UNIVERSITY OF KENTUCKY

COLLEGE OF AGRICULTURE

Extension Division

THOMAS P. COOPER, Dean and Director

CIRCULAR NO. 118.
(REVISED)

ORCHARDING

Lexington, Kentucky

January, 1926.

Published in connection with the agricultural extension work carried on by cooperation of the College of Agriculture, University of Kentucky, with the U. S. Department of Agriculture, and distributed in furtherance of the work provided for in the Act of Congress of May 8, 1914.

CONTENTS

CIRCULAR NO. 118
(Revised)

ORCHARDING

By

A. J. OLNEY and W. W. MAGILL

During the past ten years creditable progress has been made in the development of commercial apple and peach orchards in Kentucky. At the same time home orchards have continued to decline. The reasons for this are obvious. The introduction of insect and disease pests has made necessary an exacting routine for the control of these pests in order to secure satisfactory fruit production. The average farmer has not informed himself regarding the details required for orchard care, nor has he been convinced of the practicability of providing himself with adequate equipment. The inevitable result has been that home orchards are rapidly disappearing. This is to be regretted since as a result a large part of our rural population is not supplied with a sufficient quantity of desirable and healthful fruits. The situation is especially bad since the home orchard can be made a profitable and pleasurable venture on most farms if proper care is given it. However, the planting of home orchards should not be encouraged unless adequate care is assured, for the results are certain to be disappointing.

The increase in commercial plantings probably is taking place as rapidly as the industry can develop on a sound basis. Nevertheless, there is still a large field for expansion, since our commercial orchards supply but a small part of the fruit consumed in the state. The quality, attractiveness and economy of production of our fruit give Kentucky growers a decided advantage in our nearby markets over our competitors in distant fruit sections.

The general farmer operating a 150 to 200-acre farm often may handle successfully a 10-acre orchard as a side line. Orchards ranging from 25 to 30 acres should be operated, in most

cases, as the primary industry of the farm. The growing of orchards commercially is becoming highly specialized and requires a knowledge of orchard problems, business experience and organizing ability.

This circular is designed to give the amateur orchardist the fundamentals of orcharding. Technical details have been omitted as far as possible.

PREPARING FOR AN ORCHARD

Site. An orchard is a long-time investment and as the trees occupy the ground for many years, great care should be taken in selecting the best possible location and soil. The best site for an orchard is one where the land is rolling or gently sloping, with an elevation somewhat higher than the surrounding country. A high situation insures air drainage; that is, the cold air, being heavier than warm, sinks to the lower levels and as a result the fruit on the high land often escapes injury from the spring frosts. Usually it is advisable to avoid very high and abrupt hilltops, on account of their exposure to severe winds. The site for a home orchard should be chosen for convenience near the house, on an elevated, well drained, fertile piece of ground.

The recommendation for avoiding low land does not always hold true, however, for bottom lands that are near large bodies of water. In such a situation the temperature of the air is modified by that of the water and there is less injury to the fruit by a hard freeze or frost.

There is a difference of opinion regarding what is the best exposure. Any slope may be used where the soil is good and well drained, and the rock is not too near the surface.

Soil. Any good farm soil or land that grows good corn or tobacco generally is suitable for fruit growing, provided the subsoil is deep and well drained. Low, wet land is not satisfactory unless there is ample surface and under drainage to carry off the excess water.

Preparation of the Land. To insure a good growth the land should be well prepared before setting out the trees. If the land has been in sod or remained in an uncultivated state for some

time, or if the vegetation indicates a lack of fertility, it is well to cultivate the soil for a year or two and grow cover crops for turning under. It is good practis to plow the land in the fall and sow it in rye which is to be turned under the following spring.

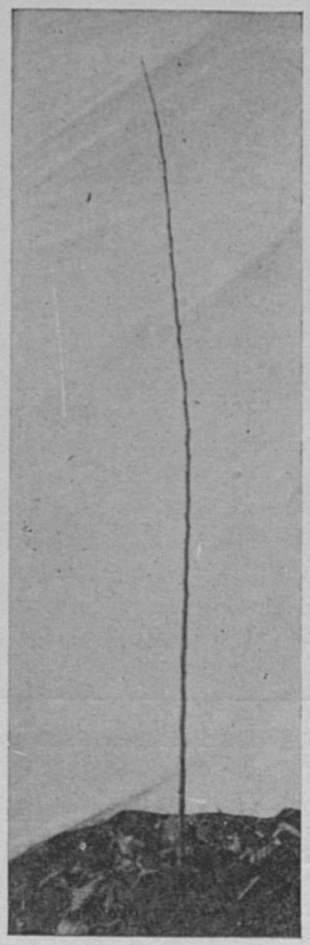

Fig. 1. Apple tree.

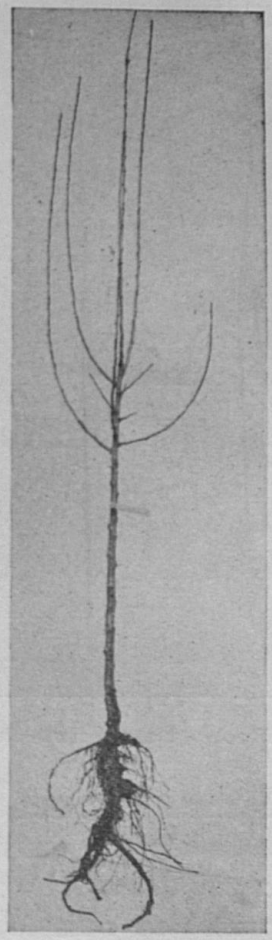

Fig. 2. A well-shaped two-year-old apple tree.

Later in the season plant soybeans, hog them down, letting the vines remain on the land the following winter and plow them under in the spring. This method of culture not only adds fertility to the soil but puts the land in good physical condition for setting out the trees.

Newly cleared land, especially when covered with a second growth of timber, should be cultivated for two or more years

in order to get rid of the stumps and underbrush. Some of the root-rot diseases affecting certain forest trees are associated with the root-rot of apple trees. In order to prevent apple trees from becoming infected, it is desirable to rid the timber land of

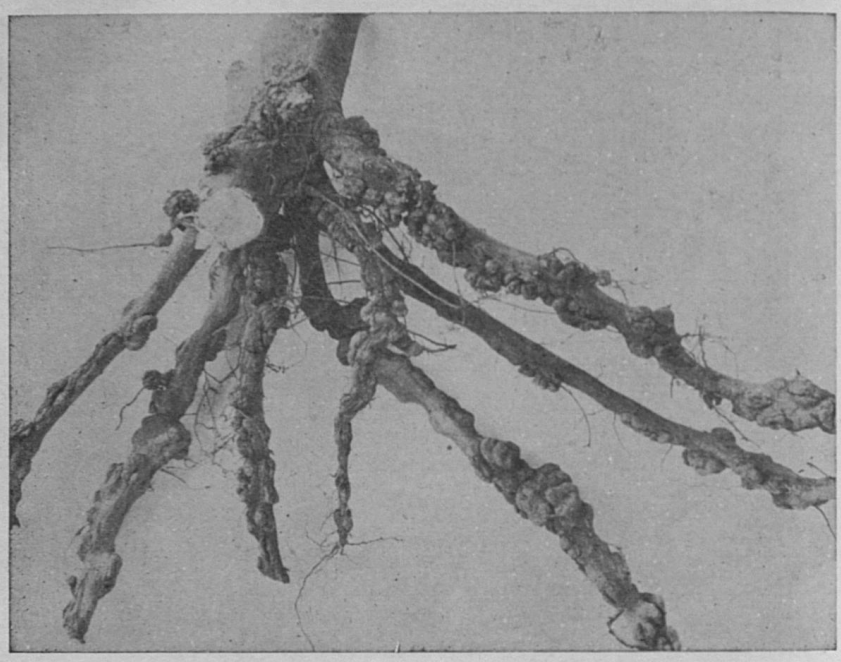

Fig. 3. Roots of apple tree injured by woolly aphis. Reject such trees as these.

all stumps and roots and cultivate the land to field crops several years preceding the planting of the orchard.

Nursery Stock. In buying fruit trees the order should be placed with some reliable nursery. An excellent plan is to visit the nursery, preferably in the fall, and select the trees. If there is a nursery nearby, so much the better, as trees procured from a local nursery can be planted without delay, the cost of transportation is reduced and injury to the bodies and roots of the trees is lessened. Sometimes, in shipping, the body becomes bruised from rough handling and the roots frozen or dried out from exposure.

In selecting fruit trees more emphasis should be placed on a good root system, a sound body, good shape and freedom from

insects and diseases, than on the method of propagation. Some dealers in nursery stock insist on handling only apple trees which are grafted on whole roots; some insist on budded trees, while others claim "pedigreed" trees are better and charge cor-

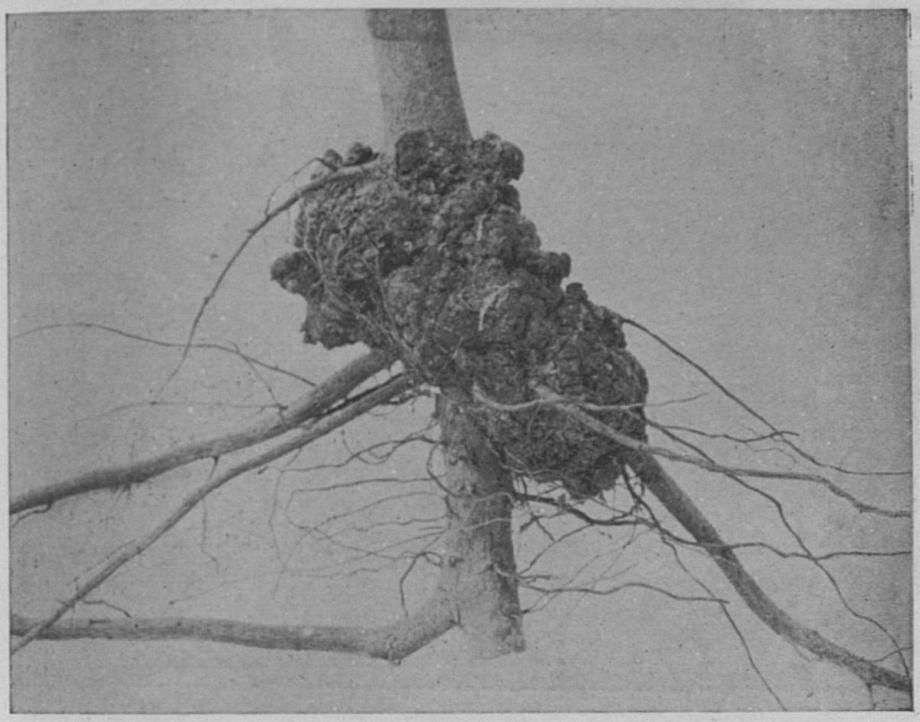

Fig. 4. Crown gall on two-year-old apple tree.

respondingly higher prices for them. For the fruit grower, one method has little advantage over another, his chief interest being to secure vigorous trees true to name. The particular section of the country in which the trees are purchased is unimportant, but the reliability of the nurseryman should be assured.

It is not uncommon to find nursery trees affected with San Jose scale, wooly aphis and crown gall. San Jose scale, a small sucking insect, infests the body and branches of trees, and can be recognized by the small reddish or purplish rings scattered over the bark. The woolly aphis, found on the roots of the trees at digging time, is recognized by the bluish-white, cottony material which covers the insect, while the roots have small, gall-

like swellings. Crown gall is recognized by a brown, warty swelling, sometimes accompanied by a mass of hairy roots. Trees having crown gall and woolly aphis should be destroyed by burning. Cutting off the galls on roots does not control this disease.

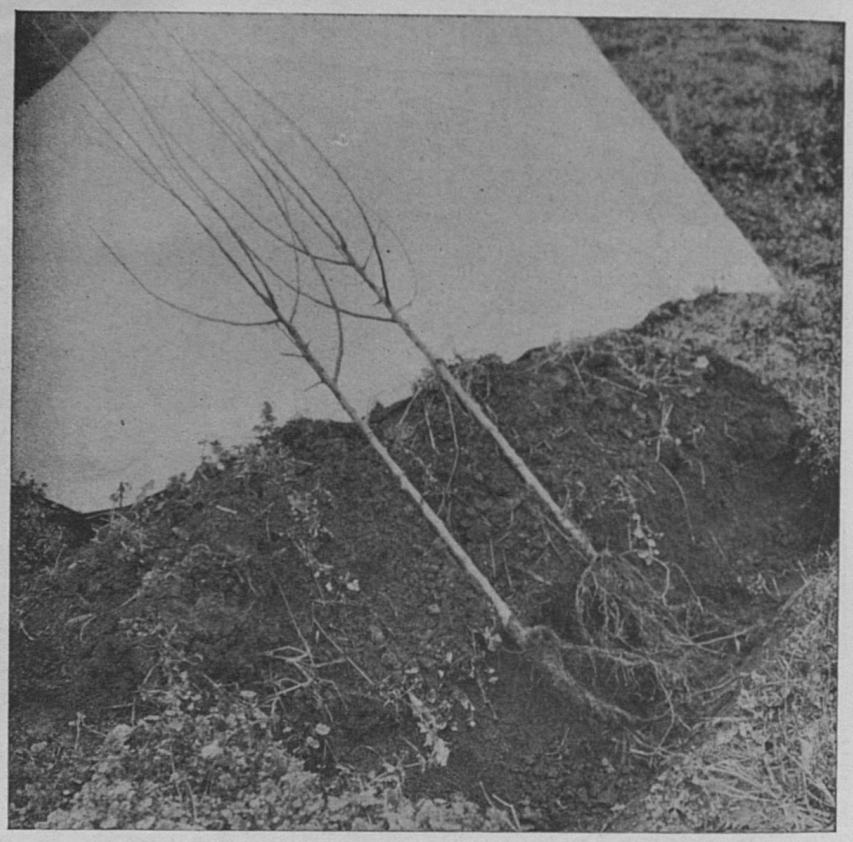

Fig. 5. Trench ready for 'heeling in."

Sometimes it is advisable to plant two-year-old apple trees, because the tops have been formed in the nursery. A tree older than two years usually is undesirable. Many nurseries now are heading their trees much lower than formerly, since low heads commonly are preferred. Some growers prefer one-year-old trees which are mere whips, so they may shape the trees to suit themselves. Two-year-old pear and cherry trees and one-year-old peach trees are preferred.

When the trees arrive from the nursery, unpack them and, if possible, heel them in or plant them at once. If this cannot be done immediately, the box or package should be kept in a cool, damp place, until the trees can be cared for properly. When the

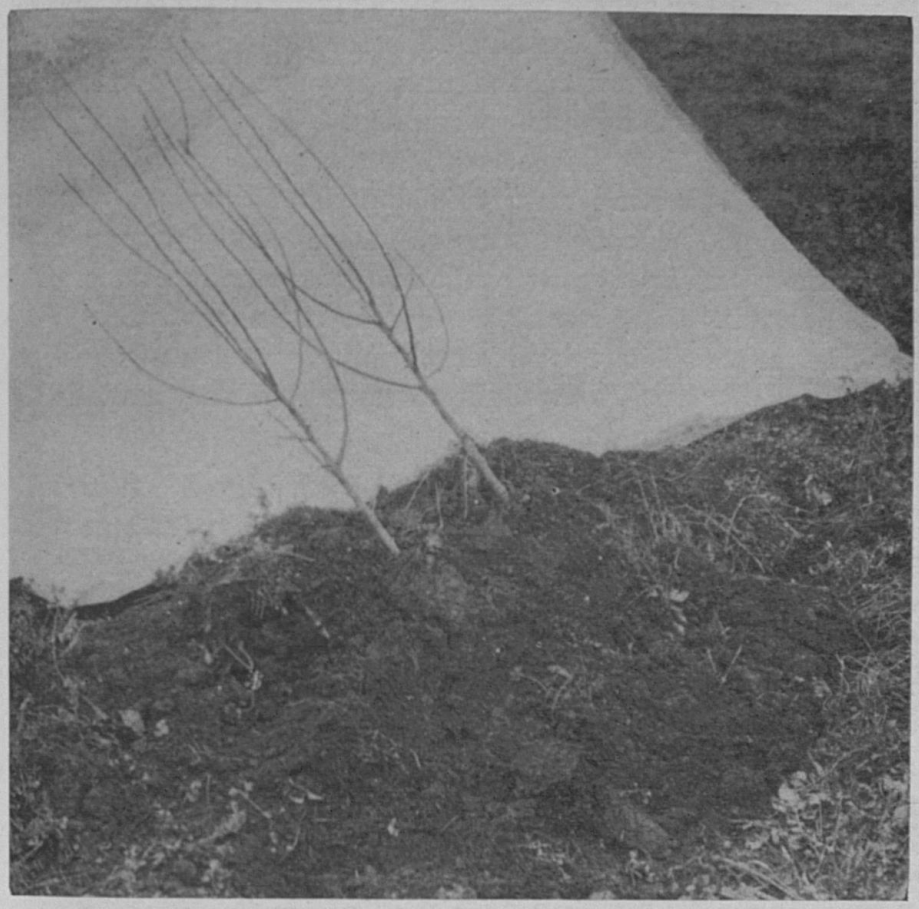

Fig. 6. Trees after "heeling in."

trees are purchased in the fall for the purpose of planting in the spring they should be unpacked and heeled in. Select a well-drained location with a loose, fine soil and open a trench one to two feet deep, throwing the dirt at the edge of the trench to make a sloping bank on which to lay the tops of the trees, with roots in the trench. Scatter the trees in a single layer close together and cover the roots and half of the tops with the dirt, taking care to protect them from possible injury from mice by

allowing no straw or litter to accumulate about them and from rabbits, if present, by the use of a simple fence of poultry netting.

Planting the Orchard. There is a difference of opinion as to whether fall or spring planting is better. Uusally in the fall the farm work is not as rushing as in the spring, the soil can be put into better condition, and there is more time for careful planting. Favorable weather conditions, good trees and well prepared land for planting should be the guide rather than the season. Fall planting usually is done in November. Spring planting should be made as early as the soil can be prepared, because late plantings usually result in a poor stand of trees. The principal point to be noted in the planting operation is to see that the moist soil is pressed very firmly about the roots. Most growers prefer to set trees slightly deeper than they grew in the nursery.

"Planting trees with dynamite" has received considerable attention from producers of explosives and from fruit growers. There are undoubtedly situations where the soil is underlaid with a thin layer of rock or other impervious material, that are improved by dynamiting. However, good farm soils with natural drainage well suited to orchards usually do not require dynamiting and it is doubtful if many advantages are to be derived from its use in most instances. Sometimes it is advisable to dynamite where there is a water-clogged subsoil, provided one can dynamite thru to a drained area underneath. If this drainage cannot be accomplished, the water will soon fill the loosened area and the same condition of subsoil will continue. In this case the tile drainage would be the only remedy for getting rid of the surplus water. When planting trees with dynamite, follow the directions given by the manufacturer supplying it.

There are several methods of planting an orchard. The arrangement of the trees in squares or rectangles is in general use and is believed to be as satisfactory as any. When trees are planted by this method it is easy to lay off the orchard and the later operations of plowing, spraying, etc., as well as intercropping with berries and vegetables, are simplified. Apple

trees should be planted thirty-five feet apart in order to give ample room at maturity. This method gives thirty-five trees to the acre. The usual planting distances recommended for pears, peaches, plums and cherries are twenty to twenty-five feet apart. When planting on a hillside where it is often too steep to cultivate, rows should follow the contour of the hill.

A convenient method of laying off the field is provided by staking the sides of the field at intervals equal to the distances between the trees. Deep furrows may be plowed from the stakes of one side to corresponding stakes on the opposite side; then cross furrows may be made between stakes of the other two sides. The intersections of these furrows, if accurately plowed, mark the locations of the trees. At these intersections, holes for receiving the trees should be made, large enough to allow plenty of room for the roots without crowding. Separate top from bottom dirt and put the top dirt in first. When trees are taken to the field, protect the roots from exposure by keeping them covered with a wet sack or canvas. A brief exposure of the roots to hot sun or drying winds may injure if not kill the tree. When planting, lean the tree slightly or place the heaviest side facing the prevailing winds. This side can be determined readily by balancing the tree in the hand.

The tops of one-year trees should be cut back to a point where the head is to be formed; if the trees are two years old, the branches should be shortened.

Use of Fillers. A filler is a temporary tree, usually of an early bearing variety, which is planted between the permanent trees for the purpose of securing larger returns from the orchard before the permanent ones are of full bearing age. The Yellow Transparent often is used for this purpose. If apple fillers are used and kept as such for a long time, the distance between the permanent trees should be not less than forty feet. The main objection to the use of fillers is that many fruit growers, thru ignorance or carelessness, fail to cut them out at the proper time and do not appreciate the damage due to crowding until after it is done.

Many growers use peach trees as fillers. This is not recommended since the apple and peach require different methods of culture. Peach trees need constant cultivation in order to produce vigorous annual wood, as the fruit buds are formed on the current season's growth. There may be a period in the soil management program where the apple will be making too much vegetative growth at the expense of the fruit bud formation. Should this condition arise it will be necessary to seed the orchard to grass, but doing this would weaken the growth of the fruit-bearing wood of the peach.

The greatest objection to interplanting apples and peaches, however, is the difference in the summer spray requirements. The summer applications of Bordeaux mixture and commercial lime-sulfur necessary for the apple trees would injure the leaves of the peach trees, if blown upon them as may easily occur.

SELECTION OF VARIETIES

One of the most important decisions to be made in starting a young orchard is in selecting the varieties. For the home orchard a larger number of varieties should be planted than for a commercial orchard, so as to provide a continuous supply of fruit for the table. A large percentage of the trees may be of winter varieties in order to have a supply during the winter.

The man who is planting a commercial orchard should study the requirements of the nearest market. His object should be to produce large quantities of fruit of the kind that the market demands.

The distance to market, the condition of roads, facilities for storage and refrigeration are factors which may influence the selection of varieties.

The matter of proper pollination of fruit blossoms, also, has an important bearing upon this question. Most varieties of apples, pears, plums and sweet cherries are in some degree self-sterile, and will not fertilize their own flowers fully enough to produce a profitable crop, if planted alone, but peaches and sour cherries will fertilize their own blossoms.

Rome Beauty, Grimes, Delicious and Jonathan are considered satisfactory pollinizers, tho one of the other three should be planted with Rome Beauty.

VARIETIES FOR THE COMMERCIAL ORCHARD

Apples. The principal varieties of commercial importance in this state are the Winesap, Stayman, Rome Beauty, Grimes Golden and Yellow Transparent.

No Kentucky apple is better known than the Winesap. It reaches its highest perfection in color and flavor in western Kentucky and on account of this and its long keeping quality it has become a commercial variety of the first rank.

The Stayman, a seedling of the Winesap, has become popular among the commercial growers. The tree is a strong grower, comes into bearing early and usually produces annual crops. It is a large apple of high quality and often outsells the Winesap on account of its size.

The Rome Beauty is especially adapted to eastern Kentucky where it has become the leading commercial variety.

The Yellow Transparent should be given more consideration as a commercial variety. The tree is an upright grower, adapts itself to almost any locality and may be planted as close as 25 to 30 feet. It comes into bearing at an early age and requires but a few sprays to rid the fruit of insects and diseases. It is the first apple on the market, has no competition and, if picked before fully ripe, can be shipped long distances. It is subject to blight.

The Grimes is always popular on the market on account of its appearance and flavor. Trees come into bearing at an early age and usually bear every year. Its chief weakness is collar-rot. This tendency may be overcome by using double-worked trees.

The Delicious has been planted extensively in this state. Orchards now coming into bearing indicate that it is a promising commercial sort. It appears to be an annual bearer and commands high prices. It keeps well in cold storage but quickly loses its quality in the average farm storage.

The following varieties have given satisfactory returns in some orchards: Jonathan, King David, York Imperial, Mammoth Black Twig, Paducah, Ben Davis and Black Ben Davis.

Peaches. Peach varieties of chief commercial importance are Red Bird, Hiley, Carman, Hale, Champion, Belle of Georgia and Elberta. All the varieties listed except Elberta and Hale are white fleshed, appear hardy in bud and are valued particularly for local markets.

VARIETIES FOR THE HOME ORCHARD

Apples. A small area, one-half to three-fourths acre, containing 15 to 20 trees, will give a continuous supply of fruit for the average family, The following varieties, from early to late, are recommended: Yellow Transparent, Red Astrachan, Gravenstein or Maiden's Blush, Grimes Golden, Jonathan or King David, Winesap, Stayman, Rome Beauty, Delicious, Hyslop, Golden Sweet.

Pears. The fruit grower and farmer are not advised to plant pears, because of their susceptibility to blight, which may not only cause considerable damage to the pear trees, but may spread to apple trees nearby. The Seckel, Kieffer, Garber and LeConte are the principal varieties grown in this latitude.

Quince. The quince, also, is very subject to blight and therefore should not be planted near the apple orchard. The Orange is one of the most popular varieties.

Peaches. The following varieties, from early to late, have been found satisfactory for home use: Mayflower, Alton, Hiley, Carman, Early Elberta, Hale, Champion, Belle of Georgia, Elberta, Heath Cling and Krummel.

Plums. The native plums, Wild Goose (2)* and Milton (2) may be depended upon to produce a crop practically every season. Other varieties valuable for home use are: Green Gage (3), unexcelled for canning; Lombard (3); German Prune (3); Shropshire Damson (3); Shiro (1); Burbank (1). Many plum varieties are self-sterile and special care should be taken to provide suitable pollinizers of the same season.

*Early flowering varieties are marked (1), mid-season (2), late (3).

Cherries. Early Richmond and Montmorency are the most important sour cherries, the latter being the most popular. Sweet cherries are not as reliable as the sour varieties but, while not recommended commercially in this state, are often prized for the home garden. Black Tartarian, Windsor, Gov. Wood and Napoleon are among the most satisfactory. At least two or three varieties of sweet cherries should be selected and planted close together to insure pollinizing, since many varieties will not bear by themselves. The sour varieties are self-fertile and will bear alone.

SOIL MANAGEMENT

One of the most important problems that should receive the attention of the fruit grower is the maintenance of soil fertility. The growth and fruitfulness of a tree depend upon the amount of plant food and moisture in the soil. The importance of these two factors is clearly demonstrated by the average neglected orchard growing on thin land. The leaves in such an orchard are small, pale green or yellow in color and often drop as early as August and September. The starved trees often bloom heavily but do not set fruit, or those that do set, drop their fruit early in the season.

On the other hand, in young orchards where continued cultivation and use of fertilizers have been followed, providing abundant nitrogen and moisture, the trees often will be making too strong a vegetative growth and fail to set fruit. In this case it may be necessary to suspend application of fertilizer and reduce the moisture supply by seeding the orchard to grass.

CARE OF YOUNG ORCHARDS

At planting time or immediately afterward the trees should be pruned rather severely. Cultivation should begin early and be repeated frequently thruout the growing season so that the conditions may be as favorable as possible for the establishment of the young trees. Either the clean culture system or the use of inter-crops is the most satisfactory treatment of the land set to young orchards, except where the land is subject to serious

washing, in which case a sod mulch method described below is followed.

Clean Culture with Cover Crops. This method of soil management is recommended particularly for young orchards; under

Fig. 7. Fall cover crop following clean culture.

favorable conditions it has promoted annual growth and productiveness as well as any. Clean culture is followed most successfully on land not inclined to wash when tilled year after year. In involves frequent tillage of the soil to preserve moisture and keep down the grass and weeds. However, since continuous stirring of the soil with constant exposure to the sun and hot winds will burn out the humus and so injure the soil texture, cover crops are recommended. Cowpeas and soybeans may be sown the latter part of June. These preferably are drilled in rows, in order to continue cultivation. About the first of September the cowpeas or soybeans are turned under and followed by rye or oats. The next spring this is plowed or disked under and cultivation continued as in the preceding year. This cultivation and turning under of the cover crops adds nitrogen

and humus to the soil and creates conditions particularly favorable to tree growth.

Clean cultivation without the sowing of cover crops will conserve moisture and make available for a limited period the

Fig. 8. Turning under cover crop.

plant food materials already in the soil, but if kept up for an unlimited time it may become difficult to grow a good stand of cover crops. The length of time that this practis can be continued depends upon the fertility of the soil at the beginning. The use of leguminous crops during the summer is primarily for the protection and improvement of the soil, while the winter cover crop assists the trees in maturing their wood and prevents erosion, in addition to its value as a soil builder.

When cultivating the orchard keep away from the trees at a distance of several feet to avoid injuring them. The ground around the trees should be hoed frequently, keeping down all grass and weeds. This culture system is continued for several years or up to the age of bearing. If too rapid a growth is made at this time, it may be advisable to stop cultivation for a time and sow grasses, followed again by cultivation. This depends upon the amount of vegetative growth the trees are making. For example, if in a single season the vegetative or terminal

growth is two or more feet, at bearing age, it may be necessary to stop cultivation in order to throw the trees into bearing. If the terminal growth is only four or five inches, cultivation should be continued.

Intercropping. Some fruit growers prefer to grow some cultivated crop or tree fillers between the trees in order to have some returns from the land. In this case the use of crops such as potatoes, tomatoes, beans, melons, etc., is advised. Corn may be used, provided the rows are planted not less than five feet from the tree rows. This lessens the danger of injury to the trees by plowing. When the ground in the orchard is being used for other purposes, it is advisable to sow a winter cover crop and to scatter manure about the trees each year, thereby replacing the fertility that has been removed.

CARE OF THE BEARING APPLE ORCHARD

The object of any method of culture is to keep the trees in a state of health and vigor which will promote maximum production. When practicable, the clean culture and cover crop system outlined for young orchards is continued and gives satisfactory results. Otherwise a method of growing grasses and the use of straw mulch known as the sod mulch system is preferred.

Sod Mulch System. Sometimes the orchard has been planted on rolling or hilly land where there is danger of washing when cultivated. In this case, especially on thin land, the growing of sweet clover to enrich the land and prevent washing and the formation of gullies is recommended. Usually it is necessary to apply ground limestone at the rate of two or more tons to the acre on most of our Kentucky soils before a good stand of sweet clover can be obtained. Where it is impossible to grow sweet clover on account of the inability to procure limestone, Japanese clover may be used and its growth increased by the use of manure and acid phosphate. In order to conserve the moisture when the sod mulch system is followed, the clovers should be cut two or three times during the season and raked under the young trees. Where straw or like material is available, it will be found beneficial to add 50 to 100 pounds of the material per tree, depending upon its size, in addition to the grass cut in the orchard.

In applying mulch care should be exercised to spread the material under and beyond the branches rather than pile it around the base of the tree, because the latter way attracts field mice. Each year enlarge the ring of mulch so as to cover the outer root

Fig. 9. Effects of too much cultivation on hillside orchard.

area. A time will come when the root systems of the trees are overlapping; then the grass should be cut and let lie where it falls. The use of nitrate of soda or sulfate of ammonia, scattered on the ground in early spring under the branches will encourage twig growth and stimulate the development of fruit buds.

The sod mulch system will fail unless sufficient mulch material is provided to hold the soil moisture during dry weather. This method is also open to the objections that mice or other rodents may harbor in the mulch, and that the mulch may catch fire and result in injury to the trees. The control of rodents is discust with orchard pests. Cultivated strips maintained on

the side of an orchard exposed to a railroad, wood-lot or stubble will serve as a protection from fire.

A combination of clean culture and sod mulch methods is being used in the western apple section of Kentucky with good results. It may be termed "modified straw mulch."

Fig. 10. An excellent stand of Japanese clover in a bearing orchard.

Nitrate of soda or sulfate of ammonia is used as described above, and the ground between the rows not covered with the straw mulch is cultivated and cover crops are sown as explained under the clean culture system. The nitrogen in the fertilizer provides immediate plant food in early spring, while the straw mulch and cultivation with cover crops holds moisture and adds organic matter to the soil.

Use of Clovers. A rotation of clean cultivation and cover crops for one year, and growing a mixture of red and alsike clovers for two years, cutting the clover and using it as a mulch, is a desirable system of soil management. If the mulch from the clovers is not sufficient, additional straw or mulch material should be used under the trees. The clover crops turned under supply the soil with nitrogen and humus; the clean cultivation the following year rids the orchard soil of weeds and lessens the danger from field mice.

Many orchards of the state are on land that will not grow red or sweet clover without the use of ground limestone, and in many sections this cannot be obtained on account of long hauls over bad roads. Under these circumstances Japanese clover may be substituted, since this legume will grow on most of the thin soil of Kentucky. The same system of soil management recommended in the use of red and alsike clovers may be followed.

Fertilizers. The fertility of the soil can be kept up by the use of well-rotted manure, 10 tons or more to the acre. This should be spread during the winter months on the ground in a circle under each tree and somewhat beyond the branches. On very poor soil some phosphate should be used also. In many places manure is very scarce and expensive and it is out of the question to use it. When the orchard is operated in connection with a large farm it may be more profitable to use the manure for the farm crops. In either case nitrate of soda or sulfate of ammonia may be substituted for manure and applied in the same area.

Orchards that are in sod or grass mulch respond quickly to the application of nitrate fertilizers applied in early spring just before the buds swell. For bearing trees at the age of 10 years, it is a growing practis to use 5 pounds of nitrate of soda or 4 pounds of sulfate of ammonia, which can be increased or decreased as indicated by the age of the trees and the amount of annual terminal growth. The use of nitrogen often so invigorates the buds as to make the blossoms more resistant to frost injury and increase the set of fruit. It also produces a larger leaf surface which assists the tree in growth. Young orchards which are being handled by the plan of turning under cover crops may not show any response to the use of nitrate fertilizers, as moisture conservation may be the limiting factor in wood growth. Acid phosphate generally has shown no direct effect on the trees, altho in a few instances when used in combination with nitrate of soda in neglected bearing orchards its use has resulted in increased yield when applied over the tree square, according to the Ohio Agricultural Experiment Station Bulletin 339, 1920.

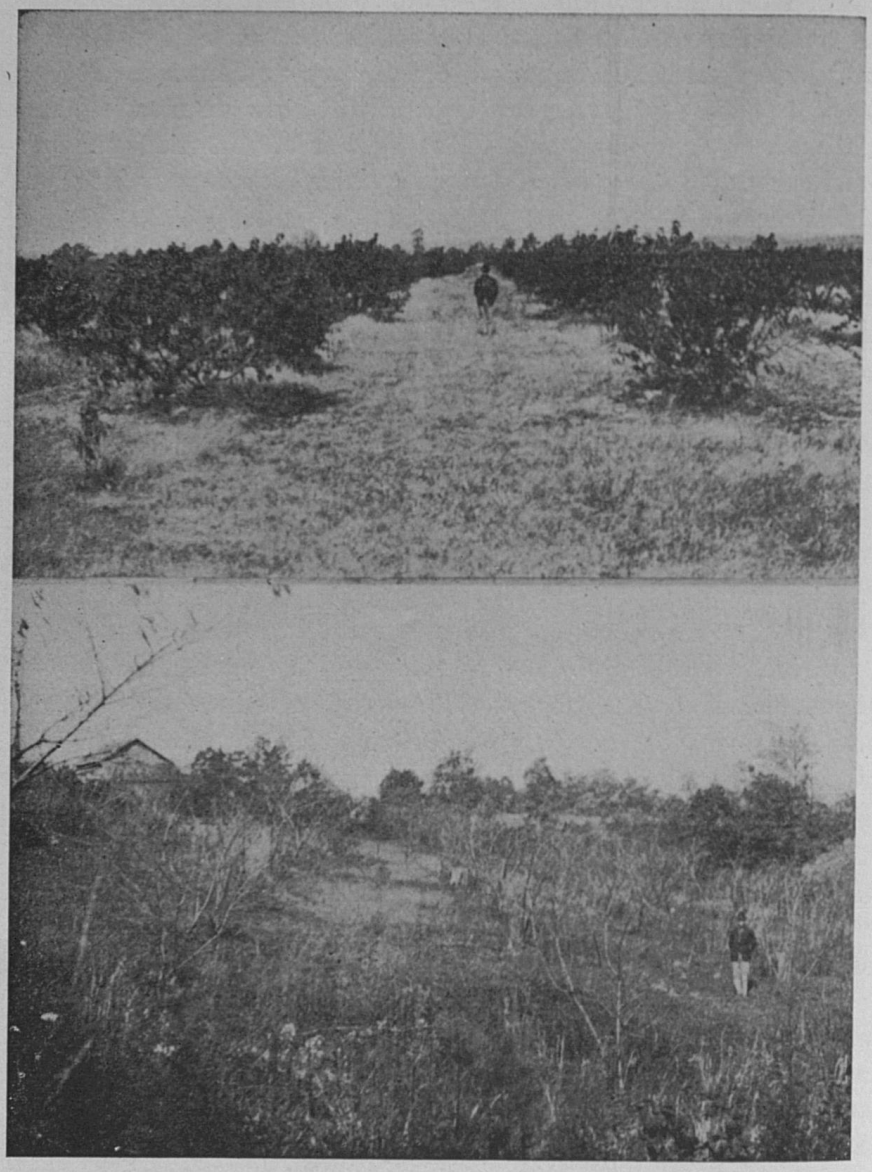

Fig. 11. (Above) Peach foliage retained on October 19th as result of good culture. (Below) Neighboring neglected orchard on the same date, all foliage gone.

Lime is beneficial since it improves the soil and exerts a favorable influence on the growth of leguminous crops.

CARE OF THE BEARING PEACH ORCHARD

After the trees are three years old, cropping between them should cease, since they now require all the space for their development. A few peaches sometimes are borne the third summer, but little fruit should be expected until the fourth season, when a good crop may be produced. The bearing orchard should be well cultivated thruout the growing season, followed by the sowing of a winter cover crop as described for the young trees. However, many growers prefer to work up the soil in the spring with a disk harrow instead of plowing, since plowing becomes increasingly difficult as the trees grow larger and are trained to spread rather low. When this is done it is desirable to sow a cover crop which will be killed by the winter and easily worked up by the disk harrow in the spring.

Oats, peas or buckwheat may be used satisfactorily in this way. It is important to disk the orchard very early in the spring as it is quite impossible to do this properly after the weeds and grass get a start. If plowing is practist the time of doing the work is not so exacting as with disking, but should never be delayed until the cover crop has become too woody and has depleted the soil moisture. Peaches are injured severely by drought and the cultivation should be such as will best conserve the soil moisture. Considerable injury often is done by allowing the cultivating tools to bark the trees.

Fertilizers. Nitrogenous fertilizers such as nitrate of soda and sulfate of ammonia are being widely used among peach growers. Except on very fertile soils applications of 1 to 3 pounds per tree, applied early in the spring, usually have proved profitable and young trees which are not making a vigorous growth usually respond to applications of ½ to 1 pound per tree.

Thinning. Peaches often set more fruit than the trees can mature properly. Thinning increases the size of the individual fruits and saves many broken limbs. Trees that are thinned usually yield as much fruit in quantity and the appearance and

quality are greatly improved. Thinning is done after the "June drop."

Small and defective fruits are taken off first so that the amount of cull fruit may be as small as possible. The further

Fig. 12. (Left) Before thinning. (Right) After thinning.
Peach trees severely thinned usually produce as many bushels per tree; both quality and price will be higher.

thinning will depend somewhat on the distribution of the small peaches over the tree. If the fruit is distributed uniformly the peaches should be thinned to five or six inches apart.

Sometimes only a few branches have set fruit and thinning to a given distance apart would materially lessen the crop. In such cases it will be necessary for the grower to judge the amount of thinning needed to produce a proper development of the fruit and prevent breaking the branches.

COMMON PESTS OF THE ORCHARD

The more common insects and diseases of the orchard are briefly described below. Control measures are suggested where they are not included in the spray program.

Apple Aphids. The aphids or plant lice are sucking insects which begin their attack as the leaves and blossoms unfold in the spring. As the leaves open, the insects gather upon the under side and by their numerous punctures cause the leaves to curl. When aphids attack the young fruit, the apples become dwarfed, knotty and worthless.

Apple Tree Borers. The round-headed and flat-headed apple tree borers often injure and sometimes kill the trees. The larvae bore into the trunk and open numerous tunnels thru the inner bark and young wood. The flat-headed borer seems to attach chiefly unhealthy trees, while the round-headed borer is not so discriminating. The presence of borers usually is indicated by dark, slightly sunken areas of bark, chiefly on the sunny side of the tree, and by the reddish castings found around the base of the trunk. Worming with a sharp-pointed knife in July or August is as effective as anything that has been tried. Orchards that are well cared for usually are free from serious attack by borers.

Apple Tree Tent Caterpillar. Leaf-eating worms which build a web over a branch and come out at intervals to feed upon the leaves. These and other leaf-eating worms are controlled by poison sprays. The fall web worm feeds within its web and is more difficult to reach with a spray. A good way to destroy them is by the flame of a torch.

Coddling Moth. This insect is the chief cause of wormy apples and the premature dropping of the fruit. The winter is past as a matured worm in cocoons under loose bark and crevices of the trunk and branches and in the rubbish that often accumulates around the base of the tree. The adult emerges in early spring and lays its eggs on the leaves, twigs and fruit, chiefly at and immediately following the blooming time. The small worms bore into the fruit thru the blossom end. Worms hatched later usually enter thru the side of the apple. Control: Poison sprays are effective.

Curculio. The adults are beetles which sting the surface of the young fruits of plums, peaches and apples, depositing an egg in each puncture. The eggs hatch into grubs which burrow thru the flesh and in the case of stone fruits are found around

the pit. In apples the injury is confined largely to the stings which result in irregular shaped fruit. Arsenate of lead is used for control.

Fruit Tree Bark Beetle. The bark beetles are very small, dark brown insects which bore into the bark of the trunk and larger branches. Their presence usually is indicated by numerout dark-colored punctures from which gum is exuding. All fruit trees may be attacked, but peaches, plums and cherries are especially subject to them. It is rare that healthy trees are attacked by bark beetles. The remedy consists in removing and burning all badly infested branches or sometimes entire trees and fertilizing and thoroly cultivating the remaining trees to bring them into a healthy condition.

San Jose Scale is common thruout Kentucky and is considered by most growers the most serious pest of the orchard. It attacks the branches, twigs, trunk, leaves and fruit and in many cases kills the tree before noticed. Thoro dormant spraying, according to the Kentucky spray schedule, should give satisfactory control.

Leaf Hoppers. Small, yellowish-green insects which sometimes attack the foliage of apples. They swarm on the under side of the leaves, puncturing the tissues and sucking the juice, giving the leaves a mottled, grayish appearance. The young are pale green and run in all directions when disturbed but the adults can jump quickly and fly away. No effective remedy has been found for their control.

Pear Slug. Slimy slug-like worms which skeletonize the upper surface of the leaves, so that only the larger veins remain. The arsenical sprays applied for the coddling moth usually will control them.

The Peach Tree Borer destroys more peach trees annually in Kentucky than all other insects combined. Trees of all ages are subject to attack. The injury is done by the borer or "grub" which eats and burrows in the soft inner bark or cambium, at and below the crown of the tree. Young trees may be completely girdled and older trees so injured that their vitality is lowered and their fruitfulness reduced.

Eggs are deposited on the base of the tree by the adult female "fly" thruout the summer, but especially in August and September. Within two weeks the eggs hatch and the young larvae or "grubs" begin feeding on the bark just under the ground level.

The first indication of borers is usually the appearance of a jelly-like gum exuding from the tree.

Until recently the main dependence for the control of the borers has been the laborious process of digging them out with knives and other appliances in spring and fall, a method which often fails to destroy all the pests.

A new and effective control has been found in the use of a chemical compound known as paradichlorobenzene.

Paradichlorobenzine (P. D. B. for short) is a white, crystalline substance that has the appearance of coarse salt, with an odor resembling that of moth balls. The fumes from this material, while harmless to persons, are poisonous to insects. Being heavier than the air, the P. D. B. fumes readily permeate the soil.

P. D. B. should be applied in Kentucky between September 20 and October 10, while the soil temperature is still high. At this time most of the eggs have been laid and the young larvae

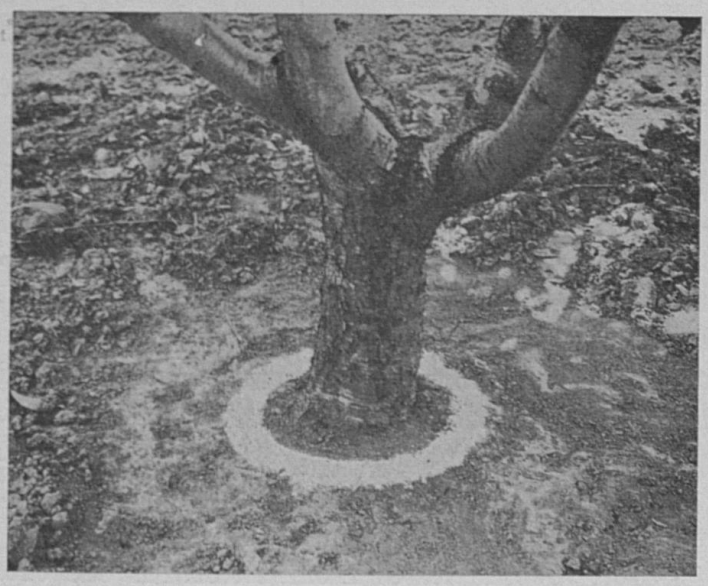

Fig. 13. The ring of P. D. B. Ready to be covered with three inches of soil.

or "grubs" are near the surface, making them more susceptible to the gas.

Scrape the grass and weeds away from the trunk of the tree, leaving the ground smooth one foot in all directions from the trunk. Any excess of gum or loose bark on the trunk may be lightly scraped off. If borer injury should be found above the ground level, mound up the soil a few inches, tho this is usually unnecessary.

The P. D. B. is applied evenly in a circular band an inch wide, entirely around the tree, care being taken that the band is not closer than 1½ inches from the tree trunk. (See Fig. 13.) For convenience in measuring the material provide a small wooden or tin box that holds the proper amount for the size of the tree being treated. After treating, mound up the soil around the tree to a depth of three inches and pack firmly with the back of a shovel. The trees must be treated each year.

1. For trees 3 to 5 years old, use one-half to one ounce per tree. After 4 weeks remove the mound, leaving the ground level.
2. For trees 6 years or older, use 1 to 1½ ounces per tree.
3. Experiments with 1 and 2-year-old peach orchards in Kentucky and adjoining states indicate that P. D. B. may be used without injury to the trees.

Numbers of reliable growers are using one-third ounce on 1-year-old trees and three-eighths ounce on two-year-old trees. They have reported complete control of the borer, with no injury to the trees, on the several thousand trees tested. *Care should be used in all cases in weighing or measuring the insecticide, especially for young trees.* As a further precaution against possible injury to the youngest trees, it is advisable to *remove the mounds after three weeks.*

P. D. B. can be purchased from most drug stores or from the various firms thruout the state who handle orchard spray materials and chemicals. In small quantities the material costs between 30c and 40c per pound, and in larger quantities, 23c to 30c per pound. With these prices the cost per tree will be from one to two cents.

Bitter Rot. Apple losses from bitter rot are often very great, a large crop being totally lost in a few days under condi-

tions favorable to the rot. The disease affects the limbs and fruit. On the limbs cankers are formed where the fungus passes the winter and developes spores in summer which are carried to other limbs or to the fruit. July and August are known as bitter

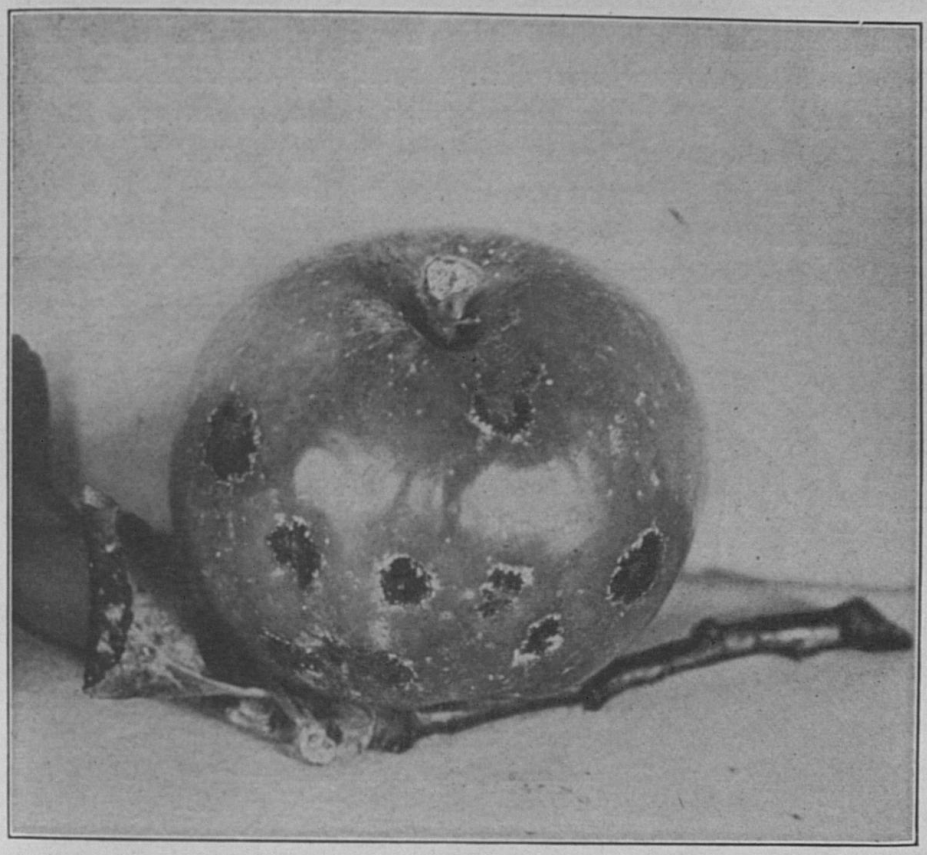

Fig. 14. Apple scab.

rot months, altho infection may take place from June to October. Bordeaux mixture is regarded as the best fungicide for this disease.

This disease often appears on individual trees in the orchard and hand picking of the first fruits infected is followed by the best growers.

Black Rot. A disease of apples causing cankers on the limbs of the trees and rotting of the fruit and, while not considered as serious in the orchard as bitter rot, the losses from it

often are large and it is especially destructive to fruit in storage.

Apple Scab. The scab is one of the most serious of apple diseases. It attacks the leaves, flowers and fruit. It is recognized by rather sharply defined circular brownish spots. The disease may result in a small set of fruit, premature dropping, small, irregular apples and in poor keeping qualities. All varieties are affected, some more than others. Bordeaux mixture has been replaced in large measure by dilute lime-sulfur as a fungicide for scab control because of the tendency of Bordeaux to russet the fruit when applied early in the season.

It is important to keep the trees well covered with the fungicide during the spring when the leaves are expanding and until the fruits are well formed, particularly if the season is rainy.

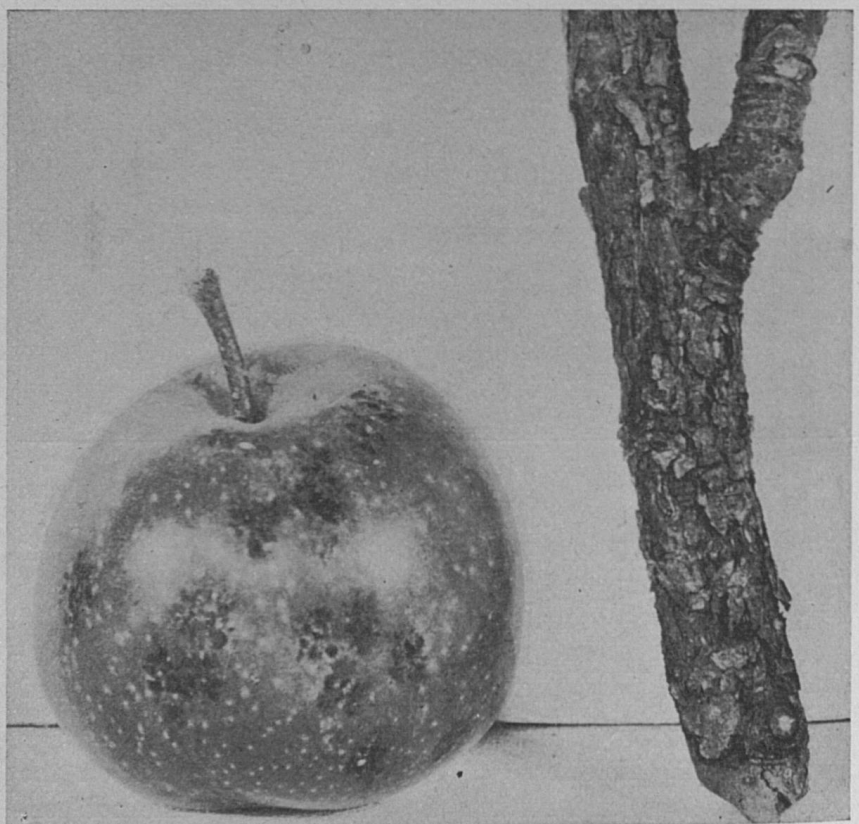

Fig. 15. Apple blotch on fruit and twig.

Black Knot. A disease of plums and cherries causing swollen black knots on the branches. Cut and burn all knots as fast as they appear. Spraying alone does not afford complete control but may be helpful as a supplement to other measures.

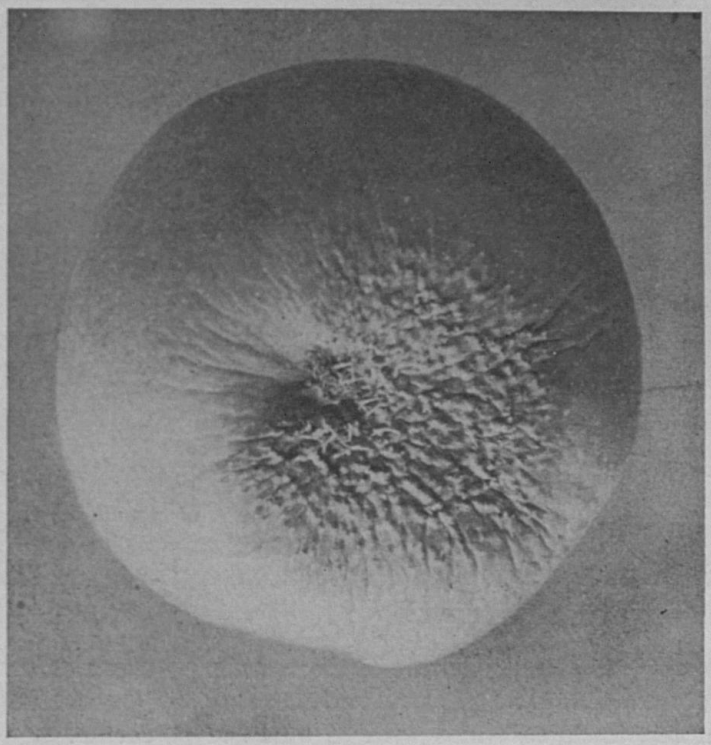

Fig. 16. Cedar rust on apple.

Blotch. A very serious fungus disease of apples affecting twigs, leaves and fruit. The limb cankers appear as rough areas on the bark which often encircle the branch, forming rings. On the fruit brownish or black irregular spots are formed which not only mar the appearance but render the apple subject to early decay. This disease is very stubborn but thoro and persistent applications of Bordeaux mixture applied as directed on the spray program are effective.

Brown Rot. One of the most destructive diseases of the peach and plum. The greatest damage usually comes when the fruit is nearly ready for the harvest. During warm, wet weather

a whole crop may rot in a few days unless checked by spraying. The use of sulfur dust is increasing among peach growers.

Cedar Rust. A disease of apples and cedar trees. It appears as orange-colored blotches on leaves and fruit, eventually producing minute fringed clustered cups. Compared to scab and blotch it is of minor importance. Spraying is not effective.

Crown Gall. A warty growth often produced at or near the crown of many kinds of trees and shrubs. This is a bacterial disease and control consists in digging out and burning affected plants as soon as discovered. Never use nursery stock having galls even tho they are small and easily rubbed off or cut out.

Fire Blight. Fire blight is a bacterial disease of pears and apples, being so destructive to most of the better varieties of pears as to prevent their commercial cultivation in this state. The blight on the apple is not usually as severe and commonly is known as "twig blight."

Winter prune all diseased branches, making the cut several inches below the diseased area. Cut out the dead wood of all the body cankers and disinfect the area with the following, known as Reimer's Solution:

Dissolve 4 tablets of cyanide of mercury in ⅓ quart of water.
Dissolve 4 tablets of bichloride of mercury in ⅓ quart of water.
Then mix these solutions with ⅓ quart of glycerine.
Apply with a paint brush.

The addition of a little aniline dye such as congo red, makes thoro painting easier.

Sooty Fungus. A common apple disease of minor importance because it is controlled easily by ordinary orchard spray practis. It usually is recognized as sooty growth in distinct round colonies on the surface of the fruit, but some times appears as small specks commonly called "fly speck." The fungus detracts only from the appearance of the fruit as it does not penetrate the surface. Its appearance in the orchard usually suggests inefficient spraying

Leaf Curl. A disease affecting the foliage of peaches. Soon after unfolding in the spring, the leaves become swollen, dis-

torted and curled, and finally drop off, thereby greatly devitalizing the tree and causing the fruit to drop also. Dormant applications before buds swell of lime-sulfur or other fungicides are effective.

Peach Scab. Most varieties of peaches are susceptible to this disease which appears as dark circular olive spots on the fruit, and discolored areas on the twigs, sometimes also affecting the foliage. Self boiled lime-sulfur or its substitutes are effective.

Rabbits. Young trees are often ruined by rabbits during the fall, winter or spring. This injury can be prevented by wrapping the small trees with paper, cloth, broom sedges, tobacco stalks, etc., but the wrapping material must be removed each spring. Most commercial growers have adopted the method of using a protector made from one inch mesh poultry wire, 16 or 18 inches high, cut in 20 inch lengths. This gives protection winter and summer for seven or eight years. Repellants such as blood, liver, sulfur washes, etc., give only limited protection and are not, therefore, recommended. Growers should avoid such preparations as axle grease, tar or oil, for they often kill the trees.

Mice. Thousands of apple trees are killed each year by field mice. These rodents feed on the tender bark of the trunk roots below the ground level. Injury of this kind is especially common in sod and straw mulched orchards. The injury usually is done in winter when their food supply is low. Preventive measures consist in removing grass, weeds, manure, etc., from around the base of the tree each fall thus breaking up their hiding places. A half bushel of coal cinders heaped around the base of the tree will hinder mice from making their burrows. Where preventive measures fail, it often is necessary to use poison to kill the mice. The formula recommended by the U. S. Biological Survey is being used effectively in commercial orchards.

The poison bait is prepared as follows: Mix together, dry 1/8 ounce of powdered strychnine and 1/8 ounce of baking soda. Sift the strychnine-soda mixture over 1 quart of rolled oats, stirring constantly to insure on even distribution of the poison

thru the grain. Heat the poisoned rolled oats in an oven until thoroly warm. Mix three parts of melted beef fat with one part of melted paraffin. While still hot sprinkle 6 tablespoonfuls of this fat over the poisoned oats, keeping the whole thoroly heated

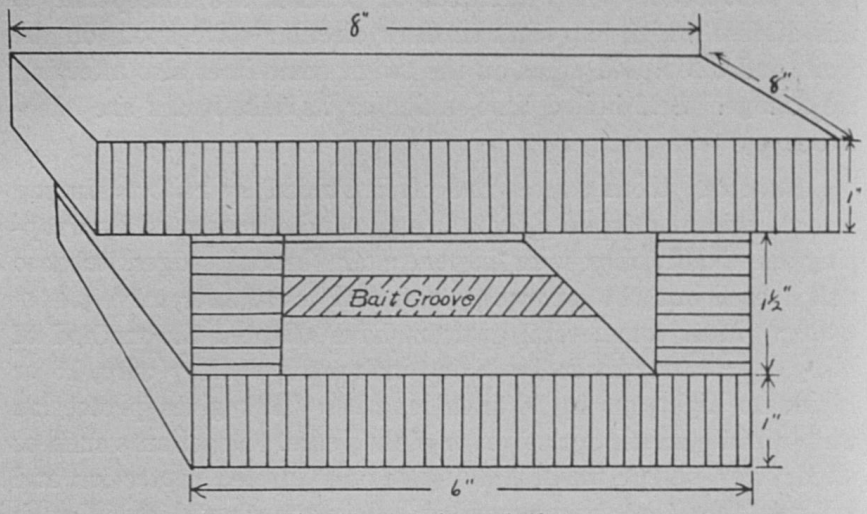

Fig. 17. A poison station.

while stirring constantly, until the oats are all evenly coated with the fat. Cool and the poison fat mixture is ready to use.

Tablespoonful quantities of the poisoned bait should be placed in small containers or stations and distributed over the infested areas.

The poison stations should be constructed so as to protect the bait from the weather and from birds and larger animals. A simple station recommended by the Bureau of Biological Survey is illustrated in Fig. 17.

SPRAYING

Spraying is one of the most important requisites for the production of clean fruit and for keeping the trees in a healthy growing condition. The other operations of orchard management such as cultivation, application of fertilizers and pruning may be attended to most faithfully, but if spraying is neglected the fruit grower rarely will be able to secure profitable returns.

Neglect of spraying and neglect of the maintenance of soil fertility are the two principal causes for unproductive orchards thruout the state.

The important factors in the successful control of orchard pests and diseases are proper materials, timely and thoro applications with an efficient spraying outfit.

Two principal classes of materials are used for spraying; fungicides, for use in control of diseases, and insecticides, for the control of insects.

FUNGICIDES FOR APPLES

Bordeaux Mixture. One of the most important fungicides is Bordeaux mixture. Prepared Bordeaux can be purchased on the market but has never proved superior to the home-made mixture and usually is more expensive. A 3-4-50 strength Bordeaux mixture has been found satisfactory and may be prepared as follows:

Dissolve 3 pounds of bluestone (copper sulfate) in a wooden or "granite iron" bucket of hot water, by suspending the bluestone in a cheesecloth sack so it will hang two or three inches into the water.

Slake 4 pounds of good stone lime, mix with a little water and strain into the spray tank or barrel and add 25 or 30 gallons of water. Dilute the bluestone solution with 8 or 10 gallons of water and add it to the lime water, stirring well as this is done, finally adding water sufficient to make 50 gallons in all. Apply at once.

Where a good grade of lump lime is not available, 6 pounds of best hydrated lime will be found a satisfactory substitute for the 4 pounds of lump lime in the above formula.

If much spraying is to be done, it is more convenient to make up in advance separate stock solutions of both bluestone and lime at the rate of one pound to each gallon of water. If these stock solutions are kept covered to prevent evaporation they can be kept for weeks ready for quick dilution and mixing as needed.

Bordeaux mixture always should be used when fresh.

Dilute Lime Sulfur is a fungicide which has replaced Bordeaux mixture in some instances for the control of diseases. It

is particularly effective against apple scab and is not as likely to russet the fruit as Bordeaux when applied immediately after the petals fall. Applications of dilute lime sulfur during hot weather are likely to cause serious scalding of the fruit, and at such times Bordeaux would better be used. However, if spraying is done during a period of wet weather, Bordeaux frequently causes injury, and dilute lime sulfur should be substituted. The dilute or summer strength may be made by diluting 1¼ gallons of standard lime sulfur to 50 gallons of water. Standard commercial lime sulfur (liquid) should test 32 degrees Baume by the hydrometer. The dilute lime sulfur ready for application should test 1 degree Baume by the hydrometer.

Do not confuse the use of lime sulfur as a fungicide with its use as an insecticide. The dilute solution for summer spraying is a fungicide; the strong solution for dormant application, the insecticide.

FUNGICIDES FOR STONE FRUITS

Self-Boiled Lime Sulfur or a substitute is used for the control of diseases of peaches and plums, since their foliage is too tender for applications of Bordeaux mixture or dilute lime sulfur. Self-boiled lime-sulfur 8-8-50 may be prepared as follows:

Slake 8 pounds of best stone or lump lime in a barrel or tight box. Use hot water when available, but only enough to start slaking.

When slaking begins add 8 pounds of flowers of sulfur (previously mixed to a paste with a small quantity of water) to the slaking lime, stirring constantly Continue to add cold water in small quantities, sufficient to keep the lime in a soft, pasty condition.

As soon as the slaking is over (usually within 15 minutes) it is important to add at once sufficient cold water to cool the mixture and stop the cooking of the sulfur. Stir vigorously and strain into spray barrel or tank, adding water to make 50 gallons of spray material.

If required, larger quantities may be made up at one time in the same proportion, as 32-32-200.

Surfur Lime Dry Mix, a favorite substitute for self-boiled lime sulfur, can be prepared at home or purchased from commercial firms. It is made from 8 pounds sulfur, 4 pounds hydrated lime, and ½ pound calcium caseinate, which is frequently sold under such trade names as Kayso, Spreado, etc. This is thoroly mixed in dry form, and used at the rate of 12½ pounds to 50 gallons of water. First, add a small quantity of water gradually to the powder while stirring, until it becomes a paste, then dilute to make 50 gallons of spray mixture.

Do not confuse this dry mix formula of lime and sulfur with the commercial brands of dry and liquid lime sulfur. Failure to take this precaution may ruin a peach crop.

DUSTING

Dusting as a means of insect and disease control in the orchard is gaining popularity each year with the commercial grower, due largely to the fact that a much larger acreage can be covered in the same length of time. However, owing to the fact that the scale insects cannot be controlled with the dusts now on the market, it is necessary to have spraying machinery. Therefore, dusting at present is only a supplement for insect and disease control, and is impractical for the small grower.

INSECTICIDES

There are two classes of insecticides, poisons for chewing and leaf eating insects, and contact sprays which kill by contact with the insect. Sucking insects such as aphis are killed by contact sprays.

POISONS

Arsenate of Lead is one of the most satisfactory poisons for spraying. The powdered product usually is preferred to the paste form, since it may be kept indefinitely in a dry place and may be used for dust applications if desired. Arsenate of lead sticks to the foliage better than Paris green and is not as likely to cause injury to tender leaves. It is liked also because it may be used in combination with most standard spray materials. Usually the powder is mixed with a small quantity of water and strained into the spray solution.

CONTACT INSECTICIDES

Lime Sulfur. The dormant strength lime sulfur is used as a contact spray for San Jose Scale. Several years ago the lime sulfur solution often was prepared at home but the home-cooked wash now has been superceded generally by the commercial forms. The liquid lime sulfur is rather disagreeable to handle and keep in storage and dealers have been quick to replace it with the more easily handled dry forms.

Oil Emulsion. Many commercial orchards have suffered in recent years from San Jose scale, and growers have been eager to learn of spray materials which would have greater killing efficiency than the ordinary lime-sulfur solution.

Some have used for this purpose the oil preparations known as "miscible oils" successfully. Others have used effectively the lubricating oil emulsion known as government oil emulsion, which is on sale by dealers in most commercial apple growing districts in prepared form ready for dilution. Oil emulsions should be freshly prepared each season, and should not be allowed to freeze as this may cause a separation of the oil, and result in injury to the trees. These sprays should be applied on clear, mild days with temperatures above 40 degrees Fahrenheit, when there is no danger of freezing temperatures for several hours following.

In orchards practically free from scale, and particularly for peach orchards, the standard liquid lime-sulfur is recommended.

Nicotine Sulfate. Nicotine sulfate has become the most popular material for the control of aphids or plant lice. It is effective yet not disagreeable to handle and is safe to apply on tender foliage.

Combining Spray Materials. Usually it is possible to combine the insecticides and fungicides and save making separate applications. However, some materials should not be mixed together.

Paris green, soap, kerosene emulsion and miscible oils should not be mixed with lime-sulfur. Nicotine when not applied in combination with other materials should always have a soap

solution added to it at the rate of 4 pounds to 50 gallons of spray. One of the combinations most commonly used is arsenate of lead and nicotine with either lime sulfur or Bordeaux mixture.

SPRAYING MACHINERY

Inadequate spraying equipment undoubtedly is responsible for many neglected farm orchards thruout the state. The smallest outfit which has been found to give satisfaction is a barrel sprayer, costing from thirty to forty-five dollars, and equipped with the following accessories: Barrel pump with agitator and pressure gauge, at least 25 feet of hose (30 to 40 feet of hose is much better), a 6 or 8-foot extension rod complete with cut-off, and a 45 degree angle disk nozzle.

Such an equipment faithfully used in a home orchard of a dozen or more mature trees, otherwise well cared for, often will result in enough extra yield and better quality of fruit, to pay for itself at market rates in one season.

A bucket or knapsack sprayer is not suitable for spraying bearing fruit trees. Where outfits of this kind are used, observation has shown that the orchard seldom gets more than one spray each season, for the operator easily gets disgusted and gives up the spraying as a slow, troublesome job. Eight or ten bearing trees justify the purchase of a good barrel sprayer, which will last for years if carefully washed and greased after each application is made.

A power sprayer driven by a small gasoline engine is more economical equipment for the orchard of three acres or over. Experienced growers have found that clean, fancy fruit is produced by better spraying, which, in turn, will soon pay for a good power sprayer.

SPRAY SCHEDULE FOR APPLES

Spray for	Time to Apply	What to Use (Use one of the formulas)
1. San Jose Scale.	Dormant season; fall of year after leaves have dropped, mild winter weather, or in spring before buds open.	(a) Standard lime-sulfur testing 32 degrees, 6 gals. Add water to make 50 gals.
		(b) Lubricating oil emulsion (government formula) 1½ gals. Add water to make 50 gals.
		(c) Commercial miscible oils or oil emulsions diluted according to the manufacturer's recommendations.
2. *Apple scab.	Just before blossoms open, when the flower buds are showing pink.	(a) Lime-sulfur, 32 degrees, 1¼ gals. to 50 gals water. Add 1½ lbs. arsenate of lead powder.
		(b) Dry lime-sulfur, 4 lbs. to 50 gals. water and 1½ lbs. arsenate of lead. If aphis be present, add ½ pt. 40 per cent nicotine sulfate to 50 gals.
3. *Apple worm (codling moth), scab, bud moth, curculio.	When three-fourths of blossoms have fallen.	(a) Lime-sulfur 1¼ gals. to 50 gals. Add 1½ lbs. arsenate of lead.
		(b) Dry lime-sulfur, 4 lbs. to 50 gals. water and 1½ lbs. arsenate of lead.
4. Codling moth, scab, blotch.	Two weeks after Spray No. 3.	(a) Lime-sulfur 1¼ gal. to 50 gals. Add 1½ lbs. arsenate of lead.
		(b) Bordeaux mixture 3-4-50. Add 1½ lbs. arsenate of lead.
5. Blotch, scab, codling moth, rots.	Two weeks after Spray No. 4.	Same as Spray No. 4.
6. *Blotch, rots, codling moth, sooty blotch.	Two weeks after Spray No. 5.	Same as No. 4.
7. Codling moth, blotch, rots, bitter rot.	About one month after Spray No. 6.	Same as No. 4.

*See note No. 2 and note No. 4 next page.

NOTES ON APPLE SPRAYING

1. Where arsenate of lead is mentioned, the powder is meant. If paste is used, double the amount.

2. With varieties such as Delicious, Winesap or Stayman, which are especially susceptible to apple scab, some growers add a pre-pink spray to the schedule, making the application from three to five days ahead of spray No. 2, using same material as spray No. 2.

3. Where lime-sulfur is used for spraying in Kentucky, most commercial growers are buying it in the liquid form.

4. Owners of farm orchards and amateur growers may not see fit to apply the regular seven or more sprays. Probably the three most important sprays are Nos. 2, 3 and 6. Note they are marked with a (*). If only one spray is applied, use No. 3 to control the worms.

5. There is a tendency during the last two years to decrease the amount of bluestone in the Bordeaux. Some growers have obtained satisfactory results using a 2-4-50 formula. This is especially true with tender-skinned varieties, such as Grimes and Jonathan.

6. The lime-sulfur (summer strength) may be used in sprays Nos. 4, 5, 6 and 7 in place of Bordeaux on varieties which are not very susceptible to blotch, such as Winesap, Stayman, Delicious, Grimes.

7. "Two weeks later" should be interpreted to mean two weeks from the time the grower begins to make the application, rather than from the time the spraying is finished.

8. In diluting stock of "government oil emulsion," the water used should be soft. If only hard water is available the oil emulsion should be added to weak Bordeaux mixture, made of ¼-pound of copper sulfate and ¼-pound of lime to 50 gallons of water.

SPRAY SCHEDULE FOR PEACHES.

SPRAY FOR	TIME TO APPLY	WHAT TO USE
1. San Jose scale; leaf curl	Dormant season	Lime-sulfur 6 gals. Add water to make 50 gals. (The various oil preparations will not control leaf curl). Where scale is spreading use an oil spray, also, for its control.
*2. Curculio	Soon as blossoms fall	1 lb. arsenate of lead, 4 lbs. hydrated lime, 50 gals. water.
3. Curculio	Ten days after blossoms fall, when the shucks are being pushed off by young fruit	Same as Spray No. 2, or the following.
4. Scab, brown rot, curculio	A month after blossoms fall	Self-boiled lime-sulfur 8-8-50 or Sulfur lime dry mix 8-4½-50 and 1 lb. arsenate of lead.
5. Brown rot	A month before fruit is due to ripen	Self-boiled lime-sulfur 8-8-50 or Sulfur lime dry mix 8-4½-50.
6. Brown rot	In damp weather. Two weeks before fruit is to ripen	Same as Spray No. 5.

NOTE.—Sulfur dusts are being used for Sprays 3, 4, 5, 6.

*Many peach growers do not apply No. 2, but commercial growers are finding it profitable. Dry lime-sulfur, liquid lime-sulfur, or Bordeaux should NEVER be applied to the peach orchard during the summer.

For spray No. 2 some growers add the fungicide to the solution, for additional control of brown rot,

SPRAY SCHEDULE FOR PEARS

Use apple sprays Nos. 1, 2, 3 and 6.

SPRAY SCHEDULE FOR SOUR CHERRIES

Use apple sprays Nos. 1, 2, 3 and 5.

1. Scale insects seldom attack sour cherries and if none are present, spray No. 1 may be omitted.

2. If serious infestation or leaf spot occurs, it may be controlled by applying apple sprays Nos. 4, 5 and 6, using Bordeaux but omitting the arsenate of lead.

SPRAY SCHEDULE FOR PLUMS

Use same schedule as for peaches.

HOME PROPAGATION OF APPLE TREES

Varieties of fruits seldom "come true" from seed; therefore are perpetuated by grafting or budding. These operations are usually of considerable interest to fruit growers. Many an orchardist has long had a desire to propagate his own trees, particularly after an unsatisfactory experience with a tree agent. The advantages which may be gained are often illusory, but the grower who takes his own cions from trees of known character has assurance that the new trees will be like the one desired. It is also possible for a grower to top work trees which have proved untrue to name or otherwise undesirable, to a good variety. This will not often be done unless the grower can do the work himself. A limited amount of work of this kind is sometimes of considerable value and satisfaction to the owner but the belief that trees can be propagated at home more cheaply than they can be purchased from a nursery, is not generally true.

Stocks. French crab seedlings are the stocks most used for apple propagation. Many of these are grown in Europe and imported by nurserymen for this purpose, altho the seed is sometimes imported and the seedlings produced in the United States.

The seeds from common apple varieties may be grown for stocks but are considered inferior and are rarely used. French stocks and grafts may be obtained from leading nurserymen.

Cions. The cions are the portions of the desired tree which are taken for propagation and are grafted into the stock. Shoots of the previous season which have made a normal growth usually

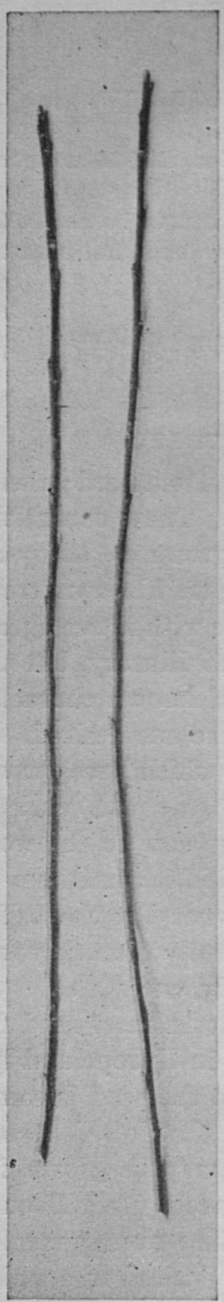

Fig. 18. Cion wood.

Fig. 19.

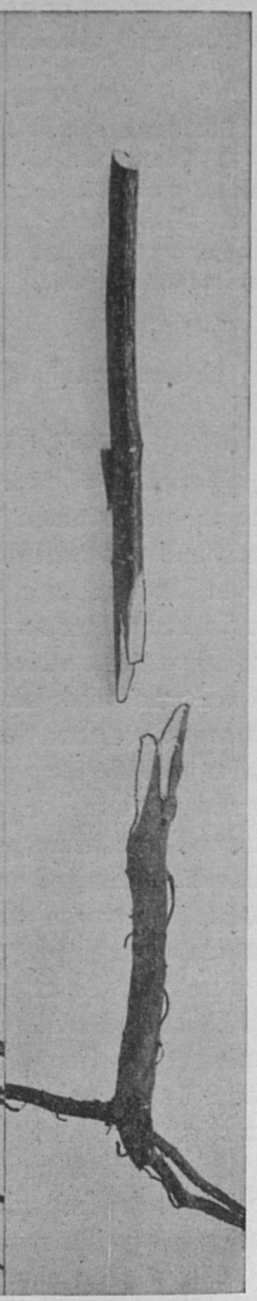

Fig. 20.

Steps in root grafting.

are selected for cions. These may be taken at any time while the tree is perfectly dormant, altho it is not desirable to cut them while the wood is frozen. For this reason some prefer to take them early in the winter before heavy freezing occurs. The cions are tied in bundles of 100 and carefully labeled. Then they are covered with damp sand or sawdust and placed in a cool cellar where precautions are taken so that they will not freeze or dry out. The temperature should be kept from 35 degrees to 40 degrees if possible.

Root Grafting. The majority of apple trees are grafted by the Whip or Tongue method during January or February. The seedling top should be cut from the stock at the junction with the roots and discarded. The root, if straight, may then be cut into two or three pieces, if desired, each of which is used as a stock. The piece of root should be at least 3 inches long and 4 or 5 inches are preferred by many. The cions usually are cut from 4 to 6 inches long. Both the stock and cion are cut diagonally. This cut should be from one inch to an inch and a half in length. A smooth, clean cut made with one stroke of the knife is desired. A vertical cut is then made in both as shown in Figure 20.

The two parts are fitted together, taking particular care to have the cambium layers of each in contact on one side. The cambium is the layer of growing tissue between the wood and the bark. If the stock and cion are of nearly the same size, it is easier to get a good union. The two parts are held together by tying them firmly with waxed grafting twine over the splices. These "grafts" are tied in bundles and again labeled and stored in the same manner described for cions.

As soon as the soil can be fitted in the spring the grafts should be planted in nursery rows. A trench is made about eight inches deep and the grafts are placed along the trench so that the top bud will be exposed just above the surface after the trench is filled. The grafts are placed about 6 inches apart in rows 4 feet apart. Permit only one shoot to start so as to insure a single straight trunk. After one season's growth the trees should range from 3 to 5 feet in height and are known as one-year-old trees.

Cleft Grafting. This is the method of grafting commonly employed for "working over" old trees. The large branches from one half inch in diameter or more are cut off squarely and split 1½ inches deep with a grafting tool and wedged apart

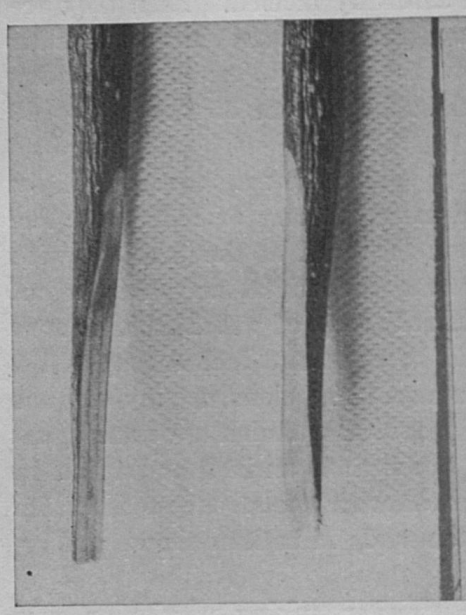

Fig. 21.
Cions prepared for cleft grafting.

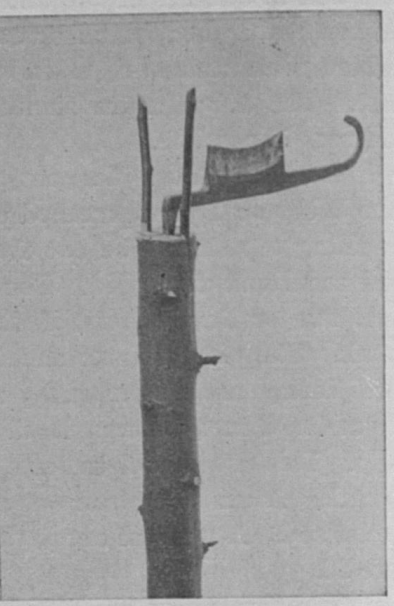

Fig. 22.
Cions set in cleft ready for waxing.

until the cions can be prepared and inserted. These cions are made about 4 inches in length and cut to a wedge at the base, the side placed outward being a trifle thicker, and one inserted on each side of the cleft. When the cambium layers are made to coincide, the wedge is generally removed and the spring of the wood should hold the cions so that tying is unnecessary. Then cover the wounds with grafting wax. This operation usually is performed early in March either just before or just as the buds are swelling. The cions, however, must be perfectly dormant if cleft grafting is to be successful. As soon as one of the cions has made a good start the opposite one should be removed.

Bridge Grafting. This is an operation to save trees which have been girdled around the base of the trunk by mice or rabbits during the winter. The ragged bark should be cut squarely

Fig. 23. Another remedy for extensive girdling. Yearling apple tree "whips" planted around injured tree, their tips grafted into trunk above girdled area. (Courtesy of Purdue University.)

away at the top and bottom of the wound to live bark. Several cions are cut about one and one-half inches longer than the distance between the trimmed edges. The ends are cut wedge shaped and inserted under the bark at the top and bottom of the wound. The cions may be placed about one inch apart around the trunk. Then cover the wound and around the ends of the cions with grafting wax. This grafting should be done as the buds are swelling in the spring.

Sometimes the base of a tree may be so badly injured that bridge grafting as described above is impossible. In such instances a number of one-year-old trees are planted closely about the base of the wounded tree and their tops grafted into live tissues above the wound.

Grafting Wax. A standard and satisfactory grafting wax is made as follows:

Melt 4 pounds of rosin and add 2 pounds of beeswax and 1 pound of tallow. When all have melted stir well to make a uniform mixture but do not allow it to boil. Pour into a pail of cold water and after cooling a little remove the wax from the water and pull as in making taffy. The wax should be pulled until it ribbons well and becomes lighter in color. It may then be made into balls ready for use. The hands should be greased with melted tallow to prevent sticking during the pulling process.