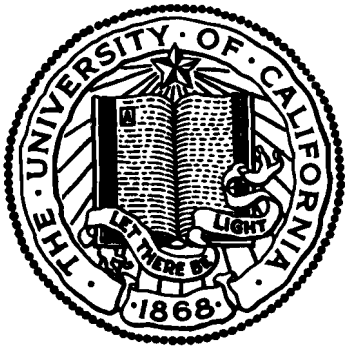
R. Scott Johnson

STANISLAUS ORCHARD HANDBOOK



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PRUNING

REASONS FOR PRUNING

If you were not to prune your trees from the time they were planted, they would grow more rapidly and come into bearing sooner. Why then, must you prune? If you did not prune, your trees would not only come into bearing sooner, they would go out of bearing sooner.

The general form of the tree must be well-suited to the type of cultural operations you find necessary to stay in business. Pruning, then, is based on thinning, sizing, picking, spraying and continued productivity of the trees

Anyone can prune your trees, and they will grow and produce a crop. The size and quality of that crop may vary considerably, as a result of the pruning. Whether or not the trees have strong limbs which can bear heavy crops year after year without breaking can be related to pruning and training.

The number and kind of limbs you choose determine how long their life might be. A few strong limbs will generally bear more fruit over the life of the trees than a large number of small limbs. Too often more limbs are left in the young tree than can be kept healthy.

There are a few rules that can usually be used in the training of young trees and the pruning of bearing trees. To be most effective in your operation, it is best to learn these rather well.

Once you know and understand the rules, the next step is to learn when and to what extent the basic rules should be obeyed. In many cases it will be to your advantage to bend or even break basic pruning instructions.

DEFINITIONS USED

LIGHT OR HEAVY pruning means that a minimum or maximum amount of pruning is done. The terms may be used with reference to a single cut or to the total amount of pruning the tree receives.

HEADING is the type of cut in which the end of a twig or limb is cut off, leaving a stub. The amount of the stub left may be a fraction of an inch or several inches.

THINNING-OUT is a type of pruning where a cut is made at a crotch. This removes an entire branch or part of that branch. Thinning cuts can be made of any size.

TRAINING, for our purpose here, is the type of cutting done so as to form or train young trees to a desired shape. It will include both heading and thinning cuts.

PRUNING generally refers to the cutting done in bearing trees to maintain tree size, form, productivity, etc.

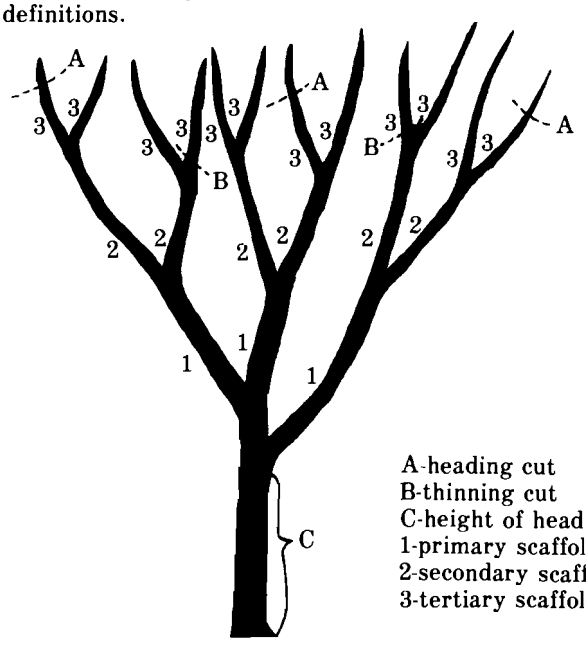
SCAFFOLD is simply another name for one of the main or framework limbs of a tree. A primary scaffold is one that connects directly to the tree trunk. Secondary scaffold limbs branch off the primary limbs. We sometimes call a third set of limbs tertiary scaffolds.

SPURS are short shoots that bear some, or perhaps practically all, of the crop. Species and varieties vary tremendously in the proportion of spurs. Spurs may live 5 years in almonds, 12 years in cherries and have lasted as long as 20 years in some apples.

HANGERS are the somewhat willowy fruiting wood that peaches and nectarines are borne on; they hang.

HEIGHT OF HEAD is the distance from the ground to the first primary scaffold limb.

The drawing below illustrates some of these definitions.



One of the features to be noticed is that of trunk and limb size. At any position on the trunk or a limb, the thickness is proportional to the number of branches above that point.

To be more specific, look at the trunk diameter just below the first primary limb, and then compare that to the diameter just above the crotch. You will notice the same relationship above and below any of the crotches that form secondary or tertiary limbs.

Remember back in section 1.1, we talked about how your trees grow? Trunk and limb size differences are due to varying benefits of food materials that were produced in the leaves. At any given point on the trunk, cambial growth is in proportion to the number of leaves above.

Apical dominance is the tendency of a terminal bud or shoot to dominate the activity below. Terminal buds produce an auxin (plant hormone) that, in moving downward through the phloem (inner bark) inhibits lateral bud growth. This dominance may prevent side branching at the start of a season or during midseason.

Apical dominance can also determine whether developing buds below it eventually become shoot or fruit buds. Great variation occurs between species,

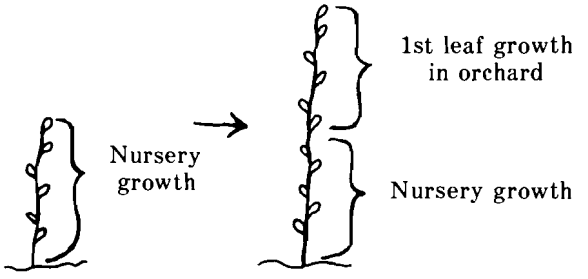
and even between varieties, as to whether apical dominance is mild or strong.

Knowing the tendency for apical, or terminal dominance as it is sometimes called, will enable you to make better decisions in the choice of cuts. There will be times when you should respect this tendency. There will be many times when you can ignore it, or even beat the tree at its own game.

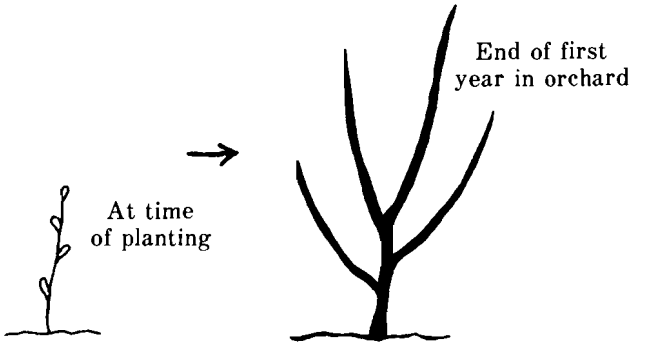
Deciduous fruit trees may be classified roughly into two groups as to whether apical dominance is of importance in the formation of branches.

In the first group are those trees that readily form branches during the growing season. Included are almonds, apricots, nectarines, peaches and Japanese plums.

In the second group, dominance of the terminal during the growing season prevents or reduces the number of buds that push into growth soon after their formation. Among this group will be found apple, cherry, fig, pear, pecan, persimmon, European plum, quince and walnut.



Strong terminal bud dominance is easily demonstrated if at planting time the terminal bud is not removed (headed). If it remains, the resulting new growth will be a continuation of the trunk with little or no branching.



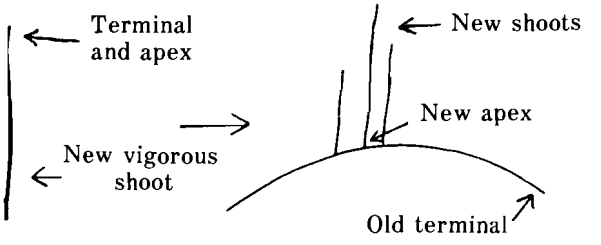
In these drawings, terminal bud dominance is not of concern at time of planting. Free breaking of lower bud into growth occurred and several branches resulted. This illustration does not mean that trees, such as almond, should not be headed when planted.

These same drawings illustrate two or three other features that you should be aware of in training young trees. First, notice that the more vertically a branch is growing, the more vigorous it tends to be.

Lower branches have wider crotch angles than those above. This tendency is regular and progressive. That is, the bottom limb will have the widest angle, the next to the bottom limb will have the next widest angle, and so on to the highest limb which will have the narrowest angle.

Putting the two pieces of information together about crotch angle and vigor can be proper when pruning a pear. But the lowest on a peach tree is generally the most vigorous. We'll talk more about this later.

Let us first talk about another form of apical dominance. Dominance is generally associated with the growing point during the growing season. It can be associated with the highest point above ground, even if that point is not the shoot tip.



If we bend a vigorously growing shoot over fairly early during the growing season, a change in the growth pattern results. Buds at the new apex will push into growth, and these will tend to exert terminal dominance.

One of the effects in the above case is to cause a greater proportion of the developing buds to become flower buds. These extra fruit buds will be to the right of the new apex (as drawn), which puts them beyond the influence of apical dominance. This dominance is the result of a chemical growth-regulating material that is produced in the leaves, and it regulates activities between the apex and points normally "downstream" from it.

Knowing how to use this last feature enables you to cause young trees to crop earlier in life. It has also been used as a means of converting strong watersprouts in the lower portions of peach trees into fruiting wood.

Remember that in thinking about definitions and so-called rules, you are dealing with a biological entity and not a computer-designed machine. What has been said is generally true, but there are all sorts of variations and exceptions.

BASIC PRUNING RULES FOR YOUNG TREES

Pruning a young tree is a dwarfing process most of the time. If a tree is growing well, any pruning will result in a smaller tree at the end of the growing season. The reason is when potential leaf area is removed, the food supply is reduced due to the reduced manufacturing surface.

The dwarfing effect from pruning occurs primarily in the portion pruned, but not exclusively. That is, if one limb is pruned and the others left unpruned, the pruned limb will grow less proportionally following the pruning than the other limbs. This concept is quite basic to knowing what you are doing.

Now then, it is true that the individual shoots growing from a pruned tree will be longer than those from an unpruned tree. But the greater number of shoots on the unpruned tree will have more total leaves, and these will produce more of the materials that are needed for growth.

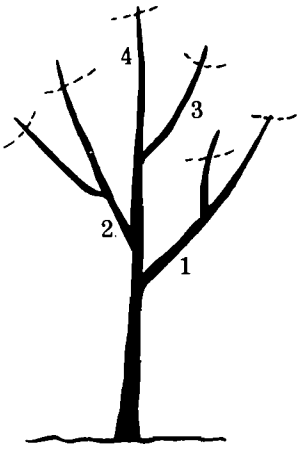
Sometimes when a tree is not growing, yet there is nothing wrong with the tree, severe pruning is in order. This severe treatment brings the top into a more favorable balance with the roots and will leave the available food reserves to a fewer number of growing points. This is a one-time operation and if vigorous growth does not result, the tree should be replaced.

The dwarfing effect we have been talking about is on young trees bearing little or no crop. Should a young tree set a heavy crop, this may seriously reduce tree growth. Should you or your pruners notice a smaller tree or several trees with a greater than normal number of fruit buds, these buds should be removed. Prune in such a manner as to remove most of the fruiting wood.

Which of the primary scaffolds is the most vigorous–the top or the bottom one? The answer will depend primarily on the species, but will vary somewhat with variety and, possibly, with rootstock. Knowing the answer for your particular case can make quite a difference in how successful you are in training your young trees.

Generally speaking, the lowest limb on the trunk will be the strongest on kinds of trees that branch freely on current season's growth. This includes almonds, apricots, nectarines, peaches, Japanese plums and, an exception to the rule, walnuts. The topmost limb on these will normally be the least vigorous.

In the above cases, this means that the lower limbs are normally pruned more severely than those limbs rising above them. You must be particularly careful in peach and walnut trees or the lowest limb will dominate the growth.

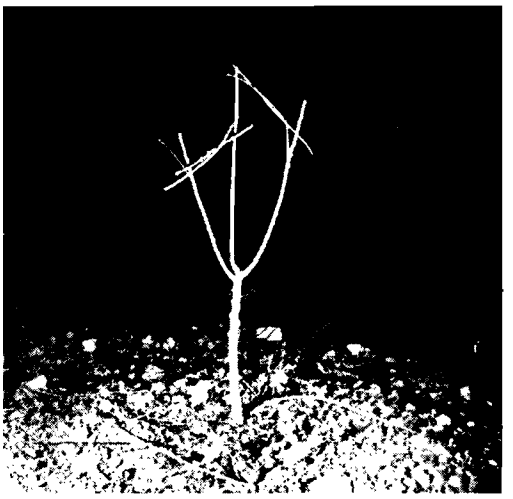


This drawing shows how you would regulate the vigor of various limbs in those kinds of trees where the bottom limb is normally the most vigorous. Limb number 2 would be the second-most vigorous, and the terminal limb--number 4--would normally be the least vigorous.

In the above example, let us assume we have either summer-pinched unwanted shoots or we have already thinned out the undesirable limbs. Our next step is to ensure that each of the remaining limbs grows in the desired proportion

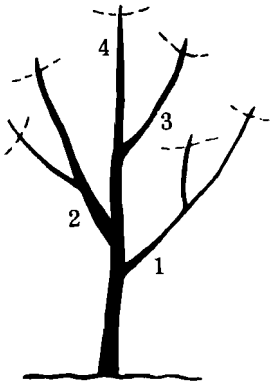
Knowing the top limb--number 4-- is the least vigorous, we leave it the longest. We head limb number 3 so that it is shorter than number 4, but is taller than number 2. Limb number 1 is headed so that its terminal is the lowest of all.

Notice that on limbs 1 and 2, we have headed the secondary scaffolds so that the portion that continues the line of the primary is the longest. This unequal pruning also allows for stronger, wider crotches and helps prevent choking out.



This one-year-old apricot tree has been pruned so that the center (top) limb has been left the longest and has the highest terminal. The lower limbs were headed so as to leave their terminals in relation to the order of trunk attachment. Spreaders are used to prevent permanent narrow crotches.

Now let's talk about those trees that do not freely branch on current season's growth. Apical dominance in this group also tends to keep the topmost limb most vigorous. Trees included in this class are apple, cherry, fig, pear, pecan, persimmon, European plum and quince.



If the same drawing were of a pear, for example, limb number 4 has a strong tendency to dominate. The upperlimbs are headed more severely than the lower ones. In this group the tendency of vertical limbs to be the most vigorous, combined with the strong apical dominance, means that chokeout limbs are not the concern that they are in, say, a peach or walnut. The heading that is done is primarily to determine where crotch formation will take place. Unequal heading is again the rule, in order to encourage wide crotch angles.

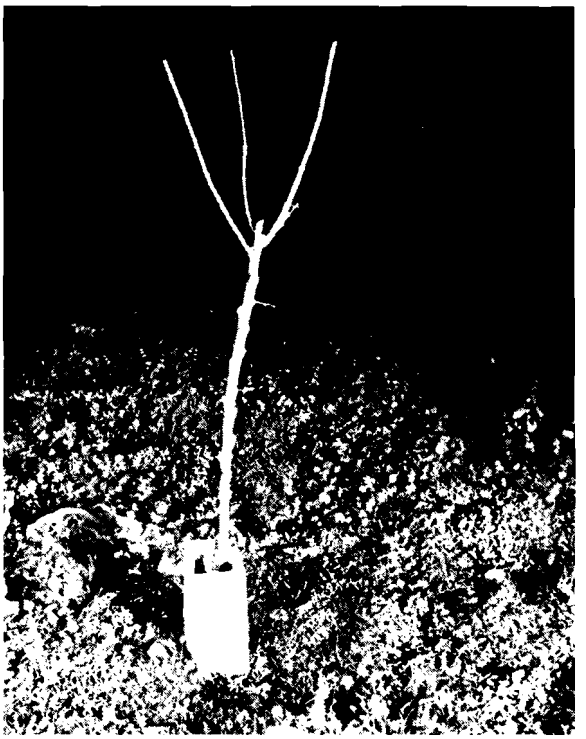
The first thing to notice is that in the orchard, pear trees do not spread as did my drawing. We do not have as much concern about narrow crotch angles in pears. Heading cuts were made primarily where crotches were desired.

Remember, however, that just because a certain kind of tree has been put into a manmade classification, it may not know this and will grow as it pleases. You must see to it that the growth is directed by whatever techniques are required to obtain the desired form.

Primary scaffold limbs should have an outside connection with the trunk. That is, main limbs should not originate from the trunk in a vertical line above or below another primary limb. One reason is that nitrogen moves upward through the inner bark in more or less a straight line and is used primarily in cell building of new tissue.

The reason for not wanting more than three or four primary limbs is that as these increase in size, there is seldom enough space for more.

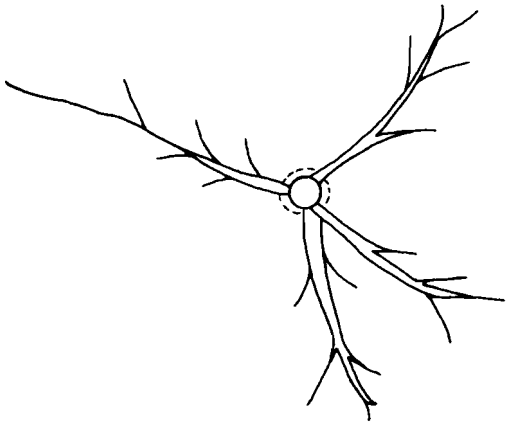
Whether or not you need to be concerned with the chance of limbs choking out will vary considerably. Almonds, for example, are closely related to peaches and, therefore, should obey the same sorts of rules. Yet, we do not have near the concern for losing limbs due to being choked out that we do in an adjoining peach orchard. Japanese plums are of even less concern.



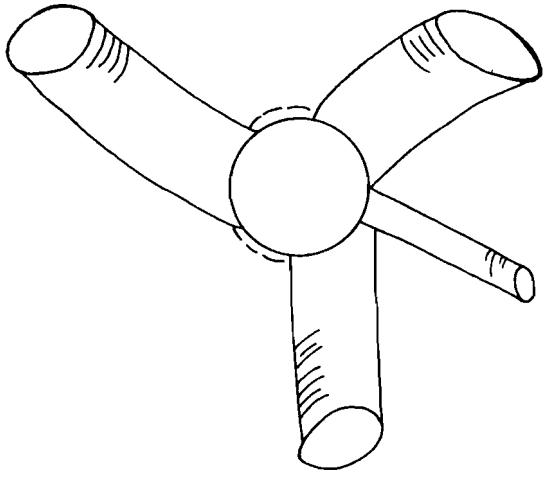
Apricots are not normally bad for chokeout limbs, but whoever pruned this tree was pleading for it to happen. The center, topmost limb was already being choked out before pruning, as indicated by its smaller diameter. Such a limb is generally not worth trying to save. The pruner may have been proud of his work but, in truth, it was very poor.

Before you start to train young trees, it just might be a good plan to wander through a mature orchard of the same varieties in your neighborhood. Do you see stubs where primary scaffold limbs were cut off? If present, does the absence of the limb result in a loss of bearing capacity?

In our local peach orchards, the usual reason for pulling out the orchard is that of too many missing limbs. One of the two major reasons for missing limbs is that they simply died out because of being in a choke-out position. The peach tree in this picture is too often seen in orchards 15 years of age and older.



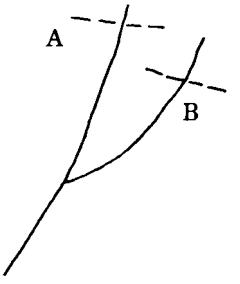
When the trees are small, there is a temptation to leave too many main or primary scaffold limbs. At this age, if we look down into the center, we see enough room for more than three limbs.



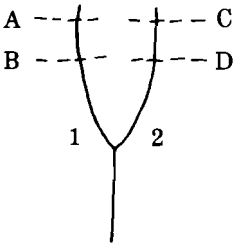
If this were the same tree a few years later and we were to look down into the center, we would see that we no longer have the nice lateral separation of limbs.

In this illustration, one of the limbs is in the process of being choked out. If this weaker limb is on the north or east side of a peach tree, it will probably die out at about seven years.

Unequal development is desirable at each and every crotch. The portion of the trunk or limb continuing above the crotch should be the larger of the two. This kind of branching allows for strong crotches on any kind of tree. That's great, but how do you always get it?

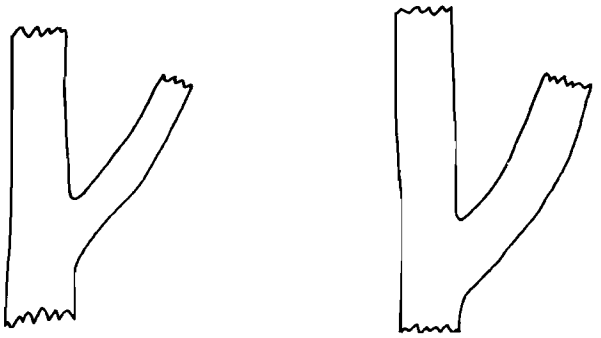


In this example, the limb that continues the line of the lower portion is headed distinctly higher than the side branch. The limb headed at A will have more growing points and, therefore, more leaves to nourish it than the limb cut at B. Remember what we said about pruning being a dwarfing process?

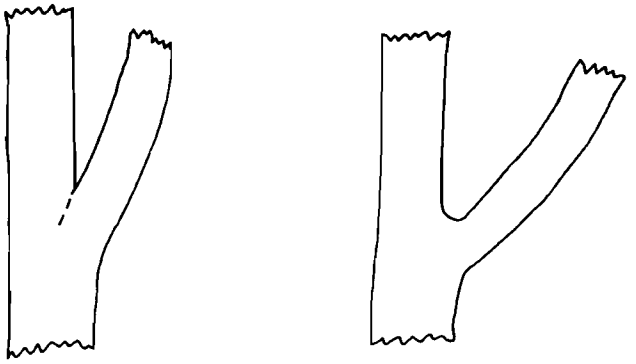


In this example, you have the choice as to which secondary will become the dominant limb. This is because they are the same size, and one does not arise from the trunk above the other. If, for some reason such as wind, you want limb 1 to be the dominant portion, it is cut at A, the limb 2 is cut at D. Should you want limb 2 to dominate, then it is cut at C, and limb 1 is headed at B.

Differential heading of developing limbs will result in wider crotches. This reduces crowding and also allows for more light penetration, which in turn produces more fruit wood development. Of equal or perhaps of more importance is the extra strength of wide crotches.



In the above examples, the crotch on the left indicates that the size of the vertical and side limbs are in the proper relationship. The example on the right indicates that the side limb now has equal vigor to that of the vertical portion and, if not pruned more severly, it may choke out the upper portion. In a peach or walnut, there is not much doubt about the vertical portion being choked out. In a cherry or pear, the vertical limb is probably not in jeopardy.

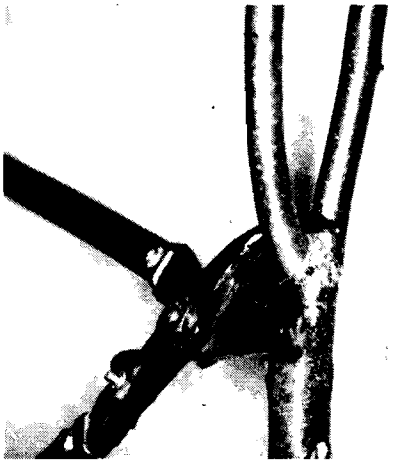


Narrow crotches are more apt to split than are those with wide angles. As a tree grows, the outer bark normally sloughs off. In the example on the left, a vigorous tree has grown fast enough to include the bark, which is a source of weakness and decay. With normal bark sloughing, the base of the limb in the right hand drawing will be surrounded more and more with trunk tissue as the tree grows.

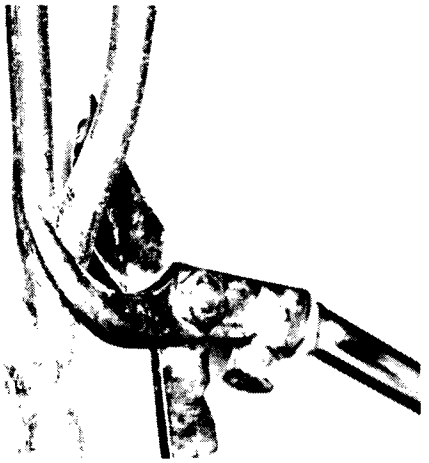
Of the tree crops grown in this area, pecans and walnuts are the most subject to weak, narrow-crotched limbs; however, other trees can have the same problems. The price that you may pay for having extremely vigorous trees is that of some breakage, do to narrow crotches.

Over the years there have been many kinds of funny stories about left-handed shovels, wrenches, and so forth. In the training of young trees, there are some definite ways to make certain cuts, and this involves how the shears are held. In the process of making thinning cuts to eliminate a crotch, the remaining portion of the limb or trunk can be split.

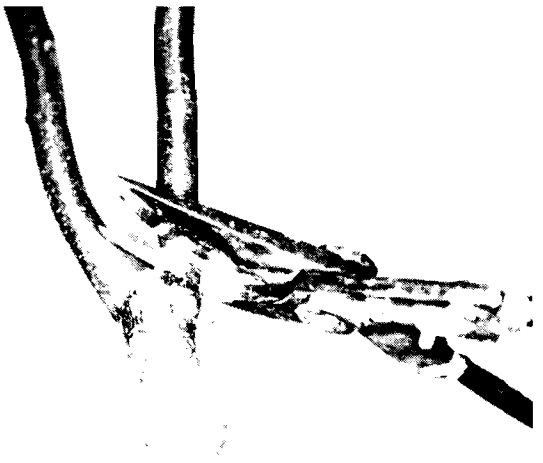
The cutting blade should move upward or laterally, never downward. To cut downward is to create pressure within the remaining stem that may well cause it to split during the process or during the following growing season. Whether the blade or bar is held against the remaining limb or trunk may determine whether or not that portion splits in the future.



The more vertical portion is to remain, therefore a smooth cut is desirable. The cutting blade is moving upward and as close as possible to the remaining portion. There is no danger of splitting, and a narrow crotch is eliminated.

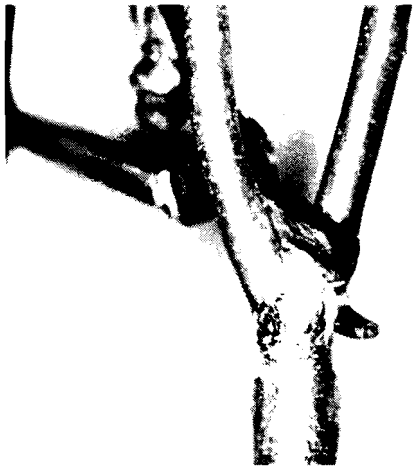


Sometimes it is not possible to hold the shears so that the cutting blade moves upward. In these cases it is okay to hold the shears so the blade moves laterally. Splitting forces are not developed, and a smooth cut is made. Even then it is not always possible to make the cut completely smooth, as can be seen where a lower cut was made.



When the more vertical portion is to be removed or a change of direction is wanted, a stub should be

left. This short stub reduces the chances of weight or wind creating enough pressure to cause the limb or trunk to split off at this point. The bar is held next to the portion to remain, thereby automatically leaving a stub and the blade is moving in a direction that does not create splitting forces.

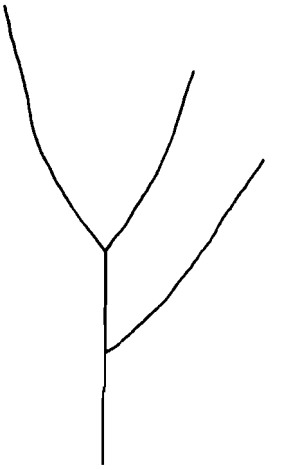


Cutting downward tends to push the portion to be removed in a direction that creates splitting forces. A small portion of bark has been removed to show where a split has developed. Such a split will seldom heal soon enough to prevent the remaining portion from being lost.

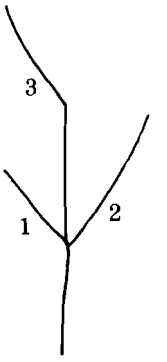
In the Stanislaus area, May and June can be quite windy. In such years, some of the proudest owners of two-to four-year-old almonds have nearly been brought to tears by what the wind did to certain trees. Probably, over the orchard, the extra size of such trees means that their earlier full production will more than make up for the damaged trees or replacement trees. But such breakage can be minimized.

After pruning and before much, if any, growth has occurred, vigorous one-year almonds should be given limb and crotch protection. A simple wrap-around as seen here is usually effective. The wrap is low on the left and high on the right so as to pull the right-hand limbs upward more than the one on the left. Limb placement up and down the trunk can be as important as the lateral distribution around the trunk, if we are to prevent choked limbs.

Many times it is not possible to get complete vertical distribution of limbs. There is nothing wrong with having two of the three limbs at the same height, if the two together are above the single.



In the above drawing we have left one limb low and the other two distinctly above it. This is an acceptable three-branch tree, when two of the three originate from the trunk at the same height. Be sure to head the upper limbs unequally.



In this drawing, where two lower limbs branch off at the same height, some risk of losing the upper limb is at hand. If limb number 3 is on the north or east side of a peach tree, it would be best to simply cut it out now and have a two-branch tree. Severe, differential heading of limbs 1 and 2 may be enough to save limbs in almonds and apricots. Where you have strong terminal dominance the risk is minor, such as with apples.

Choke-out limbs can be a major problem or can be used to an advantage. It is important that you learn to recognize them and determine whether or not they will be helpful or harmful.

In young trees, a limb that is in the process of being choked out will show a color difference at its base. Such a limb will be darker and more of a gray color where it joins the limb or limbs that are choking it.

Probably the most important thing to see about a limb that is choked out, is its base diameter in

relation to the base diameter of limbs below it or on either side. This will vary considerably with the species.

Remember what we said about pruning as little as possible? If we see a branch that will be choked out, it may be wise to leave it for extra leaf area or fruiting wood. If it will not harm other limbs and is doomed anyway, why not leave it?

This cherry tree did not know that the center and topmost limb was supposed to show more dominance. If a pruner recognizes that such a limb will not last and is really not hurting anything, it can be left for the extra leaf area. It will also tend to spread or open the tree.

The same tree after a somewhat severe and traditional method of training cherries. The choke-out limb was removed, and the two strong primaries have been headed differentially where branching is desired. Actually, the differential heading was enough, and a lot more leaf area would have been available to promote growth.

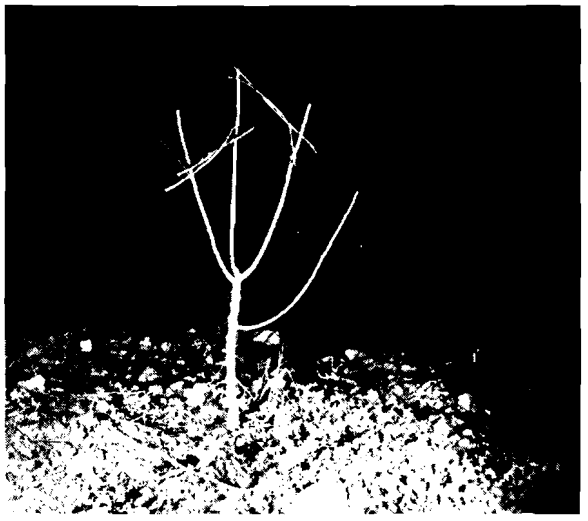
TRAINING YOUNG TREES

At planting time, or shortly thereafter, your new trees should receive their first pruning.

The primary purpose of pruning most newly planted trees is to establish the height above ground of the basic framework limbs. Of secondary consideration is balancing the proportion of the remaining top, due to some loss of roots during the digging process.

There are some species of trees that suffer enough shock in transplanting so pruning at planting time is primarily for the purpose of balancing the top to the roots. Pecans and walnuts are classic examples of this. Small pear trees may not suffer shock, but the newly planted tree in the orchard grows more vigorously if pruned back fairly severely.

Mechanical harvest is a fact, thus many trees should be trained for that method of harvest. Trunk shakers are able to remove the crop with greater ease and less damage to the tree if the trunk is fairly long. This means that newly planted stone fruit trees should be headed 28 to 30 inches above ground, rather than 20 to 24 inches as in the past.



Trees that are to be always hand-harvested, such as for fresh market only, do not need the long trunk. Height of heading need only be high enough to allow for primary branching and whatever cultural practices there will be around them. Each higher step workers must go on a ladder increases the cost of pruning, thinning and harvesting.

Fruit trees may or may not have lateral shoots at the time they are planted. If present, these are normally cut back to stubs about an inch long. The important thing is to be sure that at least one good bud is left intact on each stub.

If your trees have branches near the top that are suitable for primary limbs, there is nothing wrong with selecting three of these at planting time. These are left four to six inches long, and all others are cut back to stubs. The uppermost shoot is left about six inches long and the lowest one about four inches.

Pecan and walnut trees suffer more shock in transplanting than do most other fruit and nut trees. For this reason, it is best to severely prune newly planted trees. Leave about five buds of the scion variety above the bud or nursery graft. This would normally be six to eight inches.

TRAINING IN THE FIRST SUMMER

Shortly after the growth has started, unwanted shoots on the lower portion of the trunk should be rubbed off before they are than an inch or two in length. Where growth from the lowest shoots tends to be the strongest, it is wise to check the trees two or three times during the first year in order to ensure the original trunk's dominance over low limbs.

Here is a classic reason why early in the growing season all trees should be inspected for trouble-making shoots. The two vigorous branches on either side of the trunk are too low for machine harvested peach trees. It is too bad that a tree of this excellent vigor now has to be severely pruned in order to be acceptable.

Early summer training is generally a matter of pinching the tips out of shoots that you know you will not want as primary limbs. This will discourage growth from such shoots and encourage growth in shoots left intact.

Here is another example of the need for summer removal of troublemaking limbs. Several branches were removed that were larger than the three primary scaffolds, and one of the primaries is too weak. This tree also demonstrates the power of leaves in that the trunk size is proportional to the leaf area above a given point. It is largest just below the lowest limb that was removed and is smallest above each cut.

Once the trees are growing quite rapidly, merely pinching out the tips of undesirable shoots is not enough. You may find it necessary to remove about six inches or more in order to subdue growth.

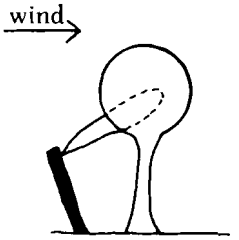
It is often possible, except with pecans and walnuts, to select three strong limbs during the first summer. Encouraging these by curtailing growth in the others means these limbs will be larger at the end of the first growing season. The time required for pruning during the first dormant season will be much less.

Because newly planted pecans and walnuts are headed so low, it is not possible or desirable to select primary limbs during the first summer. A single shoot that grows six feet or more is desired. Only enough pinching is done in order to ensure such growth on at least one such shoot.

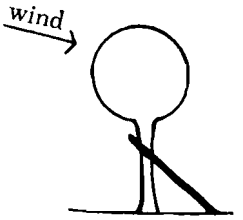
Mechanical injury is much more severe on tree trunks that are leaning. Some bracing may be necessary in order to ensure that trunks are perpendicular to the ground.

Wooden stakes, extending about three feet above the ground, are sometimes used to ensure vertical trunks. In the case of walnuts and pecans, the stakes should be about six feet above the ground. Reinforcing steel or one-inch water pipes are quite effective with walnuts, do not deteriorate, and can be reused.

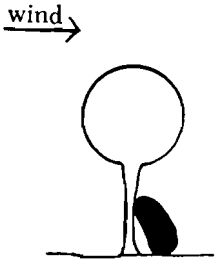
KEEPING THE TRUNKS VERTICAL



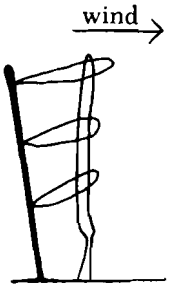
Low-branching trees can be held into the wind with stakes that are about three feet above the ground. Simply tie an unwanted portion of the tree to the stake. By fastening to an unwanted shoot or the very tip, a girdling action, if it occurs, is not harmful.



Many fruit trees can be braced by merely letting them lean against a stake driven diagonally across the downwind (southeast in the Stanislaus district) side of the trunk. This will cause some trunk scarring, but this is more unsightly than harmful. In other areas where winds are from different directions, the stake would be on a different side.



Bags of soil can be leaned into the downwind side of fruit trees in order to keep them straight or to gradually correct a lean. Each time you are near the tree, push it a bit more upright and lean the soil-filled sack a bit more against the trunk.



Walnut trees are the most troublesome in windy conditions. Stakes that extend above the ground about six feet are desired. It is best if such stakes are about 15 inches upwind from the trees. The freedom to sway with the wind allows for a stronger trunk.

Not all walnut cultivars (varieties) nor all walnuts in all districts should be staked. For example, the mid- to southern portions of the San Joaquin Valley do not have the daily wind from the northwest. Walnuts on the west side of Stanislaus County have much more of a wind problem than do those east of the San Joaquin River.

If not needed, it is better and much cheaper to not use stakes. Unstaked trees acquire a more tapered trunk and will withstand occasional winds. Rigidly staked trees become dependent upon the support and are quite subject to bending and breakage if the ties break or when the stake is removed.

TRAINING—THE FIRST DORMANT SEASON

Pecans and walnuts, at the end of the first growing season, are very easy to prune, so let's talk about them first.

For some reason, any side shoots or branches that grow on pecans and Persian walnuts during the first summer have crotches that are quite apt to split. This means that after pruning, the tree looks about like it did when you bought it.

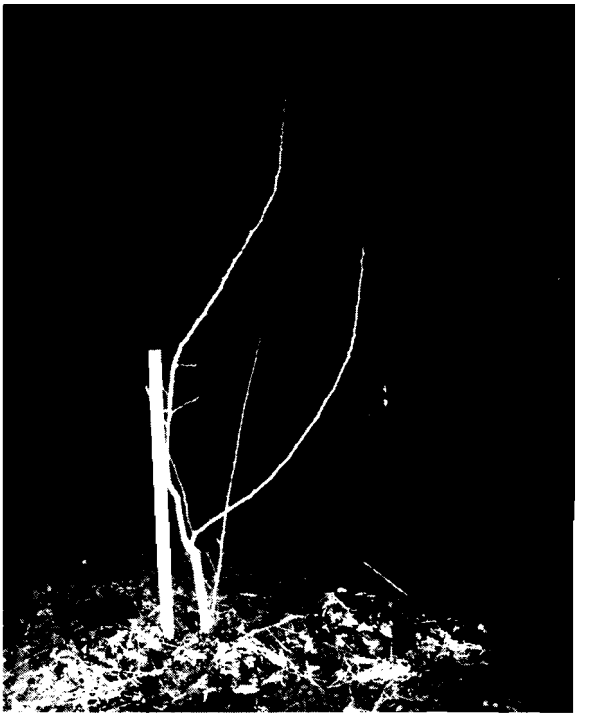
The shoot on the left shows several necked (long) buds. Since limbs that arise from such buds usually have poor angles with the trunk, necked buds should never be allowed to develop into major limbs. Secondary buds, just below necked buds, will form strong wide-angled limbs. The branch on the right shows branching on current season growth as well as necked buds. This type of crotch should be eliminated at the first winter pruning.

Vigorous trees should be six to eight feet tall or more at the first winter's pruning. Cut back to wood that is round, not angular, so as to ensure mature wood. This should be about seven feet above ground or at least three buds above the stake.

Remove completely any shoots from below the bud or graft. Any side shoots that are below three feet can be cut back to stubs of about six inches. Buds that have branches that are more than three feet above ground should be removed completely.

This mature walnut tree clearly shows what can eventually happen where branches having narrow crotches were allowed to develop.

If the trees only grew to about shoulder height, the terminal bud can be left on as you are primarily interested in upward growth. All side shoots below the terminal, if any, should be removed.



This walnut tree has actually been in the orchard two years, but will be treated as though it were one year old. You can see that when planted, the top was

headed about 12 inches above the rootstock. During the first year in the orchard, the terminal only reached about five feet above ground or the top of the stake. The terminal was not headed at the first dormant pruning because continued upward growth was more important than branching. One very low branch was headed to a two-inch stub. Note the effect of wind.

The strong rootstock shoot was removed smoothly, rather than simply cutting off at ground level. The one vigorous but very low branch just above the bud union was headed to a five-inch stub which had also been headed the previous winter. The small side shoots at stake height were left for leaf area and the start of the fruiting wood system. The top was headed at about seven and one-half feet above ground.

If the tree is only two or three feet tall, all growth should be cut off and the tree again headed about two inches above the graft or bud. One other possibility might be suggested—dig it out, fumigate the spot and start over.

Pistachio trees do not grow with the degree of vigor we see in other kinds of trees. About all you have at the end of the first year is a 30-inch or so whip.

Other fruit trees should be large enough at the end of the first growing season so that the primary framework limbs can be selected.

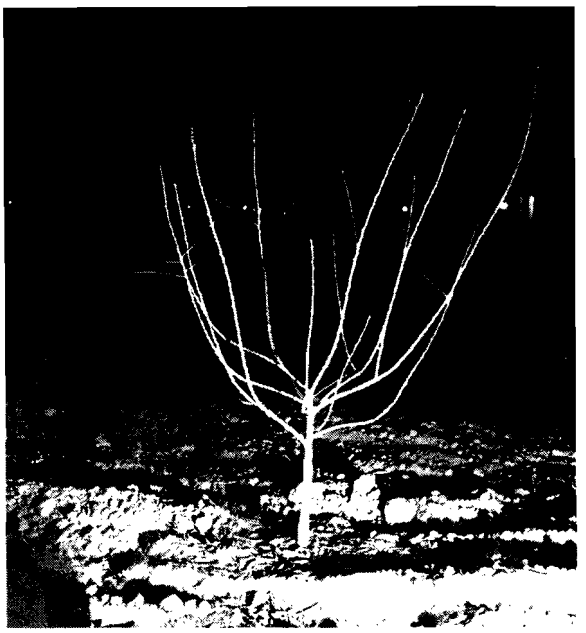
If the trees made very poor growth and suitable framework limbs are not available, you should cut all shoots back to short stubs about like after planting. If the trees are simply small as a result of poor growing conditions during the first year in the orchard, this one-time severe pruning should promote vigorous growth the second year. This is assuming you will provide more favorable cultural conditions during the second year.

Remember that normally the less you prune your trees, the larger they will be a year from now. Start by removing only those limbs that you know you cannot possibly use and that, if left, will cause problems.

Three good limbs are all that are needed at this stage. If you cannot make a vase shape with three limbs, you may use four if they are in better positions.

Our daily wind in Stanislaus County during the growing season is from the northwest. With this doing some pushing to the south and the sun doing some pulling, the tendency is for trees to have more of their tops south of a center line.

We know that the lowest limb in almond, apricot and peach tends to be the most vigorous. If you can possibly do so, leave the lowest limb on the northerly side of the trunk. Prune the north side of the tree first, and then prune the south side more severely.



This one-year almond tree will be easy to properly prune using our rules. It has good vertical limb separation, and the growth pattern indicates daily wind flow.

The low limb is on the windward side (northwesterly in Stanislaus County) and it is well below the upper two. The tree is bare, but only because no small lateral shoots were available. Lone bare limbs such as these are subject to twisting and bending during the spring months when new shoot growth becomes heavy. For this reason limb support, as with tree rope or similar material, will be necessary. The more small laterals there are on such limbs, the less the wind and weight problems.

Species that show strong apical dominance, such as apples and pears, tend to have the uppermost scaffold limbs dominate. In these cases, the upper limbs should be headed more severely than the lower limbs. For traditional vase-shaped trees, limb selection and spacing are no different.

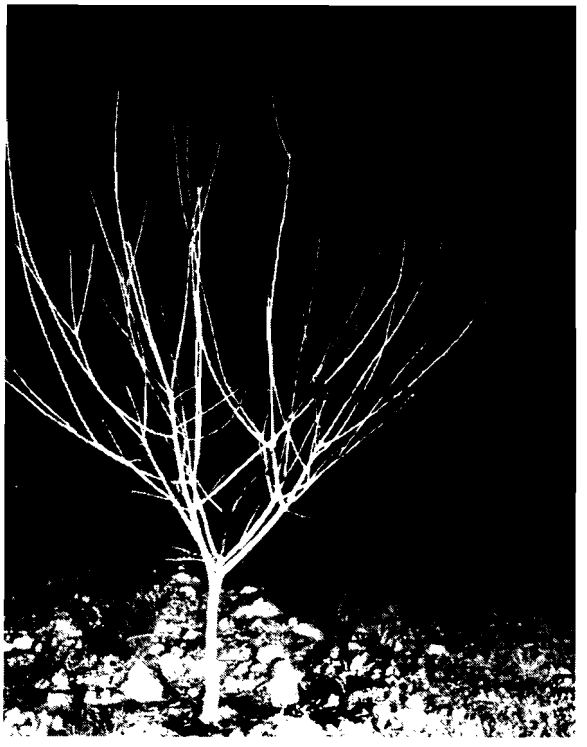
Distribution of limbs around the trunk is of more importance than vertical separation. Be sure that permanent limbs do not rise from the trunk below or above another permanent limb.

The lowest limb should be at least 20 inches above ground level. If you can, space the other two limbs vertically. Leaving two limbs near the top of the trunk is permissible.

Be sure that you do not leave two limbs low on the trunk with a single limb above. It may be better to start with a two-branch tree. See page 8.1d.

Sometimes it is possible to choose only two vigorous limbs that are properly located. If you must choose a distinctly weaker limb in order to have three limbs, the odds are against your being successful. If the weaker limb is on the north or east side of the tree, cut it off.

Light pruning is best, but if you have to do some severe cutting to obtain the tree form you want, then you must cut. Young trees will fill in vacant spaces, so at this time be sure that the limbs you keep will survive.



Here is a young almond tree that made excellent growth during the first year in the orchard. However, when the primary scaffold selections were to be made, some difficulty was found.

A close-up view shows that severe crowding and choking will occur within the next growing season. If the two very strong limbs on the right side are kept, the lower one will crowd the upper, and both are too strong in relation to the two on the upper left.

This tree has been severely pruned in order to eliminate the poor crotch development. Severity such as this has markedly reduced the potential growth for the following season. Shed your tears and pay the price.

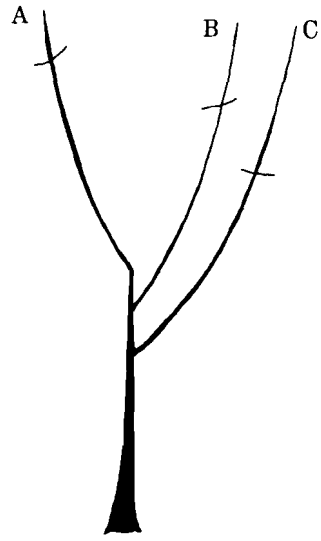
Once you have selected the framework limbs you want, do very little else. Leave all of the small twigs you can. These add leaf area to the tree and are future fruiting wood.

Heading cuts are made to determine where branching will be, or to balance a particular limb with another or the rest of the tree. Trees normally are headed in order to get secondary scaffold limbs about 25 to 30 inches from the trunk. Almonds, depending on vigor and variety, may branch freely enough so that heading is not necessary.

This almond tree made excellent growth during the first year in the orchard. The natural branching was not well distributed vertically, but did make a nice vase shape, which is generally more important.

Minimum pruning was correct in this case. Some thinning out was done. Natural branching was occurring, so little or no heading was needed.

Do not head all of the limbs at the same height above the ground. Unequal heading is the rule, with certain exceptions.



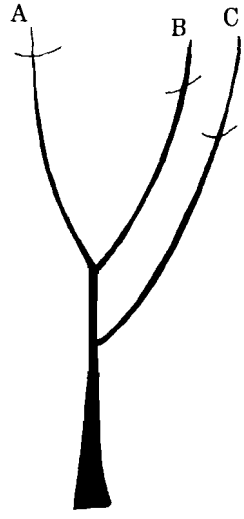
This tree is showing only the basic framework limbs (primary scaffolds).

The marks on limbs A, B, and C show the relative positions for heading cuts under a no-wind condition.

Limb A is left with the most leaf buds because it is normally the least vigorous. Limb B is intermediate, and C is the most vigorous so is cut most severely.

Because our daily winds are northerly in Stanislaus county, we find that we have better trees if we break this basic rule somewhat.

Prune the north side of the tree first. Then head the other limbs so that they are not left as tall as the north side. This practice is more important in peaches than in almonds or apricots.

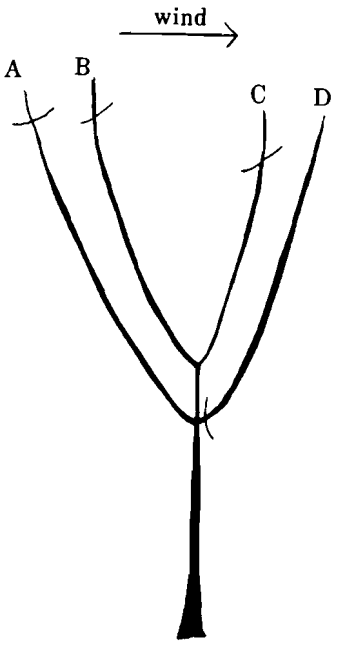


This tree does not have the vertical limb distribution, but is probably more typical.

Again, limb C is cut more severely unless it is on the north side.

Because limbs B and A are arising at the same point, we have a choice as to which should dominate.

If the wind is from the A side, leave it longer than B. If the wind is from the B side of the tree, cut A shorter than B.

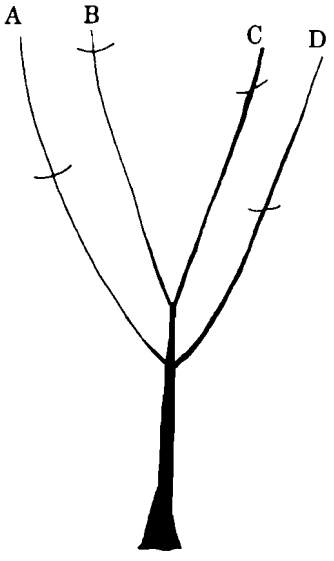


If you have a choice as to which will be the lowest limb, leave it on the northern side.

In this case, limb D is removed completely.

Depending on their relative sizes, A and B are headed equally or unequally. If where marked, A is distinctly larger than B, then limb B should be left taller than A. Remember, the basic rule can be bent or broken in wind and north side conditions.

Apricots and almonds are less subject to choke-out problems than peaches, so this must be considered.



Sometimes, through necessity or lack of nerve, you find that you have four limbs about like this.

The important thing here is to see to it that limbs B and C are left distinctly stronger than limbs A and D. Here again, this is quite important in a peach tree. In a pear, B and C are normally the strongest.

Leave the northerly limbs taller than the others. Carefully look at the trunk size above and below where limbs A and D arise.

If the trunk diameter below B and C is distinctly smaller than that below A and D, then cut A and D severely. This is necessary in any kind of tree.

Many trees just don't grow naturally into the form that we want. However, an extra two minutes or so at time of pruning may be all that is needed to mold the tree. It has required a growing season to develop something you may or may not like. Assert yourself! Push, pull, twist or bend whatever is needed to have the form you want. However, do not overprune in trying to develop the perfect tree—it seldom is found.

This tree had three primaries, but the lower one broke our rule and produced the narrowest crotch. Differential heading will help open the tree but in this case, not enough. A simple twist to two prunings gave a more desirable spread. The upper two primaries actually have a wider crotch than the angle this picture shows.

This vigorous tree has limbs that are too steep, too flat and wind-blown into the wrong position. It could be severely pruned to eliminate poor limbs,

lightly pruned and put up with them or moderately pruned and modify the limb positions.

Here we have pushed and pulled on the limb to the right. The lower portion has been opened and the top has been brought more upright. A limb on the left was pushed from the center of the tree to a more desirable position.

By varying the angle of the stick or branch used as a spreading device, the two limbs being spread can be moved evenly or differentially.

SECOND SUMMER TRAINING

Wind is the most common problem during the second growing season. Trees that are growing quite rapidly may also have a problem due to the weight of the new growth.

Trees that are lightly pruned during the first winter may have more wind problems than do those with more severe pruning. Over the orchard, however, the extra size obtained by light pruning generally outweighs the bending problems.

It is better to cut off part of those limbs that are bending out of shape than to risk losing them. In this type of pruning, you simply cut back the ends enough to relieve the bending or blowing problem.

Do not attempt to thin out the limbs in order to let the breeze blow through. This may sound logical but do not try it, or the trees are more apt to blow apart. A dense, bushy tree will tolerate more wind than one with sparse limbs and foliage, and there is protection in numbers.

In summer pruning you may have to patrol as many as three times during May and June. In doing this, there is an advantage if you walk in easterly and westerly directions (right angles to the wind). Because our winds tend to push the growth southward, it can be seen more easily when east or west of the tree. Speed is more important than preciseness in such cutting. You will find that you can make up your mind about where the limbs should be cut before you get to the tree.

Do not be alarmed about cutting off some leaves this time of year. Only the very vigorous trees have wind or bending problems, and some slight reduction in vigor is no problem.

If the tops of walnuts are growing too fast, head them in June. You can also let the lower shoots grow unchecked so as to compete with the tops. Heading walnuts in August may result in side shoots that do not have time to harden before cold fall weather, which can mean excessive loss of wood.

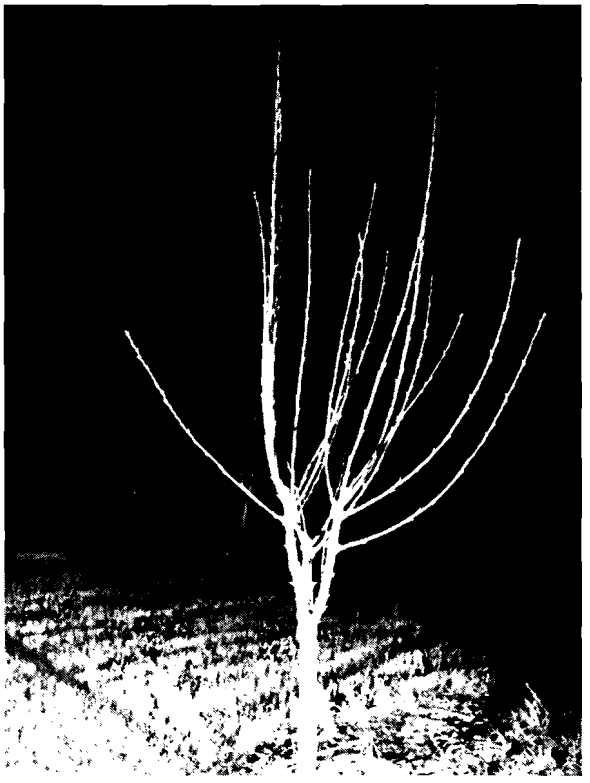
SECOND DORMANT PRUNING

Brotherly love is not a characteristic of limbs. Starting with two-year-old trees, particularly peach and walnut, you have to be on the lookout for potential choke-out limbs.

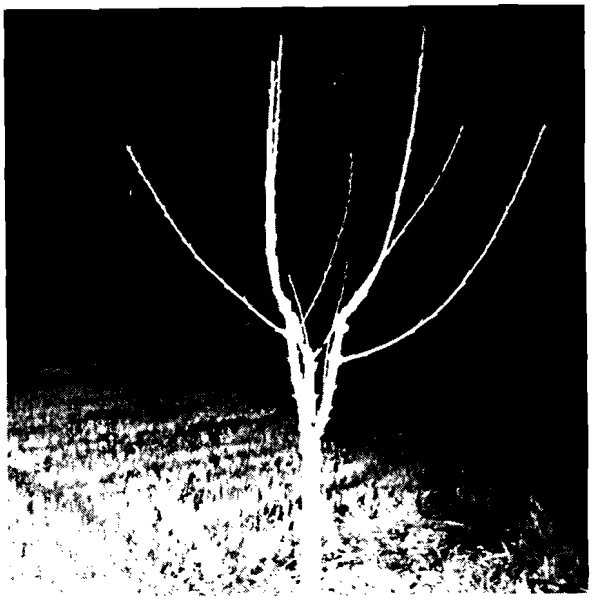
In most fruit trees, five to seven permanent limbs are enough at about shoulder height. In apricot and peach trees it is fairly important for you not to stray very much from this number at this stage.

This vigorous apricot tree shows it was headed uniformly and severely at the first dormant pruning. It is a fine tree, but would have been even larger had not the pruning been so severe.

Differential pruning, with less severity, is a better technique. Fruiting wood is starting to accumulate and with the tree's vigor, cropping should begin. The slender fruiting laterals will bend down with crop weight and thus were not left as future framework limbs.



This cherry tree was headed uniformly the previous year and has less spread than was possible. Judging by the second year's growth, it also appears that the first dormant pruning was too severe.



The angle of the picture does not, unfortunately, show the differential heading. The next set of crotches will be about 30 inches higher than the 12 to 15 inches allowed a year earlier. A few small shoots were present so have been left as fruiting wood.

This young prune tree is showing a strong primary framework and good vigor. Limb extension before crotching is about 30 inches, and some fruiting wood is developing.

Trees that are growing well can start to bear fruit during the third summer. Continue to leave plenty of fruiting wood.

Selection of limbs can begin in walnuts, choosing limbs above shoulder height, during the second dormant pruning. If possible, have the lowest limb growing into the daily wind. Any limbs below shoulder height should be headed to six-inch stubs. These will nourish and shade the trunk. Remove all rootstock growth completely.

The heading that is done on walnut scaffold limbs you have selected will depend on their vigor and the variety involved. If growth of these was more than about four feet and if they are early-bearing varieties, cut off about one-third of the terminal growth. In other varieties, simply head enough so that the growth will continue upward.

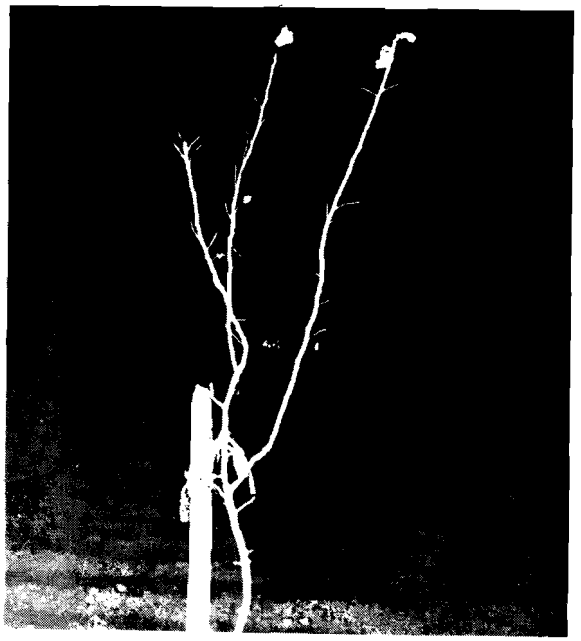
In walnuts we like a central leader tree at this stage of growth. By that we mean that the topmost branch is to be the dominant limb. Remove any branches that compete seriously with this leader. Remember what we said about comparative base diameters of limbs and color.

All branches that arise below the leader should be headed most severely so that after pruning, the top of the central leader is clearly a couple of feet taller than any other limb. This means there will not be any branches that are more than about two-thirds the length of the leader.

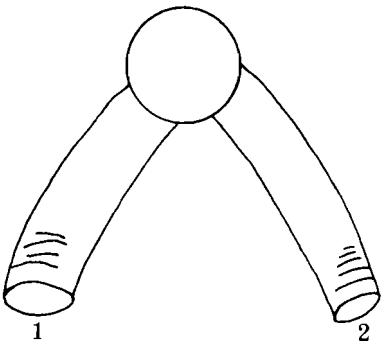
An excellent walnut tree showing the kind of vigor that can be obtained. The tree was headed about 3 feet above the stake top the previous year, and all side branches and necked buds were removed.

Limb selection has started because the central trunk is a full year older than the side branches. This will ensure strong crotches if the angles are wide. Main limbs are headed in relation to where they rise from the trunk. All small laterals have been left as leaf area and fruiting wood. The terminal limb at this stage clearly dominates.

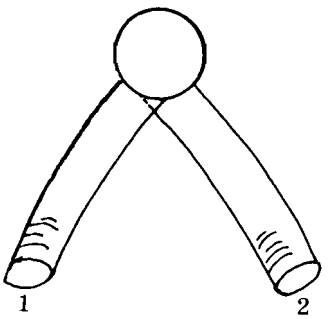
At this point in walnut pruning none of the limbs selected should have divided into secondary limbs. These would have weak crotches.



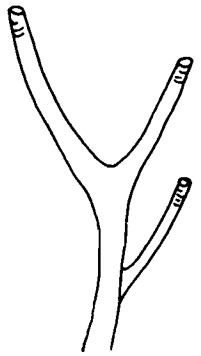
This pistachio tree has greater than average vigor but shows what can be obtained after two years in the orchard. Note that leaf petioles are clinging to the second year's growth, and that these are not side shoots. It was headed about 30 inches above ground at the first dormant pruning.



Secondary limbs should have outside connections to the primary. Looking down at such a crotch, we see that each limb has equal opportunity for norishment from the primary portion. We will determine the dominant portion by our heading one portion (2) more severely than the other.

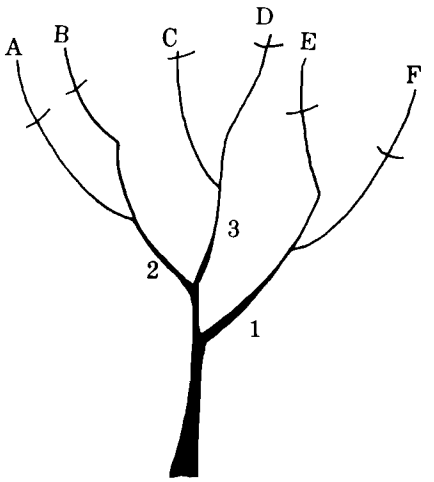


We do not actually want equal development of our secondary limbs. But, if they do not have equal access to trunk and primary norishment, the outer and lower one has too much advantage (2).



In choosing secondary limbs, we do not want three limbs rising at one location. We can have two limbs that are parallel, and a third one to the outside and below. The same rules apply here as when selecting the main limbs off the trunk.

Head the spreading portion, which is the lowest, the most severely. Then head the upper portions differently.



The same principles that are used in pruning primary scaffold limbs are used in pruning the secondary limbs.

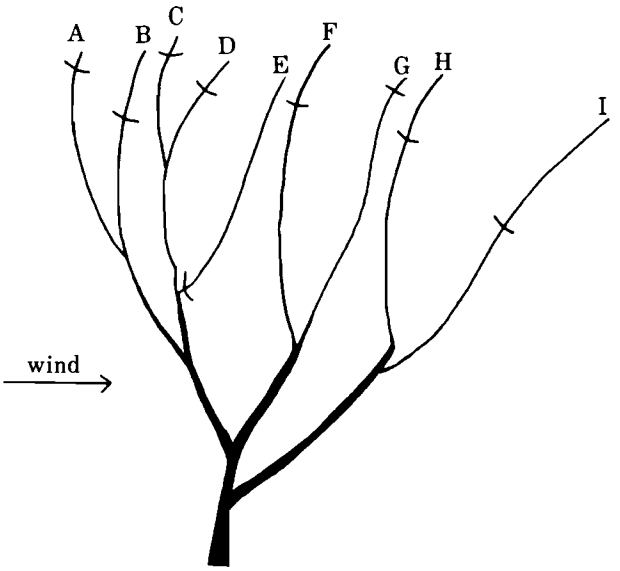
The terminals, after pruning, should be the highest above ground level on the secondary limbs that arise from the least vigorous primary. In the above example, limbs C and D are cut so as to be the tallest within the tree, because primary number 3 is the least vigorous.

Limbs A and B are part of the second most vigorous primary, so are kept intermediate in height. Limbs E and F are part of the lowest primary, so must be pruned just severely enough so as to keep this portion of the tree from dominating.

Within the secondary limbs it is still wise to practice differential pruning, so as to keep the limbs and crotches unequal.

Limb B, depending on the kind of tree, generally would be less vigorous than A, so is kept taller in order to dominate. Limb D is best kept dominate over limb C, and E is kept dominant over limb F. Here again, remember to vary the rules enough to encourage the north side.

SACRIFICE CONCEPT



In the above example we are taking advantage of what we know about choke-out limbs. Protection in numbers is also a part of training trees into daily winds. In this example we are dealing with a tree where limbs choke out readily.

Start on the northerly side, which is our windward and weak side. Limb A is the one we want, rather than B. Limb A has the outside connection; so is inherently stronger than limb B, and will choke out B. By heading B shorter than A, we ensure its being choked; and we have it as a backstop holding A into the wind, plus more leaf area for the primary portion.

Head C less severely so as to choke the backstop D. Limb E is a problem for getting F into the wind, so is removed completely. Limbs G and H are headed higher than F and I, so as to dominate.

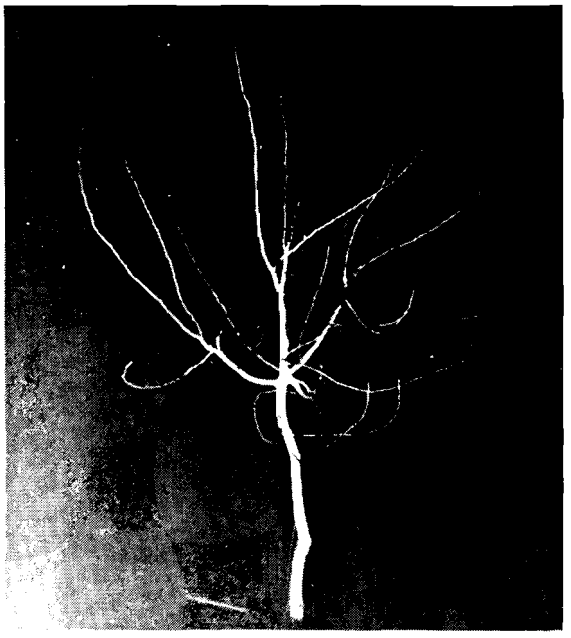
A year from now we can remove the choked limbs and use the same procedure a little higher in the tree. In the meantime, some fruit will have been borne on the choked limb.

THIRD DORMANT PRUNING

Much of the primary selection work will have been completed in walnuts. Growth rising from the stubs on the lower portion of the trunk is again cut back. This process will continue until the trunk diameter is four or five inches.

New primary and secondary scaffold limbs in walnuts are headed enough to ensure vigorous upright growth. If not headed, the resulting new growth may cause the limb to bend too far downward. If the variety concerned is fruitful on lateral buds, this may cause a weight problem and also reduce shoot growth too much.

Walnut pruning this year, and for the next few years, should be directed at maintaining scaffold limb development. Head framework limbs enough to ensure vigorous shoot growth. Shoots that are not important for limb development should be left unheaded to develop fruiting wood.



A vigorous Payne walnut that has been in the orchard three years. Many of the newest shoots are six to eight feet in length. Some thinning and heading cuts are advised.

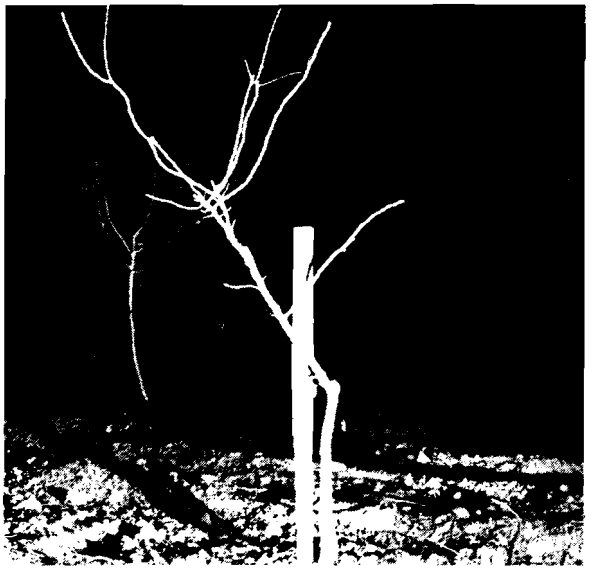
Heading cuts have been made only on limbs that are to continue the framework limbs. This may seem like a contradiction of saying that unpruned trees or limbs will grow more than pruned ones. Those not headed on early, lateral bearing types will set enough crop so that the weight of nuts and leaves will bend them downward excessively for future limbs.

Walnut fruiting habits vary considerably with varieties. The amount of thinning and heading needed is dependent on the percentage of lateral buds that are fruitful and the vigor of the tree. Fruiting wood should be kept. Varieties with a high percentage of fruitful lateral buds need to be headed more severely.

At this stage of pruning this three-year-old pistachio, all was well. Reasonable limb extension was allowed and differential heading cuts were made.

For some reason, another pruner decided to make one more cut and open the tree more. This left a very risky terminal limb. Note the diameter differences between the two limbs, and the more vertical nature (indicating more vigor) of the lower one. If the central portion is to be removed, a slight stub should be left so the right-hand branch will be less apt to split off by wind or foliage weight.

Half of this tree has been lost due to faulty pruning. Check the tree framework in the background to be sure we are talking about the same tree as above. There are certain rules you do not break!

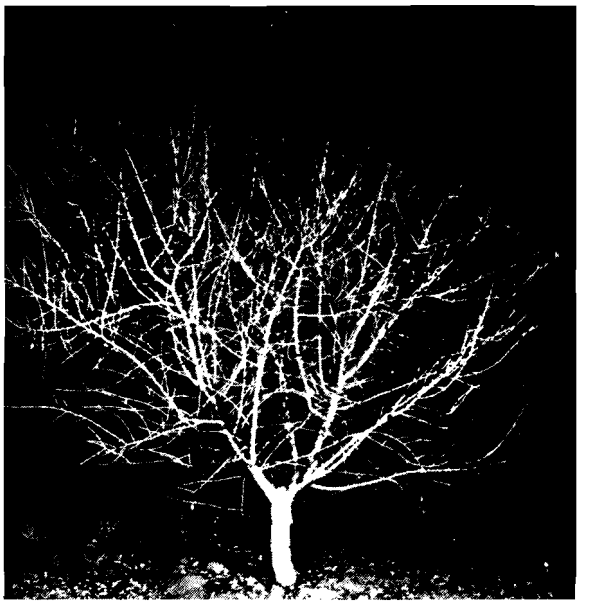


Time has been lost. The tree will continue to grow, and the lopsided nature will, in time, lessen.

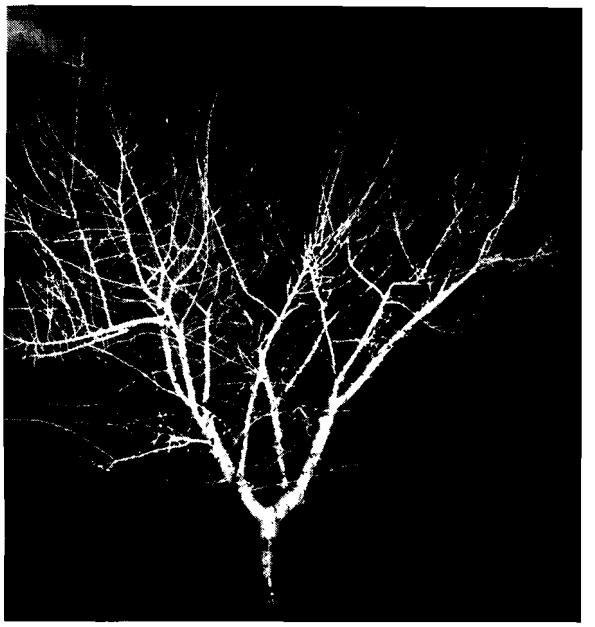
Healthy, vigorous, young orchards can and should be encouraged to bear crops. Such trees can produce fruit without seriously reducing the vegetative growth needed for future limbs.

Most fruit trees should produce reasonable crops during the coming fourth leaf. Pruning at this stage is a matter of continuing tree development and leaving enough fruit wood to bear suitable crops. Heading may or may not be needed to develop branching. Heading may also be needed to retain balance or reduce excessive bending and breaking.

Almonds are pruned enough to maintain the open center and to protect the framework limbs. At this stage there very well may be several temporary limbs at shoulder height. These may be kept for a few years, as long as they do not restrict the development of the primary and secondary limbs.



This almond tree has grown very well, and the pruning done during the first and second winters directed the growth properly. Little needs to be done other than some thinning out.



A few excessively vigorous, low branches on the right side were removed. Strong water sprouts within the tree were also thinned out. The number of primary and secondary scaffold limbs is about right—generally five to eight. Too many potential tertiary limbs are present, but removal at this pruning is neither needed nor desirable.

Apricots are borne on both spurs and new shoots. At this pruning, the spurs should not be pruned.

Enough limb thinning is done to have the third set of limbs selected, arising from secondaries. These are headed about 30 inches above the crotch where they developed.

Vigorous young apricot trees have the ability to size fruit very well. Because there are not enough spurs on trees of this age, it is best to leave a number of shoots that are 15 or so inches in length for fruit wood.

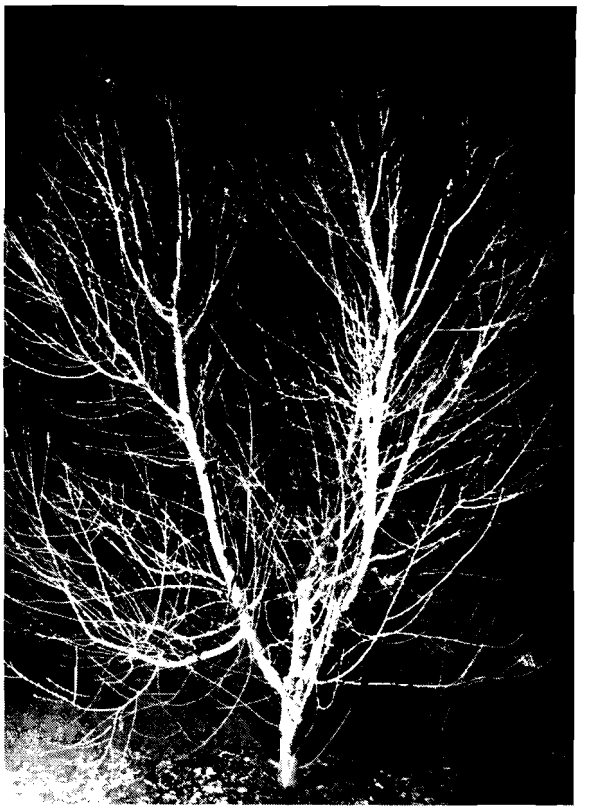
Apricots will grow into the wind better than our other fruit and nut crops. Trees with crops will tolerate wind better than those with no crop. Allowing the trees to fruit should not hurt main limbs nor slow growth too much.

Prune trees are still growing vertically and vigorously. Thinning cuts are the primary type, although the terminal portions of secondary primaries are differentially headed where crotches are desired.

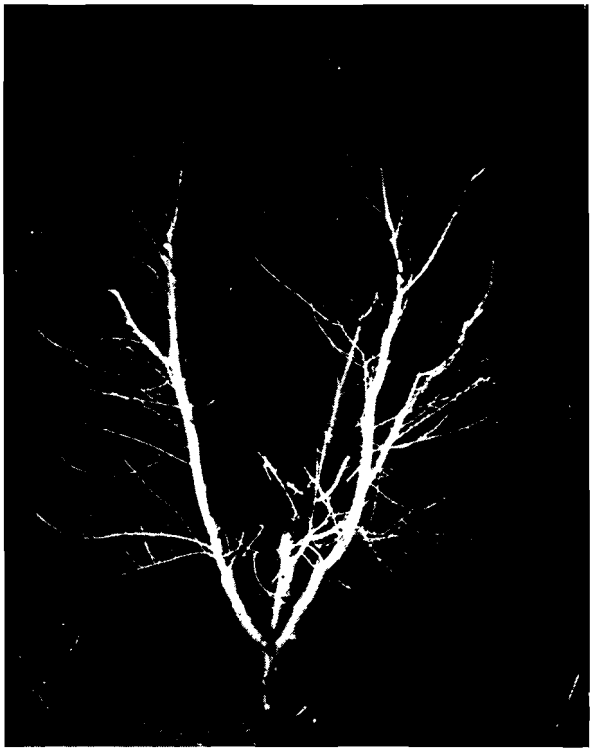
This three-year-old prune tree is developing a spur fruiting system along the scaffold limbs. Thinning cuts were made in order to open the tree and remove excessive numbers of potential limbs. Terminals were headed differentially. The primary in the center is really not in danger of choking out, but the picture angle may give that impression.

Peach trees have the greatest competition between limbs. During the third and fourth winter you should look very carefully at the primary scaffold limbs. There will be some that will, in spite of careful selection, be choking out.

Remove any primary limbs in peach trees that are not holding their own. You can still get suitable replacement secondaries while the trees are still young. If you allow such limbs to slowly die out over the next few years, there are apt to be major holes in the framework for the remainder of the life of the trees.



This vigorous clingstone peach tree has completed its third growing season in the orchard. It has an abundance of fruiting wood, but it is still in the training stage.



The tree now looks overpruned. Suitable growth for secondary scaffolds on the center and left-hand limbs was not available. These holes will fill in. Enough fruiting wood has been left on each limb, but

at this point the tree could use two more secondary limbs. More thinning of fruit wood is done near the terminal portions so as to prevent excessive bending and breakage.

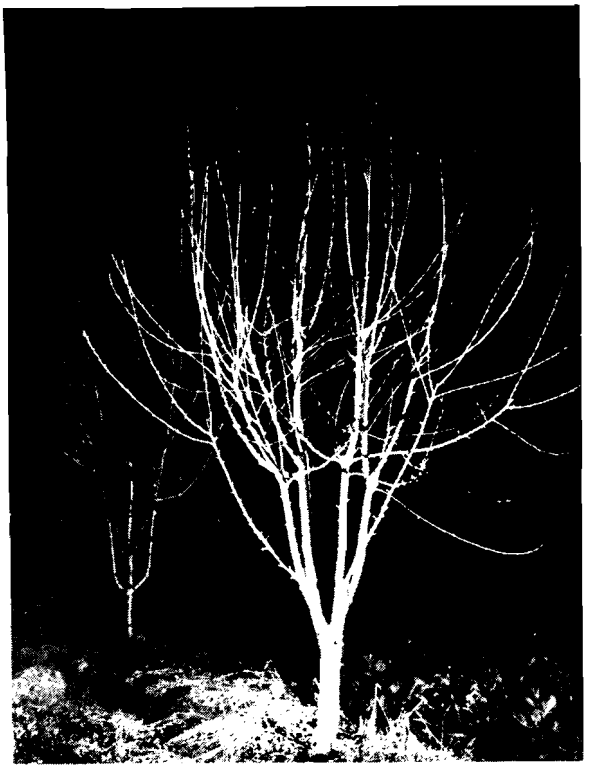
Do not make the mistake of undercropping vigorous young peach trees. To do so can start a nonbearing cycle that is difficult to break.

In any young tree it is important that you be demanding of excellence in lasting framework limbs. Prune only enough to obtain the kind of limbs that will last the lifetime of the trees. Once you accomplish your framework selection and protection, it is about time to move on to the next tree.

Bartlett pears, if growing vigorously, will have to be headed. If not, you may have long, slender limbs without side branching, or they may bend more than you are willing to tolerate.

This three-year-old pear tree had Bartlett buds inserted into the primary scaffolds after the first year in the orchard. Heading cuts have been made at the second and again at the third dormant pruning.

Cherry trees must be headed each year if spreading branches are to be had. If, however, the trees are being grown for brining cherries, the naturally tight, upright nature of the trees is allowed, and the trees are planted closer together. Fruiting wood does not develop excessively, so little, if any, is thinned out.



This cherry tree is fairly typical of what a vigorous three-year-old should be. The erect nature is evident, as is the necessity to make heading cuts to develop secondary and tertiary limbs.

A little thinning out was done, and outward growing shoots were headed so as to further open the tree and induce more branching where desired.

TRAINING AND PRUNING BY KIND OF TREE

In this section we will combine the general principles discussed in the previous sections. In addition we will consider species and variety differences. Before we go any further, it might be best to talk about what our purposes will be as the trees begin to produce.

PRUNING BEARING TREES

Bearing fruit and nut trees are pruned in order to keep the trees producing suitable crops that can be properly handled under the existing cultural practices. Specific reasons may include removal of weak, diseased or dead wood; allowing for more light; crop regulation; and rejuvenating or maintaining the fruiting wood in specific areas.

Crop regulation by pruning is generally well-recognized by fruit growers who must meet minimum size requirements at harvest. Where fruit thinning is regularly practiced, many apricot and peach growers consider pruning to be one of the less expensive means.

We know that in this area even almonds, to do their best, require some crop regulation. Even though small kernels are desired, and these come with heavy crops, overcropping can occur. Pruning each year is required to maintain regular bearing.

The amount or severity of annual pruning will range from light to heavy, depending on the kind of tree, the variety and, possibly, the market. In this area, Fay Elberta peaches are primarily used for canning. If these were shipped for fresh market, you would have to be much more concerned about size and color of the fruit, and this is one of the functions of pruning.

Perhaps at this point it might be well to go back and review briefly a few things about buds. Very shortly after a leaf is formed on a shoot or spur, a bud develops in the crotch formed between the leaf stem and the shoot or spur.

This new bud may immediately push into a new side shoot, depending on the species and growing conditions. At this stage, the bud is probably so small that you cannot even see it and all of these buds are shoot or vegetative buds. Up to this point we have been talking about any kind of tree and of any age.

Now that we have a new growing point established, the chemistry of the tree will determine whether it will continue to remain a shoot bud or whether it will, in due time, become a flower bud. There are even mixed buds; that is, they contain both shoot and flower parts. Apples and pears are examples of the latter.

Strong growing shoot growth, such as on young trees or water sprouts in old trees, have a relatively long period in which developing buds are subject to influence. In mature, spur-bearing trees, the determination, or fruit bud initiation period as it is more properly known, is very short.

Perhaps at this point a word might be said about alternate bearing. By this, we mean that if the trees have a heavy crop one year, they will have a light to

PROPORTION OF CROP BORNE AND FRUIT WOOD LONGEVITY

Fruit	Lateral on long shoots	Terminal on long shoots	Lateral on spurs	Terminal on spurs	Spur life
Almond	Minor	_____	Major	_____	5
Apple	Minor	Very minor	_____	Major	8-10
Apricot	Minor*	_____	Major	_____	3
Cherry	Minor	_____	Major	_____	10-12
Fig	Major	_____	_____	_____	____
Nectarine	Major	_____	Minor	_____	1-2
Peach	Major	_____	Minor	_____	1-2
Pear	Minor	Very minor	_____	Major	4-8
Pecan	Minor on young trees	Major on young trees	Minor on mature trees	Major on mature trees	____
Persimmon	Major	Minor	_____	_____	____
Plum, Japanese	Minor	_____	Major	_____	5-8
Plum, Euro.	Very minor	_____	Major	_____	5-8
Prunes, incl. Quince	Major	Minor	_____	_____	____
Walnut			Minor to	Equal or	6-8
Payne type bearing	Major on young trees	Minor on young trees	equal on mature trees	major on mature trees	
Hartley type bearing	Minor on young trees	Major on young trees	Minor on mature trees	Major on mature trees	5

*In this district, young apricots can bear a considerable part of their crop on long shoots.

This table was taken from Circular 444 University of California, entitled "Pruning Deciduous Fruit Trees" by Tufts and Harris. The spur-life figures have been added to the table as it appeared, and these might be called average effective lives.

moderate crop the next. Certain kinds of trees have this tendency, and the degree varies considerably. Apricots commonly experience alternate bearing, while peaches vary rarely do.

If your trees, for whatever reason, develop an alternate bearing tendency, pruning is one of the means of correcting it. If your crop was heavy, you prune very little because you know there will not be very many fruit buds for the coming crop.

If, however, you had a very light crop, you know you are in for a heavy bud set. In this case, you prune so as to remove heavy amounts of fruit wood. If your trees have this tendency and, say, frost took your crop, you again prune severely because you know a heavy set of buds is developing. Of course, if you are smart, you will check the number of fruit buds present in any year before you decide on the severity of pruning.

Fruit bud initiation may have occurred early in the summer, yet we cannot tell the amount of bud set by looking at bud development until fall or winter.

Fruit buds of almond, apple, apricot, peach, pear and plum are larger and more plump than shoot buds. Leaf or shoot buds are also more pointed than fruit buds. With cherries, you have to wait until swelling occurs to be sure. Of course, by cutting the buds lengthwise and looking closely with a hand lens, you can make the determinations much sooner.

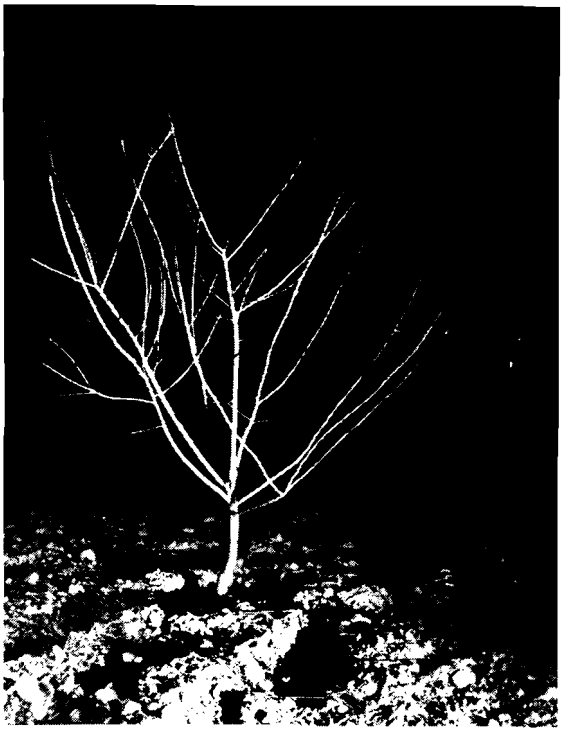
It is difficult to determine whether the terminal or lateral buds on walnuts are shoot or mixed buds. In walnuts and pecans the mixed buds have a base that is vegetative; the terminal is a female, or pistillate flower. The male flowers, or catkin buds, can be easily determined in late summer or fall in that they look like miniature pine cones. If these are present, you can be pretty sure that the other buds will have a proprotional share that contain pistillate flowers.

Knowing where to look for fruit buds will help you to determine their presence and proportion. Fruit buds are most apt to be found on short growth than on vigorous shoots, but this is variable.

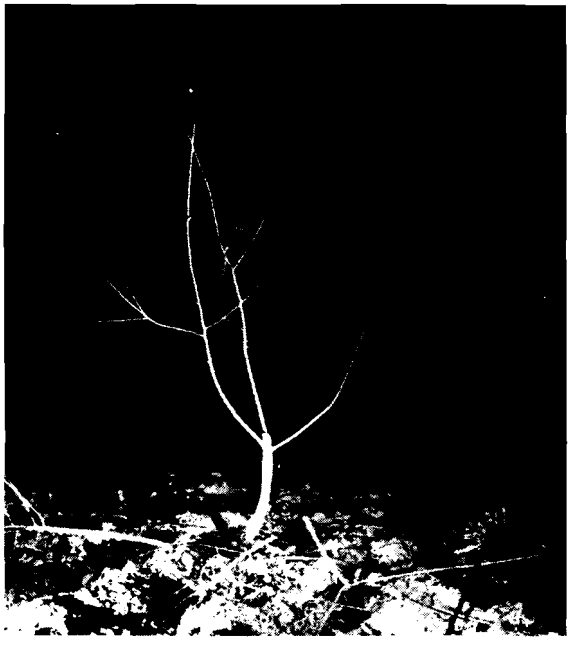
In this district we have four major tree crops, almonds, apricots, peaches and walnuts. Most of your author's experience is with these crops. For this reason, the discussions about other tree crops, such as cherries, pears and prunes, will be minimal.

ALMOND TRAINING AND PRUNING

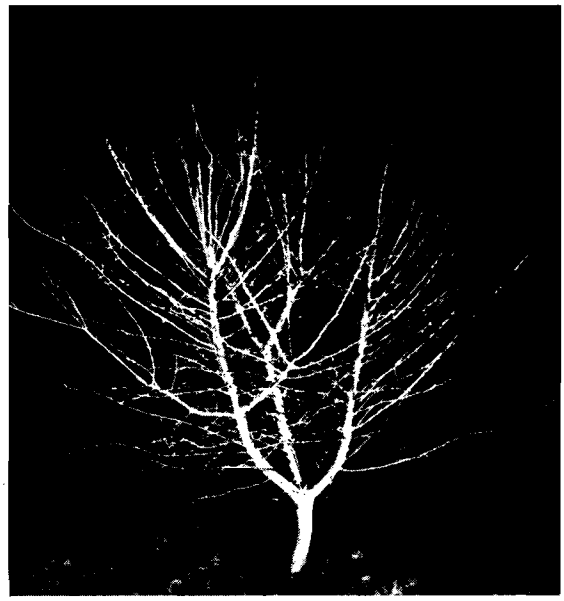
We have in almonds, a practical and philosophical consideration. Trees with four primary branches come into bearing sooner than those with only three because of the greater leaf area. As a young tree, four primary branches present no problem but when full size it will generally not be possible to attach the shaking unit to the individual limbs because of a crowded condition. However, if we allow only three primary scaffold limbs to develop and then do not allow these to branch within about 30 inches of the trunk, it will be well-suited to limb shaking after about 15 years when the trunks have become quite large. This will mean more complete crop removal and fewer shaker injuries to the trunks.



This tree has grown one year in the orchard and represents what can be done. It was headed about 2 feet above ground after planting and is now about four times that in height. All growth below twenty inches above ground was removed early in the growing season. Only those branches that had the potential for suitable framework limbs were allowed unrestricted growth.



After pruning, a typical three primary scaffold limb tree remains. Each of the limbs has about 120 degrees laterally between them and the vertical spacing is reasonable. Note, a simple wraparound tie has been used to correct excessive spreading and to prevent crotch damage during the second growing season.

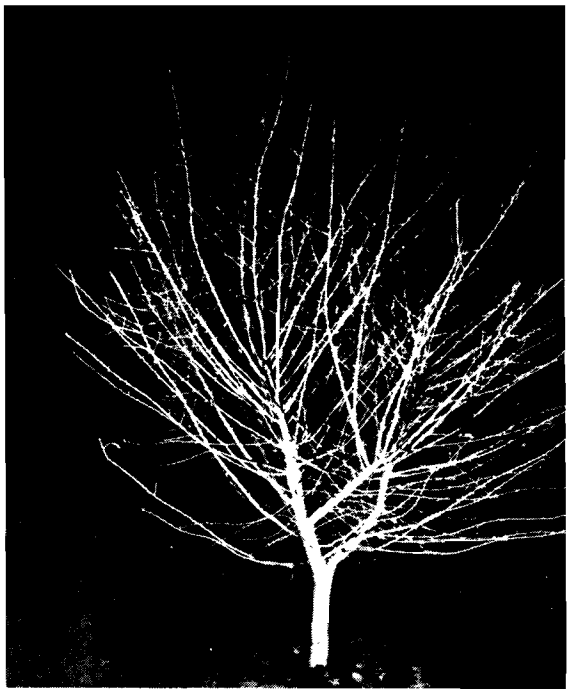


The same tree as above but one year later. The three primary limbs chosen the year before have retained their dominance and the tying of them prevented excessive spreading. At times it is necessary to do some summer heading during the second year in the orchard in order to prevent primary scaffold limbs from bending out of shape or starting to split at the crotch.

This was an easy tree to prune because no corrective work had to be done. Some thinning out cuts were made in the tops and some of the very strong unwanted shoots down low were removed. Notice that one secondary limb on the lefthand scaffold was removed. Preventing low secondary limbs will enable limb shaking after the trunks become too large for satisfactory trunk shaking. Almonds branch freely enough so that heading cuts at this stage are normally not needed. An abundance of small lateral growth remains for leaf area and fruiting wood. Trees growing this well can and should start cropping.

After three seasons in the orchard our tree shows good upward extension and an abundance of lateral shoots. Several strong water sprouts have grown in the vicinity of cuts made the previous years, but no corrective work is needed.

All that was needed was a general thinning-out of unwanted strong shoots down low and a few on the south or righthand side. This tree is ready to pay for its keep during the next growing season. Because the tree was initially headed so low, about two feet, it was wise not to allow more than three primary branches as trunk shaking will become a problem at an earlier age than had the initial heading been done at about thirty inches above ground.

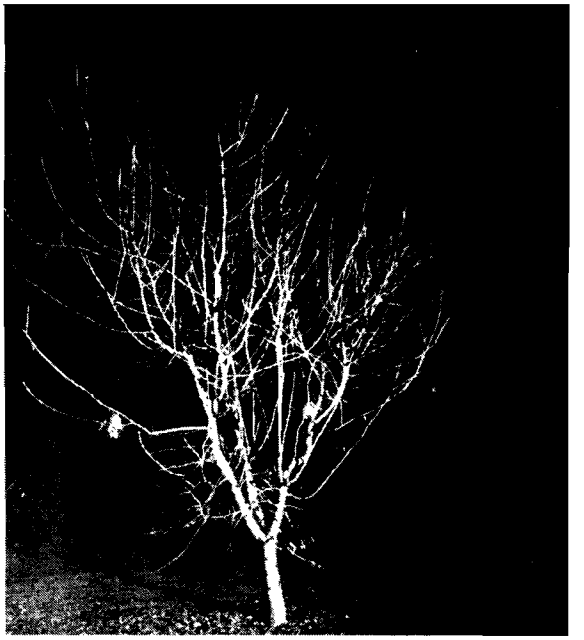


This is the same almond tree as on page 8.2d where the crowded crotch at the end of the first season was such that severe pruning was necessary. It is still a two-branch tree but has filled in very well. It would be even larger at this time if the severe pruning had not been done a year earlier.

Notice in this tree some heading cuts have been made in the terminal portion of the scaffold on the left. This was done so as to stunt that portion and use it as a backstop for the branching to its left. The summer winds are from the left as can be seen by studying the picture taken before pruning. This is putting into practice the sacrifice concept mentioned on page 8.2j. The headed portion will be removed after a season or two and in the meantime has served its purpose and possibly produced a few almonds. Your author probably made a mistake in pruning this tree. After the murderous treatment the first year, he was anxious to fill in the framework. Do you see what has happened? The low secondary limb on the left will make it difficult to limbshake this tree when the trunk becomes quite large. It would have been better to have allowed about 30 inches between the primary crotch and the secondary limb.

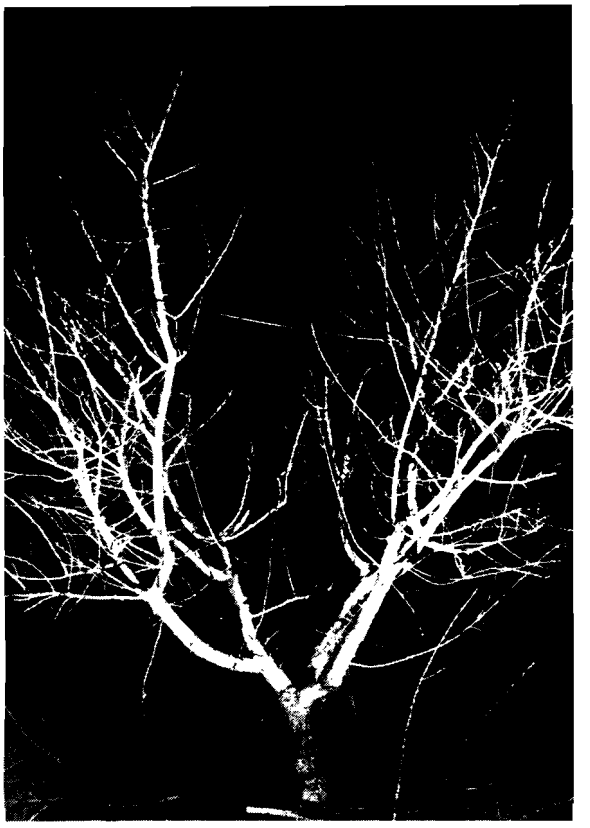
After three seasons in the orchard this tree has filled in very well. The wind from the left continues to push growth and the sun which shines from the right continues to pull growth. When we start to prune, that fact must be kept in mind.

Notice that our backstop, or sacrifice limb, on the left side has been removed. Actually it should have been retained for another season as it was doing more good than harm. For the purpose of this publication it was removed to show its eventual fate. The way branches on the left side turn towards the right clearly shows that had the sacrifice limb not been used there would be a rather poor left (north) side. Generally it was a matter of lightly thinning out the tree and removing some of the limbs that extended too far down wind.

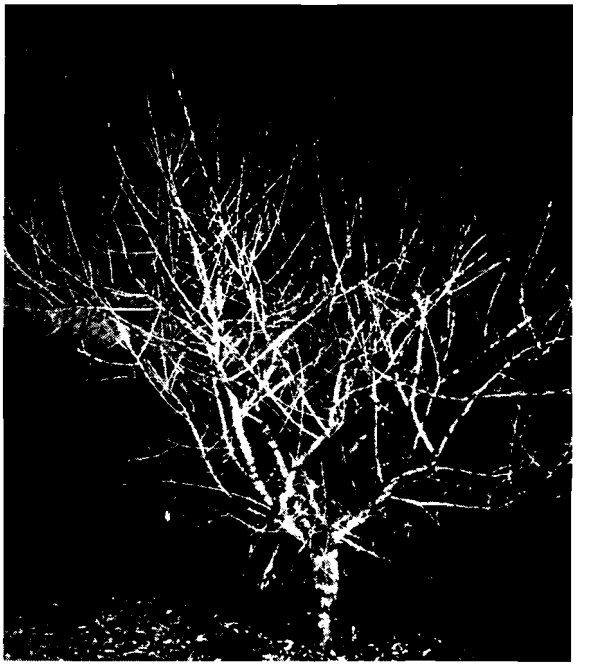


This Mission almond has completed three years in the orchard. The essential framework limbs have been selected. This upright kind of growth is typical of Mission, Merced, Thompson and Ruby, and it makes them rather easy to train. Thinning-out cuts will be necessary to eliminate some very strong water sprout growth from the vicinity of cuts made a year earlier. At this stage it is desirable to have more tertiary limbs than are needed for permanent framework. Leaving them will help the tree settle into bearing and they will be thinned out over the next two or three winter prunings.

This four-branched Nonpareil has grown three years in the orchard and is ready to pay for itself during the fourth leaf. The large number of strong water sprouts in the center indicate that possibly too much pruning was done a year earlier.



Overpruned? Yes and no. In addition to the so-called suckers growing up through the middle, one weak secondary limb was removed. The small secondary growing toward the camera in the center of the previous picture was two years old and obviously not going to ever make a suitable limb. The growth and crop during the third leaf was enough to require support and will probably need it again during the fourth year so it is now positioned higher in the tree.



At pruning time, Ne plus Ultra trees certainly do

not fit their name. The spreading, irregular growth presents a challenge to what we have said about pruning. Remember, the sculptor chips away the parts of the rock that do not look like a statue. Likewise, start cutting out shoots and branches that do not look like what you have in mind.

Now after pruning, this three year old Ne Plus shows a reasonable framework of four scaffold limbs. No major cutting of limbs was required, only a general thinning. Admittedly there are too many tertiary limbs for permanent framework. To thin out any more limbs at this time is neither necessary nor wise.

PRUNING BEARING ALMONDS

In almonds, once the framework limbs are established, you are encouraged to do very little pruning. This allows the trees to come into bearing rapidly and the crop to control the excess vigor that young trees have.

Sooner or later, the crop will reduce the vigor to a point such that the amount of crop will drop. You, as a manager, must increase the severity of pruning just ahead of the loss of too much vigor.

In almonds, the drop in crop level will occur between the fifth and eighth years, depending on how well the trees have grown. Most orchards reach this stage in their seventh summer. This means that they were not pruned enough during the fifth winter so as to slightly reduce the crop during the sixth summer.

Almonds have some tendency to bear alternately. We can, by proper pruning and maintaining high vigor, overcome this or at least minimize the variation. This means pruning some varieties more severely than others.

Almonds should be kept forever young. This philosophy is based on the fact that we can reach maximum yields before the trees are eight years old. Why then, should the bearing area of the trees ever become older than about eight years?

In an eight-year-old almond tree, the fruiting wood is generally five years or less. These two observations indicate that the fruiting area should be replaced about every five years.

A five-year renewal program would mean 20% of the fruiting wood replaced each year. This degree of severity may be too much for all varieties in all orchards. A 15% removal is probably a better figure.

Almond varieties vary in the tendency to over-crop and alternately bear. Nonpareil pruning at 15% is probably close. Merced should have about 20% removed every year, as should Mission and Thompson. Ne Plus might only need 12% renewal.

Convert these percentages into the number of limbs cut out, compared to the number left in the tree. For mature Nonpareil trees, for every branch on the ground after pruning, there should be about five of the same size left in the tree. In a Merced tree, there should be about four left in the tree for every limb on the ground.

The amount of new shoot growth throughout the trees will indicate whether the percentage of removal each year is enough, or perhaps, not enough. You should be able to see several strong shoots per tree and a lot of one-year shoots of about 20 inches in length.

In years gone by, traditional almond pruning consisted of cutting out the suckers, dead fruiting wood and once in a while, a fair-sized limb. We now consider the removal of all strong shoots and so-called suckers to be a mistake. In fact, the only ones that should be removed are those that will be growing up through the center of the tree.

In this area, most mature almonds have a large hold directly above the crotch. This open center is a means of obtaining sufficient light into the lower portions, particularly on the north side. Any strong growth that grows upwards through the center is removed, ideally in April or May while easy to pull off.

Strong shoot growth that tends to grow upward and outward is kept. A general rule would be that if it will bend outward in a couple of years as it loads with crop, it is kept. By the time this kind of wood is about seven years of age, it is bent completely over and has about completed its useful life. In the meantime, other shoots have grown up from it as it bent over and they, in turn, will be in full bearing.

This system of growing strong growth up and then letting it roll outward with crop weight works quite well on Nonpareils, but is more difficult to obtain on the more upward growing varieties. This is why they are pruned proportionally more.

The first thing you should look for in any bearing almond before starting to prune is last year's shoot growth. It will indicate whether the amount of pruning was enough to promote new growth while maturing a crop and developing flower buds for the next one.

Once you have decided about how much you want to cut out, don't become too dogmatic about that rule for the year. As you finish pruning any given tree,

take a look at the "red wood" in the top of the tree to be pruned next. In winter, the previous summer's shoot growth will have a red cast. If this tree has less of such shoot growth, prune it more severely. If it has more vigor, prune the tree a bit less.

Prune out enough wood so that light can get between the trees, as well as into them. If vigorous wood in the lower parts of the trees is not bearing, then a good bet might be a lack of light. Once the trees are large, there is nothing sacred about how you prune in order to let sunlight into the tree. If small cuts will do it, fine. If you have to remove a major limb once in a while, so be it.

Another practice of the past that should be buried is that of cutting severely once every several years and then doing very little between times. This results in light crops for a year or even two after the heavy cutting. Then overcropping will probably occur, followed by light crops before they are cut severely again.

Heavy crops do not require enormous amounts of wood. Good strong buds on reasonable amounts of vigorous, well-lighted fruiting wood can produce crops averaging more than 2500 lbs. per acre.

Regular systematic pruning is one of the cultural practices that should be done in order to obtain regular crops.

PRUNING BEARING APPLES

Apple spurs live for many years, so it is normal to expect that most will produce their crop on spurs. These normally arise from lateral buds on shoots that are two or more years old. A few varieties such as Golden Delicious may produce some fruit on the tips of the previous season's shoots.

Regular annual pruning should maintain a balance between fruit production and vegetative growth. You do not want to leave the abundance of strong shoots that we talked about leaving in bearing almonds. Vigor control is equally important but in apples we annually remove the strong vegetative shoots that are growing from spur bearing branches.

Light penetration is important for maintaining productive spurs and for allowing surface color development as the fruit ripens. Need for fruit color will vary with the variety and will be valuable for fresh use but not for processing. If suitable lighting is not maintained, the fruiting area will be reduced in the lower portions of the trees which will either mean reduced production or tree height will have to be increased. In one case, income is lost, and in the other, net income is reduced by increased production costs.

Another reason for regular pruning is that occasional heavy pruning results in strong vegetative growth which reduces light penetration into fruiting areas. Moderate amounts of wood removal every year allows for regular cropping of desirable sized fruit.

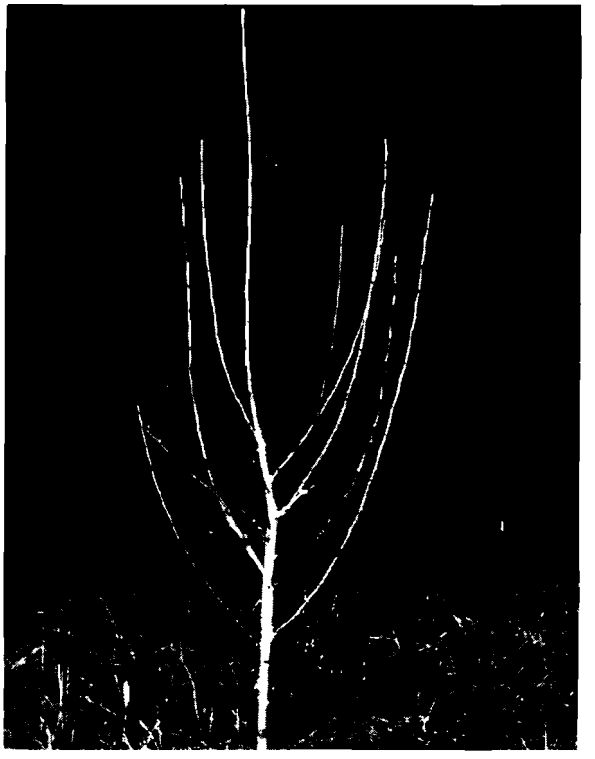
Before starting to prune a tree it is wise to take a general look at it with respect to its needs. Is the amount of vigor correct? You can increase or decrease next season's growth by the amount of crop you allow. Is the amount of interior lighting sufficient? If you must remove a limb or two in order to allow better light penetration, where will you leave more fruiting wood in order to control vigor?

The more closely planted the trees the greater must be vigor control. Healthy trees that are not cropped enough will increase in size. If tree size is not controlled then light penetration between trees becomes inadequate, and then only the tops are productive.

Now that we have done some cutting that will allow for tree size and form control plus light penetration, we prune fruiting branches. For the most part, vegetative shoots are removed, particularly those going straight up or down. Fruit produced on wood growing horizontally will receive enough light and is less apt to be marked or injured by other twigs or limbs. Horizontal limbs tend to develop spurs (for fruit) much better than vertical limbs.

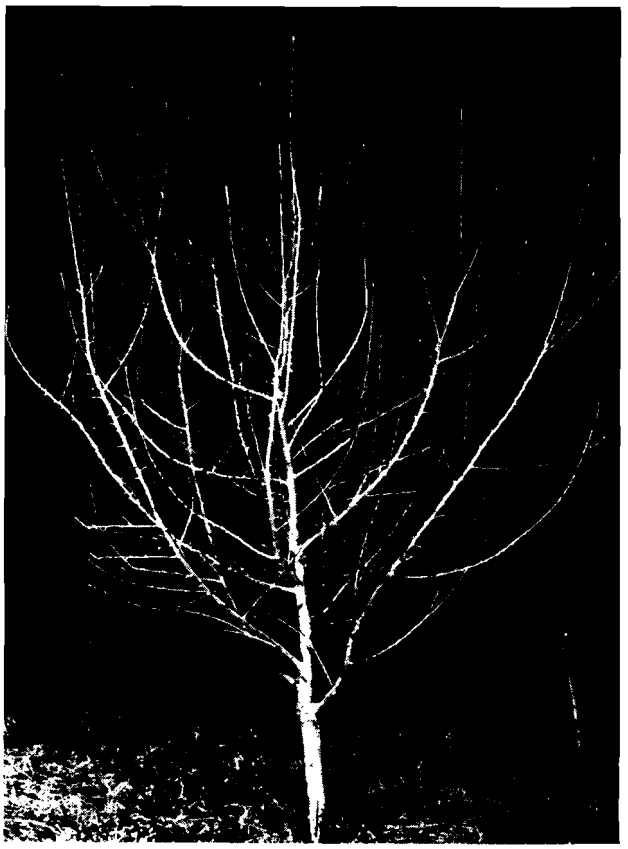
Some new wood must be kept each season so as to replace spurs that have become old, unproductive, diseased or have died. The amount will vary with variety, apparent fruit bud set, tree vigor and market for your apples.

Apples are probably trained to more styles than any other deciduous fruit tree. More research has been done in more parts of the world and their are more size controlling rootstocks available than with any other fruit crop. The verdict is not in yet as to what the ideal system(s) might be. One statement can probably be made with some assurance; the day of the very large, vase shaped tree, with its long nonproductive period and high labor costs is finished.



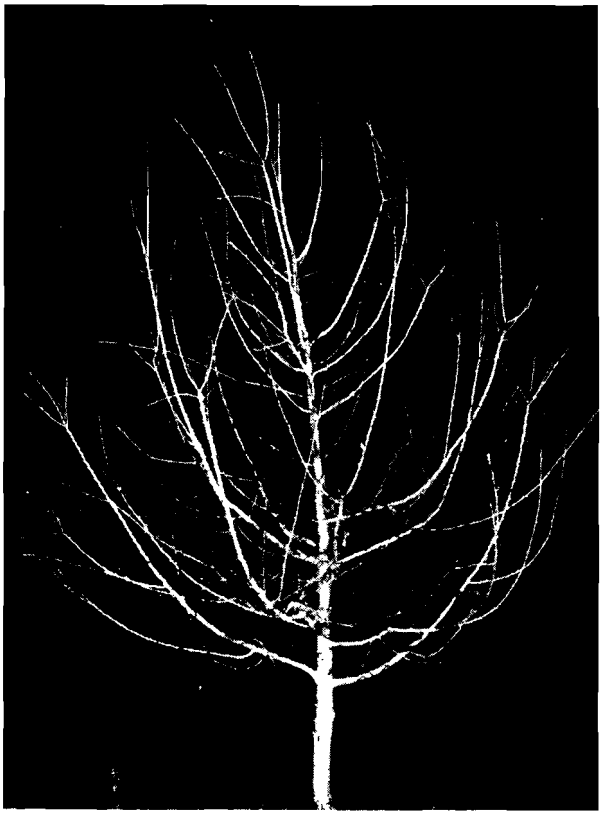
This vigorous apple has been in the orchard one year. Notice that there is no branching on current season's growth and the quite vertical nature of apple limbs. Also notice that the central leader is dominant.

Thinning cuts were used to eliminate the excessive number of possible primary scaffolds. Differential heading was used so as to get secondary limbs and suitable spreading.

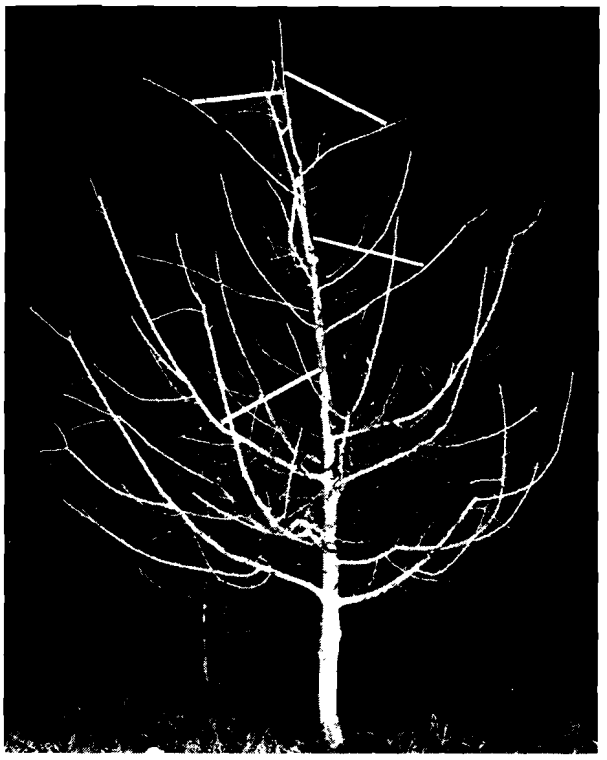


This young apple tree is showing both good vigor and spur development. The central leader is still dominating. Notice that despite the large number of spurs the terminal growth tends to keep the tree from spreading.

The strong one-year shoots were thinned out in order to keep the spurs fruitful and to allow for fruit coloring. Notice the type of spreader boards that have nails in each end. Apples should be spread more than we typically do in this area in our stone fruits, and to do so often requires use of spreader boards. The weight of new growth will not open the tree and the only fruit that may be borne will be found on the few spurs that developed on two-year wood.



Notice the absence of strong shoots from all of the terminals. This tree is now devoting much of its energy to crop development, but the shoots on the inside indicate ample vigor. Most of the shoots are now found adjoining pruning cuts made the previous year.



Now new framework limbs have been developed. Thinning out for good light penetration, heading of some terminals and additional spreading of fruiting limbs were the goals for this year.

PRUNING BEARING APRICOTS

A mature apricot produces most of its crop laterally on spurs. During the first few years crops are harvested, a fair proportion of the fruit can be on fairly long shoots that grew the previous summer. Economic life of most spurs is about three years.

Very vigorous apricot trees may not want to settle down to bearing for several years if pruning is too severe. One means of increasing spur development is to cut some of the more vigorous shoots back to a weaker lateral. At the same time, a general reduction in the amount of pruning is in order. Reducing the amount of nitrogen by about one-half will also help.

Once in production, the apricot tends to set more fruit than it can properly mature. Thinning is generally needed and, as a basic rule, pruning is a cheap means of thinning. If you regularly use pruning as a means of reducing your thinning costs, there are going to be years when your crop will be light.

Regular spur renewal is needed in apricots because of the relatively short life of the spurs. If the spur renewal pruning is not sufficient, you encourage severe alternate bearing. Alternate bearing in 'cots' is usually on an individual tree basis, so you must vary the degree of wood removal as needed when moving from one tree to another.

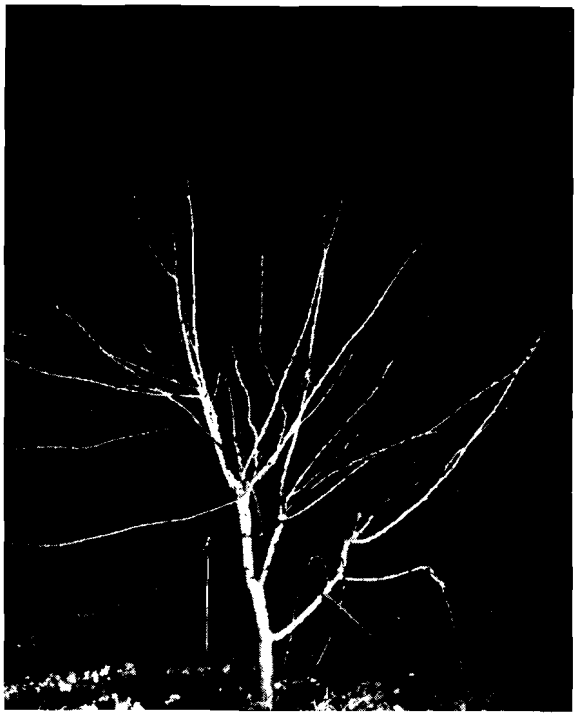
Apricot growers have on some occasions, because of low prices, simply topped the trees with a mechanical topper. Because on mature trees the crop is primarily on spurs, the crop was affected very little the next year. After a few seasons of little or no fruit wood renewal, plus the tendency to bear alternately, harvest becomes feast or famine.

Should alternate bearing develop, you should prune very little fruit wood out after a heavy crop. Following a light crop the rule is to prune out much of the spurs, especially the older ones. You cannot wait until hand-thinning time and effectively regulate bearing, as the fruit bud initiation period is over.

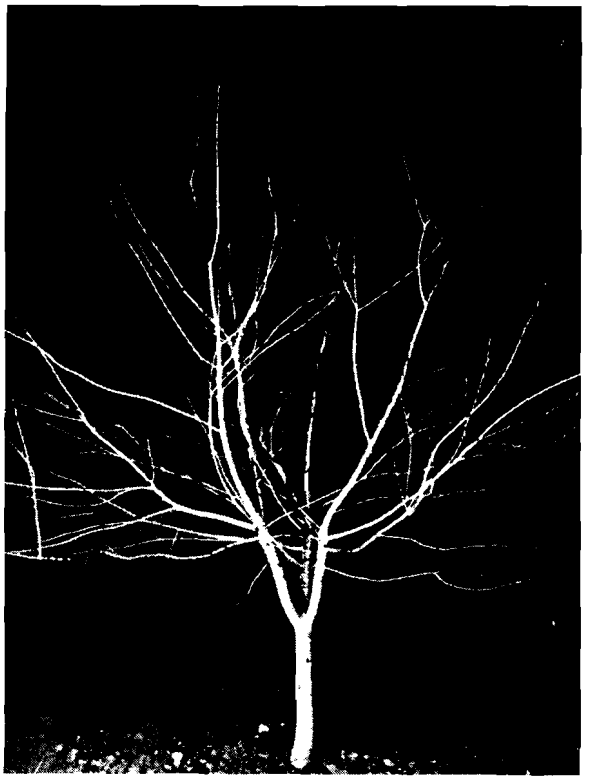
Another problem associated with simply topping your trees is that of an accumulation of weak and dead fruiting wood. This reduces the chances of new spur development. It also increases the amount of scarred fruit. This is even more of a no-no with fresh market fruit.

Fresh market apricot trees should have more detailed pruning than those where the crop is for processing. In addition to freedom from scars, more thinning out of fruiting wood is needed to ensure better fruit coloring as well as size. Overcropping will result in poorer color and delayed maturity.

A vigorous one-year-old apricot tree that has been pruned to the classic three primary scaffolds. Differential heading was about all that was needed in addition to removing one very low limb.

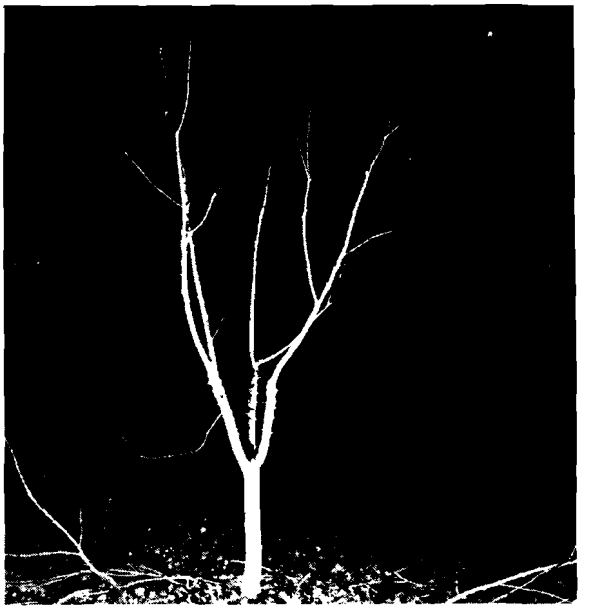


The same tree one year later (after two growing seasons in the orchard). Apricots are not as adversely affected by daily winds that distort growth in some other kinds of trees. Our northwest breezes are from the left and do show that side being pushed more vertically. This is mild compared with what it does to adjoining walnuts in the Patterson area.



This two-year tree shows that the three primary scaffold limbs were headed severely and uniformly the previous year by the grower. This resulted in much less spread, which reduces fruiting capacity during the early bearing years.

The lowest scaffold limb was just too low for future mechanical harvesting. Our second guessing now tells us that it should have been tied up the year before, if kept. The real criticism now is that the tree does not have enough spread. The tree is, however, larger because the limb was not taken off a year earlier, so my mistake was not all bad. The remaining secondary limbs were differentially headed about 3 feet from the crotch and the small lateral growth was kept for leaf area and the start of a fruiting wood system.



The tree appears to have been overpruned even though the limbs were headed about 3 feet above the previous year's cuts. Most of the cuts were a matter of eliminating strong, unusable lateral shoots. The wind is from the left but there was no opportunity to use our sacrifice concept. To have retained the strong growth to the left of the left-most scaffold would be to have restricted development of lateral limbs from it into the daily summer wind.

This apricot tree has completed three years in the orchard. It shows that at the end of the first year the heading was too severe and uniform. Pruning at the second winter was much more liberal, with longer extension of scaffold limbs and they were differentially headed.

This tree is ready to start producing enough fruit to make harvesting worthwhile during the fourth leaf. Limb terminals were lightly headed and some thinning was done. Spur development is continuing along the framework limbs and enough lateral shoots were kept to produce reasonable amounts of fruit.

Mechanical harvesting of apricots will probably be more common in the future, so some consideration of that is warranted. Limbs should not be allowed to develop one above the other so as to avoid fruit falling onto and being marked by the lower one. In the process of thinning out fruiting wood try to leave those portions where the fruit will have an unobstructed fall when loosened in the harvesting process. Fruit borne on short spurs will suffer more injury during the harvesting than fruit that developed on longer wood. The closer the fruit is to older wood the greater the chance of its striking that older wood when shaken loose.

PRUNING BEARING CHERRIES

The few cherry orchards found in Stanislaus County are sweet cherries. Cherries are slow in coming into bearing because the crop is borne predominantly on spurs. Economic life of the spurs is quite long, some ten or twelve years.

Once in bearing, the cropping level of cherries is essentially determined by pollination. Fruit that is grown primarily for shipping has fewer pollinator trees than where the crop is primarily for brining.

Cherry trees have been pruned in summer as well as winter. Summer pruning is often done in young trees as a means of reducing bacterial canker and hastening development of side limbs. To summer-prune bearing trees means to reduce their vigor. Where invigoration is wanted, dormant pruning will be more effective.

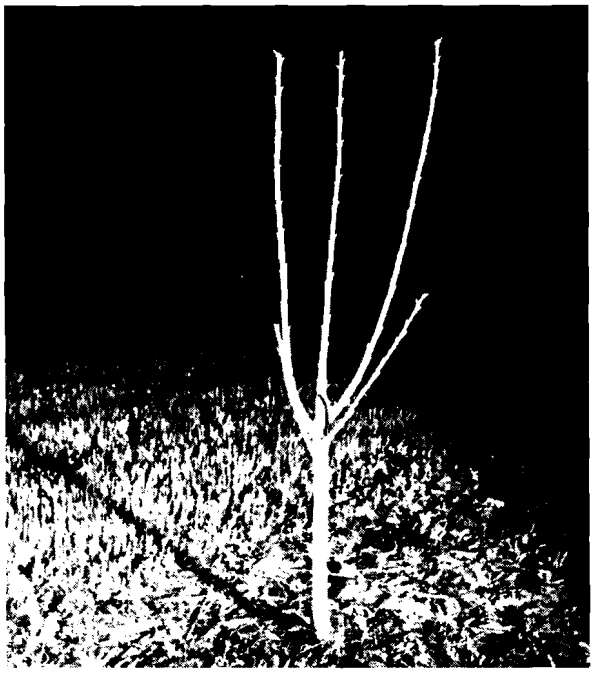
Cherries are like other trees in that most of the stimulus from pruning occurs in the vicinity of pruning cuts. If you want to stimulate new growth throughout the tree, then a large number of relatively small cuts distributed throughout the tree are needed. For this purpose cuts of about ¾" in diameter are quite effective.

Due to the long spur life of cherries, the pruning level need not be nearly as heavy as for most other deciduous fruit crops. Only about a ten percent renewal of the fruiting area is required each year.

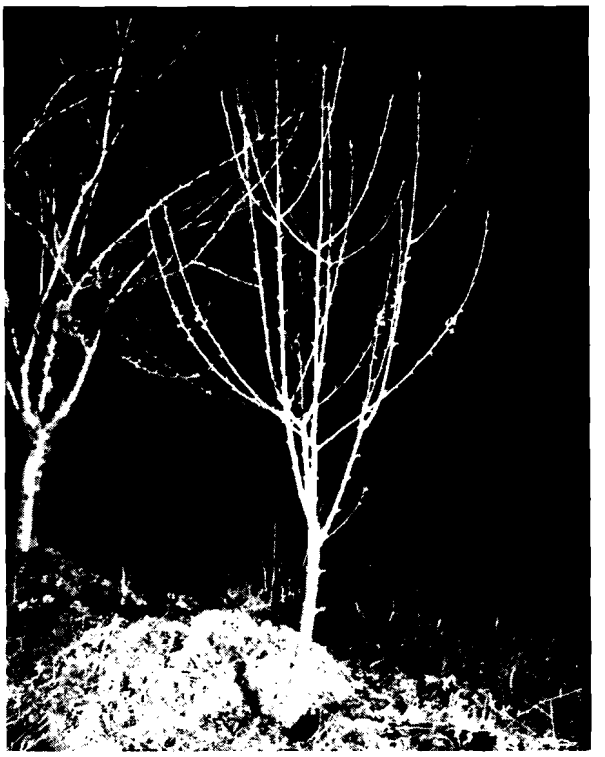
The concern about not letting limbs get too flat can result in trees that are too vertical. Cherry picking is expensive at best and tall trees such as this make it even more so. Thinning type cuts to laterals tend to spread the trees and slows the tendency to get too tall. Cherry trees can be held to selected maximum heights. This is done primarily by thinning to laterals and not by heading. Heading cuts tend to produce a rash of growth that in turn produces dense shade below. Regular selective thinning out of limbs and some fruiting wood will allow for more production in the lower portions of the trees without crop reduction.

Once the trees are in bearing, the fruiting wood should be encouraged to remain vertical rather than horizontal in tree tops. Doubling of fruit tends to be more severe on horizontal wood than on vertical wood. The explanation is that the developing buds on flat limbs absorb more heat, which during the bud-development period increases the number of double fruits.

Early in the life of the tree, minimum pruning allows the tree to spread and this, in turn, hastens bearing. This technique must be tempered, as the doubling tendency increases with wood of a more horizontal nature that is exposed directly to the sun.

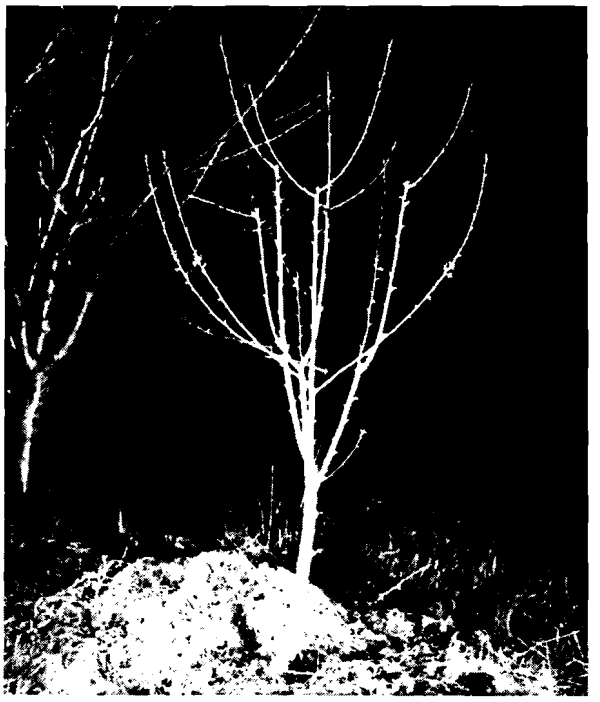


This cherry tree grew very well during its first year in the orchard. The pruner headed the limbs at reasonable lengths considering their diameter, but at uniform heights.



This orchard replant has reasonable vigor for a tree in a closely planted situation. Branching does not occur readily in cherries so heading is usually done where a crotch is wanted. The only argument with the first two prunings would be that of the uniform heading.

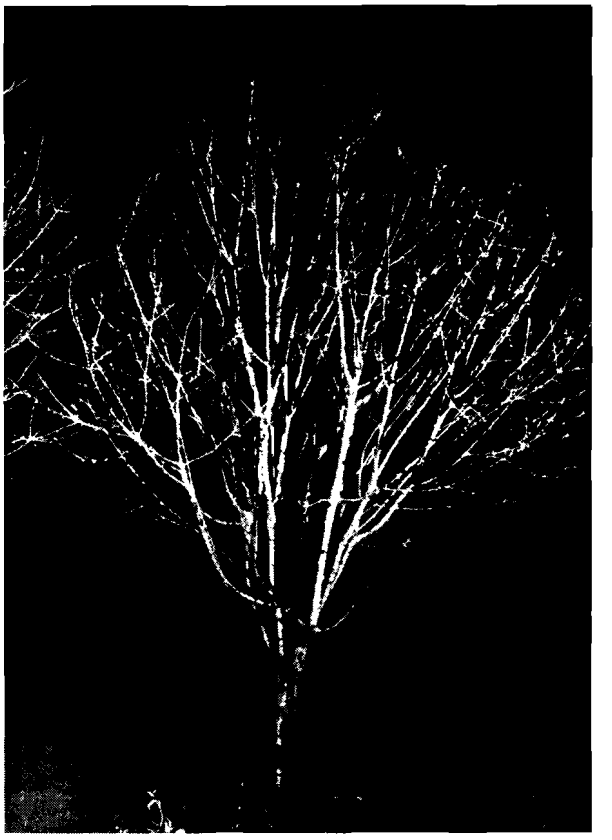
Your author made only two changes in the training process; the two primary limbs were differentially headed. Notice the center one rises topmost from the trunk, so was left the longest, and of the three major primaries, the one on the left rises the lowest from the trunk and was headed so as to be the shortest. This kind of heading will produce more spread, which in cherries is not easy to get.



The most recent terminal growth was not particularly long so only the terminal itself was removed. Some thinning out was done to allow for more spread of the branches.

This tree shows that despite slightly differential heading at the end of the first year in the orchard, the primary limbs remained vertical. The heading at that time created branching that spread somewhat.

Some general thinning-out was done and the terminals were lightly and differentially headed. Some spur development is starting along the scaffold limbs.



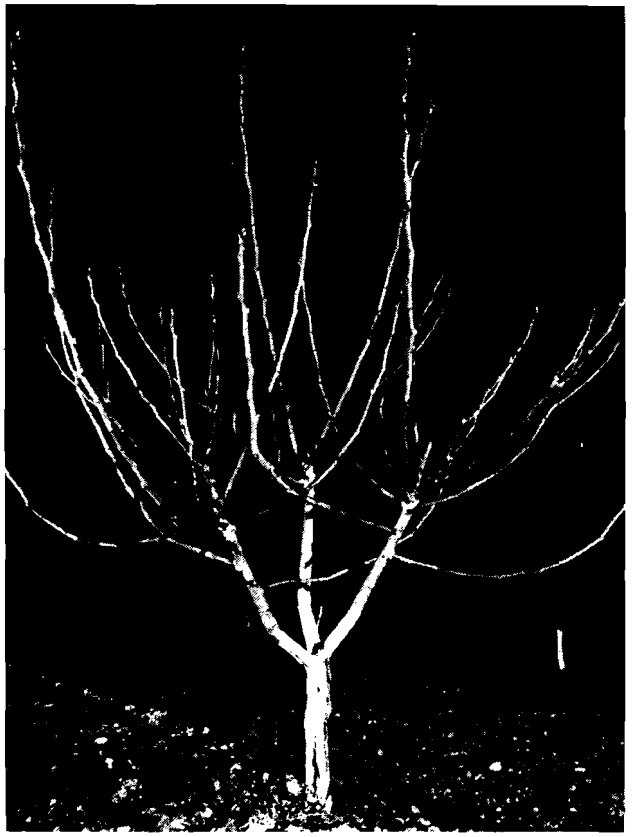
This young mature cherry is typical of those that are closely planted for brining fruit. Only enough heading was done during the first few years to promote branching. In such trees, fruit size and color are not primary considerations as they are for fresh market production.

PRUNING BEARING FIGS

Figs can branch rather freely as seen in this one-year tree. However, the nature of the growth makes one wonder if perhaps the tree depleted its water supply on at least two occasions and lateral buds pushed into growth when terminal growth also resumed.

Once you have a general idea of what is desired in the training of most fruit and nut trees, one like this is very easy to prune. Most of the small shoots were thinned off in order to direct the coming season's growth primarily upward.

Before pruning, this tree also had the potential of overcropping in the season to come and now is back to a more vegetative state of vigor.



This two-year-old fig tree showed considerably more vigor than did the one-year tree. Notice that these secondary limbs do not show the current season branching.

Remember that figs bear the major portion of their crop laterally on long shoots, so fairly severe pruning is in order. Secondary limbs were headed where branching is wanted during the third year in the orchard.

PRUNING BEARING NECTARINES

Nectarines are essentially a fuzzless peach. The bearing habits are identical. Because nectarines are marketed as fresh fruit, some very definite pruning differences occur between them and our canning peaches.

Whenever the fruit is destined for fresh market, size and color are more important than total possible tonnage. Less fruit per tree is possible.

Nectarine and shipping-peach trees are not as vigorous as processing-fruit trees. Limbs are not as vertical and this too, is a reflection of less vigor. Strong vegetative shoots in the tops are not nearly as common as with canning clingstones.

Pruning should be detailed enough that light reaches all of the fruit so that maximum color can be obtained. Removal of both dead and living twigs that can scar developing fruit is necessary.

In developing and pruning fruiting wood, it is best if the side shoots can originate from main scaffold limbs and are allowed to grow upright.

PRUNING BEARING PEACHES

Mature peaches require regular pruning, or production will decline. Virtually all of the peaches in Stanislaus County are for canning, so this discussion will be from that viewpoint. If you happen to ship a few peaches, the pruning suggestions for nectarines would be identical.

Canning-peaches should be pruned enough to stimulate sufficient new fruit shoots some ten to fifteen inches in length throughout the tree. This will coincide with strong top shoots that are three to four feet in length.

Peach trees do not have the alternate bearing tendency, so the severity of pruning will be similar from year to year. The strong shoots in the tops are cut off, weak and dead hangers are cut off and shoot growth on the inside is removed. The degree of healthy fruit wood removal is based on variety and on your philosophy.

There are two general lines of thinking with respect to pruning peaches where a minimum size is the easiest and cheapest means of thinning the crop enough to meet the needed sizes.

The other line of reasoning is that pruning should be minimal because in about two years out of five only light to moderate thinning is needed. Some varieties require no thinning those years. Moderate to heavy pruning preceding such a set would result in a light crop.

Minimum removal of annual fruit wood allows the trees to set maximum crops and has the potential of of a very large thinning bill. If you do a maximum pruning, then in a year of a light set, the crop is limited. In this district there are more years of light sets than of extremely heavy ones. Extra early varieties always set well so should have adequate pruning every year.

Your author is inclined to side with the latter thinking. Crop loading is generally the key item that keeps a peach orchard profitable. The combination of pruning and thinning should be very closely coordinated.

Enough detailed pruning should be done so as to allow for fruit growth without being scarred. The cost of such detailed pruning as required for fresh fruit is more than can be justified, unfortunately.

Pruners should be instructed to thin-out fruiting wood where peaches will not have a free fall to catching frame if machine harvesting is done. Studies made with our California machine harvesters in local peach orchards have shown that the numbers of cut fruit increase with decreasing distance between the fruit and two-year and older wood. The cuts seemed to be due to deflection after being dislodged rather than oscillation while the fruit is still attached to the hanger.

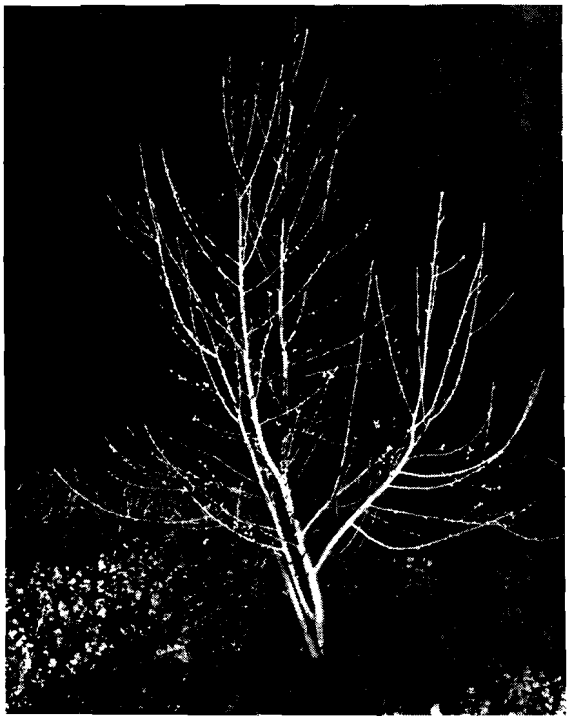
We have noted that sometimes there is better fruit removal if the hangers are fairly short but no thought was given to increased numbers of cut fruit.

We can probably decrease our fruit injury by using pruning and thinning methods that tend to allow fruit to have a free fall once separated from the hangers.

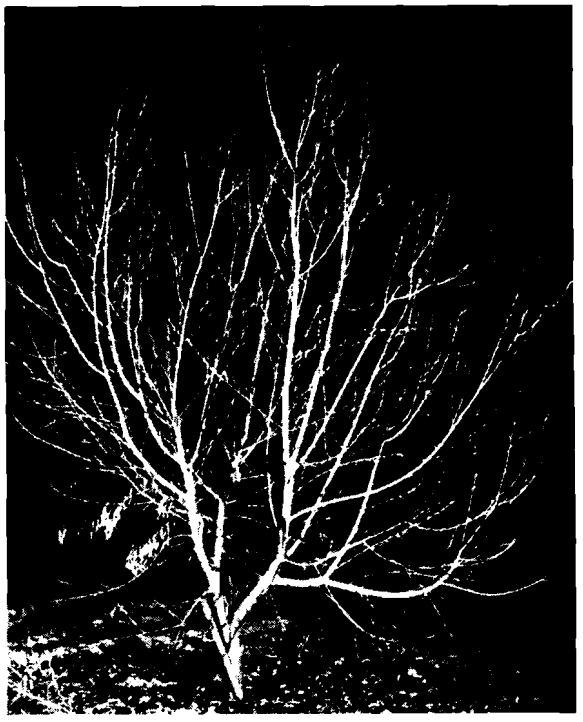
Bearing peach trees are pruned somewhat by variety. Those that set heavy crops are thinned out more than varieties that set light crops. One means of doing this is to leave fruiting wood of larger diameter on the varieties that set too heavily. Large diameter wood does not set as many fruit buds and also produces peaches of larger harvest size.

Early varieties tend to set heavy crops and do not have as long to size their crop, so need more intensive fruit wood pruning. For some reason, late varieties are more apt to have light sets and have more time in which to size their crop, so should be pruned somewhat lighter than early-ripening fruit.

Sometimes excessive amounts of fruit wood in the lower half of the tree weakens and dies. Most of the crop is produced above the wires, but to lose all the wood below that level is excessive. Loss of low fruit wood, for the most part, is due to excessively strong top growth. It is the competition from the over vigorous tops, and not shade, that kills the lower wood.



This one-year clingstone peach shows that the lowest growth was not rubbed off early in the first growing season. We not only have a totally unusable branch but, being on the windward side (left), it caused one that is suitable to be more vertical than we would like it to be. During the first dormant pruning the lower limbs of the three primary scaffolds were removed. (Photo of pruned tree not shown).

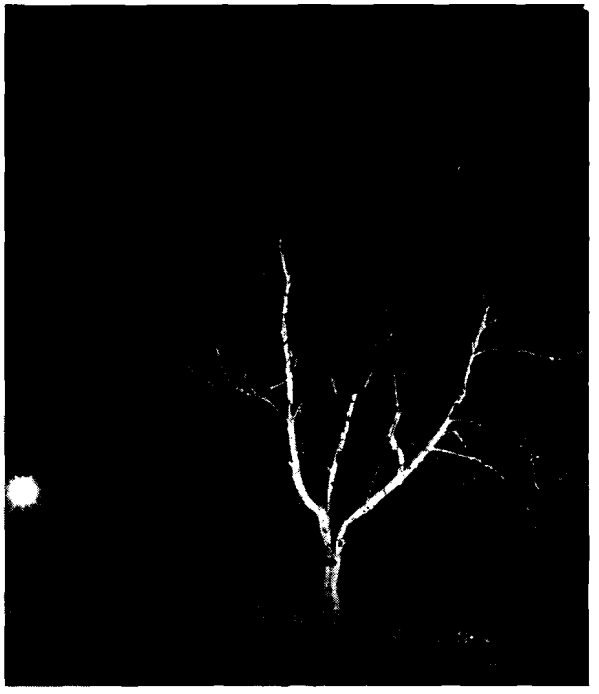


The daily northwest wind from the left is evident. Also easily noted is that the lowest limb on a peach is also the strongest and in this case is on the stronger growing side, the south. The stake that was of benefit during the first summer should have been removed as at this point it is of no value and is cutting into the trunk.

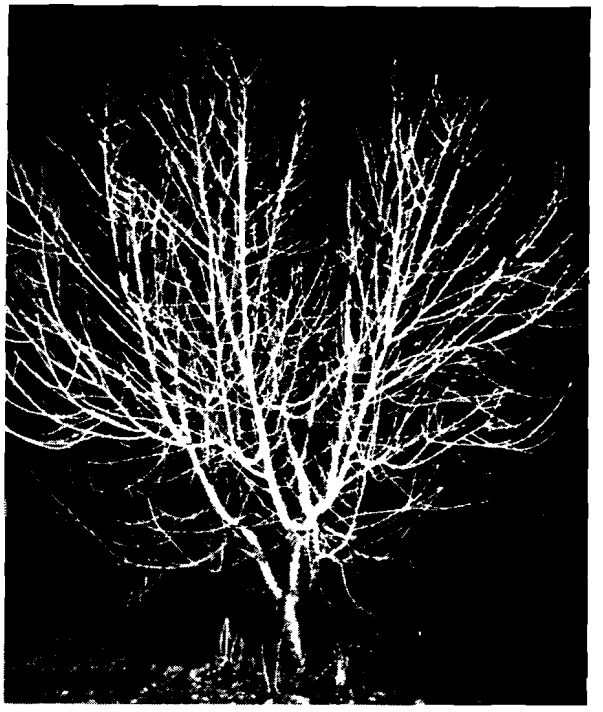
The very dangerous low limb on the righthand side has been removed completely. Notice how much it has increased in size from the previous year. The upper left limb shows two examples of the sacrafice concept. Fruiting wood has been kept for leaf area and crop, as trees during the third summer can and should produce two and one half or more tons of fruit per acre.

This two-year peach tree shows northerly side (left) that has about equal vigor to that of the south. We were able to get away with leaving two primaries much lower than the third and upper one. To have done this in the opposite way, that is two low limbs on the south side and a single, topmost one on the northerly side would have just about condemned the upper one to choking out in a very few years.

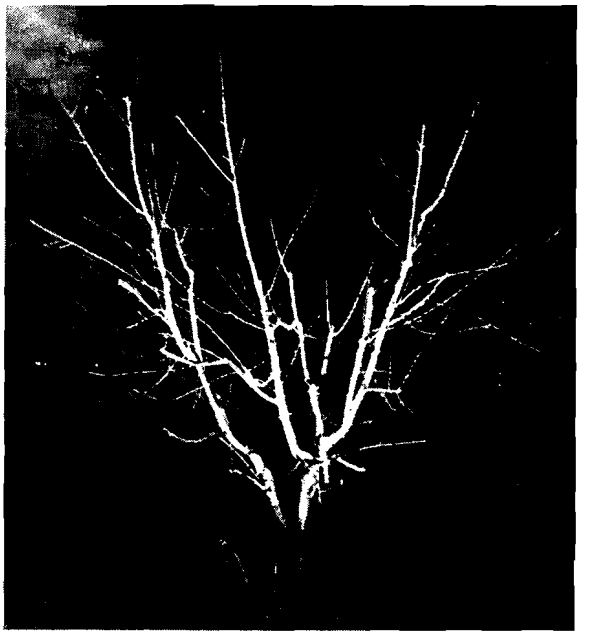
Some of the strong, upward growing shoots were thinned out and the scaffold terminals were headed where additional crotches are wanted. A spreader is used to widen a crotch and a goodly amount of fruiting wood remains. We were not able to use what appeared to be a sacrifice limb on the left side. The limb that was removed was in a desirable position, but take another look at the unpruned tree and you can see that its small diameter indicates that it would not last as a permanent limb. It is very important to eliminate these weakening limbs while the tree is in the training stage. When they are allowed to die after 8 or 10 years, the space is most difficult to refill.



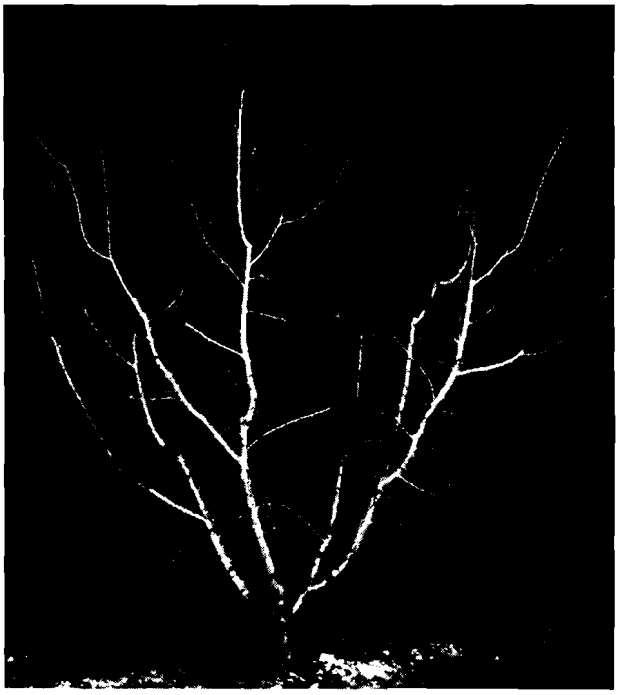
Notice that the strongest limb in the tree is our normally weak side. We have three primary limbs that will last. The tree is only three years old so more top development will occur but we have both a good framework established and enough fruit wood except on the lower left.



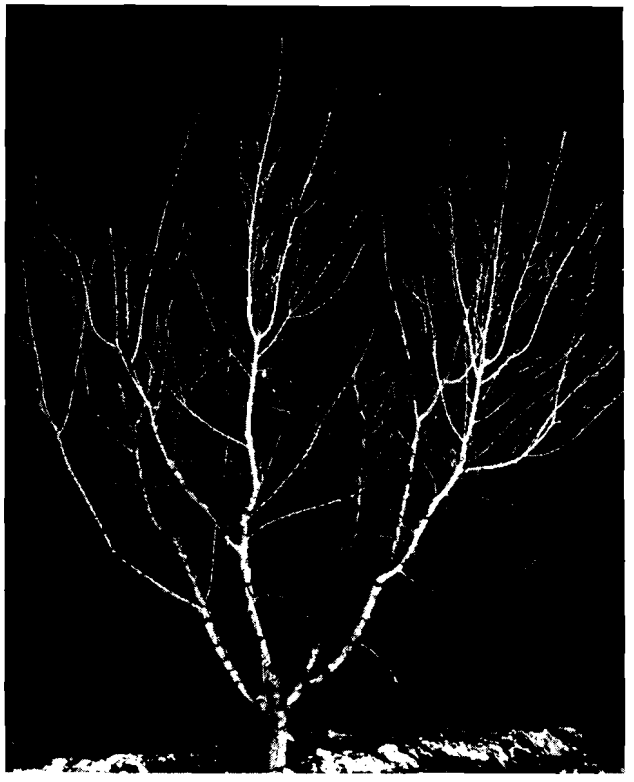
This clingstone peach has completed four years in the orchard. The low limb on the left is into the daily wind and has had sacrifice limbs on the inside during the first two years. It has grown well and was first harvested during the third growing season.



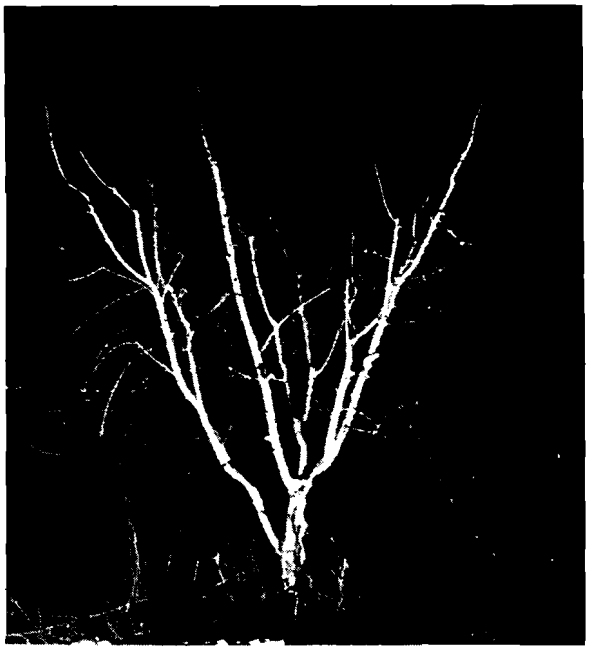
This is not a two-branch tree, the camera angle was to show the strong north limb and as such the third primary cannot be seen where it attaches to the trunk. The essential training has been done and most of the cuts were of the thinning-out type. It has not reached the full height so some training is continuing in the top. A desirable amount of fruiting wood has been retained. Proportionally more fruiting wood was thinned out of the top in order to prevent breakage in that portion.



To shift gears a wee bit, this tree is a four-year freestone peach. The fruit here is for fresh market so much more light is necessary. A nectarine would be pruned in the same manner. The vigor is excellent, so a reasonable crop should be expected.



After pruning it is very obvious that the framework limbs have been trained to spread more than is done with clingstones. Not as much weight is carried in nectarines and peaches for fresh market so spreading does not create a breakage threat. More importantly, more light is necessary in order for the fruit to have more color at harvest. An abundance of fruit wood is available for cropping.



This young mature clingstone has now grown as tall as will be allowed. Two or three more tertiary limbs will be allowed to develop in the top so as to complete the circle. At the top we like to have terminal limbs about three feet apart. If they are much closer, enough fruit wood cannot be maintained. If too far apart, not enough fruiting wood develops to utilize the maximum amount of available sunlight.

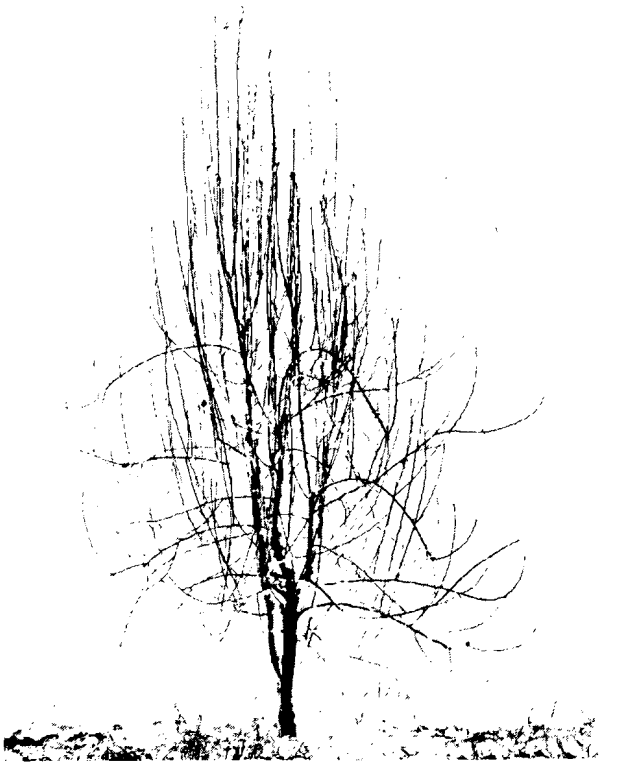
PRUNING BEARING PEAR TREES

Pear trees bear most of their crop on spurs which develop on two year old shoots and many of the spurs live for four to eight years. Bartlett, our major variety, can produce some of its fruit at the end of one year shoots. This terminal fruit assists in bending down one year old limbs which encourages spur development on these shoots their second year. It is a great aid in helping young bearing trees to produce larger crops sooner. On old bearing trees annual shoots six to twelve or more inches long will set terminal flower buds which can assist in setting a moderate crop in years of poor spur bud development following heavy crop years. Pears tend to be partially alternate bearing, so in years following heavy crops both spur and terminal buds are needed to set a crop, while in years following light to moderate crops adequate flower buds are available on spurs.

The economic life of a pear spur varies with the variety, light conditions within the tree and the age of the tree. Bartlett spurs on well-pruned trees are generally good for four to six years even if all spurs do not bloom every year. Winter pear varieties have longer lived spurs. Unpruned trees may hold spurs several years but fail to set regular crops due to overflowering. If Bartlett spurs are good for five years, about 20% of the older spur-bearing limbs should be removed annually by pruning.

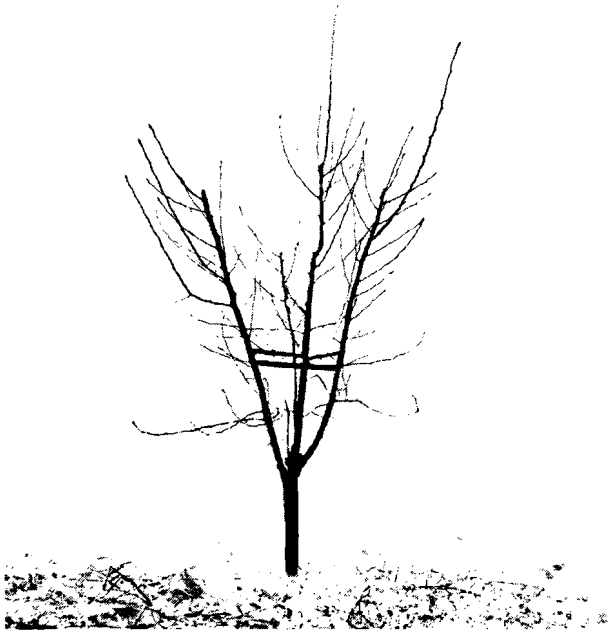
This vigorous 20 year old pear tree growing on river bottom soil shows the large amount of annual shoot growth produced by a pear tree with an average crop. To open this mature tree to sunlight, pruning must maintain a standard height, cutting back much of the previous year's shoot growth, and thin out or extend the length of about 20% of the older spur bearing limbs. Extending the length of spur bearing limbs means leaving some annual shoot growth each year and this "spurs up" for flowers and fruit iin future years. Fruiting wood can be maintained in the lower parts of the trees if these pruning procedures are followed.

The previously shown Bartlett pear tree now pruned shows that tree height was limited and healthy fruiting wood was maintained on many limbs throughout the tree. The tree was just starting to bloom so this picture shows the bloom to be developing uniformly. Note the numerous flowering spurs on two to four year old shoots near the extremities of the tree and the few flowering spurs on the older, larger diameter wood in the center of the tree. This illustrates how fruiting limbs have their spur-bearing limbs extended toward the outside of the tree.



This vigorous, unpruned five year old Bartlett tree is much more upright than similar aged stone fruit trees despite annual heading cuts on scaffold limbs every 30 inches plus, leaving unpruned potential fruiting shoots originating from these heading cuts to "lay over" and eventually develop spurs. Even with long pruning techniques pear trees just grow vertically and most new growth originates in the vicinity of a pruning cut.

After pruning it is obvious that many of the last season's vertical shoots were removed. Scaffold limbs were headed and other limbs were left unheaded. These unheaded limbs will often lay over especially if the terminal bud sets a fruit (as normal bloom or as late 'rattail' bloom) which pulls the limb down and this encourages spur development. Limbs that are flat were pulled down by their weight or the fruit they set the previous year. Note the spurs that have developed on the two year old horizontal limbs.



This is an unusually upright three year old pear tree with scaffold limbs too close together to ever develop into an open tree.

Note how spreaders (made of one inch wood with sharpened nails in each end) have spread the scaffold limbs. For this to work, caliber of limbs must be equal and wind must not be a serious problem. The only pruning done was to head the main scaffold limbs to induce branching and to thin out some of the annual shoots. The limbs are of equal caliber so they are headed at the same height and center limbs do not choke out in pear. In fact, the dominance of the center limb is so strong in pear that the pruner must not leave it longer than other limbs or it will take over and the tree will become a central leader tree.

PRUNING BEARING PECAN TREES

Pecan trees are in a class of their own with respect to growth habits and pruning needs. If you know how to prune walnuts as compared with stone and pome fruits, you will see similarities. However, the pecan has some characteristics that are unique and should be recognized.

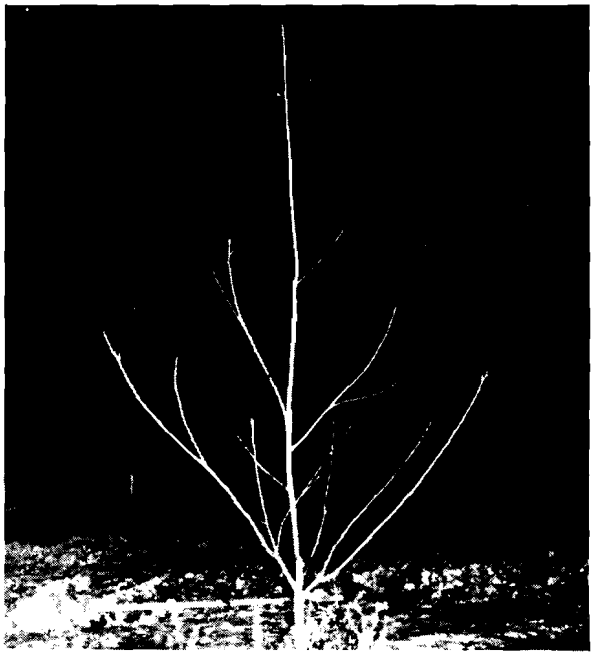
Pecan trees require three or four years from the time your nurseryman plants the seeds until a tree is ready for delivery. When dug out of the nursery row, pecans suffer a great deal of shock. For this reason it is very important to severely head the trees at time of planting into the orchard. While growth may be excellent during the first leaf in your field, many or perhaps most will not show a great deal of vigor. Starting with the second season in the orchard however, pecan trees grow quite rapidly.

Pecan trees produce necked buds as a rule and these must be dealt with when pruning during the primary framework development years. Notice also that there are typically three buds aligned vertically at each node, and all three may push into growth. The primary bud will produce a branch with a very narrow crotch and if used will make breakage a probability. All primaries should be rubbed off where scaffold limbs might be developed. Some growers also remove the secondary buds in order to get the widest possible crotches.

Terminals of pecan shoots are also characterized by many buds. In order to avoid a mass of shoots developing from essentially one position, it is wise to head terminals at least lightly.

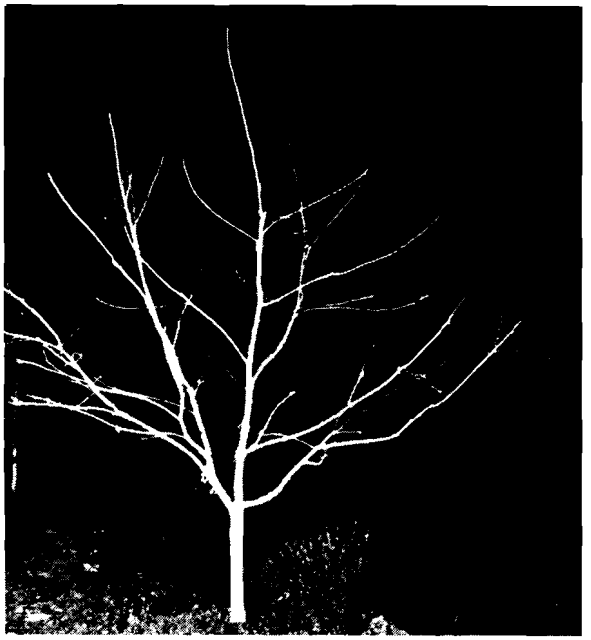
This one-year tree did not grow as well as possible but is not unusual. The odds are that it will grow quite well during the second and subsequent season.

Severe pruning, both thinning and heading type cuts, is in order. A strong, single upright shoot is wanted that will become the trunk. This type of pruning violates the primary rule of pruning as little as possible in order to obtain maximum growth. As noted however in that statement, there are certain occasions when severity is the rule, as with a one-time operation.



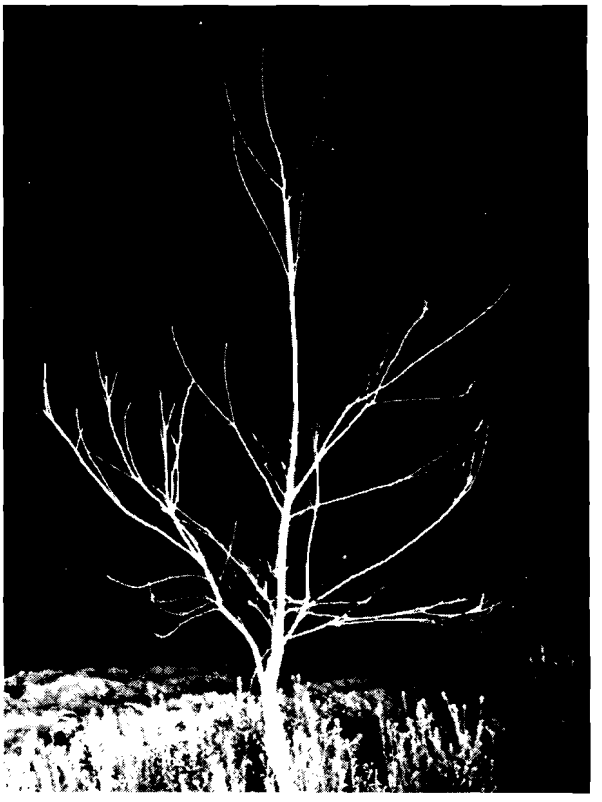
This tree has finished its second year in the orchard and demonstrates how well pecans can grow once the initial transplanting shock is overcome. Notice the small branching on the terminal portions of the two lowermost limbs. The grower did some summer heading as a means of containing vigor.

Severe heading of the terminal to a height of about six feet above ground was done to ensure branching at reasonable heights. All of the primary buds and many secondaries were removed in the process of rubbing one's hand up and down the trunk as the easiest and fastest way of avoiding narrow crotched limbs. One branch was suitable at the start of the primary scaffold system. The two smaller brances are primarily leaf area for trunk nourishment.



During the third year in the orchard this tree has shown typical pecan vigor. Notice the profusion of terminal branching that indicates the grower felt it necessary to control wild summer growth by heading. Notice also about six feet above ground on the left-hand side a cluster of limbs from a single point. This was the result of the terminal portion not having been headed at the previous pruning. This particular case is not a problem but on occasion it can be, so was pointed out at the beginning of this portion with a close-up of the terminal buds.

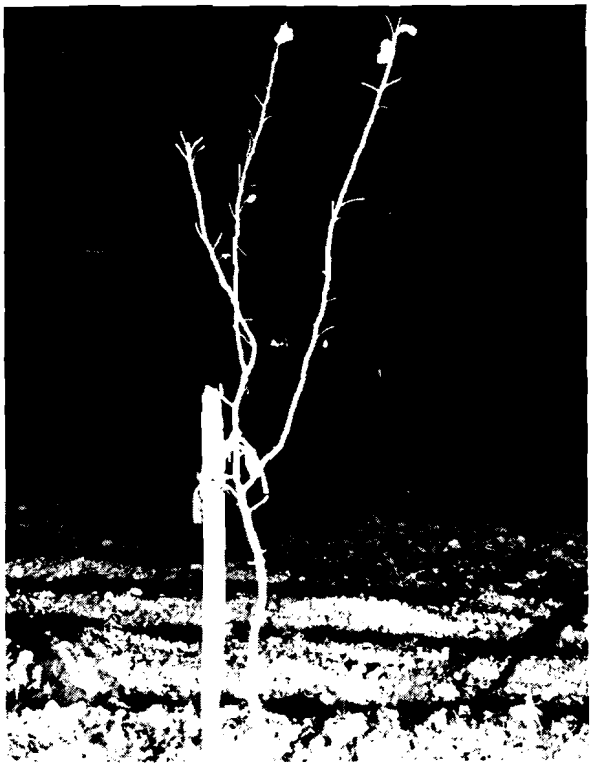
The central leader was headed about ten feet above ground and all primary buds were rubbed off. The framework limb system has been started and the terminals of each have been headed and thinned out. Notice how low the primary limbs are, which is an apparent exception to our modern training for machine harvesting. These low limbs are simply a temporary under-story and will be removed in time. In the meantime we are back to the concept of leaving an abundance of leaf area and this tree will produce some crop.



This tree has been in the orchard four years and will produce enough crop to warrant harvest. It clearly demonstrates the lower story of limbs that in time will be removed. All potential limbs have been headed to prevent a cluster of shoots and also to control excessive bending as a result of heavy shoot and leaf growth. Notice that as with pistachios and walnuts, small branches not destined for framework limbs are not headed so as to crop and bend downward.

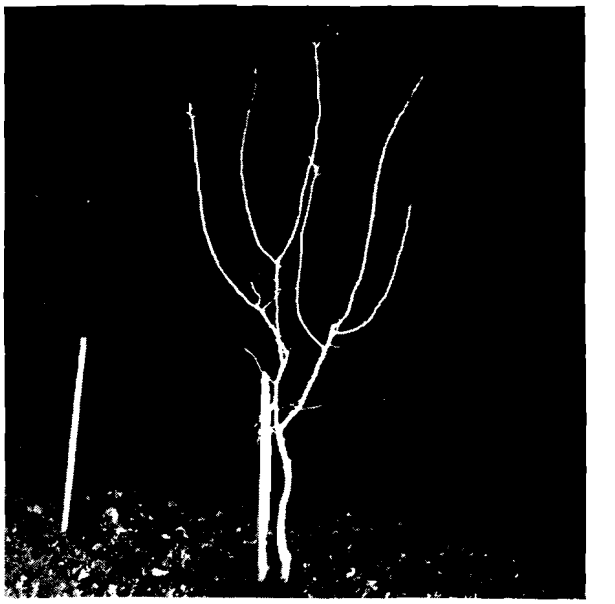
PRUNING BEARING PISTACHIO TREES

This tree has grown one year in the orchard and is typical of the growth that pistachio trees make in the first season. Pistachios do not branch as they grow, so normally there is no pruning to do on one-year trees. If a tree has not grown well it should either be cut back to within a few inches of the bud or replaced. If headed back then all of the energy should be directed into a single shoot during the second year rather than letting branching develop near the ground.



The tree has now completed two years in the orchard. There are no secondary branches nor is there fruiting wood along the primary scaffold limbs; not all of the leaf petioles (stems) have fallen. However, below the crotch some lateral fruit wood has developed.

All that was needed was differential heading of the primary scaffold limbs. As it so happened each of the only three limbs was in suitable position to be used for framework.



This tree has now completed its third leaf. Some small lateral wood developed along the primary scaffolds. A little heading the thinning out will be all that is needed.

Only one limb on the righthand side was eliminated with a thinning cut and the terminals of the secondary limbs were lightly and differentially headed.

The primary and secondary scaffold limbs have now developed. Fruiting wood is continuing to develop on limbs that are two or more years in age.

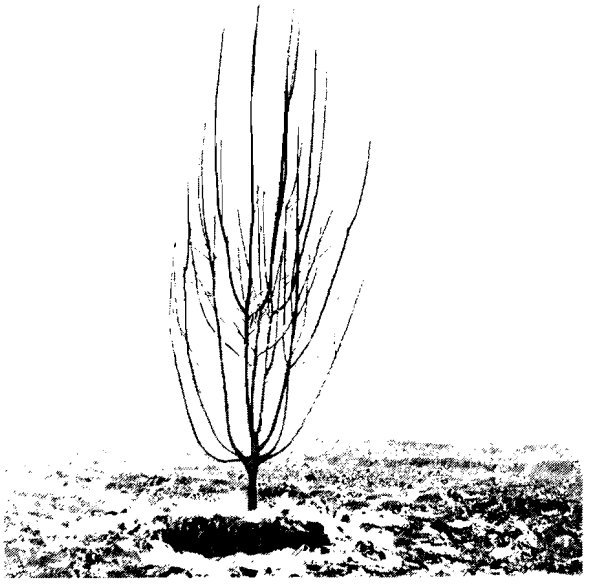
This tree has also completed three years growth in the orchard. It is not growing well and the only shoot growth it developed is in the vicinity of the few pruning cuts made a year earlier. This shows that when thinning and heading are inadequate, only lateral fruiting wood develops.

Each of the limbs that remain was headed so the extension of limbs will continue. Fruit wood can be seen along the two year and older wood only. Some leaf petioles remain along the terminal limbs.

Light and differential heading and a very few thinning cuts completed the pruning at the end of the fourth year in the orchard. This type of pruning will continue in the future. Once heading and thinning cuts are made, only fruiting wood will develop.

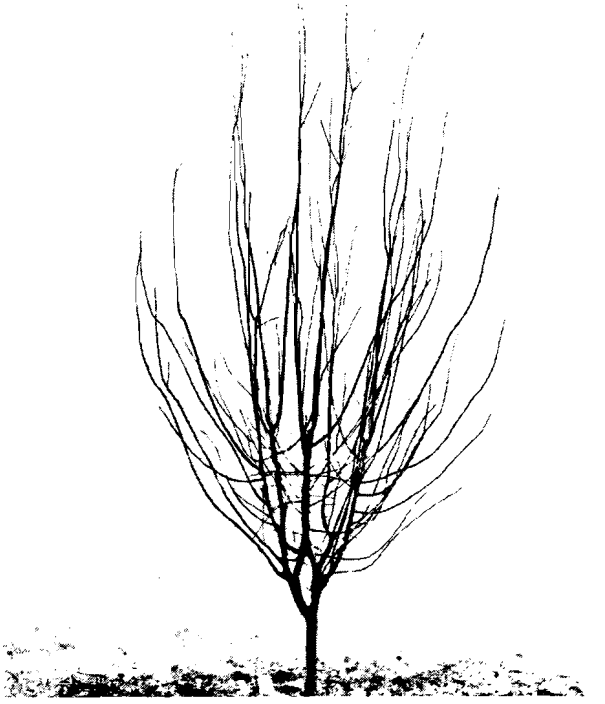
PRUNING BEARING PLUM TREES

A one-year-old plum tree that has grown well has a number of potential primary scaffolds from which to select. Training plum trees is easy because there is only a slight tendency for weaker limbs to choke out. Three or four primary scaffold limbs may be selected and all should be headed about 24-30 inches above the trunk.



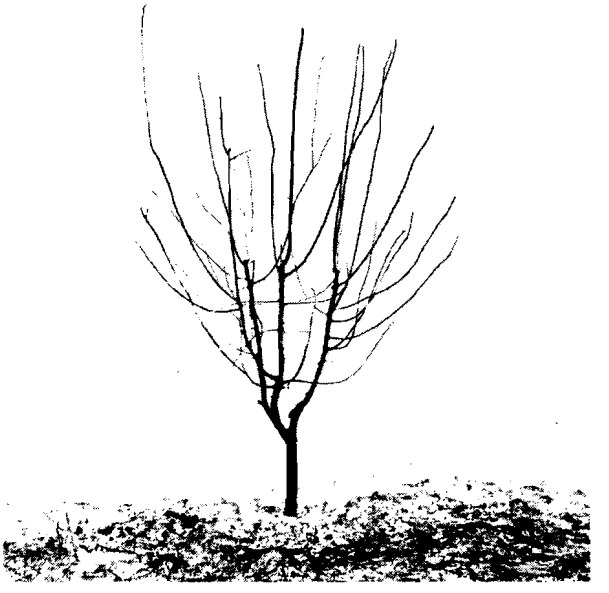
An example of how well vigorous trees can grow—This young tree has completed its second year in the orchard. In addition to the original primary scaffolds, there are a number of strong new shoots that have developed on the lower portion. These are normally removed but on occasion one or more may be substituted if a better primary can be developed instead of an original selection a year earlier.

are not removed. Trees with this sort of vigor should be encouraged to bear fruit.



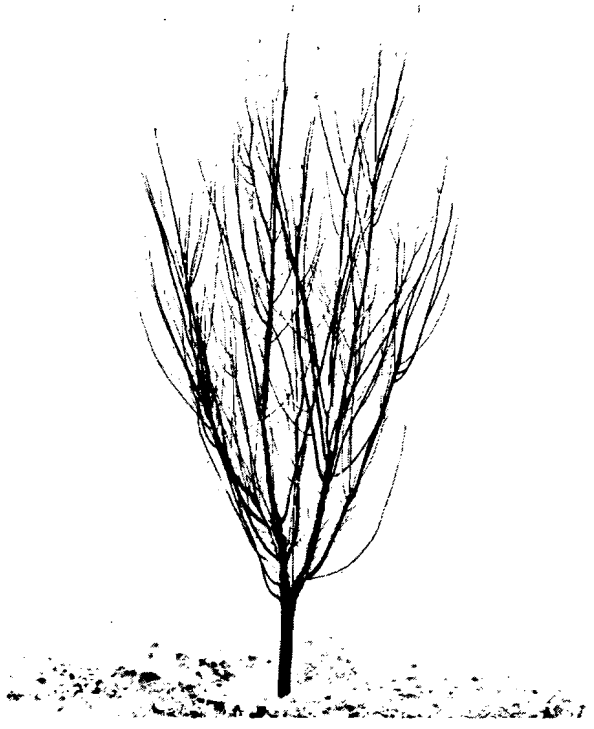
After three years in the orchard and two years of training, this tree is developing into a standard vase-shaped tree. There is good vigor, which insures sufficient branch extension and an increasing amount of lateral fruiting wood.

After pruning it can be seen that the tree form of most orchard trees is very similar. This is particularly true where the crop is hand-harvested. Secondary scaffold limbs have been selected and reasonable heading was done in the top. Time is required to develop fruiting wood so lateral shoots

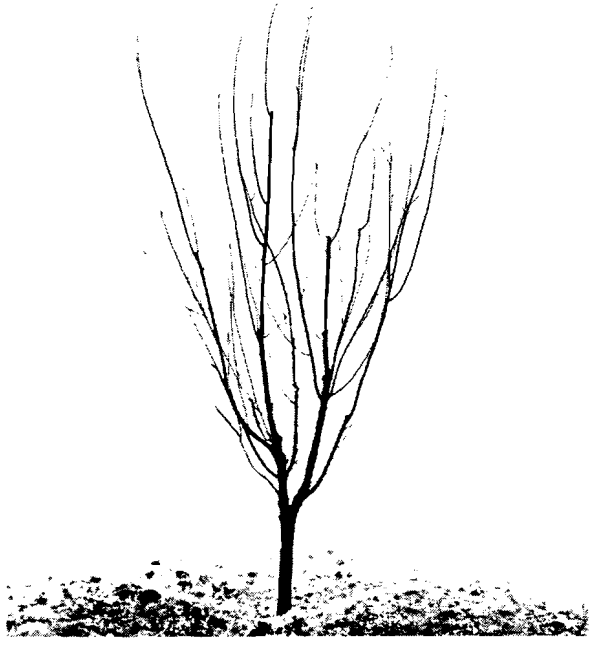


Thinning-out cuts continue to dominate the training process. Notice the few shoots that were headed this time as the need for continued strong, upward growth is less important now. This tree still has more than enough vigor to both grow vegetatively and produce a crop. Accumulation of

sufficient fruiting wood requires several years so only moderate thinning out of lateral shoots is necessary.



Three years after planting, this Santa Rosa type plum tree has nearly completed its framework development. There are enough secondary and tertiary limbs to allow for complete development.



Pruning consists of thinning-out cuts and heading to small outward growing side shoots. This is an effective way to induce fruiting and minimize excessive shoot growth for Santa Rosa-type plum trees.

PRUNING BEARING PRUNE TREES

Prune trees should be pruned each winter rather than severely once in awhile. We do not have many prune orchards in this area, so experience is lacking.

In many years overcropping is quite common in the older prune areas of the state. The results are dieback, broken limbs and small, low-sugar fruit.

Pruning is one of the effective techniques of regulating the crop. Overcropping can, to quite an extent, be prevented by regular pruning. Prune trees bear most of their crop laterally on spurs that live for five to perhaps eight years. This would indicate a pruning level that would remove 12% to 20% of the fruit-wood each year.

This young mature prune tree is in balance. It has a full complement of healthy limbs, an abundance of fruit wood and the new fruiting wood at the top indicates fair vigor. To maintain the proper balance between crop and vigor will, in the future, mean more intensive heading and thinning-out of fruiting wood. Extensive pruning at an early stage would reduce the crop potential too much.

Pruning that removes one-fifth of the wood each year is probably too severe. A program that removes one out of every eight fruiting-limbs might be in order. Fortunately, in prunes, the pruning does not have to be spur removal as such. Limbs of one-half inch to perhaps two inches in diameter cover the normal range of limbs removed by pruning.

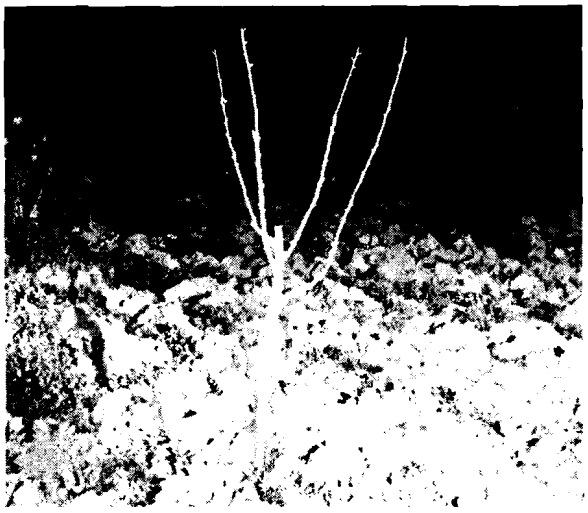
Detail or precision pruning is not needed in pruning prunes but regular annual pruning is essential. As in almonds, for every one-inch fruiting limb that is removed, six or seven should remain.

Make a pruning cut that will remove what looks to be one of the oldest or weakest bearing units. Move up, down or around the tree, past six or seven

bearing units of similar size, and then cut out the oldest or weakest one in that vicinity. Most of the cuts are of a thinning nature but some heading is necessary to keep a reasonable shape to the tree. In some prune districts it is not uncommon for orchards to be pruned with a saw, which means with severity. This sort of treatment every few years is really not the best. Light crops follow until new fruiting wood develops, then overcropping is probable. Dieback and breakage result, and then the chain saw gang moves in again.

Prunes are really plums (European) so we would expect the initial growth and training to be very similar. Most of our shipping plums are the Japanese type so their fruiting habits are somewhat different than those of European plums, but at the first few prunings the type of cutting is the same.

This tree grew reasonably well during its first year in the orchard. The pruner selected three primary limbs and they are well-spaced laterally and vertically. It is not often that choices are this good. Notice that the diameter of the lowest limb is larger than the others. While differential heading was done, the lowest limb should have been headed much more severely as it is the strongest limb on the tree and is in the strongest position on the trunk.



Another one-year prune where in this case it was possible to leave four primary scaffold limbs. The lateral and vertical separation is good but the terminal portions were headed a bit too uniformly. Remember however, in prunes the tendency for chokeout limbs is not as severe as say, in peach. Also notice the stub where the central portion of the trunk was removed; the cut should have been closer.

This is a young, mature prune tree. It has grown about as tall as will be allowed. The amount of fruit wood is sufficient. From this time on, pruning should be intensive enough to prevent excessive crop loading and allow for fruit wood renewal. Notice that strong shoot growth did develop where cuts were made a year earlier. If new growth is not vigorous, increase the severity of pruning or small fruit size will result. In some areas of California severe limb dieback and potassium deficiency will result if pruning, thinning, irrigation and potassium are not adequate.

PRUNING BEARING WALNUTS

Mature walnuts are probably the most under-pruned tree crop grown in this area. An excuse for minimum pruning is that the tree size is too large. Nevertheless, if they are not pruned enough, the crop level will be lowered and life expectancy reduced.

Most of the crop on a walnut tree is in the outer two to four feet of the branches. This fruiting area should be in a constant state of renewal. This means many cuts per tree per year.

Because of their size, it is practically impossible to prune enough from the ground or ladders. This means that some form of tower or mechanical lifting

device must be used if sufficient pruning is to be done each year. Mechanical topping and hedging are showing some promise.

Size and color of walnut kernels are important if suitable prices are to be obtained. Constant pruning is needed if walnut trees are to have enough vigorous shoot growth to produce nuts of suitable size and to provide enough shade to protect the developing crop from sunburn.

A large number of relatively small cuts is needed. Depending on variety and size of tree, the number may range from 35 one-inch cuts to perhaps as many as one hundred or more. Lateral-bearing varieties, such as Payne, need two or three times as many cuts as a variety such as Hartley.

One of the reasons that walnuts in this area do not live as long as they might is the lack of pruning. Root renewal is dependent on sufficient shoot growth, and this requires pruning.

Plant food materials (carbohydrates) produced in the leaves are transported to areas of need within the tree. Only after crop, fruiting wood growth, limb and trunk nourishment needs have been met, do any food reserves move below ground. Regular and thorough pruning stimulates growth in amounts sufficient to nourish both the above- and below-ground portions.

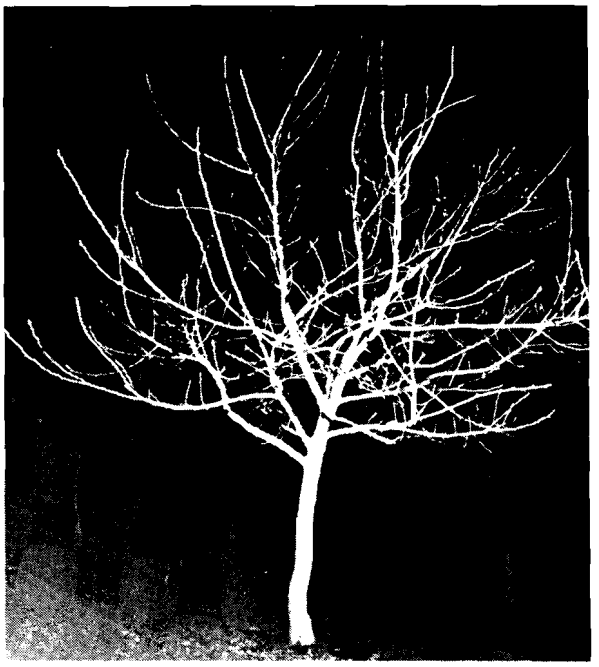
Have you or one of your neighbors ever reduced your walnut crop by pruning out too much wood once the trees are mature? On a number of occasions your author has suggested that a particular walnut orchard be pruned severely in order to let light into the trees and promote new fruit wood. Growers were told to expect a drop in crop level the following season.

The drop did not occur. They lucked out. Yet every time this suggestion was made, the crop was just as good and often of better quality. In no case was there a loss of income. Luck?

Regardless of how excellent your soil may be and how well you water, spray, fertilize and so on, the day will come when the crop will catch up with the trees. Unless you keep new wood growing as a result of sufficient pruning, the crops, and even the life of the trees will wane.

Thinning type cuts will be your most effective cuts and most of these will be in the range of one or two inches in diameter. The more these can be scattered throughout the tree the more effective the pruning. Light penetration will be increased and more new shoots will be developed. Walnuts respond well to both light stimulus and to the cut itself. Most of the response will be within about a foot of the cut so the more cuts the more response.

Remember that with walnuts, pistillate flowers develop terminally after new shoots have grown from one to a few inches. The more new shoots the more walnuts. And to get lots of new shoots you need to do lots of cutting. A few of the cuts will be three or four inches in diameter but most should be in the two inch range or less. Fifteen to twenty percent renewal a year may not be excessive.



This walnut tree shows a desirable fruitwood density. There is an abundance of fruitwood yet the tree is open enough to allow excellent light penetration.

An indication of sufficient pruning in walnuts is that they are carrying a good crop and a second flush of shoot growth in late June to early August. By early- to mid-June nut growth has been completed and trees that are in a proper state of vigor can then develop more vegetative growth. This will appear as lighter green colored, vigorous growth (flags) in the tops of your trees.

When you see the second flush of growth in mid-summer you can be reasonably sure that enough carbohydrates are being produced in the leaves to send some of that nourishment down to the root system. Without such growth you have no assurance that all of the systems are being properly supplied by the goodies produced in the leaves. A regular, intensive pruning program does not assure you that all will be well, but it is a necessary component of excellent cultural practices.

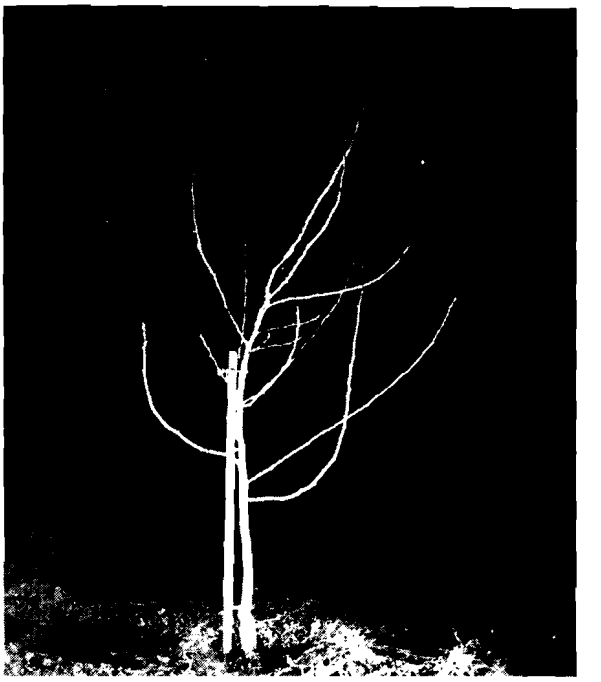
Walnut trees, at the end of the first year in the orchard, should have one or more vigorous shoots of several feet in length. Because the trees were severely headed at time of planting these are too low to be kept as branches. For this reason only one is allowed to remain to become the trunk from which branches will be allowed to develop. After the first winter pruning in the orchard the trees will look just about as they did when received from the nursery.

Remember that any buds that push into growth the first summer or even have a neck should be removed. All primary branching on walnuts should come from buds that do not push into growth until they have completed at least one winter. Buds that grow or even start to grow the same summer that they form are very apt to have crotches so weak that the resulting limbs are liable to split off at the crotch.

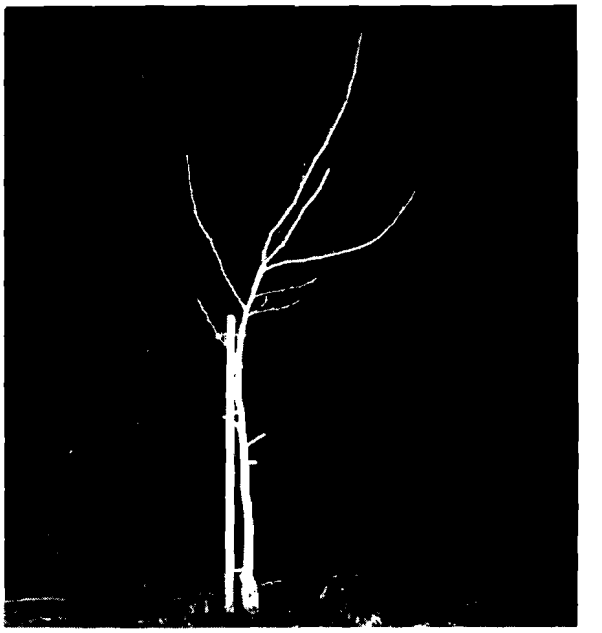
If side branches are so low that it is obvious no pruner would ever let them develop into limbs, these can be cut back to six inch stubs. These will help nourish the trunk and increase the taper of the trunk. A-1 rootstock shoots should be cut off smoothly at the trunk.

This tree has been in the orchard two years. It is obvious that stubs were left low on the trunk at the end of the first year. It is also obvious that the growth from those stubs should have been restricted during the summer so that more growth could have occurred higher in the tree. Growth low in the tree can be used as a brake, or accellerator, for top growth. Restricting lower growth encourages the top growth. Allowing uncontrolled lower growth tends to reduce top growth.

The strong, lower growth was again cut back to stubs. This will be continued until the trunk at that point is perhaps five inches in diameter. The terminals of suitable permanent limbs were headed so as to again encourage strong terminal growth. The less-vigorous branches were not headed, so that the terminal bud will be allowed to fruit and thus not develop into a limb, but will be the start of the fruiting wood system.

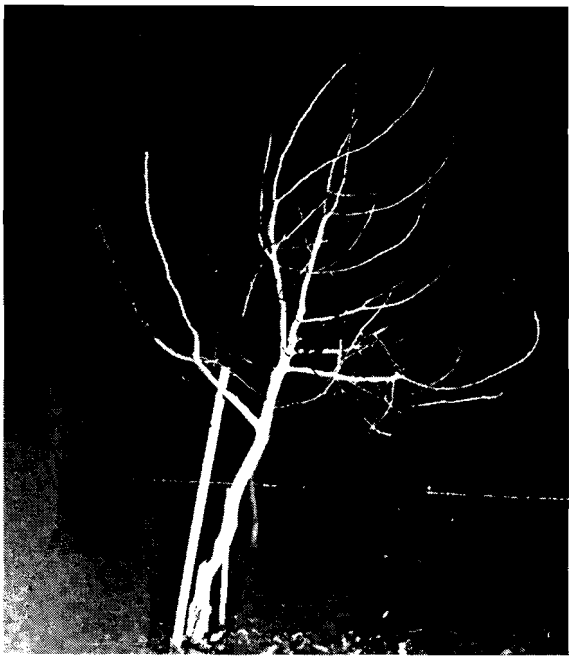


This vigorous two-year tree has grown very well in both the first and second year in the orchard. At the end of the first year only one shoot was retained and it was headed about eight feet above ground. If any neck buds were present they were removed so that all of the branches presently on the tree have suitably wide crotches.

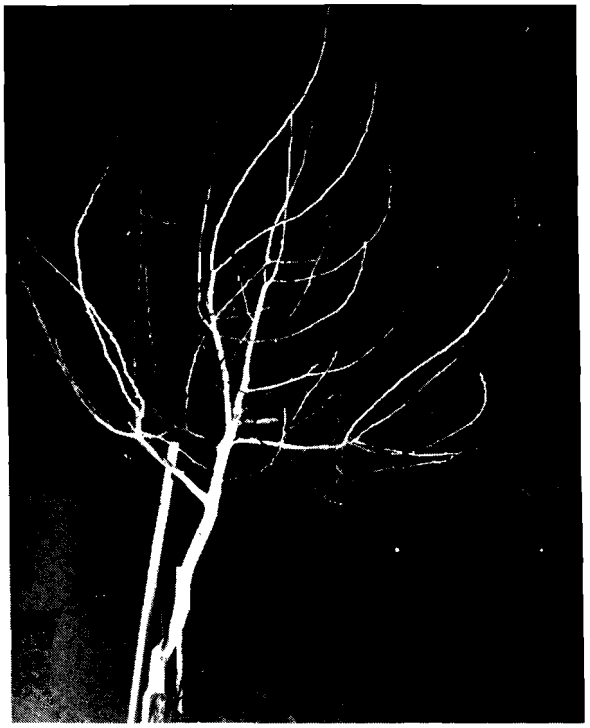


After pruning there are four possible permanent limbs. Each of these was headed so as to encourage strong upward growth again during the third year.

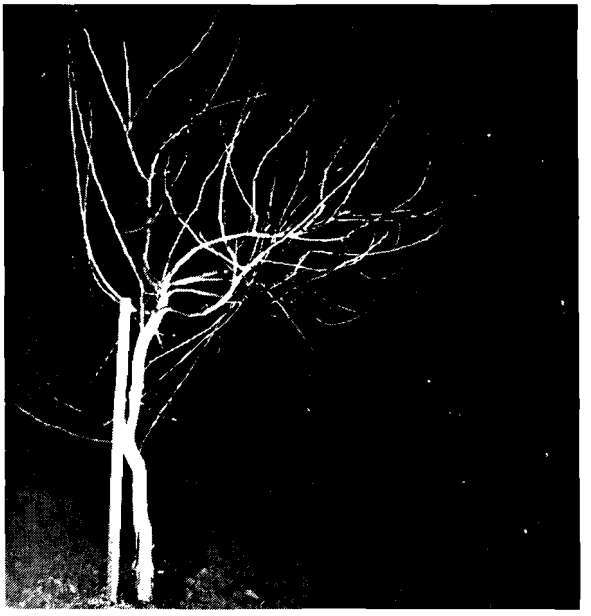
Fruiting wood is starting to accumulate and the very low branches were stubbed so as to increase trunk taper, which is virtually nil at present. The stake is too chose, thus the tree has not been allowed to stiffen on its own. Such a tree will be in serious trouble should the tie at the top of the stake break.



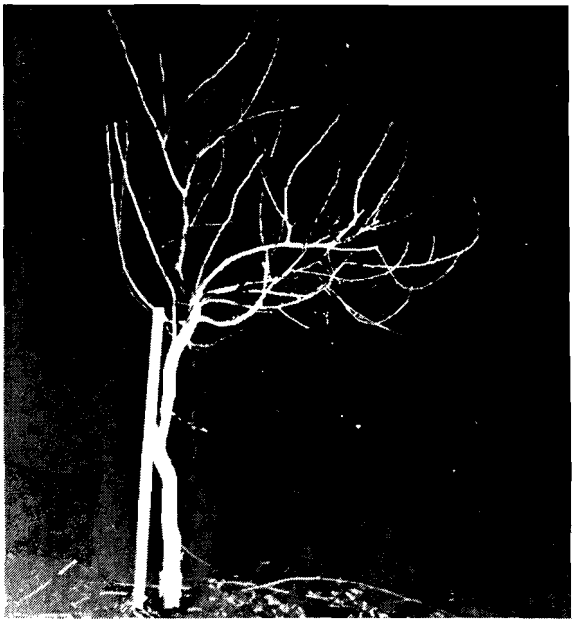
This three-year walnut has grown quite well and is showing the effects of our west side windy conditions where staking is wise. At least three quarters of the growth is south of an imaginary centerline. No attempt has been made to hold the main trunk near the stake. This sort of growth is somewhat frustrating during the pruning process but is not a serious permanent problem.



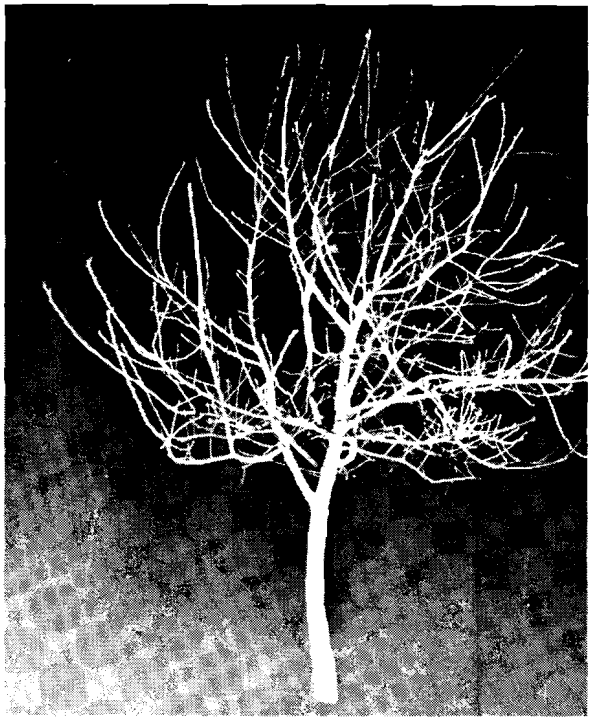
Some thinning-out cuts were made and the terminal portions of permanent limbs were headed. Just enough pruning was done on the south side to prevent the weight of growth and crop from pulling it even more downwind. We have to more or less build a brushpile as a back stop, then, in time, new developing limbs will be forced to grow into the wind. As the north side develops in the next few years the south side will be continuously headed and thinned so that in time the tree will be reasonably well balanced.



This tree has been in the orchard four years. The trunk shows that it did not grow very well during the first year, but since then the vigor has been normal. The most obvious thing about this tree is the bending caused by the daily northwest winds. You can see that what were selected as upright limbs in previous years have now become hopelessly wind-blown. This makes pruning a bit more difficult or interesting, depending on your point of view.



Again we must employ the brush-building backstop technique. Only enough heading and thinning is done on the south side to relieve some of the weight. Original primary limbs are often so bent out of position that they cannot be kept as such. Suitable strong growth is developing on the north side and these were headed. Within two or three years this will be a respectable looking tree.



The eastside wind conditions are not nearly as severe as those of the river but their effects can be seen. Most of the cuts were of the heading nature but a minimum of thinning was done. Fruiting-wood is fairly extensive in the lower portion and is not in large enough amounts in the upper portion to reduce strong growth. Most of the cuts for the next few years will be of the heading type and from then on, thinning-out will become of more importance.

OTHER TRAINING METHODS

The style or form of tree-training in this area has not changed very much during the past fifty years. We now head our stone-fruit trees (almonds included) higher at time of planting, as an aid to mechanical harvest. We train walnuts to a modified central-leader system now rather than just letting them grow.

More densely planted trees and totally different training systems have been common practice for many years in other fruit growing areas of the world. To date, most closely planted trees in Stanislaus orchards have developed into unproductive jungles. Training techniques have to be modified in high density orchards if the orchard is to be successful.

The major reason our local attempts have generally failed is that of excessive vigor. Vigor control in our stone fruits has only been possible through cropping. In apples where growth controlling rootstocks have been available, crop and vigor control have been easier. Cropping must start in the second or third year as a means of controlling vigor and also to pay for the additional investment in trees.

Discipline is even more essential in higher density planting and is twofold. You must realize that the kind of training system you are about to impose on the tree is even more different from nature's way than is your present system. The ultimate tree form, if desirable, will occur by allowing it to grow only in the way you want. You also have to discipline yourself to the extent that you are right on the spot when appropriate action must be taken. And this will probably be more than one time a year for the first few years.

There are two general approaches to higher density plantings. In both systems the trees are spaced closer within the rows than between rows. One is that of hedgerows or fruitwalls where in the closely planted direction the limbs from one tree sometimes or generally extend into the next tree. With the other system each tree is maintained as a free standing individual unit, but also smaller in size than normal because of the greater number per acre.

Plantings should, if possible, be oriented in a north-south line. The reason for this is to get maximum sunlight penetration. To plant in an east-west direction will mean that the north side of the tree-wall does not get adequate light for best fruit density and color. Growers in the southern hemisphere have shown your author where, with solid east-west rows, the south sides are not as profitable.

The next decision is that of whether or not a trellis of some sort will be used to train and support fruiting limbs. One or more wires are commonly used in apples, however in pears more hedgerow orchards use free-standing trees than wire supports. If a precise angle for the upward slope of lateral branches from the trunk is wanted, then wires are needed. In a successful clingstone peach hedgerow in this area single top wire was only used for the first few years while a single lateral limb to each side was being developed.

In training trellis plantings where each tree has two or more limbs growing from each side, that is, towards the adjoining trees, upward growth is a must. The terminals of each limb must be maintained, elevanted above all portions between it and the trunk. To do this they are kept at an angle of 30 degrees or more above the horizontal where continued extension of new growth is wanted.

Where growth-controlling rootstocks are not generally available such as with stone fruits, the tree wall or hedgerow approach is probably a better approach. Control of vigorous top growth, so that lower fruiting wood does not weaken and die, is critical.

Fruitwood thinning and renewal is not really greatly different from that of conventional vase-form trees. Fruit that is destined for fresh markets, where color is quite important, must have more sunlight than if for processing. Pickers must be able to reach slightly more than halfway through the trees in order to harvest the entire crop. Height control, as in full size trees, is a must and is aided by allowing trees to bear large crops of fruit.

Where individual trees are maintained in high density orchards, tree form is more like a Christmas tree rather than vase-shaped. Fruiting-wood is kept quite low so frosts are more of a hazard. Lower branches must receive their share of sunlight to survive and bear, which dictates their extending farther from the trunk. This type of branching eliminates this form of tree from mechanical harvesting.