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Strawberry Insects and Their Control in Missouri

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In most localities in Missouri it is possible to obtain satisfactory control of the insect pests of strawberries by the use of suitable cultural methods such as crop rotation, clean culture, plowing under patches promptly after the crop has been removed, and cleaning out brushy fence rows and hibernating places of the insects. From time to time, however, different insect pests appear in injurious numbers, and necessitate the use of more drastic specific control measures.

The purpose of this bulletin is to make available to the strawberry growers of Missouri the latest information concerning such measures, as well as the various methods of cultural control of the insect pests likely to injure strawberries.

These insects may be divided into groups according to the parts of the strawberry plant which they attack.

A. Insects Injuring Roots and Crown—

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|--------------------------------|--------------------------|
| 1. Strawberry crown borer | 5. Black vine weevil |
| 2. Strawberry rootworm beetles | 6. White grubs |
| 3. Grape colaspis | 7. Cutworms |
| 4. Strawberry root weevil | 8. Strawberry root aphid |

B. Insects Injuring Foliage and Bloom—

- | | |
|---|-----------------------------|
| 1. Strawberry leaf roller | 6. Strawberry weevil |
| 2. Obsolete-banded strawberry leaf roller | 7. Grasshoppers |
| 3. Cutworms | 8. Strawberry slugs |
| 4. Strawberry rootworm beetles | 9. Flea beetles |
| 5. Grape colaspis | 10. Red spider |
| | 11. Imbricated snout beetle |

C. Insects Injuring Young Fruit—

- | | |
|------------------------|----------------------|
| 1. Tarnished plant bug | 3. Strawberry thrips |
| 2. Negro bugs | |

D. Insects Injuring Ripe Fruit—

- | | |
|---------------|-------------------|
| 1. Crickets | 3. Ground beetles |
| 2. Negro bugs | 4. Millipedes |

A. INSECTS INJURING ROOTS AND CROWN OF PLANT

1. Strawberry Crown Borer (*Tyloclerma fragariae* Riley)

This small, brownish, snout beetle has been present in Missouri for many years and is the main cause for patches being turned down for plant certification. The eggs of this beetle are laid in crevices of the leaf sheaths and at the bases of lateral roots (Ritcher, 1939) during warm days in March and April. The larvae, or young worms, hatch and tunnel down into the crown of the plant. This usually kills the plant, or may stunt it and prevent the production of runners.

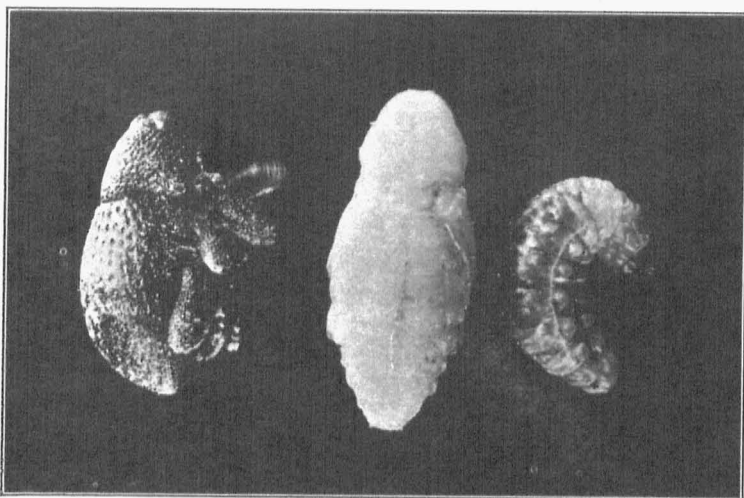


Fig. 1.—Strawberry crown borer, adult, pupa, and larva, all much enlarged.

The worms become full-grown, for the most part, in July and August, turn into whitish pupae inside the crown of the plant, and then emerge as adult beetles from July to November. These beetles cannot fly. They feed to some extent during the fall on strawberry foliage, wild cinquefoil, or wild strawberries, and hibernate for the winter in the berry patches, bushy fence rows, and uncultivated fields. In the spring, the beetles crawl to the strawberry plants and lay their eggs. Ordinarily there is only one generation a year.

Control.—(1) Set only certified plants, preferably those from states which require that patches certified be completely free of infestation, or else use fumigated plants. Taking plants from a neighbor's patch has often resulted in getting infested plants, especially if taken from old and weakened plantings. If uncertified plants must be used, dig the plants after December 1 and before March 1, as no eggs will have been deposited on the plants between those dates. (2) Set strawberries on land which has been in culti-

vation one or preferably two years previously, and at least 1,000 feet from old infested patches or areas where wild strawberries or common cinquefoil (Haseman and Sullivan, 1927) grow. (3) Destroy old beds immediately after the last picking, and do not crop patches more than three years. (4) Clean out fence rows which may serve the beetles as breeding and hibernating places. (5) If a patch is subject to an infestation of the beetles, the use of a bait

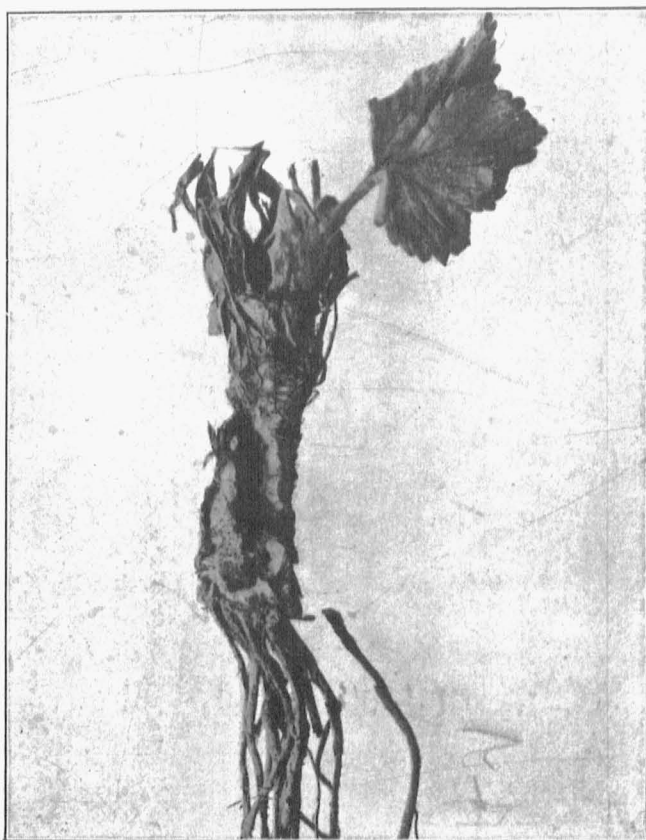


Fig. 2.—Crown borer injury to plant.

composed of 24 parts of dried, chopped apple refuse coated with 1 part of sodium fluosilicate and spread around the plants during warm days in March and April gives promise of good control by attracting and poisoning the adult beetles (Ritcher, 1940). (6) The use of sprays, as given later, for the control of strawberry leaf roller gives some control of adult beetles, but is usually too late to catch the early beetles.

2. Strawberry Rootworm Beetles (*Paria canella* Fab. and *Graphops pubescens* Melsheimer)

These beetles are about one-eighth of an inch in length, and vary from brown to black in color, or are coppery-brown. They pass the winter in the strawberry patches or fence rows under mulch, trash, dead leaves, etc., and emerge in April, May, and June. They eat holes in the leaves of the plants, and the females lay their eggs in or on the ground near the plants. The young grubs which hatch from these eggs feed on the roots of the plants for two or three months, pupate, and emerge in July and August as adult beetles. These beetles feed to some extent on the leaves again before they go into winter quarters. Their work on the leaves is most noticeable in the early spring and fall.

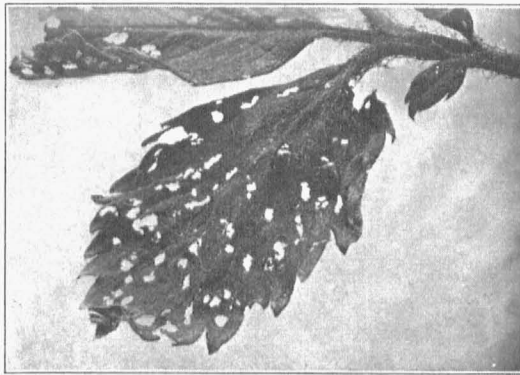


Fig. 3.—Strawberry leaves injured by adult beetles of rootworm.

Control.—Damage in old patches is much more severe than in new ones. Patches should not be maintained longer than three years. A spray consisting of 3 pounds lead arsenate, $\frac{1}{2}$ gallon summer oil, and 100 gallons of water, or a dust consisting of 1 part of lead arsenate to 4 parts of lime, will stop injury by these beetles when they are numerous enough to cause serious damage. Sprays or dusts should be applied when leaf damage is noticed, usually in early April and early August.

3. Grape Colaspis (*Colaspis brunnea* Fab.).

The damage that is done to strawberry by these pale brownish beetles, about one-sixth of an inch in length, is much the same as that done by the strawberry rootworm beetles. The life cycle is

also much the same, but the colaspis beetles sometimes emerge as adults earlier in July than the rootworm beetles, especially in the extreme southern parts of the state. These beetles are general feeders and attack a number of different plants, including wild grapes.

Control.—The control measures for grape colaspis are about the same as those recommended above for the strawberry rootworm beetles. Patches adjoining vineyards or woodlands which have wild grapes in abundance should be watched carefully during late June and early July for migrations of these beetles, and spray or dust applications should be made when the adults appear. In Ohio (Neiswander, 1940), a dust mixture of either Dutox or Kryocide, used at the rate of 1 pound to 2 pounds of talc or flour, gave good results.

4. **Strawberry Root Weevil** (*Brachyrhinus ovatus* Linne).

5. **Black Vine Weevil** (*Brachyrhinus sulcatus* Fab.).

These two black snout beetles, about one-fourth inch or slightly more in length, have not been present in numbers sufficient to cause any noticeable damage in Missouri. The chief damage is done underground by the feeding of the legless grubs on the roots and crowns of the plants, causing the plants to discolor, wither, and die in April or May. The adults are most abundant in May and June and lay eggs at that time around the crown of the strawberry plants. They appear again in late July and August, and there are probably two generations a year.

Control.—The control measures are approximately the same as those recommended above for strawberry crown borer.

6. **White Grubs** (*Phyllophaga* or *Lachnosterna* sp.).

These are the common, large, white, curved "grubworms" found in the soil. They injure the strawberry plants by eating the roots and crown, and are especially injurious where sod lands have been turned under and immediately set in strawberries. These grubs are the young of the common brown May beetles which appear in numbers in May and June. Most of the grubs live in the soil for two years, feeding on the roots of grass, strawberry, and other plants, before becoming adults.

Control.—Set strawberry plants on land that has been in cultivation for two years, if possible, or plant leguminous crops on infested sod land a year or two before setting out strawberries. If it is impossible to avoid setting plants in infested land, it has been found that a handful of a mixture composed of 1 part lead arsenate and 20 parts sand (by weight) scattered in the hole in which the plant is set will give some protection (Kerr, 1940).

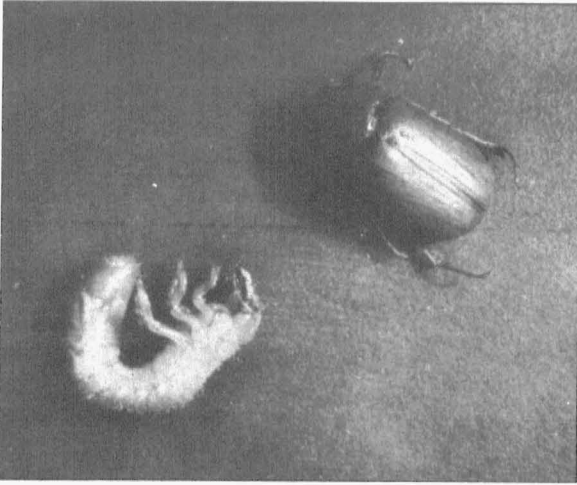


Fig. 4.—White grub larva and adult beetle.

7. Cutworms (*Rhyncagrotis* sp. and others).

These are the caterpillars of certain moths which ordinarily deposit their eggs on grasses or on the ground. The worms overwinter for the most part partially or fully grown. Their feeding is done at night when the plants attacked are cut at or near the ground line.

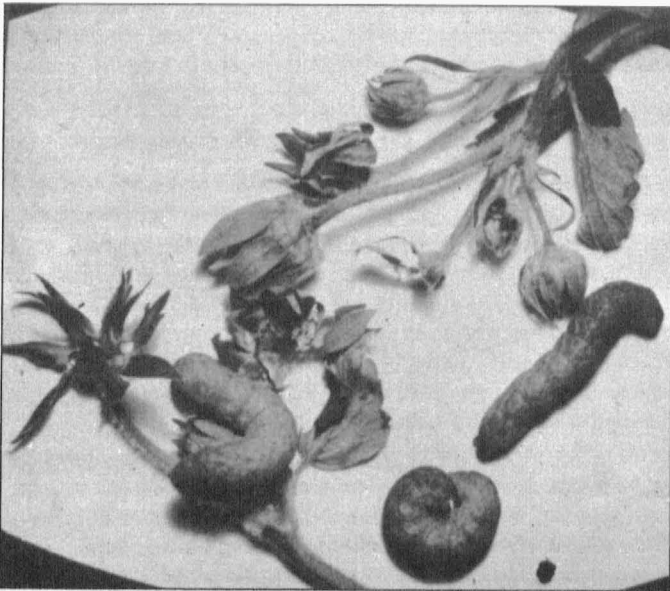


Fig. 5.—Strawberry cutworms (*Rhyncagrotis* sp.) and cutworm injury to forming berries of strawberry plants.

Some species appear in great numbers at the time of blossoming and cause severe damage by cutting the forming berries out of the bloom and damaging the leaflets. During the day, they hide in the soil near the plants, or under clods or trash nearby.

Control.—Poison bait is the best control which has been found for cutworms. It should be scattered fairly thinly over the ground near the plants in the evening about sunset or later. Enough bait for one acre should consist of 10 pounds wheat bran, $\frac{1}{2}$ pound of paris green, white arsenic, or sodium fluosilicate, 1 quart of molasses, and $\frac{3}{4}$ to 1 gallon of water. When mixing large quantities of the bait, equal parts of sawdust and bran may be used instead of using bran altogether. Mix the dry ingredients together first, dissolve the molasses in the water, and make the bait wet but not soggy. This bait is very poisonous and care should be taken that it is kept in a place not accessible to children, livestock, etc.

Do not set strawberries on land which was in sod the previous year, unless it was plowed in late summer or early fall.

8. Strawberry Root Aphid (*Aphis forbesi* Weed).

This insect is one of the so-called plant lice, and has not been of importance to Missouri strawberry growers in late years. The eggs are laid on plants in the fall and overwinter there. They hatch early in the spring, and the young aphids feed by sucking sap from the leaves and crown. Later, they are carried down to the roots of the strawberry plants by cornfield ants which colonize them there. A generation is produced underground every two or three weeks, and the feeding of the young cause the plants to lose vigor, become stunted, and fail to mature their crop. In the fall, winged forms of the aphids are produced and they emerge from the ground to lay their eggs again upon the plants.

Control.—The use of inspected and certified plants, and the cultivation in the early spring before setting plants to drive out ants which may be in the soil, are recommended. If infested plants must be used, the young aphids may be killed by dipping the plants in a solution consisting of 1 tablespoonful of nicotine sulphate to a gallon of water.

B. INSECTS INJURING FOLIAGE AND BLOOM

1. Strawberry Leaf Roller (*Ancylis comptana fragariae*)

Walsh & Riley)

The small, yellowish to greenish-brown caterpillars known as strawberry leaf rollers hatch from eggs laid in the latter part of April and early May by active, reddish-brown moths about one-fourth inch in length. The eggs are very small, slightly oval and flattened, and are deposited singly on the underside of the leaflets. The young worms feed there for two or three days, being protected by a silken web spun between two of the basal veins. They soon change their

position and begin feeding on the upper surface of the leaflet, gradually pulling its edges together with silk strands. One worm may feed on and web together several leaflets, and the flowers and young berries are sometimes also eaten. In dry springs, they may cause sufficient damage to the strawberry foliage to prevent the plants from maturing their crops, or to cause them to produce

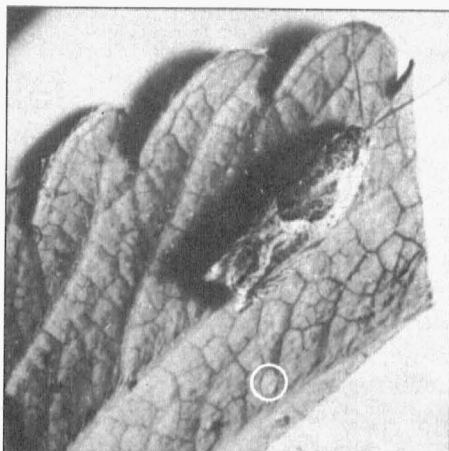


Fig. 6.—Strawberry leaf roller moth and egg on piece of strawberry leaflet.

berries of inferior quality and size. After about twenty days of feeding, pupation takes place within the folded or webbed leaflets. The adults emerge a week or ten days later. They hide under leaves and mulching material beneath the plants during the day, but may be seen to hover in numbers about the strawberry plants at dusk when they mate and lay their eggs. These insects overwinter as larvae, pupae, and probably adults, underneath or in the dead leaves in the berry patches, and there are three overlapping generations each year. The eggs usually begin to hatch about the time that the first few blossoms open in April.

Sometimes a few leaves may be noticed to have been rolled in the strawberry patches early in April, but this injury is due to a larger, light green caterpillar of another species of leaf roller, *Amelia pallorana* Rob.

Control.—In experiments at this Station, the use of dusts has proven more effective in controlling leaf roller than sprays. The following dusts and sprays have proved fairly satisfactory and are listed in the order of their apparent effectiveness.

Dusts.—(1) Cryolite-dusting talc (1 part cryolite and 3 parts talc); (2) Derris dust (5% rotenone content) mixed with pyrophyllite or cheap flour (1 part derris dust, 4 parts flour or pyrophyllite, by

weight); (3) Pyrethrum dust (.20% pyrethrins content); (4) Lead arsenate-lime dust (1 part lead arsenate, 2 parts hydrated lime).

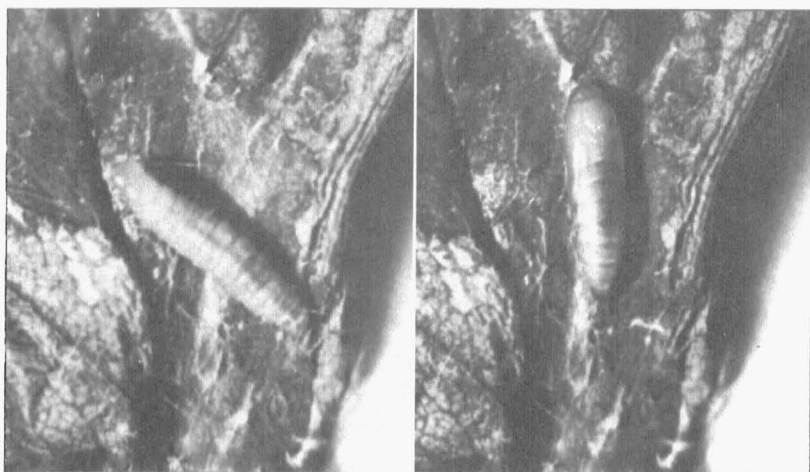


Fig. 7.—(Left) Full-grown strawberry leaf roller larva on injured leaflet. (Right) Strawberry leaf roller pupa on injured leaflet.

Sprays.—(1) Cryolite (3 pounds per 100 gallons with a spreader and sticker, but should not be used with any spray containing lime); (2) Lead arsenate and summer oil (3 pounds lead arsenate and $\frac{1}{2}$ gallon summer oil per 100 gallons of spray); (3) Nicotine sulphate and summer oil (1 pint Black Leaf 40 and $\frac{1}{2}$ gallon summer oil per 100 gallons of spray).

It is most important that the first application be put on before the strawberry leaves are rolled together, and if the application is made at the time the first few blossoms open this is usually early enough. Two more dusts or sprays should be applied at 5- to 7-day intervals. If sprays or dusts are washed off by rains, they should be applied again as soon as possible because satisfactory control will not be obtained unless the foliage is kept well covered during this period. It should not be attempted to cover more than two rows at a time with an ordinary crank duster. Ordinarily no residue problems are experienced if applications are started early enough and applied at 5- to 7-day intervals. However, if the season has been dry and the berries are beginning to get well along toward ripening at the time for the application of the third spray or dust, it may be advisable to use the nicotine sulphate-summer oil spray to avoid poisonous and unsightly residue on the picked berries.

In patches where damage is serious during May, it may be advisable to apply another spray (cryolite, or lead arsenate and oil), after the berries have been picked, for the control of the second generation of worms.

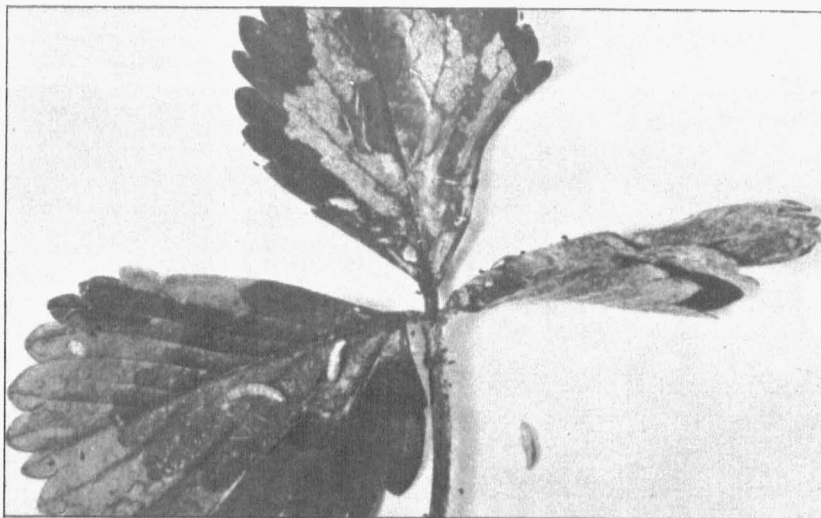


Fig. 8.—Strawberry leaf showing typical injury caused by leaf roller with larva and pupae.

The following spray materials and dusts have been tested in southwestern Missouri during the past four years with the results shown:

1939 EXPERIMENTAL TESTS

(Logan, Mo.)

<u>Treatment</u>	<u>Av. No. Leaflets Injured per 1000</u>	<u>% Control</u>
Black Leaf 40 (1 pint per 100 gal.) + 1/2% Superla summer oil	97.0	76.12
Lead Arsenate (3 lbs. per 100 gal.) + 1/2% Superla summer oil	112.0	72.43
Black Leaf 155 (8 lbs. per 100 gal.) + 1/2% Superla summer oil	193.2	52.44
Untreated check	406.2	0

(Dates of application: April 26, May 3, May 15)

1940 EXPERIMENTAL TESTS

(Logan, Mo.)

<u>Treatment</u>	<u>Av. No. Leaflets Injured per 1000</u>	<u>% Control</u>
5% Derris dust (1 part) + cheap flour (4 parts)	47.5	72.65
Lead Arsenate (1 part) + Lime (5 parts) Dust	51.0	70.64
Pyrocide Dust No. 7.5 (contains 3% petroleum extract of pyrethrins)	84.7	51.23
Black Leaf 40 (1 pint per 100 gal.) + 1/2% Superla summer oil	91.4	47.38
Lead Arsenate (3 lbs. per 100 gal.) + 1/2% Superla summer oil	93.2	46.34
Agicide Dust (1939 supply)	95.5	45.03
Black Leaf 155 (8 lbs. per 100 gal.) + 1/2% Superla summer oil	113.5	34.66
Nicosol (1/2 gal. per 100 gallons)	178.2	0
Untreated check	173.7	0

(Dates of application: May 10, May 19, May 23)

1941 EXPERIMENTAL TESTS

(Billings, Mo.)

Treatment	Av. No. Leaflets Injured per 1000	% Control
Alorco Cryolite (1 part) + Talc (2 parts) Dust	148.50	76.77
5% Derris Dust (1 part) + flour (4 parts)	186.75	70.78
Pyrocide Dust (.2% pyrethrins)	229.25	64.13
5% Derris Dust (1 part) + flour (9 parts)	261.00	59.16
Kryocide (3 lbs. per 100 gal.) + Grasselli spreader-sticker	321.00	49.77
Lead Arsenate (1 part) + Lime (1 part) Dust	355.66	44.35
Lead Arsenate (3 lbs. per 100 gal.) + 3 lbs. Lime + Grasselli Spreader-sticker	387.75	39.32
Black Leaf 155 Concentrate (3 lbs. per 100 gal.) + 1/2% Superla summer oil	393.25	38.46
Lead Arsenate (3 lbs. per 100 gals.) + 3 lbs. Lime + 1/2% Superla summer oil	395.25	38.15
Lead Arsenate (3 lbs. per 100 gal.) + 3 lbs. Lime	402.75	36.98
Lead Arsenate (1 part) + Lime (5 parts) Dust	427.75	33.06
Black Leaf 40 (1 pint per 100 gal.) + 1/2% Superla summer oil	459.25	28.13
Agicide Dust (1939 supply)	476.00	25.56
Untreated check	639.00	0

(Dates of Application: April 25, May 8, May 12)

1942 EXPERIMENTAL TESTS

(Billings, Mo.)

Treatment	Av. No. Leaflets Injured per 1000	% Control
Kryocide (1 part) + Talc (3 parts) Dust	45	91.3
Alorco Cryolite (1 part) + Talc (3 parts) Dust	53	89.8
Lead Arsenate (1 part) + Lime (2 parts) Dust	93	82.1
Pyrocide No. 10 Dust (.2% pyrethrins)	113	78.2
5% Derris Dust (1 part) + Pyrax ABB (9 parts)	127	74.5
5% Derris Dust (1 part) + flour (9 parts)	209	59.7
Lead arsenate (3 lbs. per 100 gal.) + DX (1 pint per 100 gal.)	215	58.6
Alorco Cryolite (3 lbs. per 100 gal.)	270	48.0
Lead arsenate (3 lbs. per 100 gal.) + lime (3 lbs. per 100 gal.)	271	47.8
Blackleaf 40 (1 pint per 100 gal.) + 1/2% Superla summer oil	380	26.8
Lethane - Derris spray (2 quarts per 100 gal.)	402	22.5
Basic copper arsenate (3 lbs. per 100 gal.)	501	2.8
Untreated check	519	0.0

(Dates of application: April 18, April 27, May 4)

Mowing and burning over the patch when berry picking is finished is a risky practice not to be recommended, as heavy injury to the plants is likely if the treatment is followed by a dry season.

The strawberry leaf roller has been found to be parasitized by *Simpiesis ancylae* Gir.,* *Spilochalchis albifrons* Walsh,* *Brachymeria hammari* Cwfd.,* and by *Trichogramma minutum* Riley* in the egg stage. These parasites along with weather conditions may account for a large part of the fluctuations of leaf roller populations in the state from year to year.

2. Obsolete-banded Strawberry Leaf Roller (*Cacoecia obsoletana* Walker).

The young caterpillars of these russet brown moths with a large brown band across their forewings injure strawberry foliage in much the same manner as the common strawberry leaf roller (*A. comptana fragariae*). The eggs of these moths are laid in clusters, and the pupal stage is passed inside the folded leaves. Their life cycle is much the same as that of the previously mentioned leaf roller.

Control.—This moth has never caused serious damage in Missouri strawberry plantings. The control measures recommended for the common strawberry leaf roller will probably prove equally as effective in the control of this species.

3. Cutworms (*Rhyncagrotis* sp. and others).

4. Strawberry Rootworm Beetles (*Paria canella* and *Graphops pubescens*).

5. Grape Colaspis (*Colaspis brunnea*).

6. Strawberry Weevil (*Anthonomus signatus* Say).

This small, blackish to reddish-brown snout beetle is related to the cotton boll weevil. It is about one-tenth inch in length. The female beetles come out of their winter quarters in fence rows and woodlands about the time that the first strawberry blooms appear. They lay their eggs in the opening blossoms, and then cut the stem so that the blossoms droop and wither, or drop to the ground. The young worm develops inside the blossom, feeding on the pollen, and reaches full growth by July. It then constructs a cell within the dead bloom, pupates, and emerges as an adult. The adults begin to emerge in July, feed during late summer and early fall on strawberry foliage, and go into hibernation for the winter. There is only one generation a year.

Control.—Do not permit old strawberry beds or patches of wild strawberries to serve as a breeding ground. If possible, do not set

(*Determined by A. B. Gahan, U. S. Bureau of Entomology & Plant Quarantine.)

strawberry patches next to old plantings, woodlands, hedgerows, or overgrown fence rows where the beetles may spend the winter.

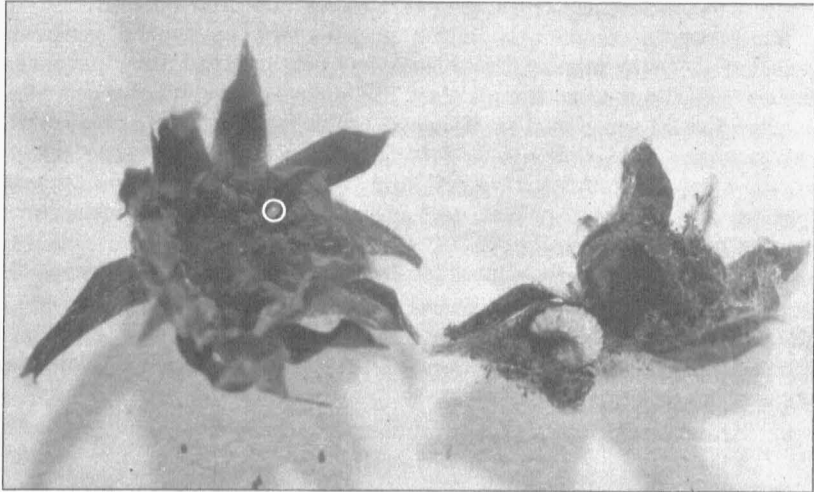


Fig. 9.—Egg and larva of strawberry weevil in dead blossoms.



Fig. 10.—Strawberry weevil on stem of strawberry blossom. An egg is laid in the blossom, and the stem is partially cut and left hanging.

The use of a cryolite-talc dust (1 part cryolite to 2 parts dusting talc), or a lead arsenate-lime or calcium arsenate-lime dust (1 part of the lead or calcium arsenate to 4 parts of lime) applied as soon

as the first plants come into bloom will help destroy the adult beetles. A heavy lead arsenate spray (3 or 4 pounds plus the same amount of lime to 100 gallons) may also prove effective.

7. Grasshoppers (*Melanoplus differentialis* and others).

When certain crops and native grasses dry up in the summer grasshoppers may migrate from them and attack strawberry patches, eating the foliage from the plants. The grasshopper which does this damage for the most part in Missouri is the large yellow differential grasshopper. The eggs are laid in the fall along ditch banks, road banks, etc. They hatch in April and May and the young hoppers feed on grasses, corn, wheat, and other plants. Attacks on strawberries are made usually in July.

Control.—The bait recommended for the control of cutworms will work equally well for the control of grasshoppers (see page 9). However, the bait should be scattered thinly early in the morning along fence rows and the borders of fields from which the hoppers are moving into the berry patch.

8. Strawberry Slugs (*Empria maculata* and *Empria ignota* Norton).

These greenish worms, when full-grown, are about three-fourths inch long, and appear on the berry plants in late April and early May when the plants are in bloom. They feed on the strawberry leaves. They mature about the first of June, enter the soil, and pass the winter there. The adults, which are sawflies, emerge early in the spring and the eggs are laid within the leaves. There is apparently only one generation a year. During the early twenties they were serious pests in Missouri, but since that time have done little damage.

Control.—The application of the same dusts or sprays recommended for the control of the strawberry leaf roller will also successfully control these sawfly larvae.

9. Strawberry Flea Beetle (*Altica ignita* Illiger).

Soon after growth starts in the spring, strawberry leaves may be riddled by small, metallic, blue-black beetles about one-sixth inch in length, which have come out of their wintering harbors nearby. These are the strawberry flea beetles, so-called because they jump much like a flea when touched or disturbed. They lay their eggs on evening primrose and related plants, and the young worms feed there, finishing their development nearby in the soil. There is only one generation a year.

Control.—Destroy all hibernating places such as bushy fence rows, weed patches, etc., near the strawberry patch, as well as evening primrose and other weeds on which the young worms may feed. In some cases, it may be necessary to make a spray application soon after growth starts in the spring. The spray should contain 3 or 4

pounds lead arsenate per 100 gallons, or if strawberry leaf spot, a fungous disease, is serious it may be applied with a 6-8-100 bordeaux mixture which also repels the beetles. Cryolite dusts or sprays, or lead arsenate-lime dusts, as recommended for leaf roller, may be used also if control of leaf spot is not thought necessary.

10. Red Spider (*Tetranychus telarius* Linn.).

This pest of strawberries is a reddish or yellowish mite which feeds on the underside of the strawberry leaves in dry summers, causing the foliage to yellow around the leaf margins. Severe attacks may cause the plants to turn brown and die, and light infestations decrease the vitality of the plants so that they put out fewer runners and are more susceptible to winter injury. The eggs of these mites are laid on the underside of the leaves, and there are several generations during the year.

Control.—The use of a finely ground dusting sulfur applied so that it covers the underside of the leaves will give good control of red spider. However, if it is used during or just before long, hot periods, it may cause considerable damage to plants.

11. Imbricated Snout Beetle (*Epicaerus imbricatus* Say).

These plump, grayish snout beetles, a little more than one-half inch in length, appear in strawberry plantings during May and, in some states, cause severe damage by eating the young berries and foliage. They feed on many other plants and are abundant in orchards. The eggs are laid on the leaves of many different plants, and the young stages of this beetle develop in the stems or on the roots of legumes or other field crops.

Control.—This beetle has never caused serious damage in Missouri. Heavy lead arsenate-lime sprays, or cryolite sprays, as recommended for the control of the leaf roller, should give control of the feeding adult beetles in May.

C. INSECTS INJURING YOUNG FRUIT

1. Tarnished Plant Bug (*Lygus pratensis* Linn.).

These brownish or greenish, active bugs, about one-fourth inch in length, appear in the strawberry patches early in the spring and feed by sucking the sap from strawberry and other succulent plants. Their eggs are deposited in the leaves of the plants and among the flower heads of weeds, and the young nymphs appear early in May. These nymphs attack the blossoms and the forming young berries, and by their feeding cause the berries to become "buttons", or stunted, hard-tipped berries. It is only occasionally that they are present in sufficient numbers in berry patches to do serious damage. They are general feeders and attack many fruiting plants, flowers, grasses, and weeds. There are several generations a year, so that

some years there is a large population present by fall. They overwinter as adult bugs in weed patches, fence rows, and occasionally in mulch in the berry patches.

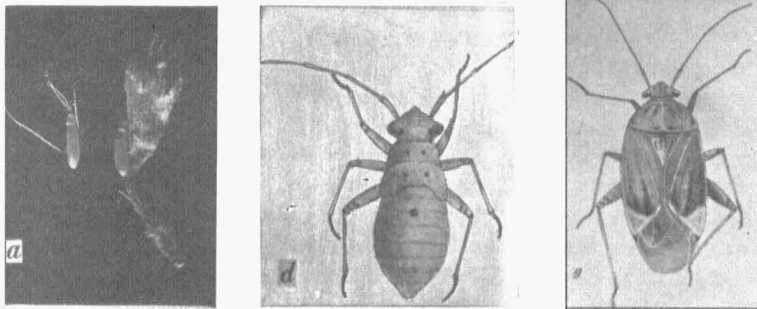


Fig. 11.—Tarnished plant bug (a) eggs, (d) third stage nymphs, (g) adult.

Control.—Destroy all overwintering places, and keep down weeds as much as possible in the berry patch and in waste lands and fence rows near the berry patch through the summer and fall. When large numbers of adults are present in the patch prior to or at blooming



Fig. 12.—Tarnished plant bug injury to berries—normal berry at left.

time, they sometimes can be driven away by dragging brush lightly over the rows on a windy day. If nymphs appear in large numbers on the plants in spite of cultural measures, a spray consisting of nicotine sulfate (1 pint per 100 gallons of water, plus 6 pounds of

soap, or 2 pounds hydrated lime) applied on a warm day will kill the nymphs. Pyrethrum dust (3 parts) and sulfur (7 parts) at 25 pounds per acre will also kill the nymphs (Metcalf & Flint, 1939), but all are expensive and satisfactory control should be obtained by the use of cultural methods.

2. Negro Bugs (*Alloeoris pulicaria* Germar).

When the strawberry blossoms open in the early spring, it is common to see the small, black, negro bugs, resembling beetles, sitting inside the blossoms on warm days. They lay their eggs on leaves and the young nymphs hatch within ten days to two weeks and feed on the plants by sucking the juices from the young berries and stems. They may cause the "button" berries in much the same manner as the tarnished plant bug. During the berry picking season, they also crawl over ripe berries and give a bad taste to them. They enter hibernation quarters early in the fall and overwinter as adults.

Control.—Destroy weeds on which the adult bugs and nymphs may feed, and also weedy overwintering places in and near the berry patches. The same nicotine sprays, or pyrethrum-sulfur dusts that are recommended above for the control of tarnished plant bug, will also control negro bugs.

3. Strawberry Thrips (*Frankliniella cephalica bispinosa* Morgan).

These are minute, yellowish, small, active insects which feed in the blossoms of strawberries and many other plants. They cause damage by rasping the forming berries and may also cause "button" berries similar to the tarnished plant bug and negro bugs. They lay their eggs in the flower buds of plants, and there is a generation every two or three weeks. They overwinter as adults and eggs on or in leaves and stems.

Control.—Derris sprays containing low concentrations (.015 to .02%) of rotenone (Peairs, 1940), and dusts of superfine dusting sulfur are said to control the thrips in the blossoms (Metcalf and Flint, 1939).

D. INSECTS INJURING RIPE FRUIT

1. Crickets (*Gryllus assimilis* Fab.).

Most farmers are familiar with the common field cricket. The adults range in color from black to brown, and are about one inch in length. They lay their eggs in damp sod during early fall. The eggs overwinter and hatch during the following spring. Partly-grown nymphs may also survive the winter. The young may take as long as three months to become adults. During the hot part of the day, they remain under rocks or vegetation where it is damp and cool. Occasionally crickets cause injury by eating holes in the ripe strawberries and by eating out the seeds.

Control.—The use of the poison bait recommended above for the control of grasshoppers and cutworms will give control of crickets

in strawberry patches, though they are rarely found in sufficient numbers to warrant the use of bait.

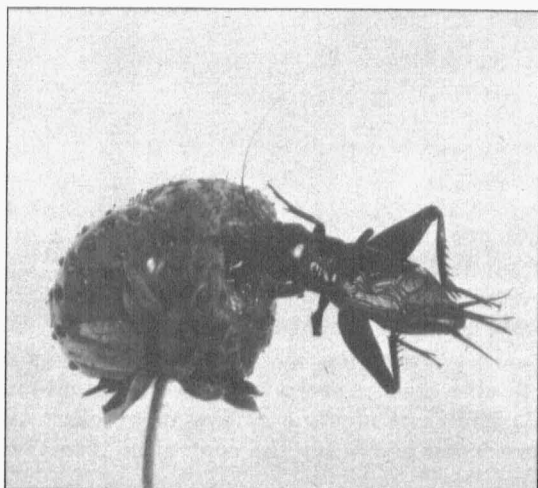


Fig. 13.—Adult field cricket feeding on ripe strawberry.

A bait that may prove even more effective, according to the U. S. Bureau of Entomology and Plant Quarantine, is composed of 1 pound white arsenic or calcium arsenate and 20 pounds cornmeal, moistened with a solution of water and molasses (9 parts water to 1 part molasses). The bait should be spread about sunset as the crickets do most of their feeding during the night. Care should be taken in spreading this bait so that no lumps of the material remain on the leaves or fruit.

2. Negro Bugs.

3. Ground Beetles (*Harpalus* sp. and others).

In heavily mulched strawberry patches, these black ground beetles, about three-fourths of an inch in length, sometimes destroy crops of berries by feeding on the seeds, and later on the pulp of the berries. They hide under stones and vegetation during the day, and feed chiefly at dusk.

Control.—Due to the fact that these beetles cause damage so rarely, no control measures have been developed.

4. Millipedes (*Julus* sp.).

The millipedes or “thousand-legged” worms generally feed in manure and decaying vegetable matter. Some species eat growing

crops in damp soil in much the same manner as white grubs and wireworms. The eggs are deposited in the soil in clusters. They hatch in two or three weeks and grow slowly. There is probably only one generation a year. At times, they attack ripe strawberries which are in contact with the soil and eat holes in them much like the crickets.

Control.—The poison bait, recommended above for cutworms and grasshoppers, will attract and kill the millipedes. It should be put around the plants in small piles or balls but not on the leaves or fruit. Cultural control measures include cultivation and proper aeration of the soil, and the use of fertilizers other than barnyard manure.

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