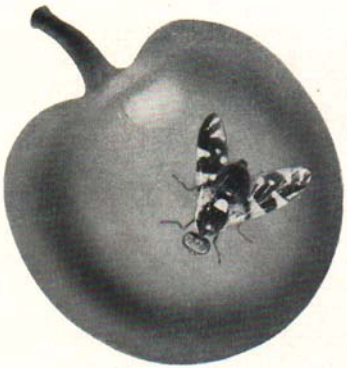
Extension Bulletin 372
March 1960

# FRUIT INSECTS
## of Michigan



COOPERATIVE EXTENSION SERVICE
Michigan State University
East Lansing

## Identification Key to Common Fruit Insects by Type of Injury

*Usual degree of injury to fruit if not controlled:*
S – Severe; M – Moderate; L – Light; V – Varies greatly with location and season; Blank – Insignificant

| Injury | Apples | Pears | Peaches | Cherries | Plums | Grapes | Strawberries | Brambles | Blueberries | Currants and gooseberries | Usual Identifying Characteristics | Pests | Page |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Pests suck sap | S | M | L | S | M | L | M | L | L | M | Small, slow-moving pests live in colonies | *Aphids* | 5 |
| | S | L | L | L | S | L | L | L | L | L | Minute 8-legged pests | *Mites* | 7 |
| | L | L | L | | L | S | | L | V | L | Greenish insects, often run sideways | *Leafhoppers* | 9 |
| | | S | | | | | | | | | Small insects, secrete honeydew on pears | *Pear psylla* | 10 |
| | V | V | V | V | V | V | | | V | V | Hard scales numerous on bark | *Scale insects* | 10 |
| | | V | V | | | | V | | | | Quick insects, larger than other sucking pests | *Plant bugs* | 13 |
| | | | | | | | M | | | | Spittle masses secreted by young nymphs | *Spittlebugs* | 14 |
| Worms in fruit | S | M | S | S | S | | | | M | | Worms with brown head but no legs | *Plum curculio* | 15 |
| | S | M | | | | | | | | | Worms with head and legs, work in core | *Codling moth* | 17 |
| | | | S | | | | | | | | Worms with head and legs, in peaches | *Oriental fruit moth* | 20 |
| | | | | | | S | | | | | Worms with head and legs, in grapes | *Grape berry moth* | 21 |
| | S | | | | V | | | | S | | Worms (larvae) without head or legs | *Apple maggot* | 23 |
| | | | | S | | | | | | | Worms without head or legs, in cherries | *Cherry fruit flies* | 25 |
| Pests chew foliage and fruit | S | M | S | S | S | | | | M | | Gray-brown snout beetles about ¼ inch long | *Plum curculio* | 27 |
| | V | V | V | V | V | V | V | | | | Worms roll leaves and feed on fruit | *Leaf rollers* | 27 |
| | V | V | V | V | V | V | V | | | | Long-legged tan beetles, congregate in groups | *Rose chafers* | 29 |
| | | | | | | V | | | | | Cutworms climb plants at night early in season | *Climbing cutworms* | 31 |
| Pests bore in bark and wood | | | S | V | V | | | | | | Large worm, works near soil level under bark | *Peach tree borer* | 32 |
| | | | S | V | V | | | | | | Medium-sized worm, works on trunk and large limbs | *Lesser peach tree borer* | 33 |
| | V | V | V | V | V | | | | | | Small borers, produce shot-hole pattern in bark | *Shot hole borer* | 34 |
| Pests feed on roots | | | | | | | V | V | | | Large grub worms, chew off roots | *White grubs* | 36 |
| | | | | | | | V | | | | Small grubs feed on strawberry roots | *Strawberry root weevil* | 36 |
| | | | V | V | | V | V | | | | Microscope reveals eel-like worms | *Nematodes* | 37 |

# Fruit Insects of Michigan

*by A. C. Dowdy, Extension Specialist in Entomology*

## INTRODUCTION

CONTROL OF INJURIOUS insects has always been a major problem of Michigan fruit growers. In recent years the pesticide industry has provided new and superior weapons for grower usage. However, insect control promises to continue as a major problem in all phases of American agriculture.

Modern fruit farmers must compete on the basis of quality. In most instances quantity is also important. Insects represent a major limiting factor of both quality and quantity in fruit production.

Growers are finding that variations in effectiveness and prices of insecticides have a tremendous effect on efficiency in fruit production. It is thus important that they understand the life history and control fundamentals of their major insect pests in order to get the best returns from insect control chemicals.

This bulletin provides basic information about the more common fruit insects of Michigan. Life histories and various factors relating to the control of these pests are discussed. Since information of this type is of a more-or-less permanent nature, frequent revisions of this bulletin are not anticipated.

Fig. 1. Not all insects are harmful. Larvae of the Green lacewing (left) and Syrphid fly (right) are common enemies of aphids. Various species of Lady beetles, in both larval and adult stages, attack other insects.

**Fig. 2. Lady beetle larvae are among the more important beneficial insects of Michigan orchards.**

Positive determination of insect problems is important for efficient control. An identification key (See inside front cover) and numerous pictures[1] are included. Because recommendations for chemical control vary from year to year, no suggestions of this type are given. Commercial growers should consult the current revision of Extension Bulletin 154, *Fruit Spraying Calendar,* for chemical recommendations.

In order to provide a bulletin of usable size only the most important insects are listed. Minor fruit pests and those limited to small areas of Michigan have been omitted. Problems with such pests can be handled by contacting local extension agents.

## SECTION I

## Pests That Suck Sap

Pests that suck sap are among the most injurious fruit pests of Michigan. Injury is sometimes overlooked because the pests are often small and feed on parts of the plant other than the fruit. A weakened plant and improper bud development usually result from such feeding. In years of drought or inadequate moisture supplies, injury is more severe.

The sap-sucking pests have a life cycle known as incomplete metamorphosis; that is, they have only three life stages — adult, egg and nymph. In certain instances, as with many aphids and scale insects, the egg stage is missing and only adults and young (nymphs) are present. In these cases adults give birth to living young.

Insects with only three life stages often have a very rapid life cycle. Some have several generations each year. Both nymphs and

[1] Several of the illustrations were provided through the courtesy of Ward's Natural Science Establishment, Rochester, N. Y. and the New York Cooperative Extension Service. Their cooperation is gratefully acknowledged.

**Fig. 3. Aphids are pests on many plants. Adults and nymphs are usually present in the same colony.**

adults represent active feeding stages. Most of the other fruit pests have four life stages and usually do not reproduce so rapidly as sucking pests (notably aphids and mites). This is an important consideration when planning control measures.

Because they have piercing-sucking mouth parts, pests that feed on the sap must be controlled with pesticides having contact and/or fumigating action. Materials that kill largely by stomach poison action are worthless or of little value against sucking pests.

**Aphids.** Aphids are among the most serious of the sucking pests in Michigan. They are found to some extent on practically all of our fruit plants. Most serious kinds (species) are found on apples, cherries, plums, and strawberries.

Aphids are small soft bodied insects, usually identified by two small cornicles (horns) on the end of the abdomen. They usually feed in groups. Winged and wingless individuals are often present in the same colony.

Most aphids that attack fruits pass the winter as shiny black eggs on the host plant. Early in the spring the eggs hatch. Females, known as stem mothers, give birth to living young, and populations build up quite rapidly. Several generations are produced each year. Some species migrate from the host plant to an alternate host at certain times of the summer. These return to the original host in the fall and deposit overwintering eggs.

Natural enemies of aphids are common in Michigan. Lady beetles feed on aphid colonies both as adult beetles and as immature larvae. Syrphid (sir-fid) flies, often seen hovering in mid-air, produce legless larvae that forage readily on aphids. Lacewings lay eggs, on silken stalks, which hatch into active "aphis lions." Tiny wasps destroy aphids by feeding as internal parasites. Unfortunately, most present-day insecticides destroy many of these beneficial insects.

Some aphid species are carriers of certain plant diseases. Viruses of strawberries, may be transported from one plant to another by winged adults.

Some species of aphids require control early in the season, and protective sprays are needed in plantings with a history of infestation. Under these conditions, control is advisable whether pests are seen or not. Aphids requiring this type of control are the rosy apple aphid, black cherry aphid, and currant aphid. Most satisfactory control is obtained with pre-bloom applications.

Three aphid species are common on apples in Michigan - - the rosy apple aphid, the green apple aphid, and the apple grain aphid. All three lay eggs on twigs in the fall. It is difficult to identify individuals of these species, which hatch from eggs in the spring. Ordinarily the rosy apple aphid is the only one which causes injury of economic importance early in the season. The green apple aphid does not usually build up to damaging proportions until early or midsummer. Control of the apple grain aphid is ordinarily not needed since this insect migrates to alternate host plants before serious injury occurs on apples.

Green apple aphids and various other aphids which build up on other fruits during the summer can be controlled when damaging infestations are observed.

The strawberry root aphid is perhaps the most common root feeding form in Michigan. Its control is best obtained by treating the soil

**Fig. 4. European red mites overwinter as tiny red eggs on the twigs of apples and plums.**

prior to planting with an effective material or dipping the roots in a recommended insecticidal solution immediately before planting.

**Mites.** Mites are similar to aphids in that they have a high reproductive rate and feed on a wide variety of Michigan fruit crops. Although mites are not true insects (having four rather than three pairs of legs) their injury is similar to that caused by other pests with piercing-sucking mouth parts. A magnifying lens is usually required for observation of their four pairs of legs and positive identification of species.

Mites are very small and are often found in great numbers. Weather factors such as warm dry periods favor mite build-up. Also certain spray materials used against other pests sometimes destroy mite enemies and allow an increase. Under such conditions, mites can become extremely injurious.

Two species, the European red mite and clover mite, overwinter as small red eggs on twigs and tree branches. After the eggs hatch, nymphs and adults of the European red mite can be identified by their red color and by stiff spines protruding from their backs. Clover mites, although sometimes red, lack the spines and their front legs are twice as long as any other pair.

Clover mites usually migrate to other host plants and are seldom troublesome as fruit pests in well sprayed plantings. However, infestations may continue into the summer on infrequently sprayed trees such as red tart (sour) cherries.

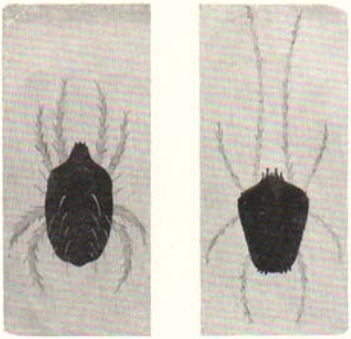


**Fig. 5. Mites are minute pests having eight legs. Viewed under magnification the European red mite (left) is seen to have spines on its back. The clover mite (right) has front legs twice as long as any other pair.**

The European red mite, which is primarily a pest of apples and plums, remains on the trees throughout the summer. Eight or more overlapping generations occur each season. In orchards where European red mites are a persistent and perennial problem, a pre-bloom application of an effective material is often advisable.

The two-spotted mite, as the name suggests, can usually be recognized by prominent dark spots showing on its back. Although they are sometimes pink or salmon colored, two-spotted mites tend to be lighter and of a more greenish appearance than either European red mites or clover mites.

Two-spotted mites overwinter in the adult stage. They hibernate under bark and debris in an orchard and are ordinarily not present in serious numbers until early summer. Generally, pre-bloom applications of miticides have little effect against them because active feeding stages are not present in numbers on the tree until the post-bloom period.

Species of mites other than those mentioned are occasionally troublesome in Michigan but are not considered general pests.

Some pesticides, while not specific against mites, tend to hold down infestations when they are applied during the regular spray program. The use of such materials is advisable. However, a close watch should be maintained throughout the summer as mite populations can build up very rapidly, especially during warm dry periods. It is best to control them before noticeable injury occurs.

When mites do build up to damaging numbers during the summer, an effective miticide should be used immediately. It is most economical to choose a material with ovicidal (egg killing) properties or one with

**Fig. 6. Pear leaf blister mites are troublesome in a few areas of Michigan. Although the mites cannot be seen with the naked eye, their injury presents a mottled effect on pear leaves.**

long residual effectiveness so that one application will provide effective control. Some growers favor a combination of two materials — one for adults and nymphs, the other for eggs. Unless eggs are destroyed, a second application may be necessary to kill young mites which hatch five to ten days after the original application.

**Leafhoppers.** Several species of leafhoppers are injurious to varying degrees on Michigan fruits. Early in the season the most serious is the grape leafhopper, which requires control every year in vineyards. Several others feed on such crops as apples, pears, strawberries, and brambles.

In addition to sucking sap, some leafhoppers are capable of spreading certain virus diseases. Blueberries, for example, are attacked by viruses transmitted by them. The adults are usually greenish insects ranging from 1/12 to 1/4 inch in length. Nymphs, the immature forms without wings, are also greenish. They are very active and, when disturbed, often run sideways on the underside of a leaf.

Being active individuals, leafhoppers come into contact with a leaf surface more than do several of the other sap-sucking pests. Most are controlled readily with pesticides having contact action.

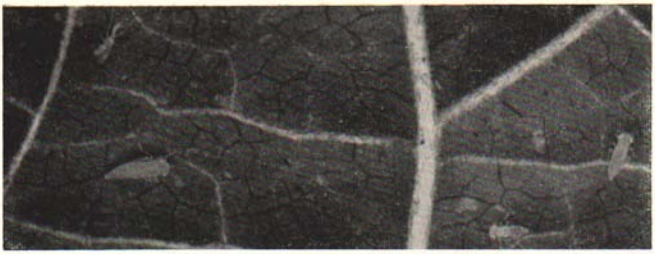


**Fig. 7. Small greenish leafhopper nymphs often run sideways on the under surface of a leaf.**

The grape leafhopper is the only species normally found in Michigan which requires special sprays. Most other leafhoppers are controlled with materials used against other pests in the spray program. (An exception to this occurs in the case of some plants produced as virus free nursery stock).

**Pear psylla.** The pear psylla is a small aphid-like insect that feeds only on pears. Like aphids and scale nymphs, the pear psylla secretes a sweet substance known as honeydew. If infestations are not controlled, the secretions lead to a sticky, blackened condition on the foliage caused by a black fungus growth which develops readily on honeydew.

The pear psylla spends the winter in the adult stage in bark crevices on pear and other nearby trees. Very early in the season, adults become active and lay their eggs on twigs and later on the pear fruits. Unless controlled, several generations are produced each season.

When viewed through a magnifying lens, the adult psylla is similar in appearance to an adult cicada. Overall length is approximately ⅛ inch for adults and fully grown nymphs.

**Scale insects.** Several species of scales are sometimes injurious to Michigan fruits. The San José, European fruit lecanium, and Forbes scales are the most serious offenders.

The scale insect itself is a small, soft-bodied individual. However, these insects secrete a hard protective terrapin-like covering which is very resistant to insecticidal materials.

The San José is a small circular scale about the size of a pin head. It is usually dark brown to black and has a raised dull yellow nipple-like center. The overall appearance during winter is an ashy-black condition on the bark. This scale attacks all Michigan fruit trees.

**Fig. 8. The adult pear psylla is about ⅛ inch long and looks like a miniature cicada.**

The Forbes scale attacks many Michigan fruit trees, but is more serious on red tart (sour) cherries than others. It is similar to the San José scale but is slightly larger and the overall appearance tends to be brown rather than dull black or ashy. Adults have a raised orange-colored central nipple.

The European fruit lecanium is a pest of blueberries, peaches, and plums in Michigan. It is much larger than the others mentioned, is brown, and has a terrapin-like appearance. Mature lecanium scales are ⅛ to ⅙ inch in diameter.

Heavy infestations of San José and Forbes scales are best controlled with a dormant application of an effective material. Dormant or delayed dormant oil sprays, sometimes applied in combination with other active ingredients, are ordinarily used.

Unless populations of San José or Forbes scales have built up in an orchard, a contact type insecticide in the regular spray schedule during the month of June tends to hold them in check. At this time, the young scale nymphs (crawlers) are migrating over the plant. Migration continues for about one week before the small crawlers insert their mouthparts into the plant tissue and take up permanent residence on the spot. The hard scale covering is secreted soon there-

**Fig. 9. The European fruit lecanium scale is a common pest of blueberries. In June many old scales removed from twigs are loaded with eggs underneath.**

after and the insect is no longer susceptible to the usual summer insecticides.

The lecanium scale can ordinarily be controlled by applying effective materials soon after the crawlers have emerged. Apply one treatment when approximately 70 percent of the eggs (present under the adult female scale) have hatched. The eggs turn from white to salmon color immediately before hatching. Hatching ordinarily occurs from mid-June to early July. If a large percentage of the crawlers are not controlled by a single application, an additional treatment is needed one to two weeks later.

**Fig. 10. Early in July, minute lecanium scale crawlers appear in great numbers on foliage and twigs of infested peach trees.**

Fig. 11. Apples infested with San José scale are red-spotted at harvest time.

**Plant bugs.** Plant bugs are larger than most of the other sap-sucking pests of Michigan. Adults range in size from about ¼ inch long (Tarnished plant bug) to the stink bugs which sometimes attain a length of ½ inch.

Tarnished plant bugs are perhaps the most serious of this group on Michigan fruits. They infest strawberries, pears, peaches, and brambles. Feeding injury on the fruit portion leads to a deformed condition often referred to as "catfacing" on peaches or "buttonberries" on strawberries.

Plant bugs can ordinarily be controlled with early-season applications of effective materials. These sprays are directed against adult insects which emerge from hibernation and feed on young plant growth. Although plant bugs may have two or more generations each year the late broods are ordinarily controlled with sprays used primarily against other pests.

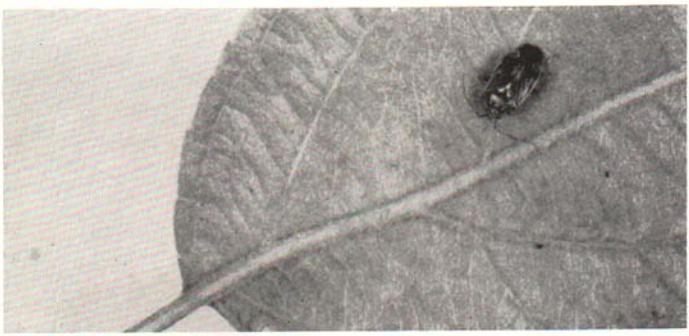


Fig. 12. The tarnished plant bug is about ¼ inch long and brownish in color. It is a widespread general feeder in Michigan.

**Fig. 13. Spittlebug adults are about ¼ inch long and resemble leafhoppers. Their color pattern varies from light tan to dark mottled brown.**

**Spittlebugs.** In the adult stage spittlebugs closely resemble leafhoppers. Adults are brownish individuals often seen in great numbers in hay and grain crops during the late summer. Many of the females lay eggs at the base of strawberry plants.

Spittlebugs generally hatch in strawberry plantings by early May. In addition to sucking sap, the young nymphs blow bubbles which produce a spittle mass. Direct injury to the plant is not severe when plants have sufficient moisture. However, the nuisance caused by the spittle masses during strawberry harvest is quite objectionable.

A spittlebug infestation can be prevented with an effective long residual type material applied in the pre-bloom period. This is ordinarily before many spittle masses have appeared. If control is delayed until the post-bloom period, when spittle masses are plainly evident, an effective material labeled for use in the post-bloom period should be selected.

**Other sap-sucking pests.** Additional insects that are occasionally troublesome on Michigan fruits as sap-sucking pests include treehoppers and cicadas. Pests of this type vary tremendously according to the year, location and weather factors, and often cause more injury to twigs by their egglaying activities than they do by actual feeding. They can ordinarily be controlled with insecticides effective against other sucking insects.

## SECTION II

### Pests That Produce Worms in Fruit

Insects that produce worms in fruit have a life cycle known as complete metamorphosis. In addition to the adult, egg, and larva (worm) stages, there is an additional stage called the pupa (resting stage) in which the insect transforms from the larva to the adult. The pupa is similar to the egg stage in that it is inactive and quite resistant to many insecticides. Often the pupa is enclosed in a cocoon or is otherwise protected so that pesticides cannot reach it.

For the most part, pests that produce worms in fruit have chewing mouth parts at some stage of their life cycle. Often they can be controlled with insecticides showing only stomach poison action. However, insecticides that exhibit stomach poison, contact, and sometimes fumigating action usually work best. Such ingredients provide a "shotgun" effect and often destroy two or more life stages of a given pest.

To prevent worms in fruit, it is usually important to apply protective sprays prior to or during periods when adults are active. Control largely depends upon destruction of adults or immature stages before the fruit is infested.

**Plum curculio.** The plum curculio is a brownish-gray beetle about ¼ inch long and differs from other curculios by having small humps on its back. It has a long snout with chewing mouthparts at the tip. Adults emerge from hibernation in and around orchards about the

**Fig. 14. The plum curculio becomes active about the time peaches are in the shuck-split stage. The small snout beetle is brownish-gray.**

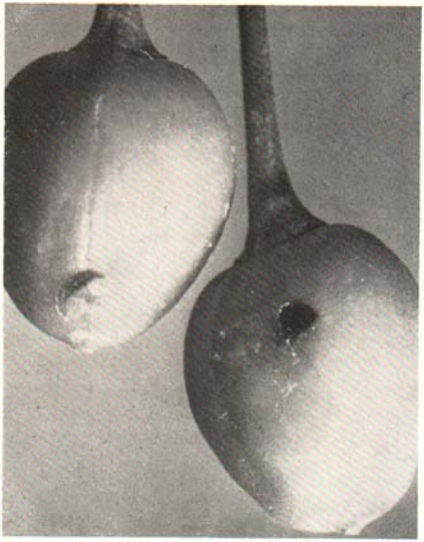


**Fig. 15. The female plum curculio inserts an egg under the flap of her crescent-shaped oviposition mark (left). The young cherry on the right shows a typical round feeding puncture made by a curculio adult.**

time peach trees are in the shuck-split stage. They injure the fruit by external feeding and egg laying activities.

Unless controlled, they feed and lay eggs in fruit from mid-May until late June. Feeding injury consists of a small round hole cut in the fruit. Egg-laying injury is characterized by a small crescent-shaped cut on the fruit surface. A small white egg is normally deposited near the center of the crescent-shaped cut.

In Michigan, apples, pears, plums, peaches, and cherries usually require protective sprays against the plum curculio. To prevent egg-laying, effective materials should be applied whether adults are seen or not. Stone fruits that are infested ordinarily drop, while apples and pears usually hang to the tree but bear egg-laying marks.

Larvae (worms or grubs) grow quite rapidly when the infested fruit drops. Full grown larvae leave the fruit, enter the soil, and change to the pupa stage. Later in the summer, adult curculios emerge from the soil, feed for a while on unsprayed fruits, and then enter hibernation quarters in the soil or under debris. Hence, only one generation occurs each year.

Fig. 16. The plum curculio larva is legless but has a brown head. When full grown it measures about ¼ inch.

**Codling moth.** The codling moth is a serious pest of apples wherever they are grown in the United States. In Michigan, protective sprays are always needed. Although pears are usually damaged to a lesser extent, they also require protective sprays.

The codling moth spends the winter as a full grown larva about ¾ inch long in a partial cocoon under flakes of bark. The larvae change to the brown pupa stage in the spring and emerge as moths during the latter part of May and throughout June. The adult moth

Fig. 17. Young apples infested with first brood codling moth larvae show an exudation of frass at the point of attack.

**Fig. 18. A codling moth larva spends the winter in its flimsy cocoon under a flake of bark. Fully grown, the larva is about ¾ inch long.**

is slightly over ½ inch long, and has a dark, chocolate-colored band along the base of the wing. The moths fly late in the evening and deposit eggs singly on the foliage and fruit.

Larvae that hatch from eggs (about one week after they are laid) often migrate to the calyx end where they enter the fruit. Before the appearance of DDT and other organic insecticides, a calyx spray of lead arsenate was standard procedure. This left a poisonous residue in the calyx end of the apple before the sepals closed and provided protection for young larvae. Present-day insecticides destroy larvae largely by contact action before the larvae can enter the fruit and cause injury. Some materials (especially those with fumigating action) act against adult moths and eggs as well.

In Michigan a second brood appears late in July. Spray dates based on the emergence of adult moths are determined by the Department of Entomology at Michigan State University. Announcements of spray dates are made by County Agricultural Agents and District Horticultural Agents in the various fruit areas. Thorough sprays during June

**Fig. 19. The codling moth has a wingspread of nearly one inch. The over-all appearance is brownish with a chocolate-colored area along the base of the wings.**

against the first brood ordinarily tend to keep second brood numbers greatly reduced.

Larvae that pick up a slight amount of insecticide but do not die until they enter the fruit produce defects known as "stings." Worms killed by fumigating action of some insecticides soon after they enter the fruit also produce this condition.

When warm temperatures prevail late in the season, codling moth activity may continue, thus presenting a hazard to fruit nearing harvest. Announcements of such late season hazards are usually made by County Extension Agents.

**Fig. 20. A full grown oriental fruit moth larva is slightly less than ½ inch long. The first brood tunnels inside peach terminals.**

**Fig. 21. Second and additional broods of the oriental fruit moth attack the peach fruit. Gum and frass exude from the point of attack.**

**Oriental fruit moth.** The oriental fruit moth is a very serious pest on peaches in Michigan. Three full broods and a partial fourth occur each year. The adult moth is approximately ⅓ inch long, and is of a basic dark brown color.

Like the codling moth, adults fly late in the evening. Females deposit their eggs on peach twigs, foliage, and fruit. Injury from the first brood is caused by cream-colored larvae which enter the terminal growth and tunnel inside succulent twigs. Larvae from later broods enter the fruit and are the most common worm in peaches at harvest. The larvae work near the pit and attain a length of approximately ½ inch. When full grown many turn pinkish in color.

Before the organic insecticides came into use, certain parasites were used to help keep oriental fruit moth larvae in check. The parasites feed on larvae which infect the twigs. However, they are largely eliminated by present-day insecticides used against other pests in the peach schedule. Thus it becomes quite important to do a thorough spray job in order to keep populations low. Early season control helps prevent a large population late in the season.

In many parts of Michigan, it has become highly important to continue an active spray program against the oriental fruit moth until peaches are harvested. Otherwise, small larvae often enter the ripen-

ing fruit near the stem, and tunnel in beside the pit. Such peaches may appear sound until they are opened. To prevent this, select an insecticide which has long enough residual action to provide protection until the crop is harvested. Also, choose an insecticide that will not exceed the tolerance established for that particular material on peaches.

**Grape berry moth.** This insect is the only serious worm found infesting grapes in Michigan. Two complete broods and a partial third occur. Damage is caused by the gray-green larvae as they feed on blossoms and fruit. First brood larvae web the blossoms and small berries together, while second and third brood larvae enter the fruit.

When a larva becomes full grown (about ½ inch long), it cuts a small flap from the edge of a leaf. The flap, about ¾ inch long, is folded over and webbed to the leaf surface. The larva changes to a pupa inside this flap.

Winter is passed in the pupa stage on the vineyard floor. Cultural practices such as discing or otherwise covering leaves help in reducing overwintering populations.

Control of the grape berry moth is similar to that employed against the codling moth and oriental fruit moth. Control measures applied against early broods help materially in reducing late broods, which are responsible for the worms at harvest time.

**Fig. 22. The grape berry moth is a severe pest of grapes. The gray-green larva attains a length of about ½ inch.**

One of the most important periods for applying insecticidal control is early August. In certain years weather factors favor a third brood build-up and additional protection is needed during mid and late August. Extension agents normally make announcements when this situation occurs.

**Fig. 23. Unless adequate control of grape berry moth is maintained late in the season, grapes may be severely injured at harvest time.**

**Fig. 24. The grape berry moth spends the winter as a pupa protected inside a small flap cut from grape foliage.**

**Fig. 25. An adult apple maggot is slightly smaller than a house fly, and has characteristic markings on its wings.**

**Apple maggot.** The apple maggot is a serious pest on apples and blueberries. Protective insecticidal applications are required each year during July and August on these crops.

Injury is caused by a maggot (typical fly larva, lacking a head and legs) which tunnels inside the fruit. Because of the winding nature of the tunnel, this pest is sometimes called the "railroad worm."

There is but one brood each year. Adults emerge from the soil late in June and throughout July. The flies are slightly smaller than a house fly and have dark bands across their wings. They feed by sponging fungi, yeasts, and liquids from foliage and fruits in the orchard. Beginning about 10 days after emergence, the females deposit eggs

**Fig. 26. Summer varieties of apples break down rapidly as a result of apple maggot attack. Like other fly larvae, apple maggots have no distinct head nor legs.**

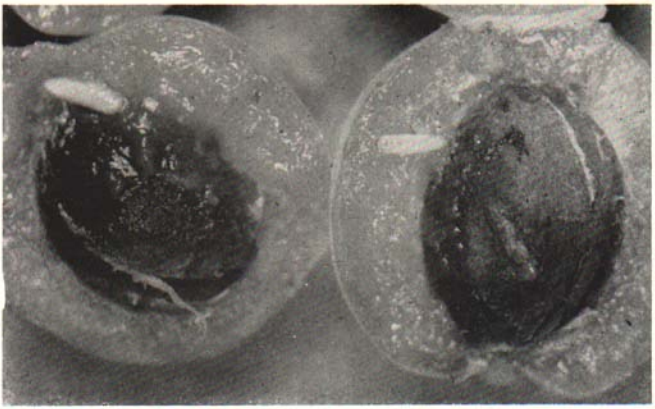


Fig. 27. Apple maggots promise to become a pest of Michigan's apricot industry.

under the skin of apples. The young maggots mature more rapidly in summer varieties of apples than in fall or winter varieties. When infested fruits drop, the larvae complete their growth very rapidly. When mature, the larvae leave the fruit, enter the soil, and change to pupae. Winter is passed in this condition.

Control depends upon killing adults before eggs are laid. Thus it is important to apply the first protective spray after adults emerge but before egg-laying begins. Because adults continue to emerge from the soil throughout July, protection is needed well into August.

County extension agents announce the timing for the first spray against apple maggot. Announcements are based on observations made in the field by entomologists checking for adult flies.

Fig. 28. The pupal stage of the apple maggot is about ¼ inch long and brown in color. Both apple maggots and cherry fruit fly larvae change to pupae in the soil.

**Fig. 29. The black cherry fruit fly has a distinctive color pattern on its wings. Adults are about ¼ inch long.**

**Cherry fruit flies.** The cherry fruit fly and black cherry fruit fly are very closely related insects. Both are present in Michigan. Because their life cycles are almost identical, both species may be controlled with the same spray.

These flies are related to the apple maggot and injure the fruit in a similar manner. There is but one generation each year. Control consists of poisoning adults within the seven to ten day interval between emergence and the start of egg-laying. Like the apple maggot, cherry fruit flies sponge food from the foliage and fruit and have dark bands across their wings.

Adults ordinarily start emerging early in June. Entomologists check on emergence each year and county extension agents make announcements to cherry growers when the first spray is needed.

The Michigan State Department of Agriculture has an eradication program against cherry fruit flies. Because it is unlawful to sell cherries infested with fruit fly larvae, it is highly important that growers maintain a rigorous control program. Ordinarily, protection is needed from early June until harvest.

**Additional worms in fruit.** Several other worms are sometimes troublesome in Michigan fruits. These include cherry fruitworm, mineola moth, peach twig borer, and drosophila (vinegar flies). In or-

**Fig. 30. Larvae of cherry fruit flies are very similar in appearance to apple maggots.**

chards (especially cherries) with a history of such problems, the worms can normally be prevented by choosing an insecticide with a wide range of effectiveness for use during June. Most materials of this type can be used alone or combined with a specific material used for control of another pest.

## SECTION III

### Pests That Chew Foliage and Fruit

Like the pests that are troublesome as worms in fruit, the insects that chew foliage and fruit have biting (chewing) mouthparts. They also have the complete metamorphosis type of life cycle. Control is directed largely against the adult and/or larva stage.

**Plum curculio.** The plum curculio, described in more detail on an earlier page as related to larvae infestation in fruit, is also a pest in the adult stage. Injury from adult feeding often occurs in the spring prior to and during egg-laying time. Small circular holes are cut in the sides of young fruit. Chewing injury of this type is usually quite minor in comparison with the more serious egg-laying activity.

In areas where a large number of plum curculio larvae mature in unprotected fruit, injury sometimes occurs in neighboring orchards during late summer and fall. This results when adult curculios emerge from the current season's brood and feed on maturing fruit prior to entering the soil and debris where they overwinter.

**Leaf rollers.** As the name implies, leaf roller larvae usually fold or roll fruit leaves. They often attach leaf edges to a fruit and feed on the leaf and fruit surfaces.

Two very serious types occur each year on Michigan fruits — the red-banded leaf roller and strawberry leaf roller. Others such as the fruit tree leaf roller, and oblique-banded leaf roller, sometimes occur on Michigan fruits. Their injury is more sporadic than perennial.

Fig. 31. Injury by red-banded leaf roller larvae may be especially costly at harvest time if late season control is neglected.

**Fig. 32. The red-banded leaf roller moth is about ½ inch long and has a reddish band across her wings. At the bottom center is a freshly-laid egg mass.**

The **red-banded leaf roller** attacks a wide variety of fruits. Winter is passed in the pupa stage on the ground. Adult moths, almost ½ inch long with a rusty band near the center of their wings, emerge early in the spring. Egg masses resembling miniature fish scales are deposited on the slick bark of apple and other fruit tree limbs. Egg-laying by the first brood is ordinarily at its peak just before and during bloom on apples. Applying effective materials soon after the bloom period greatly reduces first brood numbers. If the small worms are not controlled at this time, control becomes more difficult as the young larvae soon roll leaves and gain protection from spray materials.

A second brood of red-banded leaf rollers occurs in July and August. It is highly important that growers be on the lookout for egg masses and young larvae on leaves during this period. Unless control measures follow when these signs are present, serious loss at harvest time may result.

The **strawberry leaf roller** has a life cycle similar to that of the red-banded leaf roller. It is a serious pest each year in some Michigan

Fig. 33. A full grown larva of the red-banded leaf roller is a greenish active worm about ¾ inch long.

Fig. 34. The pupa of the red-banded leaf roller is often found in the damaged area where the insect fed as a larva.

strawberry plantings. It works primarily on strawberries but is occasionally found in injurious numbers on brambles. It is important to apply early and thorough sprays to prevent a build up of strawberry leaf rollers. Certain organic insecticides are effective either in the pre-bloom or early post-bloom period.

**Rose chafers.** Rose chafers are long-legged tan beetles about ½ inch long. They attack a wide variety of fruit plants and feed on both foliage and fruit. As the name suggests, rose chafers work on roses and a variety of flowers in addition to fruits. The beetles are native to this country and are found over most sections of the United States, extending as far west as the Rocky Mountains.

The winter is passed in the larval stage deep in the ground. As the soil warms in the spring, the larvae migrate upward and feed on the roots of grasses and various other plants. They are often associated with light soil conditions and feed extensively on quackgrass and other native grass roots. Most of the larvae transform to pupae in May and adults emerge from late May into July.

The light tan beetles ordinarily congregate in great numbers on host plants. They feed, mate, and lay eggs throughout the month of

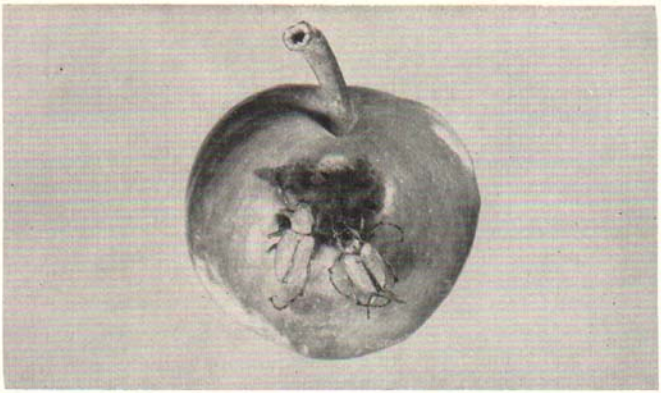


**Fig. 35. Rose chafers are long-legged buff colored beetles about ½ inch long. They often accumulate in numbers and feed on the fruit and foliage of a variety of plants.**

June and into July. The eggs are laid approximately two inches below the surface of the soil where they hatch in two or three weeks. Larvae feed and become almost full grown before migrating to overwintering quarters deep in the soil.

Where rose chafer adults are abundant, it is important to apply early and frequent sprays. Odors left by beetles that feed early on plants are attractive to other chafers. Unless early invaders are promptly controlled, serious injury may result.

The rose chafer is related to the common May beetle which also has only one generation per year. The chafer larva is smaller and more slender than the common white grub (May beetle larva). If a concentrated breeding area is found (ordinarily in a grassy field) the area may be treated with an effective soil insecticide. This eliminates many larvae and reduces the adult control problem.

**Climbing cutworms.** Climbing cutworms (larvae of some of the night-flying moths) often seriously injure vineyards and orchards by feeding on the buds early in the growing season. The worms feed at night when they emerge from the soil.

In areas of Michigan where climbing cutworms are abundant, it is important to make frequent observations of plantings during the bud stage. If feeding injury is noticed, prompt treatment with an effective insecticide is highly important.

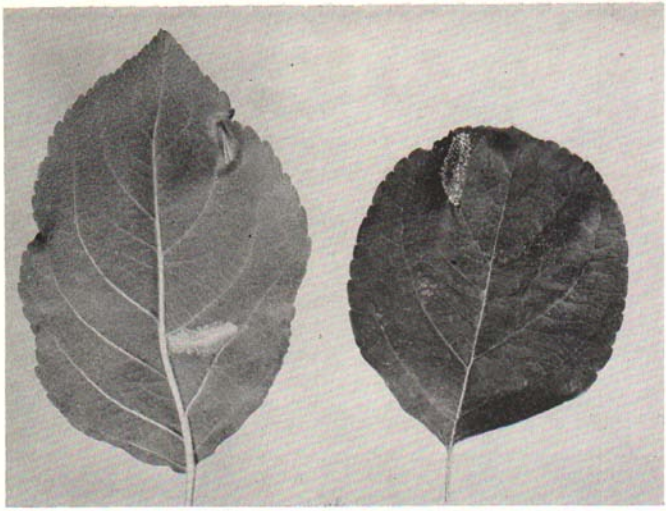


Fig. 36. Tentiform leaf-miners are minor pests of apples in Michigan. The tiny caterpillars feed on inner portions of leaves and produce a "mined" effect.

**Additional chewing insects.** Various other chewing insects occasionally injure the foliage or fruit — in either the adult or immature stages. These include the grape flea beetles, certain scarab beetles, grasshoppers, various fruit worms, sawflies, and caterpillars.

Insects of this type can normally be controlled by prompt treatment with some effective material when infestations are first noticed.

Fig. 37. Leaf-miners of a small caterpillar are sometimes seen on blueberries but at present are of little economic importance.

## SECTION IV

### Pests That Bore in Bark and Wood

There are several troublesome borers in Michigan fruit plantings. Mechanical injury to the tree results from their feeding activity and makes the tree more susceptible to drouth and to disease organisms. Most serious are the peach tree borer, lesser peach tree borer, and shot-hole borer.

**Peach tree borer.** The peach tree borer works largely on peach trees, but is sometimes a problem on other stone fruits, especially those with peach root stock. Injury is caused near the ground level

**Fig. 38.** The adult male peach tree borer and both sexes of the lesser peach tree borer are wasp-like insects. The female peach tree borer (not pictured) has dark wings and a bright orange band across her abdomen.

**Fig. 39.** The cream-colored larvae of the peach tree borer tunnels directly under the bark. Gum and fine particles of sawdust are usually found around the wound.

where borers enter the bark and feed on the cambium and associated plant tissue. Injury is ordinarily limited to a 12-inch area from 6 inches above the surface of the soil to 6 inches below the surface.

The adult is an active day-flying moth. It is steel blue in color. The males, which lack scales on their wings, resemble large wasps. Females have an orange strip across the abdomen. Eggs are deposited near the ground level on the trunk and sometimes on weeds nearby. The young larvae hatch within a few days and bore directly into the cambium.

To control the peach tree borer, it is important to apply drenching sprays with a gun at about 150 pounds pressure. Sprays should be applied when adults are actively laying eggs. Effective materials destroy the adults, eggs and/or larvae before injury is caused.

There is but one brood each year, but unlike many other fruit pests, adult emergence is spread over a considerable period of time — usually from late June until late August with the peak around mid-July. It is most important to have protective sprays on the trees from early July until mid-August.

**Lesser peach tree borer.** The lesser peach tree borer is closely related and similar in appearance to the peach tree borer. However, it is somewhat smaller and the larvae work higher in the peach tree. Injury most often occurs around cankered areas on scaffold limbs, at crotches, and the upper trunk.

The adult moths, which are slightly smaller than the adult peach tree borer, measure approximately ¾ inch in length. Both males and females have clear, transparent wings. Like the peach tree borer, they are most active on warm, sunny days and are easily mistaken for wasps.

Adults emerge two to three weeks earlier than the peach tree borer, and control measures are normally required two weeks earlier.

**Fig. 40. When the pupa stage of the peach tree borer (right) is removed from an injured tree, it is ordinarily found enclosed inside a sawdust covered cocoon (left).**

When spraying, give particular attention to cankered areas on the scaffold limbs and trunks. Sprays should be applied with a gun at approximately 150 pounds pressure.

When both the peach tree borer and lesser peach tree borer are troublesome in plantings, select a material that is effective against both pests. The period when protective sprays are needed in this case extends from late June until mid-August.

**Shot-hole borer.** The shot-hole borer is one of several small bark beetles that attack fruit and forest trees. Injuries occur both from adult feeding at the base of twigs and from galleries made by the tunneling larvae. Common host plants include cherry, peach, plum, apple, and pear.

The borers breed primarly in weakened trees or those that have been freshly killed. Female beetles enter the bark and construct an egg gallery parallel to the grain of the wood. Young larvae which hatch from eggs deposited in this gallery bore outward at a right angle to the egg gallery. As the larvae grow and consume more food, the injured area becomes fanlike in appearance, with the larval galleries radiating out from the parent egg gallery like the ribs of a fan.

When the larvae complete their development, pupation occurs at the end of the individual galleries. Later, adult beetles emerge from these sites and produce the characteristic shot-hole effect commonly observed on the bark surface.

**Fig. 41. Larval galleries radiate from an egg gallery made under the bark by an adult shot-hole borer. After the larvae become full-grown they change to pupae and later emerge as adults at the gallery ends. Holes left by emerging beetles resemble shot-holes in the bark.**

This insect spends the winter in the larval stage and adult emergence occurs in Michigan early in June. A second brood of adults normally appears during August. Adult beetles are almost black and approximately $\frac{1}{10}$ inch long.

Adult feeding injury occurs at the base of twigs and may not be noticed except where a large population has been allowed to breed in weakened or dead trees. After feeding on healthy twigs, adults are attracted to weakened trees where egg-laying occurs.

Insecticides normally used in fruit spraying schedules during June serve to control this pest in bearing orchards. However, non-bearing trees, especially in locations where populations are allowed to breed unmolested, may suffer severe injury. To control, apply effective materials early in June and/or August when adult beetles appear.

The destruction of weakened or dead host plants (wild cherry and mountain ash included) is a cultural practice which aids greatly in the control of shot-hole borer.

## SECTION V

### Pests That Feed on Roots

**White grubs.** White grubs (the larvae of the common May beetle) are often troublesome in strawberry and sometimes bramble fields where grass sod has been plowed. They feed normally on grass roots but shift readily to the berry plants. They have a brown head and attain a length of approximately one inch. The hind part of the abdomen is usually darkened in color due to the fact that soil particles in the abdomen show through.

The May beetles, often seen around lights at night, are about ¾ inch long and are dark brown. They feed on the leaves of various trees and can sometimes be heard on warm nights as they feed in elm, maple, or similar trees. The beetles return to sod fields for egg-laying. The more injurious species have a life cycle extending over three years and are in the grub stage most of this time.

The most effective means of controlling white grubs is to avoid planting in a newly-plowed sod field, or to treat the soil with an effective chemical labeled for soil usage.

**Strawberry root weevil.** Strawberry root weevil larvae are less than ¼ inch long and look like miniature footless white grubs. As the larvae feed, they injure the roots and crown of strawberry plants. Adults feed on the foliage to a limited extent.

There is but one brood each year. Adult emergence begins late in May and continues throughout June. The adults do not fly, but can crawl a considerable distance. The adult beetles are all females and reproduce without mating. Egg-laying begins about two weeks after beetle emergence. This pest has a wide range of host plants. Eggs are

**Fig. 42. White grubs are often troublesome in strawberry fields where they feed on the roots. Sod fields ordinarily require chemical treatment before planting to strawberries.**

**Fig. 43. Adult strawberry root weevils feed on the foliage of strawberry and sometimes other small fruits. The larvae are more injurious as root feeders.**

laid around strawberries, brambles, various evergreens, and many nursery plants. Strawberry fields that are irrigated appear most subject to attack.

Strawberry root weevils can be controlled most efficiently by treating the soil with an effective insecticide prior to setting strawberries in the field. Partial control can be obtained by spraying the plants immediately after harvest with some material that destroys adult beetles that are feeding and laying eggs at that time.

**Nematodes.** Nematodes are minute microscopic animals found in great numbers in practically all soils. Many types feed on decaying organic matter and are beneficial to plant life; others, however, feed on plants. These are called plant parasitic nematodes. Some are serious pests on certain Michigan fruit crops. Strawberries and young cherry trees appear to be most severely injured.

Plant parasitic nematodes are sometimes named according to the type of injury they produce. The root knot nematodes cause small gall-like growths on the roots of strawberries and other susceptible hosts. The pin nematodes have mouth parts equipped for piercing root tissue.

Nematodes capable of attacking fruits often build up in tremendous numbers in plantings of susceptible host plants. The establishment of a new fruit planting on sites heavily infested with such species can be very unprofitable.

It is often advisable to have the soil checked for nematodes prior to planting an anticipated fruit crop. Such tests can determine kinds of nematodes present and the advisability of fumigating or otherwise treating the soil. Persons interested in having such samples checked should contact Dr. John Knierim, Department of Entomology, Michigan State University.

**Fig. 44. Small gall-like growths on strawberry roots indicate the presence of root knot nematodes. All other nematode species require a microscope for correct identification.**

One means of control, which works well against certain nematodes, is to raise a non-susceptible host plant one or more years on the site before establishing a fruit planting. In this way, the life cycle can be interrupted so that chemical means of control is avoided.

In infested fields, the only means of control is to treat the soil with some effective nematocide. Special equipment is needed for this purpose and application should be made only by experienced operators.

## GLOSSARY OF ENTOMOLOGICAL TERMS

**Adult** — The sexually mature stage of insects. Adults feed but do not grow and usually have wings.

**Complete metamorphosis** — A type of life cycle with four life stages — egg, larva, pupa, and adult. Moths, flies, and beetles have this type of life cycle. The immature stages bear no resemblance to adults.

**Contact action** — Property possessed by certain chemicals whereby pests are killed by coming into contact with a treated surface.

**Egg** — The small beginning stage of an individual insect.

**Entomology** — The branch of science that deals with the study of insects.

**Fumigating action** — Property possessed by certain chemicals whereby pests are killed by fumes.

**Incomplete metamorphosis** — A type of life cycle with three life stages — egg, nymph, and adult. Aphids, leafhoppers, and plant bugs have this type of life cycle. Nymphs resemble adults but do not have wings.

**Insecticide** — A chemical used to control insects.

**Larva** (plural — *larvae*) — The immature or worm stage of insects having complete metamorphosis during which growth occurs.

**Miticide** — A chemical used to control mites.

**Nymph** — The immature stage of insects having incomplete metamorphosis during which the individual develops from the egg to the adult stage.

**Parasite** — An insect that feeds on other insects during its larval stage; is usually smaller than its host and feeds on only one.

**Pesticide** — A chemical used to control pests (insects, mites, diseases and/or weeds).

**Predator** — An insect that feeds on other insects; is usually larger than its host and may devour many during its lifetime.

**Pupa** (plural — *pupae*) — The so-called inactive stage of insects having complete metamorphosis during which the individual changes from the larva to the adult stage.

**Species** — A distinct group of animals (including insects) or plants having very similar habits and appearance. They are unable to breed with others outside their group. The apple maggot, black cherry fruit fly, and housefly are all separate species.

## Contents

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