in that they do not, as a rule, have the crown-borer of the peach to fight. In many of the peach-growing sections of the United States, this is one of the worst pests preying upon the trees. Unlike the twig-borer, which feeds upon the tender twigs and fruit, this species feeds just beneath the bark at the crown of trees, often girdling them. The adult insect is a moth which, at a glance, more closely resembles some kind of a bee or wasp, than a moth. The eggs of this moth are deposited on the trunks of peach trees, and the little worm-like larvae hatching from them, eat their way beneath the bark and there feed until full grown.

The work of the insect may be detected by masses of gum in which are mixed pellets of wood or borings which the larva chews to pieces as it feeds. These gum masses usually occur at, or just below the ground line. Their presence aids in the fight against this pest, as the burrows in which the larvae feed can always be found beneath. By using the point of a knife or a piece of wire, this burrow may be followed and the larva located and killed. No better method for combating the peach tree-borer has ever been devised than worming, as the above process is called, with a knife or some other implement that can be inserted into the burrow. Worming should be done both in the fall and spring. While the larvae often do not attain a sufficient size in the fall to be readily detected, a great many of them can be killed before they get in very far, thus preventing the damage that they might do before they could be detected in the spring.

Various other methods of control have been tried, such as wrapping the trunks with tar paper to keep the moths from deposit-

ing their eggs, applying repellants for the same purpose, and mounding the soil up above the crown of the tree. This last named method is valuable in that where it is used the larvae may be induced to enter the trunk of a tree some distance above the surface of the ground, then when the mound is removed the worms are high on the trunk, where they can be much more easily destroyed than if they were lower down.

SCALE INSECTS.

It is very fortunate that none of the scale insects have as yet been found abundantly on peach trees in Colorado. The San Jose scale has been seen on a very few trees, but not plentiful enough to do any serious injury. This pest seems to confine its attacks more to the apple in the few orchards where it has been found.

In one section of the Grand Valley a scale insect closely allied to the dreaded San Jose is found. Samples of this scale were sent to Prof. T. D. A. Cockerell, Entomologist in the State University at Boulder, who kindly determined it for me as the putnam scale. Only in rare cases has this insect been found doing serious injury.

There are other scales of minor importance that are sometimes found on peach trees; all of these insects may be successfully combated with an early spring spray of lime and sulfur, or soluble oil. If Rex lime and sulfur is used it should be diluted by using 1 part of the Rex solution to 10 parts of water. A good home-made lime and sulfur is as effective as the Rex, and should be made with 20 pounds of lime and 15 pounds of sulfur to 50 gallons of water. Soluble oil is ordinarily used at a strength of one part of the oil to from 15 to 20 parts of water.

While spring spraying for the control of these scale insects is probably more advantageous than a spray at any other time, good work can also be done with a fall application. Very often orchardists would rather spray in the fall because there is more time to do so than in the spring.

THE BROWN MITE (*Bryobia pratensis* Garman)

In Bulletin 152, of this Experiment Station, an account was given of the life habits and injuries from this species of mite, and also the red spider. As this bulletin is still available it will not be necessary to again give a detailed account of these two pests.

This mite passes the winter almost entirely in the egg stage. These eggs are tiny, red spherical-shaped, glassy objects, usually deposited in or near crotches of the branches. Hatching takes place in the spring. At first the young mites are red in color and have only six legs. Upon feeding for a short time moulting takes place, after which the mite is olive green, or brown in color, and has eight legs more or less tinged with red. It feeds principally upon the leaves, occasionally attacking the fruit, and may be detected by the

faded out, pallid appearance of the foliage, dotted here and there with little black specks of excreta. Plate I Fig. 3 shows two peach leaves which have been attacked and two which are normal from the same tree, and gives a good idea of their appearance after this pest has been feeding upon them.

Control Measures.—Experiments recorded in Bulletin 152 show that tobacco preparations are of little value in controlling this mite; that they will kill the mites, but not the eggs. As the latter are almost always present on a tree where the mites are feeding, such sprays can only be effective when repeated applications are made. The sulfur spray was again tested this season, this time at Palisade, Colorado. Some badly infested pear trees were treated, using 10 pounds of sulfur to 50 gallons of water. Results of this test were perfect, and a week after the trees had been sprayed it was hard to find a living mite on them.

An interesting point in connection with the sulfur treatment for brown mite is: The adult mites are not immediately affected by the spray, but those newly hatched die shortly after the application. An examination of a tree the day after spraying with sulfur is usually disappointing, for the adult mites may be alive and abundant. In all the tests made a very few newly hatched, six-legged mites have been found, 24 hours after spraying, and in a week's time neither adult nor newly hatched mites can be found. The sulfur adhering to the bark and leaves, undoubtedly kills the young mites as they hatch from the eggs. Whether the older ones are killed by the sulfur or simply die a natural death is a point that has not been determined definitely. As there are probably only three broods of this mite, and they are quite long lived, it would seem that the sulfur really kills the adults, but that it takes some days to do so. The important fact remains that the young mites never develop after the sulfur treatment, whether hatched or in the egg stage at the time of treatment, and that the adult mites are either killed by the sulfur or die a natural death within 7 or 8 days after treatment, thus ridding infested trees of the pest.

Lime and Sulfur an Efficient Remedy.—In Bulletin 152 the following statement was made: "Trees may be treated while dormant with lime and sulfur. This spray has no effect upon the eggs, but probably kills the young mites as they hatch." The fact that the lime and sulfur kills the young mites as they hatch was definitely established last spring at Palisade, Colorado.

Three adjoining peach orchards, each containing a great many brown mite eggs—two of them sprayed with Rex lime and sulfur 1-10, and one not sprayed—were chosen as observation places to determine this point. The eggs were found hatching in all three orchards at the same time; in the orchards which were sprayed a great

many of the tiny, red mites could be found where they had died on the limbs very soon after hatching. In no case were any found alive, except a few immediately hatched from the eggs. In the unsprayed orchard all the mites seemed to live and the trees were soon covered with them. Throughout the season the sprayed orchards were almost entirely free from mites, while the unsprayed one, located between the other two, had quite a serious infestation.

As a result of the extensive use of a lime and sulfur spray in the Palisade section the past season, the brown mite was practically exterminated, except in a few orchards where such a spray was not used.

THE RED SPIDER (*Tetranychus bimaculatus*)

This mite differs from the preceding one in its wintering habits; instead of living over in the egg stage, as the brown mite does, this species hibernates in the soil as an adult, close to trees upon which it has been feeding, or underneath rubbish of any kind. On the 7th of November, this season, they were found plentifully, under burlap bands that had been applied to trees for the purpose of trapping the codling moth larvae. Hibernation begins before the cold weather sets in; the first downward migration of mites to the soil was noticed at Grand Junction, this season, on July 26. While a few of them may work on trees until late in the fall, their damage is usually over by the 15th of August.

Eggs are laid in the spring by mites that have lived through the winter. These eggs are pearly white, and may be seen as tiny specks on the under surface of the leaves.

When first hatched from the egg this mite, like the species previously treated, has only six legs, the fourth pair developing with the first moult. They are somewhat smaller than the brown mite, usually green in color while feeding upon the foliage of trees, with minute black dots on the dorsum of the abdomen. When feeding ceases in the fall, and they begin their downward migrations to the soil, they become an orange, or red color. During my observations of this species of mite, for the past three years, a red one has never been seen on fruit trees until feeding ceases in late summer. In greenhouses this same species is very often red in color. Unlike the brown mite, the red spider has the power of spinning a web, and may easily be detected, when prevalent, by the presence of these webs on the foliage, or branches of infested trees. The appearance of injured peach foliage is not unlike the appearance of that injured by the brown mite, but is more inclined to turn yellow in patches.

Control Measures.—Sulfur is very successful in treating this mite also, whether dusted upon or applied as a liquid spray to infested trees. When applied in water, by means of a spray, sulfur should be very finely screened, and mixed with the water by using

a small amount of soap. Without the soap the sulfur will remain on the surface of the water, while with the soap it will sink to the bottom of the spray tank, and a good agitator will keep it mixed.

Lime and sulfur has not proven a successful treatment for red spider, and cannot be depended upon to do effective work when used as a dormant spray.

The use of tobacco preparations, as with the brown mite, result in little good.

TWO PLANT LICE OF THE PEACH

By C. P. GILLETTE and GEORGE P. WELDON

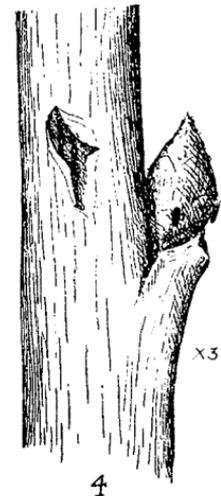
THE GREEN PEACH APHIS (*Myzus persicae* Sulz)

This is the common green peach louse so prevalent early in the season curling the leaves and often attacking the blossoms and forming peaches in a most destructive manner.

This insect was quite fully treated and figured in its natural colors in Bulletin 133 of this Station, by Gillette and Taylor. Copies of this bulletin are still available for those requesting it.

How the Winter Is Spent.—The eggs of this species of plant louse are deposited on peach trees, (occasionally on other stone fruit trees), in the fall, where they remain unhatched until early spring.

Their detection is not as easy as that of the common green apple aphid egg, but is not extremely difficult when one knows where to look for them. Last fall the eggs were deposited in such large numbers that they could be easily found in a great many orchards. In some cases the buds of peach twigs were dotted black with them. Usually these eggs are deposited on, or very close to a bud, (See Fig. 4), and very often just as deep in wrinkles or depressions as possible, and unless they are plentiful, it may require sharp eyes to detect them. When first deposited, the eggs are light green in color, turning black after exposure to the air. They are much smaller than the eggs of the common green apple aphid, which nearly every orchardist has seen, but are quite similar in shape, color and general appearance.



This pest may live over winter on vegetation that remains green throughout the winter season, so there would be a possibility of trees becoming infested at least late in the season from other sources, even though the eggs were all killed by an insecticide, or failed to hatch because of unfavorable weather conditions or other causes.

The eggs of this aphid hatch very early in the spring. E. P. Taylor reports having found them hatching at Grand Junction, Colorado, on the 16th day of February, 1907. The month of February that winter was unusually warm and the extremely early hatching of the eggs was due to that fact. However, hatching takes place when the buds have scarcely begun to swell, a fact which is not generally understood by the fruit grower, and one which is of very great importance in its relation to the control of the pest by means of a spray. The past spring, eggs were found hatching on the 7th of March at Clifton, Colorado, at which time the buds seemed perfectly dormant.

Spring Habits.—When first hatched from the eggs these aphids are dark green in color, and may be seen as tiny, dark specks crawling along the twigs, or more often, clinging to the buds. It is probable that they can exist for a number of days after hatching with little or no food. What feeding they do takes place on the buds or very tender bark into which their beaks are inserted, and from which a portion of the early flow of sap is extracted. Plant lice of the spring brood, which hatch from eggs that have remained on trees over winter, are known to the entomologist as stem-mothers. The full grown stem-mothers of this plant louse are of a pinkish or salmon color, and before there is a sign of a peach blossom in the spring, these stem-mothers have begun reproduction. Their progeny are born alive, eggs never being laid except in the fall, and then by an aphid which, though only a different form of the same species, might be taken by the orchardist for an entirely different kind of plant louse. The generation from the stem-mothers differ from the latter in that they are light green in color, with darker green, longitudinal markings on the dorsal surface of the abdomen, but are never pink like the stem-mothers. Just as soon as the buds on infested trees begin to unfold, the stem-mothers, with their progeny, are ready to enter within. At first they seem to prefer feeding in the blossoms, but after these fall, quite serious injury is often done by their feeding on the leaves. Probably the greatest injury to peaches resulting from their attack, consists in the dropping of the small fruit which has become devitalized from the loss of sap until it can make no growth, hence shrivels and falls to the ground. The injury to the peach is practically all done while it is yet in the husk or calyx tube. After the peach has cast off this calyx tube it is not likely to be molested further by the aphids, and unless it has been too much weakened before this time, the probabilities are that it will not drop as the result of aphid attack.

Summer Habits.—Fortunately this pest cannot, or does not, spend its entire existence upon the peach or other trees, but leaves them for more succulent vegetation. Shortly after the peaches are

formed, winged lice begin to appear in the colonies; these fly away to other food plants, and by the last of June very few can be found on peach trees. This is indeed a blessing to the peach grower, for should this pest continue its ravages throughout the summer on the peach, it would require great effort and expense to control it. As it is, trees often suffer a great loss of foliage, and if it were not for the wonderful power of the peach tree to recover after this injury, the result of the aphid attack would be more disastrous.

Gillette and Taylor, in Bulletin 133, of the Colorado Experiment Station, gave a list of 53 plants growing in the greenhouse, which were found to be infested with this aphid, and 25 plants growing out of doors, the out-of-door plants comprising most of the common garden vegetables and weeds. The variety of plants upon which this louse feeds during the summer time is so great that it is probable that it will seldom be plentiful enough on any one kind to do serious injury. While on the summer food plants, this aphid is usually light yellow in color, and without the green stripes so characteristic of it while feeding on the peach.

Fall Habits.—The last winged generation of lice appearing in the fall are known as fall migrants, because of the fact that they leave the vegetation upon which the summer has been spent and migrate to peach trees. These fall migrants do not deposit eggs, but give birth to the true sexual forms, males and females. The females are pink in color, somewhat similar to the stem-mothers which were on the trees in the spring, but smaller. After feeding for a time and becoming mature they deposit the eggs previously described.

Spraying Experiments.—Because of the abundance of green peach aphid eggs last winter, a number of different tests were made in the spring, with various insecticides, in order to determine their value as egg destroyers. The spraying was delayed a little too long, however, and on the 7th of March, when the first applications were made in the W. C. Strain orchard at Clifton, many of the eggs were found to be hatching, and there was no trouble in finding the little green lice here and there on the twigs. A great many of the eggs were not hatched at that time, hence the various sprays were tested as destroyers of both the eggs and the young lice. The block of trees sprayed in the Strain orchard, was only three years old, but contained both the eggs of green peach aphid and the hibernating larvae of the twig-borer in abundance. The small size of the trees made very thorough spraying possible. The work was done with a Morrill and Morley barrel pump, so it was not possible to make the applications with a high pressure. Thoroughness was depended upon to compensate for the deficiency in pressure. Tests were made in this orchard with Rex lime and sulfur, two strengths, namely: 1 gallon

of the "Rex" to 10, and 1 to 11 gallons of water; Black Leaf tobacco extract, four strengths, namely: 1 gallon to 30, 1 gallon to 40, 1 gallon to 50, and 1 gallon to 70 gallons of water; Black Leaf "40," three strengths, namely: 1 gallon to 600, 1 gallon to 800, and 1 gallon to 1,000 gallons of water; soluble oil, 1 strength, namely: 1 gallon to 20 gallons of water. Thirty-eight trees in all were sprayed in this test, and 5 were left without any treatment, for checks.

On the 8th of March, 21 trees were sprayed in Mr. M. Paxson's orchard at Clifton. These trees were five years of age, and fully as many eggs of the aphid, and larvae of the twig-borer were found on them as in the Strain orchard. The following insecticides were used on this date: Nico-fume at two strengths, namely, 1 gallon of Nico-fume to 600, and 1 gallon to 800 gallons of water. Kerosene emulsion was applied at one strength only, namely, a 15 per cent. oil emulsion prepared by using a common laundry soap. Black Leaf was applied at one strength, namely, 1 gallon to 55 gallons of water. Home prepared lime and sulfur was applied at one strength, namely, 15 pounds of lime and 15 pounds of sulfur to 50 gallons of water. This lime and sulfur was made in the ordinary way, and was boiled for one hour, so that a first class lime and sulfur spray was prepared.

On March 28th the peach buds were just showing their pink tips, and several sprays were again applied. At this time three of the tests were made with a mixed spray of arsenate of lead and one of the tobacco preparations, the arsenate of lead being used for the twig-borer, and the tobacco preparation with which it was mixed, for the aphid. The following insecticides were applied at this time to about 150 trees: Rex lime and sulfur, 1 gallon to 10 gallons of water; Black Leaf, 1 gallon to 50 gallons of water; Black Leaf, 1 gallon to 70 gallons of water, combined with arsenate of lead 3 pounds to 100 gallons of water; Black Leaf "40," 1 gallon to 800 gallons of water; Black Leaf "40," 1 gallon to 1,000 gallons of water, combined with arsenate of lead 6 pounds to 100 gallons of water; Black Leaf "40," 1 gallon to 900 gallons of water, combined with arsenate of lead 10 pounds to 100 gallons of water.

Results of Experiments.—Table II gives the results of the first examination made on March 15, of trees sprayed in the Strain orchard. It may be seen from this table that all insecticides applied on March 7th resulted in effective control, at all strengths. Subsequent examinations were made on March 24th, April 26th, and May 11th, each one indicating practically the same results. It would seem from this experiment, that just as the eggs of this aphid are beginning to hatch is a favorable time to spray for its control. Lime and sulfur proved to be a perfect spray at this time. Appar-

ently, it gave a little better final results than anything else used. Table III gives a summary of results in both the Strain and Paxson orchards. It may be seen from this table that, with the exception of Nico-fume, all the tobacco sprays of both early and late applications resulted in much good, but that lime and sulfur applied on the latest date of spraying did not prove beneficial. This application of lime and sulfur was made at a time when some of the first lime and sulfur spraying was being done in the Valley, but earlier than much of it. The experience of most of the orchardists was: that the lime and sulfur did no good applied late for green peach aphid, which tallies with our experience. This season's experiments indicate that the most important thing in connection with the control of this aphid by the use of lime and sulfur, is to get it on early; just as the eggs were beginning to hatch was found to be a splendid time. If spraying is delayed until the aphid becomes full grown, some other spray besides the lime and sulfur should be used. This spray will not kill the mature stem-mothers unless applied in excessive quantities.

The tobacco sprays are much better to use when mature lice can be found. But these preparations are also more effectual at the time when the eggs are hatching. A great amount of material is required in order to be thoro enough to kill most of the lice after they are fully grown.

The average orchardist would probably have a hard time to detect the little lice when they are first hatched, but the importance of spraying at this time should be sufficient reason for him to learn to find them. If this is not possible it would be reasonably safe to say that the lice may be found hatching after the first few days of warm spring weather in February or March, in the vicinity of Grand Junction, and that a spray at such a time would be successful. A hand lens, costing 25 to 50 cents, is of great service in finding the lice.

On March 25th some large Triumph peach trees were sprayed on the C. H. Dille place at Clifton. These trees had been sprayed a few days previously with lime and sulfur, but apparently with no success in killing the aphid, which at this time were clinging to the partially open blossoms waiting for a chance to get within. Part of these trees were treated with Black Leaf, 1 gallon to 70 gallons of water, and the rest with Black Leaf "40," 1 gallon to 800 gallons of water. By exceedingly careful and thoro spraying, entailing the use of at least ten gallons of spray to a tree, it was found that practically all the lice could be killed. The Elberta trees in this orchard did not have so many of the aphids on them, and the manager of the place decided that they did not need to be sprayed. On May 11th an examination of these trees showed the Elbertas to be badly in-

festated, and the Triumphs, which we had sprayed, were exceedingly clean. The difficulty experienced in spraying trees so late in the season, lies in the fact that the leaves always tend to curl and provide such protection for the lice, that only the most thoro work can result in much good.

THORONESS NECESSARY TO SUCCESSFUL SPRAYING.

No matter when the spraying may be done for the control of this insect, success cannot be attained unless a very thoro application of the insecticide is made. In fact, this is a general rule that will hold good in spraying for the control of all insect pests. While this point is always emphasized by entomologists, our experience with orchardists has been that many do not have a proper conception of what thoro spraying means. This may be due in part to the failure to appreciate the fact that insects multiply tremendously in a short time, and unless a spray kills practically all of a pest, such as the one in question, a few days or weeks may see them as plentiful as they were before the spray was applied. Spraying investigations in the orchard indicate, also, that much of the trouble is due to the expense of a proper treatment. Most of the insecticides used are very high priced, and the orchardist does not feel that he can go to the expense necessary to thoroly treat his trees. He very often fails to realize that work such as this, half done, is really work wasted, to say nothing of the expense.

It is safe to say that spraying for the control of the green peach aphid can only be successful when very great care is used to thoroly drench every portion of infested trees.

CONCLUSIONS.

1. Lime and sulfur, both Rex and home prepared, Black Leaf extract, Black Leaf "40," and soluble oil, may be effectively used for the control of the green peach aphid when applied in the early spring just as the eggs are hatching.

2. A lime and sulfur spray is not effective when applied two weeks or more, after the eggs are hatched, for at this time the stem-mothers are mature, or nearly so, and are able to resist the action of this insecticide.

3. Good tobacco preparations may be used with success any time after the aphids hatch, but it is more difficult to succeed late in the spring, because it is then more difficult to get the spray on all the lice, on account of the protection of the leaves.

4. The best time to spray for this insect is in the early spring when the eggs are hatching.

Table II, giving results attained in killing eggs and newly hatched lice of the green peach aphid on small trees in the W. C. Strain orchard at Clifton:

TABLE II.

Insecticide Used	Strength of Insecticide	Date of Spraying	Date of Examination	No. of Aphids on 6 Twigs From 2 Trees
Black Leaf	1-30	March 7	March 15	2
Black Leaf	1-40	"	"	2
Black Leaf	1-50	"	"	1
Black Leaf	1-70	"	"	1
Black Leaf "40"	1-600	"	"	0
Black Leaf "40"	1-800	"	"	6
Black Leaf "40"	1-1000	"	"	7
Rex Lime and Sulfur	1-10	"	"	1
Rex Lime and Sulfur	1-11	"	"	2
Soluble Oil	1-20	"	"	0
Check				93

TABLE III

Insecticide Used	Strength	Date of Spraying	General Results in Killing Aphis		General Results in Killing Twig-Borer	
			Early Spray	Late Spray	Early Spray	Late Spray
Black Leaf	1.30	March 7	Good	-----	Unsatisfactory	-----
Black Leaf	1.40	March 7	Good	-----	"	-----
Black Leaf	1.50	March 7 and 28	Good	Good	"	Unsatisfactory
Black Leaf	1.70	March 7 and 28	Good	Good	Apparently good but not enough trees	"
Black Leaf "40" ..	1.600	March 7	Good	-----	Good	-----
Black Leaf "40" ..	1.800	March 7 and 28	Good	Good	Unsatisfactory	Unsatisfactory
Black Leaf "40" ..	1.1000	March 7	Good	-----	"	-----
Nico-Fume	1.600	March 7	Poor	-----	"	-----
Nico-Fume	1.800	March 7	Poor	-----	"	-----
Soluble Oil	1.20	March 7	Good	-----	"	-----
Ker. Emul.	15% oil	March 7	Poor	-----	"	-----
Rex Lime & Sulfur	1.10	March 7 and 28	Good	Unsatisfactory	Good	Unsatisfactory
Rex Lime & Sulfur	1.11	March 7 and 28	Good	Unsatisfactory	Good	-----
Lime and Sulfur ..	15.15.50	March 7	Good	-----	Poor	Unsatisfactory
Black Leaf	1.70	March 28	-----	Good	-----	"
Arsenate of Lead	3 lbs. to 100 gals					
Lead Arsenate ..	10 lb. 100	March 28	-----	Good	-----	"
Black Leaf "40" }	1.900					
Black Leaf "40" }	1.1000	March 28	-----	Good	-----	"
Lead Arsenate ..	6 lb. 100					

BLACK PEACH APHIS (*Aphis persicae niger*)

This enemy of the peach has never been of much economic importance in Colorado. It has been found from time to time, in the peach growing sections of the Western Slope, but apparently has not been able to continue for any length of time in orchards where it has been introduced. Notwithstanding the fact that up to the present time it has never made any headway in the orchards, it is well for the peach growers not to take any chances in orchards where it does appear, but to be prompt in making a very thoro application of Black Leaf, or some other good contact spray to infested trees.

The fact that this pest has the habit of feeding upon the roots as well as the twigs of peach trees, makes it one that is dreaded. Because of its ability to live below as well as above ground, it might become a serious pest if conditions should happen, at any time, to be favorable to its development.

Very often peach nursery stock coming from an infested nursery, is found to be badly infested with this aphid. When such trees are found they should be either carefully fumigated with hydrocyanic acid gas, or sprayed with a good contact insecticide such as Black Leaf, kerosene emulsion, or whale-oil soap. Plate I, Fig. 2 shows a section of a peach twig on which is a large number of these aphids. This twig was cut from a tree which had just been removed from a box shipped into the state from an outside nursery. There were so many aphids in the box that they found their way through the cracks and could actually be seen crawling on the outside in considerable numbers. The box bore a fumigation tag and the inspector, whose duty it was to look over all shipments of nursery trees into the county, rightly condemned all the trees in the box. The dark color of the adult lice and their habit of feeding on the tender bark rather than the leaves enables us to separate this louse readily from the foregoing species.