Peach Culture in Michigan
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THE REDHAVEN PEACH

Introduced by the Michigan Agricultural Experiment Station in 1940

PEACH CULTURE *in Michigan*

By Stanley Johnston

With chapters on the Control of Peach Insects and Diseases by RAY HUTSON *and* DONALD CATION

MICHIGAN STATE COLLEGE
AGRICULTURAL EXPERIMENT STATION
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EAST LANSING

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CONTENTS

	PAGE
History	3
Present Conditions	4
Selecting a Location for Peach Growing	5
Selecting the Site	9
Varieties	12
Varieties for General Planting in Michigan	13
Varieties Maturing Later Than Elberta	14
Varieties Having Great Bud Hardiness	15
Varieties for Commercial Canning	15
Varieties for Freezing	17
New Varieties	17
Selection and Handling of Nursery Stock	18
Laying Out the Orchard	19
Planting	22
The Use of Pollinators	23
Training the Young Tree	23
Pruning the Bearing Tree	35
Brush Removal	36
Bracing	37
Soil Management	37
Fruit Thinning	43
Harvesting	45
Packing, Storage and Marketing	47
Winter Injury	49
Insects Infesting the Peach (by Ray Hutson)	53
Insects Affecting Foliage	53
Insects Injurious to Fruit	56
Insects Injurious to the Trunk, Limbs and Roots	64
Peach Diseases (by Donald Cation)	75
Infectious Diseases	75
Non-infectious Diseases	92

Peach Culture in Michigan

By STANLEY JOHNSTON

HISTORY

The peach is not native to the United States but was probably first brought to the southeastern part of the country by the early Spanish explorers. From there it spread throughout the nation until now 27 states are considered of importance in commercial peach production.

Early records indicate that the peach was first grown in Michigan in 1775 when a few pits were planted near St. Joseph by an Indian trader named Burnett. Commercial production did not begin until 1848 when three men planted, also near St. Joseph, an aggregate of 25 acres of orchard.

The industry was growing rapidly when suddenly in 1863 a new disease called 'the yellows' made its appearance. By 1877 the disease was destructively prevalent throughout the orchards of southwestern Michigan. No cure was known or has since been discovered. The only control was to pull and burn the diseased trees. Despite ravages of the disease, peach growers persevered, replanted their orchards and by 1884 the industry was recovering rapidly.

From 1884 until 1906 peach plantings increased greatly. Prices were good and there was virtually no competition on the Chicago and nearby markets. A veritable peach planting mania swept the southern and western parts of Michigan, and peaches were planted in many localities and on many sites with almost total disregard of their qualifications for growing peaches.

The peak of peach planting in Michigan was reached in 1898 when there were about 12,500,000 trees of all ages, a high percentage being young trees. Many trees were killed in the very severe winter of 1898-99. A few years later, on October 10, 1906, a unique and very severe storm struck the southwestern part of the state where peach plantings were heaviest. There was a heavy fall of snow, followed by a drop in temperature to from 11° to 15° F. at various places. The leaves were still on the trees, and many growers were still picking late varieties such as Smock and Salwey.

About 73 percent of the state's 7,500,000 peach trees were killed by this prematurely low temperature. Most of the damage occurred in the heavily planted southwestern counties of Berrien, Van Buren, and Allegan.

Since that severe blow the peach industry in Michigan has never reached its former proportions. Several reasons can be given. Growers realized that it was dangerous to rely almost entirely on one fruit for their income, especially on one as susceptible to extreme weather conditions as the peach. Consequently, new plantings were more diversified and an increased number of apple, cherry, pear and other fruits were planted.

At about this time the refrigerator car came into use and with its coming, Michigan's monopoly of the Chicago peach market disappeared. Henceforth, the Chicago markets received peaches from all parts of the country, from May to November. It is very likely that the "Big Freeze" of 1906 accomplished in a single blow what the law of supply and demand, together with better transportation and refrigeration, would have brought about slowly and possibly even more painfully over a period of years.

PRESENT CONDITIONS

Following the "Big Freeze" of October 1906, the Michigan peach industry maintained itself on the level of approximately 2 million trees until about 1920 when the census showed 2,774,860 trees of all ages. From then until the present the industry grew steadily. The 1945 census showed a total of 4,600,000 trees of all ages in the state.

In recent years Michigan has occupied from third to fifth position among peach-producing states, and in 1950 attained second position.

It is significant to note that the average production of peaches in Michigan during the 7-year period from 1900 to 1906, inclusive, was 1,857,000 bushels. The average production for the 7-year period from 1944 to 1950, inclusive, was 4,223,000 bushels, or considerably more than twice the production of the earlier period. This greater production was accomplished with about 4,600,000 trees of all ages, compared with about 7,500,000 trees of all ages during the earlier period.

It is true that peach trees were suffering somewhat from the cold winter of 1898-99, and the winter of 1903-04 was rather severe. However, the larger average yields of the later years can be attributed somewhat to better cultural methods and improved varieties.

The trend in peach production in the United States moved sharply upward, beginning in 1944 when a new record was established with about 78 million bushels. This record was broken the following year with a production of 82 million bushels, and again in 1946 with an all-time record of approximately 87 million bushels. Another large crop of 82 million bushels was produced in 1947. Since then production has been lower, owing to unfavorable weather in the southeastern states. Potential production, however, remains high.

Considering the general upward trend in peach production, there is apparently no justification for heavy new peach plantings in Michigan. Certainly there would be no reason for planting peaches in any but the best locations and on good sites. On the other hand, the recognized peach-growing areas of Michigan generally escape destructive low temperatures more often than adjacent states. This advantage, together with excellent markets within a few hours' haul by rail or truck, justify at least the maintenance of the Michigan peach industry in its present position.

SELECTING A LOCATION FOR PEACH GROWING

Three factors of importance should be considered in selecting a location for peach growing in Michigan. These are local climate, available markets and transportation facilities.

LOCAL CLIMATE

The peach is the most tender of the tree fruits commonly grown in Michigan and whether it can be grown successfully in a certain part of the state will depend upon the frequency and severity of low winter temperatures more than any other factor. Though it is impossible to state definitely what degree of low temperature is required to kill peach fruit buds, owing to variable growing conditions from year to year, experience and observation have shown that a high percentage of fruit buds of Elberta, which has in the past comprised as many as 80 percent of the peach trees grown in Michigan, will ordinarily be killed by a temperature of —12° F. Hardier varieties such as South Haven and Rochester will usually stand a temperature about 2° lower and produce a fair crop. It is likewise virtually impossible to designate exactly a temperature that will result in severe injury to the wood of the peach tree. For instance, in October 1906, millions of peach trees were killed in Michigan by temperatures ranging from 10° to 15° F., but the trees were in full leaf. If the trees are well

matured, they will usually withstand a temperature of—18° to —20° F. without being killed. The temperature at which fruit buds are likely to be killed is, of course, most important inasmuch as crops of peaches must be produced fairly regularly if the enterprise is to be profitable.

Early peach growers soon discovered that crops were more certain in orchards planted near Lake Michigan. T. T. Lyon[1], founder and donor of the South Haven Experiment Station, commented on this fact in a paper before the American Pomological Society in September, 1875. He said in part:

> It is a well-known fact that large bodies of water, especially if at the same time they are very deep, yield but slowly to the varying temperatures of the seasons, holding in store in their depths a portion of the excessive warmth of summer, till wrung from them by the angry, biting blasts of winter, and by a reverse process, to some extent, carrying a portion of the chill of winter over into the spring.
>
> In southern Michigan the prevailing winds are westerly, generally reaching us after having been subjected to the equalizing influences above described, in passing over the waters of the lake, and affording a partial exemption from the extremes of temperature that often operate so disastrously . . . upon the pomological interests of some . . . States.

The safest areas for growing peaches in Michigan are those shown in Fig. 1 which experienced a minimum temperature of —12° F. not more than seven times during the 30 years, 1910-40. On the western side of the state this area begins in southern Berrien County and extends in a belt of varying width north to the proximity of Ludington in Mason County. Its widest point is near Grand Rapids in Kent County where it extends about 25 miles inland. All factors governing the width of this belt are not known, although the topography of the country and the extent of lake area lying southwest, west and northwest are undoubtedly important factors.

On the eastern side of the state a narrow belt having the most favorable winter temperatures for peach growing extends from the southeastern part of Monroe County to a point approximately half way between Port Huron and Harbor Beach. It is doubtful if the eastern portions of Wayne and Macomb Counties should be included in this area owing to the fact that their being included is based on temperatures recorded at Detroit which are probably too high because of the location for many years of the recording thermometers on top of a tall building in the city. While a comparatively small area in eastern Monroe County and another in eastern St. Clair and Sanilac Counties apparently are suited for peach growing from the standpoint

[1]Lyon, T. T.—"The Adaptation of the Soils and Climate of Michigan to the Production of the Finer Varieties of Fruit"—Mich. Pom. Soc. Rpt. 1875, p. 323.

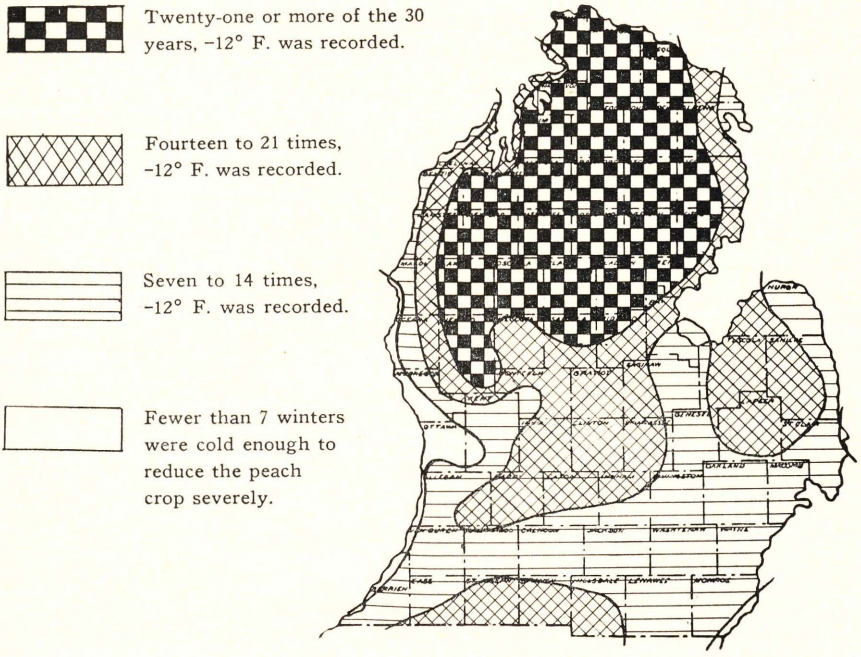

Fig. 1. Thirty Michigan winters, 1910 to 1940. The frequency that temperatures of −12° F. were recorded.

of frequency and severity of low winter temperatures, the industry has never been of importance in those areas. Heavy, poorly drained soils are rather common, and peach growing on such soils would not be successful, regardless of favorable temperatures.

In the earlier years of peach growing, it was rather commonly believed that the area along the shore of Lake Michigan from Manistee north to Charlevoix would be suitable for peach production. Several large orchards were established in that area but for the most part they were rather short-lived and unprofitable. The minimum temperature records shown graphically in Figs. 1 and 2[2] explain why this area is not suited for commercial peach production.

Though the minimum temperature records shown graphically in Figs. 1 and 2 indicate in a general way the most favorable areas for peach growing in Michigan and should prove useful to the prospective grower in selecting a location for his orchard enterprise, they are not exact because of the limited number of weather recording stations and the fact that certain stations are not located in places truly repre-

[2]The author is indebted to the late Dr. N. L. Partridge, Department of Horticulture, Michigan State College, for preparing Figs. 1 and 2.

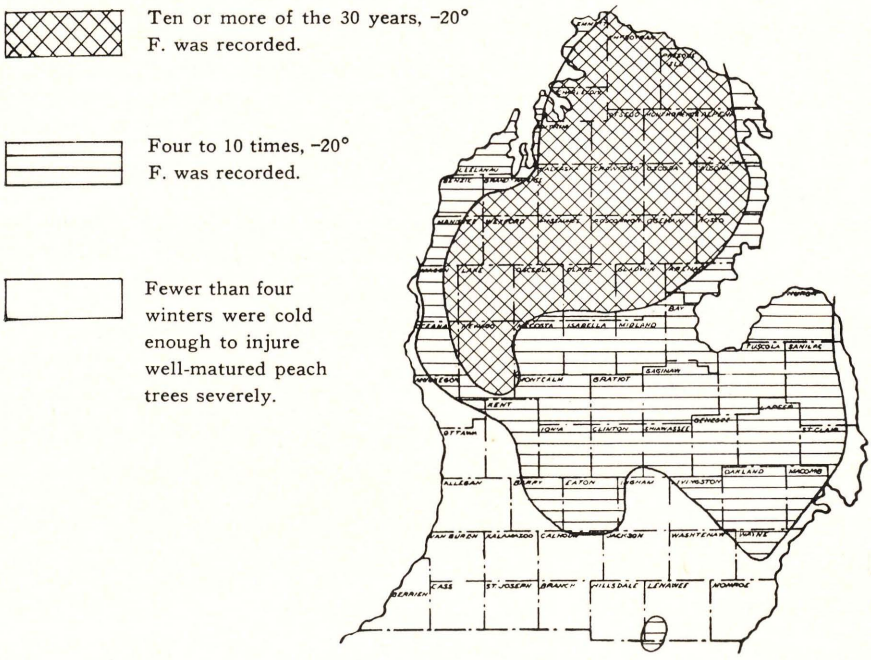

Fig. 2. Thirty Michigan winters, 1910 to 1940. The frequency that temperatures of −20° F. were recorded.

sentative of the surrounding country. Accordingly, successful peach orchards will be found here and there in the south-central part of the state which apparently are located in areas of questionable safety from the standpoint of low winter temperatures. Such orchards are few in number, however, and growers starting new orchards in those localities should proceed cautiously. On the other hand, just because a farm is located in the apparently favorable areas does not mean that the site will be safe from winter injury. This is discussed more fully under the heading of *"Selecting a Site for the Peach Orchard."*

Because the prevailing winds in the Lower Peninsula are westerly, the land adjacent to Lake Michigan experiences the delayed effect on plant growth more than the eastern side of the state adjacent to Lakes Huron and Erie. The chances of frost injury to fruit blossoms are therefore considerably greater on the eastern than the western side of the state. Likewise, the danger of frost injury in the interior part of the state is greater than on the western side because the retarding influence of the cool breezes off the lake extends only a few miles inland, the distance depending on several factors, such as the topography of the land and the area and depth of the lake lying to the west.

Of almost equal importance in avoiding frost injury is elevation. This is due to the fact that cool air is heavier than warm and on frosty nights the cool air flows off the hills to lower land. As a result, peach trees in blossom may escape injury if located on the comparatively higher land. Elevation above sea level is not so important as elvation above the immediate surrounding country. It is also more important to have a high elevation for the peach orchard if located inland to offset as much as possible the disadvantage of not having the retarding influence on vegetative growth of the cool lake breezes.

The average annual precipitation in Michigan from 1888 to 1938, inclusive, was 30.60 inches. It is somewhat higher, generally ranging from 33 to 34 inches, in the southwestern and west-central parts where most of the peaches in the state are produced. Although this amount of rainfall is, as a rule, sufficient to produce good crops of first-grade peaches, provided the trees are well cared for and not permitted to carry excessive loads of fruit, it is not too much and lack of moisture can easily become a limiting factor if the orchard is not handled properly. It is imperative that the extent of cultivation and the use of cover crops be adjusted to the amount of precipitation and the water-retaining capacity of the soil. A common error is to leave far too many fruits on the tree for the available supply of soil moisture, with the result that too many small peaches are produced.

AVAILABLE MARKETS

Michigan is located close to many large fresh fruit markets. There are also a number of processing plants in the state which process peaches both by canning and freezing.

SELECTING THE SITE

Important points to consider in selecting a site on which to plant a peach orchard include elevation above the surrounding country, soil, and the possibilities of erosion.

Experience has shown that orchards planted on sites having good elevation are not so frequently injured by low winter temperatures and spring frosts as those on low lands. There is an occasional exception to this rule if the orchard is located on a very high and exposed elevation. Such sites may occasionally suffer more than lower, better protected ones, if a severe cold wave is accompanied by high winds.

The reason for the generally better production record of peach orchards on elevations is that the cold air flows off such sites onto the surrounding lower country.

With the very important advantages of elevation from the standpoint of protection against winter and frost injury, is associated the problem of soil erosion. Most of Michigan's finest peach-growing sites are located on rather high, sloping ground and erosion has taken a heavy toll of the top soil (Fig. 3). Partridge and Veatch[3] have pointed out that the greater the degree of slope the more rapid and destructive the erosion.

For best results, the peach tree requires a reasonably fertile soil that is well drained. Generally sandy loam soils produce the finest fruits, although clay soils are suitable, provided they are well drained. Exceptionally fertile loam soils are hazardous unless very carefully handled because of the danger of the trees making too vigorous growth, rendering them more susceptible to winter injury. On the other hand, light, infertile soils will fail to produce trees of sufficient size and bearing capacity to be profitable.

Poorly drained soils have caused great losses of peach trees. Sometimes the injury is apparent the first year. Again, the trees will grow well until 3 or 4 years old and then die when an exceptionally wet or dry season arrives. Poor drainage is an important factor in Michigan because of the great variability of the state's soils. In one part of the orchard the trees may grow very well, while in another they will either die or grow so weakly that they cannot produce profitable crops. Strange as it may seem, poor drainage is frequently a problem on the very best sites from the standpoint of elevation.

A practical suggestion can be made that might be helpful in detecting poorly drained spots in the field. After the proposed orchard site is plowed, disked and harrowed early in the spring, it should be allowed to stand until a few days have elapsed, during which there have been drying winds. The wet spots can then be located because the surface soil will remain moist on them, while the soil in the remainder of the field will dry slightly on top. A field having many such spots should not be planted to peaches. Such observations should be made a year or two in advance of planting. The presence of soil mottling and grayish-drab subsoils are very good indications of poor drainage. The question frequently arises as to the advisability of try-

[3]Partridge, N. L. and Veatch, J. O. "Selection of Orchard Sites in Southern Michigan". Cir. Bull. 155, Mich. Agr. Exp. Sta. 1936.

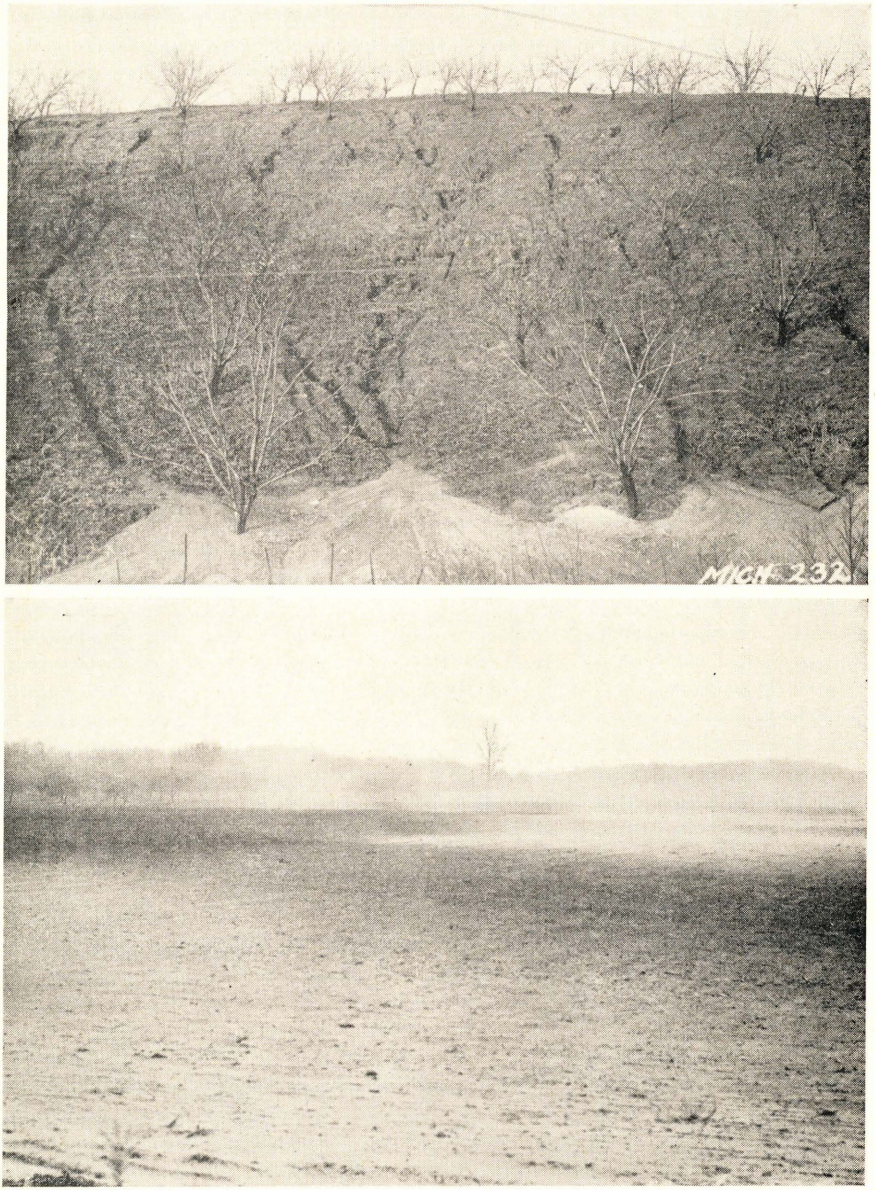

Fig. 3. Above: water erosion in a peach orchard growing on a steep slope. Many such slopes have been almost permanently ruined for future orchard use by erosion. Below: wind erosion in an open field with peach orchard in the background. Keeping the soil well supplied with organic matter and in some kind of cover crop as much of the time as is practical will reduce this cause of soil loss. (Photographs by Michigan-One Project U.S.D.A. Soil Conservation Service)

ing to tile-drain soils otherwise well suited for peach growing. While no general rule can be laid down, usually it would be better to avoid such soils for peach culture.

A new peach orchard should not be planted on land that has grown peach trees within 3 years, because of the possibility of black aphid injury to the young trees. If the old orchard is removed and a new peach orchard set within three years, the aphids still present in the soil are likely to attack the young trees in such numbers as to kill or permanently injure many of them.

However, vacancies in old peach orchards can be replanted without danger of serious attacks by black aphids if new, fertile soil is placed around the roots at planting time, and the young trees well fertilized soon after planting. One Michigan peach orchard has been successfully maintained in this way for 72 years. Many growers are now keeping excellent peach sites continuously in peaches by this method.

If possible to make plans a few years in advance of planting the peach orchard, soil-building crops should be grown and plowed under to insure a good supply of organic matter for the new orchard.

VARIETIES

The choice of varieties should be influenced by several factors, including the freedom of the particular site from winter injury, the type of market to be supplied and the distance to market. For instance, if the site is such that winter temperature drops to —12 degrees F. rather frequently, the Elberta peach should not be extensively planted. Hardier varieties are preferable. It is often considered a good policy to set the more tender varieties on the higher elevations of a particular site and place the hardier varieties on the slopes and lower elevations.

If the crop is sold largely at the orchard or nearby roadside stands, it is best to have a number of varieties ripening in succession over a period of several weeks. On the other hand, if the peaches are sold through fruit packing associations in the commercial peach growing areas, fewer varieties and only those having a good reputation in the large commercial markets should be grown in quantity. Some orchards are located far from the large city markets. Generally these orchards are designed to take care of local trade, but if a surplus needs to be shipped, the fruit should consist of varieties that are able to withstand long shipments and that are well known and in demand on the large city markets.

VARIETIES FOR GENERAL PLANTING IN MICHIGAN

Redhaven matures about 30 days before Elberta. Trees are large, productive, and above average in hardiness. Fruits are medium in size and brilliant red. The flesh is firm, fine-grained, of good flavor and resists browning on exposure to air. This is a great advantage in processing or serving fresh. The fruits usually set profusely, and rather heavy pruning and thinning are required to produce peaches of first-grade size. This variety responds especially well to blossom thinning.

Fairhaven matures about 21 days before Elberta. The variety was introduced in 1946 and therefore has been grown commercially too short a time to accurately appraise its value. A long trial period and early commercial tests indicate, however, that it is a promising variety. The trees are large, productive and moderately hardy. Fruits are medium-large, nearly round, and mostly bright golden, with an attractive bright red cheek. The skin is smooth and very tough. The golden color becomes bright while the fruit is still firm. Fruits are firm and ship exceptionally well for an early peach. The flesh is medium-yellow with a moderate amount of red color at the pit, moderately fine-tex-

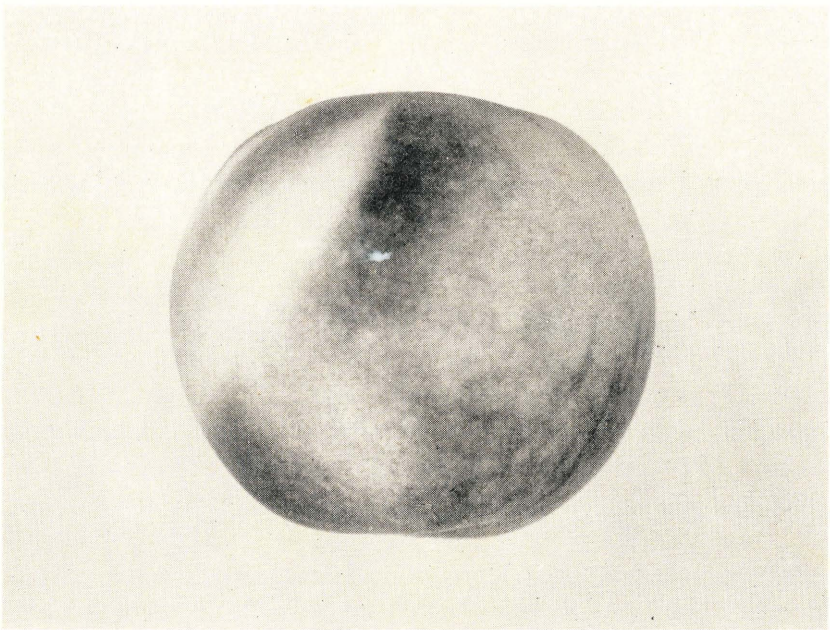

Fig. 4. The Fairhaven peach, newest of the Haven peaches, was introduced by the Michigan Agricultural Experiment Station in 1946.

tured, of good flavor and resists browning. The stone is free when the fruits are fully ripe. (Fig. 4)

Halehaven matures about 15 days before Elberta. It has been widely planted and shows adaptibility to many peach-growing regions outside of Michigan. The trees are large, vigorous, above average in hardiness and productive. The fruits are almost completely colored with an attractive red, and develop color well on shaded interior branches. Though the flesh is softer than desired, a tough skin enables the fruit to ship reasonably well. The flavor of the flesh is excellent, and the fruits are well liked for fresh use and for home canning. Fruits tend to set in profusion but good size can be obtained if well thinned.

Kalhaven matures about 4 days before Elberta. This variety has gradually gained in favor with Michigan peach growers, especially in Berrien County, until it is now being quite widely planted to partially fill the season between Halehaven and Elberta. The tree is moderately vigorous and attains good size. Fruit buds are considerably above average in hardiness. Fruits usually set profusely, and trees need to be well pruned and thinned to produce peaches of medium to large size. Fruits are well colored, having about an equal amount of bright red and clear yellow. The flesh is firm, fine-grained, of good flavor and resists browning. The peaches are excellent for freezing and moderately good for canning. A tough skin and firm flesh insure good shipping ability.

Elberta is so well known that it needs little comment. For many years it has occupied a dominant place among commercial peach varieties and many more years will elapse before it is relegated to a minor position. Though the tree is tender in bud and the fruit is of mediocre quality, the following qualities combine to maintain it in its leading position: large size, good appearance, excellent ability to withstand shipment, adaptability to many regions and the fact that it is so well known in every market. A few years ago Elberta constituted about 80 per cent of the peach plantings in Michigan. Plantings of improved, earlier maturing varieties have reduced Elberta plantings to about 45 percent.

VARIETIES MATURING LATER THAN ELBERTA

The growing of varieties maturing later than Elberta is of doubtful value in Michigan for the following reasons: 1) In seasons later than average, harvesting even of Elberta extends into the stormy period commonly experienced about September 20-25. Heavy rains and

frosts sometimes seriously injure peaches still on the trees at that time. Also, cold, rainy weather injures the flavor. 2) Markets have been well supplied with peaches from the southern states and California for several months and the demand is usually much weaker in the last half of September.

VARIETIES HAVING GREAT BUD HARDINESS

Golden Jubilee, Rochester and South Haven have serious weaknesses as commercial varieties but are very hardy in bud. These varieties probably still have a place where low winter temperatures occur frequently enough to make the growing of more tender varieties unprofitable, especially where there is a good local market.

Golden Jubilee matures about 24 days before Elberta. This variety has declined in popularity with commercial peach growers in Michigan because of its softness and poor shipping ability. However, the tree is large, productive and considerably above average in bud hardiness. Also, the fruit has very good flavor and is excellent for canning and freezing. Peach growers serving local markets may find it a valuable variety to include in the orchard.

Rochester matures about 22 days before Elberta. The trees are vigorous, far above average in hardiness, and productive. The fruits usually set profusely and unless the trees are well pruned and the fruits well thinned, many small peaches will be produced. Fruits are usually rather small, dark red in color, very fuzzy and susceptible to brown rot. The flesh is very good in flavor, and the peaches are well liked for home canning.

South Haven matures about 17 days before Elberta. This fine old variety originated on the A. G. Spencer farm near South Haven as a bud sport of St. John. It has been widely planted in the past and has proved to be very hardy in bud and productive. The fruits are excellent in flavor but, unfortunately, the flesh is too soft for a satisfactory shipping peach. South Haven is the pollen parent of the Halehaven and Fairhaven varieties and a grandparent of Redhaven.

VARIETIES FOR COMMERCIAL CANNING

Owing to the close proximity of many large cities and one of the most heavily populated areas in the United States, Michigan peach growers have produced peaches primarily for the fresh fruit markets. Consequently the varieties grown have been mostly yellow-fleshed, freestone kinds. During years of heavy crops with large supplies and low prices on the fresh markets, many peaches have been used by

canners, but gradually, year by year, the quantity used in this way has dwindled in the face of severe competition from California canned clingstone peaches.

The clingstone peach makes a better appearing canned product than the freestone owing to the firmer-textured flesh retaining its shape during the canning process. In addition, the juice is clearer and the color of the flesh better. Because of better appearance, canned clingstone peaches have been more in demand. Canners also prefer to use clingstone peaches rather than freestones as they can be pitted by machine, and there is less waste because of their firmer flesh.

Fruit growers in California, being far removed from the large fresh fruit markets of the country, early became interested in the processing of fruits and soon discovered the merits of the clingstone peach for canning. As a result, they encouraged the industry and developed a list of suitable varieties for canning purposes. At the request of fruit canners in Michigan a collection of clingstone varieties, including the most important ones grown in California, were brought to the South Haven Experiment Station for trial in 1923. Without exception, the California varieties were found to be unsatisfactory in one respect or another, usually because of poor growth or unproductiveness.

Among the other varieties tested was a clingstone seedling from the New Jersey Experiment Station, later named **Ambergem.** After preliminary trials it was planted on a fairly extensive basis commercially in 1938. The variety proved to be satisfactory in the orchard and was found to be especially hardy in bud. There are now somewhat over one thousand acres of the Ambergem variety in Michigan.

Commercial canners would like to have other clingstone varieties, suitable to Michigan conditions, maturing earlier than Ambergem to extend the processing season. A search is being made for such varieties.

While the clingstone peach has some advantages over the freestone from the standpoint of the processing operation, many prefer the flavor and texture of the canned freestone. Considerable progress has been made in recent years by some processors in packing a superior canned freestone product.

Elberta and **Halehaven** are the two freestone varieties most commonly used for commercial canning in Michigan. Elberta makes a good canned product if well grown in a favorable season. However, the flavor of Elberta is likely to be bitter if the season is late, cold or wet. Halehaven has excellent flavor canned, but the flesh is some-

what coarse and soft to withstand processing operations to best advantage.

Kalhaven has a firm, fine-grained flesh that withstands the processing operations satisfactorily.

Among the newer Michigan varieties, **Redhaven** makes an excellent canned product but the pit clings somewhat unless the peaches are fully mature. **Fairhaven** is new and just coming into production commercially. Preliminary trials indicate that it has promise as a commercial canning peach. The pit is usually free while the flesh is firmer than that of Halehaven, and it has good flavor.

There has been a marked decline in the home canning of peaches in recent years. On the other hand, there is an increased interest on the part of Midwestern and Eastern processors in peach canning. The loss of a portion of the home canning market is a serious blow to peach growers, and they should give careful consideration in making new plantings to use only varieties that are liked by commercial canners as well as being suitable for the fresh market. In that way the grower has the advantage of two possible markets for his peaches, rather than only one.

VARIETIES FOR FREEZING

The commercial processing of peaches by freezing is comparatively new. The industry expanded rather rapidly during World War II. Owing to the very rapid growth of the industry, some mistakes were made. It was discovered that varieties differed greatly in their ability to make an excellent frozen product. Much has been learned and the industry is growing again, especially that portion which freezes peaches for commercial pie makers and the hotel and restaurant trade.

Varieties recommended for growing in Michigan that are superior for freezing include **Redhaven, Fairhaven,** and **Kalhaven.** All of these varieties have firm flesh of fine texture resistant to browning on exposure to air.

Elberta and **Halehaven** are moderately good for freezing. However, Elberta is likely to be bitter in flavor in cold, wet seasons. The flesh of Halehaven is somewhat soft and browns easily.

NEW VARIETIES

Only varieties have been recommended for general planting that years of testing have shown to be satisfactory for growing in Michigan.

Many new varieties have been introduced in recent years by experiment stations and nurserymen. These are being tested at the

South Haven Experiment Station. It is quite possible that some of these varieties may be on the recommended list in the future.

All new varieties should be first planted in small numbers. It should be remembered that the percentage of new varieties that succeed in becoming standard varieties is extremely small. A good rule for the fruit grower to follow regarding varieties would be the passage in the Bible (First Thessalonians, 5:21): "Prove all things. Hold fast that which is good."

SELECTION AND HANDLING OF NURSERY STOCK

The peach tree is susceptible to so many serious and often uncontrollable diseases that the greatest care should be exercised in the purchase of nursery stock. The chance of obtaining stock that is untrue to name is also especially serious in the case of the peach as the trees cannot be successfully grafted to another variety, as is true with some other tree fruits that prove to be untrue to name. Price, therefore, should be a minor consideration in the purchase of peach nursery stock. A saving of 10 cents a tree would amount to $10.80 an acre if the trees are planted 20 x 20 feet, a very small item in comparison with the total investment and possible profits over a period of years. To take a chance on diseased or misnamed stock for such a trifling saving would be very unwise. The reliability of the nurserymen should receive first consideration. The prospective purchaser should also determine if the nurseryman grew the trees himself or purchased them from someone else. There is greater danger of mistakes occurring when the trees have passed through other hands.

Inquiries are frequently made concerning the advisability of purchasing trees in the South for northern planting. Provided the trees are well grown, free from disease and have been properly handled, stored and shipped, there is no reason why they should not grow satisfactorily in the North. There is, however, always an added danger in bringing in trees from a distance in that a new disease may be introduced into the orchard. There are several serious virus diseases of peaches in other parts of the United States that have not yet become established in Michigan.

Medium-sized peach trees are generally preferred, although many persons desire the large sizes provided they have been well heeled-in or stored in cellars in such a manner that they have not been winter-injured. Small sizes are less likely to survive if a very dry season is

encountered the first year. They may also indicate, in some instances, that the reason for the small size is an inferior rootstock.

Peach trees in the nursery row are usually dug late in the fall and either heeled-in or placed in storage cellars. If the trees are heeled-in they should be placed in a trench in a well drained location with the tops pointing south. The roots should be covered deeply with the soil extending well up on the trunks to prevent any injury to the crowns during the winter. Trees are usually received in bundles and often heeled-in without opening. This often results in some of the trees drying out. The bundles should be opened and the trees spread out in the trench before being covered with soil. Peach trees properly heeled-in should pass the winter safely.

If the field is not ready for planting when the trees arrive from the nursery in the spring they should be heeled-in to make certain that they will not dry before planting.

It is not advisable to plant peach trees in the fall in Michigan.

LAYING OUT THE ORCHARD

How the orchard will be laid out will depend upon the method of planting that is to be used. In the past, commercial orchards in Michigan have commonly been planted on the square system, with the trees usually spaced 20 feet each way and cultivated both ways. The continued use of this method has been instrumental in aiding the loss of soil by erosion and, in nearly all cases, modifications of this method or the use of others should be used to preserve the remaining topsoil.

If the site is reasonably level and erosion is not especially serious, it is recommended that the trees be planted 24 feet x 18 feet rather than 20 feet x 20 feet. The wider spacing between the rows will make it possible to travel through the orchard late in the season for the purpose of applying dusts or sprays for the control of brown rot. Harvesting operations will also be simplified. This planting distance will require 100 trees per acre, while the 20 foot x 20 foot distance requires 108 trees. The loss of eight trees per acre with the wider planting distance will be more than compensated for in better spraying and more efficient handling of the fruit during the harvesting season. Even though the orchard is planted on only a slight slope, the rows should be arranged so that cultivation will be across the slope rather than up and down.

After the orchard is planted in this manner, it is suggested that only a narrow strip along each side of the tree rows be cultivated the first three years, widening the cultivated strip each year as the trees be-

come larger. The row "middles" can be used for cover crops, possibly two a year, which can be plowed under in order to add as much organic matter as possible before the trees become large enough to occupy all of the land. This is especially important in the young peach orchard because it is frequently difficult to get a good cover crop to grow in a bearing orchard. After the third year, on most peach orchard sites, the tree rows can be seeded and the "middles" cultivated through the spring and early summer until time for sowing a cover crop.

Though it is believed that erosion can be controlled satisfactorily in a high percentage of peach orchards by the use of a minimum amount of cultivation, sod strips and cover crops, certain sites more subject to erosion but not too irregular as to direction of slope (still having sufficient topsoil to produce a reasonably good peach orchard) might need to be planted on contours. The use of contour planting requires that tractor and truck operators and teamsters must not cut across from one row to another but must follow the row to the end. To cut across would soon open new channels for the water to follow and erosion to occur. It is also somewhat more difficult to spray or dust orchards planted on contours because of the variable direction of the wind as the row changes direction. Those items add a little to the cost and inconvenience of caring for the orchard. On the other hand, contour planting is undoubtedly the best method of holding soil and moisture in orchards on sites where the simpler methods will not prevent erosion. In each instance the pros and cons must be balanced. Often it is possible to break the orchard into sections, some of which may be set to straight rows, thus giving opportunity to cross rows and avoid long hauls in the orchard. To lay out an orchard on contours properly requires special knowledge and training (Fig. 5). If the grower decides that his orchard should be planted in this manner he should make inquiry for assistance through his county agricultural agent or Soil Conservation Service officials who are doing this type of work.

It has been a rather common practice in Michigan to plant peach trees and apple trees together. The advantages of this plan have been: 1) To obtain an earlier income than could be obtained from the apple trees alone, and 2) to have a permanent apple orchard on the land after the shorter-lived peach trees were removed. There have been two serious disadvantages of this method of planting: 1) The spraying program for each fruit is so conflicting that considerable loss and damage has frequently occurred, and 2) many of the choicest peach sites in the state are now occupied by apple orchards. Very often fruit

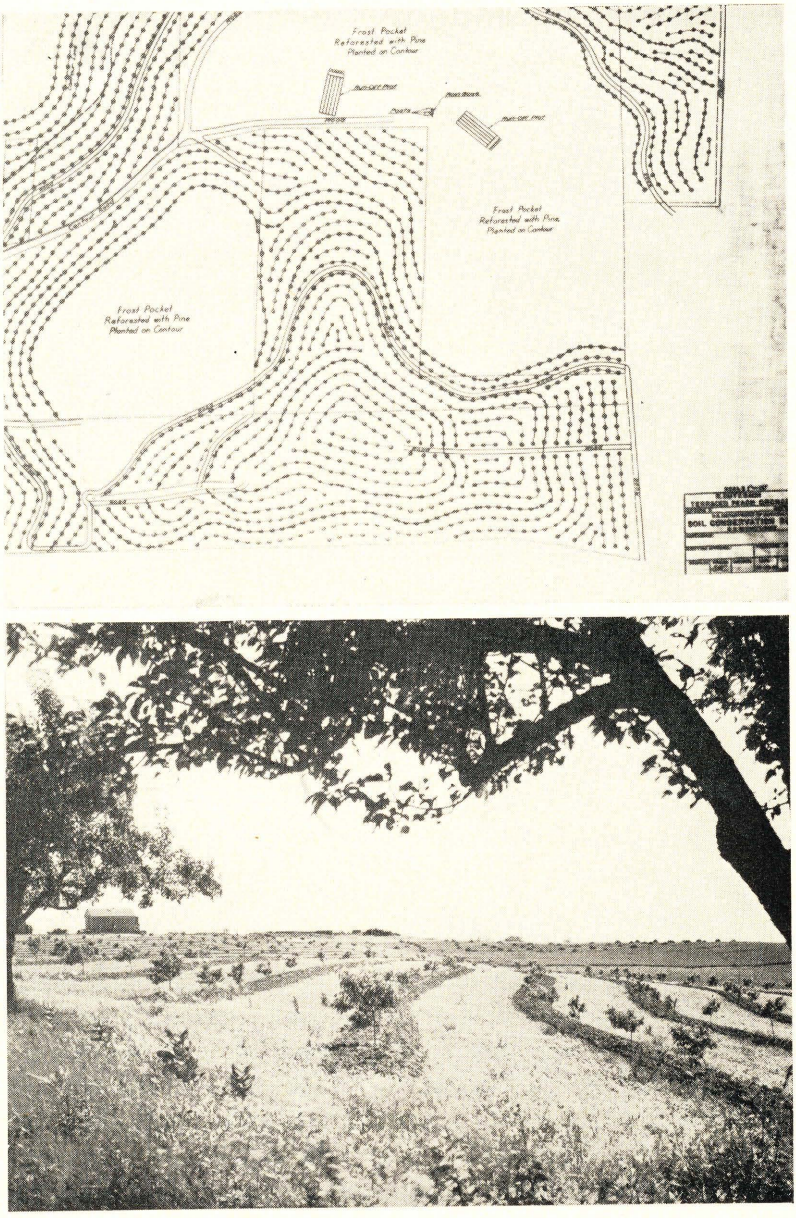

Fig. 5. Contour planting plan prepared by the Michigan-One Project, Soil Conservation Service, U. S. Department of Agriculture. The trees are planted 18 x 22 feet on the average. Sites on which erosion is too difficult to control by simpler methods and which still have sufficient top soil to produce a profitable orchard can be planted on the contour plan.

growers wish that these sites were available for peaches but hesitate to remove mature apple orchards already there. If peach and apple trees are to be planted together, it probably would be best to do so only on sites that are essentially apple sites. Choice peach sites should be retained for peaches.

PLANTING

Planting should be done as early in the spring as the soil can be prepared. Early planting is desirable because it gives the trees more time to become established before late spring or early summer drouths which sometimes occur. Ample help should be provided at planting time so that the various operations can be performed without too much delay. After the field is marked out, tree holes should be dug well in advance of the planters. Some growers use planting boards to insure proper alignment of the trees and others simply dig the holes at the intersections made by the marker and keep the trees in line by sight as the planting is carried out.

Care should be used to prevent the roots from becoming dry before planting. For larger operations, the trees can be loaded on a truck or trailer at the heeling-in grounds and covered with a thick layer of wet straw. Tarpaulin covers are helpful. Trees should not be laid out far ahead of the planters. It is a good policy to have the roots actually moist when the tree is planted because the soil adheres to the roots at once, which is beneficial.

The bruised ends of the roots should be trimmed before planting and all broken and discolored roots removed.

Experiments have shown that the addition of 10 to 12 quarts of granulated peat moss or new soil well supplied with organic matter in the tree hole is beneficial in instances where the soil is somewhat low in organic matter or has been used for previous orchards. This material should not be used alone but should be mixed in about a half and half proportion with the soil present in the field. No fertilizer should be added to the soil placed in the tree holes because instances have been observed where trees have been killed as a result of this practice. The tree should be planted deep enough so that the bud union is about 2 inches below the surface of the soil. Trees are sometimes planted too shallow and frequently too deep.

To prevent the roots from drying after planting, the soil should be well firmed about the roots during the planting operation. Care should be used to work the soil under the crown to avoid leaving an air

space. Shaking the tree up and down two or three times during the planting process helps distribute the soil around the roots.

Normally, sufficient rainfall occurs in Michigan following the planting season to insure enough moisture for the young trees. However, a few instances are on record where lack of rainfall at that time has resulted in newly planted trees dying or being greatly stunted in growth the first year. If exceptionally dry weather prevails following planting, or the soil is dry at planting time, the grower could spend his time to good advantage and profit in watering the young trees.

THE USE OF POLLINATORS

Before the orchard is planted, consideration should be given to whether the varieties planted are self-fertile. Most peach varieties are self-fertile. Possibly the best known self-sterile variety is J. H. Hale. Others include June Elberta, sometimes called Mikado, Hal-Berta Giant, Candoka and Welcome. None of these is recommended for planting in Michigan. However, if a self-sterile peach variety is planted, it should be planted in double rows, alternating with two rows of a self-fertile variety. Two rows of a variety are easier to handle than one at harvesting time. In addition, bees should be kept, unless a neighbor has an apiary near at hand.

TRAINING THE YOUNG TREE

The peach is inclined to form an open-center type of tree in which the main scaffold limbs arise from a comparatively short space on the trunk. This type of tree was accepted by the early peach growers, and usually the young tree was headed at from 18 to 30 inches above the ground, depending on whether the grower believed in low or high-headed trees, and from three to five scaffold limbs were allowed to develop near the top. In recent years, since the central-leader method became popular for training several other kinds of fruit trees, experiments have been conducted to ascertain if this type of training can be used successfully with the peach. A modification of the open-center method has also been developed that is worthy of trial. Essential points of the three systems of training, including the strong and weak features of each, are given in the following pages.

OPEN-CENTER METHOD

There has been considerable difference of opinion among peach growers regarding the proper height at which to head the young peach

tree that is to be trained to an open center. After weighing all of the evidence it appears that the low-headed tree, from 18 to 24 inches in height, has the most advantages, especially since it is no longer considered necessary to remove every weed and blade of grass from beneath the tree. It is also possible to cultivate under low-growing trees with the new type of orchard tools, whereas formerly it was virtually impossible. Low-headed trees have the advantage of making many orchard operations, such as pruning, thinning and harvesting, easier and less expensive. High-headed trees carrying a load of fruit are more susceptible to injury from strong winds and the trunks of such trees usually show more winter injury on the southwest sides because more trunk area is exposed and unshaded during the winter when that type of injury occurs. They are also more likely to sway in the wind, especially when young, with the result that a crevice may develop between the tree and soil in which water can collect, with ice formation and injury to the trunk resulting.

The most common type of open-center tree is one having from three to five or even more scaffold limbs arising from a comparatively short space on the trunk. Observation indicates that three scaffolds are better than a larger number because there is greater danger of poor unions at the point of attachment with the trunk where more than three scaffolds are retained (Fig. 6). Three scaffold branches are selected that are well distributed around the trunk and as near the head as possible. If they are close together they will form a knot-like growth at the head of the tree that will be exceptionally strong (Fig. 6).

The length to leave the scaffold branches at the time the tree is planted will depend upon their size and uniformity. If they are large and uniform in size they can be left 10 to 12 inches in length, but if they are rather slender and uneven in size it is better to cut them off near the trunk, although not so close as to remove the basal buds (Fig. 7). New shoots will develop from these basal buds and three of these, well distributed around the head of the trunk, can be selected for the main scaffold branches.

Much can be done to train the young peach tree properly by this method if it is given a little attention during the first few weeks following planting. If the grower will examine the young trees about 2 or 3 weeks after planting, and with a sharp knife remove all shoots but those which are to make the scaffold branches, the growth of the tree can be directed into the branches that are to be retained. The young trees should receive another inspection and light, corrective

Fig. 6. Above: a thirteen-year-old Elberta tree developed by the three-scaffold method of training. The trunk and head of the tree are in sound condition. This tree should live for several more years at the height of its bearing capacity. Below: the result of too many scaffolds causing crowding and narrow angles. This tree is of the same variety and age as the one shown above.

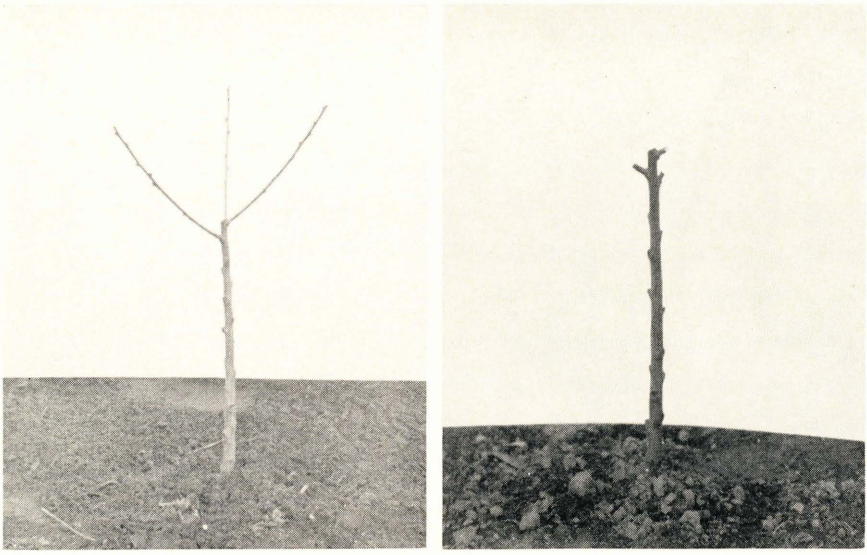

Fig. 7. Trees pruned immediately after planting, to be trained by the three-scaffold method. If three suitable branches of equal size can be found close together they can be retained and cut back to 10 or 12 inches in length as shown at the left. Often three branches of sufficient vigor and uniformity cannot be found, especially at a height of 18 to 24 inches. In this case it is best to cut back the branches present to short stubs, being careful not to cut away the basal buds next to the trunk. Shoots developing from these buds can be selected for scaffold branches.

shoot-removal about two weeks after the first. If this light, corrective shoot-removal is done the first season soon after planting, a more severe second-year pruning can be eliminated, much to the advantage of the tree.

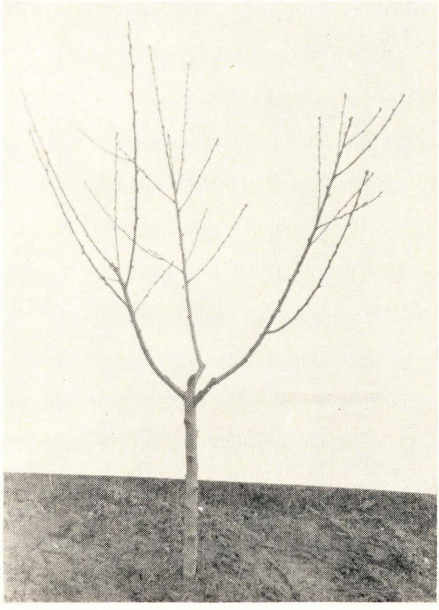

Fig. 8. A one-year-old tree trained by the three-scaffold method. The three scaffolds grouped closely together should develop a knot-like head of great strength. Pruning should be as light as possible during the first two or three years, but every effort should be made to keep the three scaffolds in balance. This can be done by doing the most pruning on the most vigorous scaffold branches.

A light corrective pruning will be necessary during the spring of the second year (Fig. 8). At this time any additional shoots on the trunk that escaped attention the previous season should be removed. The three scaffold branches should be brought into balance, if one or two are making a much greater growth than the others, so that they will develop as nearly uniform in size as possible. By the third year the structure and shape of the tree should have progressed to the point where practically no pruning will be needed, unless it is to remove a particularly wayward branch or keep the tree in balance by subduing an occasional over-vigorous branch.

CENTRAL-LEADER METHOD

Because the central-leader type of training has become popular with several other kinds of fruits, experiments have been conducted to ascertain if this type of training can be used successfully with the peach. It has been found that this method must be modified somewhat when applied to the peach tree because the terminal shoot or leader does not grow upright, as is true, for instance, with the apple or pear, but off to one side at about a 45-degree angle. Therefore, if this type of training is used it is necessary to head the tree from 36 to 48 inches high and select the scaffold limbs at intervals along the trunk at the end of the first year, because there will be no opportunity to select additional scaffolds later (Figs. 9 and 10). It is readily apparent that large nursery trees are necessary if this method of training is to be used because of the necessity of forming the central leader and selecting all of the scaffold branches the first year. Medium or small-sized trees should be trained by some other method. Skill and careful attention are

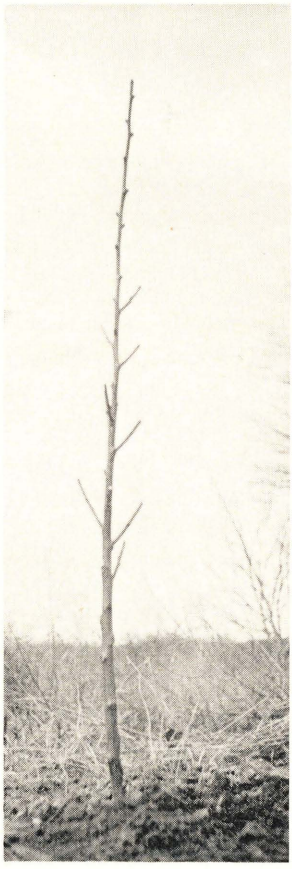

Fig. 9. A peach tree pruned immediately after planting to be trained by the central-leader method. The tree has been headed high, about 40 inches from the ground. All of the scaffold branches have been cut back to stubs. Only large nursery trees can be used successfully for this method of training. (See Fig. 10)

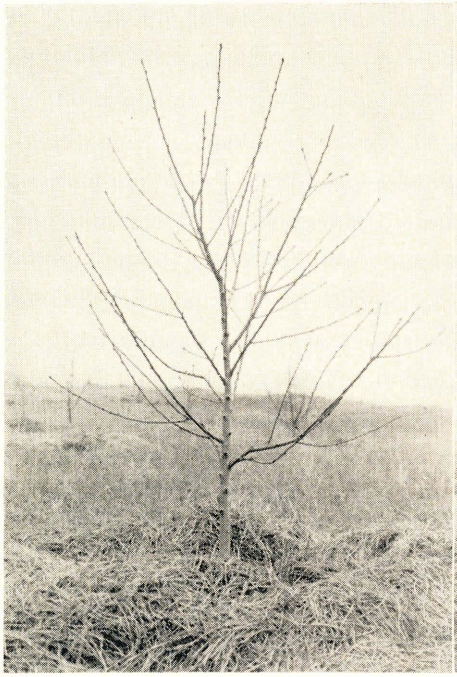

Fig. 10. A central-leader peach tree at the end of the first year's growth. All wide-angled scaffold branches should be retained. Two sharp-angled scaffold branches about halfway up the trunk should be removed. The top branches should be thinned lightly to prevent them overgrowing the lower branches.

Fig. 11. A nearly perfect 3-year-old central leader tree with one weakness that should be corrected before the tree becomes larger. One branch of the Y-crotch at the top of the trunk should be removed. This will prevent splitting of the trunk at this point when the tree is in full production. The scaffold limbs are well spaced and have wide angles at the point of attachment with the trunk. Care must be used in this type of training to keep the tree in balance and prevent either the lower or upper scaffold branches becoming dominant.

required to develop trees properly by this method because of the inclination of the peach tree to form an open-center type of tree. As a result, the lower scaffold branches sometimes outgrow and shade the upper ones to such an extent that they have to be removed, leaving a low-headed open center tree with a large pruning wound in the head. Sometimes the upper scaffold limbs outgrow the lower ones, shading them out so that their removal becomes necessary. A high-headed tree with large pruning wounds on the trunk is the result. Care

must be used, therefore, in the pruning that the trees receive the second and third years particularly, that the scaffold limbs are kept in balance. The upper scaffolds should not be allowed to dominate those below. Neither should the lower scaffolds be allowed to dominate those above.

Fig. 12. A very good five-year-old tree trained by the central-leader method. The angles at the points of union of the scaffold limbs with the central leader are wide with one possible exception (right center). The tree has good balance between lower and upper scaffolds.

It has been observed that scaffold limbs forming a narrow angle at the point of attachment with the trunk are common in trees trained by the central-leader method. The crotches at such angles frequently do not mature properly, with the result that this area is very susceptible to winter injury. Injury at these vital points on the trunk permits the entrance of borers and peach canker disease, with the result that the tree's life is considerably shortened. Care should be used in retaining only those scaffold limbs that have wide-angled unions at the point of attachment with the central leader (Figs. 13 and 14). Because of the great importance of having scaffold branches which originate from the central leader at a wide angle, it is better to allow all of the scaffolds

that will develop to remain on the central leader the first growing season. An opportunity is then afforded the next spring of selecting and retaining all scaffold branches having wide-angled unions at the point of attachment with the central leader and removing all of those having narrow angles (Fig. 10).

Fig. 13. Narrow-angled crotches do not mature properly in the fall and are therefore subject to winter injury. Note the winter injury in the narrow-angled crotch, lower left, and the absence of it in the two wide-angled crotches above. (See Fig. 14)

SIDE-LEADER METHOD

This method of peach tree training was first observed, studied and developed by W. W. Teichman, a peach grower living near Eau Claire, Mich. Mr. Teichman called it to the attention of experiment station workers who have put the method to further tests and have found that it has sufficient merit to justify reporting it here so that peach growers in general may know about it and give it a trial if they think that it might be useful to them.

The first trees of this type observed by Mr. Teichman had apparently developed naturally. They were probably trees of the kind frequently observed in one-year-old orchards where, for some reason or other, only one scaffold limb developed. Cutworms are sometimes responsible for this condition when they destroy almost all of the buds on a newly planted tree. Often the grower considers such a tree virtually worthless and will replace it, if not too late, or will pull it out with the idea of planting another tree in the same spot the next season. By using the side-leader method of training, these trees can be developed into some of the best in the orchard.

To train the young tree by this method, one branch is selected, at the desired height for the head, which is as nearly horizontal in direction as possible and has a wide angle at the point of attachment with the trunk (Fig. 15). This branch is headed back to 10 or 12 inches

in length and all of the remaining branches are removed. It is considered better if the branch selected is on the side opposite the prevailing winds. If it is known beforehand that this method is to be used, a suitable branch can be selected and placed in this position during the planting operation. The reason for doing this is that the force of the prevailing winds blowing against the branch and its secondary branches will aid in keeping it in more of a horizontal position which will result in the scaffold branches arising from it having wide-angled unions at the point of attachment with the original side-leader (Fig. 17).

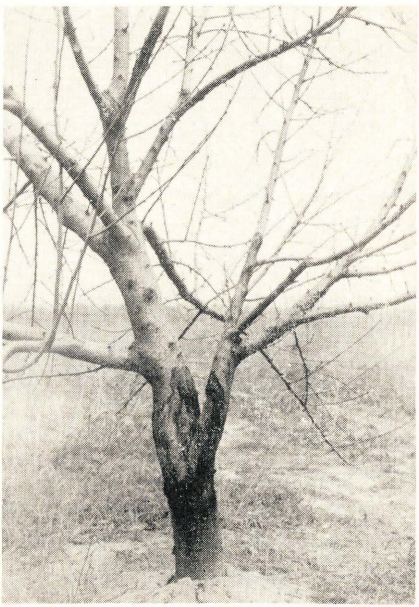

Fig. 14. A central-leader tree having generally wide-angled crotches at the points of union of the scaffold branches with the trunk. The one exception (lower right) has resulted in a poor connection which has been winter-injured. This injury has provided an entrance for borers and peach canker disease which will result in shortening the tree's life. Great care should be used to eliminate all narrow-angled scaffold branches as early as possible on central-leader trees. The angle of the scaffolds in the three-scaffold, open-center type of tree, where the scaffolds originate at nearly the same point, does not seem to be so important as on the central-leader tree where the trunk continues beyond the union with the scaffold branch.

During the first season, three scaffold branches are allowed to develop from the side-leader, retaining those that have wide angles at the point of attachment. Others should be removed as they develop. The pruning given during the second and third springs is somewhat similar to that given in the regular three-scaffold method already described. The problem is primarily to keep the scaffold limbs in balance until the tree is well established. To do this it is very important to keep the terminal scaffold as the leader. This can be done by pruning the other two scaffolds sufficiently to keep them slightly smaller. If this is not done during the first three or four years, the two scaffold branches nearer the trunk will have a tendency to grow faster and strangle the terminal scaffold, leaving a two-scaffold tree which is not so desirable as one having three scaffolds (Fig. 16). Despite heavier

pruning on the side branches, the three scaffolds will be of nearly equal size when four or five years old. This is to be desired, for the nearer equal the three scaffolds are in size in the mature tree the stouter the head and longer-lived the tree.

The heads formed by this method of pruning are generally very strong. Instances of defective unions at the point of attachment of the scaffolds with the original side-leader are extremely rare. Fig. 17 shows the development of this type at the end of the fourth year. Fig. 18 shows another tree in full bearing trained by this method.

The pruning given the tree immediately after planting by this method may seem to be unusually severe. Actually, however, it is no more severe than that given trees pruned to a whip or three short stubs, as is frequently done in the three-scaffold, open-center method. On the average, trees trained by the side-leader method should be as large as those trained by the three-scaffold method at the end of three or four years' growth. Because of using large nursery stock and having less wood re-

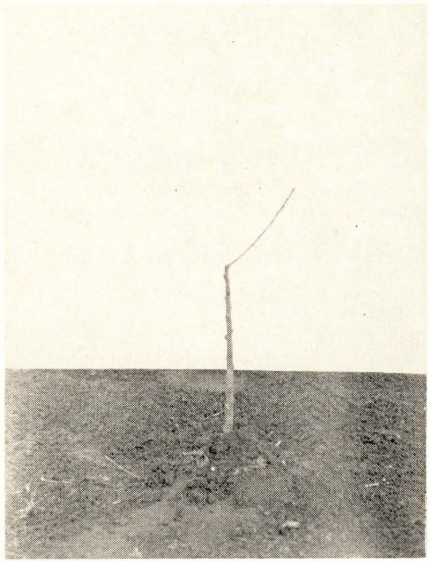

Fig. 15. A peach tree just planted and pruned to start its training by the side-leader method. One strong lateral branch is selected that is as nearly horizontal as possible. In planting, this branch should be placed opposite the direction of the prevailing wind. Three shoots to be used as scaffold branches are allowed to develop from it the first season. Others should be removed then or the following spring.

Fig. 16. A 4-year-old peach tree trained by the side-leader method in which the two scaffold branches nearest the trunk were permitted to outgrow the terminal branch. This condition can easily be prevented by pruning the lower scaffolds heavier the first three or four years, thereby allowing the terminal scaffold to remain the leader until the form of the tree is well established.

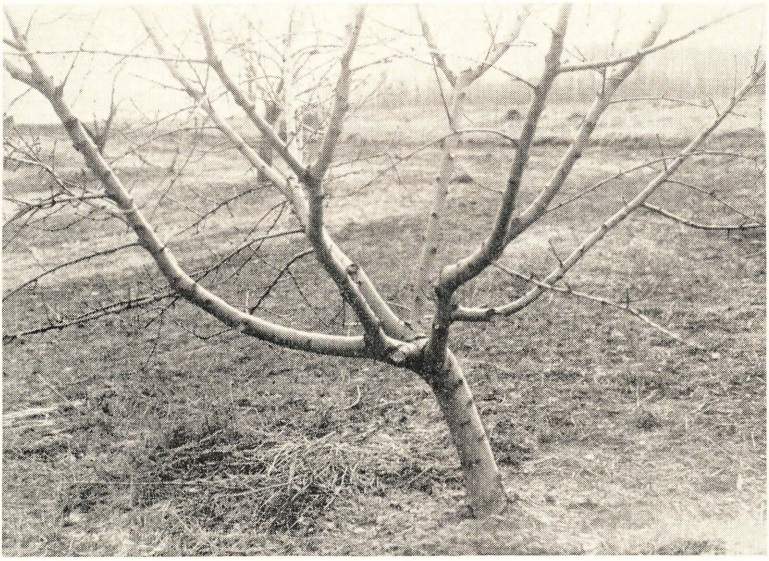

Fig. 17. A 4-year-old Halehaven tree trained by the side-leader method. The scaffold branches are well spaced and have strongly knit unions with the head of the trunk.

moved at planting time trees trained by the central-leader method should be somewhat larger in 3 or 4 years than those trained by the other two methods. On the other hand, there is some evidence to indicate that trees trained by the three-scaffold or side-leader methods may, on the average, have less trunk injury and therefore be generally longer-lived. The slight loss in production early in the life of the tree could easily be made up and exceeded by a somewhat longer life when the trees are in full bearing.

No attempt is made here to prove that one method of training is best for all conditions. Excellent trees can be grown with the proper nursery stock by a careful workmen with any of the three methods. Each may be useful under different circumstances. The strong and weak points of each method have been mentioned to aid the grower in the very important work of properly training the young peach tree. Upon his success or failure will depend to an important degree the length of life, total productiveness and financial success or failure of the orchard.

Regardless of which method of training is used, only a light, corrective pruning should be given the trees during the second and third years. The small wood in the center of the tree, which was commonly removed in the past, should be left, as it is on this wood that the

first peaches will be produced. If this wood is left on the tree it is possible to harvest a fairly good crop of peaches the third growing season. In the spring of the fourth year the small wood in the center of the tree can be removed, because it has fulfilled its purpose. It may be necessary to head back the tops lightly to prevent the main branches from becoming too long and limber. If little bud-killing has occurred during the winter it would be advisable to do some wood removal by thining out crowding or weak branches, thereby reducing the prospective crop of fruit and providing for the production of suitable new wood for the next year's crop. The light pruning recommended during the first few years of the peach tree's life is a wide departure from methods in use a number of years ago when it was considered necessary to remove nearly all of the wood in the centers of the young trees in addition to removing at least half of the new growth each year. It was thought that such a type of pruning was necessary to insure the development of a strong tree. However, it has been clearly demonstrated that such a type of pruning does not create a strong tree, but greatly reduces its growth and yield, in addition to keeping it in a highly vegetative state of growth which renders it more susceptible to winter injury.

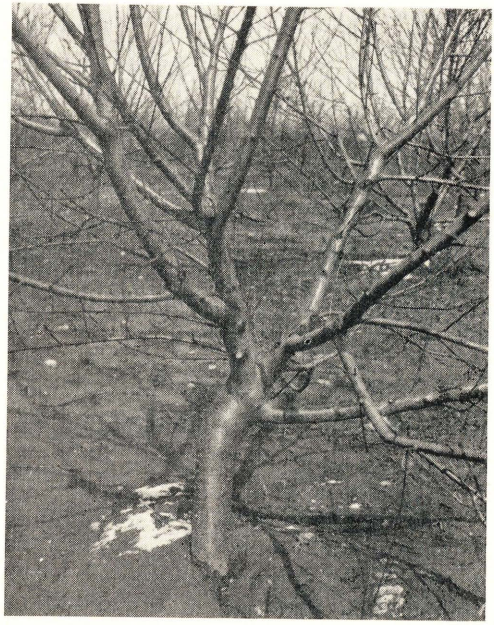

Fig. 18. A J. H. Hale tree, noted for its poor trunks and weak crotches, in full bearing and trained by the side-leader method. The scaffolds which grew from the original side-leader are sturdy and have wide angles and sound unions at the point of attachment with the trunk.

BEST TIME TO PRUNE YOUNG TREES.

Young peach trees should not be pruned in Michigan until after March 1 because the peach canker disease is more likely to be spread by earlier pruning.

PRUNING THE BEARING TREE

The severity of the pruning given bearing trees in Michigan should be largely determined by the number of live flower buds remaining on the trees about March 1.

If the trees at that time are carrying a high percentage of live flower buds they should receive some heading back to prevent their growing too tall, as well as a sufficient thinning out of shoots to assist in reducing the task of fruit thinning and to insure a reasonable amount of strong new wood for the following year's crop.

If low temperatures have greatly reduced the number of live flower buds it would be better to leave the trees unpruned, except for the removal of dead wood and broken branches, in the hope that sufficient live buds remain for at least a partial crop.

It is easy to be deceived when one inspects the trees to determine the amount of bud-killing that has taken place. In some instances growers have thought that all buds were dead and have severely cut back trees to renew the tops, only to discover later that enough live buds were present to produce at least a partial crop.

In determining the extent of injury to flower buds following low temperatures, care should be exercised to see that buds are examined from all parts of the tree, and from trees growing in all parts of the orchard.

In the past, severe cutting back of bearing peach trees following total winter-killing of flower buds has been a common practice. It is doubtful if such severe pruning should be done under any circumstances. The very vigorous growth sometimes resulting from such pruning is susceptible to winter injury. Many large pruning wounds are made which do not heal well and which provide entrances for wood-destroying insects and diseases. It is considered wiser to prune with moderate severity each year that the percentage of live buds present early in March gives promise of a full crop.

At one time it was thought that peach trees should be heavily cut back provided temperatures had been sufficiently low to injure the wood. The fallacy of this belief has since been demonstrated, and it has been shown that such trees recover better if left virtually unpruned. The objection may be raised that peach pruning cannot be left until March 1 because of the necessity of having the brush out of the way at least by the latter part of March, so that the dormant spray for the control of leaf-curl can be applied on time. It is sug-

gested in this connection that more fall spraying for the control of leaf-curl be done because many orchards are almost impassable late in March when the frost leaves the ground; moreover the rush of spring work would be considerably relieved and peach pruning could continue through April if necessary. Other tree fruits should be pruned in late fall and early winter and the general farm work planned so that peach pruning can be left until last and then rushed through to completion. Pruning later than the blossoming season is not advised.

The usual pruning of bearing peach trees consists of a combination of heading back and thinning out. Little heading back, aside from that needed during the training period, should be necessary until the trees become too high to harvest easily, or until new terminal growth is slowing down to less than approximately 12 inches in length.

When heading back is needed in the bearing trees, the cuts should be made to a side branch in 2- or 3-year-old wood. Numerous cuts in 1-year-old wood result in a dense growth of short shoots in the top of the tree which interferes with the best coloring of the fruits. Cutting back the tallest branches to side branches is an effective way to keep the tree from growing too high.

POWER PRUNERS AND PRUNING PLATFORMS

Bearing peach trees require considerable annual pruning. This is an expensive task and involves a lot of hard work. Careful consideration should be given to the use of power pruners. There is evidence to indicate that such equipment will speed up the pruning of bearing peach trees from 50 to 100 percent, and the work is made easier. Ladder work is eliminated and compressed air provides the energy.

Ladder work can also be eliminated to some extent by the use of a one- or two-story platform built on a wagon, truck or trailer. Men standing on either side of the platform prune one side of each of two rows as the vehicle is slowly moved between rows. Mechanically elevated platforms are also being tried.

BRUSH REMOVAL

The removal of pruning brush from the peach orchard by hand is a tedious and disagreeable task. However, if it is done with a tractor brush-pusher, 30 to 50 acres of brush can be removed per day by three men—a tractor operator, one man following up throwing missed brush into the next row, and another watching the fire and indicating where the next load is to be placed.

BRACING

The peach tree frequently bears so heavily and its wood is of such a brittle nature that bracing the branches in some manner is sometimes necessary to prevent serious breakage. Wooden props were commonly used in the past to support the heavily loaded branches, but they are not used as much as formerly because of the increasing difficulty and expense of obtaining them and the amount of work required to haul them into the orchard, put them in place, and take them out again after harvest. Wire braces made of heavy grape trellis wire stretching to opposite branches and fastened by means of large screw eyes have become popular and are now used extensively. Though braces may be required under certain conditions, especially if the trees are old and have been allowed to grow too high, pruning and thinning operations should be such that only a minimum amount of bracing will be necessary.

SOIL MANAGEMENT

The peach orchard soil should be managed in such a manner as to produce large crops of first grade peaches and, at the same time, to prevent soil erosion and over vigorous growth which will be subject to winter injury.

In the northern peach-growing areas the prevention of winter injury is a problem of first importance and the peach grower must keep it constantly in mind in all of his cultural operations. To insure greater safety from winter injury in these areas, young peach trees should not make more than 18 to 24 inches of new terminal growth annually. Twelve inches of new terminal growth is sufficient to maintain mature trees in good vigor and full production. Excessive annual growth may result in short-lived or injured trees where low winter temperatures are commonly experienced.

Each grower will have to study his own orchard and determine the cultural practices that will result in his trees making the desired amount of growth. The amount of nitrogen applied to the trees needs to be regulated carefully. No more cultivation should be done than is necessary. Excessive cultivation depletes organic matter, increases erosion and is expensive. Good cover crops help prevent erosion, reduce the chances of winter injury and build up the soil.

It is practically impossible to recommend a definite amount of nitrogen-carrying fertilizer to apply to a peach orchard or a peach tree. Usually tree growth is not uniform. Therefore, individual tree appli-

cations should be made. The old rule of applying nitrogen-carrying fertilizers at the rate of one-fourth pound per tree per year of age is only an approximation and often a poor one at that. It is much safer to err on the side of too little nitrogen than too much, for there is ample evidence to indicate that over-nitrated trees make excessive growth and are, therefore, more susceptible to winter injury. On the other hand, trees of very low vigor are subject to winter injury of a different type. The best situation is to maintain the trees in good vigor but not making excessive growth.

In the early days of peach growing, barnyard manures constituted the main source of fertilizer for peach trees. Though still useful, manures are so scarce and difficult to obtain that peach growers have come to rely largely on commercial fertilizers. If manure is used it should be applied lightly in the fall or winter. Heavy applications in the spring may cause the trees to grow too late in the fall. If manure is available, commercial nitrogen-carrying fertilizers should not be needed.

Peach trees are very sensitive to a deficiency of potash in the soil. The leaves of trees suffering from potash deficiency are smaller than normal, narrow, have upturned margins, are yellowish-green, and have many small red spots, especially near the margins. Such trees should not be confused with those having certain virus diseases which have a somewhat similar appearance.

As our orchard soils become older, more instances of potash deficiency are occurring. Potash deficiency can be brought about by the excessive use of lime in the peach orchard because some potash is made unavailable in soils nearly neutral or alkaline in reaction. Peach trees will grow and produce well on very alkaline soils provided large amounts of potash are present in the soil. Such is the situation in many Western soils used for peach culture. However, the most economical use of potash will be attained in most Michigan peach orchards if the pH of the soil is not permitted to exceed 6.0. Moderate amounts of lime are recommended where the soil is very acid.

Manganese deficiency is rather common in Michigan peach orchards where the pH of the soil is about neutral or above. Trees suffering from manganese deficiency have leaves with much lighter colored green areas between the veins. This condition can be corrected temporarily by spraying the trees with 2 pounds of manganese sulfate in 100 gallons of water as soon as the symptoms are observed. A second application may be needed in about 2 weeks. Symptoms are likely to

reappear later in the season and will almost certainly be present the next year.

No other minor element deficiencies of importance have appeared in Michigan peach orchards.

No direct benefits have been observed from applying phosphorus to peach trees in Michigan. However, cover crops usually grow better where phosphorus is included in the fertilizer treatment and good cover crops are essential in successful peach growing.

Peach trees require large amounts of soil water to mature big crops of peaches of first grade size. The soil should be well filled with organic matter to increase its water-holding capacity. Moderate cultivation should be given to help retain soil moisture. Cultivation of peach orchards is generally practiced in Michigan, although a few orchards are in permanent sod where irrigation water is available. Also, trees on steep slopes are often grown under the straw mulch system.

In order to conserve organic matter, cultivation of peach orchards is done less frequently and not as thoroughly as in earlier times. The orchard should be cultivated as little as possible and still obtain satisfactory growth and production of peaches of adequate size.

The topography of the site will influence the amount of cultivation given and the use of cover crops. If the site is on a slight slope erosion probably can be satisfactorily prevented by the use of sod strips in the tree rows, continuing to cultivate the centers of the rows until time to sow a cover crop. It has been found that these strips have little influence on yields and do not materially increase the insect and disease control problem. The width of the uncultivated strip will depend largely on the erosiveness of the soil. While sites on reasonably level land present a much smaller erosion problem and can be cared for more economically, it is not always possible to locate the peach orchard on such sites and rather steep slopes may have to be used to obtain the proper elevation. In such cases, provided there is sufficient top soil left to produce a profitable orchard, it may be necessary to use contour planting and terraces in order to control erosion. If the orchard is planted on contours the row middles should be cultivated until time to sow a cover crop.

Cultivation should start in the peach orchard as soon as possible in the spring. The trend in recent years has been toward earlier cultivation in the spring and earlier sowing of cover crops in the summer. The main reason for this trend has been to encourage new growth

earlier in the season, then checking growth earlier by ceasing to cultivate and sowing cover crops. This causes the trees to mature earlier in the fall, making them more resistant to winter injury.

There is a difference of opinion about cultivating the peach orchard before and during blossoming. Some think that to do so will increase the chances of frost injury. A careful study of the evidence on this question indicates that it is safe to cultivate before bloom, but not during the blossoming season. In fact, temperatures are usually higher over firm, bare land on a frosty night than over land on the same level which is in cover crop. However, cultivation should cease far enough ahead of blossoming to allow the soil to settle. Freshly cultivated soil acts as an insulator which prevents the radiation of heat from the soil below the cultivated level. Instances are on record where blossoms were seriously injured by frost in orchards cultivated the day before the frost. On the other hand, crops have been saved in orchards cultivated well ahead of blossoming; others have been lost in adjacent orchards at the same elevation and in which the cover crops were still undisturbed.

Cultivation should always be across the slope, rather than up and down, to aid in preventing loss of soil by erosion.

Young orchards, especially if planted on good soil and growing vigorously, do not need to be cultivated so long as bearing orchards. Frequently a cash inter-crop to be harvested and sold is grown between the trees. This should not be done unless the soil is fertile enough to stand the added drain without injuring the present and future growth of the trees. Cash crops to be grown between the rows should be chosen which will mature in midsummer and not require late cultivation. It is advisable to stop cultivating young peach trees by the middle of July to prevent excessive or late growth which would render the tree more susceptible to winter injury.

In many young orchards only a strip along the rows need be cultivated and the centers can be planted to cover crops to be plowed under, thereby enriching the soil prior to the time that the trees will occupy all of the land and render difficult the growing of satisfactory cover crops. Cultivation should continue longer in the bearing than in the young peach orchard for the reason that great quantities of water are needed to mature a large crop of peaches to proper size.

Cover crops sown early in July will frequently compete severely with the trees for moisture during August or early September and cause a serious reduction in the size of the peaches. This is especially

true during dry summers. Early sown cover crops that have made a strong growth during the latter part of July and early August frequently must be mowed to reduce competition with the trees for soil moisture. Though this is helpful in some instances, it is far from being entirely successful. It is doubtful if cover crops should be sown in the full-bearing peach orchard before the first or middle of August in Michigan, and if the soil is very dry the sowing might well be postponed until the arrival of sufficient rainfall to insure germination of the seed. There is not much danger of peach trees carrying a full crop entering the winter in an immature condition. If the crop has been lost because of bud killing the previous winter or for some other reason, the cover crop should be sown earlier.

For many years rye was the most commonly used cover crop in the peach orchard. Sometimes it was combined with vetch. However, vetch makes so little growth before the cover crop should be plowed under in the spring that its use has been gradually discontinued. Rye has many advantages as a cover crop for the bearing peach orchard. Unlike many other cover crops, it succeeds in developing a fair stand of plants in an orchard carrying a full crop. The seed will often remain in the soil during a long period of dry hot weather and germinate fairly well later in the season. The growth made by rye the year that it is sown does not compete with the trees for moisture nearly so severely as some other crops, such as Sudan grass. Rye lives over winter. The principal objection to its use has been the failure to plow or disk it under sufficiently early in the spring to prevent severe competition with the trees for soil moisture and nutrients just as growth is starting. It should be plowed or disked under in the spring when 4 or 5 inches high.

Instead of rye, some growers like to use wheat because they think that it has all of the advantages of rye but does not grow so rapidly in the spring. This allows the grower more time to plow or disk the cover crop under before it competes too much with the trees for moisture and plant nutrients.

Sudan grass seeded at the rate of about 20 pounds per acre usually makes a good cover crop for the peach orchard, although it may make sufficient growth to compete with the developing crop, and also be such a nuisance at harvesting time that it will have to be mowed. Cover crop mixtures are sometimes used and have some advantage in insuring "a catch," for one kind may grow if another fails. A successful mixture is made up of 2 parts by volume of Sudan grass, 1 part

Japanese millet, 1 part German millet and 1 part amber sorghum. This mixture is broadcast at the rate of 2½ to 3 pecks per acre or drilled at the rate of 2 pecks. Like Sudan grass, this mixture may have to be mown during the harvest season. Sudan grass, or the mixture just described, rather than rye is recommended for young orchards because it can be planted rather early and will make more growth the first year. Occasionally weed seeds are so prevalent in orchard soils that a satisfactory cover crop can be obtained by simply ceasing cultivation

Fig. 19. A one-year-old peach orchard on level ground and planted on the square system. The fine cover crop will check tree growth, reduce winter injury, protect the roots from freezing, and provide organic matter for the soil. (Photograph by Michigan-One Project, U.S.D.A. Soil Conservation Service)

and allowing the weeds to grow. However, the weed growth in most orchards is not uniform and in such cases the weeds should be supplemented by a sown crop. The places in which the weeds do not grow are generally those most deficient in organic matter.

Reference has already been made regarding the importance of the cover crop in checking growth, thereby enabling the trees to mature their wood properly before the arrival of winter. It is also important

that the soil be covered to provide protection to tree roots. Many instances are on record where peach trees have been killed from root injury where no cover crop was provided and no snow was present, leaving the bare soil exposed to severely cold weather.

FRUIT THINNING

Barring the loss of flower buds by winter cold or blossoms by spring frosts, the normal bearing peach tree will produce many more fruits than it can mature to 2 inches or more in diameter.

Peach thinning is a laborious, monotonous, expensive task, and yet it is one of the most important and necessary operations in successful peach growing. The loss of a quarter-inch in size, from 2-inch to 1¾-inch fruits, will often mean a loss in revenue of from $0.50 to $1.00 per bushel. Sometimes the smaller sizes cannot be sold at all.

When labor was scarce during World War II, great interest was shown in devising quicker and less laborious ways of doing the peach thinning job. Probably the most widely used of these methods is known as pole thinning. Various kinds and lengths of poles are used. The most common one is a bamboo pole having a 15-inch piece of rubber garden hose attached to one end. A few inches of the hose is pulled over the end of the pole and made secure with tape or wire. The rest of the hose hangs free. Just a piece of 12-inch hose is effective for close work (Fig. 20).

Thinning is accomplished by striking the small branches a sharp blow, and by gently tapping and rubbing clusters of small peaches with the rubber hose. Peaches are not seriously injured in the process. Many growers send a few expert thinners ahead with poles to take off the bulk of the load quickly and then follow with a crew of hand thinners to put on the finishing touches.

This method works well on varieties maturing in midseason or later. Pole thinning is, however, not effective until the peaches are nearly an inch in diameter. It has been found that this is too late to obtain best results with very early varieties. Amazingly good results can be obtained by thinning Redhaven, and other varieties of about its season, at blossoming time. Mature fruits are larger and tree vigor is improved on blossom-thinned trees, compared with those on which the young fruits have been allowed to grow for 3 or 4 weeks before being thinned.

Various methods of blossom thinning have been tried. These include spraying with dinitro materials, the use of brush brooms of

Fig. 20. The use of a bamboo pole with rubber hose attached hastens peach thinning and saves much ladder climbing. A short piece of hose alone is helpful for close work.

various kinds, spraying with water under high pressure, and the removal of blossoms by hand.

Experiments have been conducted for several years with the use of dinitro materials as sprays when about 90 percent of the blossoms are in full bloom. Materials most commonly used are Elgetol, DN Dry Mix No. 1 and DN-289.

Results with these materials have been variable. Some years excellent thinning has been obtained, and other years little thinning occurred. There is also the hazard of excessive thinning by this method. Research work is continuing with these materials. In the meantime, it is suggested that growers contact research workers in this field before using chemical materials for peach thinning.

Brush brooms made of vigorous growing peach branches are used by some growers. A wire brush broom is used to some extent in the South. Trees are brushed most effectively when the blossom buds are in the "balloon" stage, just before opening, although the operation can be carried on through the blossoming season. Some growers have found this method quick and effective.

Spraying with water under 500-600 pounds pressure has been used to thin peach blossoms. While this method has given good results in the hands of a careful operator, it has the objections of engaging

sprayers and tractors at a busy time of year for such equipment, using great quantities of water, and knocking off large numbers of small leaves.

Thinning blossoms by hand is being done successfully. The thinning is done when most of the blossoms are in the balloon stage. They break off easily and the operation proceeds at a good pace. Thinning at this time can be done in about half the time required to thin the young fruits. This method is not so fast as brush broom thinning, but a better distribution of the remaining blossoms can be obtained.

All of these methods have their advocates, and the grower of very early maturing varieties could well afford to try them and use the one he likes best.

An important point to keep in mind, if blossom thinning is used, is the chance of frost occurring after the thinning is done. If there is little chance of frost causing additional thinning, about twice as many blossoms should be left as fruits desired. If late frosts are likely to occur, possibly four times as many blossoms should be left as fruits wanted at harvesting time. Some additional thinning may be necessary later when the extent of fruit set can be determined.

As a guide for thinning operations, it should be remembered that about 195 peaches of the 2¼- to 2½-inch size are required to make a bushel. This is the most popular size for both fresh market and for processing.

Sprays of naphthaleneacetic acid have been used experimentally at the time of shuck-fall, but considerable injury has resulted to foliage and new growth, in some instances, and thinning does not occur until the time of the June drop. This is too late to be of maximum benefit to early varieties.

HARVESTING

The first few baskets of peaches offered for sale usually bring a high price. As a result, the market is immediately flooded with immature peaches. The price drops quickly, but the harvest continues, with the peaches usually being picked a few days too early throughout the season. It is true that the peach is a highly perishable fruit and must be handled rather quickly in order to have it reach the consumer in sound condition. In doing this, however, there has been generally so much haste involved that the consumer has often received a product of poor quality. Peaches that are well ripened and have their full flavor are one of our most delicious fruits, but those that are picked

too early have a bitter flavor that almost completely subdues any desire for more. Not only is flavor impaired by too early harvesting, but the peaches do not attain their best color and size.

McMunn and Dorsey[5] of the Illinois Experiment Station made some studies on the influence of time of harvesting Elberta peaches on total yield, size of fruit and keeping quality. The date at which commercial harvesting commenced in the orchard in which they were working was August 15. With regard to the influence of time of picking on total yield, they state:

> "If 100 bushels were harvested on August 15, 107.9 bushels could have been harvested on August 17, 116.5 bushels on August 20, and 124.4 bushels on August 22."

With reference to the influence on size of fruits:

> "On August 15 but 47.8 percent of the fruits were 2¼ inches and above, 70.9 percent were in this grade on August 17, 84.9 percent on August 20, and 93.7 percent on August 22."

Regarding storage ability, they reported:

> "These storage studies point clearly to the fact that fruit harvested as much as seven dyas later than is normally done in Illinois, will hold up in transit, and for at least two weeks in storage with no more loss than is encountered in harvesting at a more immature stage, and at the end of the storage period the fruit of the later picking will be of more attractive color and of better quality."

This experiment indicates that too early picking results in lower yields, grades and quality, and the losses are very substantial—sufficient to mean the difference between operating the orchard at a profit or loss in certain seasons.

What is the best time to harvest peaches? Probably just as the ground color is beginning to change to yellow (or white for white varieties) and while the peach is still firm. In order to obtain maximum yields and fruits of best color and quality, it is necessary to pick the trees more than once during the harvesting season. Some growers pick their trees two or three times, taking off only those fruits of first-grade size and color. Others pick as many as 5 to 10 times, removing only the largest and best colored fruits, leaving the smaller fruits to gain size and color before being harvested. Maximum yields of first-grade fruit can be obtained by the use of this method. Some try to harvest the fruit all at one picking; this naturally results

[5]McMunn, R. L. and Dorsey, M. J.—"Investigations on Delayed Harvesting of Elberta Peaches"—Trans. Ill. State Hort. Soc., Vol. 68, pp. 491-502, 1934.

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.

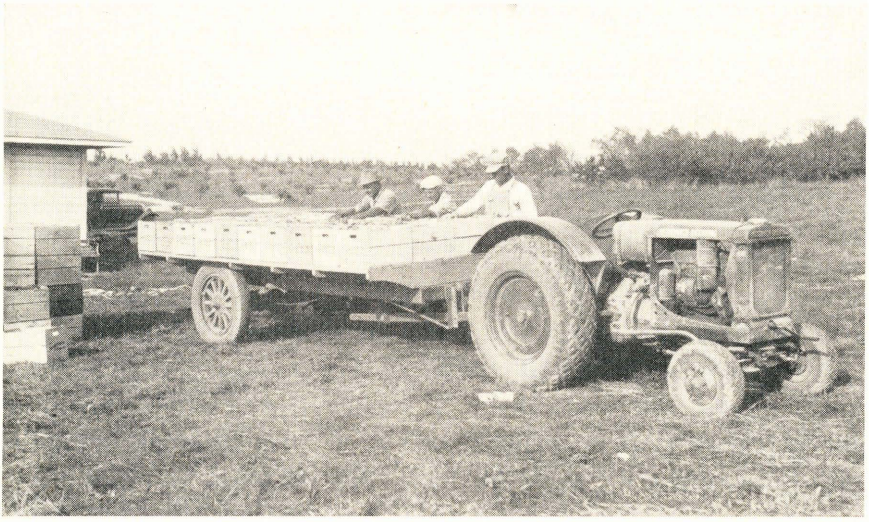

Fig. 21. A low trailer attachment for the tractor, which is very useful in moving peaches out of the orchard during the harvest with ease and speed.

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

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

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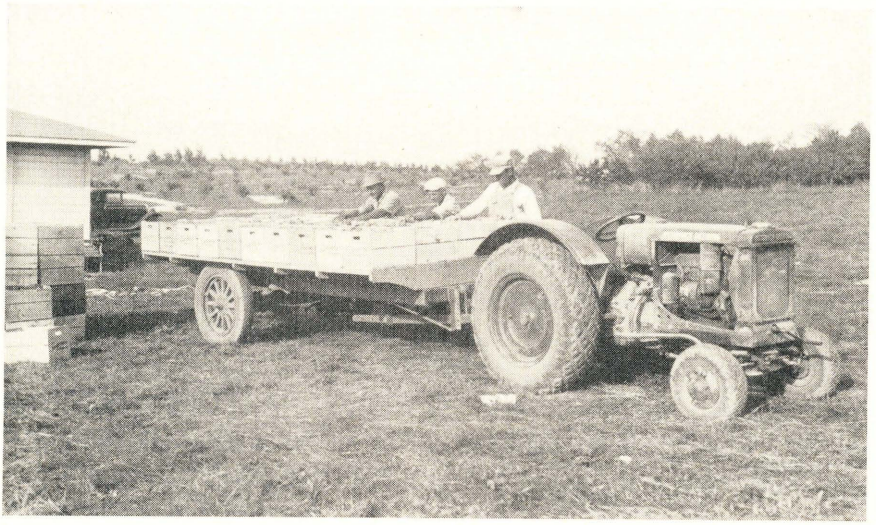

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peaches, while the half-bushel is used considerably for earlier and softer varieties.

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.

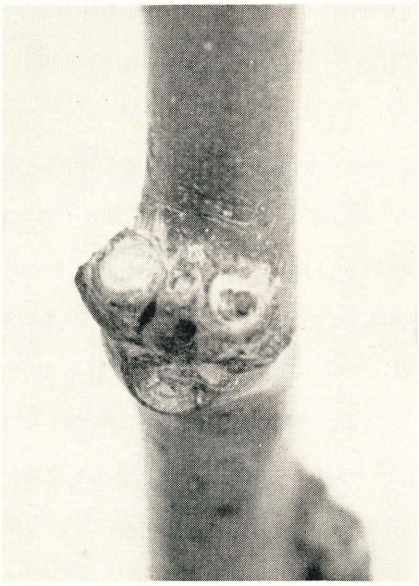


Fig. 22. Two peach flower buds with a leaf bud in the center. The flower bud at the right was winter-killed, while the one at the left was injured very slightly but not enough to prevent its blossoming.

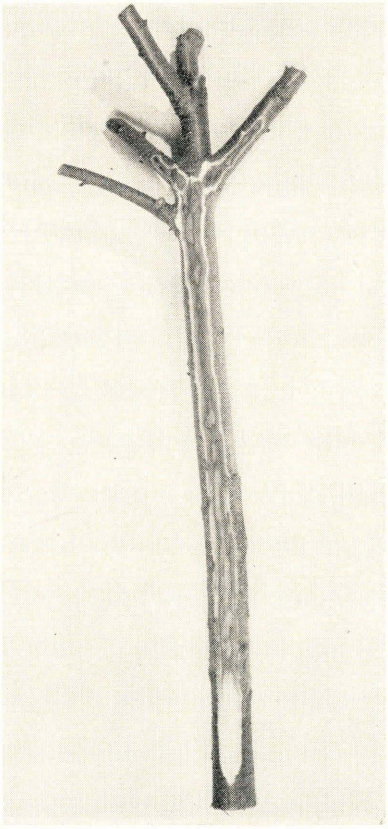


Fig. 23. Two-year-old peach tree showing severe winter injury above the snow line. Lower 3 inches of trunk was protected by snow. It is doubtful if a tree injured this severely will live. New shoots may develop just below the injured area, and a new tree trained from one of these.

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.

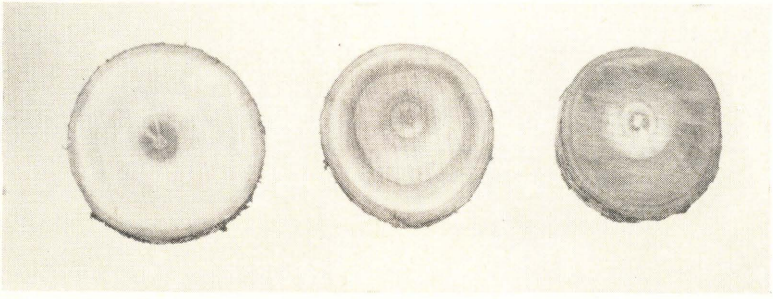


Fig. 24. Cross sections of one-year-old peach trees showing varying degrees of winter injury. Left: Very slight injury. Center: Moderate injury. Right: Severe injury.

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.

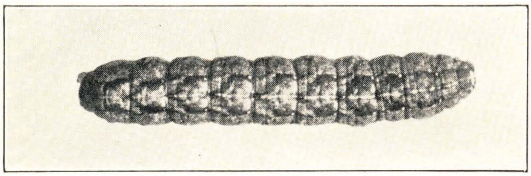


Fig. 25. The most common climbing cutworm attacking peach trees.

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.

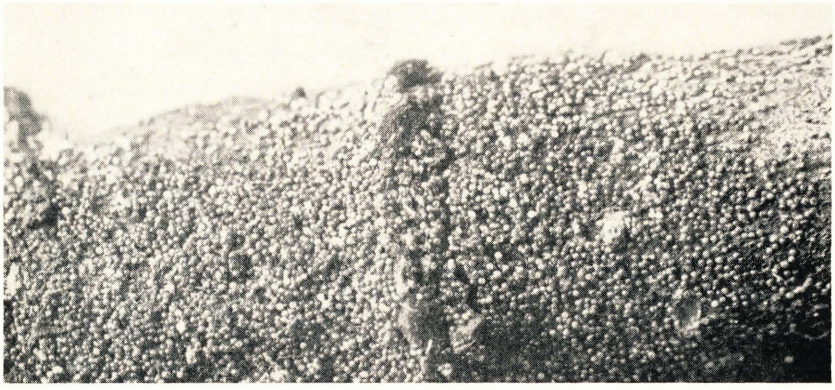


Fig. 27. Eggs of European red mite massed on twig, greatly enlarged.

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,

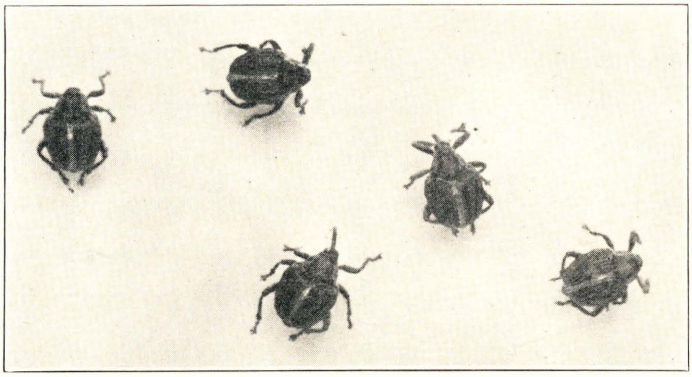


Fig. 28. Adult plum curculios, enlarged.

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.

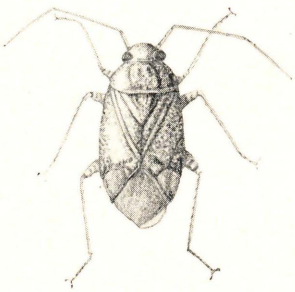


Fig. 30. Adult tarnished plant bug, enlarged.

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.

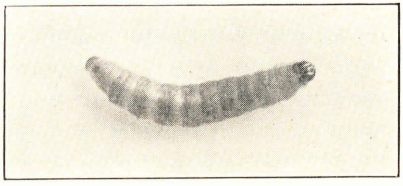


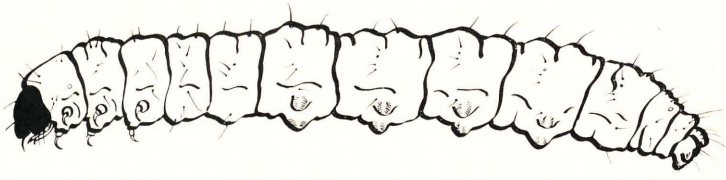
Fig. 31. Oriental fruit moth larva, enlarged about two times.

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.

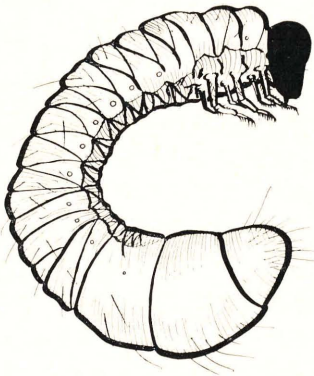
Injury—Oriental fruit moth larvae kill back the twigs in their burrowing. Usually this is not unduly serious, although it induces

MOTH - FLY - BEETLE LARVAE

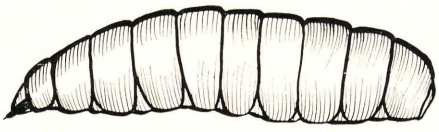


Caterpillar

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

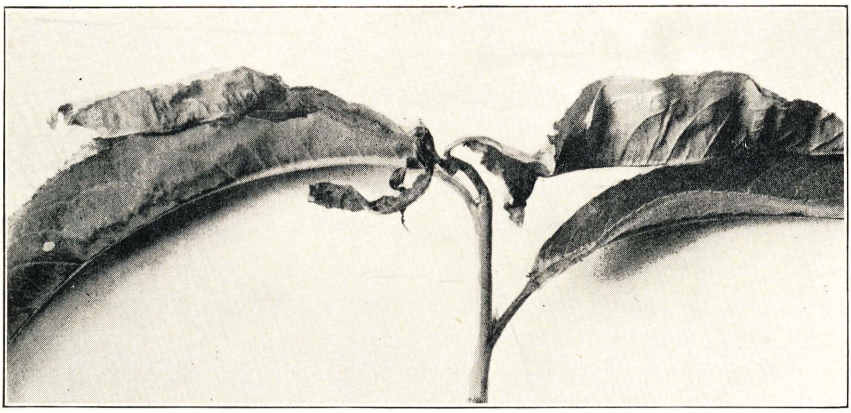


Fig. 33. Peach twig killed back by oriental fruit moth larva.

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.

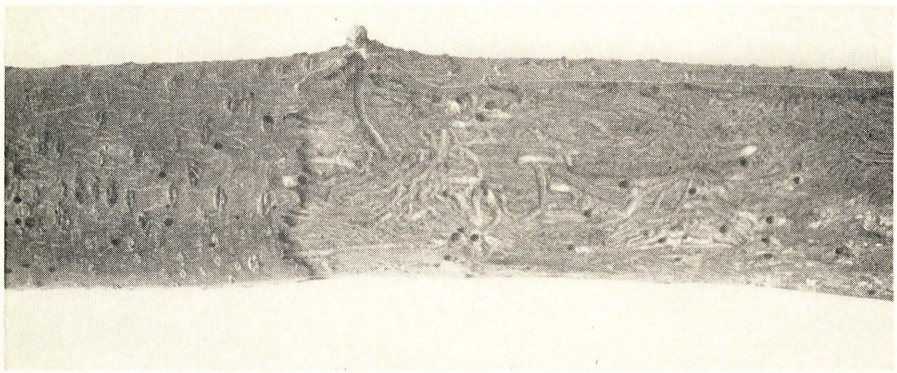


Fig. 35. Breeding galleries of shot-hole borer.

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.

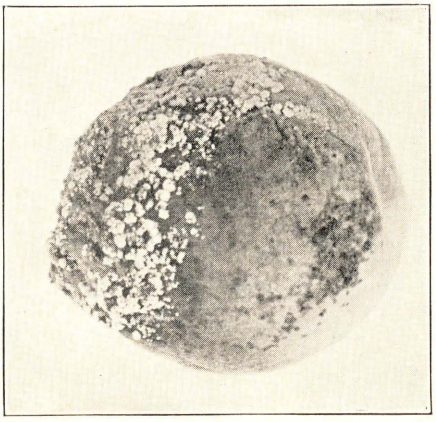


Fig. 38. Brown rot on the fruit.

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.

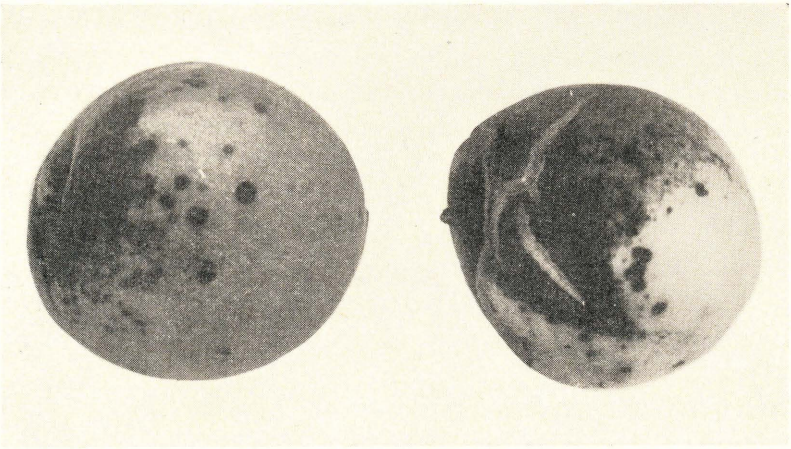


Fig. 39. Peach scab. Cracking of the fruit results in severe cases.

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.

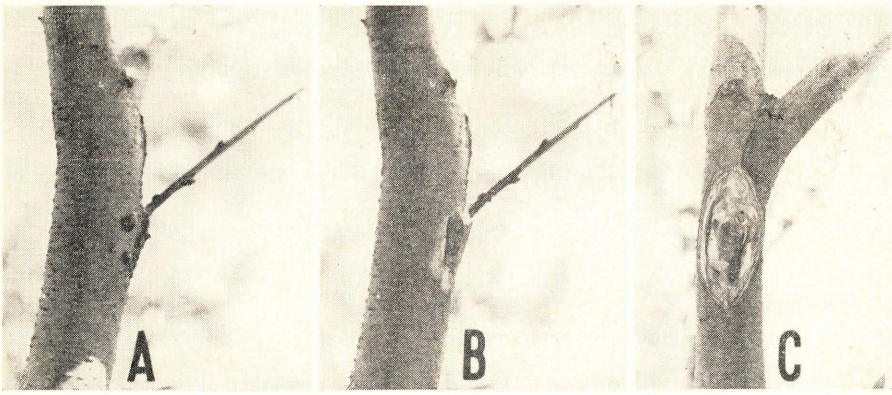


Fig. 42. Treatment of peach cankers. A. Gumming at the base of a dead twig signifies a canker. B. Bark cut away exposing dead cankered area. C. Finished canker treatment. Twig removed, area cleaned out to live bark, wound pointed at top and bottom. Ready for disinfectant and paint.

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

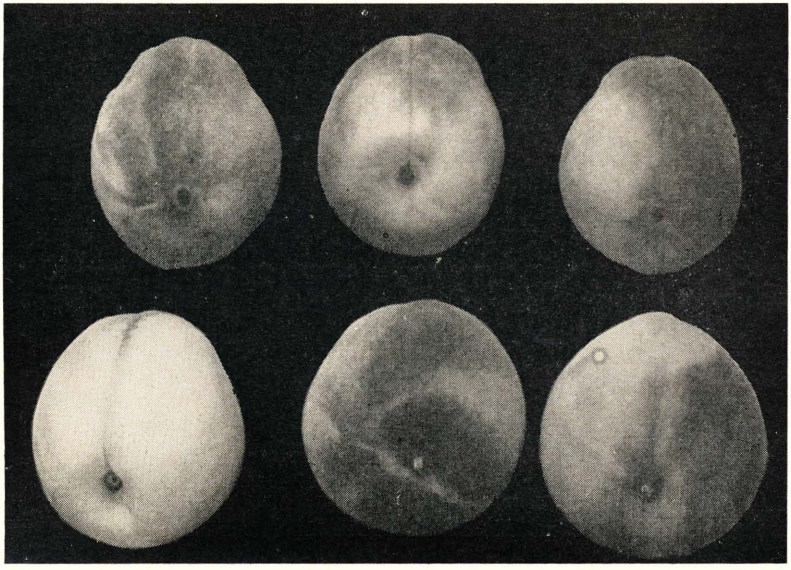


Fig. 45. Red suture of peach. Top row diseased. Bottom row healthy.

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

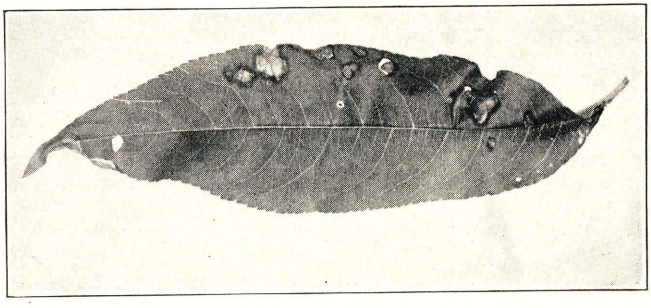


Fig. 51. Arsenical injury on a peach leaf.

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.