UNIVERSITY OF MISSOURI COLLEGE OF AGRICULTURE
AGRICULTURAL EXPERIMENT STATION
M. F. MILLER, *Director*

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Young Orchards; Planning, Planting And Management

T. J. TALBERT

Fig. 1.—Contour peach orchard interplanted with tomatoes.

The early life of the orchard is the most important. Trees neglected for a single season during this period may be ruined. On the other hand, good culture will bring earlier and more abundant harvests. Healthy vigorous trees will also live longer, establish more regular bearing habits and produce higher quality fruit than weak and devitalized trees. Strong trees are also more resistant to attacks of harmful insects and diseases.

Buying Good Trees

It is false economy to plant inferior or low grade fruit trees. The best which can be secured are, in the end, the most economical and profitable. Success or failure may depend upon their vigor and freedom from pests. Therefore, it is highly important to obtain the best, whether propagated at home or purchased from a com-

mercial nursery. Well-matured healthy stock withstands transplanting better and develops into more profitable fruit plants than small, stunted, and less hardy trees.

Setting at Proper Time

Apples and Pears.—Late fall and early winter planting of apple and pear trees is generally preferred in Missouri to spring planting. The results are not enough better, however, to justify a year's delay in setting.

Sour Cherries.—Sour cherries and other stone fruits have usually been planted in the spring. Cherries are believed to be the most difficult of the orchard fruits to transplant successfully. Often from one-third to two-thirds of the trees die when set in the spring. This high mortality necessitates frequent replanting before a full orchard stand is secured.

Fall planting of sour cherry trees, at the Missouri Experiment Station, has uniformly resulted in a good stand. Those set in the fall have usually transplanted as successfully as apples or other fruits. For Missouri conditions, therefore, late fall or early winter is the best season for setting sour cherry trees.

Peaches.—In central and north Missouri, peach trees may usually be planted more safely in the spring than in the fall. This is true because a severe winter following autumn setting may badly injure or kill the trees. Even mild winters may injure newly set trees so that the wood turns brown within. Thus damaged, the trees frequently die or at best make poor growth. Early spring setting, therefore, is generally preferred for the peach, especially in the central and northern parts of the state. Mounding the base of the tree trunks with soil to a height of about 3 or 4 inches and covering the surface soil over the roots with a mulch of hay or straw 3 or 4 inches deep will help materially to prevent cold injury. The soil mound should be leveled in the spring and cultivation practiced during the growing season.

Plums.—The Japanese varieties and other slightly tender species of the plum are subject to winter injury in Missouri and are more safely set in the spring. American and European plums, however, benefit from late fall and early winter planting about as much as apples and pears.

Handling Fresh Stock

Examination and Care.—As soon as the trees are received, the roots should be examined for moisture. If none is present, they should be wet at once and kept damp until heeled in or transplanted. Should the stock be dried out much, burying it completely in damp, but not wet, earth and leaving it four to six days to be properly restored may prove helpful.

Heeling-In.—If the trees cannot be planted immediately upon arrival they should be heeled in as soon as possible. This may be accomplished by digging a shallow trench and covering the roots, and a foot or more of the lower part of the stems or trunks, with moist earth. The ties of the tree bundle should be cut and the trees spread out in the trench to place the moist soil in close contact with the roots. This prevents the formation of air pockets and subsequent drying of roots. When thus spread out, the varieties may be distinguished by marked stakes driven between the different lots.

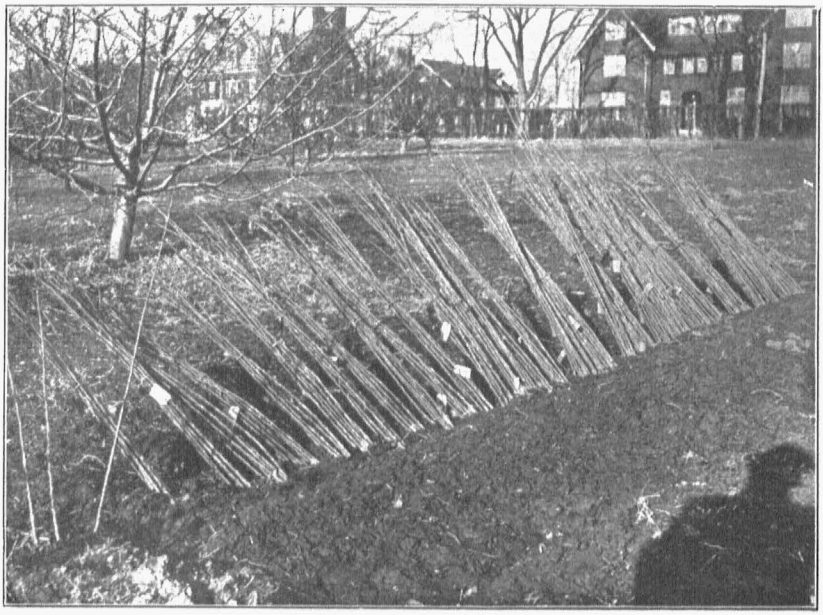

Fig. 2.—Apple trees heeled-in temporarily, awaiting weather and soil conditions favorable for transplanting.

Protection from Freezing and Drying.—The roots of young, dormant fruit trees are easily killed by freezing. In fact, they cannot endure the low temperatures to which tops may be exposed without injury. They are also damaged by drying out in handling. The fact that they may be kept uncovered for a time in a moist packing shed, or in the field during a moist still day, should not encourage the belief that exposure to winds and a dry air is non-harmful.

In setting large areas, trees are frequently distributed ahead of the planters and the roots left exposed too long to drying conditions of sun and wind. Exposure of freshly dug trees for fifteen minutes if the day is dry and windy, and for more than thirty

minutes on an average sunny day, may be injurious. When setting, the roots may be kept in a barrel partly filled with water, covered with damp packing material, or wrapped in damp gunny sacks.

Soil and Water Conservation Practices

In order to keep orchard soils from eroding and becoming less fertile, it is obvious that a well planned program of soil and moisture conservation should be developed if possible before planting the trees. Such an undertaking need not be elaborate or difficult. Through the adoption of sound and practical methods, any orchardist should be able to maintain soil fertility and prevent damaging erosion.

Orchard soil productivity includes the nature of the soil, its depth and topography, its handling in the past, the use of manures and commercial fertilizers, the amount and kind of cultivation, and the crops grown and their use.

Organic matter which is so important in maintaining soil fertility may be destroyed by cultivation. However, some fruits, such as peaches, generally require cultivation even under the most satisfactory conditions. With this fruit, however, less cultivation may often be sufficient. Apple and pear trees may be grown successfully while young under a somewhat reduced program of cultivation and, when the bearing period is reached, the trees may be maintained in good production under a permanent sod mulch system through supplementary fertilization practices. Producers usually will find it advantageous to reduce cultivation as much as possible consistent with the keeping-up of satisfactory growth and production.

Contour Tillage.—Erosion can be partially controlled through contour planting and tillage, the construction of dams, use of cover crop rotations, and strip cropping. The furrows made on the contour by tillage store rainfall and prevent much washing. The tree row is usually maintained as a low ridge and if made on the contour it may conserve both soil and moisture. The implements used in preparing, planting or cultivating, provide small channels and ridges in the soil which hold the rainfall for a short time, allowing more of it to be absorbed.

Only when it is necessary to destroy deep-rooted weeds or grass is deep cultivation more effective than shallow cultivation. Moreover, there is nothing gained by cultivating more than required to destroy weeds and keep the surface soil porous and loose enough to retain and absorb rain water.

Terracing.—Orchard lands are now terraced effectively against soil erosion and the loss of water from the soil through run-off. The practice may be particularly well adapted to rather sloping land where erosion is a serious problem. The work is generally most satisfactory if done properly before the trees are planted. More-

over, planting on the terrace ridge is usually considered advantageous. Spacing the terraces about the distance desired for the trees should give good results in most cases. On more level land, if the terraces are spaced two tree rows apart they may be even more desirable, all factors considered.

The land may be terraced, where the need is evident, after the trees are planted. The work is made much more difficult, however, and the terraces are more likely to interfere with such orchard operations as spraying, harvesting and the like. In general, the terraces for orchard lands should be lower and farther apart than for other crops.

While the establishment of terraces is not difficult, yet the work should be performed properly. Where help is needed, this can usually be obtained from the county agent, agricultural college, or some orchardist familiar with terracing practices.

Preparing the Soil

Well-drained, typical fruit soils may be prepared for orchard setting by deep plowing and thorough harrowing or disking as for potatoes, corn, or wheat. Thoroughly prepared, friable, and loose soil in good working condition grows much better trees during the first few years than unplowed or poorly cultivated land. Planting truck or field crops without thorough soil preparation would be unthinkable, yet thorough preparation for the planting of young fruit trees is often neglected.

Where the orchard location is too hilly and steep to permit cultivation on account of the danger of serious soil erosion, the natural growth of weeds and grass should not be plowed up. It would also be well to consider the planting of trees on the contour plan. This may permit the cultivation of a strip of land including the tree row at least 6 to 8 feet wide. If such strip cultivation is continued for a few years after the trees are planted and supplemented with sufficient hoeing to destroy the weeds and grass within a few feet of the tree trunks, it should help materially in growing good trees.

Choosing the Varieties

Pollination Requirements.—One of the important factors in the management of orchards is the proper arrangement and use of varieties for pollination purposes. Cross-pollination in some instances may not be needed. Under certain nutritional requirements and weather conditions, the set of fruit for a large majority of the different kinds may be greatly improved, however, if provisions at planting time are made for cross-pollination.

For good results, the varieties should bloom at approximately the same period because varieties which do not blossom at the same time will not cross-fertilize each other. Varieties which generally produce an abundance of viable pollen are always preferable,

and if they are also valuable commercial sorts, regular in bearing and ripen their fruits at desirable periods, they are to be sought all the more.

Also, the pollen of fruit trees is generally of a sticky or waxy nature and is not spread widely by air currents. Insects, therefore, are largely responsible for carrying the pollen from blossom to blossom. In the spring at blossoming time the common honeybee is chiefly responsible for cross-pollination. Good orchardists plan to have at least one strong colony of bees placed on each acre of orchard during the blooming period.

Apples.—The Missouri Agricultural Experiment Station has found that such satisfactory pollinizing varieties as Delicious, Golden Delicious, Grimes, Jonathan, Rome, York, Huntsman, Gano, Duchess, Yellow Transparent, Wealthy, Ingram, and Ben Davis are self-fertile to only a limited extent. They will, therefore, in most years be benefited by cross-pollination. Two varieties planted together in strips of four rows each or three varieties planted alternately in strips of two rows each would be much more likely to produce regular cropping. Three varieties consisting of two rows each will assure the greatest benefit from cross-fertilization. Moreover, all the varieties in this group are inter-fertile.

ORCHARD VARIETIES FOR MISSOURI

Fruit	Commercial Plantings	Home Plantings
Apples, Early	Transparent, Duchess, Wealthy.	Transparent, Duchess, Wealthy, Summer Champion.
Apples, Fall and Winter	Jonathan, Golden Delicious, Delicious, York, Turley, Rome Beauty, Winesap.	Jonathan, Grimes (Double-worked), Golden Delicious, Delicious, Staymared, Turley, Rome Beauty, Gano, Winesap.
Pears	Seckel, Duchess, Garber, Kieffer, Douglas.	Tyson, Seckel, Garber, Douglas, Duchess, Kieffer.
Peaches, Early	Red Bird, Fair Beauty, Golden Jubilee, July Elberta, Halehaven.	Red Bird, Mikado, Redhaven, Golden Jubilee, July Elberta, Halehaven, Alton.
Peaches, Mid-season	Belle of Georgia, Early Elberta, Elberta, Shippers Late Red.	Champion, Belle of Georgia, Early Elberta, Elberta, Shippers Late.
Peaches, Late	Salberta, Frank.	Salberta, Frank. (It is generally a hazard to plant late peaches where serious attacks of Oriental Fruit Moth occur.)
Cherries, Sour	Montmorency.	Richmond (Early Richmond), Montmorency.
Cherries, Sweet and Semi-sweet		Governor Wood, Napoleon, Royal Duke, Late Duke.
Plums	Stanley, Shropshire, Damson, Italian Prune, German Prune.	Wild Goose, Shropshire, Damson, Stanley, Green Gage, Italian Prune, German Prune.

Varieties which are self-sterile (unable to set fruit and mature it with their own pollen), at least in most localities and in most years, are the Winesap group to which belong the Winesap, Stayman, Arkansas (Black Twig), Kinnard and Arkansas Black. They are unfruitful when planted in solid blocks and when pollinated with their own pollen. Moreover, they will not pollinate each other effectively and are inter-sterile. If this group is interplanted as suggested with varieties from the first group, they should yield good crops.

The set of all varieties of apples, whether rated as self-sterile or self-fertile, is usually increased if facilities for adequate cross-fertilization are provided. This can usually be accomplished by planting from three to five different varieties in strips of two to four rows each, alternating the strips with each other across the orchard. For example, starting at the border of a planting with two rows of Winesap, there should follow a good pollenizer of this variety such as Jonathan including two rows; then a good pollenizer of Jonathan like Delicious should follow with two rows, etc., including other varieties if used until the planting is completed.

Pears.—While some varieties of pears are self-fertile, others partially so and still others self-sterile, like the apple, the set of all varieties of pears will usually be increased materially through proper cross-pollination. This may be provided for as in case of apples, and practically any of the varieties grown successfully in the state will act as good pollenizers for each other. At least two varieties should be planted in every case and the trees located for best results in adjoining rows.

Peaches.—The peach, with the exception of a few varieties is self-fertile. Single varieties, therefore, may be planted in large blocks. All agree, however, that better sets of fruit may be obtained if several varieties are planted in strips of two to four rows each, alternating with each other across the orchard.

Cherries.—All the commercial varieties of sour cherries are self-fertile in Missouri. In years when cold rainy weather prevails at blooming time, the set of sour varieties generally may be greatly benefited by cross-fertilization. As in the case of peaches, the proper arrangement of pollenizers may increase production especially in bad pollination years.

Most varieties of Duke cherries, especially May Duke, Royal Duke and Late Duke, are self-sterile due to their hybrid nature. They should, therefore, be interplanted with the chief sour varieties. These are Montmorency, Early Richmond and English Morrello.

The popular varieties of sweet cherries are self-sterile. For example, such varieties as Bing, Lambert, Governor Wood, and Napoleon with each other are self-sterile. Strains of Black Tartarian

and Black Republican generally yield satisfactory results as pollenizers for the different sweet cherry varieties.

Plums and Prunes.—Nearly all the varieties of Japanese plums and many of the European plums are self-sterile. For this reason, they present serious pollination problems when considerable acreages are planted. The varieties of prunes range from self-fertile to self-sterile and generally require, for good fruit setting, cross-fertilization.

Practically all varieties of American species of plums are self-sterile. Plums and prunes, therefore, should not be planted in solid blocks. Proper interplanting using two or more varieties is likely to prove helpful in securing good sets of fruit.

Dwarf Fruit Trees.—Fruit trees which have been forced to grow slower and to remain smaller than they normally would or which are inherently dwarf in make-up are known as dwarf fruit trees. A dwarfing stock is smaller, weaker and slower growing than the variety propagated upon it.

Dwarfing is brought about by growing the trees on roots which are normally dwarf in size; by checking the growth of the roots through pruning or growing them in a restricted area; and by pruning the top severely to check or slow-up growth.

Dwarf fruit trees, although grown more extensively abroad, have not as yet been successfully and widely accepted in this country nor adapted to commercial orchards. The trees produce a smaller amount of fruit and are shorter lived than standard trees. They require more care than the standards in pruning, tillage and fertilization. Dwarf trees are also more costly to grow in the nursery. They are generally difficult to secure, since there has not been a sufficient demand for them to warrant extensive commercial propagation.

For the amateur, however, the dwarf trees may offer less difficulties in the performance of such operations as pruning, spraying, fruit thinning and harvesting. The trees come into bearing earlier than normal fruit trees. Due to the small area required, the producer can grow a larger number of varieties in a given plot than he can of the standard sorts. Generally, however, growers have preferred the normal or standard fruit trees.

Planting Operations

Distance of Planting.—The distance of setting varies with soils, varieties, pruning practices, spacing, habits of growth, and climatic conditions. Space between apple trees therefore may range from 36 by 36 for the more upright and less vigorous sorts on thinner soils to 40 by 40 feet for the spreading and strong growing varieties on richer and more productive soils. The mistake is often made of planting too close. Pears should usually be set about 30 feet apart

each way; peaches, 20 to 24 feet; plums, 20 to 24 feet; cherries (sour) 24 to 30 feet; cherries (sweet), 28 to 32 feet; and quinces, 18 to 22 feet. The tendency should be to plant trees farther apart since experimental evidence has proved its value.

A greater distance between trees is desirable, not only to prevent interlocking of the branches and interference with orchard operations when the bearing period is reached, but also to reduce competition between the root systems. The roots may extend much farther in all directions than the branches. In fact, the roots often overlap and compete for moisture and nutrients long before the branches give trouble.

The Square System.—This method of laying off the ground for planting is generally used because it is easy and efficient. According to it, a base line is commonly established on one side of the field, fixed about 20 to 30 feet from the fence or road and marking the first row of trees. Stakes several feet in length should be driven into the ground at each end. If the row is long or the land uneven one or more stakes may be needed between them. They are placed by sighting over the two end stakes. The distance between the trees is then measured off and a small stake driven down to mark the place where each tree should be set.

Planting on the contour will require changes in the suggestions given above. Cultivation and orchard operations may be confined to one direction or to the space between the contour tree rows or terraces. Furthermore, on the steeper slopes to save more soil and water, it may be advisable to space the trees farther apart or closer together in some areas than the standard planting distance. Through proper measurements and calculations, short or point rows may generally be avoided and the number of trees per acre should not differ materially from plots planted according to the square system.

Determining Number of Trees Needed.—The number of trees required to plant an acre may be determined by multiplying the distance they stand apart and dividing the figure into the number of square feet in an acre—43,560. For example, with apple trees planted 40 feet by 40 feet, multiply 40 by 40. This amounts to 1600 square feet. Then, 43,560 square feet divided by 1600 square feet gives a quotient of 27—the number of trees required to plant an acre when spaced 40 feet apart each way.

Removing Labels.—Trees frequently arrive from the nursery with variety name labels attached with wire to one or more tree trunks in each bundle. It is very important that these be removed at time of planting as they may girdle and kill the trees in a year or two if neglected. But if attached to one of the limbs or branches, the wire may not do much damage even though it is not removed.

Keeping an Orchard Record.—An orchard record should be made for each plot of ground soon after the trees are planted. Since this

is to be a permanent record the notes and entries should be kept in a book prepared for the purpose, or on a well-adapted form.

Preparing the Trees for Setting.—In preparing the plants for setting, all portions of roots mutilated in digging or handling should be removed with pruning shears or a sharp knife. Where long slender roots appear, they should be cut off to about the length of that particular plant's general root system. The larger and more vigorous the root system, however, the better the tree as a rule.

Making the Holes.—Making the holes for planting is a simple matter if the land is well prepared. They should be large enough to receive the roots without bending them from their normal position and deep enough to let the trees stand about two inches deeper after planting than they stood in the nursery row. A spade or shovel is generally the most convenient and effective tool for use in making the tree holes. Frequently, however, if the ground is dry or stony, a grubbing hoe may be found of value.

Fig. 3.—Compacting soil around roots.

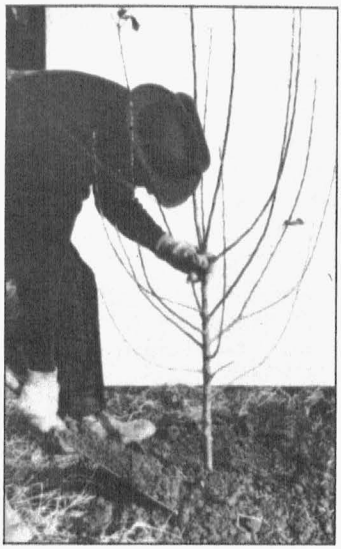

Fig. 4.—The last few shovelfuls of soil are laid on loosely to prevent baking.

The use of dynamite to shatter and loosen the soil has been investigated by the Missouri Agricultural Experiment Station and others. The practice has not resulted in any advantage to the trees. This has not only been true of tight, impervious subsoils but of looser and more friable soils. In clays, a little wet when dynamited, distinct harm may be done by plastering it together and forming a cavity or pocket which may prevent good water drainage. In

such instances trees are often injured for lack of proper drainage in wet weather. The soil and subsoil should always be dry enough to work properly before dynamiting. Tight, impervious soils requiring dynamiting are usually unsuited for the growth and development of a good orchard.

Setting the Roots.—The roots should be set to stand in their normal position. Twisting or bending should be avoided as bending a main root greatly lessens its capacity to absorb water and prevents its normal growth. The roots may be kept in their proper position and the soil compacted about them by shaking the tree vigorously with one hand while the earth is being sifted from the shovel with the other. In this way the dirt falls lightly among the roots instead of bending them down and leaving air pockets as if it were scraped into the hole in masses.

Compacting the Soil.—Layer by layer, as the soil is shaken into the tree hole, it should be packed firmly by tramping from time to time. Much of the mortality of fruit trees is due to bending the roots and failure to compact the soil in planting. It is impossible to pack the soil properly if the hole is entirely filled before tamping. The last two or three shovelfuls are not tamped and allowed to lie loose to prevent surface soil baking.

Watering.—Where water is available it may aid materially in establishing the trees by preventing injury through root drying and assuring growth. When the tree hole is from one-half to two-thirds full of tamped soil, it may be filled with water and the soil filling discontinued for a few hours or until the water has been absorbed. In filling-in the soil after watering, tamping is not needed.

Planting Trees in Sod

Where trees are set in sod as in a lawn, or on steep slopes where cultivation is impractical, or where replanted between established trees in an uncultivated orchard, the newly set plants make much better growth if the soil is spaded to a depth of 10 to 12 inches to kill back the competing roots and the surrounding grass to a distance of 4 to 6 feet. Such preparation gives opportunity for the trees in sod land to become established. It is difficult to make replants live in an established orchard unless proper care is taken.

To successfully grow trees in sod, they must be given special care and attention until bearing age. Hoeing or plowing 4 to 6 feet in all directions around each tree is essential. From three to five such cultivations may be required during the growing season. Cultivation may be made easier and less expensive through the use of a plow of the double-shovel type. A wheel from some discarded farm implement having a diameter of 6 to 10 inches when attached to the beam of the plow may facilitate the work. The operator is able to plow the ground near the trees and then by elevating the

handles, the shovels are removed from the soil and the weight is transferred to the wheel. When the next tree is reached, the plow shovels are lowered and put into operation. Two or three rounds with such an implement reduces hoeing to the minimum for each tree.

Most young trees also need fertilizing. This may be accomplished by working 10 to 12 shovelfuls of manure into the soil through early spring cultivation. Since the foliage of young trees is susceptible to disease and insect attack, it is well to spray them regularly if required when spraying the bearing orchard. Proper pruning should also be practiced each year.

In growing young orchards, mulching is sometimes helpful, especially if readily available fertilizers are used when needed for better growth. If the material such as straw, hay, etc., can be procured and applied in sufficient quantities to keep down grass and weeds around the trees and between the rows, it is all the more valuable. This culture supplemented by fertilization should produce as vigorous trees as the use of cultivation and cover crops. Mulching has the disadvantage, however, of creating a fire hazard and in some instances, causing an increase in rodent damage.

Fertilizing

Manure.—All factors considered, no nitrogen-carrying fertilizer is believed to be better than manure. Manure not only acts as a fertilizer to supply fruit trees with readily available nitrogen but it improves the aeration and tilth of the soil. The mechanical or working condition of the soil is improved. Also through the humus supply, the water-holding capacity is improved and danger of washing and injury from drought in dry seasons are reduced.

Commercial Nitrogen.—The chief substitutes for manure are nitrate of soda, sulphate of ammonia, calcium cyanamid, ammonium nitrate and urea. These commercial products contain much larger percentages of nitrogen than manure. They are also far less bulky, and easier to transport and handle. Sodium nitrate contains 15 or 16 per cent nitrogen, depending upon methods of preparation, while ammonium sulphate contains about 20 per cent nitrogen, cyanamid 21 per cent, and ammonium nitrate 32 per cent. From these percentages, the grower finds that only about three-fourths as much sulphate of ammonia and cyanamid or one-half as much ammonium nitrate are needed as nitrate of soda for the same amount of nitrogen.

While manure is all important in orchard fertilization, it is believed that even were it obtainable in sufficient quantities, most good growers would supplement it with a commercial nitrogen fertilizer. For instance, spring applications of chemical fertilizers are much more effective in increasing growth than manure applied at the same time. This is because most chemical fertilizers are more readily and quickly available to the tree roots.

Amount of Fertilizer to Use.—The amount to use per tree depends upon the size and age of the trees and the cultural practices used. For sod orchards, about one-fourth pound for each year of age, is customary while in cultivated orchards only about half that amount is needed.

Young fruit trees even when planted on moderately fertile soil, may be maintained in good vigor without using nitrogen fertilizers by proper cultivation of the soil and the application of stable manure or the growing of a leguminous green manure crop. If the land is kept in sod with ring or strip cultivation, then the trees should be fertilized at the rate of 3 ounces of a 20-21 per cent fertilizer and 4 ounces of one containing 16 per cent nitrogen per year of age of apple trees, and slightly more for stone fruits till they are 4 or 5 years old. At this age cherry and peach trees will be producing crops, and apple trees should enter the bearing age. If vigorous apple trees are overstimulated at this period, the bearing age may be delayed.

Care of Young Orchard

Soil Management.—Regardless of soil types, the particular fruit section, or the kind of fruit grown, the adoption of fundamental practices is necessary for a permanent soil management program. These consist of the maintenance of an adequate supply of organic matter, the presence of nitrogen in sufficient quantities, and the control of run-off water to check erosion and conserve the moisture supply.

Tillage Practices.—The organic matter of the soil acts as a storehouse for moisture and nitrogenous compounds. With its gradual depletion, the nitrogen disappears and growth is reduced. Constant tillage tends to reduce or "burn out" the humus supply. The cultural practices, therefore, that make nitrogen most rapidly available, at the same time most rapidly deplete the total supply. To maintain the soil organic matter, manures or cover crops must be incorporated in the soil from time to time.

Much argument pro and con has prevailed regarding the clean cultivation question and in the opinion of many the problem has not been settled. Nearly all agree, however, that the pendulum is now swinging toward less frequent and shallow cultivation. Tillage practices are changing and the reasons are believed to be good.

The experience of several years ago showed that clean tillage without cover crops hastened the liberation of plant food and the plants made good growth at first and produced abundantly. But this distinct improvement for clean cultivated trees was in most instances short-lived. Tillage was given too much emphasis; so to place the orchard industry upon a profitable basis it has been necessary to substitute the use of cover crops and less cultivation.

Clean Cultivation and Cover Crops.—Clean cultivation with cover crops usually means the planting of some crop in the orchard, following early spring and summer tillage, which when plowed under the following spring will add organic matter to the land. Thus both nitrogen and humus may be added, and by keeping the land covered during the fall and winter the soil moisture supply is conserved and erosion largely prevented. In the young orchard this system is quite important as the soil organic matter should be built up while the trees are young.

The seeding is usually done in the summer or early fall in order to secure a fairly good growth before winter weather prevails. The practice is to turn under the cover crop early in the spring and continue cultivation. An interval then of about four to six weeks occurs in most sections during which the soil is bare or free of a cover crop. After this period another cover crop is usually needed.

Trashy Cultivation.—This method of culture is also known as stubble-mulch cultivation. It consists of cutting and chopping into the soils the stumps of oats, wheat, clover, beans, grasses, etc., left on the ground after reaping. Moreover, such mulch materials as straw, hay and manure may be spread and partially incorporated in the soil through the use of farm implements suited to the purpose.

Stubble-mulch or trashy cultivation leaves the surface rough and littered with the stubble or mulch partly covered with soil. The trashy and rough soil surface tends to hold and absorb rain water even when received in fairly large amounts on moderately steep slopes. It reduces evaporation, prevents soil washing and blowing, keeps down weed growth, and improves soil texture.

It may be important that mulching crops be disked or cultivated before they compete with the trees for soil moisture. If trashy cultivation is carried out to meet the needs, it may supplement materially the grower's soil and moisture conservation program.

Use of Cover Crops

Value as Soil Builders.—It is true that growing cover crops may compete with the fruit trees during the late summer and early fall for soil moisture and nutrients. But this effect is usually desired as it tends to slow up or check growth and thus cause wood tissues to harden for winter protection. Annual cover crops are not usually deep-rooted and so may not influence deep-rooted tree fruits. Therefore both the nitrogen and the organic matter supply may be maintained.

A cover crop checks the flow of water arising from rain and snow, increases soil moisture absorption, and materially lessens surface washing. Also if a leguminous cover crop is plowed under and the soil is cultivated early in the spring, the maximum quantity of nitrates is available during the early growth period. For land

where the organic matter supply and nitrogen seems insufficient for a thrifty, healthy growth, this system of soil improvement and management has great merit.

Overwintering Legumes.—Leguminous cover crops that overwinter usually include winter vetch, crimson clover, red clover, mammoth clover, and sweet clover. Of these, vetch is considered the best winter cover, particularly in the young orchard. It is always preferred for localities subject to cold winters.

With legumes which have the ability to take free nitrogen from the air and fix it through organisms in the root nodules, the total nitrogen supply in some soils may be actually increased. It is frequently found that the amount added through the legumes is greater than that used by the trees or lost through other sources. Thus land deficient in nitrogen as well as humus usually benefits from leguminous cover crops such as those mentioned. Moreover, nitrogen is added to the soil through the most economical method.

Overwintering Non-Legumes.—Overwintering non-leguminous crops commonly used in orchards are rye, wheat, and winter oats. Like legumes, these have many advantages such as holding the snow, preventing erosion, conserving moisture when plowed under, and increasing the soil aeration and organic matter supply. They lack, however, the important ability to store nitrogen and thus increase the supply.

Non-Overwintering Cover Crops.—Some of the cover or green manure crops killed by frost in autumn and early winter are valuable for growing in the late summer and early fall after cultivation ceases and, when killed by frost, to cover the soil, prevent erosion and deep soil freezing, and hold the snow. Also when plowed under they add large quantities of nutrients and thus materially increase the organic matter supply. Legumes most suited for this purpose are cowpeas and soybeans, and non-legumes are rape (Dwarf Essex), turnips, millet, and weeds allowed to grow in late summer and fall.

Intercropping the Orchard

In planting intercrops, a certain portion of land should always be reserved for the trees. This should be a strip not less than 6 to 8 feet wide along each row and should be widened with each year's tree growth to allow sufficient room for unobstructed root extension. The space reserved should be given thorough and timely cultivation at the same time the intercrop is tended. Many vegetables and truck crops such as beans and peas, tomatoes, early and late cabbage, potatoes, sweet potatoes, squashes, pumpkins, carrots, and turnips may be used as orchard intercrops.

If properly handled they should not injure the fruit plants and in many cases may actually benefit them. In fact young trees often

do not receive cultivation and fertilization unless garden and truck crops are grown. The latter demand care and cultivation and therefore may cause the orchard to receive better treatment. If the fertility of the soil is also maintained, the land may be made to pay a fair to good return before the trees come into active bearing.

Corn as an Intercrop.—The results from a four year experiment recently completed at the Missouri Agricultural Experiment Station, Columbia, confirm the above suggestions. A ten acre orchard was divided into blocks of 2½ acres each for the following soil management practices: Corn intercrop, clean cultivation, lespedeza, and grass sod. Ordinary hybrid field corn was planted as the corn intercrop.

During this four year period, and subsequently, the apple trees in the corn intercrop block grew just as well, if not better, than in the other soil management blocks. Moreover, the soil moisture was in this block maintained fairly well even during the drought periods of July and August. The average growth of twigs in inches for the different blocks follows: Corn intercrop, 16.4, lespedeza 15.8, clean cultization 13.5, and grass sod 12.2.

Why and How to Prune

While the discussion which follows applies more especially to apples and pears, the same principles and practices hold for pruning peaches, plums and cherries. With the peach it is important that the trees be headed low and that the fruiting wood be kept near the ground. Bearing trees are cut back somewhat more severely than others because the fruit is borne on one-year-old wood. The fruiting wood should be maintained near the main trunk and not too far out on the scaffold branches. If the young trees are properly pruned at planting time they do not usually require severe pruning during the first two or three years of growth.

So-called corrective pruning during the first few years in the orchard is done largely to thin out interfering or competing branches, and since such cutting need not be severe it does not delay bearing materially or reduce the size of the trees. Severe or heavy pruning, however, does delay the time of bearing. The leaf area is reduced and later, as a result, the root area also decreases to maintain the balance. Trees not pruned or lightly pruned are generally larger at bearing age than those which have been pruned heavily.

Pruning is necessary to correct the shape or form of the tree and thereby to develop strong branches for carrying a heavy load of good colored fruit. Beyond this, however, severe cutting should be avoided. Light cutting each year keeps the branches properly spaced and in balance, but even this should be reduced to a minimum as the trees come into bearing.

Cutting Back Damaged or Weak Trees.—Young fruit trees up to two years of growth in the orchard with trunks damaged seriously by hail, rabbits, or due to other causes fail to make a satisfactory growth during the first and second year after planting may be cut back to stumps from 4 to 6 inches high. Sprouts should arise from the remaining portion of the stem and continue growth in a satisfactory way. One good sprout starting above the graft or bud union should be allowed to grow to take the place of the top or part removed.

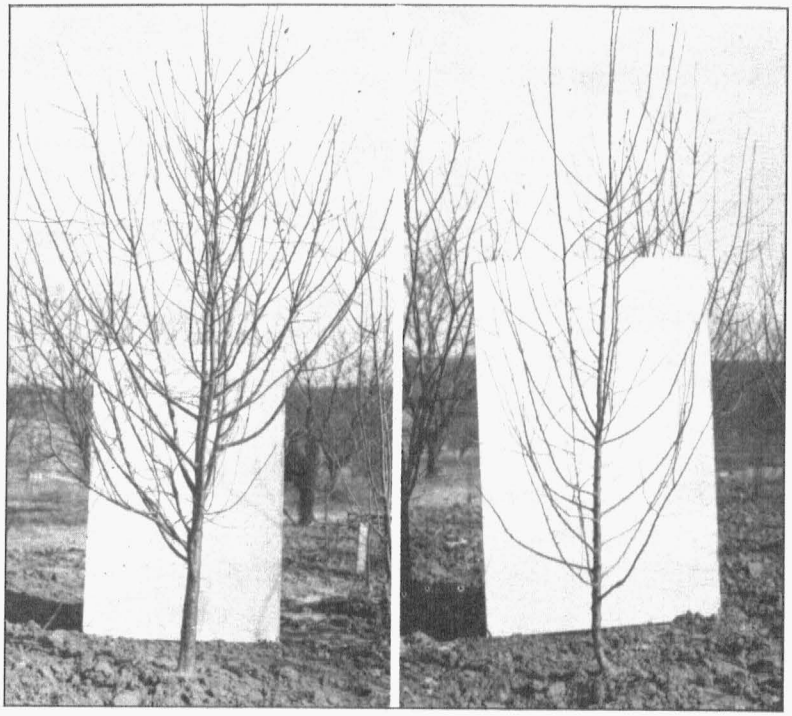

Fig. 5.—(Left) Typical 4-year-old apple tree, not cut back. (Right) Typical cut-back apple tree after two year's growth from a stump about 4 inches high. The tree was planted as a 1-year-old, and after two seasons' growth in the orchard it was cut back.

The best season for cutting back is early in the spring just as growth is starting or shortly before. The mortality has increased as the season advanced up to the first of June. Moreover, the later the cutting back in the spring, the less likely the tree is to produce satisfactory sprouts to continue the growth of the tree.

In comparison to normal or untreated trees, no material difference has been noted in the age of coming into bearing between untreated trees, trees cut back at planting time, and after one to two years'

growth in the orchard. Trees cut back after 3 or 4 years' growth in the orchard, however, may be delayed in coming into bearing as much as two or more years.

The main or scaffold branches in cut-back trees start much nearer the ground. In most instances well placed branches push out at heights from 14 to 18 inches above ground and spread out at a much wider angle than branches from trees not cut back. The branches are better placed up and down the main stem of the tree trunk, enabling the pruner to select without difficulty the branches desired for a well-shaped and well-balanced head.

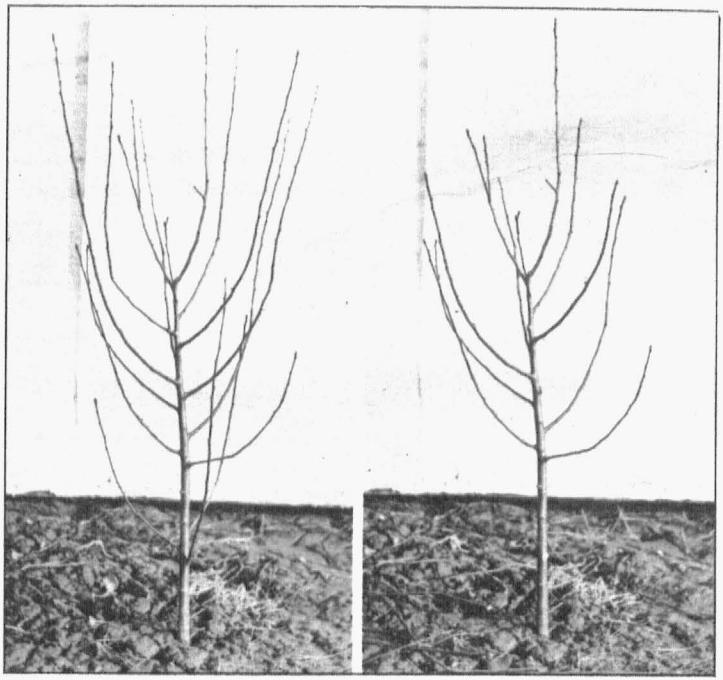

Fig. 6.—Young apple tree after a year's growth in the orchard, before and after pruning. (Was a 1-year-old when set in the orchard.)

The response from the cutting back treatment on all kinds of young fruit trees is, in general, quite similar. The common shade trees also show the same effect in vigor of growth and character of branching as that described for young fruit trees.

Pruning at Planting Time.—The newly set tree is pruned primarily to reduce its evaporating surface until new growth becomes well established to supply moisture. Incidentally too, it may serve to start a proper framework or branching system. The degree of

pruning differs with the species. Trees like the peach, which start new branches readily from the central trunk but the twigs of which tend to dry out badly, should be cut back severely. Trees, however, like the sour cherry which does not start growth readily from dormant buds on the older parts but which makes its new growth from the active terminal buds should be pruned very little.

Apple and Pear.—The apple and pear should be pruned moderately. The side branches should be cut back to reduce them one-half to three-fourths of their length and the central stem should be shortened but still left from 10 to 16 inches higher than any of the surrounding branches. At the end of the first season's growth the permanent framework may be established by removing all but three to five well-distributed, outward-spreading limbs, thus securing a modified leader tree. If the tree is large enough that permanent limbs may be chosen at transplanting, the permanent framework may be established then. The selected branches should be arranged up and down and around the main stem, if possible, at a distance of 8 to 14 inches apart. If the tree is a one-year-old whip having no branches, it should be shortened to a height of 2½ to 3 feet to secure a good branching system below the point of cutting.

Peach, Nectarine, and Japanese Plum.—The peach should usually be pruned to a single stem either by removing the side branches entirely or shortening them to stubs 3 or 4 inches long and cutting the main trunk to 2 to 3 feet in height. The nectarine and Japanese plum should be treated similarly except that the latter may retain stubs a few inches long, or three to five main limbs if the branches are large, properly spaced, and well-established. These species start new growth most readily from the main trunk or the base of the limbs. Remaining branches or stubs should be spaced several inches apart and arranged up and down and around the trunk.

American Plum.—The American plum should be cut back somewhat less severely than the apple. If the tree is well branched, three or four main limbs may be left intact to form a permanent head and the remaining stem and branches may be removed. The side branches left may be shortened one-third to one-half their length.

Sour Cherry.—The sour cherry should not have its permanent branches cut back, as it starts new growth most readily from the larger, active buds at the terminals. Three to five main limbs should be chosen for the permanent framework and the remaining ones removed. The limbs which are left should keep their terminal buds intact. Instead of cutting back twigs, they should be merely thinned to four or five well-spaced branches arranged up and down and around the main stem at distances of 6 to 10 inches. Under

Missouri conditions cutting back the branches is likely to kill or seriously injure the trees.

Time to Prune Transplanted Trees

For late fall and early winter planted trees, the Missouri Experiment Station has found that better growth results if pruning is done soon after the trees are set. This holds true for young trees generally. Subsequent pruning should be done some time after the leaves drop in the fall and before they appear in the spring. Any time during this dormant season, whenever men may work comfortably out-of-doors, is satisfactory. With large orchards one of the chief difficulties is that of getting the pruning done. Labor, however, may usually be secured more easily during the fall and early winter than during the rush work period of early spring just as growth starts.

Spraying

The foliage of young trees sometimes suffers seriously from attacks of disease and insects. Therefore it should be carefully watched during the first two or three years after planting as well as later and at the first indication of injury steps should be taken promptly to prevent it. Only peach foliage may not need spraying.

Summer Sprays.—Where both diseases and insects are to be controlled, a combination spray such as is employed in bearing apple orchards may serve the double purpose. This may consist of lime-sulphur solution at the rate of 2½ gallons to 100 gallons of water to which two pounds of arsenate of lead is added, or bordeaux 4-6-100 may be used with two pounds of arsenate of lead.

The fungicides, lime sulphur and bordeaux, control such diseases as scab and black rot leaf spot on the apple, and leaf spot on cherries and plums. Arsenate of lead or poison is used to check biting and chewing insects like canker worm, several species of foliage eating caterpillars, etc.

When aphids become very numerous on young trees nicotine sulphate, ¾ pint to 100 gallons of water, may be used. Nicotine at the same dilution may also be added to the combination sprays mentioned. Frequently oil emulsion, ¾ gallon to 100 gallons, is added to the bordeaux combination spray, as it has been found effective against aphids and is also inexpensive. In spraying, the work must be done very thoroughly. Sucking insects must be hit and wet by the solution to secure good results.

Dormant Sprays.—All young trees may soon become infested by San Jose scale. To keep this insect under control it is necessary to spray almost annually. The dormant season which occurs between the dropping of the leaves in the fall and their appearance in the spring is the proper time. Lime-sulphur solution at the rate of 1 to 7, or oil emulsion at the dilution recommended by the manu-

facturer is an effective control. Where peach leaf curl, a fungous disease of peach foliage, is also present, the lime sulphur if applied before growth starts will control both curl and scale. Oil emulsion too if added to bordeaux 4-6-100 makes the spray effective against both. The spray to be effective against the leaf curl disease must be applied before the buds begin to swell or the beginning of growth in the early spring. In bearing orchards, the dormant spray is handled in a similar manner.

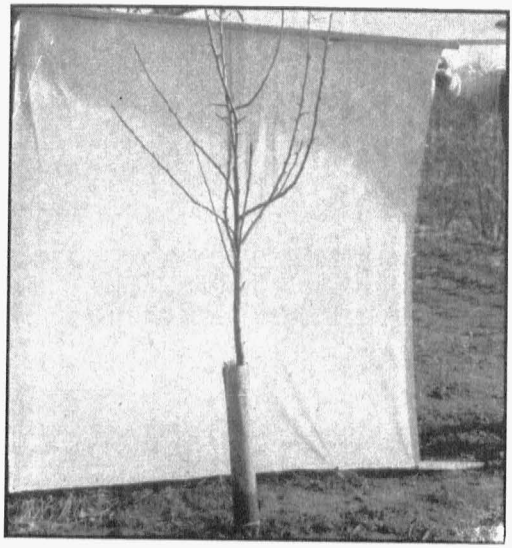

Fig. 7.—Wood veneer wrap encloses the tree trunk for protection against rodents and borers. It is fastened with a string and tied near top and bottom.

Protection Against Rodents and Borers

Rodents.—Good orchard cultivation, particularly for young trees, from early spring until about the middle of July or first of August, tends to prevent serious injury by field mice. In the winter, trash, litter, and dead grass and weeds which may form a harbor for the meadow mouse should be kept away from the tree trunks. For sod orchards, damage may be largely prevented by hoeing in the fall a strip a few feet wide around the tree trunks to keep the space cleared of weeds, litter and mulch. To prevent cold injury during the winter, it may also be well to rake up and mound the soil about the base of the tree trunks to a height of about 4 or 5 inches. In the spring, however, the mounds should be leveled and cultivation continued.

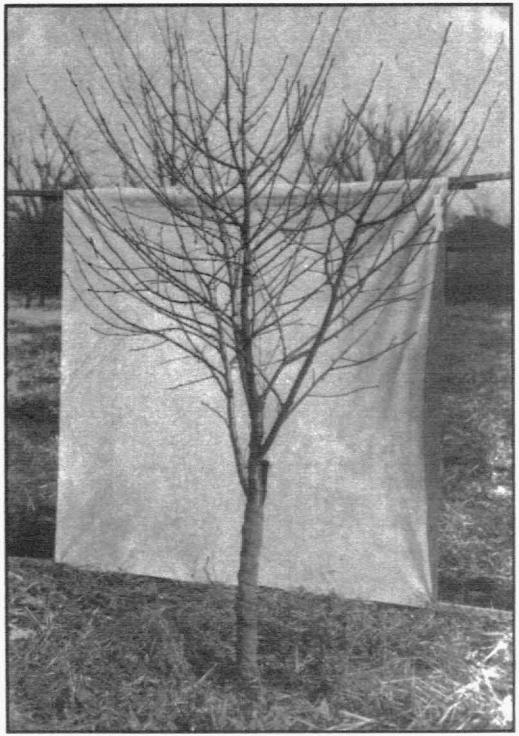

Fig. 8.—Gunny sack used as a wrap to protect tree trunk. It may be fastened with a string or thumb tack.

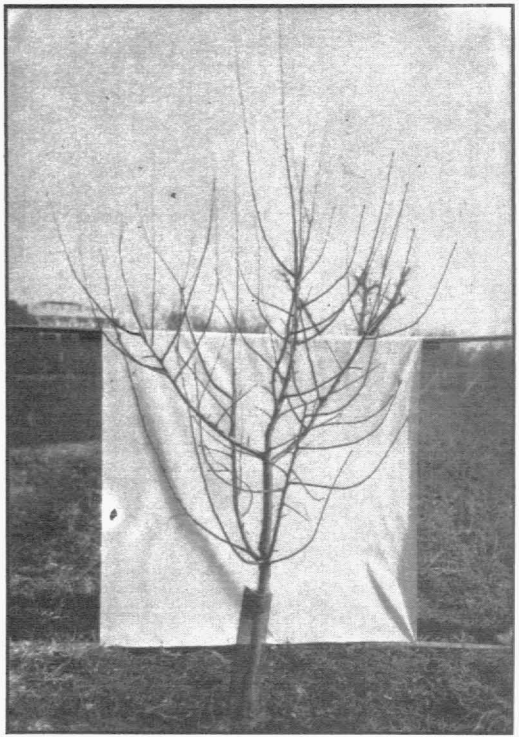

Fig. 9.—Apple tree trunk showing hardware cloth in use as a protector against rabbits, field mice and borers. It is held in place by bending one or more of the cut ends of the wire into the mesh near the top and bottom.

The only safe way, however, to prevent rabbits and mice from gnawing the bark off the trunks of young fruit trees is to wrap or inclose the base or the trunks from 3 or 4 inches within the ground to a height of about 18 or 20 inches. Where the branches are less than 18 inches above the soil the wrappers should include both trunk and branches to a height of about 18 to 20 inches. Some of the most common all-purpose wraps are galvanized fly screen wire, hardware cloth, old newspapers, and gunny sacks torn in strips 6 to 8 inches wide. Other suitable types are wood-veneer wrappers, patented wire wrappers, especially prepared paper wraps, and building paper. The same tree trunk wraps or protectors, if properly selected and placed, may not only prevent injury by rabbits and field mice but assist materially in preventing injury by borers. See Figures 7, 8, and 9.

Borers.—Some of the best methods of controlling the flat-headed and round-headed apple tree borers are:

(1) The trees should be kept vigorous through good cultivation, proper fertilization, judicious pruning, and the application of such sprays as are needed to prevent foliage injury. Healthy strong trees resist the attack of borers. In fact, weak and stunted trees usually show much greater injury.

(2) All weak and dying trees and branches should be cut, pruned away, and burned in order to destroy the hibernating and breeding places of the borers. Too much emphasis cannot be placed upon this method of control.

(3) Tree trunk protectors such as screen wire, hardware cloth, and wood-veneer wraps may assist materially in borer prevention and control. These protectors are formed into a cone-shaped cylinder around the tree trunk and should extend into the soil about 3 to 5 inches and above the ground to a height of about 12 to 16 inches. For best results, the rim at the top of the cylinder should be filled with such material as gunny sacks, old rags, cotton or grass to keep the cylinder in place and prevent occasional borer entrance. Screen wire or wood veneer cut into strips 12 by 18 or 18 by 18 inches usually proves satisfactory. They may protect the tree trunks for several years if given proper attention each year by widening to care for needed trunk growth expansion and to make secure against rodents and borers.

Gunny sack and paper wraps of several kinds may also prove helpful in preventing injury by borers, rabbits, field mice and sun scald if properly placed and maintained. The wraps should be kept on the tree trunks throughout the year and it is very important that they extend into the soil from 3 to 4 inches as most borer injury occurs at the crown or just below it. After 4 or 5 years apple and pear trees may not require further trunk protection.

(4) Through the use of repellent washes and sprays on the tree

trunks injury may also be greatly reduced. The method is not as effective, however, as the use of wraps. Applications may consist of ordinary whitewash to which a small quantity of lead arsenate is added. The wash may be made thin enough to pass through a spray nozzle or thick enough to apply with a paint brush. The applications should be made often enough to keep the tree trunks thoroughly covered from early June until late September.

Peach Tree Borer.—This insect is often ranked as the most serious pest of the peach tree. At or near the surface of the soil, the worms gnaw away the tender inner portions of the bark. The insect's presence is indicated by a considerable flow of wax. Nectarine, apricot, cherry, and plum trees are infested by the same borer.

Chemical Treatments.—The paradichlorobenzene (PDB) treatment is one of the most common methods of control. It may be applied safely to peach trees five years of age or older, but it may be dangerous to use on trees less than five years old. Young peach trees may not be protected from serious injury by employing the borer control methods suggested for young apple trees. In the treatment with PDB, grass and trash should be removed from about the base of the tree. From three-fourths to an ounce of the chemical is placed in a closed ring about two inches from the base of the tree. This is covered with two or three inches of soil, which is firmly pressed down with the foot or back of a shovel or hoe.

The period for most effective treatment will range from about September 10 to 25. PDB costs from 18 to 25 cents a pound. The cost of one application including labor will vary from three to five cents a tree. Chemical concerns handling spray materials may be able to supply growers with the product. This treatment should not be extended to fruit trees other than the peach, as it may cause serious injury.

A new chemical known as Ethylene Dichloride Emulsion is now being suggested to peach growers for the control of the peach tree borer. It is said to have a number of advantages over PDB. It is effective at low temperatures and can therefore be used late in the fall and early in the spring when it is too cold for PDB to be effective. It also appears to be safer on young trees, as well as more effective than PDB. As with other new remedies, it would be wise for growers, if interested, to try it out on a small scale before adoption as a general control measure. The product may be secured from concerns handling spray chemicals.

Use of Wrappers.—The wraps suggested for the apple tree borers may also be used against the peach tree borer on trees of all ages. In general, the paper and gunny sack wraps have not been as effective against the peach tree borer on stone fruit trees as they have been on apple and pear trees against the flat-headed and round-headed borers.