Insects and Insecticides.

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NOTES ON

INSECTS AND INSECTICIDES,

BY

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INTRODUCTION.

During the past year an increased number of inquiries have come to this station, in regard to insect pests. It is thought advisable to issue this as the first of a series of bulletins devoted to such insects as are most injurious to the farm and garden crops of the Territory. We ask, therefore, that farmers and fruit-growers throughout the Territory co-operate with us in the investigation of injurious insects. You can do this by informing us of all insect depredations in your locality and by sending specimens of the insect. Correspondence will receive prompt attention. We will freely give what information we can on the more important facts in regard to such pests and also upon the best known methods of counteracting their injuries. Do not send insects in a letter, as they will invariably be crushed beyond recognition in the mail. In sending specimens to us for investigation, write a letter giving all the information you can as to the insects' food habits, the relative injury that they are doing, and whatever else may aid us in advising methods for combating them.

Such insects as have come under our personal observation are discussed in this bulletin. As the average farmer can put to little use a complete description of such small forms of life, in most cases, we have given only a few brief facts, which we trust will be sufficient to identify the insects herein treated.
Brief Hints on Insects and Insecticides.

So far as injurious insects are concerned they may be conveniently grouped under two classes, viz: Those which eat the foliage or fruit and those which suck the juices of the plant. The former have strong jaws or mouthparts, and as they frequently devour the entire leaf their injury is very apparent. In the latter the mouthparts form a sucking-tube, by means of which they are enabled to pierce the bark or epidermis of the plant and suck its sap.

Insects which eat the foliage may generally be destroyed by applying some poisonous substance to the infected plant. In feeding on the foliage, if any of the poison be consumed by the insect it ordinarily is effective. On the other hand, it is very evident that insects which feed upon the juices of the plant, by piercing through the epidermis, will be little effected by the application of a poison to the plant itself. Following from this, we have two general classes or groups of insecticides; those which kill by being eaten and those which kill by contact.

Of all the different substances used in the destruction of masticating insects, i.e., those which feed by eating the foliage, none are so reliable, or so universally used as the arsenites. Primarily among these are London-purple and Paris-green. The white arsenic itself, as an insecticide, has nearly gone out of use. For purposes of general spraying London-purple is preferable to Paris-green, as it is more soluble in water, less expensive, and not so heavy, hence it does not require so constant stirring to keep it in suspension in the water. London-purple, however, should not be used on plants with tender foliage, as it is quite apt to burn the leaves. If lime water be added to the poison it will render it insoluble and in this condition it may be applied with comparative safety to the tenderest foliage. In spraying the foliage of peach, apricot, and kindred plants, Paris-green should be used at a strength of 1 lb. of the poison to 250 gallons of water. London-purple, without the use of lime, should never be used on the above plants. On ordinary foliage either of these substances should be used at a strength of one pound of the poison to 200 gallons of water. If it be found
on trial that injury to the foliage occurs, a little slaked lime may be added, or the strength of the mixture reduced by adding water.

It is very essential in spraying that every portion of the infected plant be reached by the poison. Success will depend, to a great measure, upon the thoroughness and force used in applying the mixture.

The application of insecticides in water is most convenient and effective by using a spray pump. A great many of these pumps are on the market, nearly all of which are suitable for the work intended, especially if they are fitted with suitable nozzles.*

It is very evident that plant lice, bugs, and all other insects which suck the juices of plants, will not be destroyed by the application of Paris-green, London-purple, or similar poisons; they must be treated with some insecticide which will kill by contact. Of all the various substances used for this purpose there is nothing more effective than kerosene oil. When used as an insecticide, kerosene oil should be so combined with soap and water as to form a perfect emulsion. This compound as prepared by Dr. Riley is as follows: "Dissolve one half pound of hard soap in one gallon of water. While boiling hot add two gallons of kerosene oil and stir and churn thoroughly for several minutes or, until the mixture is thoroughly emulsified and appears like thick cream." When ready to use dilute to any required strength. For general purposes, to one part of the emulsion add ten parts of water. For tender foliage it should be diluted much more. When diluted fifteen times it is effective in treating plant lice. If the emulsion at any time proves injurious, it is too strong and should be diluted with water. In our hot summer climate, the preparation will separate even when made with the greatest care, hence it should not be prepared many days before it is required.

Bisulphide of carbon is a valuable insecticide, but the person who handles it should exercise the greatest care. It evaporates rapidly and when mixed with air is very inflammable. It may be used to advantage in destroying ants. A few openings

*Information in regard to spraying apparatus may be obtained by writing to the Station Entomologist.
are made in the ant-hill and one or two table-spoonfuls of the fluid is poured into the openings, which should immediately be covered with a blanket. The volatile poison permeates all parts of the nest. After a few moments the blanket may be removed and the poisonous gas exploded by means of a torch.

Of the various washes used against scale-insects, the following is reported as a very effective wash in treating the San Jose scale (Aspidiotus perniciosus, Comstock). It should be applied only in winter when the trees are dormant:

- Resin .......................... 30 lbs.
- Caustic Soda ..................... 9 lbs.
- Fish oil ........................ 4½ pints.
- Water to make .......................... 100 gals.

To prepare: Boil the resin, oil and soda in twenty gallons of water until all is dissolved, now add thirty gallons of hot water and strain, add fifty gallons of cold water and the mixture is ready for use.

As a summer wash for the same purpose as the above, the following, which has been successfully used in California for some time, is recommended:

- Caustic soda ........................ 5 lbs.
- Tallow ................................ 20 lbs.
- Resin ................................ 20 lbs.
- Potash ................................ 5 lbs.
- Water to make 25 gallons.

The soda and potash should be dissolved in five gallons of water; heat the tallow and resin together and add to the soda and potash. Stir thoroughly and after allowing to stand for two or three hours add twenty gallons of water. This wash should be made at least 24 hours before using.

Some Injurious Insects.

CANAIGRE BEETLE.—(Gastroides casea, Lec.)*

Both in the mature and larva state this insect feeds upon the foliage of canaigre, (Rumex hymenosepalus). Although, as yet, it has appeared in numbers sufficient to be injurious, only over limited areas, in some localities it has been very destructive.

*This beetle was determined for me by Dr. C. V. Riley, Washington, D. C.
During the past season it was not as destructive, as in the previous year. From the habits of the insect and the nature of its food plants, it is quite evident, that no extensive injury will be done canaigre, from this source, only in exceptional seasons. In my observations, it has only been found on this plant; however, it is recorded as being found throughout the southwest and to feed upon various species of Dock and smart-weed. In general the habits of the insect are somewhat similar to those of the Colorado potato beetle. When disturbed they fall to the ground and curl their legs to their bodies, appearing as if dead.

Last year the beetles appeared during the latter part of February, about the time canaigre begins its spring growth. On March 3rd, growing specimens of the plant were brought to the laboratory that the habits of the insect might be more closely observed. The next morning, eggs were found upon the leaves. They were oblong, bright yellow, and deposited upon both surfaces of the leaf, generally fifty or more in a place, lying flatwise in parallel rows. Where eggs were deposited upon dry leaves, the larvae, on hatching, were apparently unable to move to the green plant; but soon perished, although the dried leaves were in contact with the growing plant.

The immature or larva form, when fully grown, is about three lines long and a third as wide. It has a small black head and dark body. Its odor is characteristic of the potato beetle, and it feeds upon both surfaces of the leaf, eating out the chlorophyll and leaving behind a thin skeleton. Two weeks after the eggs hatch, the larvae are fully grown; and soon enter the ground, or curl up under a lump of dirt or a dried leaf, to pupate. Two or three days later, the larva skin is cast and the pupa comes out, bright yellow in color.

Sixteen to eighteen days after the larvae enter the ground the mature insect appears; the entire period from the egg to the beetle taking about a month. The mature insect is less than a line in length; and in color, from bright metallic green to nearly black. It is oblong-oval with head and thorax densely punctate.

REMEDIES:—We were very successful in the treatment of this insect, by thoroughly spraying with Paris-green as soon as the beetles appeared in early spring. By a thorough application of this remedy, there is little danger to canaigre from this
source. Sometimes, it may be necessary to spray again as soon as the larvae hatch. London-purple was found equally as effective. The foliage of *Canaigre* is thick and will withstand both Paris-green and London-purple to almost any strength. However, when prepared by the ordinary formulac, either is of sufficient strength to destroy the insect.

The larva of a Lamellicorn beetle has been found working to some extent in the fleshy roots of *Canaigre*. This large white grub eats its way into the root, closing the orifice through which it entered by its own excrement.

As yet I have been unable to find this insect in the mature form.

**GREEN JUNE BEETLE.**—(*Allorhina sobrina*).

There is no insect of the Southwest, that is more injurious to ripening fruit than the adult form of this insect. It appears here in great numbers during July and remains until late fall, and is especially injurious to ripening peaches, apricots, and grapes.

Specimens of this insect have been sent to this department from many different localities in the southern half of the territory. From all those regions it is reported as the most injurious of the insect pests.

It may be recognized by its color, having a bright metallic green body and dull green wings bordered by a brownish band. It is frequently an inch in length, and $\frac{3}{4}$ of an inch in width.

**REMEDIES:**—Although one of our most common insect pests, it is among the most difficult to eradicate. The immature or grub form lives in the ground and feeds upon the roots of plants. It is almost out of the question to think of combating them in this form, as they only make their presence known, when insufficient numbers to perceptibly injure vegetation by eating the roots. When in sufficient numbers, within a limited area, it is advisable to undertake their destruction by a thorough application of Kerosene Emulsion to the infected soil. *

As the beetles feed upon ripening fruit, the arsenites cannot be used to destroy them, neither can other insecticide be used that will render the fruit unfit for market. We know of no way of getting

*See experiments with Kerosene Emulsion for grubs in the soil by W. B. Alwood under Dr. C. V. Riley's direction.*
rid of these beetles, other than by hand picking. As they only attack mellowing fruit, it is sometimes advisable to pick it before it begins to soften. This is especially true where it may be ripened in a fruit house or barn out of reach of the insects; and this without material injury to the fruit, or impairing its quality. With choice grapes, etc., the bunches may be enclosed in paper sacks sometime before ripening. The fruit will ripen as well within the sacks and all insects will be excluded. At best but little can be done to prevent the ravages of this insect.

LOCUST BAGWORM.—(*Thyridopterix, Sp., fab.*)

My attention was first drawn to this insect more than a year ago by the great number of its sacks or bags hanging from the twigs of the Black Locust trees growing in the vicinity of Tucson.

Here, for the past two seasons, this insect has almost completely defoliated our Locust trees; so much so that persons growing trees of this species are seriously considering whether it would not be better to cut them down than to have them so overrun by this pest.

Throughout the winter, the bags containing the hibernating eggs may be seen hanging from the trees. Soon after the leaves start, here the latter part of March, the newly hatched larvae begin feeding upon the foliage and to make cases from fragments of leaves held together by threads of silk. Within these cases, with only head and forelegs protruding, they crawl about and feed upon the leaves. The cases enlarge as the larvae develop until they are nearly an inch and a half in length.

Although this species of bagworm is especially injurious to the Black Locust, I have found it upon a great variety of plants, including trees, shrubs, and even herbs. However, only on the Locust has it appeared in sufficient numbers to be considered especially injurious. It feeds to some extent upon the peach, apricot, pomegranate, rose, cotton, and cedar.

REMEDIES:—The simplest and most effective remedy, is a thorough application of Paris-green or London purple soon after the larvae hatch and begin to feed upon the foliage.

During the winter, the bags which contain the eggs are conspicuous and may be removed and destroyed. If delayed until the leaves start, it is impossible to remove them, as the greater number will be hidden by the foliage.
PROCRIS-WORM.—(*Procris Americana, Harris.*)

During the past season this insect was found in considerable numbers upon the wild grape, (*Vitis Arizonica*), growing in the vicinity of Ft. Lowell, and later upon cultivated grapes about Tucson.

The insects may be known by the feeding habits of the larvae. They feed in company, arranged in a regular row on the under surface of the leaf; most frequently with their heads pointing toward the apex. When young they eat out the mesophyll, i. e., the more tender parts of the leaf, leaving the framework. Later they devour all but the midrib and larger veins.

Here they are most destructive in the early part of the season, and may be treated successfully with little danger of injury to the fruit. A full grown larva is a little more than a half inch in length, slightly hairy, with two rows of black dots on the back.

**REMEDIES:**—A thorough spraying with Paris-green or London purple is effective in destroying them. Either of these remedies may be applied with perfect safety during the period when the pest is apt to cause the greatest amount of injury.

Neither Paris-green nor London-purple, however, should be applied to grapes for some time previous to the ripening of the fruit. This is especially true in this region, where we have no rains to wash the poison from the vines, after it has been efficient in destroying the insects.

TWELVE SPOTTED VINE BEETLE.—(*Diabrotica tenella, Lec.*)

This is a small yellow and green beetle, with twelve dark spots in two rows on each wing. It has been sent here from Yuma and Huachuca and reported injurious at both places. It causes the greatest amount of injury to melon vines, in early spring, just as they are starting from the ground. From Huachuca it is reported as causing considerable injury to the foliage of apricots and peaches, even feeding to some extent upon the leaves of corn.

The larvae live in the ground and when numerous are of more or less injury to corn and other green roots.

**REMEDIES:**—When the insect is injurious to young vines, such as watermelon and musk-melon, the hills may be protected by frames covered with cheese cloth or other thin material, thus ex-

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*This insect was determined for me by Dr. C. V. Riley, Washington, D. C.*
cluding the pest. This may be practiced rather successfully, from the fact that the insects are most injurious when the plants are small, and may be covered with little expense for material or time. Although the arsenites do not seem to be very effective in the treatment of these insects, I know of nothing better. Where abundant, upon the foliage of fruit trees or shrubs, I would suggest a thorough spraying with Paris-green or London-purple; the strength of the mixture depending upon the tenderness of the foliage treated.

PLANT LICE. — (Aphides, Spp.)

During the months of spring and early summer, considerable damage is done to roses and other garden plants by two or three species of Plant Lice. When these small insects are found in large numbers, as they frequently are, they are exceedingly injurious.

The real damage, may be overlooked by the gardner or fruit-grower, as the insect does not feed upon the foliage, but pierces the epidermis and sucks the sap.

With roses they collect about the buds in such numbers that the flowers when developed are small and imperfect.

REMEDIES: — From the fact, that plant lice do not eat the foliage, it is evident that the application of a poison, such as one of the arsenites, will have little effect upon them. For outdoor plants, I know of nothing so effective in their destruction, as kerosene emulsion.

For roses it is especially desirable to apply the emulsion in the early morning or late in the afternoon.

The standard emulsion diluted to one part of prepared emulsion to fifteen or even twenty parts of water, will be effective. If the emulsion is too strong, it has a tendency to destroy or injure the foliage, especially if applied in the heat of the day.

SCALE INSECTS. — (Species of Aspidiotus and Lecanum).

Although as yet no complaints have come to the Station in regard to injury to fruit trees from the ravages of these insects,* without doubt they are found to some extent within our territory. The fruit regions of southern California are much injured each year by

*Since this Bulletin went to the printer I have had an opportunity to personally examine a number of orchards in Salt River Valley. I find that the San Jose scale is established in a number of orchards there.
these pests. Our somewhat similar climate and proximity to that region makes it necessary to exercise the greatest vigilance to keep them from our orchards. When once established, scale insects are exceedingly injurious and very difficult to eradicate, frequently destroying whole orchards.

A few of our native trees and shrubs, are subject to attack by species of scale. However, the scales found upon our native trees are not injurious to cultivated fruits.

REMEDIES:—From the fact that these insects are protected by a scale or covering, they are difficult to eradicate.

In the preceding pages, are given several of the best known remedies for these pests, including the well-known summer and winter washes, which have met with considerable success in California.

Fruit growers of Arizona who find scale insects upon their trees will confer a favor by reporting the same to this department and sending specimens for identification.

There is no doubt but that the various species of scales are among the most injurious insect pests of the southeast, and it is of much importance that they be not allowed to get established in our orchards. At their first appearance we should be fully prepared to combat them.