Peach Culture in Michigan
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PEACH CULTURE *in* MICHIGAN

By Stanley Johnston

With Chapters on Peach Insects and Peach Diseases and their Control by Ray Hutson and Donald Cation

The Halehaven Peach. Introduced by the Michigan Agricultural Experiment Station in 1932

MICHIGAN STATE COLLEGE :: AGRICULTURAL EXPERIMENT STATION

SECTIONS OF HORTICULTURE, ENTOMOLOGY and BOTANY

EAST LANSING

The Redhaven peach is a promising new variety resulting from a cross between Halehaven and Kalhaven and matures about a month earlier than Elberta.

PEACH CULTURE IN MICHIGAN*

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. Finding a congenial home, it was widely planted, trees even escaping from cultivation and growing in large numbers in the wild state. Pits are still gathered from the descendants of these trees for use as rootstocks in commercial nurseries.

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 near St. Joseph planted an aggregate of 25 acres of orchard. President A. S. Dyckman (1), in an address before the State Horticultural Society in 1874, made the following comments concerning this venture:

> "When, about the end of the last half century, Eleazur Morton, George Parmelee, and Curtis Boughton, the pioneers of St. Joseph peach culture, set their respective orchards, an aggregate area of about 25 acres, people opened their eyes with amazement at this exhibition of lunacy, thinking the production of such large orchards would overstock the market. Now, with their estimated 594,467 peach trees in that region, in 1872, besides extensive orchard interests at South Haven, Saugatuck, Holland, Grand Haven, Spring Lake, and other points north along the shore, our Western Michigan fruit growers are relieved from the charge of lunacy, notwithstanding the reckless manner in which they are raising peach trees by the hundreds of thousands. But, to bring this subject to full comprehension, one should visit Chicago in the season of harvest, and see the wilderness of fruit, by every avenue of commerce, seeking destination in every corner of the great Northwest. People are in sober earnest; the fruit supply has become one of the great necessities of trade, and especially does the peach, with its delicious and health-giving qualities, find a welcome in every mart."

The industry was growing rapidly when suddenly in 1866 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.

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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, in 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.

As a result of this prematurely low temperature it was estimated that the number of living trees in Allegan County was reduced from 1,089,418 to 264,847; in Berrien County from 1,377,734 to 267,800; in Van Buren County from 1,201,166 to 114,183; in Kent County from 861,405 to 173,982. For the state there was a reduction from about 7,500,000 trees to approximately 2,000,000. Oceana, Mason, Manistee, Grand Traverse, Leelanau, Lenawee, Oakland, Macomb, Lapeer, St. Joseph and many other northern, central and eastern counties retained their numbers of trees or gained slightly from 1904 to 1910.

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.

Table 1. Number of bearing and non-bearing trees in the United States and in states which have peaches on the market during the Michigan peach marketing season. (Source: United States Census.)

State	1920		1930		1935	
	Bearing	Non-Bearing	Bearing	Non-Bearing	Bearing	Non-Bearing
New York	3,038,023	658,868	1,683,521	785,698	1,702,390	440,392
Ohio	2,924,177	970,183	2,356,404	1,461,539	2,486,068	833,057
Indiana	860,024	568,046	1,324,844	604,558	1,092,634	242,071
Illinois	1,011,325	839,712	2,989,997	1,037,459	2,841,878	322,663
Michigan	2,010,022	764,838	2,007,743	1,173,238	1,956,917	940,506
Missouri	2,358,925	716,325	1,611,593	668,953	1,785,474	402,286
Oklahoma	2,879,945	637,762	1,384,806	442,445	978,999	169,880
Idaho	178,434	26,648	95,758	22,427	78,928	32,819
Colorado	446,943	32,158	454,101	334,565	621,128	136,979
Utah	554,202	28,551	491,430	206,197	439,194	107,312
Washington	649,085	50,254	532,497	227,315	605,828	121,586
California	9,057,760	1,366,941	10,222,215	1,633,516	8,029,435	826,747
United States	65,646,101	21,617,862	58,911,983	20,134,313	54,073,841	12,995,221

PRESENT CONDITIONS

The numbers of bearing and non-bearing peach trees in the United States and in states which place peaches on the market at the same time as Michigan, are shown in Table 1 for each of the census years, 1920, 1930 and 1935. The data presented in Table 2 are of interest with reference to the trend of peach production in the United States and certain key areas during the period 1920-39. It will be noted that during the last five years of this period, 1935-39, average production per year increased 8,841,000 bushels, or about 19 per cent over that of the

Table 2. Peaches: Production and seasonal average price, 1920-39.

Year	California			Southern States[1]	Other States	Total United States	Seasonal average price per bushel received by producers
	Clingstone	Freestone	Total				
	1,000 bu.	1,000 bu.	1,000 bu.	1,000 bu.	1,000 bu.	1,000 bu.	Cents
1920	5,750	9,376	15,126	11,582	17,893	44,601	204
1921	4,667	8,251	12,918	13,023	6,872	32,813	148
1922	8,084	9,126	17,210	17,423	22,772	57,405	133
1923	7,084	8,751	15,835	11,354	17,601	44,790	137
1924	5,625	8,001	13,626	22,112	16,016	51,754	124
Average 1920-24	6,242	8,701	14,943	15,099	16,231	46,273	149
1925	9,584	6,667	16,251	18,530	10,736	45,517	137
1926	13,626	8,626	22,252	20,673	23,384	66,309	99
1927	13,418	6,626	20,044	11,585	11,558	43,187	117
1928	17,251	8,501	25,752	22,680	17,630	66,062	97
1929	7,501	5,875	13,376	13,505	17,856	44,737	137
Average 1925-29	12,276	7,259	19,535	17,395	16,233	53,162	117
1930	22,585	10,584	33,169	12,885	9,292	55,346	89
1931	16,543	7,584	24,127	24,893	28,033	77,053	57
1932	14,168	8,626	22,794	5,854	14,646	43,294	53
1933	14,626	7,459	22,085	13,455	9,731	45,271	76
1934	13,501	7,126	20,627	19,040	8,018	47,685	81
Average 1930-34	16,285	8,276	24,560	15,225	13,944	53,730	71
1935	12,001	5,875	17,876	17,022	19,792	54,690	85
1936	14,043	7,292	21,335	14,565	11,583	47,483	95
1937	15,418	7,834	23,252	14,176	22,296	59,724	102
1938	13,042	7,459	20,501	16,680	14,764	51,945	77
1939 [2]	15,210	8,501	23,711	17,444	20,575	61,730	84
Average 1935-39	13,943	7,392	21,335	16,977	17,802	55,114	89

[1]Includes North Carolina, South Carolina, Georgia, Florida, Tennessee, Alabama, Mississippi, Arkansas, Louisiana, Oklahoma, and Texas.
[2]Oct. 1, 1939 estimate.
Data from Agricultural Outlook Charts for 1940 compiled by the Bureau of Agricultural Economics, U. S. D. A., except averages.

Table 3. Total peach production in Michigan with average prices received by producers.

1920–1939

Year	Production in bushels	Average farm price received by producer
1920	1,177,000	2.30
1921	389,000	2.90
1922	1,091,000	1.50
1923	834,000	1.79
1924	383,000	2.30
Average 1920-24	775,000	2.16
1925	483,000	2.20
1926	1,334,000	1.00
1927	615,000	2.10
1928	1,235,000	1.55
1929	998,000	1.80
Average 1925-29	933,000	1.73
1930	1,011,000	1.50
1931	2,372,000	.60
1932	2,208,000	.70
1933	259,000	1.75
1934	644,000	1.75
Average 1930-34	1,299,000	1.26
1935	2,477,000	.85
1936	1,720,000	1.50
1937	2,652,000	.95
1938	1,341,000	1.30
1939	2,760,000	.70
Average 1935-39	2,190,000	1.06

NOTE:—Prices for 1920-25, inclusive, are as of September 15. Prices for 1926-39, inclusive, are average for the season. 1939 figures are preliminary estimates.

first five years. For the same comparative periods California showed an increase of approximately 42 per cent, the southern states 12 per cent and all other states as a group about 9 per cent. The trend in peach production in Michigan during the same 20-year period is shown in Table 3. It will be noted that there has been a steady and marked increase in production over this period, with the average production during the last five years about 200 per cent higher than for the first five years of the period. New peach plantings in Michigan have been sufficiently extensive to maintain, or possibly moderately increase, present production.

An analysis of the trend in peach production in other key states indicates that there will probably be (1) a slight upward trend in California, (2) much heavier production in the southern states, par-

ticularly because of very heavy plantings in South Carolina where there has been about a 600 per cent increase in planting since 1930 with about two-thirds of the trees not yet of bearing age, and (3) a continuation of the upward trend in Pennsylvania, Virginia, West Virginia, Delaware, and the western states other than California.

Of particular interest to peach growers in Michigan is the situation in Illinois, Indiana, Ohio and, to a less extent, New York, for the reason that these states compete with Michigan in peach production more directly than others. Great numbers of peach trees were killed in those states in the severe winters of 1933-1934 and 1935-1936. On the basis of available information, the number of peach trees in those states is still probably considerably short of what it was previously but replanting has been going on more extensively than anticipated. The trend has also been toward earlier maturing and hardier varieties than Elberta.

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 per cent 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.

Reference has already been made to the first commercial peach plantings near St. Joseph in 1848. No doubt those plantings were made because the owners had been encouraged by the success of other small, home plantings in their neighborhood. It remained for the severe winter of 1855-56 to emphasize the advantage of the land adjacent to Lake Michigan on the western side of the state for peach culture. Bradford and Cardinell (2) refer to the winter of 1855-56 in which the temperature dropped to as low as —24° F. in south-central Michigan as follows:

> "In the midst of this destruction, which became historic from Iowa and Minnesota to Tennessee and Delaware, appeared an exception which was destined to change the geography of Michigan peach growing. A correspondent of the Michigan Farmer wrote: 'In the eastern and middle sections of the state, the peach crop and the entire trees, to a large proportion, are dead or so nearly so as to be useless. When in Van Buren County, in the vicinity of Mattawan and Paw Paw, we saw trees loaded with peaches. We were also informed that, in that county, from Paw Paw to the lake shore, the crop of peaches was good.' At Grand Haven there was no injury. St. Joseph in 1856 shipped a small quantity of peaches to market. From this time the real development of the peach industry on the lake shore was under way. The plantings made here immediately after this winter were so extensive that they occasioned fears of overproduction."

Following that severe winter various observers commented from time to time in the Michigan State Horticultural Society Reports and elsewhere about the moderating influence of Lake Michigan on the climate of the territory adjacent to the shore from the Indiana boundary to the Grand Traverse region. The reasons for this moderating influence on the climate were well stated by T. T. Lyon (3) in a paper presented 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

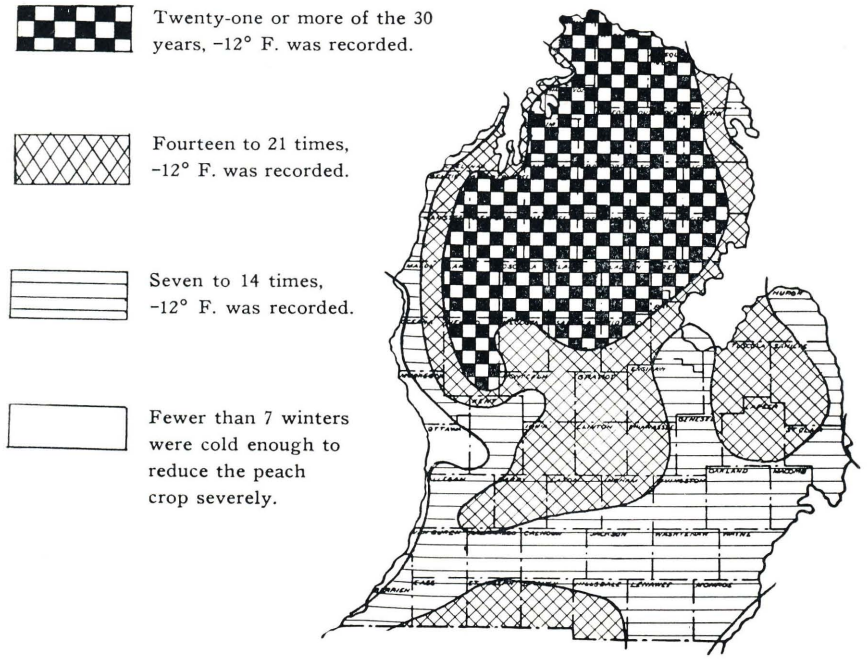


Fig. 1. Thirty Michigan winters, 1910 to 1940. The frequency that temperatures of —12° F. were recorded.

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 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 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-

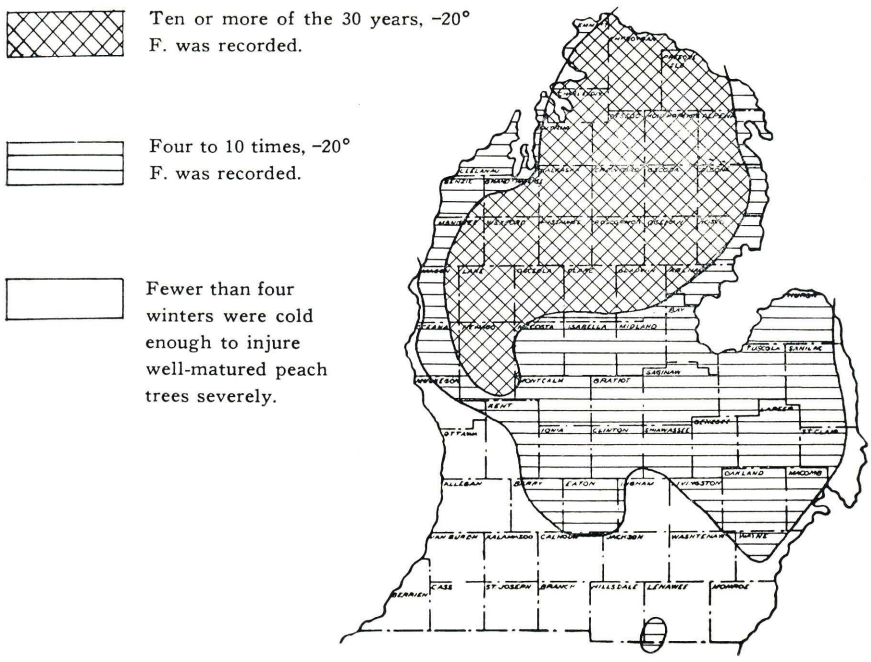


Fig. 2. Thirty Michigan winters, 1910 to 1940. The frequency that temperatures of —20° F. were recorded.

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 eleva-

tion 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 1888-1938, 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—In addition to numerous fresh fruit markets, which are the principal outlets for Michigan peaches, several canning plants provide a market for certain varieties, especially clingstone peaches, in which there is considerable interest at present. The canneries are also very useful in providing an outlet for freestone peaches in years of such heavy crops that the fresh fruit markets are unable to absorb them all.

SELECTING THE SITE

A study of the history of peach growing in Michigan, as told in the reports of the Michigan State Horticultural Society extending back to 1870, indicates the great importance of elevation in successful peach growing. Orchards planted on sites having good elevation are not so frequently injured by low winter temperatures as those on low lands, although there may be an occasional exception if the orchard is located on a very high and exposed elevation. Trees on such a site, following a severe cold wave accompanied by a high wind, may show more injury than those on slightly lower and better-protected sites.

With the very important advantages of elevation from the standpoint of protection against winter and frost injury is associated the problem of soil erosion (Figs. 3 and 4). Partridge and Veatch (4) in their discussion of the selection of orchard sites have this to say regarding the relationship of the degree of slope to the amount of erosion:

> "Slopes are of special significance in the evaluation of land for orchard use. The most practical classification of these is on the basis of gradient, expressed in percentage of rise per hundred feet of horizontal distance; and the grouping of gradients into five classes, namely: (1) level to 3 per cent; (2) 3 to 8 per cent; (3) 8 to 15 per cent; (4) 15 to 25 per cent; and (5) slopes greater than 25 per cent. The reason for directing attention to the degree of slope is because, other elements being the same, erosion due to washing varies directly with the steepness. Erosion is probably responsible for larger losses of soil fertility than any other factor in Michigan."

Because of the significance of elevation in peach growing, a high percentage of sites on which peach orchards have been grown inter-

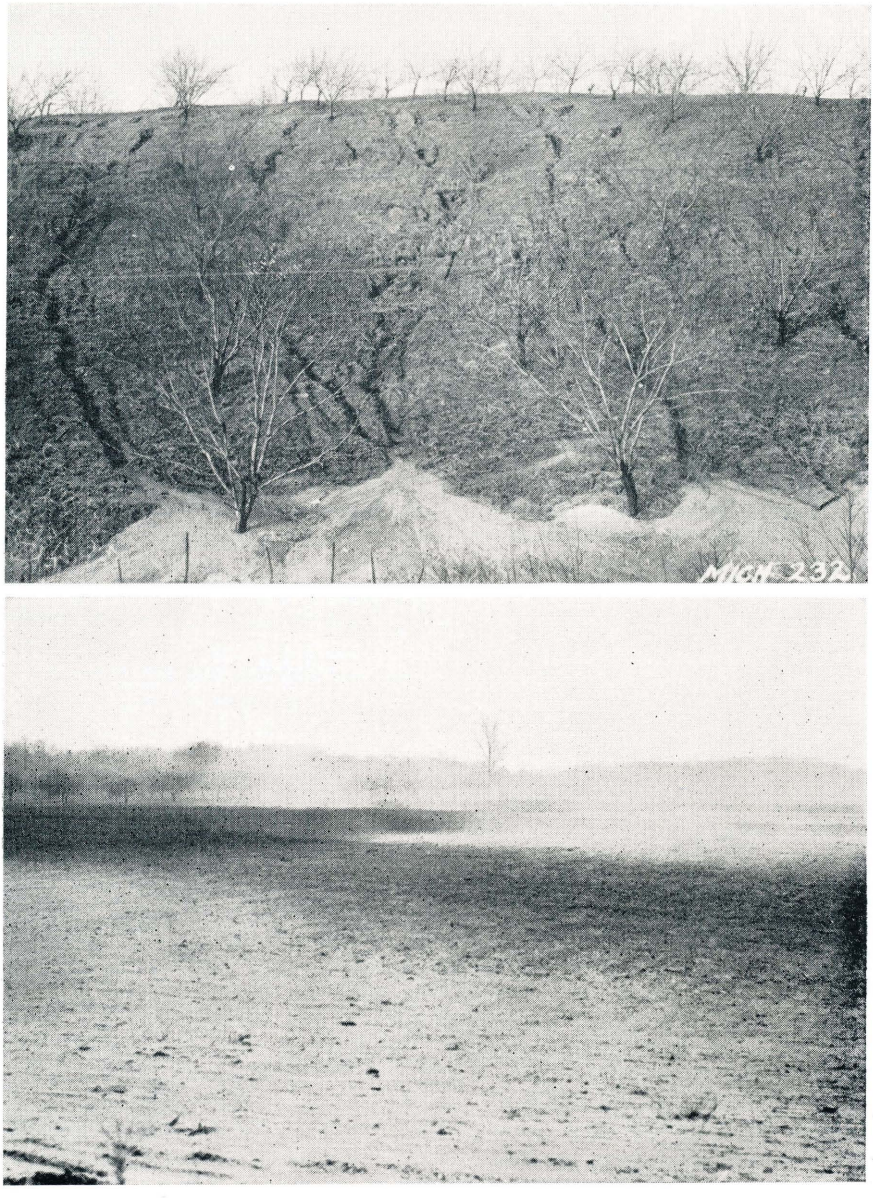


Fig. 3. Above: water erosion in a peach orchard growing on a steep slope. Many such slopes have been almost permanently ruined for future orchard use by erosion. Below: wind erosion in an open field with peach orchard in the background. Keeping the soil well supplied with organic matter and in some kind 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)

Fig. 4. Erosion causes heavy loss of topsoil on much gentler slopes than those shown in Fig. 3. This illustration shows destructive wash in a cultivated peach orchard on a gentle slope with a gradient of about 3 per cent. Erosion on such a slope can be controlled with comparatively simple methods.

mittently for many years has been on rather steep slopes that have become badly eroded. It is doubtful if many of these sites can be used again profitably without several years of soil building.

Owing to the comparatively short time that investigational work has been carried on regarding the effects of erosion on orchard soils and to the different degrees of injury that equal soil losses cause on various soil types, insufficient data are available to state definitely how much erosion must take place on a particular site to render it unprofitable for peach growing. Partridge and Veatch (4) have pointed out that the greater the degree of slope the more rapid and destructive the erosion. This is verified by the data shown in Fig. 5, which were obtained in a peach orchard in Berrien County.

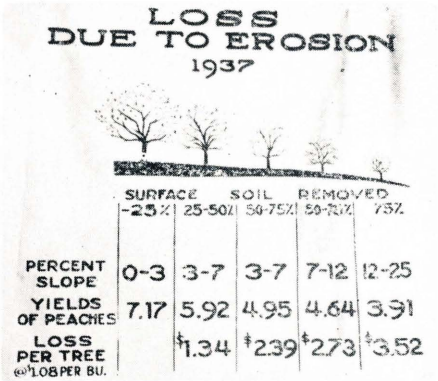


Fig. 5. Erosion is taking a great share of the financial returns from many Michigan peach orchards. Often the amount is so large as to make the enterprise unprofitable. (Photograph and data from the Michigan-One Project, Soil Conservation Service, U. S. Department of Agriculture)

Another question of importance that the peach grower may have to decide is with regard to how great an expenditure would be justified in attempting to save or improve the soil on a peach site that had once produced profitable peach orchards, but

which has eroded to an extent where a new orchard would be only moderately profitable, or which has eroded so badly that replanting would be inadvisable. Each site must be studied individually to answer this question. A site that will produce peaches 25 years out of 30 is very valuable. A peach crop in a year when many other locations in Michigan and in other states have been frozen out will pay for a great deal of effort to save or rebuild the soil on that particular site.

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 three or four years of age 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 trying 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.

Peach trees should never be planted on land that has grown peach trees within three years, because of the possibility of black aphid injury to the young trees. A moderate number of them on the roots of mature trees is not serious, but if the old trees are removed and a new peach orchard set the following year, the aphids will attack the young trees in such numbers as to kill or permanently injure many of them.

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° rather frequently, the Elberta peach should not be extensively planted. Hardier varieties such as South Haven, Rochester or Halehaven 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.

That the peach variety list changes rapidly is evidenced by the fact that of all the commercial peach varieties recommended for planting in Michigan 25 years ago, Elberta alone remains. This is in contrast to the variety list for apples, pears, plums and cherries. One important reason for this rapid change in the peach variety list is the comparatively short life of the tree. This is due to susceptibility to winter injury and several destructive diseases and insects. Consequently, peach orchards are replanted much more frequently than other tree fruits, thus affording an opportunity to try some of the new varieties that appear promising. Moreover it takes a much shorter time to develop and test new peach varieties than other fruits, especially when compared with the apple and the pear. As the result of fruit breeding projects conducted by various experiment stations, a keener search for promising bud sports, and the usual introduction of new kinds by nurseries, the fruit grower is being offered many new varieties from which to make his selection for new plantings. All new varieties should first be planted in small numbers. A good rule for the fruit grower regarding varieties, would be the passage in the Bible (First Thessalonians, 5: 21): *"Prove all things. Hold fast that which is good."*

A few old varieties which are of such poor quality that they should be discarded are still being offered by nurseries. If the housewife succumbs to the beauty, for instance, of some Early Red Bird cling peaches and takes them home only to find that not only is it almost impossible to remove the rubbery flesh from the pit, but that after part of the flesh is removed it is of very poor quality, she is likely not to buy peaches again for a long time. If the demand for peaches is to be maintained and increased, it is imperative that the nurseries, fruit growers, and experiment stations cooperate in an effort to see that only varieties of good quality are grown.

The following varieties are recommended as standard for Michigan at present. They are all yellow-fleshed, freestone varieties, inasmuch as white-fleshed or cling peaches are not popular on the fresh fruit markets of the middle west. A canning industry based on yellow-fleshed clingstone peaches is developing in Michigan. This will be discussed later. The varieties described in the following notes are listed in the order of ripening.

Arp (Arp Beauty) matures about 40 days before Elberta. The trees are vigorous, productive and apparently rather hardy. The color of the fruit is bright and attractive. The flesh is yellow, slightly coarse, clings to the pit slightly, and is of good quality. Because of the soft texture of the flesh the fruits cannot be shipped, but the variety is useful in a limited way for local and roadside markets.

Redhaven matures about 30 days before Elberta. This variety originated at the South Haven Experiment Station from a cross between Halehaven and Kalhaven and was introduced in 1940. The trees are of standard size and apparently above average in hardiness. The fruits are medium in size and brilliant red in color. The flesh is firm, fine-grained and of good flavor. Because of a tougher skin and firm flesh, this variety gives promise of handling better than most varieties of its season. The fruits set profusely and will need to be well thinned. It has been so recently introduced that sufficient time has not elapsed to determine its true value. (See inside front cover picture.)

Golden Jubilee matures about 24 days before Elberta. It has been planted on a wide scale in eastern United States and to a moderate extent in Michigan. The trees are of standard size and apparently of average hardiness. Fruit buds of this variety are hardier than those of Elberta but not so hardy as those of Rochester or South Haven. The fruits are of Elberta type and usually are of good size and well colored, having a fairly equal balance between red and yellow. The flesh is moderately firm, fine-textured and of good flavor. There is a tendency for the flesh to mature first on the suture side, a characteristic that injures its shipping quality. Sometimes the fruits are too flat in shape, especially if the trees are heavily loaded. Slowness in coming into bearing has been frequently observed. The fruits are very popular on roadside markets. Planting of this variety should probably be restricted to quantities that can be disposed of on local markets or those within a short trucking distance.

Rochester, a comparatively old variety that holds its popularity in some places despite several weaknesses, matures about 22 days before Elberta. The trees are vigorous, far above average in hardiness and very productive. In fact, they are so productive that unless the trees are well pruned and the fruits well thinned many small peaches will be produced. The fruits are often small, dark red in color and very fuzzy. Because of the excessive fuzziness, the fruits are susceptible to brown rot. The flesh is of good texture and excellent quality, and very popular for home canning. Though this variety has many faults, its hardiness, productiveness and good quality render it useful for planting in some locations, especially where low winter temperatures occur frequently enough to make the growing of more tender varieties unprofitable.

Early Halehaven matures about 22 days before Elberta. It originated as a limb sport on a Halehaven tree growing in the orchard of John Nametz near Benton Harbor and was discovered in 1938. It is apparently a Halehaven peach in all respects except that it ripens about a week earlier. It should be useful where a peach of the Halehaven type is desired for the earlier season.

South Haven matures about 17 days before Elberta. This peach originated on the A. G. Spencer farm near South Haven as a bud sport of St. John. It was discovered in 1911 and introduced in 1918. It has been widely planted and has been generally well liked for its hardiness, productiveness and good quality. Though exceptionally hardy in bud, the trunks have been rather susceptible to winter injury. Furthermore, the flesh and skin are somewhat tender for long distance shipment.

Halehaven matures about 15 days before Elberta. This variety originated as a cross between J. H. Hale and South Haven made at the South Haven Experiment Station in 1924. It was named and introduced in 1932. It has been rather widely planted, showing adaptability to many peach-growing regions outside of Michigan, especially in the east and south. The trees are large, vigorous and productive. The trunks seem to be hardier than those of South Haven but the fruit buds seem slightly less hardy. The fruits are almost completely colored with an attractive red, and develop color well on shaded interior branches. (See front cover picture.) Though the flesh is somewhat softer than desired, a tough skin enables the fruit to ship well, even though they have been left on the trees until well matured. The flavor of the flesh is excellent and the fruits are well liked for fresh use or for home canning. Fruits of this variety tend to set in profusion and thorough thinning must be practiced to insure good size.

Kalhaven matures about 4 days before Elberta. It originated as a cross between J. H. Hale and Kalamazoo at the South Haven Experiment Station and was released in 1936. The tree is slightly smaller than those of most standard varieties but is sufficiently vigorous and intermediate or better in hardiness. It is normally very productive and the fruits will need to be well thinned to attain good size. The fruits are well colored, having about an equal amount of bright red and clear yellow. The flesh is firm, fine-grained and of good flavor. A tough skin and firm flesh insure ability to stand shipment. This variety has been released such a short time that further observation will be necessary to determine its importance as a commercial variety.

J. H. Hale matures approximately with Elberta. Though the fruits of this variety are possibly the most beautiful of all the standard varieties now being grown, serious defects, such as weak, semi-dwarf trees, susceptibility to winter injury, self-sterility and susceptibility to bacterial leaf-spot, make the growing of this variety hazardous and of doubtful profit despite the fact that price per bushel usually exceeds that for any other variety. A few growers having ideal conditions for this variety have found it profitable, but they are the exception.

Elberta is so well known that it needs little comment. For many years it has occupied a dominant place among commercial peach varieties and it will be many more years before it is relegated to a minor position. Though the tree is tender in bud and the fruit is of mediocre quality, 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, all combine to maintain it in its leading position. Within recent years Elberta constituted probably 80 per cent of the peach plantings in Michigan and some other states. Because of a growing interest in earlier and hardier varieties, it will probably not occupy so prominent a position in the future.

Fertile Hale matures about the same time as Elberta. It was found in the orchard of Lawrence LaDuke near Lawrence, Mich., in 1928, and is apparently a whole-tree sport of the J. H. Hale. This is a comparatively new variety that has, in general, made a good impression, but whose ultimate value, as is true with all new varieties, must be determined after the passage of time. The trees are large, vigorous, productive and somewhat hardier than Elberta in bud. Characteristics of the fruit are intermediate between those of the J. H. Hale and Elberta, depending on the season and the amount of fruit on the tree. The fruits are usually as large or larger than Elberta and similarly colored. The flesh is moderately firm, slightly coarse and of good quality. This variety should not be confused with J. H. Hale, but should be grown strictly on its own merits.

The coming of the Oriental fruit moth and its severe attacks on late maturing peaches in particular, caused a loss of interest in late varieties. Since parasites of this pest have been released that have brought it reasonably well under control, there has been a renewed interest in varieties maturing after Elberta, although some persons doubt the need of such varieties because the use of cold storage has increased to such an extent that peaches of the Elberta season can be held until about the first of October, after which there is little demand for fresh peaches.

It is unfortunate that the grower who wishes to plant peach varieties maturing later than Elberta has little of unquestioned value to choose from. **Shipper's Late Red** has attracted some favorable comment but unfortunately at least four strains of this variety have been reported, all different and some of little value. **Wilma,** maturing about a week after Elberta, produces fruits of excellent color and size but the variety is very tender in wood and bud and should be planted only on the most favorable sites. **Salberta** matures a few days later than Wilma and is an Elberta type fruit with little red color. It is of only moderate value.

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, for instance, two serious diseases of peaches, the phony disease of the south and the "X" disease of the east that have not yet been found in Michigan orchards. Also, difficulties in connection with purchases made nearer home are usually more easily adjusted than when the nursery is located far away.

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 invariably pass the winter safely. There have been some complaints regarding trees stored in nursery cellars. If these cellars are maintained at the proper temperature and humidity, the trees should be held in them satisfactorily.

If the field is not ready to plant 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 ft. x 18 ft. rather than 20 ft. x 20 ft. 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 ft. x 20 ft. 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 become 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

Fig. 6. A peach orchard having sod strips in the rows with the row middles being cultivated. The rows and sod strips should extend across the slope. This is a simple and very effective way of checking soil erosion in many orchards on moderate slopes.

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 (Fig. 6).

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. This method of planting is new in Michigan and time will be needed to determine its ultimate value. However, it is believed that contour planting may be useful on those sites where erosion is somewhat more severe than usual and yet where the site has not been completely ruined by erosion. 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. 7). 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 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.

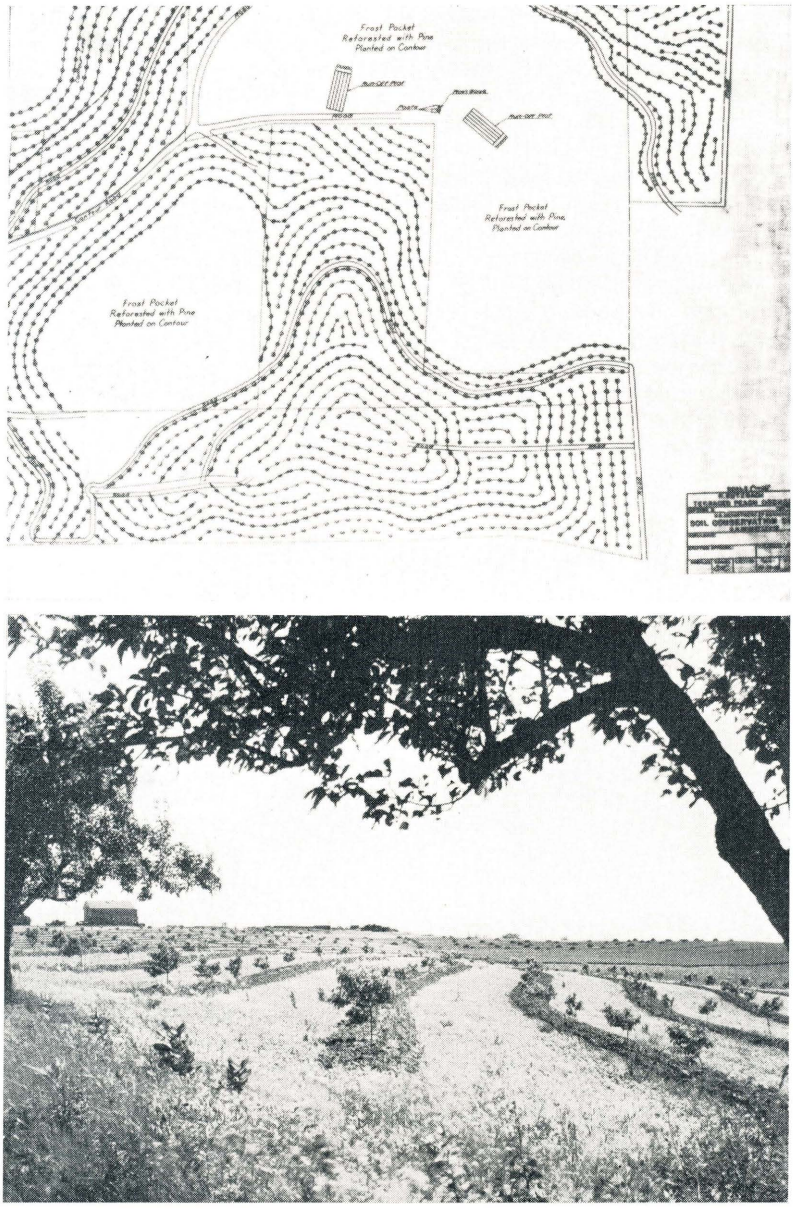


Fig. 7. Contour planting plan prepared by the Michigan-One Project, Soil Conservation Service, U. S. Department of Agriculture. The trees are planted 18 x 22 ft. on the average. Sites on which erosion is too difficult to control by simpler methods and which still have sufficient top soil to produce a profitable orchard can be planted on the contour plan.

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 wagon 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 or 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, with the possible exception of J. H. Hale, 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

Fig. 8. Above: a twelve-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.

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. 8). 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. 8).

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. 9). 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

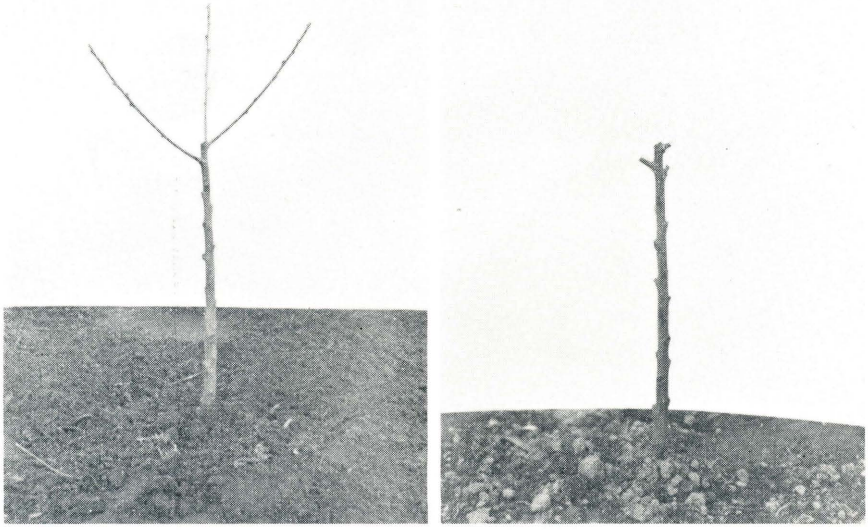


Fig. 9. Trees pruned immediately after planting to be trained by the three-scaffold method. If three suitable branches of equal size can be found close together they can be retained and cut back to 10 or 12 inches in length as shown at the left. Often three branches of sufficient vigor and uniformity 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.

two or three 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 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.

A light corrective pruning will be necessary during the spring of the second year (Fig. 10). 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.

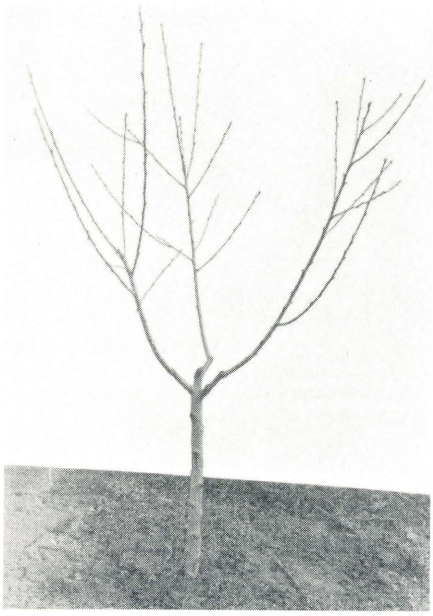


Fig. 10. A one-year-old tree trained by the three-scaffold method. The three scaffolds grouped closely together should develop a knot-like head of great strength. Pruning should be as light as possible during the first two or three years, but every effort should be made to keep the three scaffolds in balance. This can be done by doing the most pruning on the most vigorous scaffold branches.

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.

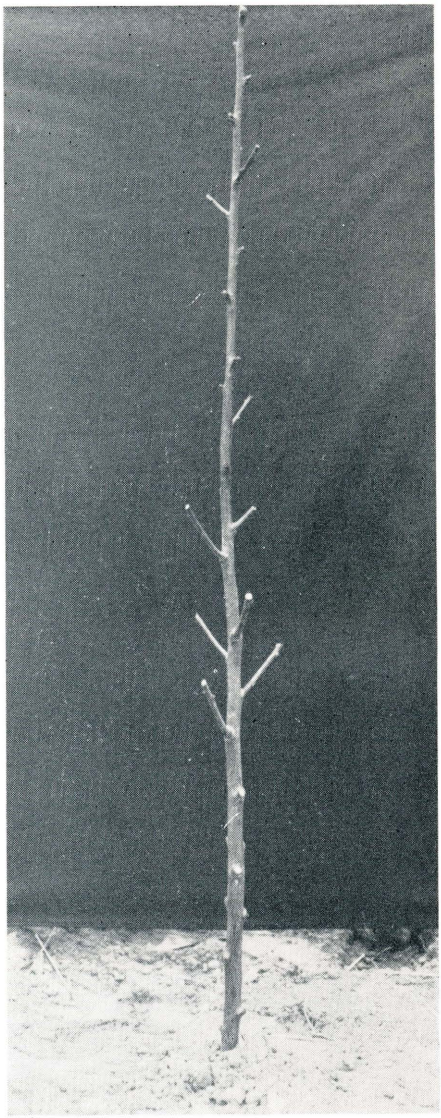


Fig. 11. A peach tree pruned immediately after planting to be trained by the central-leader method. The tree has been headed high, about 40 inches from the ground. All of the scaffold branches have been cut back to stubs. Only large nursery trees can be used successfully for this method of training. (See Fig. 12)

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. 11 and 12). 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

Fig. 12. A central-leader type peach tree at the end of the first year's growth. Part of the scaffold branches have been removed and two or three more having narrow angles at the point of attachment with the trunk should be removed. (See Fig. 16)

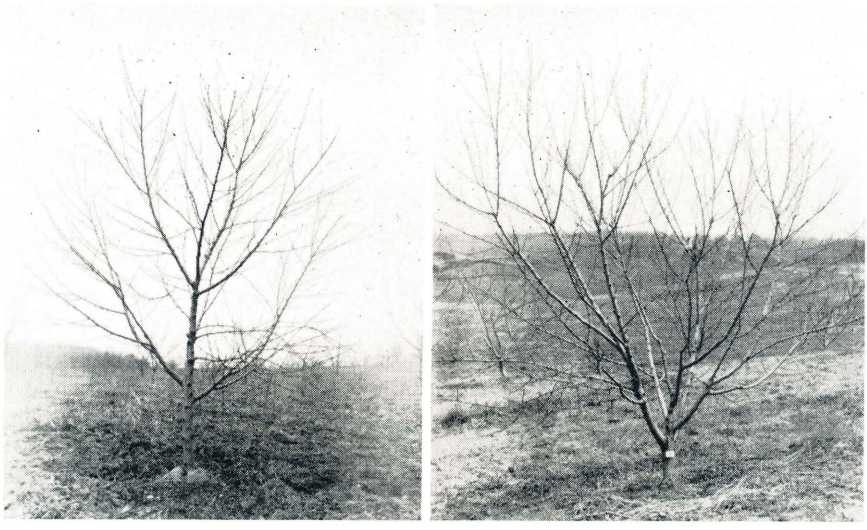


Fig. 13. Two conditions that need careful attention in trees trained by the central-leader method. Left: a two-year-old tree with too much growth in the top. Unless some of this is removed the lower scaffolds will be shaded to such an extent that their removal will be required within three or four years leaving large pruning wounds on the trunk. Right: the lower scaffold branches have been allowed to grow so much faster than the upper ones that the latter are being shaded out and will have to be removed, leaving a large pruning wound in the head of the tree.

Fig. 14. A two-year-old central-leader tree having good balance between the upper and lower scaffold branches. The small branches on the trunk should be removed within a year or two before they become large enough to leave large pruning wounds on the trunk, when they are eventually shaded out and have to be removed.

trained by some other method. Skill and careful attention are 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

Fig. 15. 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.

wounds on the trunk is the result (Fig. 13). Care must be used, therefore, in the pruning that the trees receives 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 (Figs. 14 and 15).

It has been observed that scaffold limbs forming a nar-

Fig. 16. 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. 17)

row 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. 16 and 17). 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. 12).

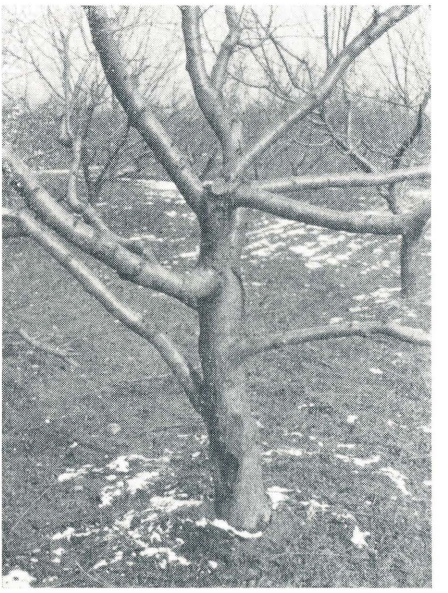


Fig. 17. A central-leader tree having generally wide-angled crotches at the points of union of the scaffold branches with the trunk. The one exception (lower left) has resulted in a poor connection which has been winter-injured. This injury has provided an entrance for borers and peach canker disease 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.

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 is 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. 18). 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. 21).

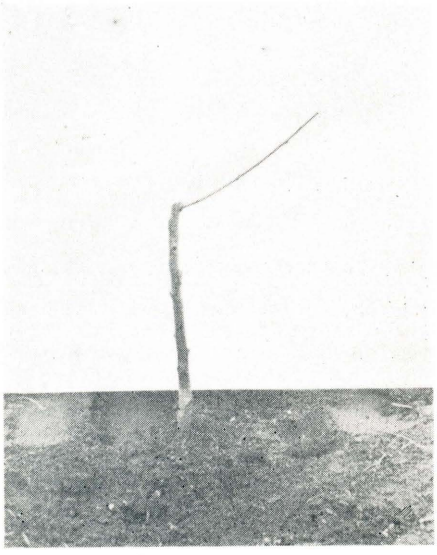


Fig. 18. A peach tree just planted and pruned to start its training by the side-leader method. One strong lateral branch is selected that is as nearly horizontal as possible. In planting, this branch should be placed opposite the direction of the prevailing wind. Three shoots to be used as scaffold branches are allowed to develop from it the first season. Others should be removed then or the following spring.

Fig. 19. A tree trained by the side-leader method at the end of the first year's growth. Three scaffold branches have been selected on the side-leader. Judging from the position and appearance of these, a strong tree should develop. Care will have to be used to subdue the two lower scaffolds sufficiently to permit the terminal branch to continue as the leader. Otherwise it will gradually be pinched out, leaving a two-scaffold tree. (See Fig. 20)

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 (Fig. 19). 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. 20). 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.

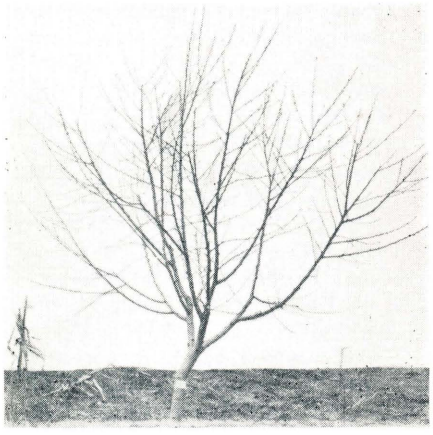


Fig. 20. A four-year-old peach tree trained by the side-leader method in which the two scaffold branches nearest the trunk were permitted to outgrow the terminal branch. This condition can easily be prevented by pruning the lower scaffolds heavier the first three or four years, thereby allowing the terminal scaffold to remain the leader until the form of the tree is well established.

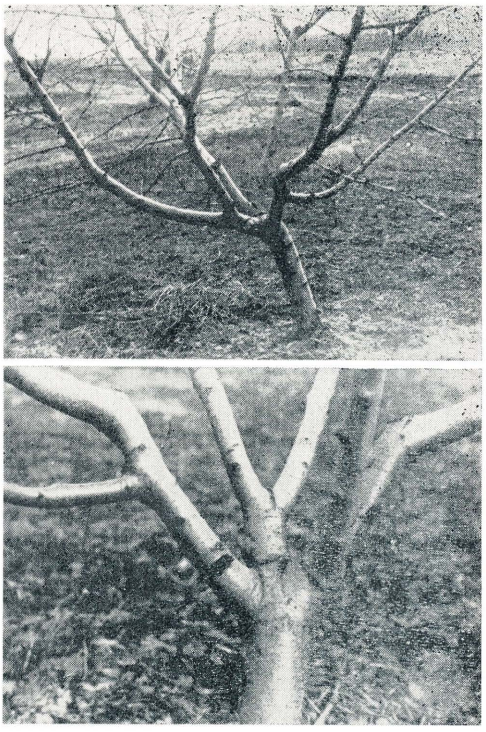


Fig. 21. Two views of the same tree, a four-year-old Halehaven, trained by the side-leader method. The scaffold branches are well spaced and have strongly knit unions with the head of the trunk.

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. 21 shows the development of this type at the end of the fourth year. Fig. 22 shows a full bearing tree that developed naturally by this method. Note the wide-angled crotches, sturdy scaffold branches and stout-looking head. Fig. 23 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 removed at planting time trees trained by the central-leader method should be somewhat larger in three or four 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.

Fig. 22. A peach tree in full bearing that developed naturally by the side-leader method of training. Note the three strong scaffolds with wide-angled crotches that developed from the original side-leader.

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 workman 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 succcess 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 thinning 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.

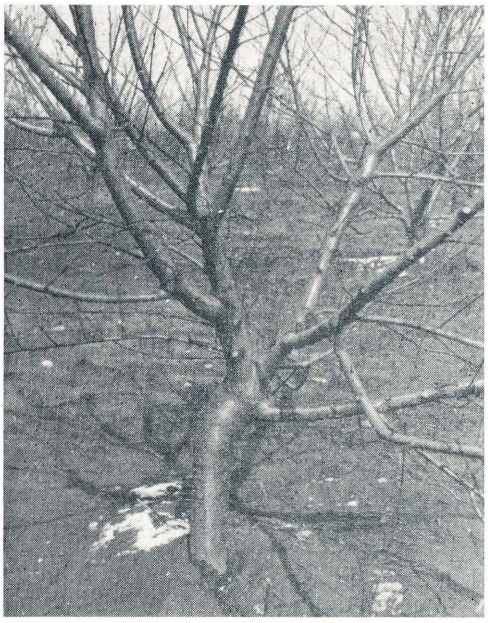


Fig. 23. A J. H. Hale tree, noted for its poor trunks and weak crotches, in full bearing and trained by the side-leader method. The scaffolds which grew from the original side-leader are sturdy and have wide angles and sound unions at the point of attachment with the trunk.

PRUNING THE BEARING TREE

After the tree is four years of age it can be considered, for the purposes of this discussion, as being in full bearing. The severity of the pruning given bearing peach trees in Michigan should be largely determined by the number of live fruit buds remaining on the trees about the first of March. If the trees at that time are carrying a high percentage of live fruit buds they should receive some heading back, to prevent their growing too tall, and sufficient thinning 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. On the other hand, if low temperatures have greatly reduced the number of live fruit buds it would be better to leave the trees unpruned, save for the removal of dead wood and broken branches, in the hope that sufficient live buds remain for at least a portion of a crop.

It is easy to be deceived when one inspects the trees to determine the amount of bud-killing that has taken place. Instances are on record where growers thought that all of the buds were killed and accordingly gave their trees a severe deheading to reduce their height and encourage the formation of new wood, only to learn to their sorrow by means of a few trees that for some reason had been unpruned, that not all of the buds were dead, but that a fair crop of peaches could have been

harvested and sold at high prices if the trees had remained unpruned. In determining the extent of fruit bud injury after low winter 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. Frequently there is much more injury in the bottom of the tree than in the top. Again, the injury may be greater on one side of the tree than on another, or the buds on the trees in one part of the orchard, perhaps on a lower elevation, may be injured much more than those in another part.

It has been rather commonly accepted as a standard practice that bearing peach trees on which virtually all of the fruit buds have been killed by winter cold should be severely deheaded to reduce the height of the trees and to develop vigorous new wood. The wisdom of such a practice can be questioned when one considers the possibility of his occasionally being mistaken in the number of live buds left and the subsequent loss of a part of a crop of peaches that usually would sell at high prices. In addition, trees receiving a severe deheading type of pruning and carrying no crop during a favorable growing season could easily enter the following winter in such a succulent condition as to be very susceptible to winter injury. Another objection to severe deheading of bearing peach trees is that many large pruning wounds are made which do not heal well and which provide entrances for wood-destroying diseases and insects. It would seem wiser to prune with moderate severity each year that the percentage of live buds present early in March gives promise of a full crop. There would then be no danger of an over-vigorous growth because of the necessity of the trees maturing a crop.

At one time it was thought that peach trees should be heavily deheaded 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.

It is not only best to delay the pruning of bearing peach trees in Michigan until about the first of March to determine the number of live buds present, but young trees should not be pruned until about the same time or later because the peach canker disease is more likely to be spread by earlier pruning. The objection may be raised that peach pruning cannot be left until the first of March 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 suggested 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. Fall spraying for leaf-curl should be in accordance with recommendations given in the Spraying Calendar (Mich. Agr. Ext. Bull. 154). 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.

Two general methods of pruning bearing peach trees are used—thinning out branches and heading-back. Gaston (6) has shown that

more first-grade peaches are produced on strong wood than weak, and while the trees are making a reasonably vigorous new growth because of being comparatively young or growing under favorable conditions, thinning out of weak wood is all the pruning that is necessary. However, as the trees slow down in growth, some heading back becomes necessary to insure a supply of strong new wood. Little heading back, aside from that needed during the training period, should be necessary until the trees are possibly five or six years of age, or until new terminal growth is slowing down to less than approximately 12 inches in length. When heading-back is needed in the bearing tree, the cuts should be made to a side branch in two or three-year-old wood. Numerous cuts in one-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.

BRUSH REMOVAL

The removal of pruning brush from the peach orchard is usually a tedious and disagreeable task. However, if it is done with an outfit such as that shown in Fig. 24, it is done quickly, easily and efficiently. With the tractor brush-pusher, 30 to 50 acres of brush can be removed

Fig. 24. A tractor attachment to push brush out of the orchard. This device saves a great deal of time and hard work and is especially useful in the large orchard.

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. A wooden rake, six feet long, two feet wide with five to eight tapered teeth made of hardwood, and with wire braces extending from the handle to cross-bar makes a very handy tool to pull the brush to the center of the row in advance of the brush-pusher.

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 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.

USE OF FERTILIZERS

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.

An application of nitrogen carried in sulphate of ammonia, nitrate of soda or cyanamid is the most common fertilizer practice now employed in Michigan orchards. Sulphate of ammonia has been more widely used in the past because of its higher nitrogen content and somewhat lower price. Cyanamid has been used to some extent in recent years; it should be applied in the fall, spring applications having sometimes resulted in injury, especially to stone fruits.

Though nitrogen applications have been very beneficial to some trees and certain orchards, their careless use on peach trees has resulted in great damage in many instances by over-stimulating the trees, thereby making them more susceptible to winter injuries which provide entrances for disease organisms and insects. Often the orchard has not been examined to see if by slackening growth and generally poor color of foliage it was in need of an application of nitrogen, but the application was made anyway because a neighbor was putting on fertilizer, or because it was considered "just a good thing to do." Also,

in many instances the different requirements of individual trees in the orchard have not been considered. A tree growing on an impoverished and eroded knoll and another in a low and fertile spot have both received the same amount per tree, regardless of the fact that the tree in the fertile soil was probably already making too much growth.

It is almost impossible to recommend a definite amount of nitrogen-carrying fertilizer to apply to a peach orchard or a peach tree. If the growth of the trees has been uniform, the problem will be easier. However, tree growth in most orchards is variable. In general it can be said that if young peach trees are making approximately 18 inches of new terminal growth and the foliage is of good color without fertilizer, they do not need it. The same can be said of bearing trees making about 12 inches of growth. The trees should receive only enough fertilizer to maintain the proper amount of growth and no more. To determine this amount will require some study and observation on the part of each grower on his own farm. The old rule of applying nitrogen-carrying fertilizers at the rate of one-fourth pound 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 than too much for there is considerable evidence that the lives of many peach orchards have been greatly shortened because of too much growth, making them an easy prey to the cold of a severe winter.

There has been considerable interest regarding the possible deficiency of other fertilizer elements, especially potash, in Michigan peach orchard soils. However, cases in which there has been an actual potash deficiency for tree growth have been extremely rare. If a deficiency of potash or some other element is suspected, it would be best to have a sample of the soil and leaves analyzed. If there is a deficiency it is very likely to be only in certain limited areas in the orchard, and it is unnecessary to incur the expense of applying fertilizer to the entire orchard.

METHODS OF CULTIVATION AND USE OF COVER CROPS

The early growers cultivated their peach trees so thoroughly that it was considered almost a sin to leave a weed in the orchard. Though this thorough cultivation of virgin soils resulted in excellent tree growth, its continued use tended to reduce the organic matter content of the soil and encourage soil erosion. In recent years there has been a trend in the direction of less cultivation. This has extended all the way from cultivating less frequently and leaving some weeds and grass in the orchard to a complete lack of cultivation and use of sod, sometimes supplemented by a mulch placed around the trees. Peach trees can be grown satisfactorily in some soils in sod if well mulched. However, mulching material is scarce and comparatively expensive in the commercial fruit-growing areas; consequently mulching is often inadequately done. There is the added danger of injury from mice and fire in mulched orchards. Young trees grown with mulch may need slightly more nitrogen at first, but often less will be needed, especially

on loamy soils, after the trees become older. The trees will indicate by their growth if additional nitrogen is needed.

Nearly all growers agree that cultivation in the peach orchard should be reduced to the minimum, consistent with the production of good crops of peaches of first-grade size. Just what the minimum amount of cultivation should be cannot be stated definitely but will vary from orchard to orchard, depending largely on the fertility and moisture-retaining capacity of the soil. For instance, an orchard on a fertile soil of high moisture-retaining capacity might be handled to good advantage under a system of a nearly permanent cover crop which would be disked in the spring and then allowed to grow, mowing it in the summer if a dry period occurred. On the other hand, an orchard on a lighter and more infertile soil could not be handled successfully by this method. It would require longer periods of cultivation to remove competition for moisture and leave sufficient for the trees.

The successful use of a nearly permanent cover crop in peach orchards in some other parts of the United States has provided an incentive for its wider trial in Michigan. It should be recognized, however, that in the other states where it has been used successfully, rainfall has been as much as 25 per cent more than in Michigan and, in general, the soils have been more retentive of moisture than those

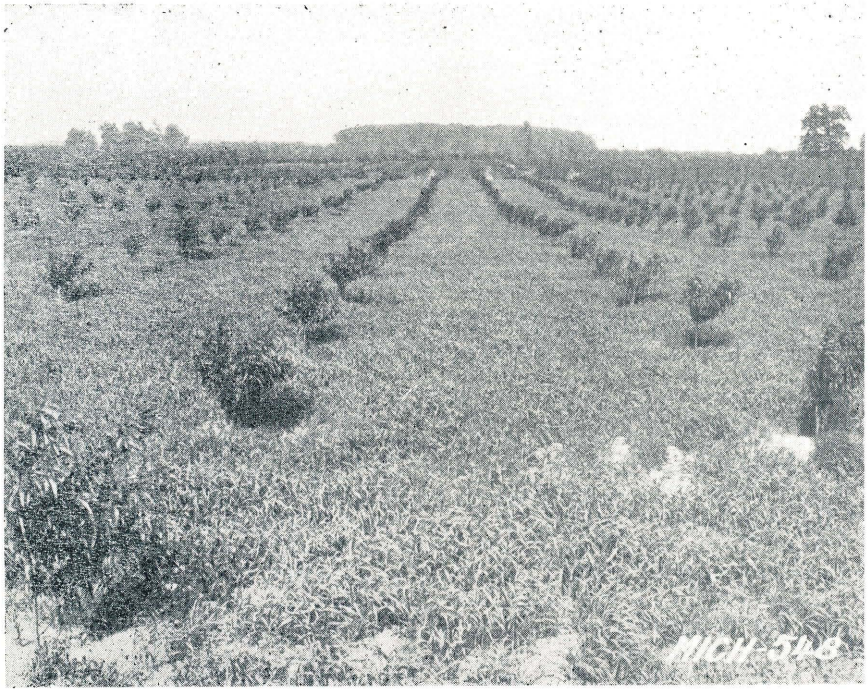


Fig. 25. A one-year-old peach orchard on level ground and planted on the square system. The fine cover crop will check tree growth, reduce winter injury, protect the roots from freezing, and provide organic matter for the soil. (Photograph by Michigan-One Project, U.S.D.A. Soil Conservation Service)

commonly used for peach growing in this state. It will be necessary for each peach grower to study this problem in relationship to his own soil, and climatic conditions, and adjust the amount of cultivation given his orchard accordingly. Sandy soils will generally be too dry to support a permanent or semi-permanent cover crop. Deep, friable, loamy soils will be suitable for continuous or semi-continuous cover. Heavy clays will present a drainage problem and are likely to be too wet at times and too dry at others.

The topography of the site will also 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. A second reason for early cultivation has been to destroy as many as possible of the overwintering larvae of the oriental fruit moth which pass the winter in the soil. There has also been a tendency to cultivate less frequently than in former years. Frequent and thorough cultivation causes too rapid loss of organic matter from the soil with a consequent reduction in its fertility and water-retaining capacity. Cultivation should be only frequent enough to keep down weed growth reasonably well until the cover crop is sown. Cultivation should be only across the slope 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. 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 rye 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 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.

It may be very difficult or even impossible to get a good cover crop established on an infertile orchard soil without the use of fertilizer. In this connection, Partridge and Toenjes (7) state:

> "Liming or marling the soil usually will increase the growth of the cover crop, even of non-legumes, where a test shows that the soil is deficient in lime. Fertilizing the cover crop usually will increase its growth. . . . An application of 100 to 150 pounds of a high grade complete fertilizer is recommended, a 4-16-4 or similar fertilizer on loamy soils of moderate fertility, a 10-6-4 or other fertilizer rather high in nitrogen on sandy soils or those of low fertility."

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.

MOUNDING TREES FOR WINTER

In the earlier days of commercial peach growing it was rather common to mound soil around the crowns of the trees to protect this part of the tree against injury from low temperatures. This practice was based on the fact that the extremities of the tree mature first and the crotches of the large scaffold limbs and the crown last. Therefore, these areas are particularly susceptible to low temperatures, especially early in the winter. The early reports of the State Horticultural Society are well supplied with contradictory reports regarding the value of mounding. Weighing all of the evidence on both sides of the question leads to the belief that mounding of old peach trees means little either in the way of safety or danger, but that the mounding of young trees is likely to result in injury more often than it will afford protection. The reason for this is that young trees, especially if high-headed, sway rather easily, resulting in the opening of a space between the mound of earth and the trunk. Water is likely to accumulate in this space, form ice and cause serious injury to the crown, often girdling it. This is sometimes serious when mounding is not done as the trees may sway enough to make an opening at ground level between the tree and the soil. Though mounding young trees may be hazardous, it is almost equally so to have a depression around the trees in the fall in which water can gather. The soil around the tree should at least be level with, or preferably slightly higher than, the surrounding soil. It is all right to leave a depression around newly planted trees to allow water to run toward them, but this depression should be filled before winter.

If young trees, one to three years old, inclusive, are treated with paradichlorobenzene in liquid form or ethylene dichloride emulsion for peach borer control it has been found that mounding will give a higher percentage of control. The grower, therefore, is confronted with a

choice between two evils; either to mound the young trees for better borer control and run the risk of collar injury from ice formation or leave them unmounded and fail to kill all of the borers present in the crown of the tree. This problem can be solved to a considerable extent by growing low-headed trees which will not sway nearly so much as those that are high-headed. Also, unless infestation is very severe, borers can be removed by hand with the aid of a sharp-pointed knife and pliable wire until the trees are more than three years of age.

FRUIT THINNING

Barring the loss of fruit buds by winter cold or blossoms by spring frosts, the normal bearing peach tree will produce many more fruits than it can mature to two inches or more in diameter. Gardner, Marshall and Hootman (8) reported that only one-half to two-thirds of the Michigan commercial peach crop meets the A-grade specification for size (minimum diameter of two inches), and that there is an average difference in price of $0.40 to $0.50 per bushel between 2-inch and 1¾-inch (A- and B- grade sizes) peaches and corresponding differences between peaches of other sizes. Despite these facts, that through long experience have become very apparent, fruit thinning is all too commonly one of the most inefficiently conducted operations in peach growing. Several reasons can be given why thinning is so often improperly done. First, failure to visualize at thinning time how much the young peaches will expand in size before the harvesting season if given an opportunity. Weldon (9) has pointed out that it takes twice as many 2-inch as 2½-inch peaches to equal a given weight. Second, failure to realize that, because commercial peach thinning is done after the June drop, the remaining fruits will nearly all stay on the tree until harvest, and that it is better economy to pick the excess fruits at thinning time and throw them on the ground than to be compelled to pick them at the regular harvesting season with the resultant extra handling costs and lower value of a crop of small peaches. Another reason for inefficient thinning is that it is a monotonous task and it is natural to hurry too much or to find excuses to do something else. Thinning crews require constant and careful supervision for best results.

The oldest and most common method of thinning is to thin the fruits to some standard distance apart, usually from 6 to 8 inches, depending upon the size naturally attained by the variety being thinned. For instance, varieties like Rochester and Admiral Dewey that normally set heavily and at best produce peaches of only moderate size need to be thinned heavier and the individual peaches left farther apart than such varieties as Elberta and J. H. Hale which tend to produce more A-grade peaches in size even though somewhat crowded on the branches. Though this method is fairly successful in the hands of a grower who has a keen appreciation of how many peaches of first-grade size can be produced by a tree growing under certain soil and climatic conditions, it often results in far too many peaches being left on the tree.

Another method more commonly used in California, where a high percentage of the peaches grown are of the clingstone type for can-

ning and for which uniform size of fruits is imperative, is to estimate how many peaches of a certain size a tree should produce and thin to approximately that number. As a basis for this method of thinning, it is necessary to know how many peaches of different sizes are necessary to make a bushel. Weldon (9) states that the following data were gathered by W. J. Schaefer, General Superintendent of Canneries, California Growers Association, as the result of careful records made in 1922:

Diameter of Peach	Number in 10 pounds
2 inch	76
2⅛ inch	63
2¼ inch	56
2⅜ inch	45
2½ inch	38
2⅝ inch	33
2¾ inch	29
3 inch	22

To obtain the number of peaches per bushel in each grade, multiply the number in 10 pounds by five. As an example of the practical application of this method of thinning, a grower may decide that he wishes to grow 2½-inch peaches and that his trees are capable of producing about 4 bushels of fruit each. Because it would require 190 peaches of that size per bushel, it would be necessary to leave about 760 peaches on the tree to obtain the desired yield. Actually a few more than 760 peaches should be left to take care of some loss from insect injury and to replace a few peaches on the tree that for some reason never attain marketable size. Leaving a slightly larger number will probably be taken care of without difficulty because of the tendency of almost all thinners to leave more peaches on the tree than they should. Thinning by count does not mean that the peaches on every tree are counted. The owner or a well trained foreman thins a tree or two of each variety and of trees of different ages scattered here and there throughout the orchard and these trees serve as examples for the thinners to follow as closely as possible. Thinning by this method does not insure completely successful results in all instances. Good judgment is needed with any method. Trees will vary in size and vigor and should be thinned somewhat lighter or heavier as the occasion demands. It is believed, however, that some study devoted to this method will give the grower and his aids a much better understanding of the number of peaches of a certain grade required to make a bushel, and the number of fruits a tree might be expected to mature to obtain a certain yield of peaches of the desired grade.

Gaston (6) found that the largest and best colored peaches are produced on the more vigorous new wood, even though the fruits are more crowded than on weaker wood. Because the strongest new wood in the bearing peach tree is located principally in the upper and outer part of the tree, the peaches can be left closer together in that area than on the weaker wood in the interior part of the tree. In keeping with these observations, some growers prefer to make a hurried thinning early in the season to remove the excess load quickly. As the season advances a distinct variation in the size of the remaining fruits appears. The trees are gone over a second time, carefully removing all undersized and blemished fruits, even stripping the peaches from

some weak branches but allowing all of the larger fruits to remain, although in pairs or clusters. This amounts essentially to grading on the tree.

The best time to start thinning peaches commercially is just after the June drop. At that time it may be assumed that nearly all of the remaining peaches will stay on the tree until maturity and consequently the extent of the thinning task can be determined better than earlier. Injury from the rose chafer is about over and all injured peaches can be removed in the thinning process. It is best to thin early-maturing varieties first. For the greatest benefit, thinning should be completed as soon as possible after the June drop, although some benefit will be derived if it is prolonged until a short time before harvest.

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 (10) 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 per cent of the fruits were 2¼ inches and above, 70.9 per cent were in this grade on August 17, 84.9 per cent on August 20, and 93.7 per cent on August 22."

Regarding storage ability, they reported:

> "These storage studies point clearly to the fact that fruit harvested as much as seven days 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—suffi-

cient 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.

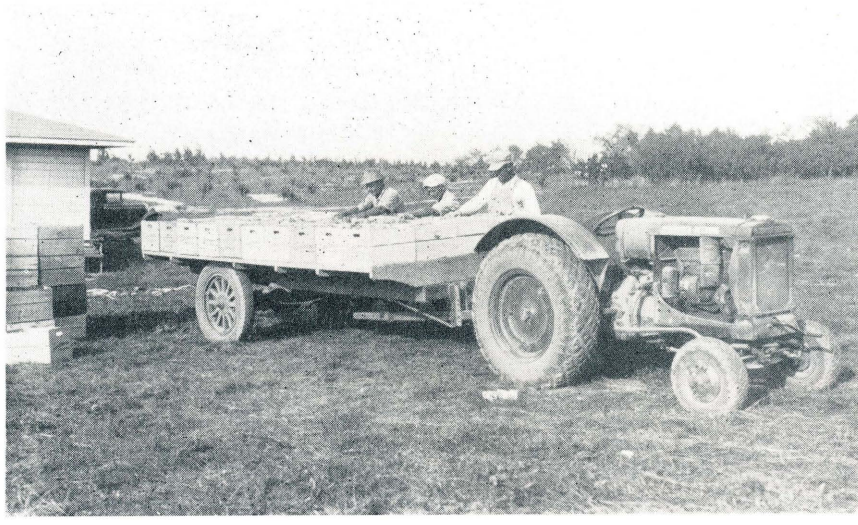


Fig. 26. A low trailer attachment for the tractor that is very useful in moving peaches out of the orchard during the harvest with ease and speed.

Some try to harvest the fruit all at one picking; this naturally results in many small and immature peaches being harvested, or, if the one picking is delayed, many fruits that are overripe.

Because of their perishable nature, peaches should be carefully handled to prevent cuts and bruises. Picking containers should be lined with canvas and pickers should be taught to empty their picking baskets carefully. The handling of peaches in the orchard has been made easier and faster by the use of tractors and low trailers, such as shown in Fig. 26.

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

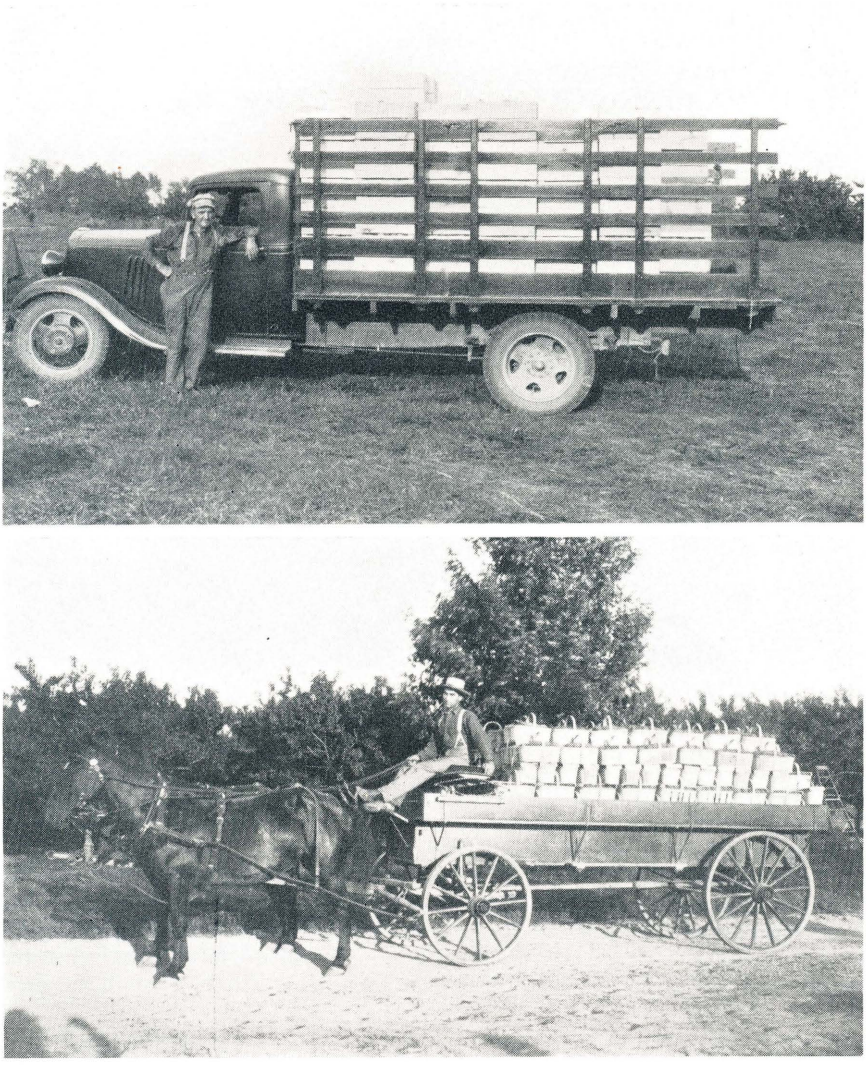


Fig. 27. The old and the new. Hauling peaches 40 years ago with a team and wagon to the boat or train for transportation to Chicago. Note the small baskets used at that time, those on top being filled with fancy fruits and covered with red tarlatan. The modern truck has greatly widened the distribution of peaches to the advantage of both producer and consumer.

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 (Fig. 27). 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. They have also been of value in keeping Elberta peaches to supply the market for two or three weeks after the harvest has ended.

Peach fuzz is very objectionable to some people and machines are now available which brush the fuzz from the peaches before they are packed for market. This practice has been so well received that a premium is usually offered for peaches from which the fuzz has been removed. Such peaches, however, are more subject to brown-rot because the protective coating of sulphur left from spraying the fruits shortly before harvest is largely brushed off in the fuzz removal process. Some machines employed in the removal of fuzz are equipped to dust the peaches with sulphur at the end of the process just prior to packing. Dusting should be done to insure the consumer receiving peaches that will keep for a reasonable length of time. If there is no dusting attachment on the machine, an application of dust in the orchard about a week before packing will be helpful in reducing loss from brown-rot.

Virtually all of the Michigan peach crop is packed in bushel baskets. On the whole, this has been a satisfactory package, although many persons believe that a smaller package could be used to advantage. Claims made for the smaller package are that more mature peaches could be packed, thereby insuring the consumer a better product, and that there would be less bruising than in the bushel basket.

It is believed that too large a portion of the peach crop is being packed in bushel baskets marked with the minimum size of two inches. The best peaches are often used to face the package and it is impossible for the buyer to tell just 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.

PEACHES 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.

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 seedling from the New Jersey Experiment Station, later named Ambergem. After several years of testing, the Michigan Fruit Canners, Inc., decided to give it a fairly extensive commercial trial and placed a total of about 50,000 trees with a number of peach growers in the southwestern part of the state. These trees are now just coming into bearing so that a few more years are required before the success of the venture can be determined. It is of interest to note that in the severe cold wave of January 1940, this variety apparently came through with enough live buds for a crop where almost all of the standard freestone varieties had few buds surviving.

It is very likely that the production of freestone peaches for fresh fruit markets will always be the major interest of the peach growing industry in Michigan because of its location near numerous large fresh fruit markets. However, growing fruit for the commercial canner has certain advantages that appeal to many producers, and the development of a clingstone peach canning industry would provide them with an opportunity to grow peaches for this market. The grower should realize that the clingstone peach is strictly a commercial canning crop and that it would be very difficult, if not impossible, to sell any quantity of this type of peach on the fresh fruit markets.

WINTER INJURY

Gardner, Marshall and Hootman (8), following investigational work concerning certain orchard practices related to peach growing, reported in part as follows:

> ". . . the fact that stands out prominently in all the work is that winter injury to the fruit buds is the limiting factor of first importance in the peach industry in Michigan. . . . In most seasons, there is enough bud killing to seriously reduce the crop in some of the commercial sections and with some varieties, and the years when winter cold makes a more or less clean sweep are all too frequent. . . . The best insurance and the most practicable method of dealing with the problem, is to plant only on locations and on sites which are favored by moderating lake breezes or by exceptionally good air drainage or in locations which are protected in some other way so that winter injury to buds and wood will be reduced to a minimum. Furthermore, the various orchard operations should be planned and carried out with this constant threat of winter injury in mind if the maximum income from the orchard is to be realized."

The results of winter injury are very apparent and even spectacular when a peach crop is lost because of all of the fruit 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.

The following suggestions are offered as a means of reducing losses caused by winter injury:

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. Delay pruning until the first of March to aid in preventing the spread of the peach canker disease.
5. Be very careful in the use of fertilizers. Young trees making about 18 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 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. Avoid mounding young trees from one to three years of age, inclusive. 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.

INSECTS INFESTING PEACH

RAY HUTSON
SECTION OF ENTOMOLOGY

INSECTS AFFECTING FOLIAGE

Climbing Cutworms

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

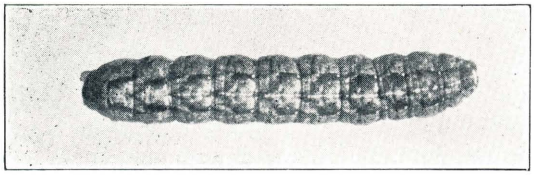


Fig. 28. The most common climbing cutworm attacking peach trees.

Life History and Habits—Cutworms are active at night and for this reason 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 is characteristic of cool, moist springs and continues longer under such conditions. The parent moth is of a brownish dark color, inconspicuous, and from one to one and one-half inches in spread. When grown, climbing cutworms change into pupae and shortly the moths emerge and lay eggs for the next generation. In most cases three generations will develop.

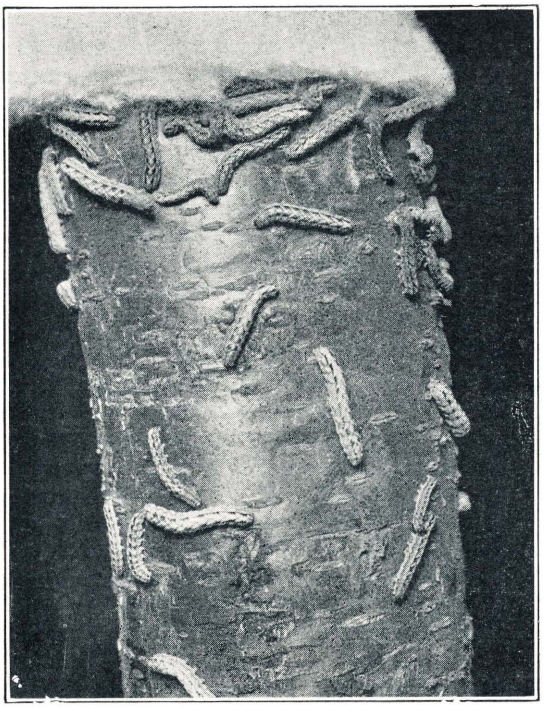


Fig. 29. Flashlight picture of climbing cutworms stopped by band of cotton batting.

Control—Control of climbing cutworms is obtained by mechanical barriers, although destruction of breeding and over-wintering quarters markedly reduces their numbers. "Tanglefoot,"

and cotton batting are the commonly used barrier materials; when properly applied and attended they turn back cutworms. A "Tanglefoot" band one inch wide is necessary to stop climbing cutworms. It is best applied with a thin, flat paddle directly to the bark of the tree, after removing bark flakes on rough-barked trees. Bands must be complete, else the cutworms will pass. On young trees it is better to spread the tanglefoot thinly and evenly upon a strip of paper, which is fastened securely about the tree. It is sometimes necessary to place cotton batting around the tree first and apply the tanglefooted paper over the cotton to make sure the cutworms will not crawl beneath the paper.

Periodical inspections and freshening of bands during the cutworm season is necessary, especially if high winds prevail. Sand and other debris will stick to the band and bridge it. Tanglefoot can be freshened by drawing a paddle or other tool over its surface, working the sand into the sticky material.

Young peach trees in sandy locations, should be banded as set and the banding supplemented by the scattering of poison bran bait about the trees, for climbing cutworms will sometimes girdle young trees when kept from reaching the foliage. To prepare poison bran bait mix thoroughly:

1 bushel of bran
½ gallon of cheap molasses
Enough water to moisten
1 pound of white arsenic (not calcium arsenate or lead arsenate)

When completely mixed, stir in enough amyl acetate (banana oil) to scent the mass. Two ounces will be sufficient.

Mites

Principally Paratetranychus pilosus

The only mite of consequence in Michigan on peaches is the European Red Mite.

Appearance and Habits—Mites, though they resemble insects, are eight-legged, spider-like creatures, red in color, and barely visible to

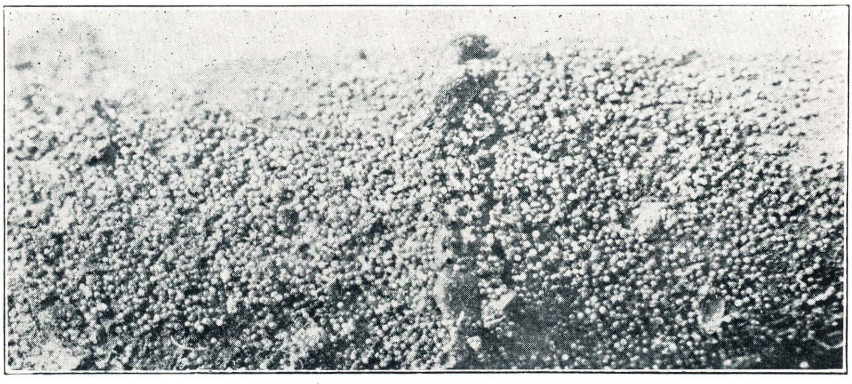


Fig. 30. Eggs of European red mite massed on twig, greatly enlarged.

the naked eye. They over-winter 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 mites is approximately 35 days, each female producing about 30 eggs. Thus it is possible for a comparatively small population of eggs on the trees in the spring to give rise during the summer to an extremely annoying plague.

Leaves injured by red mite 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, sometimes becoming bronzed. In heavy infestations, it is possible for the mites to cause the defoliation of the trees. However, the devitalization of the leaves and interference with their processes cuts down the amount of food manufactured and, as a consequence, trees which have been heavily infested with mites do not mature so much high quality fruit and are more subject to winter-killing and other effects of winter weather.

Control—Mites on peach trees can be eliminated by the application of a dormant oil spray. During winter, infested trees show large numbers of tiny red pin-points near buds and other scars. Eggs of the red mite are characteristic, but may be distinguished from eggs of related species only by microscopic examination. Home-made or manufactured sprays can be used to control this pest. Manufactured sprays should be applied as directed; home-made emulsions of at least 3 per cent actual oil, emulsified with bordeaux or casein spreader, are satisfactory. In spraying peach trees it is usually desirable to combine the spray for red mite with the leaf-curl application. When using lime-sulphur for peach leaf-curl with oil emulsions, it is not advisable to use more than 5 gallons of lime-sulphur to each 100 gallons of spray. In spraying peach trees for red mite, it should be kept in mind that mites are on all parts of the tree and thorough coverage is necessary, but all precautions regarding over-spraying of trees should be observed as well as those applying in the case of oil sprays. The most important of these is to avoid spraying when the temperature is below 40° F. or is likely to become so within two hours after spraying.

The Spraying Calendar (Mich. State Coll. Agr. Ext. Serv. Bull. 154) gives formulae for the preparation of oil emulsions.

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 3/8 inch long, fat, 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.

Fig. 31. Adult plum curculios, enlarged.

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. Generally speaking, 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 four or five weeks. Infested fruit often falls from the tree and brown-rot infection follows the burrows of the

Fig. 32. Plum curculio larva in damaged peach.

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 emergence of curculio adults from the soil will normally occur from 11 to 14 weeks after peaches bloom.

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. To illustrate this destructive potentiality, each curculio will make one feeding puncture per day during its active period of two to three 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 of curculios.

It is difficult to control severe curculio infestations by spraying alone. Destruction of infested fruit and of 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 efficacious only at the time the curculios are coming out of their winter quarters but are nearly worthless at other times. Arsenical sprays for curculio control on peach should contain two pounds of arsenate of lead in 100 gallons of spray at the "shuck-fall" application (App. 2 in the spraying calendar). A similar application should be made two weeks later (App. 3 in the spraying calendar). Arsenical injury on peach should be avoided (see directions in current spraying Calendar) by use of zinc sulphate lime corrective 4.4.100 or by use of basic lead arsenate.

Tarnished Plant Bug

Lygus pratensis

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, for in such places 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.

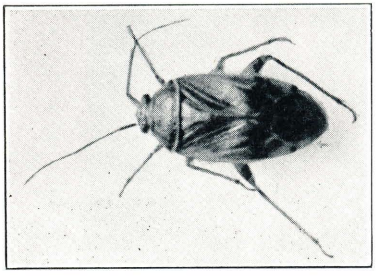


Fig. 33. Adult tarnished plant bug, enlarged.

Life History—The winter is passed by the adult bugs hidden away in trash and rubbish and in patches of the weeds. Early in the spring, they leave these hiding places seeking 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 six weeks mate and become the parents of another generation. Generation after generation continues through the summer, three or four weeks being required for each. It is the over-wintering adults of the tarnished plant bug that are largely responsible for injury to stone fruits.

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 will callus over and later become a puckered scar or "cat face".

Control—Insecticides are almost useless against adult tarnished plant bugs because of their habit of quickly flying when disturbed. The numbers of over-wintering adults and their consequent injury can be reduced by destroying the breeding and over-wintering places in proximity to plants which it is desired to protect. Weeds in the orchard or around it should be cut down. The destruction of trash and rubbish in and about the orchard late in the fall or early in the spring will eliminate the over-wintering places of large numbers of the bugs.

Orchards kept covered by sulphur applications during June are not so heavily infested as those not treated. Sulphur is used for diseases of peach and any sulphur suitable for disease control is repellent for tarnished plant bug on peach.

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 except California and Colorado. It attacks peach readily and is found occasionally upon other stone fruits. Quince is a favorite host.

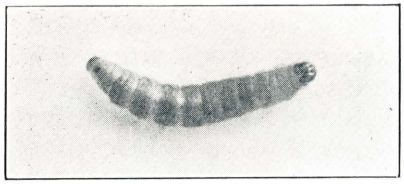
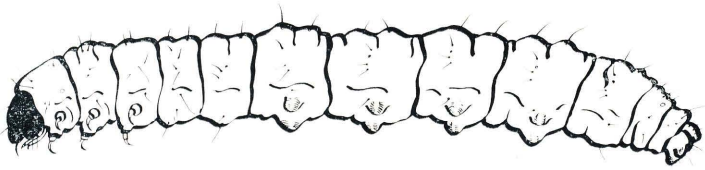


Fig. 34 Oriental fruit moth larva, enlarged about two times.

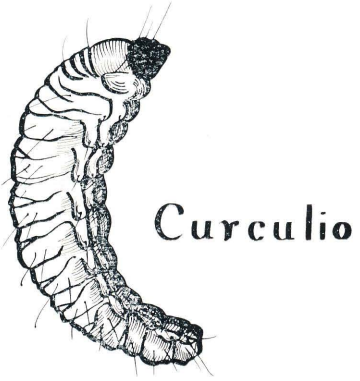
Appearance—The oriental fruit moth is a small, dark-colored moth, about three-eighths of an inch in wingspread. The larva, which is the destructive stage, resembles that of the codling moth and, where apples and peaches are interplanted, may sometimes be mistaken for it. It can, however, be distinguished from the codling moth by a comb-like structure on the posterior 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 per cent of the

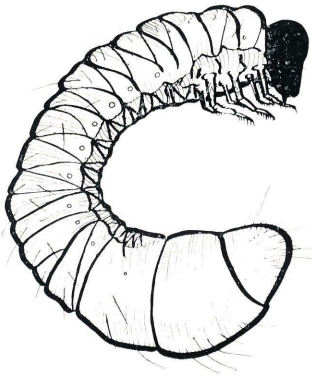
MOTH - FLY - BEETLE LARVAE



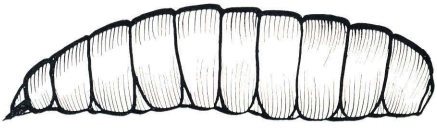
Caterpillar



Curculio



White Grub



Maggot

Fig. 35. Common larval types of moths, beetles, and flies.

Fig. 36. Peach twig killed back by oriental fruit moth larva.

worms pass the winter in trash beneath peach trees. This percentage varies somewhat according to the character of the trees but is a good approximation of our Michigan situation. 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 four 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. This does not, as a usual thing, amount to very much, although it induces a bushy appearance in young trees or nursery

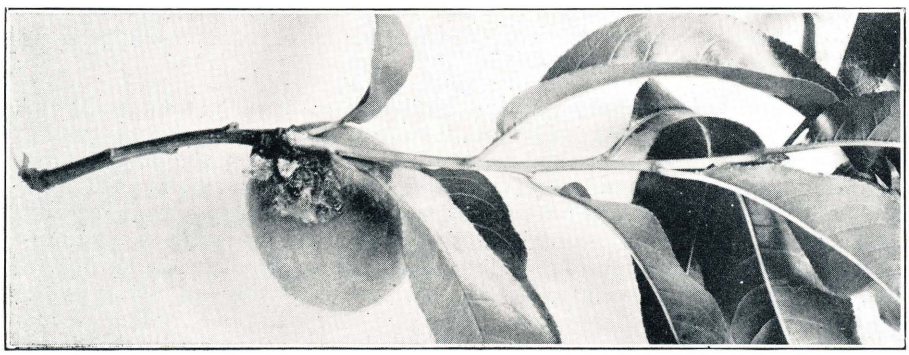


Fig. 37. Visible injury on peach caused by oriental fruit moth larva.

stock. It is 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 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, so-called invisible, type of injury comprises about 20 per cent 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.

Control Measures—Several parasites attack the oriental fruit moth. About 60 have been recorded in the United States, about 16 of which appear in Michigan. A most effective one, present in our Michigan peach-growing districts, affects a borer of ragweed which grows everywhere. Another which has been introduced into the state infests the strawberry leaf roller and is now available commercially.

Much effort has been expended in a search for an adequate, effective insecticidal control, and large numbers of materials have been tested. Some promising results have been obtained, but there is yet no material which can be recommended. Certain supplementary measures, if faithfully followed, will reduce trouble from oriental fruit moth. Cultivation of the peach orchard before blossoming-time will greatly reduce over-wintering oriental fruit moth larvae, for many of the insects go through the winter on the ground beneath the tree. Trees regularly treated with paradichlorobenzene for peach tree borer suffer less severely from oriental fruit moth. Oriental fruit moth larvae are most injurious on late varieties.

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 all over the eastern United States as far south as Alabama and Georgia, and is in eastern Canada as well.

Appearance—The common name, shot-hole borer, is derived from the habit of the adult insects, about 1/10 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 pruning stubs, dead limbs and prunings piled about the orchard in brush heaps, filled-in gulleys, or thrown in hedge-rows. A common but often overlooked breeding place is in wild cherry injured by fire. After wood is dry, it seems to have no further attraction as a breeding-place for the 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 mechanical 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 young trees. In the case of dying wood, which is no longer able to exude a copious discharge of gum as the result of injury, the beetles emerge about the first of June, 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 increases in size and, finally, ends in a small chamber, where the larva changes to a 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. There are ordinarily two generations in Michigan, while further south four sometimes occur.

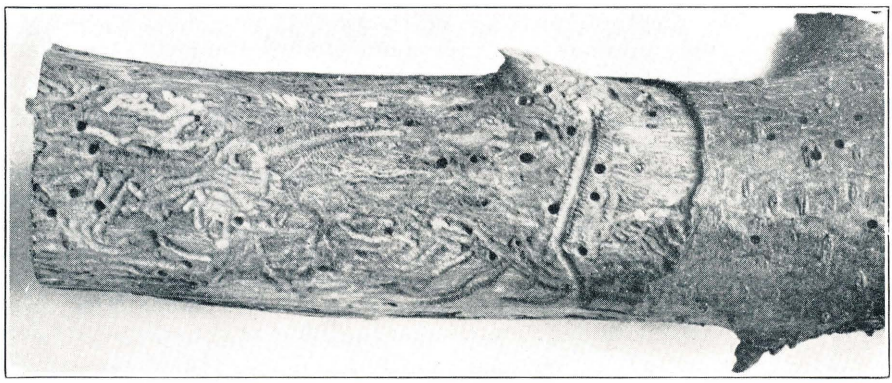


Fig. 38. Breeding galleries of shot-hole borer.

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 shot-hole 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 borer 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.

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 Borer

Aegeria pictipes

The lesser peach borer has increased in numbers during recent years. This insect 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, larger limbs, and in the crotches of the tree. Another important difference in habit is that the lesser peach borer usually commences its attack at the injured areas resulting from weather, pruning, cultivation or animals. It has been observed working upward from injury initiated 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 7/8 inch long when mature. Injury on stone fruits, particularly peaches, it attended in most cases by the exudation of gum. Crotches are a favorite place of attack and 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 borer appear in June or July, or sometimes 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 one pound of paradichlorobenzene in two 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 per cent of the borers will be killed.

By removing a part of the gum, virtually 100 per cent control can be obtained. It should be pointed out 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.

Peach trees in a healthy condition are less subject to infestation by lesser peach tree borer. Measures tending to reduce winter injury are especially valuable. Measures which can be recommended are proper pruning and avoidance of injuries in cultivating.

Peach Tree Borer

Aegeria exitiosa

This is the most important insect affecting peaches in Michigan. Despite the widespread publicity given the paradichlorobenzene treatments during the past 20 years the peach borer causes the death of thousands of peach trees in Michigan every year. In addition, it is indirectly responsible for the death of many thousands more, in that the injuries inflicted by the borers pre-dispose 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 injury is on 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 one inch in length, or slightly longer. Their injury results in the accumulation of reddish frass or sawdust about the base of the tree, which becomes covered with a gummy exudation 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" in color 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 one and one-fourth 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 rank growth.

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 infestation 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 on light soils though 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. They 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 three years old.

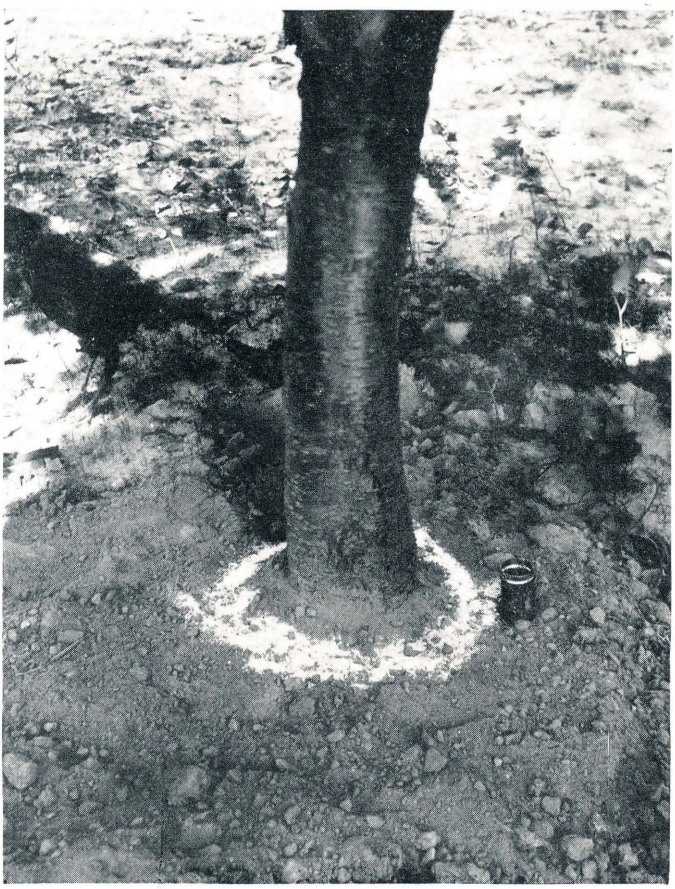


Fig. 39. Ring of P.D.B. about tree ready for mounding.

For trees more than four 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 should be considered. However, the rule of ¾ ounce for trees between four and six 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, one to two 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 the formation of the ring of paradichlorobenzene, it should be covered 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 material away from the trees after about three 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.

Ethylene dichloride emulsion has been developed within recent years as a control of peach tree borer. This material kills peach tree borers at lower temperatures than paradichlorobenzene and it is safer for use on younger trees. It is sold with careful directions as to dilutions suitable for trees of various ages and these directions should be followed carefully. Treatment with ethylene dichloride emulsion is possible in the spring but fall treatment is preferable. If peach trees are treated in the spring another treatment should be given in the fall. When using ethylene dichloride emulsion be sure to keep it well stirred.

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, Mich. 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 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 young 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 the infestation by this pest or through failure to take precautions against it. The aphids are, apparently, able to survive as long as three 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 certain precautions are taken.

When on the leaves, they can be readily killed by the use of a contact spray, such as nicotine. Eliminating them on the roots, however, is not so readily accomplished. The planting of old peach orchard sites with leguminous crops for a period of three to five years will eliminate this pest, but this is impractical under many circumstances. Many different schemes have been tried in an effort to permit the continued use of suitable sites for growing peaches. No insecticidal method for control of underground black peach aphids can be recommended. The best measure thus far devised is that of digging a good-sized hole and packing this with clay or clay loam in which the tree is planted. Considerable volumes of soil must be transported, approximating at least one-half cubic yard per tree, which makes the operation rather expensive. It has never been widely used, but in most cases it is reasonably efficient.

San Jose Scale

Aspidiotus perniciosus

The female San Jose scale is larger than the male and is grayish in color, circular in outline, and about 1/16 inch in diameter. The male scales are more oval, with the longest diameter about 1/16 inch. 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-like objects.

Fig. 40. San Jose scale, greatly enlarged.

Life History—As a usual thing the only scale 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 two or three months and all stages of this insect can be found on the tree during the summer. There are, ordinarily, two or three 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.

Injury—Injury by the San Jose scale on peach is confined almost entirely to the damage which it does to the trees. The bark of the twigs and limbs becomes so thoroughly encrusted by the grouping of the 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-sulphur 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 deciding what spray to use on peaches, for the trees must be sprayed for peach leaf-curl during the dormant period. A 3-per cent homemade casein or bordeaux oil emulsion in bordeaux (8-12-100) will control scale, red mite and leaf-curl. Directions for making this spray are detailed in the Spraying Calendar (Mich. State Coll. Agr. Ext. Serv. Bull. E154). There are proprietary oil sprays which can be combined with fungicides according to the manufacturers' recommendations.

The sprays for San Jose scale are safe for dormant application only. Spraying for scale requires a thorough application to the twigs and all parts of the tree.

PEACH DISEASES

DONALD CATION
SECTION OF BOTANY

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 in appearance, and to show a distinct curling inward. The diseased leaves acquire reddish or purplish tints

Fig. 41. Peach leaf-curl.

and later show a silvery coating on the surface. Affected leaves drop off in June and new leaves are developed at the expense of reserve food material stored in the tree. 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 waxy coating 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-sulphur, 5 gallons in 95 gallons of water, is the cheapest and best spray to apply. A fall spray after the leaves have fallen also controls leaf-curl. Bordeaux, 8-8-100, is used for fall spraying, as lime-sulphur sometimes causes injury to immature wood. The advantage of fall spraying is that sprays can be applied 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 or using unreliable spray materials such as liquid lime-sulphur which has been frozen or dry lime-sulphur which has lost its strength after being kept several years.

If for any reason the disease is not controlled, ammonium sulphate or high nitrogen fertilizer, 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 this 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 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 and during shipment but 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 blossoms are attacked they become brown and shriveled and bend downward, adhering to the twig. Masses of dusty spores are often found on the dead flower parts. The fungus travels through the flower stem into the twig causing a small canker or killing the twig. When twig blight results the leaves turn light brown and remain attached.

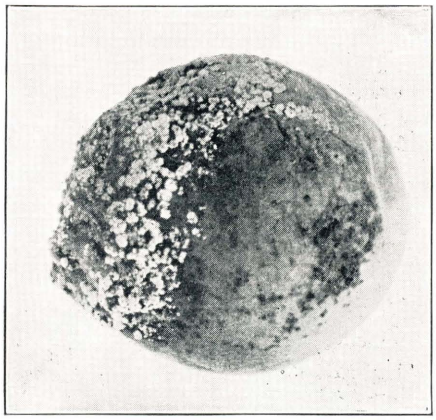


Fig. 42. Brown rot on the fruit.

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 fruit, but more often it gains entrance through insect or mechanical injury. Brown rot begins as a small brown rotted spot which enlarges rapidly, especially 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 of brown rot depends primarily on sprays, although early spring cultivation and destruction of mummies are desirable practices. Pre-bloom sprays of liquid lime-sulphur, 2 gallons in 100, are advised in some states for the control of blossom blight and a wettable sulphur spray at shuck-fall is sometimes recommended. For standard varieties in Michigan pre-bloom sprays are of doubtful value, although they might well be applied on Rochester, Prolific, Dewey and varieties which are more susceptible to blossom blight.

It is well known that injuries caused by curculio and oriental fruit moth provide entrances for the brown rot fungus. Control of these insects is necessary for the best control of the disease Brown rot is favored by warm, humid conditions. Several days of light drizzling rains result in more damage than short heavy downpours.

It is important to keep the fruit protected with sulphur sprays, beginning one month before harvest. A spray of wettable sulphur or a dusting with sulphur one week before harvest prevents rot at picking time and definitely protects the fruit during shipment. A dust just before harvest is preferable to a spray as sprays tend to blotch the fruit.

Peach grading machines cause small bruises. Peach brushing attachments on the grader break off the leaf hairs at the sockets which provide points of entrance for the fungus. Sulphur dusting attachments on the grader are a necessity when brushers are used. A sulphur dust in the orchard immediately preceding picking is especially valuable if there is no sulphur dusting attachment on the grader. Wettable sulphurs control brown rot and are safe to apply at any time during the growing season. Sulphur dusts are also effective and many peach growers have dusting equipment for emergency applications during wet periods or use dusts for the entire 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, shallow 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 sulphur two weeks after shuck-fall and another spray one month before ripening is adequate to control this disease for Michigan conditions. These sprays are also indicated for the control of brown rot.

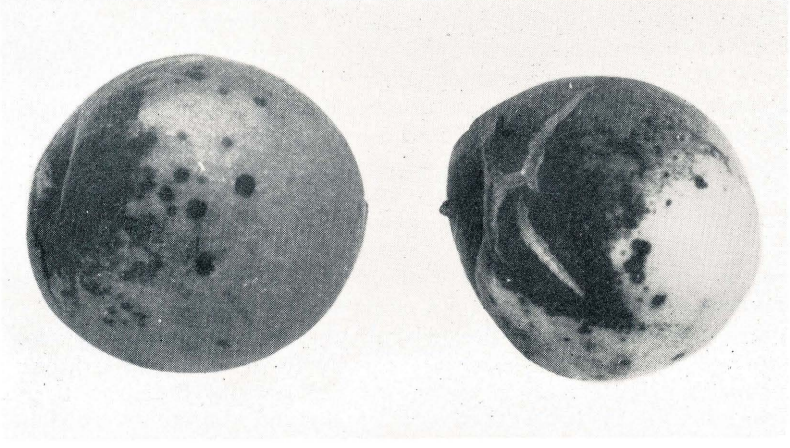


Fig. 43. Peach scab. Cracking of the fruit results in severe cases.

Coryneum Blight

Coryneum beijerinckii

Coryneum blight *(Coryneum beijerinckii)* is a fungous disease which can cause serious damage to the fruiting wood, lowering the yield. It defoliates the trees and spots the fruit. The disease is important spasmodically in certain localities in the state, 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 spots fall out, leaving a clean round hole.

Fig. 44. Coryneum blight. Clean, round shot-holes are left on the leaves.

Defoliation follows severe attacks. During the winter, infected buds on the one and 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.

When coryneum blight is present a fall spray as the last of the leaves are falling, using 12-12-100 bordeaux is recommended. In one instance when the disease was first noticed in the late spring, applications of wettable sulphur, 6 pounds in 100 gallons of water, applied every 10 days were very beneficial.

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.

Fig. 45. Peach cankers on limbs and in the crotch.

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 in spreading through the tissues during the winter while the tree is dormant. During the growing season the tree attempts to close the wound by forming callous tissue or wound bark. The fungus attacks and kills this newly formed tissue during the winter. Over a period of years a series of dead callous 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 operations in the late spring resulted in 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.

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.

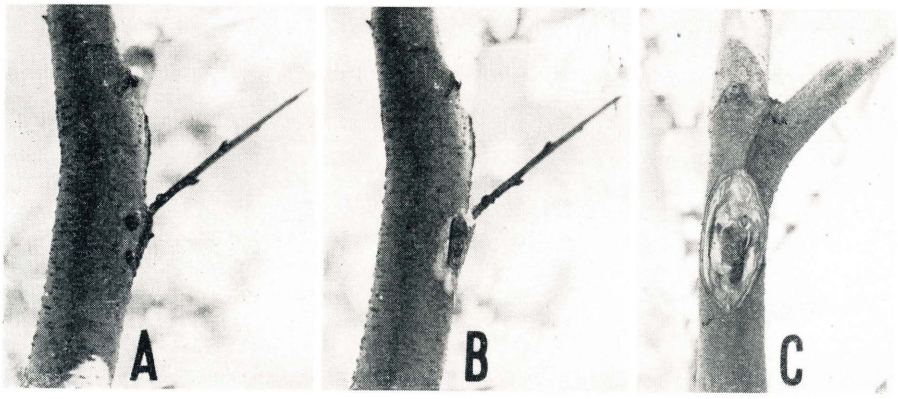


Fig. 46. Treatment of peach cankers. A. Gumming at the base of a dead twig signifies a canker. B. Bark cut away exposing dead cankered area. C. Finished canker treatment. Twig removed, area cleaned out to live bark, wound pointed at top and bottom. Ready for disinfectant and paint.

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.
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 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 lower its marketability. This disease was somewhat troublesome in certain Michigan orchards previous to 1931. From 1931 to 1937 only a few scattered minor cases were observed. During 1938 and 1939

the disease increased, particularly in young orchards and in a few bearing orchards.

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.

On the fruit the symptoms are first seen as small, dark, sunken spots with a water-soaked border. These spots later appear as small, black, corky, angular, individual or coalesced cracks extending into the flesh.

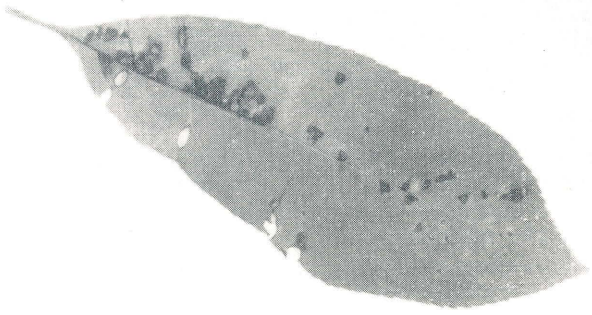


Fig. 47. Bacterial spot on peach leaf. Small angular spots, many spots running together along the mid-rib.

As the damage from bacterial spot is seldom 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 sulphate-lime, 4-4-100, to arsenical sprays. In severe cases from five to seven applications of zinc sulphate-lime, 8-8-100, applied every ten days to two weeks beginning at petal fall, reduces defoliation and fruit damage to a minimum. There have been only a few orchards in the state where the latter program would have been profitable in 1938 and 1939. The writer has seen no peach orchard in Michigan where it would have been advisable during 1931 to 1937 inclusive.

Peach Virus Diseases

Virus diseases are caused by self-generating plant proteins or organisms too small to be seen with a microscope. Peach yellows, little peach, and red suture are the important virus diseases now found in

Michigan. A new virus disease called rosetted-mosaic has been found in several orchards in Berrien County in the past 10 years. Other major peach virus diseases not found in Michigan but causing widespread damage elsewhere are phony peach of the southern states, peach mosaic of the western states, and yellow-red virus of Connecticut and New York. Some eight or ten other peach virus diseases are known elsewhere but are not widespread. Some of these are mild in nature and the extent of their damage to the peach is not well known.

Peach yellows appeared in Michigan in 1863 and soon became widespread, wiping out the peach industry in the early seventies. Little peach appeared in 1893 and red suture became widespread and epidemic in 1931. The history of peach virus diseases indicates that alternate periods of activity and quiescence can be expected.

Fig. 48. Peach yellows. Small pale wire-sprouts are characteristic of this disease.

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-tasting and bitter. Yellow foliage, small wire sprouts, gradual loss of vigor and finally death of the tree are all characteristic.

Little Peach—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. (Illustrated on outside back cover.)

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 the foliage accompanies the disease and there is a faint bronze appearance of the tree when viewed as a whole. The fruit is of poor quality and breaks down rapidly during shipment.

Rosetted-mosaic has been but briefly described. The symptoms shown are a short rosetted growth with a chlorotic mottling and distortion of the leaves on some varieties. 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. Rosetted-mosaic has also appeared in plums which showed no other symptoms than a decline in vigor.

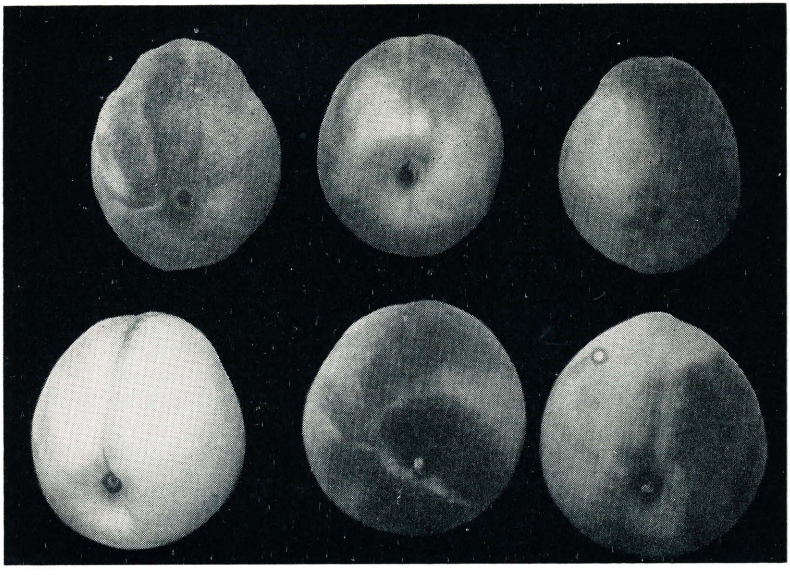


Fig. 49. Red suture of peach. Top row diseased. Bottom row healthy.

Fig. 50. Red suture disease. Clumping and twisting of foliage from a tree showing severe symptoms.

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 found in the roots inasmuch as it is artificially transmitted only by root grafting.

Peach mosaic was discovered in Texas during 1931 and has since been found scattered throughout the western states. 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.

The **yellow-red virosis** of peach and chokecherry (formerly called X-disease) appeared in Connecticut about 1930 and has since spread alarmingly to New York peach orchards in Hudson Valley and across western New York on chokecherries. There is some indication that this disease is prevalent on chokecherries in Illinois, Wisconsin and Utah. The progressive symptoms on chokecherry 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, shotholing and ragged appearance of the leaf followed by severe defoliation

Fig. 51. Red suture disease. An advanced case in an orchard.

are characteristic. Trees appear entirely healthy until late July and August when symptoms become evident. The trees appear to recover at the beginning of each season but the symptoms always repeat again in the summer. (A tree infected with yellow-red virosis is shown on page 82.)

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 diseases 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

Fig. 52. Rosetted-mosaic. Artificially transmitted to nursery trees. Top: June 12, two trees showing delayed foliation symptoms. Healthy tree on right. Bottom: August 20, stunted, rosetted growth on the diseased trees.

Fig. 53. Rosetted-mosaic. Extreme symptoms in a commercial orchard.

Fig. 54. Yellow-red virosis, "X" disease. Defoliation of affected branches in early August. Retention of tip leaves is typical.

carry peach yellows and little peach without showing symptoms. Other species of the genus *Prunus*, such as cherry, almond and apricot, may also carry 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 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 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 leave clean 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 ap-

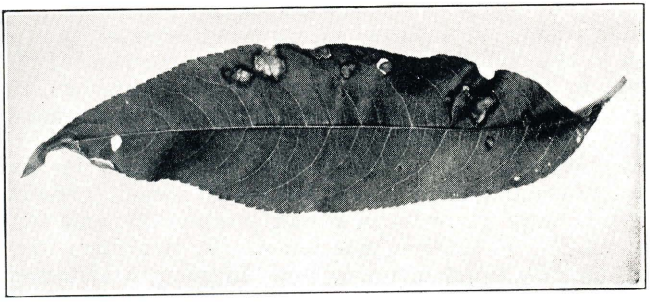


Fig. 55. Arsenical injury on a peach leaf.

Fig. 56. Arsenical injury on twigs.

pears as a brown area where the leaf petiole subtends the bud. This dead brown area on the bark may or may not reach the cambium. Arsenical injury may be seen one or two years later as rough areas on the bark of two or three-year-old wood.

Until the more efficient arsenical correctives were discovered, dusting caused less arsenical injury than spraying. A 95-5 lime, lead arsenate dust was used for curculio control and an 80-15-5 sulphur, lime, lead arsenate dust was used when a fungicide was also required.

Zinc sulphate lime or iron sulphate lime are now used to correct 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.

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Plate 1. Symptoms of peach yellows as they appear in fruit and leaf are shown in A and B, contrasted with the healthy condition in C and D. Fruits of yellows-infected trees ripen somewhat prematurely.

Plate 2. Symptoms of little peach or "littles" as they appear in the fruit and leaf are shown in A and B, contrasted with the healthy condition in C and D. Fruits of "littles"-infected trees ripen somewhat after the normal ripening period for the variety.

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