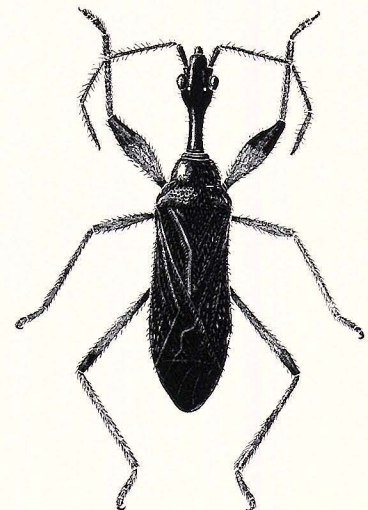
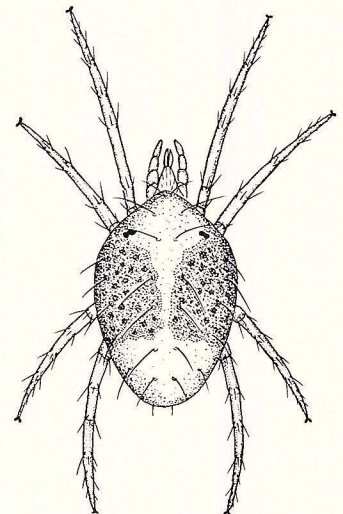
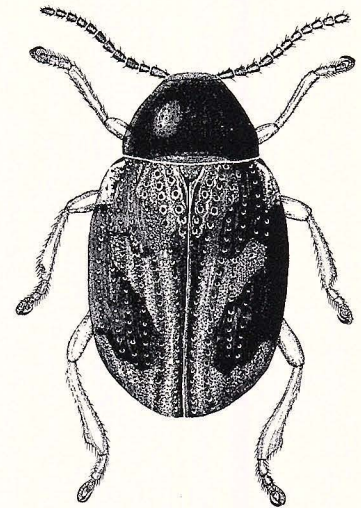




# Insect and Mite Pests of Strawberries in Ohio

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OHIO AGRICULTURAL RESEARCH AND  
DEVELOPMENT CENTER — WOOSTER, OHIO



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# INSECT AND MITE PESTS OF STRAWBERRIES IN OHIO

ROY W. RINGS and R. B. NEISWANDER<sup>1</sup>

## INTRODUCTION

This bulletin has been prepared to aid strawberry growers in recognizing insect and mite problems. After a pest causing trouble is identified, either by the presence of one or more life stages or by its characteristic injury, then proper control measures may be applied. Since chemical control recommendations change from year to year, growers should obtain current control recommendations from their county agent, extension specialist, or the Research Center.

Strawberries are native to most regions of the temperate zone. However, the large-fruited, productive varieties now cultivated have been developed from a chance crossing of two species, both native to the Americas. A Chilean species (*Fragaria chiloensis*) was introduced into France in 1712. Later it became established in English gardens, where the North American species (*Fragaria virginiana*) was being grown. It is quite probable that a chance crossing of these two species in England marked the beginning of commercial varieties presently used in the United States.

Strawberries are among the most important fruit crops grown in Ohio and are exceeded in value only by apples, peaches, and grapes. The most recent figures available indicate that more than 1,700 acres of strawberries are harvested in Ohio. Strawberries enjoy the prestige of being the most important of the home-grown fruit crops.

The annual income from strawberries in Ohio usually exceeds \$1 million. Because of the importance of the strawberry industry in Ohio agriculture, it is appropriate that attention be given to the more important insect and other pests which attack this crop. These pests can cause serious economic loss by markedly reducing crop yields and quality.

## RELATIVE IMPORTANCE OF INSECT AND MITE PESTS

The majority of the insect and mite pests reported in this bulletin are native to the United States. Before strawberries were grown commercially, most of these pests fed upon and bred in cinquefoil (*Potentilla*), American wood strawberry (*Fragaria ameri-*

*cana*), and the Virginia strawberry (*Fragaria virginiana*).

When new pests of strawberries were imported from other countries, populations rapidly built up and serious damage to strawberry plantings resulted. A good example of this is the strawberry leaf roller, which was introduced from Europe to the United States in about 1866. Control measures have been developed and many native parasites now attack this species. So it is much less important now than it was 20 years ago.

Until recently, the most serious pests of strawberries were the strawberry leaf roller, the strawberry rootworm, the strawberry crown borer, white grubs, the meadow spittlebug, and the two-spotted spider mite.

Because of a change in production practices, the cyclamen mite is now one of the most serious pests of strawberries. With modern innovations such as virus-free stock, chemical weed control, and disease-resistant varieties, some growers now harvest the same beds for several years. Where plantings are maintained over relatively long periods of time, the cyclamen mite can be a problem of increasing concern.

The identification of virus diseases as the cause of "running out" and the close association of aphids with virus transmission have increased the importance of this group of insects. Aphids injure plants in three ways: (1) by sucking sap from the plant, (2) by injecting toxic materials into the plant and thereby causing stunting or deformation of tissues, or (3) by acting as carriers of viruses.

## FIELD KEY FOR IDENTIFICATION OF INSECTS AND OTHER PESTS ATTACKING STRAWBERRIES

### A. External Chewing Insects which Eat Holes in Leaves or Eat Large Portions of Leaves:

1. Small greenish or bronze caterpillars which fold or roll strawberry leaves together and feed within the rolled portion.  
(Figure 3) **Strawberry leaf roller**
2. Small holes eaten in leaves. Shiny, oval beetles, 1/8 inch long, with four dark blotches on wing covers. Active only at night.  
(Figure 7) **Strawberry rootworm**

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3. Small holes eaten in leaves. Yellowish-brown beetles, 3/16 inch long, with brown legs and yellowish-brown antennae. Active during day. (Figure 8) **Grape colaspis**
4. Large portions of leaves eaten by green larva with black eye spots on each side of head. Feed mostly at night. (Figure 9) **Strawberry sawflies**

**B. Very Small Mites which Injure Leaves by Sucking Sap:**

1. Leaves curled, bronzed, and sometimes speckled with white. Greenish mites, almost invisible, present on underside of leaves. If mites are numerous, silken webs appear on underside of leaves. (Figure 10) **Two-spotted spider mites**
2. Leaves stunted and dwarfed, causing a rosette of leaves due to failure of stems to elongate. White to light-brown mites, almost microscopic, feed on young, unfolded leaves in crown of plant. (Figure 11) **Cyclamen mite**

**C. Insects and Other Pests Attacking Blossom Buds and Fruits:**

1. Buds and newly formed fruits dried up on the partly severed stems or entirely eaten. Dark, reddish-brown snout beetles, from 1/12 to 1/8 inch long, make punctures in buds. Very small, legless, white-bodied grubs feed within buds. **Strawberry weevil**
2. Large holes eaten into ripe or nearly ripe fruits. Large, stout caterpillars, from 1 to 1-1/2 inches long, are striped, mottled, or dingy gray. Feed at night and hide beneath debris or in soil during day. (Figures 12-14) **Cutworms and armyworms**
3. Berries soft and sometimes moldy. Small, black bugs, about 3/8 inch long, with a sharp beak as long as body. (Figure 15) **Strawberry bug**
4. Achenes (seeds) eaten and sometimes entire surface of berry eaten. Fairly large (1-inch), hard-shelled, black or brown beetles which hide under debris during day and are active at night. (Figure 16) **Ground beetles**
5. Small, moderately-deep holes in berries accompanied by slimy trails on berries or leaves.

Elongated slimy animals with or without a shell. (Figure 17) **Slugs or snails**

**D. Insects Attacking Stems and Crowns:**

1. White, frothy masses cover small, green insects which suck sap from stems. Active from bloom to late June. (Figure 18) **Meadow spittlebug**
2. Plants stunted and small grubs in crown of plants. Larvae are white, legless grubs about 1/5 inch long. (Figure 19) **Strawberry crown borer**
3. Pale yellowish or whitish aphids, without wings, on the underside of strawberry leaves, usually with their slender beaks inserted in leaf tissue. Winged forms have a dark thorax and head and a light green abdomen. (Figure 23) **Strawberry aphids**

**E. Insects Attacking Roots:**

1. Large, white grubs, up to 1 inch in length, with brown heads. Usually hold the body in a curved position and have distinct, well-developed, slender legs. Feed on strawberry roots from early spring to early fall. (Figure 24) **White grubs**
2. Strawberry plants lacking in vigor, foliage of a pale color, fruit drying up or failing to mature properly. Roots of injured plants covered with dark, bluish-green aphids. Aphids insert slender beaks in roots to suck sap. **Strawberry root aphid**
3. Plants stunted, leaves closely bunched together, dark bluish-green leaves. Small, white grubs feed entirely on small rootlets of the strawberry. As larvae become larger, they feed on larger roots and crown. Adults feed on leaves and stems and sometimes on fruit but this injury is never serious. (Figure 27) **Strawberry root weevils**
4. Small, white, brown-spotted grubs, about 1/8 inch long, feed on roots of strawberries during May and June. Infested plants are weakened and have poorly colored foliage. Brownish or copper-colored beetles, about 1/8 inch long, feed on foliage of strawberries during early fall. (Figure 7) **Strawberry rootworm**



## INSECTS AND MITES ATTACKING FOLIAGE

### Strawberry Leaf Roller, *Ancylis comptana fragariae* (Walsh & Riley)

The strawberry leaf roller was introduced into the United States from Europe many years ago. Riley (19) reported this species causing trouble in Illinois nearly 100 years ago. The pest has spread across the northern United States from the Atlantic to the Pacific Coast. It occurs throughout Ohio but heaviest infestations have been encountered in the Dayton area.

In the early stages, a larva may feed on either side of a leaf. As it becomes larger, it usually feeds on the upper surface. Here, by means of fine silken threads, it folds the leaflet at the midrib and feeds inside this enclosure (Figure 1). This type of damage may be seen in early May and again in early August when second generation larvae occur.

Only the epidermis is eaten but continuous feeding causes the entire leaflet to turn brown and die. Sometimes two adjacent leaflets are tied together and, in case of a heavy infestation, an entire leaf or

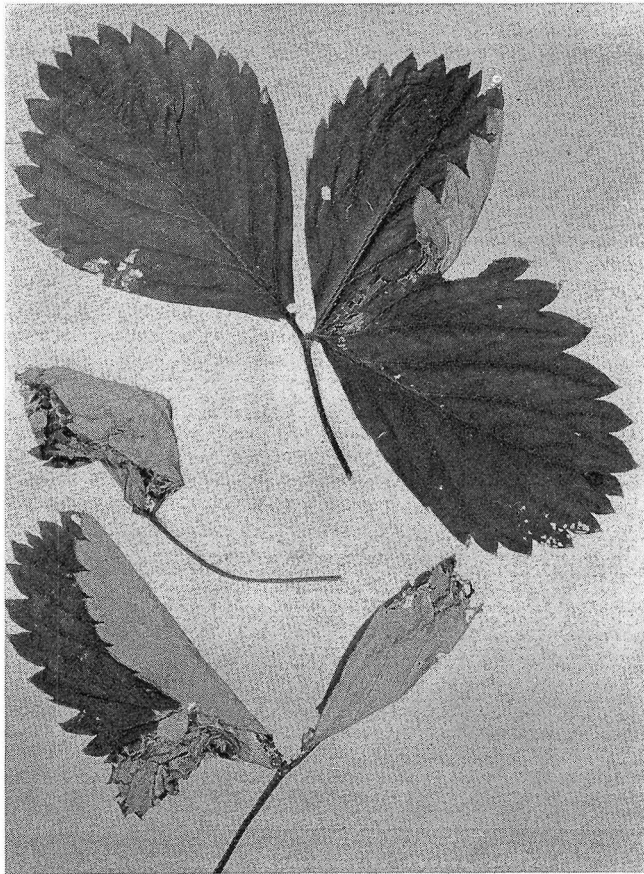


Fig. 1.—Strawberry leaf roller injury.

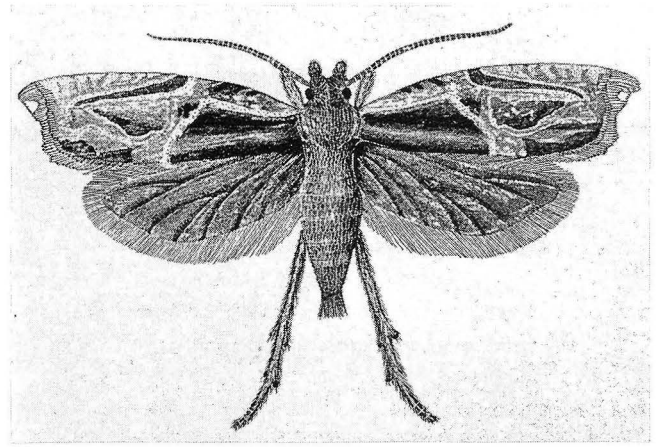


Fig. 2.—Strawberry leaf roller moth (enlarged about seven times).

even several leaves may be webbed together. Sometimes newly formed leaves are attacked and webbed together before they unfold. This type of damage may be seen during late May and in June when first generation larvae are abundant. The same damage is caused by larvae of the second generation in late July and in August.

In Ohio two full generations occur each year and a partial third generation does not complete development. The first generation from egg to adult requires about 54 days. The time required for completion of development in the second generation is somewhat shorter, averaging about 46 days because of higher daily temperatures (11).

The adults (Figure 2) are beautifully colored, reddish-brown moths which have a wing-spread of approximately 1/2 inch. First generation moths are on the wing from about April 20 to June 1 and second and third generation moths are present from July 1 through late September. First generation moths deposit small, translucent eggs on the foliage of the strawberry, usually on the underside, about the middle of May. The larvae which hatch from these eggs cause the damage by feeding on the foliage.

Young larvae are usually pale green but change to gray-brown as they become fully grown (Figure 3). No special markings or distinguishing characteristics are present. A fully developed larva is approximately 1/2 inch in length. The larva changes into a yellowish-brown pupa, which remains inside the folded leaf until it is ready to emerge as a moth.

Strawberry leaf rollers are very susceptible to attack by various hymenopterous and dipterous parasites. Because of this, populations are usually kept at non-economic levels. The two most important hymenopterous parasites are *Cremastes cookii* Weed and *Macrocentrus ancylivorous* Rohwer. Although

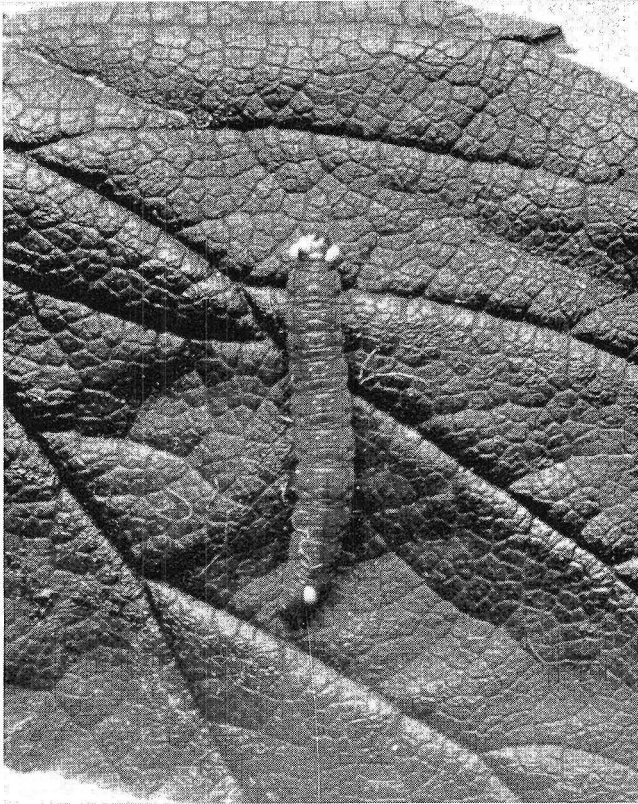


Fig. 3—Larva of the strawberry leaf roller (enlarged about four times). Eggs of a larval parasite are shown on head and on anal segment. Photo courtesy of Entomology Research Division, U. S. Department of Agriculture.

these parasites vary greatly in abundance from season to season, they have been responsible for approximately 70 percent of the total parasitism recorded (11).

#### **Oblique-banded Leaf Roller, *Choristoneura rosaceana* (Harris)**

Although this pest has not been reported attacking strawberries in Ohio, it can be expected to appear as a strawberry pest at any time since it is common in all parts of the state. Bennett (3) reported this species attacking strawberry foliage in Tennessee. Martin (9) reported this species on sweet clover, yellow goatsbeard, and Scots pine.

The damage caused by this species is similar to that produced by the strawberry leaf roller as leaves are rolled or webbed together. However, the oblique-banded leaf roller partially or completely consumes the webbed leaflets while the strawberry leaf roller feeds only on the surface of the foliage. Lar-

vae of the oblique-banded leaf roller are somewhat larger than larvae of the strawberry leaf roller. So a small number of oblique-banded leaf roller larvae can do considerable damage.

A technical difference is that the larva of this species has 8 prongs in the anal comb while there are only 6 prongs in the comb of the strawberry leaf roller (Figure 5). Unfortunately, the anal comb characters can be seen only under a compound microscope.

The adult moth can be identified by the chevron-like stripes on the wings (Figure 4). The moths fly principally at night but can be seen occasionally during the day.

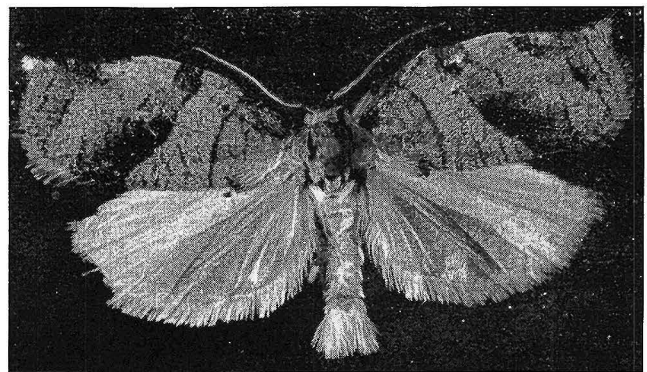


Fig. 4.—Oblique-banded leaf roller moth (enlarged four times).

#### **Blueberry Leaf Roller, *Sparganothis sulfureana* Clemens**

This leaf roller is common in the state and economic infestations have been observed on blueberry in the Massillon area. It is found often on strawberries in Tennessee and has a great number of other host plants, including cranberry, apple, celery, corn, honey locust, willow, and horseweed.

The damage from this species is very similar to the two leaf rollers discussed previously. About the only difference is that this species and the oblique-banded leaf roller partially devour the leaf while the strawberry leaf roller feeds only on the epidermis.

Both the strawberry leaf roller and the blueberry leaf roller have 6 prongs in the anal comb. However, in the strawberry leaf roller there is a single point on the tip of each prong while there are two points on the tip of each prong of the anal comb in the blueberry leaf roller. This character can be seen only with a compound microscope.



# KEY TO STRAWBERRY LEAF ROLLERS

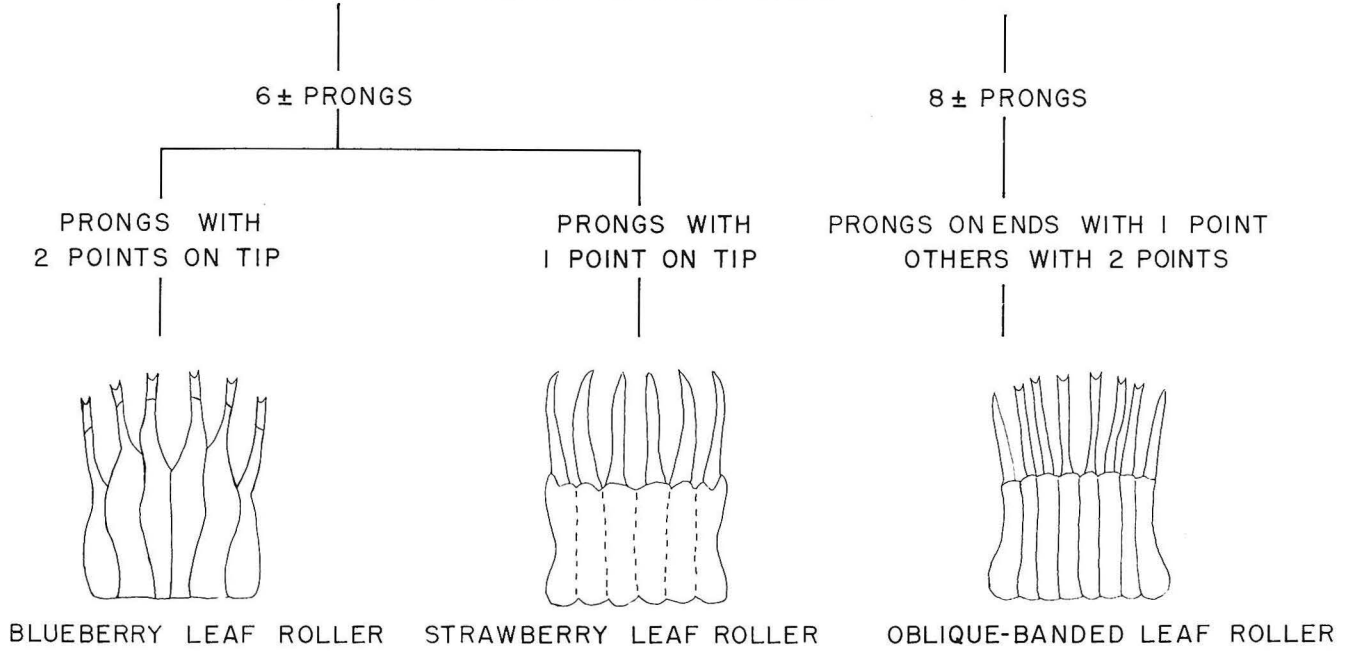


Fig. 5.—Pictorial key to strawberry leaf rollers based on characteristics of anal comb. Redrawn after Bennett (3).

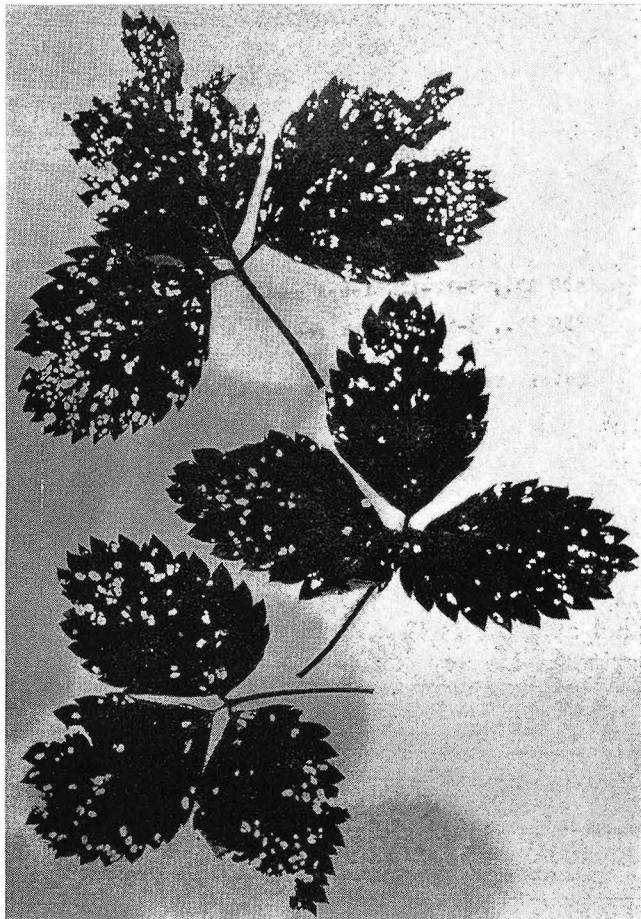


Fig. 6.—Strawberry leaves riddled by feeding of strawberry rootworm.

## Strawberry Rootworm, *Paria fragariae* Wilcox

This is the beetle which most often causes trouble on strawberries in Ohio. The most severe damage is caused by the adult beetles which eat holes in the leaves. When adults become abundant, the leaves are riddled with holes (Figure 6) and sometimes plants are killed.

The strawberry rootworm is a shiny oval beetle, usually brown varying to black, with four darker

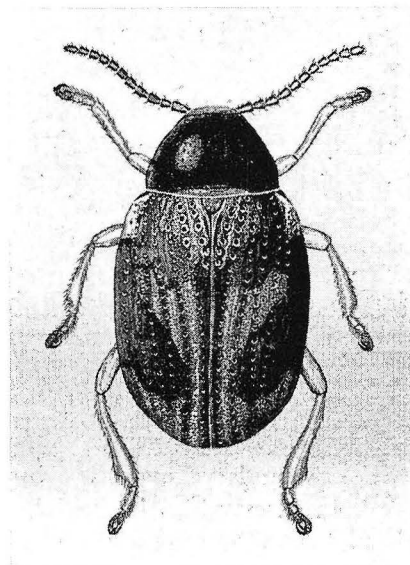


Fig. 7.—Adult strawberry rootworm (enlarged 14 times.)

blotches on the wing covers (Figure 7). It is slightly more than 1/8 inch in length.

The beetles feed chiefly at night and are seldom seen during the day, regardless of the density of the population. They are usually concealed during daylight hours in the litter around strawberry plants or in crevices in the soil.

To observe them at work, Neiswander (12) occasionally visited a heavily infested field in the evening during August. No beetles were seen on the foliage while daylight remained. However, by 8:45 p.m. they were found readily with the aid of a flashlight. By 9:30 p.m., they were so abundant that 20 were collected in an area of 1 square foot. As many as three beetles were observed frequently on one leaflet. When disturbed, the beetles quickly folded their legs, dropped to the ground as though dead, and were immediately concealed in the mulch.

The beetles hibernate under mulch, in crevices in the soil, or in other protected places. They begin feeding and laying eggs when warm weather arrives. The feeding punctures have been observed in early May and gradually become more numerous until the middle of June. The eggs are laid during this period on the older leaves near the ground. As the larvae hatch, they burrow into the ground where they feed on the roots for approximately 2 months.

To determine the depth at which larvae were feeding, similar soil samples taken at varying depths were sifted through an 18-mesh screen. All larvae found were within 6 inches of the soil surface and 65 percent were located in the top 2 inches.

Adults of the first generation have been observed as early as July 16, with continued emergence throughout August. The newly emerged beetles feed extensively on the foliage of strawberry in early fall. The damage caused in late summer and fall is usually more severe than that which appears in the spring.

#### **Grape Colaspis, *Colaspis flavida* (Say)**

The larvae of this species attack the roots of strawberries and the adults feed on the foliage. A number of strawberry plantings in Ohio have been damaged by this species. The adult beetle, about 3/16 inch in length, is uniformly yellowish-brown with brown legs and yellowish-brown antennae. Adults have been observed in the field from June 22 to September 14 but were most abundant in July and August.



**Fig. 8.—Grape colaspis and feeding damage on strawberry (slightly enlarged). Photo courtesy of Department of Entomology, Purdue University.**

This insect first attracted attention in 1893 near Cleveland, Ohio, where a severe outbreak occurred in the Lake Erie grape belt. It is still a more common pest of vineyards than of strawberry plantings.

After overwintering, the beetles emerge from the soil in late June and feed upon the upper surface of strawberry leaves (Figure 8). In contrast to the strawberry rootworm, adults of the grape colaspis feed during the day and occasionally may be seen eating strawberry foliage.

After feeding for about 2 weeks, female beetles begin to deposit egg clusters. Other clusters are laid at intervals of about 4 days, since each female oviposits four or five times. The total number of eggs laid by each female averages more than 100. The eggs hatch in 8 days to 2 weeks, depending upon the temperature.

After hatching, the tiny grub takes advantage of any crevice in the soil and burrows down to the roots of the plant. It spends the rest of the season feeding on the finer roots and then spends the winter as a partially grown larva.



## Strawberry Sawflies, *Empria maculata* Norton and *Empria ignotata* Norton

Two species of sawflies sometimes attack strawberries. Webster (22) reported *E. maculata* causing damage near Cleveland in 1896. However, neither species has been troublesome in Ohio in recent years. This is probably because parasites have been keeping populations low.

The adult sawflies are black-bodied, four-winged flies, about 1/5 inch in length, which have a row of whitish spots on each side of the abdomen. They appear quite early in the spring and deposit eggs in the strawberry leaves.

About the time of first bloom, tiny, green larvae (Figure 9) or slugs issue from the eggs and feed on the foliage. When abundant, they may completely destroy the foliage in a few days. Much of their feeding occurs at night. During the day, the larvae

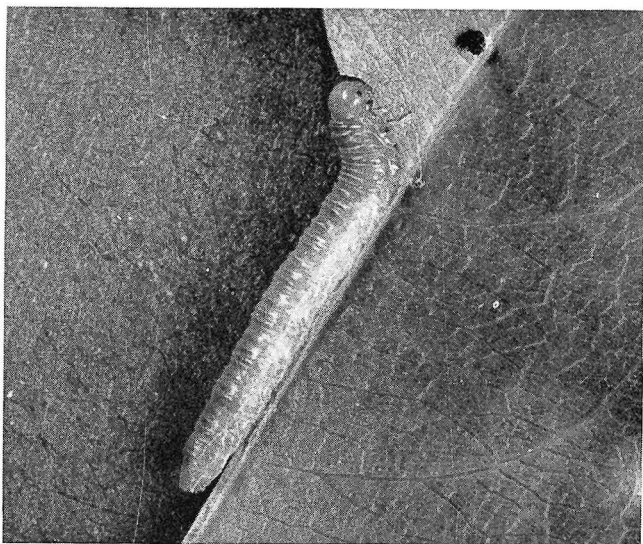


Fig. 9.—Sawfly larva (enlarged about three times).

remain curled up on the underside of the leaves or hide at the base of the plant. When the larvae reach maturity, usually during June, they are approximately 3/4 inch in length. They then enter the soil where they remain until the following spring.

### Two-spotted Spider Mite, *Tetranychus urticae* (Koch)

The two-spotted spider mite frequently attacks strawberry plants. The adult is approximately 1/50 inch in length. Its color varies from pale greenish-yellow to dark crimson, usually marked with dark spots (Figure 10).

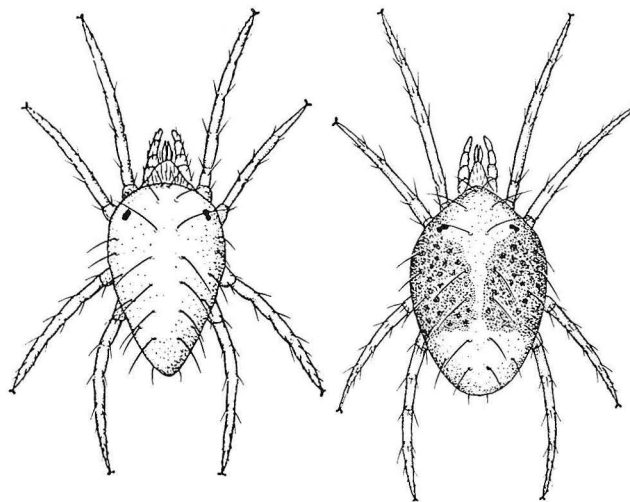


Fig. 10.—The two-spotted spider mite (enlarged about 50 times). Male is at left and female at right.

This mite is widely distributed and can be found in almost every field. It attacks a wide variety of plants, including truck crops, shade and fruit trees, and ornamental plants. Feeding and egg deposition occur on the underside of the leaves and a tangle of fine silken webs occurs there in heavy infestations. Heavily infested fields lose their healthy green color and become a coppery-bronze color. The mites suck sap from the leaves and can interfere with normal physiological processes, such as the production of sugars.

The length of the life cycle varies with seasonal and weather conditions but may be completed in approximately 2 weeks. Reproduction may be continuous from early spring until late fall. The species overwinters as a mature, fertile female in protected places in the field. Hot, dry weather favors rapid population increases, particularly in July and August. If mite populations reach 5 per leaflet before July 30, control measures are required.

### Cyclamen Mite *Steneotarsonemus pallidus* (Banks)

This mite is so tiny that it is scarcely visible to the unaided eye. It is primarily a pest on greenhouse plants but has caused serious economic losses to strawberry plantings (Figure 11).

The cyclamen mite feeds on the young unfolding leaves in the crown of the plant and causes these leaves to appear stunted, crinkled, and malformed when they emerge. Later it feeds on the blossoms and causes a distortion of the fruits. After the mite becomes established, it is difficult to control.

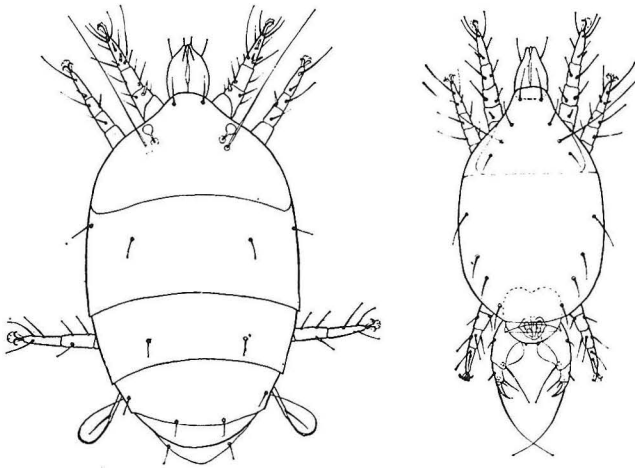


Fig. 11—Cyclamen mite (enlarged about 180 times. Female is at left and male at right. Illustration courtesy of the British Natural History Museum.

Schaefer (21) in New York found that populations began to increase in late May, when blossoming started, and peaked in early July during fruiting. A sharp decline occurred during July and August and a second, lower peak was observed near the end of September.

In setting a new planting, it is important that plants be used which are free from mites.

### PESTS ATTACKING BUDS AND FRUITS

#### Strawberry Weevil, *Anthonomus signatus* Say

This dark reddish-brown weevil is about 1/10 inch long, with the head prolonged into a slender, curved snout about half as long as the body. In the eastern United States, this insect is known as the "strawberry clipper" or simply the "clipper" because of its habit of clipping buds.

The beetles leave their winter quarters in fence rows and woodlands about the time the first strawberry blooms appear. Eggs are deposited in the opening blossoms or in buds which are nearly mature. The stem of the bud is then cut so that it hangs by a mere thread or falls to the ground. In about 1 week, the eggs hatch into white, legless grubs. The larva develops inside the bud and reaches maturity in 3 or 4 weeks.

Adult weevils appear in early summer. After feeding on the pollen of various flowers for a short time, adults seek hibernating sites in midsummer. The weevils remain in these sites until the next spring. Only one brood appears each year. Injury is most likely to occur when strawberries are grown adja-

cent to woodlands or other suitable hibernating quarters.

This weevil also attacks blackberries, raspberries, dewberries, and boysenberries.

#### Cutworms, *Peridroma saucia* Hubner, *Feltia subgothica* (Haworth), and others and Armyworms, *Prodenia ornithogalli* Guenee and others

These voracious caterpillars are omnivorous and may appear at any time during the growing season. Young plants are occasionally damaged by cutworms which cut them off at the soil surface. On older plants, they feed on the leaves but cause insignificant damage unless they are very abundant. The great-

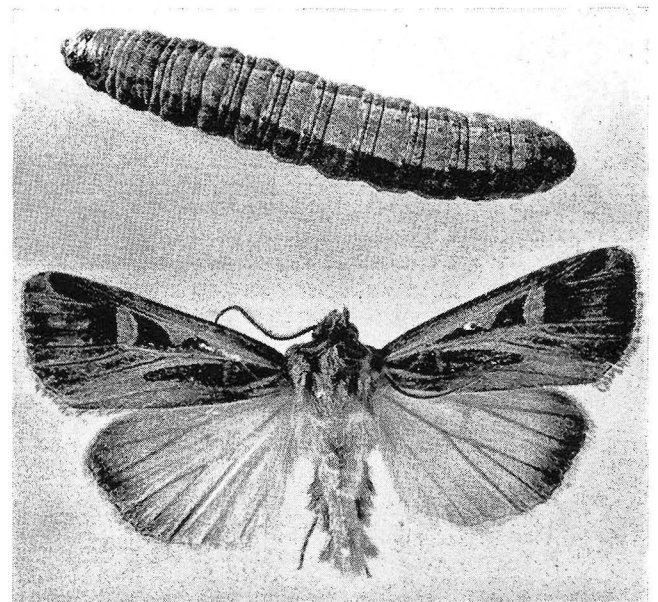


Fig. 12.—Larva (above) and adult (below) of the dingy cutworm, *Feltia subgothica* (Haworth). Enlarged about three times.

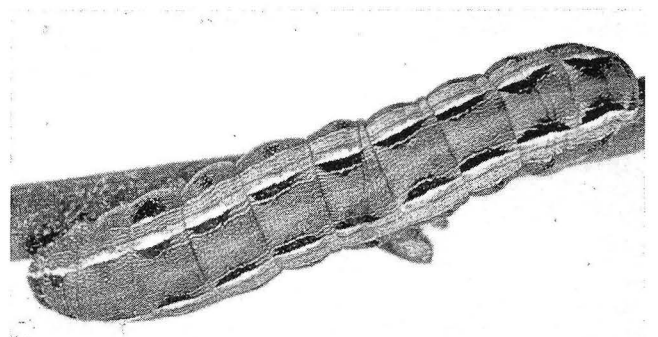


Fig. 13.—Larva of the yellow-striped armyworm, *Prodenia ornithogalli* Guenee (enlarged about two times.



est damage results from their feeding on ripe fruit and making large holes in the berries.

These stout caterpillars are nearly 1-1/2 inches long and are striped (Figure 13), mottled, or dingy gray (Figure 12). They are seldom observed in the field since they usually feed only at night. During the day they burrow down into the soil or hide beneath plant debris on the ground.

Most cutworms attacking strawberries overwinter as partially grown caterpillars in strawberry fields. They become active very early in the spring. As the weather warms up, they reach full growth and then pupate in the soil. The adult moths are brownish or grayish (Figures 12 and 14) and are active only at night. Several generations occur each year.

Cutworms eat large holes in the fruit of strawberries. These holes are larger than those made by leaf rollers and no slime occurs as in the case of slugs. Since each cutworm feeds on a number of berries, the damaged fruits tend to be concentrated in localized areas.

#### Strawberry Bug, *Myodochus serripes* Oliver

This insect (Figure 15) occasionally injures strawberries in Ohio. It is approximately 3/8 inch in length and has a sharp beak which is one-third as long as the body. The head tapers into a relatively long, narrow neck. The adult insect has long legs and, when disturbed, runs rapidly and hides quickly.

Two generations may occur each year but injury has been observed only during July and August. The insects feed on the ripening berries by in-

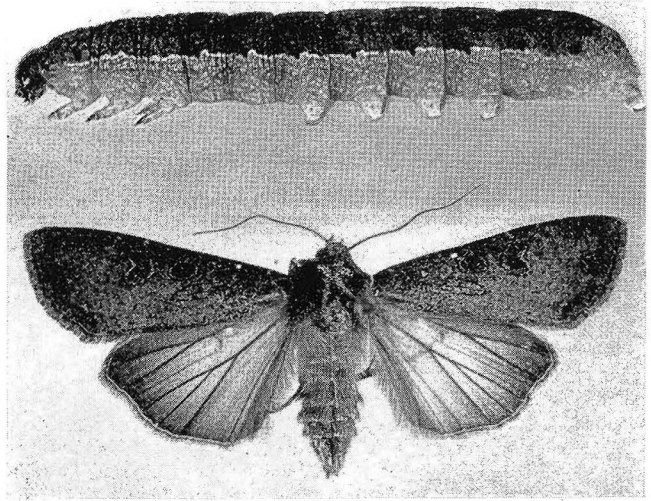


Fig. 14.—Larva and adult of the variegated cutworm, *Peridroma saucia* Hubner (enlarged about two times).

serting their long beaks and sucking the juices. Injured berries become soft and are often covered with mold.

#### Ground Beetles,

#### *Harpalus pennsylvanicus* Dej. and other species

Ground beetles (Figure 16) are hard-shelled, black or brown beetles which normally feed on smaller soft-bodied insects. However, they will attack ripening strawberries lying on the ground. Such an incident occurred once in a planting of everbearing

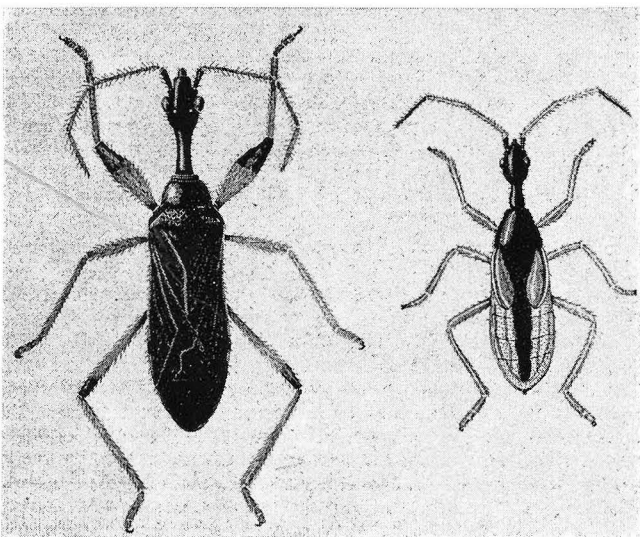


Fig. 15.—Adult (left) and nymph (right) of the strawberry bug, *Myodochus serripes* Oliver (enlarged eight times).



Fig. 16.—A ground beetle, *Harpalus pennsylvanicus* Dej., which sometimes damages strawberries (enlarged three times).

strawberries in northeastern Ohio. More than 50 percent of the ripening berries and many green berries were damaged. The skin of the injured fruits was broken and on some berries the entire surface was eaten. Microscopic examination of the injured berries indicated that the beetles were feeding primarily on the strawberry achenes.



Fig. 17.—Garden slug on strawberry leaf (enlarged three times). Photo courtesy of Research Branch, Canada Department of Agriculture.

## Slugs and Snails

Both slugs and snails can be highly destructive as they feed on berries lying on the ground. These pests are not insects but are molluscs. They are more closely related to clams, oysters, and other shellfish.

Slugs and snails make small, moderately deep holes in ripening berries. These holes may be recognized as being caused by slugs and snails because of the slimy trail left on the surface of the fruit. Slugs and snails usually cause most injury in damp spring months. Slugs (Figure 17) are active mainly at night and do not possess shells.

## INSECTS ATTACKING STEMS AND CROWNS

### Meadow Spittlebug, *Philaenus spumarius* (L.)

Meadow spittlebugs are small, green insects enclosed in white, frothy, irregular masses, 1/2 inch or more in diameter. These sometimes appear on the stems and leaves of strawberries (Figure 18) at about the time of bloom. The insects are known as spittlebugs because of the peculiar spittle-like substance with which they cover themselves. They are often seen in meadows and on plants in uncultivated fields.

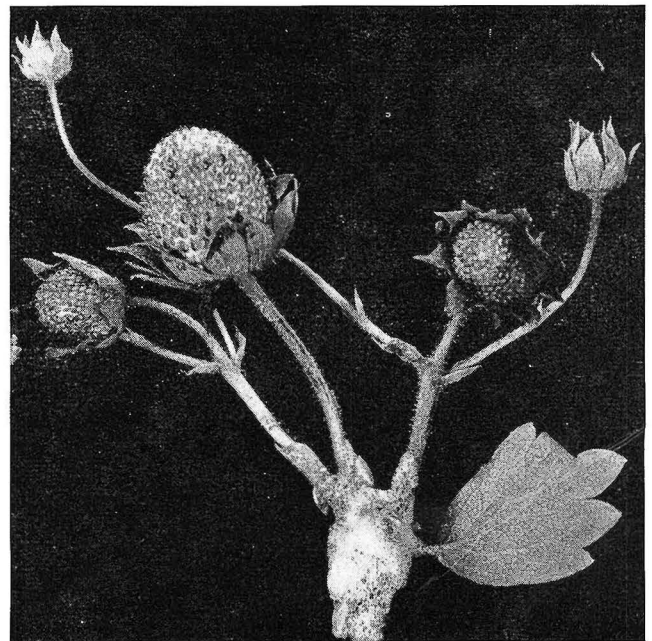


Fig. 18.—Frothy spittle mass produced by meadow spittlebug on strawberry plant.

Spittlebugs have sharp beaks with which they pierce the stems of plants and sap the plant juices. The insects first feed at the base of the plants but later move up to the more tender foliage. The



nymph or young stage produces the frothy material and it remains in this protective substance until the adult stage develops.

The insect lives during winter in the egg stage (23). The nymphs appear in April or May and complete their development in 5 to 8 weeks. Egg laying occurs primarily during September and October. Eggs are deposited on the lower parts of the strawberry plant. Only one generation appears each year.

Feeding activities of the insects cause plants to become stunted and the berries do not attain full size. The spittle masses on the plants are very annoying to strawberry pickers.

### Strawberry Crown Borer, *Tyloderma fragariae* (Riley)

This pest is capable of being very destructive in seasons which favor its development. However, the damage to strawberry plantings is not widespread in most years. The principal damage occurs from the grub-like larvae (Figure 19) which tunnel through the crowns of strawberry plants and eventually kill or stunt the plants.

The adult is a small snout beetle (Figure 20), slightly less than 1/5 inch in length. It is deep



Fig. 19.—Strawberry crown cut open to show larva of crown borer and its injury (about natural size).

chestnut-brown and has three, irregular, dark spots on each wing cover. The thorax and wing covers are densely punctured.

The beetle is incapable of flight and is distributed principally through the shipment of infested strawberry plants. New plantings of clean plants are seldom attacked if they are located some distance from infested plantings or beds of wild strawberries

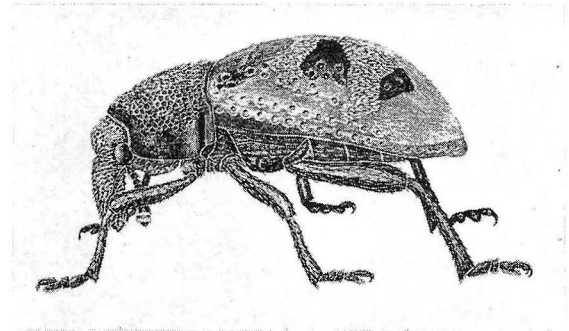


Fig. 20—Strawberry crown borer adult (enlarged ten times).

or cinquefoil. A new infestation spreads relatively slowly across a planting.

The adults appear in late summer and fall and hibernate in the soil or in debris around the plants. They become active in early spring and may feed on the foliage before egg laying begins. They start depositing eggs in late March or April and may continue until August, although the largest number of eggs usually are deposited in June. Most eggs are laid on the crown of a strawberry plant near the base of a leaf stem. The length of time required for the eggs to hatch varies with weather conditions. They may hatch in 8 or 9 days in warm weather but 3 weeks or more may be required in cool weather.

The larva is a white, legless grub and is approximately 1/5 inch in length when full grown (Figure 21). When mature, it changes to a pure white pupa (Figure 21) inside the crown of the plant. After about 10 days, the pupa changes to an adult beetle. The adult feeds for several days inside the burrow, during which time the body hardens and attains its dark brown color. It eats an opening to the outside, emerges, and feeds on the foliage before seeking hibernating quarters in the soil or under debris near the plants.

The adults are seldom seen by growers. Their color blends well with the soil and debris and when feeding they are usually concealed by the foliage.

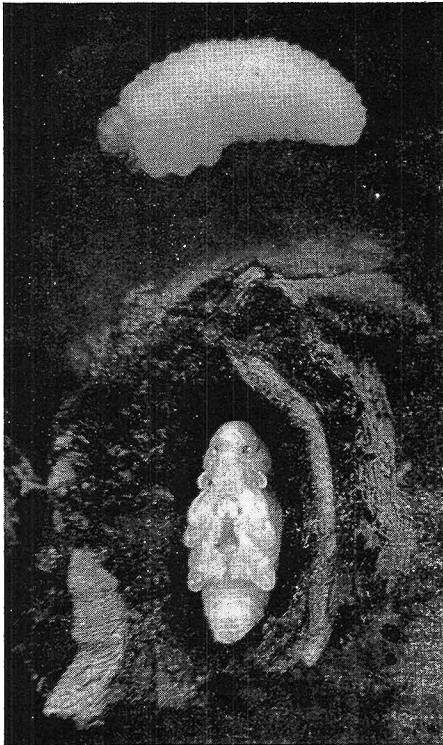


Fig. 21.—Larva (above) and pupa (below) of strawberry crown borer (enlarged about seven times). Photos courtesy of Department of Entomology, University of Arkansas.

When disturbed, they immediately drop to the ground. The earliest adults may appear in June but the largest numbers usually appear during August. Occasionally this insect may hibernate as a larva and change to the pupa stage in early spring. However, by far the largest number hibernate as adults. Only one generation occurs each year.

**Strawberry Aphids,**  
*Pentatrachopus (Capitophorus) minor* (Forbes)  
 and *Pentatrachopus (Capitophorus) thomasi*  
 (Hille Ris Lambers)

The lesser strawberry aphid and Thomas' strawberry aphid are of major importance as insect vectors of strawberry viruses. The strawberry aphid, *Chaetosiphon fragaefolii* (Cockerell), is the most widely distributed member of the strawberry aphid complex. It has not been recorded in Ohio, although it occurs in northern New York and Wisconsin. Both of the first-named species have proved capable of transmitting many virus components. Natural transmission of viruses is undoubtedly brought about by these aphids, which are commonly found feeding on strawberry foliage.

The different species of *Pentatrachopus* may be separated by studying the setae (hairs) on the dorsal aspect of the abdomen (Figure 22). *P. thomasi* has eight rows of setae on the dorsal area while *P. minor* has only vestigial setae or prominent setae in the dorsal rows only.

For many years some strawberry varieties lost vigor, failed to produce a normal number of runner plants, and were less productive. Berries were few in number and small in size. This rapid degenera-

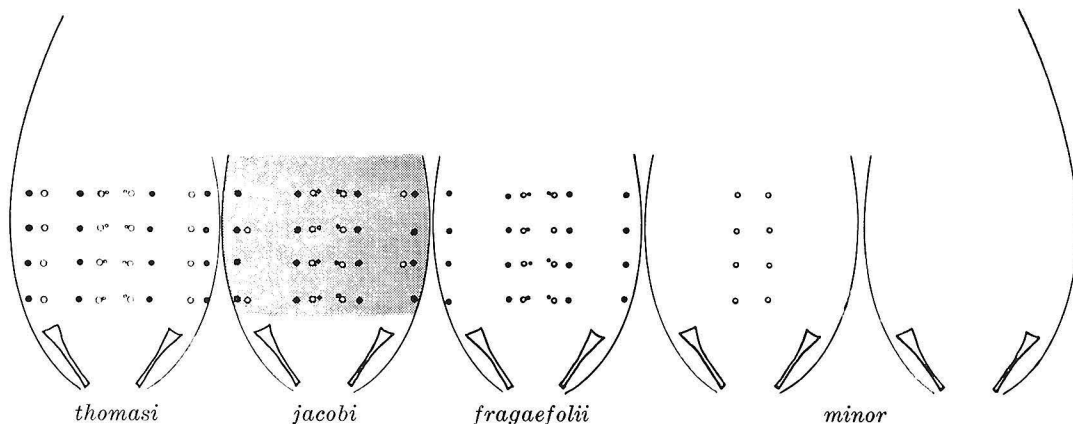


Fig. 22.—Diagram illustrating abdominal chaetotaxy in four species of *Pentatrachopus* (after Schaefer (20)). Drawing courtesy of Department of Entomology, New York Agricultural Experiment Station.

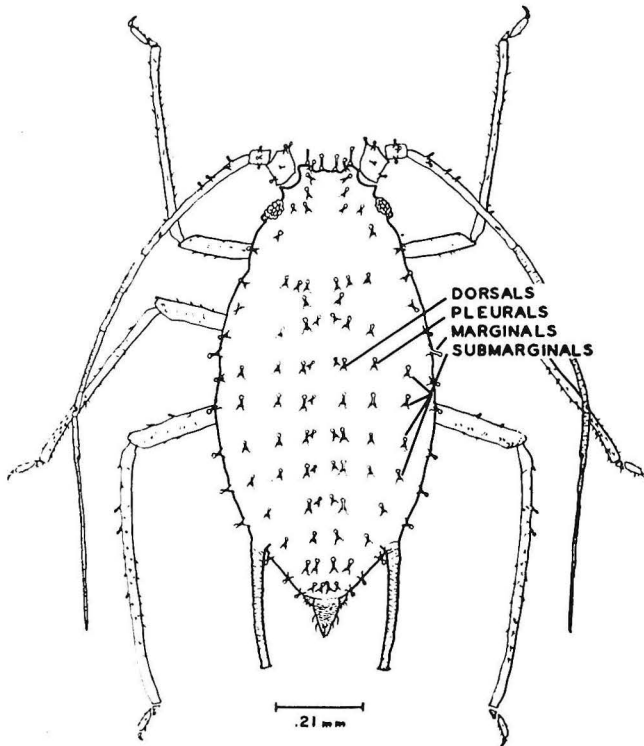


Fig. 23.—Strawberry aphid (after Schaefer (20)). Drawing courtesy of Department of Entomology, New York Agricultural Experiment Station.

tion of superior eastern varieties was termed “running out”. In recent years it has been proven that virus diseases transmitted by strawberry aphids are the most important reasons for decline or running out.

Because of the seriousness of virus infections, virus-free stocks have been isolated by state and federal agencies. These virus-free stocks are maintained and increased by cooperating nurseries. Reliable nurserymen take every precaution to keep their virus-free selections from subsequent infection and checks are made before fields are certified.

If a grower desires to increase his virus-free plants, he should start with certified plants and establish a virus-free bed at some distance from his bearing plantings. He also should make certain that all wild strawberries are eliminated from fence rows and neighboring fields. The virus-free bed can be protected from infection only by extensive insect control methods. It is advisable that the grower plant a new virus-free bed from certified plants each year.

The wingless females of Thomas’ strawberry aphid are clear white in the early instars. As the nymphs develop they become greenish-white. All

instars have rather conspicuous capitate setae arranged in 8 rows on the dorsal surface (Figure 22).

In the growing season, most aphids are found feeding on the underside of young leaves and on young petioles. They pass the winter on the underside of old leaves lying on the soil. Winged forms first appear in Ohio in early May and may be found through May and June.

## INSECTS ATTACKING ROOTS

### White Grubs, *Phyllophaga* species and related species

White grubs formerly were among the main pests of strawberry plants. However, due to the development of effective and long-lasting control programs, they are no longer a major threat.

White grubs are the immature forms or larvae of May beetles or “June bugs”. The grubs are large, thick-bodied, and dirty white (Figure 24). When fully grown, they are approximately 1-1/2 inches long. White grubs feed on the roots of a variety of plants and often cut strawberry plants completely off just below the crown. When dug from the ground, the larvae always lie in a curved position (Figure 24).

In a comprehensive study of May beetles, C. R. Neiswander (10) stated: “The grubs of May beetles are primarily grass root feeders. They are native to the United States and were undoubtedly abundant



Fig. 24.—White grub (enlarged three times). Photo by C. R. Neiswander.



in the prairie grasses at the time America was discovered. They attain their greatest accumulation in Ohio in bluegrass lawns and pastures. However, they do severe damage to corn, potatoes, strawberries, and other crops when such crops follow bluegrass which has been infested with grubs. Outside of turf areas, their damage is more conspicuous in cultivated row crops, such as corn or potatoes, than in full coverage crops, such as wheat or oats."

The most severe damage usually occurs between the time of planting and runner development. Damage is most likely to occur when strawberries are planted on newly plowed sod.

May beetles are dark brown in color and vary from 1/2 to 7/8 of an inch in length (Figure 26). They are often attracted to lights and during June may sometimes be seen in considerable numbers around street lights.

The beetles remain concealed near the soil during the day but at dusk they emerge and fly to ornamental or forest trees to feed. Sometimes they congregate in such numbers that they completely defoliate isolated trees. They return to the soil just before dawn.

Eggs are deposited in the soil at a depth of 1 to several inches. They are apparently deposited most abundantly in sod which has not been disturbed for years, although they occur in almost any type of soil porous enough to permit the female beetles to crawl into it.

The eggs hatch in 3 or 4 weeks. The tiny larvae feed largely on vegetable matter in the soil dur-



Fig. 25.—Strawberry plant killed by white grubs.

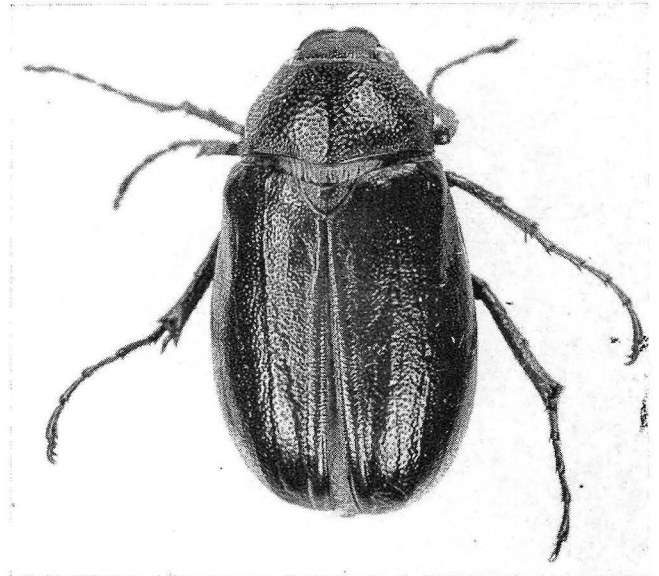


Fig. 26.—May beetle, adult stage of white grub (enlarged about three times).

ing the remainder of the first season. When cold weather appears, most species of white grubs migrate down below the frost line and remain there until the following spring.

The grubs spend all of the next summer feeding on the roots of plants. During the second winter, they continue as larvae below the frost line in the soil. In the third year, they return to the plant roots and feed until late June or July, when they change to pupae in small earthen cells. The adults emerge from the pupal cases a few weeks later but remain in the soil until spring. Thus, eggs are laid every third year. Since the beetles are abundant at 3-year intervals, severe damage usually occurs only every third year.

However, two species complete their development and change to the adult stage in 1 year. One of these is the well known Japanese beetle, *Popillia japonica* Newman, and the other is the northern masked chafer, *Cyclocephala borealis* Arrow. These species attack the roots of certain grasses and may sometimes become abundant enough to cause severe damage. Occasionally they cause trouble in strawberries.

#### Strawberry Root Aphid, *Aphis forbesi* Weed

This aphid was originally described in Ohio by Weed (25) during a period when it was a severe pest. The strawberry root aphid is widely distributed throughout the strawberry-growing regions of the United States and Canada.

Infested plants are characterized by a lack of vigor, unnaturally pale foliage, and immature or desiccated fruit. Second-year plants rarely suffer as much damage since they are well established and have many more plants to support a given root aphid population.

In autumn, females of this pest deposit their shiny black eggs on the stems and leaves of strawberry plants. The eggs hatch early in the following spring and the young bluish-green nymphs feed on the newly developed strawberry leaves.

When the aphids become abundant, they are soon found by ants which carry them to the strawberry roots. Here the aphids feed by sucking the sap from the root tissues. The ants also take aphids from one plant to another, thus spreading the infestation.

A number of generations of wingless females are produced during the summer. Under favorable conditions, growth may be completed in as little as 2 weeks, after which the females are soon capable of giving birth to 50 or more living young. When cold weather approaches in the fall, winged forms again appear and move from the roots to the foliage.

When preparing ground for a new strawberry planting, a thorough and deep cultivation early in

the spring will aid in the destruction of ant colonies. This will reduce the chances of a root aphid infestation.

#### Strawberry Root Weevils, *Brachyrhinus sulcatus* (Fabricius), *B. ovatus* L., and *B. rugostriatus* Goeze

Six species of root weevils were reported by Wilcox (26) as causing damage to strawberries in Oregon and Washington. Three of these species occur commonly in Ohio and two are considered economic pests. However, none have severely injured strawberries.

The black vine weevil, *Brachyrhinus sulcatus* (Fabricius), (Figure 27C) is a pest of *Taxus* in Ohio. It has not been reported as a strawberry pest. This weevil is sometimes a serious pest of strawberries in Europe.

The strawberry root weevil, *Brachyrhinus ovatus* L., (Figure 27A) has been found on the roots of strawberry in Ohio but not in sufficient numbers to warrant control measures. It occasionally causes damage by feeding on the roots of young hemlocks or spruce trees. Frequently it becomes a household pest in late summer and fall when great numbers of

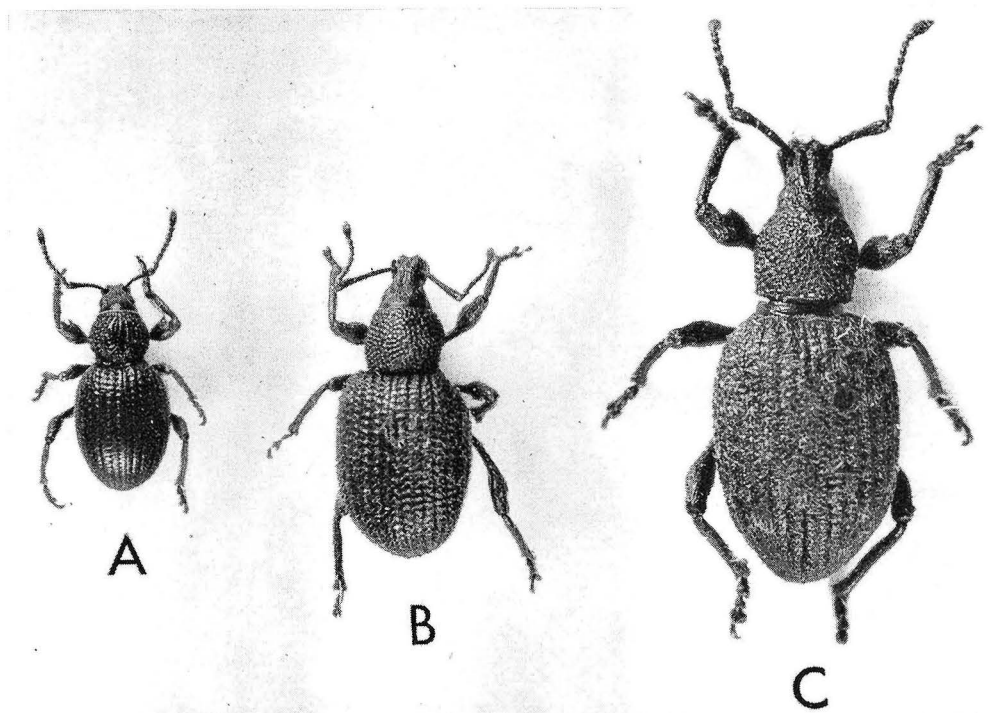


Fig. 27.—Strawberry root weevils (enlarged six times). A. Strawberry root weevil, *Brachyrhinus ovatus* L. B. Rough strawberry root weevil, *Brachyrhinus rugostriatus* Goeze. C. Black vine weevil, *Brachyrhinus sulcatus* (Fabricius).

the adult beetles wander into houses, apparently in search of hibernating quarters.

The rough strawberry root weevil, *B. rugostriatus* Goeze, (Figure 27B) is common on fruit trees in June and occasionally enters residences for hibernation. It has not been a serious pest of strawberries in Ohio but has been a pest on the West Coast.

In the adult stage, these insects are black and vary from 3/16 to 3/8 inch in length. The strawberry root weevil, the smallest of the three species, is only 3/16 inch in length. The rough strawberry root weevil is slightly more than 1/4 inch long. The largest of the three is the black vine weevil, which is about 3/8 inch long.

These insects cannot fly and apparently all are females. The beetles appear primarily during June. They feed on the foliage at night and hide in the soil or under plants during the day. Eggs are dropped to the ground under the plants on which the adults feed. Larvae enter the soil where they feed on the roots. Only one brood occurs each year.

### SUMMARY

Insect and mite control problems keep changing because of weather conditions, the development of new controls, the influence of chemical controls on non-target organisms, and the introduction of new pests from other areas.

Cool, wet springs usually result in high aphid populations. Ladybird beetles, which normally keep aphids at low levels, are not as active during cool, wet weather. On the other hand, hot and dry summer weather favors rapid development of two-spotted spider mite populations. Exceptionally cold winters may reduce certain pests to such a low level that it may be several seasons before they recover and become damaging again.

The importance of white grubs as strawberry pests decreased considerably as a result of the use of

aldrin and dieldrin as soil treatments. Because one preplanting treatment of these chlorinated hydrocarbons protected plantings throughout their life, these treatments were economical and widely accepted. Often the application of chlorinated hydrocarbon insecticides such as TDE, DDT, aldrin, or dieldrin for control of an insect pest will stimulate rapid buildups of mites. Growers should anticipate such problems and be prepared to combat them as soon as they appear.

New insect pests may be expected to gain a foothold in Ohio by natural spread from other areas as well as by new introductions. This threat becomes greater as more direct airline flights are scheduled from Europe to U. S. cities. The opening of the St. Lawrence Seaway exposed the agricultural heartland of the midwest to new invaders from throughout the world.

The environment has a very direct effect upon the behavior of insects and mites and may determine whether or not an insect actually is or is not a pest. For example, a field of wild strawberries adjacent to a cultivated one may act as a constant reservoir of pests. If it is destroyed for some reason, real trouble can be anticipated as hungry pests spread out in all directions in search of food.

To newcomers to strawberry growing, it may appear that strawberry plantings are relatively free from insect and mite problems. This is a popular misconception because many pests are so small that they can hardly be seen with the naked eye or the insects feed underground or at night when they cannot be seen.

Successful production of strawberries on an economic basis requires that the grower be familiar with the symptoms of insect and mite injury. Then corrective measures can be undertaken before pest populations reach damaging levels.



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