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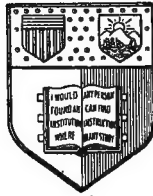
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Insects and insecticides.



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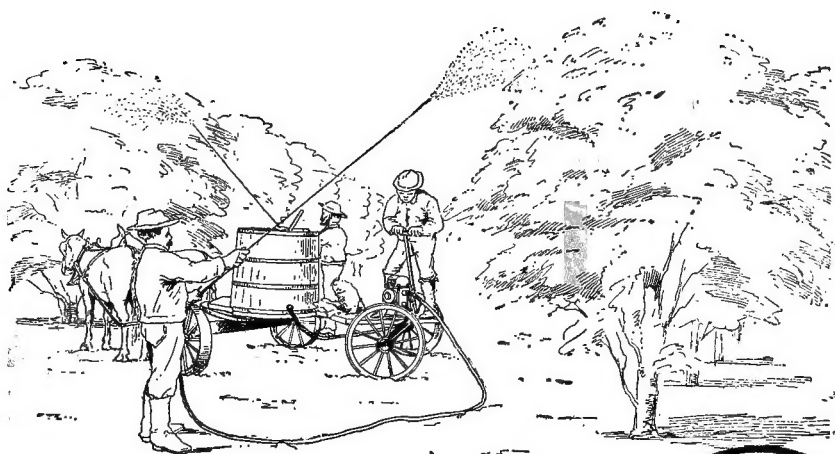
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STATE HORTICULTURAL COMMISSION

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INSECTS AND INSECTICIDES



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HORTICULTURE.

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INSECTS AND INSECTICIDES.

In order to intelligently apply insecticides, and to be able to judge whether one remedy or another will be more effective, it is necessary to understand something of the habits of the different insects attacking plants. Many insects, like caterpillars, grasshoppers, and beetles, devour the foliage, while others, such as scale insects, plant lice, squash bugs, etc., injure the plant by inserting their sharp beaks into its tissue and sucking the sap from beneath the surface. Insects of the first class can nearly always be destroyed by means of poisons, such as paris green and various forms of arsenates. Those of the second class, or sucking insects, are unaffected by these poisons and must be killed by contact sprays, such as kerosene emulsion, whale-oil soap, crude-oil mixtures, or the lime-sulphur-salt remedy. Another class of insects, and which none of the above remedies will reach, are those which burrow into the bark and trunks of trees. These must be treated mechanically—dug out, and barriers or repellants provided to prevent them from regaining entrance into the trees. In the following pages the most successful remedies are given, but, under certain climatic conditions or in abnormal seasons, other steps may become necessary and advice from the State Commission of Horticulture should always be obtained in cases where any doubt exists.

It should be remembered that the successful application of remedies is dependent upon the exercise of proper judgment. It is essential to first positively identify the insect to be destroyed, then to know the most effective remedy to use, and finally to apply it at the proper season. Promptness, thoroughness, and persistency, combined with good judgment, are the essential factors necessary for the successful application of insecticides.

This office is at all times glad to render any assistance possible in determining the identity of insects and in advising as to the remedy to be used for their control. Insects should not

be sent by mail in envelopes or pasteboard boxes, as they are almost invariably crushed beyond recognition; strong wooden or tin boxes should be used. Openings to admit air are not necessary. Plant specimens, showing the injury done, are desirable. *The name and address of the sender should be on every package.* It will help greatly if correspondents, when writing about insect pests, will give as full a description of the habits, food plants, injury and abundance as possible. Specimens of twigs, living plants with foliage, etc., should be wrapped in damp (not wet) cotton cloths so that they will reach us in fresh condition.

Correspondents can materially aid the work of this department by informing it of their success or failure in using the methods recommended for controlling injurious insects, at the same time giving a detailed account of the method used and the results obtained. Such information will prove of value to all.

SCALE INSECTS.

These insects are among the most dreaded pests on fruit trees in the State, owing to their prolificacy and easy mode of transportation. They are generally firmly attached to the foliage or bark of trees, and when present in great numbers soon kill the plant on which they are feeding.

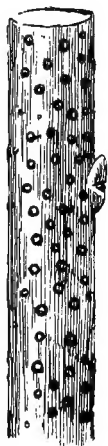


FIG. 1. San José scale on twig.

All the species in our orchards have been introduced. Although many now have their natural enemies, it having been the policy of this department for many years to control these pests by their natural parasites, yet it is

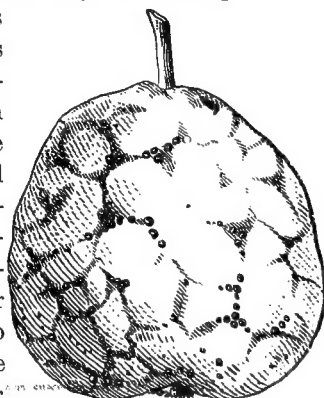


FIG. 2. Pear, showing effects of San José scale.

necessary, in abnormal seasons, to use artificial means to combat them. The grower very often overlooks the few small

specks on the leaves, fruit, or bark of his trees until it is too late. The proper time for effective work is when the insects first appear, and not after the trees are half killed by their attack.

Nearly all species of scale insects can be killed by the remedies recommended in this bulletin, but some species have to be treated by fumigation with hydrocyanic acid gas; especially is this true on evergreen trees, it being difficult, owing to the dense foliage, to reach every individual by sprays, and a sufficient number always escape to reinfest the trees. Our report for 1903-04 gives a list of scale insects and also illustrates many species of parasites which attack them, colonies of which will be supplied to growers on application to this department.

Following are the sprays recommended for the various scale insect pests:

Winter Wash for San Jose Scale, Pear Diaspis, and Greedy Scale.—Following is the lime-sulphur-salt solution:

Unslaked lime.....	40 pounds.
Sulphur	20 pounds.
Stock salt.....	15 pounds.
Water, to make.....	60 gallons.

Place 10 pounds of lime and 20 pounds of sulphur in a boiler with 20 gallons of water, and boil over a brisk fire for not less than one hour and a half, or until the sulphur is thoroughly dissolved. When this takes place, the mixture will be of an amber color. Next place in a cask 30 pounds of unslaked lime, pouring over it enough *hot* water to thoroughly slake it; and while it is boiling, add the 15 pounds of salt. When this is dissolved, add to the lime and sulphur in the boiler, and cook for half an hour longer, when the necessary amount of water to make the 60 gallons should be added.

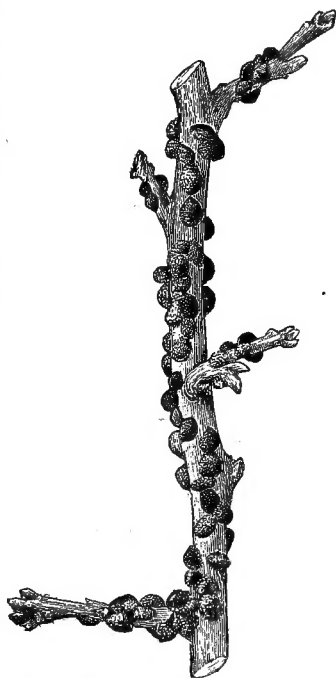


FIG. 3. Brown apricot scale (*Eulecanium armeniacum*, Craw).

Rosin Wash for all Species of Scale Insects on Deciduous Trees.—The following are the proportions of materials for the winter wash:

Rosin	30 pounds.
Caustic soda (98%)	8 pounds.
Fish oil	4½ pints.
Water, to make	100 gallons.

Place the rosin, caustic soda, and fish oil in a large boiler, pour over them about 20 gallons of water, and cook thoroughly over a brisk fire for at least three hours; then add *hot* water, a little occasionally, and stir well, until you have not less than 50 gallons of hot solution. Place this in the spray tank, and add cold water to make the necessary amount. *Never add cold water when cooking.*

Distillate Spray for Young Black Scale on Orange Trees.—To be used with power machine, fitted with an agitator, speeded at 65 or 70 revolutions per minute:

Distillate 28°	2 gallons.
Water	100 gallons.

Use only the best 28° distillate and see that a perfect mixture is attained at nozzle before applying to trees. This can be determined by agitating for a sufficient time to thoroughly mix the contents of tank; the time will vary somewhat according to speed and construction of agitator. Examine the mixture at nozzle by holding hand in front of same; when the mixture is at its whitest it is ready to apply.

When engine stops from any cause, immediately discontinue application of spray. When starting up again, empty hose into tank until the mixture is again at its whitest. Apply spray at a pressure of 160 pounds.

Do not spray an orchard in need of irrigation. Trees that are not in a thrifty condition should be sprayed with a weaker solution.

Avoid spraying during the prevalence of high winds, cold weather, or when trees are wet with rain or fog.

For Red Scale increase the solution to 2¼ per cent on orange and to 2½ per cent on lemon trees, and add one quart of pure turpentine to the 100-gallon tank.

Distillate Emulsion for Black Scale on Citrus Trees.—The following are the proportions for the stock solution:

Distillate 28° (untreated).....	5 gallons.
Hot water.....	5 gallons.
Whale-oil soap.....	1½ pounds.

The whale-oil soap must first be dissolved in the water. Then add the dissolved soap to the distillate. It is important that the distillate be placed in the mixing vessel first, then place the dissolved soap on top. Then attach the spray pump to the bottom of the vessel in which the compound is being mixed, and keep pumping it out of the vessel through the spray pump and back into the vessel, until the whole becomes of a rich creamy substance. Keep pumping or churning it through the pump until it becomes a complete emulsion, without a speck of free oil in sight, which will take from ten to fifteen minutes. When properly emulsified, it should increase in volume about one third, because it becomes aëriated.

After the stock solution has been thoroughly prepared, it will readily mix with cold water. To each gallon of the above stock solution add 14 gallons of cold water. Always place the emulsion in the spray tank first, then add the water, as by this means a more uniform mixture can be made. This emulsion can be applied with an ordinary hand spray pump.

Summer Wash for San Jose Scale and Other Armored Scales on Deciduous Trees.—Following are the proportions of materials to be used:

Whale-oil soap.....	20 pounds.
Sulphur.....	3 pounds.
Caustic soda 98%.....	2 pounds.
Water.....	100 gallons.

Place sulphur and caustic soda in about two gallons of water and boil for at least one hour. Dissolve the soap by boiling in water. Mix the two solutions, and reboil all for a short time. Apply the spray warm.

This wash also makes a good combination spray for scale and fungus.

For Individual Trees and Shrubs on a Small Scale use the following:

Whale-oil soap.....	1 pound.
Hot water.....	5 gallons.

Dissolve the soap by boiling, and apply warm.

Hydrocyanic Acid Gas Treatment, for Destroying Scale Insects on Citrus Trees.—This treatment should be used in the night so as to avoid light, heat, and sea breeze, which neutralize the effect of the gas. The chemicals used for producing the gas are: Sulphuric acid (commercial), cyanide of potassium (98% to 99%), and water.

The following instructions must be carefully observed: First, the tent, which must be air-tight, is placed over the tree; second, the tent is made air-tight around the bottom by throwing some loose soil over the bottom of the canvas; third, the necessary amount of sulphuric acid, together with the required amount of water, is put in a glazed earthenware vessel, and placed under the canvas, and the cyanide of potassium is added. A piece of sacking or burlap is thrown over the top of the vessel, to spread the gas and prevent it from burning the leaves immediately above the generator. The tree is left covered forty minutes.

The Riverside County Board of Horticultural Commissioners recommends the following proportions of chemicals:

Height of Tree.	Diameter of Tree.	Water.	Cyanide C. P., 98 per cent.	Sulphuric Acid, 66 per cent.
<i>Fect.</i>	<i>Fect.</i>	<i>Ounces.</i>	<i>Ounces.</i>	<i>Ounces.</i>
6	4	2	1	1
8	6	3	1½	1½
10	8	5	2½	2½
12	14	11	5	5½
16	16	17	8	9
20	16-20	22	10	12
20-24	18-22	30	14	16
24-30	20-28	34	16	18
30-36	25-30	52	24	28

The cyanide should be used about the size of walnuts, so that the chemical action will be less violent. The gas is also generated more evenly, and there is not so much danger of the chemicals boiling over or spattering the tent. As soon as the tent is removed, the vessel is rinsed with clean water and prepared for another charge.

APHIDS, OR PLANT LICE.

Next to the scale insects are the aphids, or plant lice, as they are generally called; these also belong to the sucking insects.

Plant lice are small, usually green, but varying to brown or black insects, and are generally found on the under side of

leaves or on growing shoots. These insects multiply very rapidly, but fortunately for the grower the hot summer climate of California prevents long duration of their attack and there also exist in California hordes of natural enemies which attack them shortly after their appearance and soon reduce their numbers.

In favorable seasons, however, plant lice become a very serious pest and artificial means for fighting them have to be resorted to. Nearly all varieties of fruit trees are attacked by them and a great many of our early fruits are rendered unsalable by the abundance of honey-dew exuded by these insects.

The principal known species are:

Woolly Aphis (*Schizoneura lanigera*).—This little insect secretes a white cottony mass about its body and infests both the roots and the branches of apple trees. Its presence can be readily detected by this white cottony mass, and upon close examination the brownish-pink lice are found under the cotton. The root form causes great

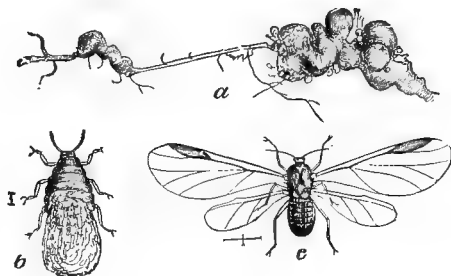


FIG. 4. Woolly Aphis of the apple (*Schizoneura lanigera*, Hausm.)

damage to the tissues of the roots by forming swellings or galls, giving an unhealthy growth, which soon kills the small roots. As the root-infesting form is by far the most destructive, it is important that remedial measures should be directed against it. By eradicating the root form in winter a great reduction in the branch or aerial form follows, but it can be readily understood that this underground form is extremely difficult to combat.

Early in the fall dig a trench around the tree, uncovering the crown roots as much as possible; in this trench place one or two shovelfuls of unslaked lime, according to the age and size of the tree; add enough water to slake the lime, and cover up with earth. The rain will keep carrying the lime to the roots and reduce the pest. As a substitute for the unslaked lime, gas lime is very often used, but great caution must be

exercised, for if applied in too great quantity there is danger of killing the tree. One or two shovelfuls can be used on an old tree, but a young tree should not be treated with this substance.

The use of tobacco dust has given good results, particularly on young trees and nursery stock. The application should be made in the fall of the year, so that the rains can leach out the tobacco juice and bring it in contact with the aphids.

For the branch, or aërial, form a good kerosene emulsion or whale-oil soap wash (summer formula) will soon reduce the pest.

KEROSENE EMULSION.

Coal oil (150° test).....	4 gallons.
Laundry soap.....	1 pound.
Water.....	2 gallons.

Dissolve the soap by boiling in the water, and when dissolved and while boiling pour with a dash into the kerosene. Churn the mixture for ten or fifteen minutes, either by pouring back and forth from one vessel to another, or by pumping the liquid back upon itself. The emulsion should have the consistency of cream.

For a winter wash when trees are dormant, use one gallon of emulsion to six gallons of hot water.

For a summer wash use one gallon of emulsion to ten gallons of hot water.

Prune Aphis (*Aphis prunifoliæ*).—These insects are readily recognized by their bluish-green color and by the abundance of honey-dew generally found on the ground under the infested trees. In abnormal seasons only does this pest become injurious to the prune trees. Our native lady-birds and syrphus flies generally keep this species under control, but in the absence of these friends use the summer formula of the kerosene emulsion or the whale-oil soap solution.

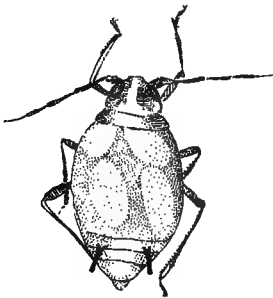


FIG. 5. Prune Aphis (*Aphis prunifoliæ*).

Black Peach Aphis (*Aphis persicæ-niger*).—This insect is one of the most dangerous foes of the peach tree, and the grower should, at the very start, wherever he notices its

appearance, thoroughly eradicate it. It is a small brownish-black insect and exists in the wingless as well as in the winged form. It attacks the roots as well as the foliage, and this makes it all the more difficult to combat. The branch form is readily controlled by the use of kerosene emulsion or the whale-oil soap wash, using the summer formula; but, so far, no wash or remedy has been found to give perfect results on the root form, only partial relief having

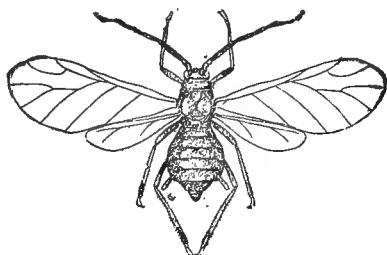


FIG. 6. Black Peach Aphis (*Aphis persicz-niger*).

been obtained by the use of a diluted kerosene emulsion, used around the base of the tree and applied during or just before a rain. This allows the water to carry the emulsion to the infested parts. Tobacco dust, as recommended for the root form of woolly aphis, will also give partial relief.

Hop Louse (*Phorodon humuli*).—The following is recommended, to be applied as a spray:

Whale-oil soap.....	7 pounds.
Quassia chips	8 pounds.
Water	100 gallons.

Soak the quassia chips for eight or nine hours in hot water. Dissolve the whale-oil soap, by boiling, and mix the two liquids, adding enough water to make 100 gallons.

The best machine to use is the Knapsack sprayer with a Cyclone or Vermorel nozzle, using a very fine spray and applying it to the under side of the foliage.

CANKER OR MEASURING WORMS, TUSSOCK MOTH, LEAF-ROLLERS, AND OTHER LEAF-EATING CATERPILLARS.

For these pests the following is recommended:

Arsenate of lead	12 pounds.
Water	200 gallons.

Rub up the desired quantity of arsenate of lead into a smooth, thin paste in a small amount of water, and pour into the spraying tank or barrel. Keep the mixture well stirred and use a fine spray with plenty of pressure. A warm, sunny day should always be selected.

Cankerworms.—Two species of cankerworms do damage to our trees, but they so closely resemble each other that it is difficult to distinguish them in the larval form. The adult moths, male and female, do not resemble each other, the male being winged, the female wingless. The proper time for fighting this pest is when the wingless female makes her appearance out of the ground where she has been hibernating in the pupal form. For years many devices have been used to prevent the

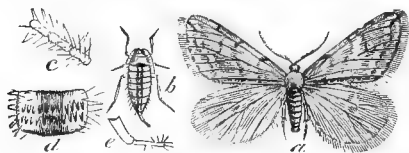


FIG. 7. Spring Cankerworm (*Paleacrita vernata*).

a. Male moth. b. Female moth. c. Three joints of antennæ of female moth. d. Abdominal segment of female moth, enlarged. e. Ovipositor, enlarged.

female from ascending the tree, and any substance which will retain its stickiness will be good for this purpose. During 1905 extensive experiments were

carried on with tree tanglefoot, a very sticky substance manufactured in the East. The results were very gratifying; in fact, tests were made side by side with the wire-mesh trap, and the tanglefoot gave by far the better results. The substance should be applied in early November, and is put on a paper band which

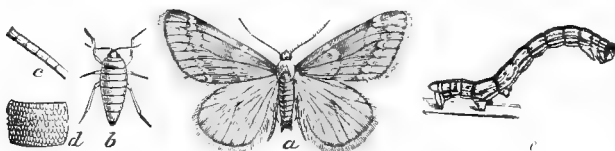


FIG. 8. Fall Cankerworm (*Alsophila pometaria*).

a. Male moth. b. Female moth. c. Joints of antennæ of female, enlarged. d. Segment of body of female, enlarged. e. Larvæ of cankerworm.

has been fastened to the tree, and when the wingless moth crawls upon it she is held captive and soon perishes.

If through neglect in banding the trees the moths ascend to the branches and deposit their eggs, producing a brood of worms, the only remedy is the arsenate of lead solution.

Tussock Moth (*Hemerocampa vetusta*, Bois.).—The larva of this moth does not form a tent, as in the case of the forest-tent caterpillar, which is often taken for it. It is generally found singly on the under side of leaves, or along the stems of new growth, and is a very general feeder. Gathering the white,

woolly egg-clusters in pruning season has proved very successful in combating this pest in certain sections, while in other

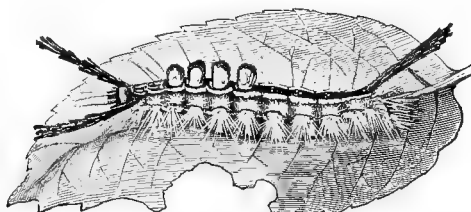


FIG. 9. Tussock Moth, caterpillar.

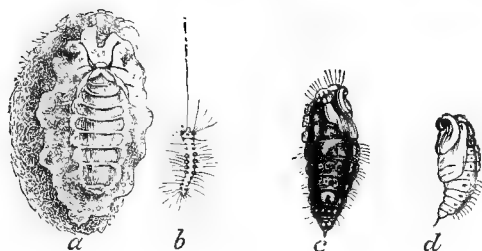


FIG. 10. Tussock Moth.

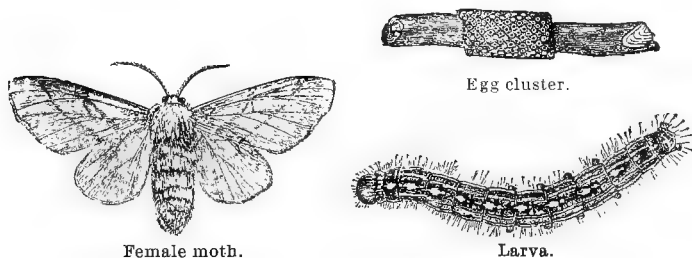
a. Female moth. b. Young larva. c. Female pupa.
d. male pupa.



FIG. 11. Tussock Moth, male.

sections it is held in check by parasites which attack these egg-clusters. In very badly infested orchards spraying can be resorted to, and the arsenate of lead solution will be found a good remedy.

Tent Caterpillars.—These caterpillars are at times very abundant and cause a great deal of damage to the foliage of



Female moth.

Egg cluster.

Larva.

FIG. 12. Tent Caterpillar (*Cistiocampa sylvatica*).

fruit trees. The presence of the caterpillars can easily be detected by the tents or webs which the colony of worms spin in the tops of the trees. Collecting and burning these tents,

in which the caterpillars rest during the day, is about the quickest and best method to check their ravages.

Leaf-Rollers (*Cacæcia* sp.).—These caterpillars are generally concealed in a few leaves rolled together, and feed at night. They have been known to do a great deal of damage in favorable seasons, and very often have been taken for cankerworms, but the dark green color with a black head and the non-looping movement of the body correct this error. In orchards where spraying with paris green or other arsenates is done this pest soon disappears, as any arsenate spray, by poisoning the leaves, will soon reach it.

CUTWORMS AND GRASSHOPPERS.

The following poison bait is recommended:

Bran	40 pounds.
Middlings.....	20 pounds.
White arsenic.....	20 pounds.
Cheap molasses.....	2 gallons.

Thoroughly mix the bran, middlings, and arsenic together dry, then add two gallons of cheap molasses and sufficient water to make the whole into a crumbling moist mash. Place a tablespoonful of the mixture a few inches from the tree or vine.

Cutworms (*Peridroma saucia* and *Agrotis* spp.).—Cutworms are the larvæ or caterpillars of owlet moths. They feed at night, resting underground during the day. Their natural food is weeds, clover, grasses, etc. In wet seasons, when weeds are abundant, cutworms are found in great numbers, and when the grower turns under the weeds, depriving the worms of their natural food, they will attack cultivated plants, trees, and vines. The most successful way of fighting cutworms is to place a poisoned food wherever this pest is doing damage, care being taken not to allow livestock or poultry to run where the poison is placed. Alfalfa or any succulent vegetable, such as cabbage or lettuce, can be dipped in a strong solution of arsenic and water and placed on the ground around the damaged plants, but the bran-and-arsenic remedy given above is more generally used.

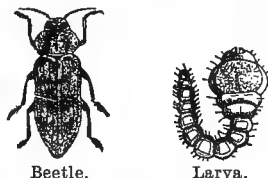
It has been found that their numbers can be greatly diminished and the loss from their depredations materially checked

by gathering the worms by jarring the vines over canvas sheets and collecting them while hoeing the weeds around the vines.

Grasshoppers.—Grasshoppers appear periodically in large swarms and farmers are at a loss to know what to do. This is generally the case when the insects are on the wing, at which time it is almost impossible to combat them. The proper time to eradicate a swarm of grasshoppers is when they are in the nymph or wingless stage, at which period they are slow of motion and can be driven on to any kind of dry material and destroyed by burning. Grasshoppers generally breed in pasture lands or uncultivated fields near cultivated areas, and as the pastures dry up they migrate to the cultivated fields. It is absolutely necessary to check this wandering before the insects develop wings. A great many devices have been invented to prevent them from entering cultivated grounds, and by the use of smudges swarms have been scattered, but these methods have generally been used on prairie lands. If the pasture lands are beginning to dry up and the young hoppers are starting to move, a very successful attack can be made by using the poison bait recommended herein.

FLAT-HEADED APPLE-TREE BORER (*Chrysobothrys femorata*).

Whenever fruit trees become burned they at once become infested with the flat-headed borer, a yellowish-white grub, with large, flat head, the larva of the beetle. All trees, when planted, should be placed as nearly as possible as they stood in the nursery, for by reversing the north side to the south they invariably become sunburned. Tree-protectors or a good whitewash will prevent this trouble, if used in time. If borers infest a tree, they must be removed and the trunk of the tree painted with the following solution:



Beetle.

Larva.

FIG. 13. Flat-Headed Apple-Tree Borer.

Unslaked lime	50 pounds.
Whale-oil soap	12 pounds.

Slake the lime with sufficient water to make a thick whitewash; dissolve the whale-oil soap by boiling, and add this to the lime, mixing it thoroughly; the whole should have the consistency of cream. Apply to the trunks of sunburned trees.

PEACH-TREE BORER (*Sanninoidea opalescens*).

The larva of this insect is a pale-yellowish, cylindrical grub, nearly an inch in length, and very destructive to the lower trunk and roots of peach, almond, apricot, prune, and cherry trees. Many devices and remedies have been used to check its work, but none have proven entirely satisfactory. The worming or digging-out method, although very expensive, is no doubt the most reliable one, and when followed by the appli-

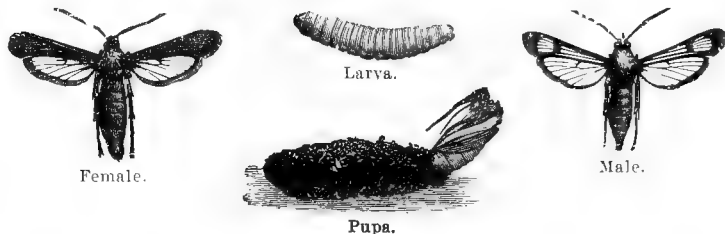


FIG. 14. Peach-root Borer (*Sanninoidea opalescens*).

cation of a barrier, or preventive, to keep out the new brood, which is absolutely necessary, has given good results.

In the digging-out method, the earth should be removed from around the tree and wherever gum is found, the borer chisel should be carefully used and the borers removed, care being taken not to remove too much bark. The proper time to do this is in November, December, or January. After the trees have been thoroughly gone over, a barrier compound should be applied. The following two mixtures have given good results:

Mixture No. 1.

Unslaked lime	50 pounds.
Whale-oil soap	12 pounds.
Coal tar	1½ gallons.

To make the compound, slake the lime and tar together, adding enough water to make a medium thick whitewash. Dissolve the soap with hot water and add this to the lime solution, using enough water with the mixture to make a thick, paste-like whitewash.

Mixture No. 2.

Unslaked lime	50 pounds.
Crude oil, 16° Beaume	3 gallons.

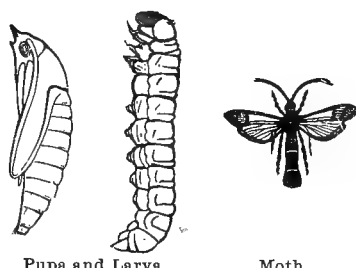
Slake the lime and crude oil together, adding enough water to make a thick whitewash.

The application of crude oil alone (14° or 16° Beaume) will

successfully drive out or kill the small borers, but does not seem to affect those that are full grown. The constant application of crude oil alone to trees, especially in warm localities, should be avoided, as experience has shown that it is detrimental to the bark.

STRAWBERRY AND CURRANT BORERS.

These pests usually attack old plantings. The best remedy for the strawberry borer is to dig up, as soon as discovered, the plants showing infestation. In the case of the currant borer, the infested canes should be carefully removed below the point of infestation and immediately burned.



Pupa and Larva.

Moth.

FIG. 15. The Currant Borer (*Egeria tipuliformis*).

PEACH MOTH (*Anarsia lineatella*).

The sudden wilting of the young, tender growth of peach,

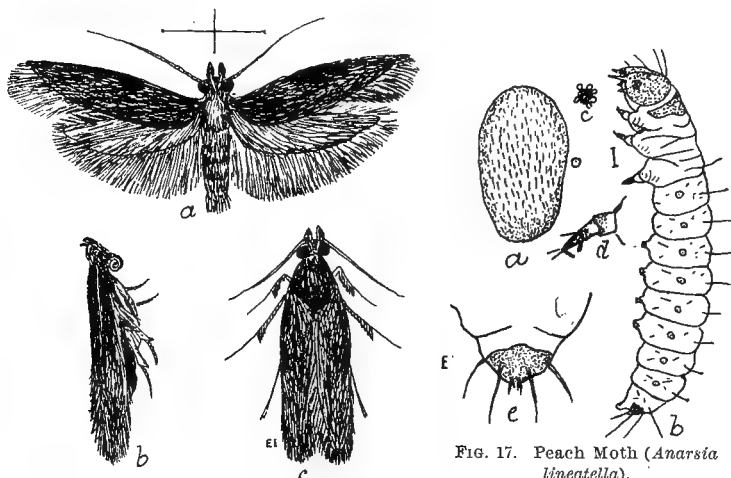


FIG. 16. Peach Moth (*Anarsia lineatella*).

a. Moth with spread wings. b, c. Same with wings closed, illustrating positions normally assumed. All much enlarged. (After Marlatt.)

FIG. 17. Peach Moth (*Anarsia lineatella*).

a. Egg. b. Young larva. c. Eye. d. Thoracic leg of same. e. Anal segment from above. All greatly enlarged. (After Marlatt.)

apricot, and prune trees is caused by a small reddish-brown worm, the larva of the peach moth. This worm hibernates

during the winter months in the soft bark of the crotch of the tree, and can be killed by the use of the lime-sulphur-salt solution, or by a good kerosene emulsion. Care should be taken to select sunny weather and spraying should be put off as late as possible, preferably just before the swelling of the buds. Either spray will penetrate the burrows and kill the small worm.

CODLING-MOTH (*Carpocapsa pomonella*.)

The larvæ of the codling-moth, or worm of the apple, possibly do as much

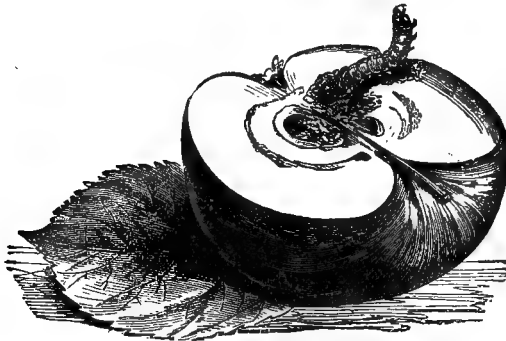


FIG. 18. Codling-Moth (*Carpocapsa pomonella*), larvæ in apple.

damage to the apple and pear crops in this State as anything which attacks fruit trees. Thorough spraying, clean culture, and collecting all fallen fruit go far toward coping with the pest. The newly introduced

parasite, *Calliephixetes messor*, Grav., has already taken hold of this pest in several sections and may prove a great aid in keeping it in check in the future. During the present season the arsenate of lead seems to be the leading spray material in use, owing to its adhesive properties.



FIG. 19. Codling-Moth (*Carpocapsa pomonella*). Showing variations. All natural size.

This material in a prepared form and ready for use simply by the addition of water in sufficient quantity, is on the market in different sized packages. A

great deal of disappointment in the use of paris green generally occurs, on account of either poor material or unfavorable weather conditions. The weather does not seem to have the same effect on the arsenate of lead as it does on other sprays, and storms do not seem to remove this poison, as it is not susceptible to the rain.

Mixture No. 1.	
Arsenate of lead	8 to 12 pounds.
Water	200 gallons.

Make the arsenate of lead into a smooth, thin paste by using the necessary amount of water, then pour into the spray tank, and keep well stirred while spraying. Use a fine spray with plenty of pressure.

Mixture No. 2.	
Paris green	1 pound.
Unslaked lime	6 pounds.
Water	200 gallons.

Make the paris green into a paste before placing it in the spray tank. Slake the lime with plenty of water and strain thoroughly so as to eliminate all particles which might clog up the nozzle. Place the lime solution and paris green in the tank with the water and stir the mixture constantly while spraying. Lime water alone has been used, but it is preferable to use the lime, as it shows when the trees have been sprayed thoroughly.

PEAR OR CHERRY SLUG (*Eriocampa cerasi*).

When the pest first makes its appearance, especially on young trees, a good dusting with air-slaked lime or, better, hydrated lime, will check the damage. Spraying with arsenate of lead, as recommended for cankerworms, will be found very efficient on larger trees.

CABBAGE WORMS, CUCUMBER BEETLES, DIABROTICA, AND FLEA BEETLES.

The following are recommended:

Wet Sprays.

(1) Arsenate of lead.....6 to 8 pounds.	(2) Paris green 1 pound.
Water	Unslaked lime..... 2 pounds.
.....100 gallons.	Water
160-200 gallons.

Dry Sprays.

(1) Paris green 1 pound.	(2) White arsenic..... 1 pound.
Hydrated lime, air-slaked lime, or wheat flour	Hydrated lime, air-slaked lime, or wheat flour
.....10 pounds.12 pounds.

Both the wet and the dry sprays, when thoroughly mixed, will be found very efficient in eradicating these pests by either dusting with the dry compound or spraying in the regular manner with the wet solution.

SQUASH BUG (*Anasa tristis*); **HARLEQUIN CABBAGE BUG** (*Murgantia histrionica*); **BOX ELDER PLANT BUG** (*Leptocoris tririttatus*).

These insects are too well known to need description. The females, which hibernate during winter in dried leaves and weeds along fences, lay their eggs on the under side of the leaves or on the stems of young plants. To be successful in fighting these pests the hibernating females must be gathered before they lay their eggs, thus preventing the spring brood from making its appearance. This has been done on a large



FIG. 20. Harlequin Cabbage Bug (*Murgantia histrionica*).

a. Larva. b. Pupa. c. Eggs, natural size. d. Eggs, enlarged. e. Eggs seen from above, enlarged.

scale and is the only true way of preventing the enormous increase which generally occurs where these pests are let alone. In case the spring brood makes its appearance, about the only available method is hand picking or jarring them into receptacles containing kerosene. Where the pest is very numerous the planting of early trap crops has also been found quite successful.

HESSIAN FLY (*Cecidomyia destructor*).

This is one of the pests which, in favorable seasons, appear in our grain fields and it does considerable damage to the growing grain. The adult fly is a small black gnat, resembling somewhat the mosquito on a very small scale. The female deposits her eggs on the leaves and leaf-stalks of the sprouting grain. These eggs, which are very minute, are pale orange in color, with reddish dots, and are laid with the head end downward. As soon as the tiny grub hatches, it goes down the stem and forces itself between the stem and the sheath as near the joint as possible. At this point the grub makes its attack

by sucking the sweet juices of the stalk, which soon wilts and falls over. After the grub has attained its full growth it passes into a brown pupa form, which resembles a flax seed, and the empty pupa case is left protruding from the stalk after the fly has emerged.

Where this pest has appeared it is advisable to burn off the stubble in the fall, as this will destroy the "flax-seed" pupæ, which hibernate in the stubble. It is also advisable to sow the grain as late as possible.

GARDEN SLUGS OR SNAILS.

Although slugs or snails do not belong to the same sub-kingdom as insects, yet the damage which some of them inflict on vegetables and other products of the gardener and florist is sufficient to cause mention of these pests in this bulletin. They are generally found in damp places, hiding under stones and in cracks of the ground in daytime. In the evening they come from their hiding places in search of food, and as they are voracious feeders, they often do great damage.

At sundown thoroughly drench the garden. Place pieces of board, shingles, or even cabbage leaves on the beds where the damage has been done. The slugs will congregate on the under side of these traps instead of returning into the wet soil and can easily be killed in the morning. Spreading fresh slaked lime on the ground around the plants that have been attacked will act as a repellent, but if much watering is done the lime will soon be washed away.

RED SPIDERS AND MITES.

Red spiders appear as minute red, reddish-brown, or yellow specks on either the surface or the under side of the leaves and by the aid of a hand lens are easily recognized. The eggs are generally laid in masses on the under side of branches and around the buds, this being particularly true of the almond bryobia. The damage done by these minute creatures can easily be noticed. The mites suck the sap from the cells of the leaves, which take on a pale color and finally drop to the ground. The following remedies have been used to advantage:

For Red Spider or Yellow Mite on Deciduous Trees.—Soon after the trees are in leaf in the spring, and while they are damp

with dew in the morning, thoroughly dust them with sulphur: Use sulphur bellows, or if the orchard is extensive, fix up a broadcast seeder on a wagon. With this arrangement an orchard can be treated very thoroughly and with dispatch. Infested orchards should be treated at least three times during the spring and early summer.

While this is true generally, sometimes the dry sulphur does



FIG. 21. Yellow Mite.

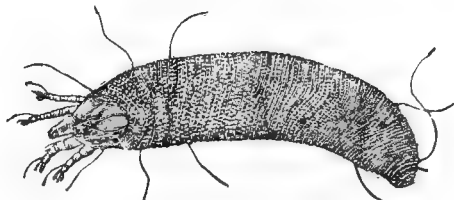


FIG. 22. Pear-Leaf Blister Mite (*Phytoptus pyri*), very greatly enlarged.

not seem to do the work, owing to climatic conditions, and it is best to apply the sulphide of potash wash, as follows:

Caustic soda 98%.....	10 pounds.
Sulphur.....	20 pounds.
Dissolve in water	20 gallons.

Take the sulphur, mix it to a paste—not sloppy—with cold water in a barrel, then add to this wet sulphur 10 pounds of caustic soda (98 per cent), and it will boil the sulphur just like lime slaking; have 20 gallons of water to add to it as it boils, to prevent its burning. This is the stock solution, and when ready to spray the mites or spiders, put 40 gallons of water in another barrel, and take a half gallon of the stock solution and add to the 40 gallons of water, straining it to take out any sediment there may have been in the sulphur. Remember, this is for mites and spiders only. This stock solution should be diluted one-half gallon to 40 gallons of water, and applied with a spray pump under 100 pounds pressure.

The distillate spray of 2 per cent strength with the addition of 7 pounds of flour of sulphur has proved very effective in some sections of the State. To use the sulphur in this mixture, it is necessary to first make a paste of the sulphur before adding it to the distillate mixture.

For Pear-leaf Blister Mite, Walnut-leaf Blister Mite, Grape-leaf Mite, Orange and Lemon Peel Mites.—The burrowing mites, or *Phytopti*, differ from all the other mites in having but two

pairs of legs, always located near the head (see figure), whereas the "red spider" (*Tetranychus*) has three pairs in the young stage and four pairs in the adult, located upon the sides. The body of the *Phytoptus* is cylindrical, transparent, and long, as compared with the other portions of the mite. From the position of the legs it has to drag its body in walking.

Kerosene emulsion is considered the most effective wash for winter use. It is very effective when diluted with from three to eight parts of water and sprayed on the infested trees or vines before the leaves start. Trees sprayed with the strongest solution are practically free from this pest. Those sprayed with the weaker solution show very few galls—not over one per cent of the number that were on the trees the preceding year. Summer treatment with liquid remedies is of little avail. As soon as the leaves start in the spring they should be liberally treated with dry sulphur in the early morning while yet damp with dew; a second and third application as the growth develops will be found effective.

