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PRUNING DECIDUOUS FRUIT TREES IN THE SOUTHWEST

By F. J. Crider

A portion of C. I. Craig's apple orchard, near Superior, Arizona. Mr. Craig practices intermediate pruning.

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PRUNING DECIDUOUS FRUIT TREES IN THE SOUTHWEST

By F. J. Crider*

INTRODUCTION

Pruning is one of the most important of all orchard operations. Greater success in orchard work can be accomplished by proper pruning, and perhaps more damage done by injudicious cutting of fruit trees, than by any other orchard practice. The basis of all pruning is closely allied to the fundamental principles of plant growth; the practices of pruning are governed by climate, kind of fruit, and the particular purpose for which the fruit is grown. The objects in pruning are to develop a strong, well-proportioned tree; to modify its shape and growth to meet natural, local conditions; to satisfy economic requirements, such as cultivation, spraying, and harvesting; to influence production and the character of the fruit; and, to maintain the full vigor and health of the tree.

In Arizona the long growing season, particularly in the southern half of the State, coupled with good soil and sufficient irrigation water, causes very vigorous tree growth, which must be taken into consideration in pruning. The long periods of intense sunshine are a most valuable asset, or a costly detriment to the fruit grower, in accordance with the regulation of the growth and development of the tree. This is also true of other climatic factors, such as high temperatures, lack of rain at certain seasons, and low humidity.

Realizing Arizona's peculiar climatic conditions and the importance of carefully regulated pruning practices as a means of meeting these conditions, the author has devoted much attention during the past 6 years to the study and development of pruning methods, in an attempt to assist Arizona fruit growers in the solution of their pruning problems. The pruning outline furnished herewith, being the result of experiments in the development of young orchards at the different Experiment Station farms and observations made throughout the State, is considered most adaptable in the establishment of deciduous fruit orchards in Arizona.

PRUNING AT THE TIME OF TRANSPLANTING

All deciduous fruit trees require pruning when they are planted This cannot be done satisfactorily before the tree is planted, because

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the point at which the cut should be made is difficult to determine without first seeing the tree in its permanent location. The exact methods of handling the newly transplanted tree depend upon the kind of fruit, age of the tree, and the individuality of the tree itself. Since it is advised that our growers start their orchards with medium to large size 1-year-old trees, we shall begin our pruning outline with this age and type of tree in mind.

EFFECTS OF TOP-REMOVAL

It should be remembered that in digging the tree from the nursery much of its root system has been left in the ground. As it will be some time after transplanting before the newly planted tree can develop new roots and take moisture and nourishment from the soil, the first leaves that open (particularly if the tree is not planted until spring) will draw all of their sustenance from the nutriment stored up in the tree. Unless a part of the top is removed these leaves and growing shoots will exhaust this material before the root system is able to furnish more and, as a result, the plant will either die or make a weak, sickly growth the first season. If it survives, the weakened effect can be seen in after years. On the other hand, if a considerable part of the top is removed, a balance between the top and root system will be maintained and the roots will be able to perform their function of supplying the top with moisture and plant food before the leaves have exhausted the nourishment stored in the main roots and trunk, and as a result the new growth will be strong the first season

Growth always starts first on the terminals, with the uppermost buds in the lead. Therefore, if top-pruning is neglected the greatest growth will be from these terminals, which is contrary to the essential requirement for producing a stocky, well-balanced tree. By removing the greater part of the top, the desirably located trunk buds are forced into activity and growth is delayed somewhat until the fibrous, feeding roots become more numerous and stronger. Removing a part of the top also lessens the "whipping" effect of strong winds until the roots are well established, which is an important item in some localities.

HEIGHT OF HEAD

The amount of top to remove from a 1-year-old tree depends upon the height of head most desirable for the kind of tree in question, as related to its environment. By the term "head" is meant, not the point at which the top of the tree is removed as sometimes thought, but the point at which the lowest main branch leaves the trunk of the tree.

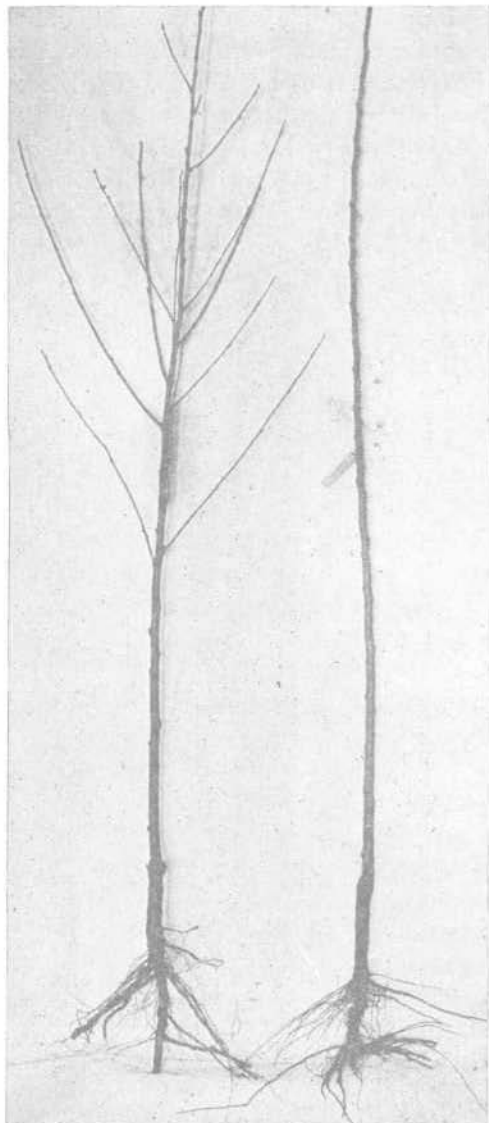


Fig. 1.—Showing usual types of young, well-grown nursery trees. Having fresh, vigorous buds, they should develop strong, well-placed scaffold limbs.

However, the height of the head, which is the distance from the ground to the under side of the lowest branch of the tree, is determined, where proper tree selection and pruning practices are followed, by cutting back the top a certain distance from the ground. For instance, if a young, well-grown tree is planted, shoots will develop all along the trunk, and by careful selection of these for scaffold limbs the grower can regulate the height of head or exposed portion of the trunk. On the other hand, if an older, poorly grown tree is selected, all of the side branches are likely to form near the top and, in spite of the best effort of the grower, the tree will be high-headed.

Fig. 2.—Showing too high heading and badly formed crotches. The tree was doubtless too old when planted to develop a well-shaped top.

It is a pleasing sight as well as a financial asset for the grower to have an orchard of uniform, properly headed trees. This can be obtained only by purchasing young, vigorous trees, which will allow the height of head to be regulated according to a fixed standard.

The height of the head necessarily varies according to climate and

Fig. 3.—This tree has been ruined by sunburn on the southwest side of the trunk, due to high heading.

the kind of tree. In Arizona low-heading has been found most satisfactory, and the practice cannot be too strongly emphasized. If trees are given long trunk-exposure they inevitably become sunburned on the southwest side where the afternoon sun is most intense, the injury

being done both by direct heat and by reflection from the hot, dry soil in summer. Such injury is farther reaching than the mere mechanical scorching and cracking of the bark, since it gives access to destructive insect and plant disease pests.

In addition to forming low heads, the trunks of newly planted trees should be protected from sunburn. The ordinary, perforated tree protector used for citrus trees may be used, or the trunks may be wrapped with a few folds of newspaper tied at the top and near the bottom and made loose enough to allow the air to circulate freely around the trunk. The wrapping should be done soon after the tree is planted but should not extend above the point where it is intended to form the first scaffold limb. The upper part of the trunk should be whitewashed, and for this the following formula has proved satisfactory: 7 pounds unslaked lime, 2 pounds sulphur, 2 pounds salt, mixed with water sufficient to make a thin paste. The wrapping should be allowed to remain until the trees develop ample top to produce shade for the trunk, which is usually after the second growing season.

Low-heading has other advantages, since it lessens the expense of pruning, spraying, thinning, and harvesting, as well as affords less damage to trees and fruit by winds. The objection to low-heading on the ground that it hinders cultivation cannot be sustained if the branches are trained in an ascending direction and if low, extension implements are used for cultivation.

REMOVING THE TOP

With the question of the height of the trunk decided, the next matter for consideration is where the cut should be made to remove the top. This depends upon the number of scaffold limbs to be formed and the distance apart they are to be located, which, in turn, are governed by the kind of tree and its ultimate growth. Taking a peach tree requiring a 12-inch trunk as an example, and assuming that three scaffold limbs located 4 inches apart are desired, then the top should be removed approximately 21 inches from the ground. This gives 12 inches to the first, 16 inches to the second, and 20 inches to the third limb, leaving 1 inch above the last limb. In other words, the point where the cut is made to remove the top is determined by the location of the lowest scaffold limb. The fact that this feature is not given greater consideration is one of the chief reasons why the scaffold limbs of many of our fruit trees are undesirably located, near the top of the trunk.

Table I suggests a suitable number of scaffold limbs, with approximate distances apart, for the leading deciduous fruits under Arizona conditions.

TABLE I.—SUGGESTING AN APPROPRIATE LENGTH OF TRUNK, NUMBER OF SCAFFOLD LIMBS, DISTANCE APART TO LOCATE SCAFFOLDS, AND DISTANCE FROM GROUND TO FIRST CUT ON NEWLY PLANTED TREE.

Fruit	Length of trunk between lowest limb and ground	Suitable number of scaffold limbs	Suitable distance apart for scaffold limbs	Distance from ground to first cut on newly planted tree
Peach	8 to 12 in.	3 or 4	3 to 4 in.	15 to 21 in.
Plum	8 to 12 in.	4 or 5	3 to 4 in.	21 to 29 in.
Prune	8 to 12 in.	4 or 5	3 to 4 in.	21 to 29 in.
Nectarine	8 to 12 in.	3 or 4	3 to 4 in.	15 to 21 in.
Quince	8 to 12 in.	4 or 5	3 to 4 in.	21 to 29 in.
Apple	16 to 20 in.	3 or 4	4 to 5 in.	25 to 36 in.
Pear	16 to 20 in.	3 or 4	4 to 5 in.	25 to 33 in.
Apricot	16 to 20 in.	3 or 4	3 to 4 in.	25 to 33 in.
Persimmon	16 to 20 in.	3 or 4	3 to 4 in.	25 to 33 in.
Fig	16 to 20 in.	3 or 4	4 to 5 in.	25 to 36 in.
Cherry	16 to 20 in.	3 or 4	3 to 4 in.	25 to 33 in.
Pecan	3 to 3½ ft.	3 or 4	6 to 10 in.	4 to 6 ft.
Walnut	3 to 3½ ft.	3 or 4	5 to 6 in.	4 to 5 ft.

TREATMENT OF SMALL SIDE TWIGS

One-year-old trees of some kinds, such as the apple and fig, have the form of a straight whip in which case it is only necessary to remove the top at the desired point, as previously discussed. However, trees like the peach, apricot, and plum usually have several small, side branches below the point where the top is removed, which must be considered.

The mistake is sometimes made of cutting the longer of such branches back 4 to 5 inches from the trunk in an effort to force them into scaffold limbs or of removing them entirely close to the trunk. In the first case, such immature twigs are too weak to form the basis for scaffold limbs. Though one or two may be sufficiently heavy for this purpose, this number alone would make an unbalanced tree. In the second case, if the twigs are cut close to the trunk, basal buds are destroyed which may be needed later for the development of scaffold limbs.

The best and only safe way is to cut these small branches back to short stubs, ½ to 1 inch in length, as shown in figure 4.

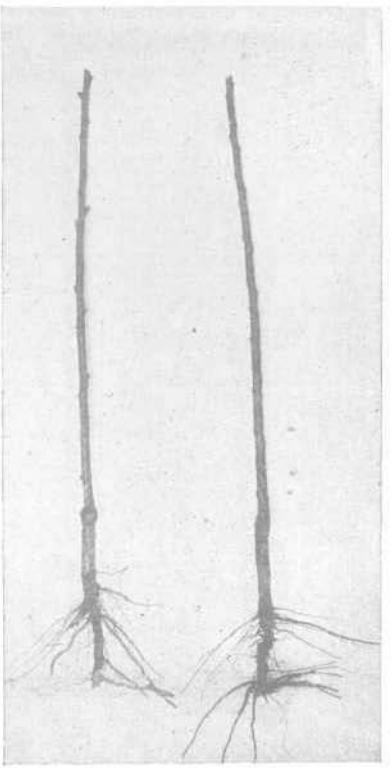


Fig. 4.—The same trees as shown in figure 1 after being pruned. Note the short stubs left on the branched tree to protect the basal buds.

PRUNING THE FIRST SUMMER AFTER PLANTING

This is the most important period in the development of the young tree, for it is during this first growing season in the orchard that the scaffold limbs are formed. It is the period during which the tree requires the most constant and careful attention in the removal of undesirably located shoots, the tipping back of useful shoots, and the encouragement of growth of the shoots selected for the scaffold limbs. To do this satisfactorily, each tree must be gone over three to five times during the growing season. It is never advisable to allow the young tree to go through the first season without pruning.

SELECTING SHOOTS FOR SCAFFOLD LIMBS

In the case of a normal, 1-year-old tree which is the type to be considered here, the buds along the trunk become very active as the

Fig. 5.—Normal, well-developed peach tree the first season after planting. The shoots for the scaffold branches have been selected, though their connections with the trunk cannot be seen clearly on account of the leaf growth.

spring temperatures become warmer. When this growth is 4 to 6 inches long, the tree should be gone over carefully and the shoots for the scaffold limbs selected. First, select the shoot for the lowest scaffold limb which will determine the height of head or length of the trunk, then select the other shoots according to their number and the distance apart desired. (Table I.)

The number of shoots for scaffold limbs should be limited to as few as possible above three; in most cases three are preferable. When too many are left, the scaffold limbs become crowded in a few years, necessitating the removal of one or more of them, which makes a large, undesirable opening in the tree.

It is essential to make the selection of shoots so that the scaffold limbs will be located equidistant around the trunk and will form a well-balanced tree. Location, and not individual vigor, is the impor-

tant factor in making the selection. Treated properly, the smaller shoots will in time become as robust as the larger ones. Sometimes at one or more points, the shoots will be found in pairs, which requires care and patience to remove one without injuring the other.

Fig. 6.—Showing the pinching back of undesirably located lateral growth. The leaf-clusters on the lower portion of the trunk are important in furnishing shade and manufacturing plant food.

TREATMENT OF REMAINING SHOOTS

After the shoots are selected for the scaffold limbs, two series of subsidiary shoots are left, those below the lowest scaffold limb, and those between the scaffold limbs. The tips of the shoots on the lower part of the trunk, i. e., below the lowest scaffold limb, should be pinched out rather than entirely removed at this time, leaving a cluster of leaves on each one. There are two reasons for this: First, the leaves serve a useful purpose in shading the trunk, if it is not artificially protected; and second, this additional leaf surface (the leaves are agents in the manufacture of plant food) strengthens the growth of the tree. It has been proved by repeated experiments that young trees

so treated develop a stockier trunk by the end of the growing season than do those having all of the lower leaves removed. A stocky, well-formed, healthy trunk is essential, since it is the foundation upon which the entire framework of the tree is built. It is sometimes necessary to re-tip these lower shoots once or twice during the season, and this is just as important, when necessary, as leaving them in the first place. Their period of usefulness lasts only through the first growing season, and hence they are removed the succeeding winter.

The growth occupying the spaces between the shoots selected for the scaffold limbs should be removed entirely or pinched back very closely, leaving only the basal leaves.

This general form of tree should be maintained throughout the first growing season. Though it requires constant vigilance on the part of the orchardist to keep the tree in this shape, it is the only way in which uniformly developed trees can be produced.

All sucker growth should be kept removed; this growth usually does not occur after the first season.

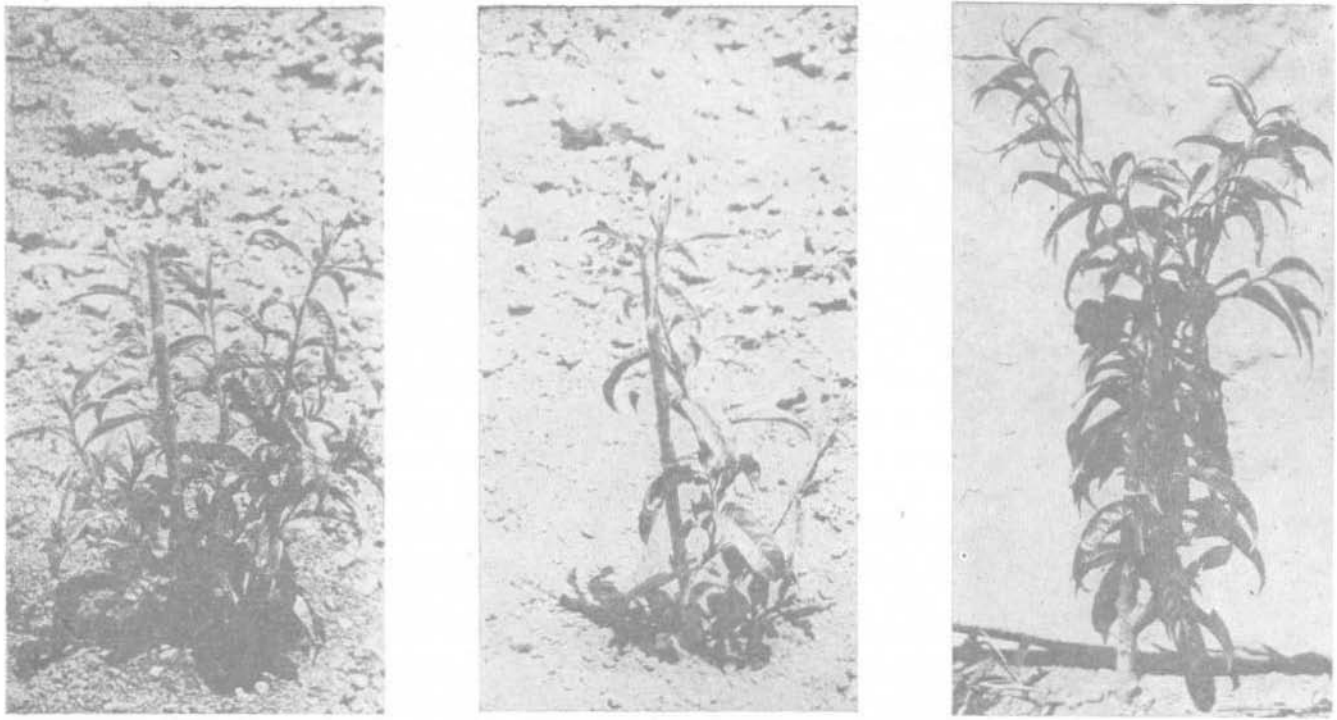
SHOULD THE GROWING SCAFFOLD LIMBS BE TIPPED?

The long growing season in parts of Arizona causes the shoots selected as primary scaffold limbs to develop very rapidly, inviting the temptation to cut them back during the first summer. Such practice is not considered advisable for the following reasons: First, the entire strength of the tree is required at this time to produce a vigorous root system, stocky trunk, and strong primary scaffold limbs Tipping the branches during the first summer diverts the energies of the tree into less desirable channels, causing the development of numerous laterals, the growing tips of which rob, rather than strengthen, the tree. Second, of this numerous growth of laterals, few attain sufficient size by the end of the growing season to form secondary scaffold limbs. As a result, the orchardist, when pruning the following winter, is at a loss to know just how to prune the tree. The same care in selecting and developing the primary scaffold limbs should be used in forming the secondary ones.

The only condition in which it is considered desirable to tip a scaffold shoot is when it develops a vigorous growth at the expense of other scaffold limbs. Tipping is then justifiable in order to give all the branches equal chance to develop normally.

TREATMENT OF MAL-FORMED TREES

The preceding discussion has dealt with the normal tree. Very often a tree will fail to send out shoots just where they are wanted. They



Figs. 7-a, 7-b, 7-c.—Correcting young tree deformity. Reading left to right: 7-a.—Young tree with all new growth near ground; 7-b, same tree with all branches removed except two, one being tied to old trunk and the other left as a precaution against injury to the first; 7-c, same tree 4 weeks later, showing top and superfluous branch removed. Note the development of scaffold branches and the fact that the new trunk is still tied to the older trunk.

Figs. 8-a, 8-b, 8c.—Correcting young tree deformity. Reading left to right: 8-a.—Young tree with improperly placed side shoots, three on one side near the top and two near the ground; 8-b, the same tree with all shoots removed except the two lower ones, one of these being tied to the old trunk to hold it in an upright position; 8-c, same tree 3 weeks later just after the top has been pinched out to force the development of laterals.

may appear only near the top or near the ground; they may all come out on one side; or they may appear singly or in pairs. In any event, the only time to remedy this condition satisfactorily is during the first growing season; if left longer the tree becomes permanently deformed. With careful pruning to direct their growth such trees can be made the equal of normal trees.

The remedy consists in removing all of the shoots except one, which is most desirably located, and in training this shoot to form the permanent trunk. For example, if only two shoots appear on the body of the tree, one near the ground and the other near the top, remove the one near the top, without shortening the trunk, and when the lower shoot is 6 to 10 inches long, bring it to an upright position and tie it to the old trunk. If necessary, tie the shoot a second time when it has grown another 6 inches. When its growth is 6 to 8 inches above the top of the original trunk, cut it off at the same distance from the ground as the old trunk. In a short time laterals will develop which are treated in the same manner as described for the normal tree during the first summer. When handled in this way, the growth of the tree will often overtake that of the other trees by the end of the first season, forming a nicely developed top. The treatment of deformed trees will be better understood by referring to figures 7 and 8. When one or more shoots form only at the top, the treatment is the same, except that this necessitates developing a tree with a higher head than is ordinarily recommended.

FIRST DORMANT PRUNING

Throughout the southwestern half of Arizona, at the lower elevations, dormant pruning may be done any time during late fall, winter, or early spring, until the buds show signs of activity; at the higher elevations, on account of possible danger from cold injury, it is better to delay pruning until late winter or early spring.

If handled as previously outlined, the young tree will now have three or four well-developed primary scaffold branches with some intermediary twig growth. Pruning at this time consists mainly in cutting back these scaffold limbs in order to induce the formation and development of secondary scaffold branches. The point where they are cut is an important matter. If the cut is made too low, the framework of the tree will soon become crowded. In a series of experiments by the author to determine the most satisfactory length for primary scaffold limbs, a length of 18 to 26 inches was found to be

Fig. 9.—Showing method of pruning the first winter after planting. The subject of the photograph is a young fig tree.

most suitable for the common fruits, such as the peach, plum, apricot, and apple. Scaffold limbs 12 to 14 inches in length on peach trees caused the tops to become crowded the third year after planting, necessitating the removal of one, and sometimes two, of the leading branches. In general, it was found that the length of the scaffold limbs should be in proportion to the natural size or development of the different kinds of trees, about as follows: 18 to 20 inches for

the peach; 20 to 24 inches for the apricot; and 22 to 25 inches for the apple.

The only additional pruning necessary after the scaffold branches are cut back is to remove all twig growth on the trunk, from the previous summer, and to thin the intermediary twig growth.

Fig. 10.—The same tree as shown in figure 9, 1 year later.

PRUNING THE SECOND SUMMER

With the main scaffold branches cut to an appropriate length, numerous laterals will be forced out along their bodies. From these laterals the shoots are selected to form the secondary scaffold branches.

SELECTION OF SHOOTS FOR SECONDARY SCAFFOLD LIMBS

Two secondary scaffold branches are developed from each main scaffold. When it is seen that at this stage each of the primary scaffolds is multiplied by two, the reason for advising not more than three main scaffold branches becomes apparent.

The location of the secondary scaffold branches is important and

the selection of the shoots from which they are to be formed should be made early, i. e., when the new growth is not more than 4 to 6 inches in length. Using one main scaffold branch as an example, one of these shoots must be located near, and the other about 6 to 10 inches below the terminal of the scaffold in question; both should never be near the terminal. They must be on opposite sides of the main scaffold,

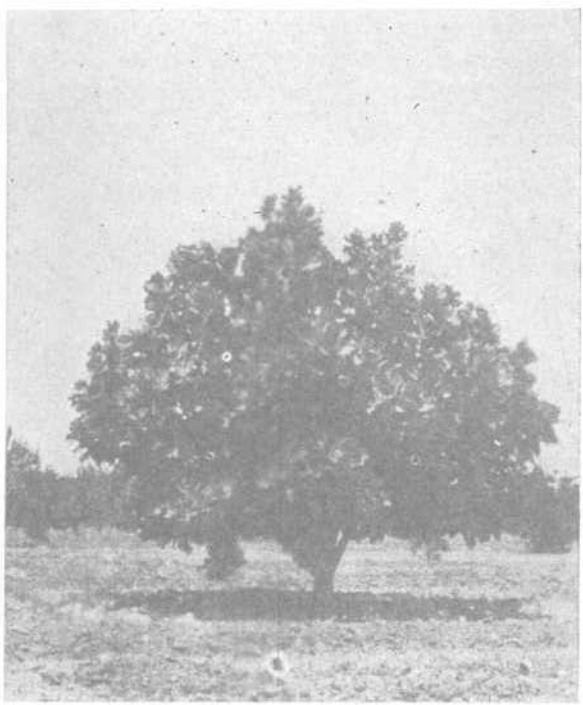


Fig. 11.—The same tree as shown in figures 9 and 10, 5 years after planting.

arranged in a plane inclined toward the horizontal rather than the vertical. To produce a tree of the best shape with a top that is well-balanced and not crowded, the entire arrangement of secondary scaffolds must be in a definite order. The proper arrangement of main and secondary scaffold limbs is represented by a drawing in figure 12.

After the shoots for the secondary scaffold limbs are selected, the shoots occupying the spaces between them on the main scaffold branches are pinched back closely and not allowed to develop. Other shoots, below the secondaries, which show evidence of making a vigorous

growth are pinched back or entirely removed, as their condition and location seem to warrant.

Subsequent treatment should be directed toward keeping all lateral growth sufficiently subdued by frequent checking to allow the shoots selected for the secondary branches to develop properly, maintaining the lead over all other growth; also, to keep the center of the top sufficiently open to allow the entrance of sunlight and the free circulation of air. If the growth in the center becomes too crowded, shade will prevent the proper maturity of twigs which later should bear fruit. Such crowding is most likely to occur with stone fruits. In maintaining a rather open top, the production of low, inside fruit is encouraged

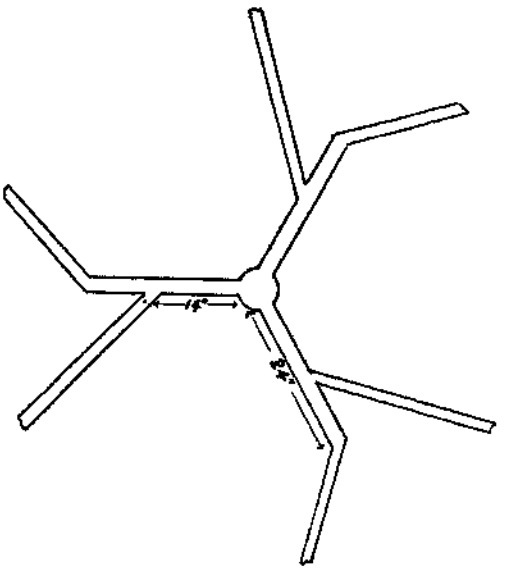


Fig. 12.—Diagram showing arrangement of main and secondary scaffold branches in horizontal cross-section.

Should any of the secondary branches make a decidedly more vigorous growth than the others, the tips must be pinched out in order to maintain an even growth throughout the tree. Again, should the secondaries make a long, spindling growth with few side branches, all of the tips must be pinched out to encourage side branching. However, this should not be done until they have reached a length of at least 3 feet, otherwise the top may become too crowded.

To regulate the growth of the young tree properly during the second season requires as much vigilance and constant attention as during the preceding summer, and the work is just as necessary. The un-

Fig. 13.—Failure to direct properly the growth of the young tree during the first summer causes its energy to be wasted in the development of unnecessary branches which later must be removed.

initiated orchardist may regard this as an undue precaution and a waste of time, but it is nevertheless true that the more care used in directing the growth of the tree during its formative period, the more profitable it will be when it comes into bearing. Furthermore, the strong, rapid growth of most fruit trees under Arizona conditions, makes summer pruning of young trees necessary for their proper development.

SUBSEQUENT PRUNING

If pruning has been done well during the first 2 years, the trees will have developed a strong, evenly balanced framework, capable of sustaining subsequent growth and fruit production. Later pruning *must have as its main object the development, regulation, distribution,* and maintenance of fruiting surfaces. The general methods of pruning will depend very largely upon the system of pruning to be followed and its relation to the kind of fruit.

SYSTEMS OF PRUNING

The form of orchard trees in general is in accordance with one of two general types of pruning, commonly known as the central leader, and the vase-form types. The former preserves the central trunk of the tree as a unit or in a modified form, giving a comparatively tall tree with two or more whorls of branches. In the vase form the central trunk or leader is cut off while the tree is young, and the growth directed into main and secondary scaffold branches, as previously described under the handling of young trees.

The vase type of tree has been used in the treatment of the subject of pruning in this publication and is recommended because, under Arizona conditions, it has been found to have greater advantages in the growing of deciduous fruits than has the central leader type of tree. These advantages are enumerated as follows:

(a) There is less danger of sunburn, since the tree is divided into a number of main stems.

(b) For the same reason there is less likelihood of the tree being destroyed by blight.

(c) The center of the tree, when properly handled, is kept supplied with fruiting wood.

(d) The head being closer to the ground, orchard operations, such as pruning, spraying, thinning, and harvesting can be carried on more economically.

In the vase-form type of tree, several different systems of pruning may be followed. The system commonly followed in the past is known as the "short" system. Later, Professor J. C. Whitten, then Horticulturist of the Missouri Agricultural Experiment Station, developed the "long" system which has become widely used, particularly in California. More recently the author developed what is termed the "intermediate" system which has proved to be especially adapted to Arizona conditions. In brief, the short system of pruning consists in severely cutting back the annual growth about one- to two-thirds; the "long" system in thinning out the entire top of the tree, without heading the branches; the intermediate system is a compromise between the short and the long systems of pruning.

INTERMEDIATE SYSTEM OF PRUNING

This system of pruning was first tested at the Arizona Experiment Station farms in 1921, and since then it has been practiced in all our Station orchards and is now followed by a number of growers of de-

ciduous fruits throughout the State. It was developed from a series of comparative tests between the short and the long systems of pruning, neither of which was found to be well suited to Arizona conditions. In the former, the top of the tree was so much shaded that the fruit did not ripen sufficiently early to attain proper color. Although it reached good size, the yield was not as great as it should be for commercial production. With earliness and high color

Fig. 14.—Showing three improper steps in the handling of this young peach tree: (1) Allowing one too many scaffold branches to develop; (2) allowing the scaffolds to form too near the same point; and (3) heading them too close to the trunk. This has caused the branches to become crowded before the tree is 4 years old.

as very important factors in Arizona, where the bulk of the fruit is marketed in the fresh state, it was apparent that this was not the best system of pruning. In the use of the long system of pruning the disadvantages of late ripening and low yield were overcome, but the fruit was of small size and badly sunburned. An effort was made, therefore, to discover a system of pruning which would combine the advantages of both the short and long systems without the disadvan-

Fig. 15.—Five-year-old apricot tree pruned according to the intermediate system.

tages of either; hence the "intermediate system." These experiments were conducted with the apricot, peach, plum, and apple.

In the practice of the intermediate system of pruning, the terminal branches of the bearing tree are cut back, but not as severely as in the short system. A branch is never cut to a stub, but always to a side branch. The cutting is not so severe as to produce a thick, heavy top, yet enough wood is removed to give size to the fruit, which is a very important factor in marketing fresh fruit. In the treatment of lateral growth, these small branches and twigs are removed outright or cut to a smaller side branch, as their condition and location may suggest; they are never cut to stubs. In this way, the top of the tree is kept sufficiently open to admit sunlight and a free circulation of air. Keeping the top open by thinning, rather than stubbing the branches, not only causes the development of fruit on the inside of the tree, but the added sunlight causes the fruit to ripen early and gives it high color.

The increase in earliness of apricots pruned according to this system, as compared with the short system, at the Salt River Valley Experiment Farm during the past 3 years has ranged from 6 to 8 days. Such difference, coupled with a good yield, is a decided financial asset to the grower.

OTHER PRUNING FACTORS

While the methods of pruning all young, deciduous fruit trees are more or less similar, as the trees grow older their differences in general growth, shape, and fruiting characteristics become more pronounced, requiring greater study and care in order to meet their individual requirements, and to serve better the economic needs of the grower. This is best understood by special reference to some of the more important features.

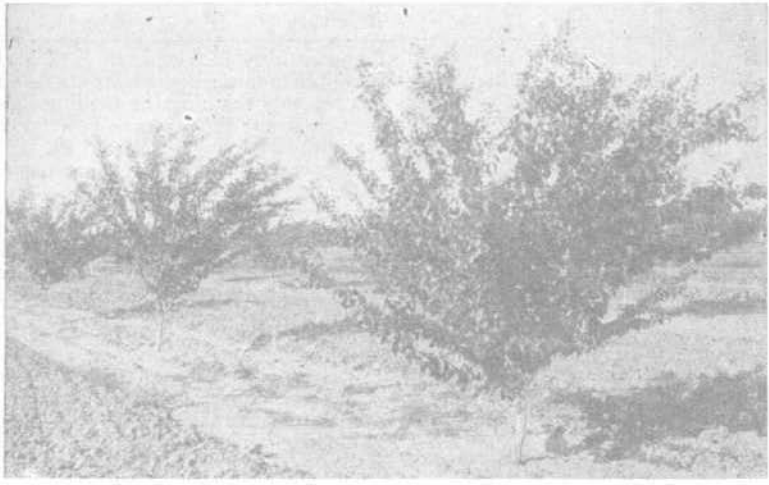


Fig. 16.—Young apricot orchard, Salt River Valley Experiment Farm, during the third growing season. The trees have been pruned according to the intermediate system.

FRUITING HABIT

Each plant has its own characteristic fruiting habit, and in order to be able to prune intelligently and correctly the grower must know something of the fruiting habits of the particular fruit he is growing, otherwise he is likely to make costly mistakes which are difficult to remedy. For example, should he inadvertently cut away the fruit-bearing surfaces of some varieties of fruits, this wood would not be replaced for several years, in the meantime causing heavy loss of crop. The chief fruiting habit factors, as related to pruning, are the loca-

tion of the fruit buds and the age and character of the wood upon which these buds are borne. The differentiation of these factors and their relation to pruning practices are summarized briefly in Table II.

TABLE II.—SHOWING THE RELATION OF FRUIT BUDS, PARTICULARLY THEIR LOCATION TO THE PRUNING OF THE LEADING DECIDUOUS FRUITS.

Fruit	Location of fruit buds (Considered at time of winter pruning.)	Suggested pruning practices
Apple Pear	Mainly on spurs which persist indefinitely; infrequently on 1-year-old spurs and branches.	Moderate annual pruning, consisting mainly in thinning out surplus shoots and removing interfering branches; terminal branches not shortened; spurs preserved. Practice varied according to variety.
Peach	Laterally on twigs and branches of the previous season's growth; singly or in pairs, with branch bud between.	Comparatively heavy pruning, by shortening main branches to strong laterals and severely thinning the fruiting shoots —forcing new growth each year. Extra long branches may be shortened. Little difference exists in the fruiting habit of varieties.
Apricot	Mainly on shortened spur-like twigs; lightly on lengthy 1-year-old branches; on previous season's growth.	Little less severely than peach, shortening main branches to strong laterals, and keeping top open in order to prevent shading and injury to spur-like growth which produces best fruit. Fruit spurs rarely thinned until they show loss of vitality.
Plum (Japanese)	Mainly on short spurs; also, in the leaf axils of 1-year-old branches; on previous season's growth.	Rather severe pruning, corresponding closely to the apricot. Severe thinning of minor branches is necessary to prevent over-bearing and at the same time force new desirable fruiting wood.
Prune	Chiefly on short spurs which persist indefinitely; on previous season's growth.	Very moderate thinning of the top, of the nature of that given the apple.
Cherry	Mainly on short spurs of older wood and near the base of stronger growing new wood; on the previous season's growth.	Very moderate thinning of the top; removal of interfering and injured branches.
Almond	Laterally on spur-like growth and directly on stronger, growing branches; on the previous season's growth	Severe thinning of minor branches to prevent crowding; shortening lengthy branches to strong laterals; preserve spur-like twigs.

TABLE II.—(CONTINUED.)

Fruit	Location of fruit buds (Considered at time of winter pruning.)	Suggested pruning practices.
Quince	Terminal on leafy shoots proceeding from the previous season's growth.	Rather heavy thinning, similar to the peach, to induce new, vigorous fruiting wood.
Nectarine	Same as peach.	Same as peach.
Fig	First crop, laterally on wood of the previous season's growth; second and third crops on current season's growth.	No winter pruning of fruiting wood; general thinning of top after first crop is harvested to prevent crowding, entirely removing the smaller branches rather than leaving stubs.
Persimmon	Laterally on current season's wood.	No pruning except to maintain the shape and to remove interfering branches.
Pecan	On current season's wood, developed terminally from shoots of preceding season's growth.	No pruning except to remove improperly located branches.
Walnut	Same as pecan.	Same as pecan.
Blackberry Dewberry Raspberry	On leafy shoots of the current season's growth, contained on stalks developed entirely during preceding season.	Remove old canes immediately after harvest; cut out tops of new canes to induce branching and the development of greater fruiting surface.
Currant	On spurs and branches of the previous season's growth, the spurs retaining fruiting habit for a number of years	Renew fruiting wood by regular removal of older canes, allowing more vigorous wood to take their places.

HABIT OF GROWTH

Differences in general habit of growth of different kinds and of different varieties of trees play an important part in pruning. In the case of the apple and pear with the same fruiting characteristics, their habits of growth are so unlike that the general methods of pruning the two are very different. The same differences exist in the habits of growth of different varieties of the same fruit, particularly plums, apples, and pears. While some varieties have beautifully rounded tops, the shapes of others are decidedly upright or spreading; others are drooping or even straggly. Some produce an open, nicely balanced

top; while others have a compact top. Thus, it will be seen that the orchardist must study the characteristics of his trees, even though he may understand the general principles of pruning, before he is able to prune his orchard correctly.

Fig. 17.—The same age apricot tree, as shown in figure 15, short-pruned.

These differences in habits of growth cannot be entirely overcome by pruning, but they can be greatly remedied with care and persistence. Cutting to outside lateral branches and buds with trees of upright habit, to inside laterals and buds with spreading trees, and to side branches and buds for lateral extension are means whereby such lack of symmetry may be corrected. Other deformities of growth, such as undue open spaces, may be controlled in the same way. Work of this sort is more effective if done in summer, as well as during the winter pruning.

The individuality of trees of the same variety is also a matter which demands the best judgment of the pruner. While the general charac-

teristics of growth may be the same for a particular variety, no two trees in any orchard are alike in every respect. After all, the unit of profit is the individual tree and the better acquainted the grower becomes with its peculiarities of growth and bearing, the better orchard he will have and the larger will be his returns.

INSIDE FRUIT WOOD

Low, inside fruiting can best be obtained by keeping the inside fruiting surfaces in a healthy, active condition. This can be done by allowing sunlight to enter the tree. The process of photosynthesis carried on in the leaves, whereby crude plant materials contained in the soil, water, and air are made assimilable, is increased with the intensity of light. It is evident, therefore, that if the top of the tree is kept reasonably open by the judicious removal of inner branches in winter and the thinning of growing shoots in summer, the remaining parts will be slow to deteriorate. The numerous dead twigs and weak fruit spurs, commonly seen throughout the lower portion of the tree, are caused by too little sunlight.

In advising the maintenance of open-topped trees it is, therefore, not intended that large openings be made at any time, but that more or less diffused sunlight be admitted by uniform thinning. Sunlight is injurious only as it comes in direct contact with exposed parts of the larger branches.

For summer thinning to be effective in promoting fruitfulness on the inside of the tree, the shoots must be removed or pinched back while they are small, i. e., not more than 6 to 8 inches in length. In allowing them to become long and spindling, their usefulness as fruit-bearing surfaces is destroyed and some of the bad effects of shading other parts of the tree are already produced. After the first 4 or 5 years, or when the tree begins bearing good crops, this heavy growth of inside shoots does not occur unless the tree is pruned too severely, or becomes injured.

Another advantage of thinning the young, inside shoots in summer is the reduction of succulent growing tips which, until the leaves become older, are robbers instead of manufacturers of plant food.

SUMMER PRUNING TO INDUCE FRUITFULNESS

Although it is known that summer pruning, shortly before the season of growth ends, has the effect of stimulating fruit-bud formation, it has not been found necessary under Arizona conditions. The gen-

eral tendency is for our trees to overbear rather than set too little fruit. Unless done at exactly the right time, the practice is likely to cause more harm than good; and until some special condition arises, making summer pruning more desirable than is now evident, it is not advisable as a means of increasing fruit bearing in Arizona.

Fig. 18.—Showing branch of plum tree before the fruit was thinned.

THINNING THE FRUIT

In the practice of any of the systems of pruning, particularly the intermediate system which is recommended for Arizona, thinning the fruit is necessary with most varieties. Pruning reduces the amount of thinning, but the removal of enough wood to thin the crop properly results in over-stimulation of growth and too much shading. While to some the work of thinning may appear to be an unnecessary orchard expense, it is the only way whereby fruit of good marketable quality can be secured. The work should, therefore, become one of the regular, essential orchard practices. It is particularly necessary in Arizona where most of the fruit at present must be marketed in the fresh state.

Thinning must be done mainly by hand, though a rubber hose attached to a pole may be used if handled with care, in whipping the fruit from the slender terminals of apricot trees. The time to thin fruit is important; if done too early or too late, satisfactory results will not be attained. The greatest strain on the resources of the tree, resulting

Fig. 19.—Showing branch of plum tree after the fruit was thinned. The photograph was taken 2 weeks after thinning.

from the growing crop, is after the pits of the fruits begin to harden. Therefore, thinning must be done before the pits reach this stage. The distance apart the fruit is spaced depends largely upon the kind of fruit and the condition of the trees. No definite distances can be given, but, in general, apricots and plums should not be left closer than 3 to 4 inches, and peaches not closer than 4 to 6 inches. Clusters and pairs of fruit should be separated in order to insure uniform shape and color, and the larger specimens should take precedence over the smaller ones. Usually a short fruit spur should contain only one specimen; a twig 6 to 8 inches long only two, located on opposite sides. Not all trees require thinning of the fruit as some trees nat-

urally set less fruit than do others. In the case of a heavy set, at least one-half, and sometimes two-thirds, of the crop should be removed.

Thinning is a very important factor in preventing overbearing, a condition which often results in permanent injury to the tree. The writer has in mind a plum tree on the Agricultural Experiment Station grounds that was allowed to go through one season with a very heavy crop. As a result, some of the branches were broken and the fruit was small and of inferior quality. In addition, the limbs retained the drooping effect produced by overloading, inducing sunburn on the upper sides and the production of water sprouts. Aside from the water sprouts, the tree made practically no growth. The following year it failed to produce any fruit, the next year it bore only a few fruits, and the third year only a very few more, apparently being permanently weakened. Whole orchards have been known to be ruined in the same way. The only remedy for such a condition is to cut back the trees severely and form practically new tops, which means a loss of crop for 2 or more years, depending upon the kind of fruit.

SUCKERS AND WATER SPROUTS

Suckers and water sprouts are robbers of nourishment which should go to the development of the essential parts of the tree. The former constitutes the growth appearing around the base of the tree, which may come from above but which usually originates below the bud-union. As a rule this growth appears on young trees, and if allowed to remain through the growing season will have a weakening effect on the tree. It should be kept removed by rubbing off the sprouts while they are young and tender.

Water sprouts usually appear on the trunk and scaffold branches of older trees, and are induced by heavy pruning. Forming in the shaded top, they become long and spindling with few leaves, and in such condition play no part in strengthening the tree. They should be removed as soon as they appear, before they have had time to shade or otherwise injure the essential parts of the tree. The orchard should be gone over at least twice during the summer to remove water sprouts; suckers can be removed during the summer pruning.

AMOUNT OF WOOD REMOVED

The amount of wood removed in pruning has a marked influence on the bearing tree. In fact, both growth and fruit bearing are largely regulated by the amount of wood allowed to remain on the tree. Some

kinds of fruit, as already pointed out, require the removal of more wood than do others. Heavy cutting has a tendency to stimulate wood growth, including water sprouts and suckers, and lessen fruit production; also it may cause irregular, intermittent bearing. In the case of fruits like the apple, which retain their fruit-bearing surfaces for a long period of years, heavy wood removal will lessen the fruit crop for a number of years, until the tree can develop new wood and fruit spurs. When a tree has been stimulated by such treatment it requires time and careful attention in pruning to enable it to regain its original shape; sometimes it is difficult ever to make it begin fruit production again.

It must be understood, however, that heavy wood removal has its rightful place in pruning. Where trees have become weakened by overbearing or neglect, with the annual growth very short and lacking in vigor, severe pruning is necessary as a means of stimulating active growth. However, in performing such work, due attention must be paid to the maintenance of the proper shape and balance of the tree. To avoid undue stimulation of growth, it is often necessary to extend the period of rejuvenation through 2 or 3 years, particularly with the apple and pear. In the case of stone fruits, which recover from the effect of heavy pruning more quickly, the whole top may be removed at once. However, severe cutting back of the top of older trees should be followed by careful thinning of the new growth the following summer in order to prevent overcrowding and to induce the formation of properly balanced, new scaffold branches. This extra care should also be exercised during winter pruning.

Light, regular pruning has the effect of inducing fruitfulness, but where size is an important consideration, it can be carried to the extreme. While light pruning increases the yield it decreases the size of the fruit, unless the crop is carefully thinned.

Knowing the relation of the amount of wood removed in pruning to the growth and fruiting habit of the tree, the grower is able to regulate his pruning practices to give the best results under his particular conditions.