in many small and immature peaches being harvested, or, if the one picking is delayed, many fruits that are overripe.

While the general tendency is to pick peaches too green, serious loss can occur if the grower falls behind in his picking operations. Peaches that are too ripe will not withstand handling and shipping. Careful planning and accurate timing are required to harvest peaches at the proper stage of maturity.

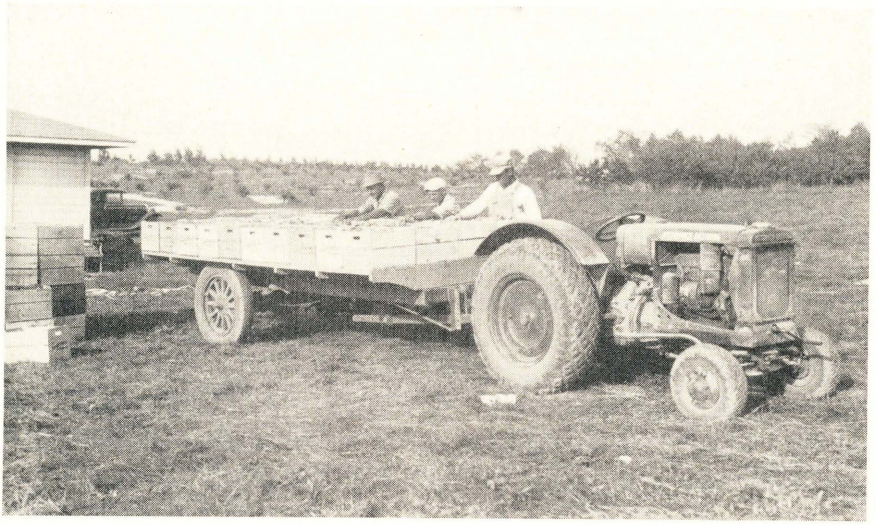


Fig. 21. A low trailer attachment for the tractor, which is very useful in moving peaches out of the orchard during the harvest with ease and speed.

Because of their perishable nature, peaches should be carefully handled to prevent cuts and bruises. Picking containers should be rigid and lined with canvas. Pickers should be required to empty their picking containers carefully. Field crates or boxes should be clean and in good condition. Every effort should be made in handling peaches to prevent bruising and injury.

PACKING, STORAGE AND MARKETING

There was a time when each grower was also his own packing house supervisor and sales manager. In keeping with the present day trend toward specialization, a large share of the peaches grown in Michigan are now handled through fruit associations where the fruit is packed and sold for the grower. Many growers, however, still pack and sell their own fruit.

The common use of the truck has been a very important factor in widening the distribution of peaches. Many small communities that in former years were virtually unsupplied with peaches now receive them almost daily by truck. This has been to the advantage of both grower and consumer.

The use of cold storages has been steadily increasing for the purpose of holding peaches off the market during periods of oversupply, and to reduce spoilage losses while fruit is held for processing.

Peach fuzz is very objectionable to some people. Machines are now in use which brush the fuzz from the peaches before they are packed for market. At the same time, the peaches can be dusted with sulfur to help control brown rot during transit and use by the consumer.

Nothing demoralizes the peach market quicker or more completely than to find brown rot prevalent in the packed fruit. This disease has almost ruined the peach market during some wet growing and harvesting seasons. The grower must make every effort to control brown rot if he is to retain buyer and consumer confidence in peaches.

Brown rot is difficult to control in wet seasons. In recent years much research has been done on the control of this disease, and sufficient knowledge is available for its control if properly applied. Control directions are given in the section on peach diseases.

Encouraging results in the control of brown rot and Rhizopus rot during transit, storage and retailing have resulted from the prompt precooling of peaches. Perhaps the fastest method of removing heat from the fruit is by hydrocooling. In the process, known commercially as Stericooling, a chlorine-type compound is added to the ice water to act as a fungicide. Experiments in Michigan during the past few years by Cardinell and Barr[7] have shown that peaches can be picked in the firm-ripe stage, showing good color, treated for 15 minutes by the Stericooling method and reach distant markets with almost no loss from rot.

Most of the peaches in the Midwest and East are marketed in bushel and half-bushel baskets. An intensive search has been underway in recent years to find a more satisfactory package. Wooden boxes and cardboard cartons of various kinds have been tried but none has yet received general approval. The tub bushel basket remains the principal package for midseason and later maturing

[7]Cardinell, H. A. and Barr, C. G.—"The Michigan Peach Picture in the National Frame."—The 1950 Peach Annual of the National Peach Council, page 38.

peaches, while the half-bushel is used considerably for earlier and softer varieties.

The Spartan box has been used considerably in the southeastern states and has been tried in a small way in Michigan. Peaches carry well in it but, when opened, the jumble pack is not so attractive as the faced pack in the bushel basket.

Cell-type packages made of cardboard have been tried experimentally but have not gained wide acceptance. They are useful in delivering mature peaches to nearby markets.

Experiments have been conducted in a number of states with small consumer boxes designed to offer the consumer 8 to 12 firm-ripe peaches per package. Packing such small packages with nearly ripe peaches is expensive and the price received must be sufficiently high to justify the extra cost.

Retail store tests have indicated clearly that firm-ripe, well-colored peaches will greatly outsell poorly-colored, immature fruit. The peach industry should make every effort to see that the consumer is able to get ample supplies of such fruit. This will require continued studies regarding the best handling methods and better packages.

In the meantime, the bushel pack could generally be greatly improved. Too large a proportion of the peach crop is being packed in bushel baskets marked with the minimum size of 2 inches. The best peaches are often used to face the package, and it is impossible for the buyer to tell what is underneath. There may be large, coarse-textured and poorly-colored fruits mixed with medium-sized, firmer peaches of good color. Closer sizing would result in a better grade and would be helpful to the commercial fruit buyer and the ultimate consumer. Anything that will help to standardize the pack such as better grading, closer sizing and making the face more nearly representative of the rest of the package will enhance the reputation of the grower or the packing association for fair dealing and will be found to be a good policy financially as well.

WINTER INJURY

The importance of winter injury as a factor in peach growing was again brought to the attention of Michigan and Midwestern peach growers with stunning suddenness during the night of November 24, 1950.

A new record for November cold was set with temperatures ranging from 10 to 19 degrees below zero throughout the major part of

the western Michigan fruit-growing area. Peach flower buds were mostly killed and extensive damage to trees occurred.

The results of winter injury are very apparent—and even spectacular—when a peach crop is lost because of all of the flower buds being killed, or the trees themselves virtually killed by one extreme drop in temperature. Of almost equal importance, though less noticeable, are the minor injuries in the tree which provide an entrance for the peach borer and the destructive peach canker disease, which, working together, considerably shorten the life of the tree.

Winter injury might be described as injury to wood and dormant flower buds by low temperature, as compared with frost injury which is usually restricted to opening flower buds or blossoms. Winter injury, however, is a broad term, and injury of this type may occur in the fall or spring. In fact, one of the greatest peach tree-killing experiences on record was the October Freeze of 1906 when very late-maturing peaches were still on the trees.

Winter injury cannot be avoided entirely, but losses from it can be reduced considerably by following these suggestions:

1. Commercial peach orchards should not be planted in those parts of the state where the temperature frequently drops below —12°.

2. Choose a site that has good elevation above the surrounding country (some exceptions may be made in the most favorable areas very near Lake Michigan), and a moderately fertile, well-drained soil. Exceptionally fertile soils are likely to be hazardous. Such soils should receive a minimum of fertilizer and cultivation.

3. Choose varieties that are hardiest in fruit bud and wood.

4. Avoid severe, heavy pruning.

5. Be very careful in the use of fertilizers. Young trees making about 18 to 24 inches of terminal growth and having foliage of good color without fertilizer do not need it. The same can be said of bearing trees making about 12 inches of terminal growth. More growth is dangerous. Owing to variations in soil fertility the amount of fertilizer per tree should also vary. It is better to err on the side of too little than too much nitrogen fertilizer. Peach trees making a moderate growth will live longer than those growing too fast.

6. Begin cultivation early and stop early (late June or early July) in young orchards, or bearing orchards not producing a crop because of winter-killing of fruit buds or other reasons. Mature orchards

bearing a crop will usually need to be cultivated longer (about the first or middle of August) and can be cultivated longer without much danger of the trees not maturing properly before winter.

7. Sow a cover crop at the time of the last cultivation.

8. Fill any depressions in the soil around the base of the tree to prevent the accumulation of water and ice formation.

9. Peach trees carrying a heavy crop should be well thinned, not only to insure having a high percentage of fruits of first grade size, but to conserve the vitality of the tree and to permit it to enter the winter in good condition.

10. If certain diseases and insects, for example leaf-curl and borers, are not controlled, their attacks will greatly weaken the tree and render it more susceptible to winter injury.

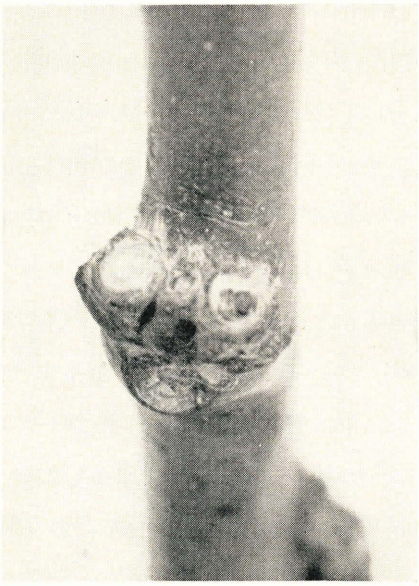


Fig. 22. Two peach flower buds with a leaf bud in the center. The flower bud at the right was winter-killed, while the one at the left was injured very slightly but not enough to prevent its blossoming.

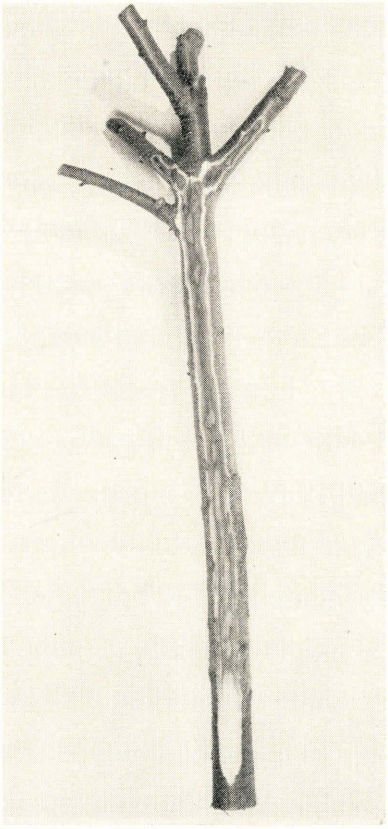


Fig. 23. Two-year-old peach tree showing severe winter injury above the snow line. Lower 3 inches of trunk was protected by snow. It is doubtful if a tree injured this severely will live. New shoots may develop just below the injured area, and a new tree trained from one of these.

SUGGESTIONS FOR CARE OF WINTER-INJURED TREES

While the losses from winter injury can usually be lessened by observing the foregoing suggestions, occasionally temperatures drop so low, or occur at such unseasonable times, that injury cannot be altogether avoided.

If the wood of peach trees has been injured it will show discoloration. Slightly injured wood will be light brown or amber. Severely injured wood will be very dark, sometimes almost black (Fig. 24). Suggestions for handling injured peach trees are as follows:

1. Delay pruning until growth starts. Then, remove only dead and weak wood. Make no large pruning cuts.
2. Do not use dormant oil sprays on injured trees.
3. Apply nitrogen fertilizer about the time growth starts.
4. Protect foliage from diseases and insects. Do not omit the leaf-curl spray. Protect young trees against cutworms.
5. Give trees good cultural treatment. Keep weeds away from young trees.
6. If bark splits, tack it down at once and paint with tree paint. Dead areas should be cleaned out and covered with tree paint.
7. Do not be hasty in removing injured trees. Give them good care and see what they can do for themselves.

BLACK-HEARTED NURSERY STOCK

Nursery stock not stored in cellars or well heeled-in at the time of the low temperature is likely to be black-hearted. It is a waste of money to plant such trees. Examine nursery stock carefully before accepting or planting.

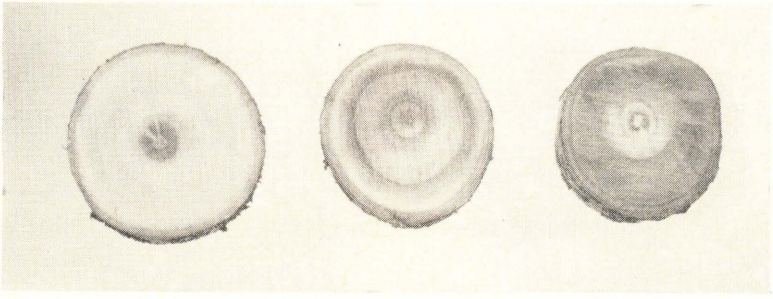


Fig. 24. Cross sections of one-year-old peach trees showing varying degrees of winter injury. Left: Very slight injury. Center: Moderate injury. Right: Severe injury.

INSECTS INFESTING PEACH

RAY HUTSON
DEPARTMENT OF ENTOMOLOGY

INSECTS AFFECTING FOLIAGE

CLIMBING CUTWORMS

Climbing cutworms are heavy-bodied caterpillars, sometimes 2 inches long with climbing habits. They vary so greatly in color that no description based on that characteristic is possible. These insects, like all cutworms, are most abundant on grass sod.

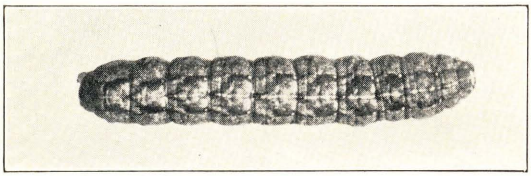


Fig. 25. The most common climbing cutworm attacking peach trees.

Life History and Habits—Because cutworms are active at night their depredations are often unidentified. They winter over as partly grown caterpillars in rubbish or at the roots of plants in or about orchards. Awakening in the spring with enormous appetites, they climb to the topmost part of the tree, sometimes a single branch being selected, and start eating downward. Cutworm damage commonly occurs in cool, moist springs and continues longer under such conditions. The parent moth is tan, brownish or dark, inconspicuous, and from 1 to 1½ inches in wing spread. When grown, climbing cutworms change into pupae,

Fig. 26. Flashlight picture of climbing cutworms stopped by band of cotton batting.

and shortly the moths emerge and lay eggs for the next generation. In most cases three generations will develop.

Control—Control of climbing cutworms can be obtained by mechanical barriers, although destruction of breeding and over-wintering quarters markedly reduces their numbers. Tanglefoot and cotton batting were formerly used as barrier materials. When properly applied and attended they turned back cutworms.

Young peach trees in sandy locations should be banded with an asphalt or other stiff paper band, and this measure should be supplemented by the scattering of poisoned bran bait about the trees, for climbing cutworms will sometimes girdle young trees when kept from reaching the foliage. To prepare poisoned bran bait, mix thoroughly the following ingredients:

Bran	100 pounds
or	
Mill-run bran	25 pounds
Sawdust, 3 times the volume of bran	3½ bushels
Chlordane	1½ pound (actual)
or	
Toxaphene	1 pound (actual)
or	
Sodium fluosilicate	6 pounds
or	
White arsenic (not lead or calcium arsenate)	1 pound

Add water to make a moist, crumbly mash. Spread wet bait uniformly by hand at the rate of 40 pounds per acre. The same results can be obtained by spraying or dusting the ground with Chlordane or DDT at the rate of 1 pound of actual chemical per acre.

MITES

Principally Paratetranychus pilosus and Tetranychus bimaculatus

The only mites of consequence in Michigan on peaches are the European Red Mite, *Paratetranychus pilosus*, and the Two Spotted spider mite or Greenhouse Red Spider, *Tetranychus bimaculatus*.

Appearance and Habits—Mites, though they resemble insects, are eight-legged, spider-like creatures, usually red, and barely visible to persons with normal eyesight. They over-winter according to the species and then appear, usually, about the time the second cover spray is going on apples. They may appear sooner but usually are

of no importance prior to that time. In dealing with mites it is essential to know which one is causing the trouble. Mites are commonly more troublesome in interplanted peach orchards.

The European Red Mite over-winters in the egg stage on all parts of the tree. In spring the eggs hatch and the young mites start feeding on the opening leaves. When grown they mate and the females lay eggs, which hatch in a few days into another generation. The average length of life of these mites is approximately 35 days and each female produces about 30 eggs. That is true in Michigan under ordinary summer conditions. When the weather becomes hot and dry, of course, the female's productivity is increased.

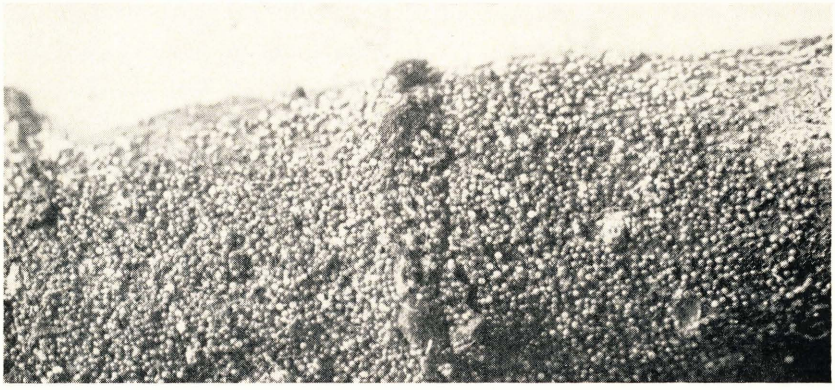


Fig. 27. Eggs of European red mite massed on twig, greatly enlarged.

The Two Spotted Mite, which is also sometimes called the Greenhouse Red Spider, normally does not over-winter in the egg stage on the tree. There may be occasional survivals, but usually the infestation arises from migration by these mites from the orchard cover. This mite infests practically any plant that grows in the orchard, having perhaps a preference for legumes, although all sorts of weeds are potential hosts. The productivity of the female Two Spotted Mite much exceeds that of the European Red Mite, and the Two Spotted Mite has a shorter life history. The latter is particularly favored by hot, dry weather.

From what has been stated about these two species of mites, it is apparent that most trouble from them is experienced during hot dry weather. It is thus possible for a comparatively small population early in the spring, to give rise, during the summer, to an extremely annoying plague.

While it is possible for one to distinguish between species of these mites with the aid of a magnifying glass, it is difficult otherwise. As has been indicated, the Two Spotted Mite or Greenhouse Red Spider may vary in color. When green or greenish mites are present, obviously the species is not the European Red Mite which is never green. Injury by these mites is similar. The leaves show small areas from which the green tissue has been removed. The damaged areas are shallow and on drying cause a discoloration of the foliage, which sometimes becomes bronzed. In heavy infestations, it is possible for the mites to cause defoliation of the trees with consequent injury to the fruit. However, the devitalization of the leaves and interference with their processes reduce the amount of food manufactured and, as a consequence, such trees do not mature so much high quality fruit and are more subject to winter-killing and similar effects. One of the most damaging things about a heavy mite infestation during July and August is that it cuts down food storage in the buds, which influences markedly the crop in the following year.

Control—Formerly it was the practice to spray with oil for European Red Mites during dormancy. This is still recommended but not many growers now use dormant sprays when other materials are available which will take care of the mite problem on foliage.

On the market today are at least a half dozen miticides which are practically specific for the control of mites and most of them are quite effective against this pest. Applications of parathion, EPN 300, or TEPP as suggested in the Spraying Calendar (Extension Bulletin E-154), when used at manufacturers' recommendations, give very excellent control. There are new miticides to fit special conditions appearing every day. Some of them are useful, but it is advisable to learn about their properties before using them.

It should be noted again that many of these materials are extremely poisonous in a concentrated form; hence, the label on the package should be read and due care taken in preparing and applying the spray. The **Spraying Calendar** (Michigan State College Cooperative Extension Bulletin E-154) should be consulted.

INSECTS INJURIOUS TO THE FRUIT

PLUM CURCULIO

Conotrachelus nenuphar

The plum curculio is one of the most destructive insects infesting peach fruit. It attacks all stone fruits and is likewise destructive to

pome fruits. In Michigan the plum curculio is periodically of importance in certain districts, although there is no way of predicting in advance where these districts will be.

Appearance and Habits—The adult plum curculio is a small snout-beetle about 3/16 inch in length, variable in color through shades of brown and brownish-black. These insects are sluggish in cool weather and have the habit of feigning death when disturbed. Adult curculios may live as much as a year under favorable conditions. The larva or grub develops from an egg laid in the fruit. Upon hatching, the larva is small; when mature it is approximately ⅜ inch long, fat,

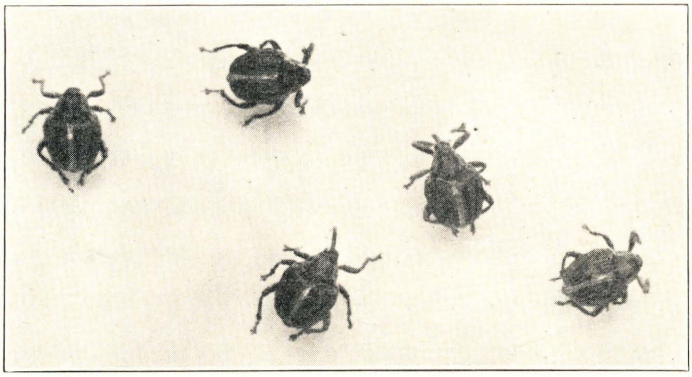


Fig. 28. Adult plum curculios, enlarged.

footless, and has a distinct brown head capsule. It differs from the oriental fruit moth larva in being unable to straighten its body and crawl.

Life History—It is necessary to understand the life history of this insect before it can be controlled. The adults over-winter in trash and rubbish in or about orchards, and injury is always more severe about the borders of infested orchards. All cover is utilized by these insects but favored places are overgrown fence rows or stone fences.

The adult beetles become active in the spring when the weather warms their hiding places. Usually this will be about the time shucks are falling from peaches. At first the adults feed on the foliage, but when large enough they attack the fruits and begin laying eggs. Both feeding and egg-laying punctures appear as small, round holes in the surface of the fruit. However, egg-laying punctures may be distinguished from feeding punctures by a crescent-shaped cut in

the skin of the fruit, which prevents the developing fruit from quickly crushing the egg or young larva in the hole behind it. The young curculio hatches from the egg and feeds for 4 or 5 weeks. Infested fruit often falls from the trees and brown rot infection follows the burrowing of the larvae. Larval development continues uninterrupted in dropped fruit that is not dried. When grown, the larva deserts the fruit and pupates 3 or 4 inches in the ground. The peak of the emergence of curculio adults from the soil will normally occur from 11 to 14 weeks after peaches bloom.

Fig. 29. Plum curculio larva in damaged peach.

Injury—The curculio is very destructive, not only in the larval stage but also because of the feeding habits of the adult. The feeding punctures of the adult lower the grade of the fruit, and one adult may destroy a considerable quantity of fruit. For example, each curculio will make one feeding puncture each day during its active period of 2 to 3 months.

Control—The curculio can be controlled by taking advantage of its habits. The Spraying Calendar recommendations will take care of most infestations. Refinements will clean up heavy infestations.

It is difficult to control severe curculio infestations by spraying alone. Destruction of infested fruit and over-wintering quarters are supplementary control measures which cannot be overlooked. Infested thinnings and "drops" are rendered harmless by throwing them out into the sunshine between the rows, where they will heat, decay and dry out, destroying the larvae inside. Fence rows, brush-filled

gullies, brush-piles, neglected fields and the borders of woodland should be cleaned if possible. Stone fences are favorite wintering places for curculio.

Spraying and dusting for curculio are most efficient at the time the curculio are coming out of their winter quarters. The time-honored arsenical sprays for curculio control should contain 2 pounds of standard lead arsenate in 100 gallons of spray at the shuck-fall application (application 2 in the Spraying Calendar). A similar application should be made 2 weeks later (application 3 in the Spraying Calendar). Arsenical injury on peach should be avoided (see directions in current Spraying Calendar) by use of zinc sulfate-lime corrective 4-4-100.

All available information indicates that the newer chlorinated hydrocarbons and organic phosphates are much more efficient for the control of curculio than the lead arsenate spray given above. Parathion, EPN 300, and methoxychlor are the materials which seem to fit our conditions best, although under certain circumstances others of the organic phosphates and chlorinated hydrocarbons will result in off-flavor or "flatting" of the processed fruit. It is advisable to read all labels concerning the use of these materials. The labels state on which crops a chemical can be used, and unless the label specifically mentions the peach, it is questionable whether the material should be used. Sprays and dusts of the organic materials listed, applied at petal-fall, shuck-fall and one week later than the shuck-fall, have given excellent control of the curculio on the peach. Every effort should be made to make a thorough application.

TARNISHED PLANT BUG

Lygus oblineatus

The tarnished plant bug is a small, brownish sucking insect, found all over the world. Fruit, foliage, and the woody tissues of stone fruits are attacked. This insect is particularly destructive to young peach trees, causing the malformation of growing twigs known as "die-back"to nurserymen, and is the chief cause of the injury to the fruit known as "cat-facing". It is most numerous in areas where composite weeds such as mare's tail and goldenrod are abundant. There it multiplies most rapidly. The nymphs of the tarnished plant bug differ in appearance from their parents and are of varying shades of green, their younger stages superficially resembling aphids.

Life History—The winter is passed by the adult bugs hidden away in trash and rubbish and in patches of weeds. Early in the spring, they leave these hiding places to seek new growth for feeding and egg laying. The number of eggs deposited depends largely upon the amount of succulent tissue available and varies from a few to several hundred. The young nymphs complete their growth, and in about 6 weeks mate and become the parents of another generation. Generation after generation continues through the summer, 3 or 4 weeks being required for each. It is the over-wintering adults of the tarnished plant bug that are highly responsible for injury to stone fruits.

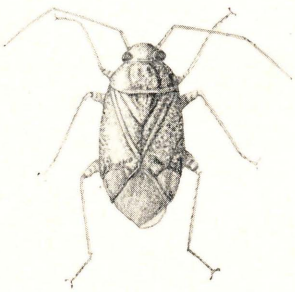


Fig. 30. Adult tarnished plant bug, enlarged.

Injury by the tarnished plant bug consists in the withdrawal of juices from the tissues of growing tips, causing their collapse and subsequent death. The insect sucks the sap from beneath the skin of the fruit and causes an injury which callouses over and later becomes a puckered scar or "cat-face".

Control—Tarnished plant bugs are usually more numerous in proximity to woods and other overgrown, over-wintering places. However, they normally do not appear year after year in an orchard. These things are mentioned to emphasize the necessity for inspecting peach trees occasionally while the fruit is small. During the time that the fruit is just coming out of the shuck stage and immediately thereafter, one should inspect the trees every day or two because that is when the bug does the greatest amount of its damage. Obviously, the avoidance of breeding and over-wintering places and the exercise of vigilance are necessary in the control of this insect.

The ordinary brown rot applications of sulfur do influence this insect, but they alone are not sufficient to guarantee freedom from trouble. It is suggested, again, that close watch be kept of the development of the fruit about the time shucks split. When these bugs appear—and they can be readily seen—applications of DDT or parathion should be used. Two pounds of DDT, 50-percent wettable powder, or 1 pound of parathion or similar material can be used. Because of the agility of these insects, careful application is necessary for control. Usually a second application is unnecessary if the

timing is correct. It is doubtful whether routine spraying for this insect is warranted.

ORIENTAL FRUIT MOTH

Grapholitha (Laspeyresia) molesta

The oriental fruit moth was introduced into the United States about 20 years ago in Washington, D. C. It is now found in all peach-growing sections of the United States. It attacks peach readily and is found occasionally upon other stone fruits. Quince is a favorite host.

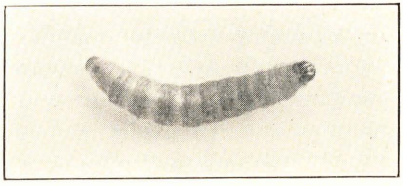


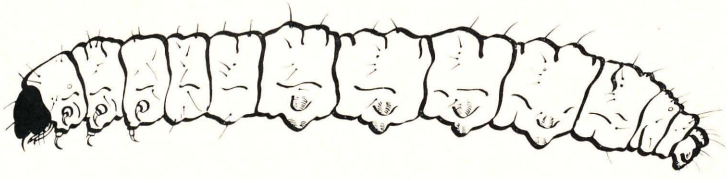
Fig. 31. Oriental fruit moth larva, enlarged about two times.

Appearance—The oriental fruit moth is a small, dark moth, about three-eighths of an inch in wing-spread. The larva, which is the destructive stage, resembles that of the codling moth and, where apples and peaches are interplanted, may sometimes be mistaken for it. It can, however, be distinguished from the codling moth by a comb-like structure on the rear end of the body. The larva is slightly smaller than that of the codling moth.

Life History—The oriental fruit moth over-winters as a larva upon the peach tree or in the trash underneath. At least 80 percent of the worms pass the winter in trash beneath peach trees. This percentage varies somewhat according to the character of the trees. About blossom time these worms change to pupae and emerge as moths which lay their eggs upon the undersides of the leaves. The larvae hatch in a few days and burrow into the twigs. After about 4 weeks, they change into pupae and then into moths. Depending upon weather conditions, this process continues throughout the summer, producing four generations and sometimes a partial fifth. The feeding habits of the first two generations of larvae are similar. However, some of the third generation attack the fruit, while the last two generations inflict severe damage on peaches. Inasmuch as each female lays a large number of eggs, a few larvae surviving the winter become the parents of large numbers of worms that attack late fruit.

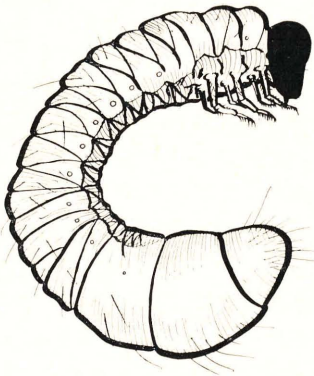
Injury—Oriental fruit moth larvae kill back the twigs in their burrowing. Usually this is not unduly serious, although it induces

MOTH - FLY - BEETLE LARVAE

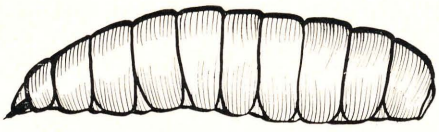


Caterpillar

Curculio



White Grub



Maggot

Fig. 32. Common larval types of moths, beetles, and flies.

a bushy appearance in young trees or nursery stock. It is the injury to the fruit which is of consequence and this is of two kinds. The visible injury needs no description. The worm burrows into the peach, usually in the neighborhood of the stem, leaving a mass of

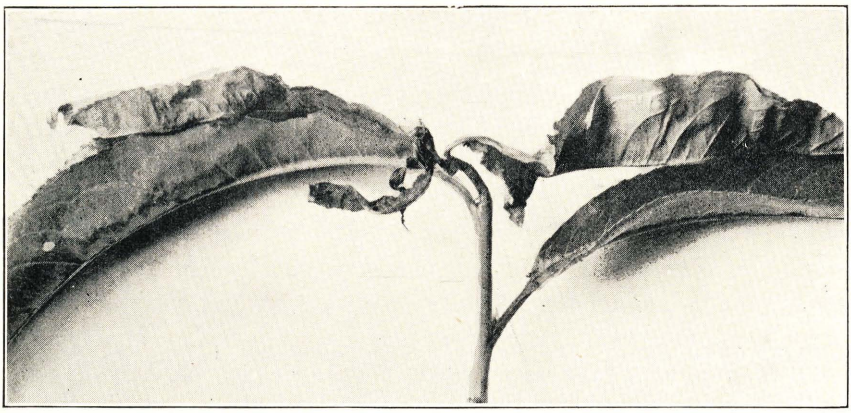


Fig. 33. Peach twig killed back by oriental fruit moth larva.

frass and gum to mark its entrance. It then works about the stone of the peach and various organisms complete the destruction of the fruit. The other, or so-called invisible, type of injury comprises about 20 percent of the total and is so named because the entry hole is not visible. Such a peach shows no indication of injury until the fruit is cut open.

Fig. 34. Visible injury on peach caused by oriental fruit moth larva.

Control Measures—Several parasites attack the oriental fruit moth. About 60 have been recorded in the United States, of which about 16 appear in Michigan. A most effective one, present in the Michi-

gan peach-growing districts, affects a borer of ragweed which grows everywhere. Another which has been introduced into the state infests the strawberry leaf roller.

Much effort has been expended in a search for an adequate, effective insecticidal control for the oriental fruit moth, and great numbers of materials have been tested. The best control seems to be the use of either DDT or parathion. The timing of such sprays is an important part of the picture and has been thoroughly investigated. Apparently the curculio sprays of organic phosphates help somewhat in reducing the numbers of larvae which attack the twigs at that time. However, no certain statement can be made regarding the value of early applications for oriental fruit moth. This is particularly true of efforts to direct the spray at the emergence of the moth. Results have been erratic. The best timing for the sprays is to make applications at the peak of the second brood or shortly thereafter. This timing has been worked out, in particular, because of the residue hazard attending use of the materials, such as DDT. In Michigan, two sprays of DDT or parathion applied at about a 10- to 12-day interval, on Haven peaches, with the first one about July 15, have usually given best results. As for later peaches, such as Elberta, the procedure is a trifle different and, seemingly, the residue problem can be met when three sprays are applied, starting at about the same time as for the Haven varieties but including an additional spray. This spraying schedule applies to the use of DDT particularly. More sprays can be applied when parathion is used because this material disappears more rapidly and so long as it is applied at least 3 weeks before harvest there is no danger of residue.

Of course, in using parathion and organic insecticides, it is good policy to read the labels and faithfully observe all of the instructions.

INSECTS INJURIOUS TO THE TRUNK, LIMBS AND ROOTS

SHOT-HOLE BORER

Scolytus rugulosis

Peach trees in poor condition may be injured by the shot-hole borer. This borer, an imported insect, has been here since 1877. It has spread over all the eastern United States as far south as Alabama and Georgia and is also in eastern Canada.

Appearance—The common name, shot-hole borer, is derived from the habit of the adult insects, which are about 1/16 inch long, of

boring small holes through the bark, either for feeding or to provide escape for the grown-up beetles from the pupal chambers. Infested trees appear as though hit by a charge of bird-shot.

Habits and Life History—Every kind of fruit tree grown in Michigan is attacked, as well as related species of thorn, cherry, plum, peach, mountain ash, and shad-bush used as ornamentals or growing wild. The shot-hole borer works on the trunk, limbs and branches of all these trees, and the characteristic shot-holes indicating the breeding quarters of the pest are common on dying trees, as well as on pruning stubs, dead limbs and prunings. A common but often overlooked breeding place is in wild cherry injured by fire. After wood is dry, it has no further attraction as a breeding-place for the borer.

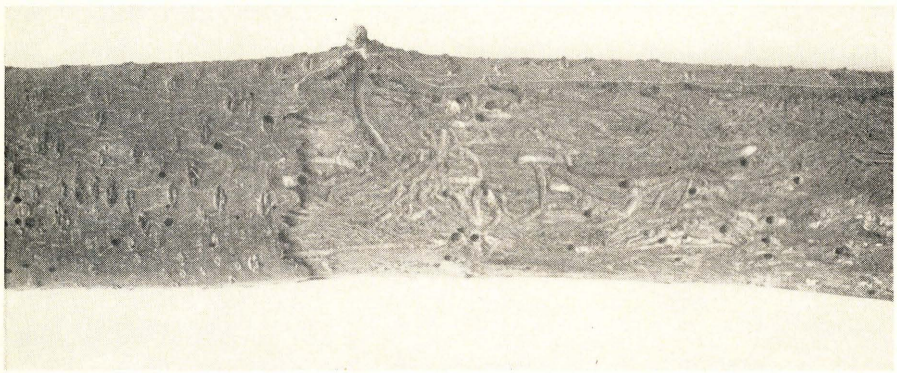


Fig. 35. Breeding galleries of shot-hole borer.

Shot-hole borers, after emergence and prior to egg-laying, sometimes cause the exudation of gum which is the characteristic reaction of stone fruit trees to any injury. Sometimes following repeated feeding attacks by shot-hole borers, a tree may be so devitalized that it will become favorable for their breeding. This is especially true with the case of young trees. In dying wood which is no longer able to exude a copious discharge of gum as the result of injury, the beetles emerge about June 1, mate and lay eggs in special brood chambers. These eggs hatch into tiny grubs, which start burrowing away from the brood chamber at approximately right angles. As the size of the larva increases, its burrow also is increased in size and, finally, becomes a small chamber, where the larva changes to pupa and then to a beetle. From this chamber, another of the characteristic small shot-

holes to the surface is constructed. These beetles seek out devitalized trees and lay their eggs which, in turn, hatch again into larvae, and it is in this stage that the winter is passed. In Michigan, there are ordinarily two generations in June and early September, while farther south four sometimes occur.

Control—The activity of the larvae in the cambium destroys patches of this essential tissue, and where there is more than a very small area affected nothing can be done. Such a tree immediately becomes a desirable breeding-place for the next generation of beetles.

Inasmuch as the shot-hole borer selects for the deposition of eggs trees which are devitalized, it follows that trees appreciably infested with borers are worthless and should be burned. Possible exceptions to this are the infestations of large limbs, which have been injured by girdling, by splitting off the trunk, or other causes. It has been noted, however, that sometimes beetles feed on healthy trees. Ordinarily, the attacks of feeding shot-hole borers do not directly result in the death of healthy trees, but sometimes twigs are killed upon which the leaves persist, giving the appearance of rosettes of dead leaves which draw attention to the presence of the pests.

The only time when spraying is effective is when young trees are attacked by beetles which are trying to find a place to lay eggs. Occasionally, the beetles will become numerous enough that they will attack trees which are bearing fruit. In such instances, spraying is warranted although, of course, one must keep in mind the possibility of residues when fruiting trees are concerned. Practically any of the chlorinated hydrocarbons can be used on young trees to protect them. The only thing that can be used on fruiting trees is DDT, and in using DDT it is a good plan to use at least 2 pounds of actual DDT in 100 gallons of water. One should remember that the pest is attacking the limbs and trunk, and the spray at this concentration should be directed at the trunk. Care should be used if the application is near harvest. Under no circumstances should other chlorinated hydrocarbons be used on fruiting trees because of danger of causing off-flavor or lack of flavor in the fruit.

PEACH TWIG BORER

Anarsia lineatella

The peach twig borer is a small moth attacking the twigs. The injury is confused with that of the oriental fruit moth. The larvae

can be distinguished from the oriental fruit moth in most cases by their chocolate-brown color, whereas the oriental fruit moth is some shade of "dirty-white" or pink. This insect has never required control measures in Michigan.

LESSER PEACH TREE BORER

Conopia pictipes

The lesser peach tree borer has increased in numbers during recent years. It is distinguished from the more destructive peach tree borer working on the crown of the tree by its smaller size, as well as by its habit of operating higher on the trunk and larger limbs, and in the crotches. Another important difference in habit is that the lesser peach tree borer usually commences its attack at the injured area, resulting from weather, pruning, cultivation or animals. It has been observed working upward from injury started by the peach tree borer. It seldom attacks trees free from other injury.

Injury—The damage is caused by the destruction of the cambium layer by the burrowing of the "dirty-white," brown-headed caterpillars. The size of these larvae varies according to their age, but they are approximately ⅞ inch long when mature. Injury on stone fruits, particularly peaches, is attended in most cases by the exudation of gum. Because crotches are a favorite place of attack, oftentimes large masses of gum will accumulate there. The weathering of this gum, together with the efforts at callus formation made by the tree, sometimes result in the very conspicuous deformations on the limbs at the points attacked.

Appearance and Life History—The wasp-like parent moths of the lesser peach tree borer appear in June or July, or occasionally in late May if weather conditions are favorable. Adult lesser peach tree borers are marked with pale yellow stripes on the abdomen, in contrast with the orange marking of the female peach tree borer. Soon after the emergence of the adults, eggs are laid, and the larvae start burrowing into the bark of the tree. There is one generation a year. This insect is common all over Michigan and the entire United States east of the Rocky Mountains where peaches are grown. It also attacks plum, cherry, wild plum, wild cherry, and various related ornamental and wild plants.

Control—This insect has been successfully controlled in Michigan by painting the injured areas with a solution of 1 pound of para-

dichlorobenzene in 2 quarts of raw cottonseed oil. Ordinarily, this amount of paradichlorobenzene dissolves readily in raw cottonseed oil. However, in late fall it may be necessary to warm the oil slightly before putting in the paradichlorobenzene. The solution is applied by daubing upon the infested areas. If this is done without removing the gum or frass approximately 90 percent of the borers will be killed. By removing a part of the gum, virtually 100 percent control can be obtained. It should be emphasized that this material, though an effective remedy, should not be used when the tree is in a rapidly growing condition. Furthermore, it should not be used on very young trees. Treat affected areas only.

Spraying or treating against the lesser peach tree borer is a stop-gap measure; a better procedure is to manage the trees in such a way that they will not be attractive to the adult borer. The most effective spray is parathion 1 pound, 15-percent wettable powder, and 100 gallons of water directed into the affected areas and repeated in about 10 days or 2 weeks. The time for the spray is late June and early July. As has been noted, this will not remove the attractiveness of these places to borers but will kill off the borers in the affected area and give the tree a chance to aid itself in recovering.

Healthy peach trees are less subject to infestation by lesser peach tree borer. Measures tending to reduce winter injury are especially valuable. These are early planting of cover crops, proper pruning and avoidance of injuries in cultivating.

PEACH TREE BORER

Conopia exitiosa

This is the most important insect affecting peaches in Michigan. Despite the widespread publicity given the extremely effective paradichlorobenzene treatment during the past 20 years the peach tree borer causes the death of thousands of peach trees in Michigan every year. In addition, the peach tree borer is responsible for the death of many thousands more, because the injuries inflicted by the borers predispose the trees to injury from drouth, shot-hole borer and other causes. The peach tree borer is a native insect which, prior to the introduction of peaches into America, worked on wild plum, wild cherry and other related plants. Today its chief host is peach, although it is known to attack other cultivated plants, relatives of the peach, as well as related ornamentals.

Appearance and Life History—The borers, or larvae, are thread-like when they first start working, but when mature are about 1 inch or more in length. Their injury results in the accumulation of reddish frass or sawdust about the base of the tree, which becomes covered with a gummy exudate as the insects tunnel into the deeper layers of the bark. "Gummosis" is the reaction of the tree to mechanical injury of any kind, but the gum from peach borer injury is mixed with sawdust. In heavy infestations, very noticeable amounts of the gummy frass will accumulate. The winter is passed in the burrow. Very early in the spring, the insects become active and, owing to their larger size, do a correspondingly larger amount of damage. In Michigan, the feeding by these insects continues until sometime in June. The mature larva is "dirty-white" and has a brown head. When grown the larva changes into a brownish pupa, an inactive state, either in the burrow, near it, or in the soil. The pupal interval varies but averages about one month.

Since several sizes of borers are present, the period of their emergence extends from the latter part of June until late August. The adult is a wasp-like moth, steely-blue in color, and about 1¼ inches in wingspread. It differs from most moths in that it flies in the daytime. Males and females differ greatly in appearance. The male moth is smaller, with three or four yellow stripes across the abdomen, while the female has but one orange band. Each female after mating lays from 200 to 800 eggs in the vicinity of or upon the trunk of the tree. They seem more likely to lay their eggs on trees or about trees which are surrounded by a rank growth of vegetation.

Injury—The larval stage or "borer" of this insect causes the damage by feeding on the cambium tissue. This tissue is destroyed at the point where the insect is feeding and since dozens of these pests may infest one tree, large amounts of the cambium may be destroyed. Complete girdling of the tree occurs with heavy infestations of this pest. All degrees of girdling are accomplished by this insect. In all but the lightest infestations the foliage assumes a pale color. This alteration in the condition of the foliage is one of the most confusing factors in making the diagnosis of virus diseases of peach. Injury is greatest in trees on light soils, although those on heavier soils are not free from attacks.

Control—Many different ways of eliminating peach tree borers have been attempted by growers in the 200 years they have been

fighting this pest. These run the entire gamut of possibilities, but the only remedy until the discovery of paradichlorobenzene was that of digging them out. This method is still good for small numbers of trees under 3 years old.

For trees more than 4 years old, the use of paradichlorobenzene is a satisfactory control for the peach tree borer. However, success of treatment is subject to limitations, most important of which are the life history of the borer, weather, and soil conditions. The best balance of these factors is during early September in Michigan. At that time, most of the eggs are hatched, the soil temperature is above 60°F., and the soil is workable. Soil temperature is important, for if below 60°F., the chemical is inactive.

In calculating dosages for peach trees, the size of the trunk rather than the age of the tree should be considered. However, the rule is ¾ ounce for trees between 4 and 6 years old, and 1 to 1½ ounces for older trees, as determined by the diameter. There are precautions which must be remembered in applying paradichlorobenzene. Peach trees are very susceptible to overdoses of this material. Therefore, do not exceed recommended dosages and be sure to keep the chemical from actual contact with the tree, and never use it in summer.

Paradichlorobenzene is applied by forming a ring of the crushed crystals, at the proper dosage for the tree, 1 to 2 inches from it. This can be accomplished more easily if weeds, gum, and grass are removed, without loosening the soil or exposing the roots to the chemical. After forming the ring of paradichlorobenzene, one should cover it with a few shovelfuls of earth. Paradichlorobenzene applied in this way changes into a gas which kills the borers. It is best to draw the materials away from the trees after about 3 weeks. Mounding about young, high-headed trees many times results in the formation of a water-holding pocket about the base of the tree. The freezing of such pockets of water has killed large numbers of trees.

During the last few years DDT has been tried experimentally by growers. One and one-half pounds of actual DDT per 100 gallons of spray applied as a special spray at the rate of one-half gallon per tree is an excellent treatment. Erratic results have followed efforts to apply DDT for peach tree borer at the same time as sprays for oriental fruit moth are being applied. It is for this reason that this is designated a special spray.

BLACK PEACH APHID

Myzus persicae-niger

The black peach aphid, as its name indicates, is more commonly found on peaches, although it also affects other stone fruits, such as plum and cherry. It is a native insect and was first described from near St. Joseph. This insect is prevalent throughout the peach-growing sections of the state.

Appearance and Habits—The black peach aphid differs somewhat from the majority of aphids occurring in Michigan in that the primary damage to the affected plant comes from the occurrence of tiny, blackish-plant-lice upon the roots. This insect is more abundant in sandy soils, but sometimes occurs in heavier soils. Under ordinary moisture conditions, the insects are less able to travel about in the heavier soils than in the lighter ones. Black peach aphid spends the greater part of the year upon the roots of peach trees but sometimes migrates to the leaves of the peach tree during the summer. However, it is in only occasional years that the aerial form is common in Michigan. This circumstance makes for a rather slow spread of the insect in most years from infested to uninfested ground.

Life History—The life history of the black peach aphid is peculiar in that no males of this species have ever been seen. The unfertilized females give birth to other females in unbroken continuity. This circumstance induces rapid increases in the number of the pests under favorable weather conditions. Usually most of the year is spent on the roots of the tree where the young are born, grow up, reproduce and die. When these insects infest the leaves of peach trees, winged forms appear and migration takes place to other host-plants. The activity of these insects depends largely on weather conditions, but usually the number of annual generations is from four to six.

These aphids are abundant in virtually every peach orchard which has reached an age of two or three years and while feeding on the roots is almost continuous, older trees ordinarily are only slightly damaged. On younger trees, however, the damage is serious, producing a weakened condition which may cause death of the tree, directly or indirectly, through action of other hazards, such as borers and various kinds of winter injury. The unthrifty appearance and the poor foliage color of infested trees render difficult the identification of other troubles such as the virus diseases of peach.

Control—Since these insects are present in most older plantings of peaches, the folly of replanting peaches at once in the holes made by the removal of old trees should be apparent. Thousands of young peach trees are lost every year through inattention to infestation by this pest or through failure to take precautions against it. The aphids are, apparently, able to survive as long as 3 years in the soil after the removal of their host-trees. Consequently, any peach trees planted in such soil within the period stipulated are likely to be injured unless precautions are taken.

Control—When on the leaves, they can be readily killed by the use of a contact spray, such as nicotine, parathion, or TEPP. Eliminating them on the roots, however, is not so easy. The planting of old peach orchard sites with leguminous crops for a period of 3 to 5 years will eliminate this pest, but this is impracticable under many circumstances. Many plans have been tried in an effort to permit the continued use of suitable sites for growing peaches. Dusting about 1 ounce of a 5-percent chlordane dust on the roots of the peach tree in the hole as it is planted is a good insecticidal treatment.

SAN JOSE SCALE

Aspidiotus perniciosus

The female San Jose scale is larger than the male and is grayish, circular, and about 1/16 inch in diameter. The appearance of both sexes is due to the shield, or protective covering, of the insect. The minute insects themselves are plump, yellowish, legless, sack-life objects.

Life History—As a usual thing the only scales that survive the winter are partially grown nymphs. In mild winters sometimes a few full-grown females survive. In the spring, the partially-grown nymphs complete their growth, the males acquire wings, fly about and fertilize females, which soon give birth to living young in large numbers. The young mature and they themselves start reproducing in 35 to 50 days. Mature females live and reproduce for 2 or 3 months, and all stages of this insect can be found on the tree during the summer. There are, ordinarily, one and one-half or two generations a year. The reproductive capacity of this insect is so great that small numbers of live scales in the spring may encrust a tree before fall.

Fig. 36. San Jose scale, greatly enlarged.

Injury—Injury by the San Jose scale on peach is confined almost entirely to damage which it does to the trees. The bark of the twigs and limbs become so thoroughly encrusted by the grouping of scales as to present a grayish appearance. Such an accumulation of insects constantly sucking the juices from the tissues of infested plants becomes apparent only after great damage is done. The inconspicuous nature of the individual scales, combined with their enormous powers of reproduction, makes such damage possible in a comparatively short time. It often happens that a promising young orchard in the spring will be merely dead trees by fall.

San Jose scale spreads from one tree to another in the newly hatched "crawler" stage and may be carried over short distances by the wind. Birds and wild animals serve as carriers. It is possible for an orchardist to spread this pest from one part of his orchard to another on his clothing.

Control—San Jose scale and other scales on peaches can be controlled either through the use of lime-sulfur or oil sprays. Do not proceed blindly, but determine during the dormant season if trees are infested and plan accordingly. The Department of Entomology will identify specimens. Other considerations necessitate care in de-

ciding what spray to use on peaches, for the trees must be sprayed for peach leaf-curl during the dormant period.

Another insecticidal control against scale is afforded by the summer applications of parathion or DDT against insects or mites occurring from June 15 to July 15. When these insecticides are used during this period scale is unlikely to become established. 1½ pounds of parathion per 100 gallons of spray has killed scale crawlers in all cases tried. When an infestation of scale starts, determine when the crawlers are active and make a special application against them.

PEACH DISEASES

DONALD CATION
DEPARTMENT OF BOTANY AND PLANT PATHOLOGY

INFECTIOUS DISEASES

PEACH LEAF-CURL

Taphrina deformans

Peach leaf-curl *(Taphrina deformans)* is caused by a fungus which attacks the young leaves early in the season. The fungus stimulates abnormal cell division in the leaves which causes the leaves to become thickened, blistered or wrinkled. The diseased leaves frequently acquire reddish or purplish tints and later show a silvery coating on the surface. Affected leaves drop in June, and the new leaves are developed at the expense of reserve food material stored in the tree.

Fig. 37. Peach leaf-curl.

Defoliation from this disease not only weakens the tree and destroys the present year's crop, but also reduces the crop the following year.

The fungus lives harmlessly throughout the year on the outer surface of the twigs. It can attack only young leaves when they are developing slowly, as in a cold, wet spring. The disease is prevalent in Michigan in three years out of five.

This fungus must be killed before it has a chance to infect the leaves. When the symptoms appear sprays are of no value. Only one spray during the dormant season, applied thoroughly and before the buds swell, affords perfect control. When the trees are sprayed in the spring, liquid lime-sulfur, 5 gallons in 95 gallons of water, has been the cheapest and best material to apply. A spray in the fall of the year after the leaves have fallen also controls leaf-curl. Bordeaux 6-8-100 is used for fall spraying, as lime-sulfur sometimes causes injury to immature wood. The advantage of fall spraying is that it can be done on calm clear days while the ground is firm and when other work is not pressing. Failure to control this disease by spraying has been traced to lack of thorough coverage, spraying too late in the spring after the buds have started to swell or using unreliable spray materials such as liquid lime-sulfur which has been frozen or dry lime-sulfur which has lost its strength after having been kept several years.

Many other eradicative fungicides, such as those of the dinitro class or mercurials will give good control. The usual summer applications of wettable sulfur are reported adequate to control the disease without using a dormant application, especially under conditions not too favorable for disease development. However, the dormant application is always good insurance against possible loss.

If for any reason the disease is not controlled, ammonium sulfate or other high nitrogenous fertilizers, scattered on the ground around the tree before June 1, will help the tree to form new leaves and overcome the shock of partial defoliation. About ¼ pound for a very young tree and up to 4 pounds for a mature tree is the approximate amount to apply. The dosage is regulated according to the size and vigor of the top and consequent spread of the roots. The fertilizer should be scattered well out under the spread of the branches and kept away from the trunk. It will be washed down to the roots and take effect with the next good rain. Do not apply fertilizer after June 15. At that late date, the application of the fertilizer would cause the tree to continue growth late in the season and fail to mature

its wood properly for winter. If leaf-curl infection is severe, it is also advisable to remove the fruit immediately to prevent further drain on the tree's reserve food.

BROWN ROT

Sclerotinia fructicola

Brown rot *(Sclerotinia fructicola)* is the most serious fruit rot of the peach. The fungus causes loss not only in the orchard, but during shipment, and even after the fruit has reached the consumer. The same fungus rots plums and cherries. Blossom blight, twig blight, cankers and fruit rot result from brown rot infection. When attacked, the blossoms become brown and shriveled. They bend downward and remain attached to the twig. Masses of dusty spores are often found on these dead flower parts, especially following wet weather. The fungus may travel through the flower stem into the twig causing a small canker, or even killing the twig. Such twig blight kills the leaves which turn light brown and remain attached.

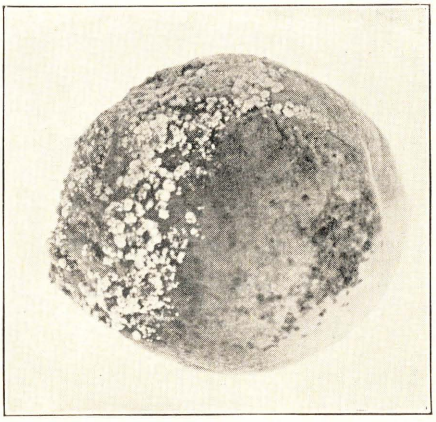


Fig. 38. Brown rot on the fruit.

Brown rot on young green fruit is rare. The danger of fruit infection increases as the fruit approaches maturity. The fungus is known to enter the uninjured skin of the ripening fruit, but more often it gains entrance through insect or mechanical injury. Brown rot begins as a small brown, rotted spot which enlarges rapidly on ripe peaches, until the whole fruit is affected. The fungus invades all of the fruit using up the moisture and food materials until a dried fruit or mummy remains. These mummies hang on the tree and produce spores the following year. When they fall to the ground, the partly buried mummies produce small mushroom-like fruiting bodies which discharge their spores into the air about blossom time. Disturbing the buried mummies by cultivation before the bloom period prevents formation of the spore-bearing fruiting bodies.

Control—Although wettable sulfur is a good protective fungicide for open blossoms and is generally recommended for the protection

of ripening fruits, it does not eradicate established infections. Indeed, brown rot is very difficult to control under the severe conditions of a high spore load and humid weather. A good wettable sulfur program may give but little better than 50 percent control when compared with unsprayed trees. The effective control project must be centered on keeping the spore load at a minimum. Blossom blight control is a part of the program as the retained, infected blossoms are responsible for much of the spore load.

Mechanical Reduction of Spore Load—Overwintered mummies hanging on the tree should be knocked off before spring growth. This is a cheap, easy operation, and the one mechanical control that cannot be disputed. The recommendation of pruning out of cankers is impracticable if not impossible as cankers are small and impossible to locate except by careful scrutiny of every twig. Cultivation before bloom may be of some value in destroying the fruiting bodies of buried mummies, but with intelligent blossom spraying even this measure may be unnecessary.

Spray Control—The two vulnerable points of entrance for the brown rot fungus are the inside parts of open blossoms and the ripening fruit. The peach tree is very resistant to infection at all other times. If the grower does a thorough job of blossom protection and of ripening-fruit protection, other fungicidal sprays are not necessary except for peach scab control. Of course, good insect control is necessary in between these periods.

Blossom Blight Control—The inner parts of the blossoms are very susceptible during the first five days after opening. The blossoms are resistant by the time of petal fall, and the petal fall spray is of very little value for brown rot control. Also, sprays before the flower blossoms open are considered of no value. Even with a heavy spore load from apothecia on the ground, and from cankers or mummies in the trees, there will be no infection if warm, dry weather persists. But during wet weather, the open blossoms must be protected by fungicidal sprays or dusts. A sulfur coating early in the rain period is very effective. One such dust application properly timed is all that is necessary for control in many seasons. Otherwise sprays should be applied several days apart to keep all opening blossoms covered and the applications should be continued until all the blossoms are open.

Where the spore load is light and blossom blight has never been a problem, the blossom sprays may be omitted.

Fruit Rot Control—The final phase in brown rot control is the protection of the fruit during the final month on the tree. Sprays are indicated every 14 to 7 days, with the intervals shortened as maturity approaches. At that time the fruits are shielded from sprays by foliage and are hard to wet. Spraying through the tree to cover the inner surfaces of the fruit is good practice. Weak lime-sulfur added to wettable sulfur seemingly is the best protection. Dusts have some advantages over sprays for peaches as they may be applied rapidly with light equipment, when dangerous weather threatens. Dusts penetrate through the foliage and are held by the hairy surfaces of the fruit. However, the rapidity of dusting is being challenged by concentrated spray applications. The best prevention of brown rot in the crate is complete control in the orchard. Rough handling makes infection sites for fungi, whose spores are present on the surface. Prompt and rapid cooling of peaches after harvest prolongs storage life.

Peach-grading machines cause small bruises. Peach-brushing attachments on the grader break off the leaf hairs at the sockets and provide points of entrance for the fungus. Sulfur dusting attachments on the grader are advisable when brushers are used. A sulfur dust in the orchard immediately preceding picking is especially valuable if there is no sulfur dusting attachment on the grader. Wettable sulfurs help control brown rot and are safe to apply at any time during the growing season. Sulfur dusts are also effective, and many peach growers have dusting equipment for emergency applications during the wet periods or use dusts for the entire summer disease and insect program. Dusts, however, are not considered satisfactory for leaf-curl.

PEACH SCAB

Cladosporium carpophilum

Peach scab *(Cladosporium carpophilum)* is a fungous disease causing black, surface spots which detract from the appearance, quality and value of the fruit. On the twigs the fungus causes superficial, oval, light brown areas with a slightly raised margin. Peach scab is rarely troublesome in Michigan commercial orchards because the sprays used for brown rot give excellent control of this disease. Although fungous spores are present at petal fall, the young peaches do not wet easily and are hard to infect at that time. A spray of wettable sulfur 2 weeks after shuck-fall and another spray 1 month before

ripening has been considered adequate to control this disease for Michigan conditions. The older practice of using arsenate of lead for curculio control also kept scab in check. With the newer types of insecticides the sprays for peach scab should not be omitted.

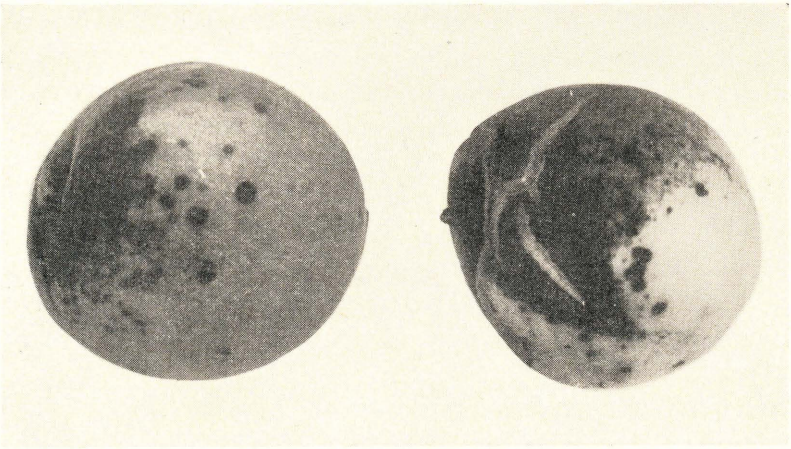


Fig. 39. Peach scab. Cracking of the fruit results in severe cases.

CORYNEUM BLIGHT

Coryneum beijerinckii

Coryneum blight *(Coryneum beijerinckii)* is a fungous disease which can cause serious damage to the fruiting wood, lowering the yield. The fungus may also defoliate the trees and spot the fruit. The disease has been important only in occasional years in localities outside the so-called peach belt, but has not been found in the main peach districts of Berrien, Van Buren, and Allegan Counties.

Infections of Coryneum are characterized on green shoots, limbs, and fruit by a distinct spot with a bright red border and a cream colored center. On the leaves, the infected spots fall out, leaving a clean round hole. Defoliation follows severe attacks. During the winter, infected buds on the one- to two-year wood are killed, together with the surrounding wood tissue, resulting in small cankers. Frequently the twigs are girdled and killed. Copious gumming from lesions on the twigs is characteristic of this disease, although gumming may occur from any type of wound, and does not necessarily indicate Coryneum infection.

When Coryneum blight is present, an autumn spray is recommended using 12-12-100 bordeaux as the last of the leaves are falling.

Fig. 40. Coryneum blight. Clean, round shot-holes are left on the leaves.

In one instance when the disease was first noticed in the late spring, applications of wettable sulfur, 6 pounds in 100 gallons of water, applied every 10 days were very beneficial. Ferbam is effective for early summer applications to stop leaf and fruit infections if winter control was not obtained.

PEACH CANKER

Valsa leucostoma

Peach canker *(Valsa leucostoma)* is a fungous disease which results in a die-back of the twigs and perennial lesions on the trunk or branches. In the early stages a sunken brownish area accompanied by exuding gum is characteristic of the disease. When cut open, the under bark is brownish in contrast to the pale, yellowish green of healthy bark. Later the bark becomes shriveled and black and separates from the underlying wood.

The fungus enters the trees through dead twigs, wounds or injured areas. Twigs injured by the oriental fruit moth are especially susceptible to attack. The fungus is most active during the winter,

spreading through the tissues while the tree is dormant. During the growing season the tree attempts to close the wound by forming callus tissue or wound bark. The fungus again attacks and kills this newly formed tissue during the next winter. Over a period of years a series of dead callus ridges in an ever-widening cankered area show the struggle for supremacy between the tree and the fungus. Cankers are more prevalent on weak trees or trees which have been forced heavily by nitrate fertilizers and late cultivation. In Canada pruning in the late spring resulted in markedly fewer cankers than similar pruning during the fall or winter. The later the cover crop was sown after July 1, the greater the number of cankers.

Fig. 41. Peach cankers on limbs and in the crotch.

Experiments in both Canada and Michigan indicate that sprays are of little value in controlling the disease. The following practices reduce the peach canker problem:

1. Train young trees to an open center and strive for wide-angled crotches.

2. Postpone pruning operations until late March or April. At that time cut out small branches showing cankers. Make cuts at least several inches back of the last signs of the disease and cut close to the next larger branch.

3. Make all other pruning cuts close to the next larger branch, leaving no stubs. Disinfectants are necessary only on large cuts. Remove all dead wood at pruning time. If any is overlooked it should be removed by late June.

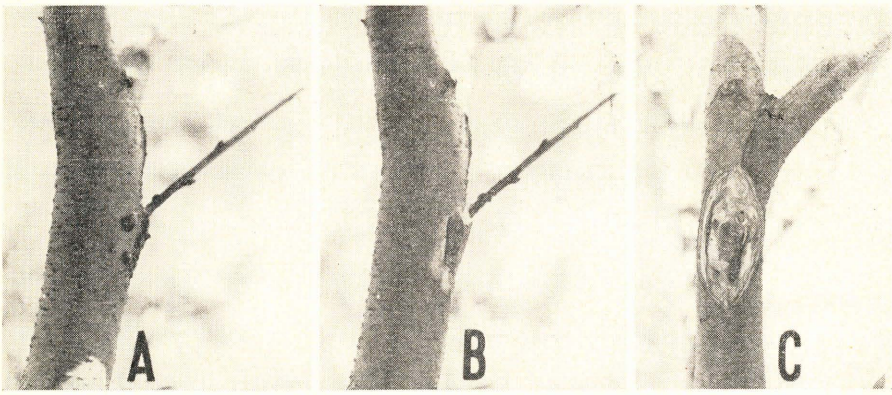


Fig. 42. Treatment of peach cankers. A. Gumming at the base of a dead twig signifies a canker. B. Bark cut away exposing dead cankered area. C. Finished canker treatment. Twig removed, area cleaned out to live bark, wound pointed at top and bottom. Ready for disinfectant and paint.

4. Clean out cankers in crotches and on large limbs during late May and June. Cut around the cankered area to clean, live bark. Make cuts clean at the sides and bring them together to a point at the top and bottom. Disinfect with bichloride of mercury, 1-500 (4 half gram tablets in 1 pint of water), or dissolve the mercury in a solution of ½ pint of water and ½ pint of glycerine. Paint the wound with an asphalt wound dressing.

5. Sow a cover crop in the orchard as soon after July 1 as conditions will permit, taking into consideration the age of the trees, size of crop and the amount of moisture in the soil. Non-bearing orchards can be seeded much earlier than those in full bearing.

6. Be careful not to use too much nitrogen-carrying fertilizer. (See discussion of winter injury).

BACTERIAL DISEASES

Bacterial spot *(Phytomonas pruni)*, is a disease resulting in many local infections. It may seriously defoliate the trees in the early season, lowering the yield and quality of fruit. The deep, cracked spots on the fruit detract from its sale value. This disease was somewhat troublesome in certain Michigan orchards previous to 1929. From 1929 to 1937, a relatively dry period, only a few scattered and minor cases were observed. During 1938 and 1939 the disease increased, particularly in young orchards and in a few bearing orchards. It may become troublesome in the occasional planting.

Bacterial spot is distinguished on the leaves by the small size of the spots, which are angular, dark brown or purple. A number of spots may fuse, involving extensive areas. Spots are sometimes more numerous along the mid-rib. Infections allow spray chemicals, particularly arsenate of lead, to enter and kill the leaves. Serious defoliation may be expected when the disease is present.

Fig. 43. Bacterial spot on peach leaf. Small angular spots, many spots running together along the mid-rib.

On the fruit the symptoms are first seen as small, dark, water-soaked spots. These spots later appear as small, black, corky angular, individual spots or the lesions may combine to form corky cracks.

As the defoliation from bacterial spot is less serious on trees in good vigor, the first step in control is to increase vigor with nitrogenous fertilizers and good soil management. The secondary damage from arsenical injury may be avoided by adding zinc sulfate-lime, 4-4-100, to arsenical sprays. In severe cases from five to seven applications of zinc sulfate-lime, 8-8-100, applied every 10 days to 2 weeks beginning at petal fall, reduces defoliation and fruit damage to a minimum. In past years, there were only a few orchards in the state where a spray program was advisable to keep the disease in check.

PEACH VIRUS DISEASES

Virus diseases are caused by self-increasing plant proteins. They are believed to be living, parasitic organisms although too small to

be seen with a microscope. Peach yellows, little peach, and red suture are the important virus diseases now found in Michigan. "X" disease is well distributed on chokecherry throughout the state, but the disease has been found on peaches and cherries in only a few orchards where chokecherry were growing nearby. A virus disease called rosette-mosaic has been found in several orchards in Berrien County in the past 20 years, but was probably reported as southern peach rosette before that time. Other major peach virus diseases not found in Michigan, but causing widespread damage elsewhere are phony peach and peach rosette of the southern states and peach mosaic of the western states. Some eight or ten other peach

Fig. 44. Peach yellows. Small pale wire-sprouts are characteristic of this disease.

virus diseases are known elsewhere. Some of these are mild in nature and their damage to the peach is not extensive.

Peach yellows appeared in Michigan in 1863 and soon became widespread, wiping out the peach industry in the early seventies, but the disease is now very rare. Little peach appeared in 1893 and red suture became prevalent and epidemic around 1931 to 1934. The history of peach virus diseases indicates that alternate periods of activity and quiescence can be expected.

Peach Yellows—The best known symptom of peach yellows is the premature ripening of the fruit, with red spots on the skin and red streaks in the flesh. The fruit is insipid and lacks flavor. Yellow foliage, small wire sprouts, gradual loss of vigor and finally death of the tree are all characteristic.

Little Peach—This has been the most destructive peach virus disease in Michigan during the last 30 years. The most damage has occurred in a relatively few townships in Berrien County. This disease can be identified by its small late-ripening, worthless fruit. The foliage is clustered and in the later stages of the disease is off-colored and yellow. When the disease is first evident an excessive number of buds on the two year old wood send out short shoots. This accounts for a large number of leaves crowded into a short space. After several

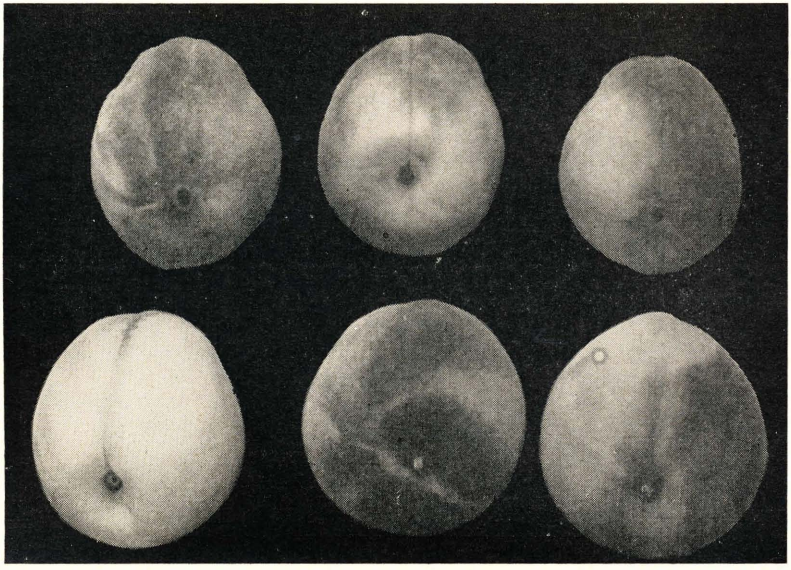


Fig. 45. Red suture of peach. Top row diseased. Bottom row healthy.

years the gradual decline may give the tree an appearance merely similar to winter injury or starvation.

Red Suture—The outstanding symptoms of red suture are a premature ripening of the suture side of the peach, frequently accompanied by a rough or bumpy surface. A characteristic clustering of

Fig. 46. Red suture disease. Clumping and twisting of foliage from a tree showing severe symptoms.

the foliage can be detected by one well acquainted with the disease and there is a faint bronze appearance of the tree when viewed as a whole. The fruit is of poor quality and crushes readily during shipment.

Fig. 47. Red suture disease. An advanced case in an orchard.

Rosette-mosaic—This disease is not very frequent. The symptoms shown are a short rosetted growth with a faint mottling and distortion of the leaves early in the season. The foliage starts slowly in the spring. There is no general yellowing, but rather the rosetted foliage may be deeper green than normal and the leaves are more normal in size when compared with southern peach rosette which produces dwarfed, yellow, rosetted leaves. Rosette-mosaic has also appeared in plums which showed no other symptoms than a decline in vigor.

Phony Peach Virus—The phony disease of peach, at present localized in the southern United States, is characterized by the healthy green color of the tree, but despite the apparent vigor there is a gradual decreased growth so that the tree becomes stunted and decreases in production. The infectious principle is most prevalent in the roots inasmuch as it is artificially transmitted readily by root grafting.

Peach Mosaic—This disease was first reported in 1931. It has been very destructive in the western states, but has never been reported east of Colorado and Texas. The symptoms are variable on

different varieties, producing one or more of the following reactions: Breaking of the color (stripes) in the flowers, retarded foliation in the spring, variously mottled and deformed leaves, twig abnormalities and malformation of fruit.

Fig. 48. Rosette-mosaic. Artificially transmitted to nursery trees. Top: June 12, two strees showing delayed foliation symptoms. Healthy tree on right. Bottom: August 20, stunted, rosetted growth on the diseased trees.

"X" Virus Disease—"X" disease appeared in Connecticut about 1930 and has since spread alarmingly to New York peach orchards in the Hudson Valley and across western New York on chokecherries.

Fig. 49. Rosette-mosaic. Extreme symptoms in a commercial orchard.

Fig. 50. Yellow-red virosis, "X" disease. Defoliation of affected branches in early August. Retention of tip leaves is typical.

The diseased chokecherries are now found throughout their natural range across the northern part of United States and throughout Michigan. Fortunately there are few chokecherries growing near orchards in the main peach producing areas. However the, disease has caused considerable loss to a few peach growers in the eastern portion of the state. The progressive symptoms on chokecherries are at first a brilliant red coloration of the leaf, with the veins remaining green during the first year. In the following years yellowing, rosetting and finally death, occurs. On the peach, yellowing of the foliage, red spots, shot-holing and ragged appearance of the leaf followed by severe defoliation are characteristic. Trees appear entirely healthy until late July and August when symptoms become evident. Often only a few branches show the symptoms. The trees appear to recover at the beginning of each season but the symptoms always repeat in the summer. (A tree infected with yellow-red virosis is shown on page 82.) The virus is now known to infect cherries causing wilt and decline of cherry trees grown on Mahaleb roots and less decline but small, late ripening, worthless fruits on cherry trees grown on Mazzard roots.

In Michigan and other eastern states, the disease has not affected peach trees when the chokecherry bushes have been eradicated for a distance of 500 feet from the edge of the orchard. Eradication of chokecherry is most easily and cheaply accomplished by spraying them early in July with one of the specific weed killers such as Ammate or Atlacide dissolved at the rate of ¾ pounds in 1 gallon of water. The chokecherry leaves should be wet well with the spray.

TRANSMISSION AND SPREAD OF PEACH VIRUS DISEASES

The infectious principle of any peach virus disease can be transmitted by budding or grafting living tissue from diseased trees to healthy trees. The viruses are spread to healthy trees in the orchard by means of sucking insects after they have fed on the juices of diseased trees. A leaf hopper, *Macropsis trimaculata*, spreads yellows and little peach, but the identity of the insects which spread other peach virus diseases is not known. Some varieties of plums are known to carry peach yellows and little peach without showing symptoms. Other species of *Prunus*, such as cherry, almond, and apricot, may also carry some of the virus diseases transmissible to peach.

The virus of little peach, peach yellows, and red suture can be killed or inactivated in young nursery trees or bud wood by exposing

to a definite warm temperature for a certain period of time. A time-temperature relation is also known for phony peach, but other viruses will stand more heat than will the peach buds. Peach virus diseases are incurable in the orchard and infected trees do not produce salable fruit.

The control of peach virus diseases must depend on eradication or exclusion. The diseases must be eradicated from the orchards by destroying the diseased trees. They are excluded by selection of disease-free propagation wood and the removal of natural hosts from the vicinity of nurseries and orchards.

It is established by Michigan law that growers must remove promptly those trees showing evidence of virus diseases. Inspection and quarantine for these diseases are under the control of the State Department of Agriculture.

NON-INFECTIOUS DISEASES

ARSENICAL INJURY

Acid lead arsenate, when used without a corrective, usually causes severe injury to peach trees and may do more damage than the pests being controlled. Injury symptoms may appear long after the spray is applied. On the leaves the first signs of arsenical injury are noticed

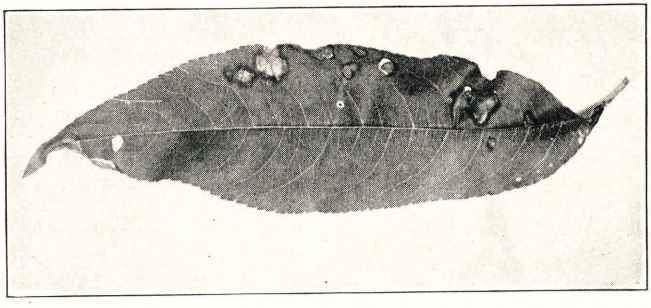


Fig. 51. Arsenical injury on a peach leaf.

as a reddening of the small veins in certain spots on the under side of the leaves. These areas soon die, leaving large, rather irregularly shaped, brown, dead spots. The leaves frequently show scalloped, burned edges. Yellowing of the leaves and defoliation accompany the other symptoms. The dead spots on the leaves eventually fall out, leaving a margin of brown dead tissue on the inner edge of the shot-hole. This distinguishes arsenical injury from Coryneum lesions

which have clean-edged holes. Bacterial spots are differentiated by their angular shape and small size, together with their dark brown to black color. Bacterial spot and arsenical injury are difficult to differentiate when associated on the same tree.

On the twigs of the current season's growth arsenical injury appears as a brown area around and below the bud. This dead brown area on the bark may or may not reach the cambium. Arsenical injuries may be recognized 1 or 2 years later as rough areas on the bark of 2- or 3-year-old wood.

Zinc sulfate-lime or iron sulfate-lime is now used to prevent arsenical injury resulting from sprays. One of these mixtures should always be used with acid lead arsenate. No correctives are required when basic lead arsenate is used. Within recent years, other less injurious insecticides have replaced arsenate of lead for peaches.