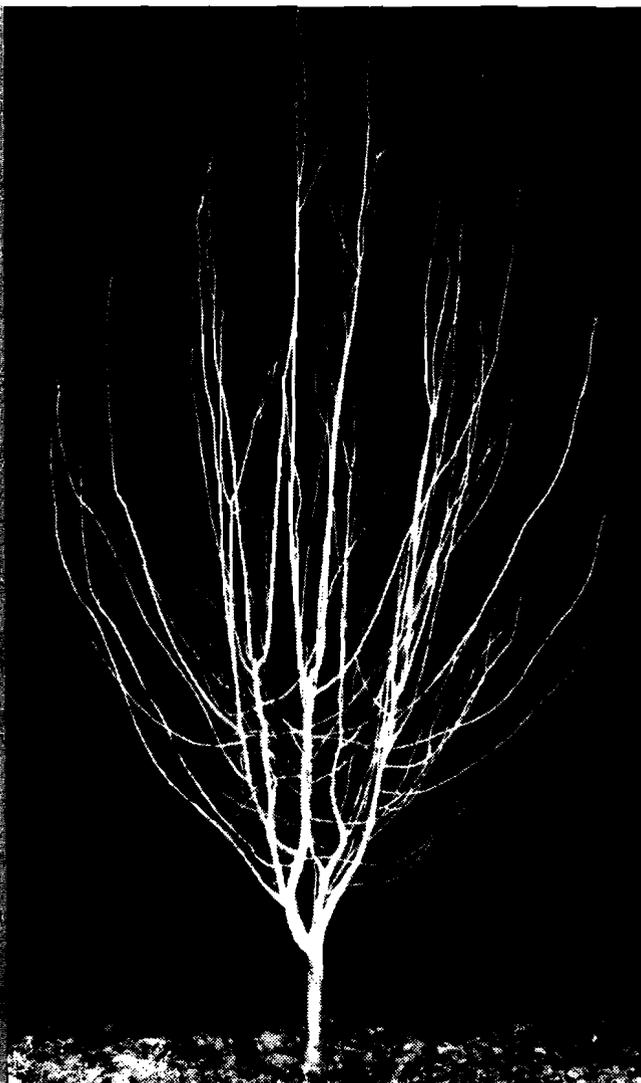


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Pruning Fruit and Nut Trees



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A glossary of terms used in this publication can be found on page 46.

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Pruning Fruit and Nut Trees

PRUNING EQUIPMENT

In pruning, three tools are usually needed: pruning shears, pruning saw and, often, an orchard ladder.

Pruning shears commonly have two blades: a single-beveled cutting blade and a hooked or curved noncutting blade. The head usually contains a bumper to reduce pruner fatigue. Handles are of hardwood or metal and the overall shears (head and handles) come in lengths up to 36 inches. The long-handled pruning shears are used to make cuts up to 1 inch in diameter and are often called "lop-pers." Smaller hand shears can be used on young trees and limbs of ½-inch diameter or smaller. Pole pruners with a shear head mounted on an 8- to 12-foot pole also are available as an alternative to using a ladder for access to the upper portion of large trees. The cutting blade is operated by a lever-and-rod mechanism.

Pruning saws have a wooden handle with an 8- to 15-inch curved saw blade. The teeth are wide set (about 6 teeth per inch) so that green wood can be cut easily. Pole saws (a regular pruning saw on a

long pole) are sometimes used for making saw cuts in large trees rather than using a ladder.

Orchard ladders are wood or aluminum and commonly manufactured in even-foot lengths, such as 8, 10, and 12 feet. They are three-legged (tripod) with the third or positioning leg hinged at the top to the other two. *Do not use four-legged ladders for tree pruning* because they lack stability on uneven ground surfaces. *Do not use tripod orchard ladders on cement or other hard, smooth surfaces* because the single leg will slide and the ladder will collapse. Mechanical, man-positioners (commonly called pruning towers) are sometimes used in place of ladders.

Mechanized shears and saws are also used. These are operated by electrical, hydraulic or pneumatic means. Tree topping and side-hedging are sometimes done mechanically, using a series of large circular saws or a sickle bar arrangement, although this practice may be questionable for some species.

PRUNING FRUIT AND NUT TREES

There are two pruning phases in the life of fruit trees. In the first young trees (age 1-4 to 6 years) are pruned or *trained* to provide a structurally strong framework for supporting a maximum fruiting area easily accessible for cultural and harvest operations. In the second phase older trees are *pruned* to maintain, renew, and evenly distribute fruit wood throughout the tree. At pruning time weak and

broken limbs, interfering branches and unneeded water sprouts also are removed. In California, deciduous fruit trees are normally pruned during the dormant season each year.

TRAINING SYSTEMS

Three training systems are usually used for developing fruit and nut trees in California: open center, modified central leader, and central leader. The

system selected depends mainly on the growth habit of the species of tree being trained and also on tree spacing.

The Open-Center or Vase-Shaped System

The open-center or vase-shaped system is most commonly used in California on almond, apricot, cherry, fig, nectarine, peach, pear, persimmon, plum, pomegranate and prune. Many apple and pistachio trees are also trained to this system.

Tree shaping to the open-center system is accomplished in a few basic steps. Variations are necessary because of differences in growth and bearing habits of the various species and varieties.

Pruning at planting. The tops of newly-planted trees should be pruned at planting time. Cut back (head) the tree at a point 24 to 32 inches above the ground. Hand-harvested trees are headed lower than mechanically-harvested trees which need higher heads for equipment access. Small trees (3/16- to 3/8-inch trunk diameter) usually have no lateral branches on their trunks. To prune properly head back (top) the trunk with one cut at the desired height above ground (Figure 1). The primary scaffold limbs that develop within 6 to 10 inches of this cut will form the tree head (crotch). Bigger trees (1/2-inch diameter or larger) usually have lateral branches along their trunks. Some of these branches can be removed completely, but others in desirable locations for permanent scaffolds should be headed back, leaving 2- to 4-inch stubs with one or two lateral buds (Figure 2). The trunk should be headed at the same height as smaller trees. Some larger trees (particularly yearlings) have potential scaffold limbs that can be headed back 6 to 8 inches from the trunk.

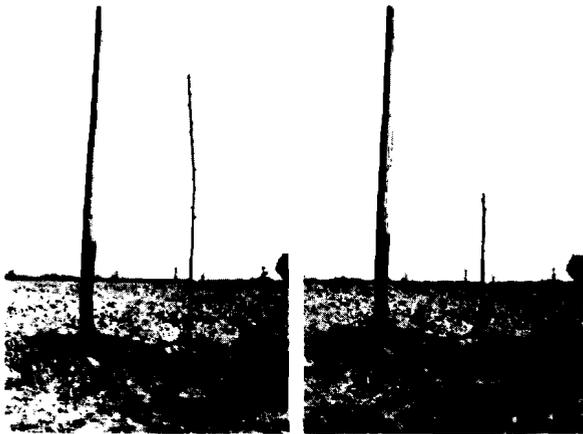


Figure 1. Many nursery trees have no lateral branches. To promote the development of primary scaffold branches, the unheaded tree (left) was cut back to 24 to 32 inches above the ground (right).

Many growers summer-prune during the tree's first growing season. This mainly involves removing undesirable branches (not wanted as permanent limbs), pinching back less desirable branches, and removing suckers. This allows good growth on branches desirably located for permanent scaffolds. The orchard is walked two or three times during the summer for pruning so that limbs are quite small when removed. All pruning is a dwarfing process, but summer pruning is especially devitalizing and can result in excessive growth reduction if too much leaf surface is removed. Thus, one should use caution in utilizing this practice and only experienced personnel should perform the task. Summer pruning can help spread the growth of some upright growing species.

First-year dormant pruning. Primary scaffold limbs are usually selected at the end of the first year's growth. These develop into the tree's main structural limbs, supporting top growth and crop load in later years. Most potential scaffold limbs grow just below the point where the tree was headed at planting time. Select three to four limbs that are distributed evenly around the trunk and, if possible, spaced approximately 6 inches apart vertically on the trunk, leaving small lateral branches along these scaffold branches for early fruiting, tree growth and sunburn protection (Figures 3 to 5).

Do not select scaffold limbs that are directly above one another. Avoid upright limbs with narrow, acute angles from the trunk because they tend to be poorly attached to the trunk. Flat-angled (horizontal) limbs should not be selected for scaffold limbs because they will not give an upward growth pattern. For most species, angles for limb attachments of about 45 degrees are desirable. In windy areas it is advisable (where possible) to have the lowest scaffold growing toward the prevailing wind. If the



Figure 2. Nursery tree with lateral branches (left) was headed at 24 to 32 inches above ground, and many of the lateral branches were removed (right). A few lateral branches were cut back to leave short stubs, with one or two buds on each to develop into potential primary scaffold branches.



Figure 3. The unpruned 1-year-old peach tree (left) had numerous potential scaffold limbs arising from its trunk. With pruning (right), three limbs were left, spaced about 120 degrees apart around the trunk and several inches apart vertically. These scaffold limbs were headed slightly to promote branching at the desired points during the next growing season.



Figure 4. Trees with poor limb distribution on the trunk and uneven growth can be trained to develop satisfactorily. The unbalanced almond tree (left) was balanced by cutting the large scaffold limb more severely than the others (right).

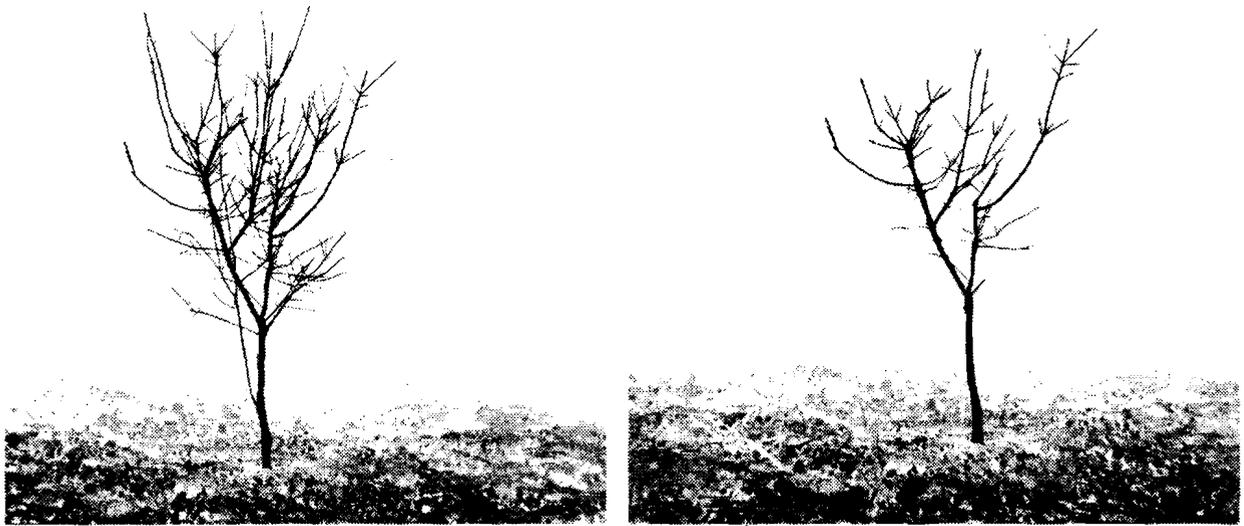


Figure 5. Some trees (left) do not have three desirable scaffold limbs. In such cases, a branch arising from a primary scaffold can be selected to fill in the space and provide another scaffold limb. The third scaffold limb was selected by cutting off weak limbs in the center of the tree and leaving a strong outside branch (right).

trees grow poorly the first year, severely prune primary scaffolds to three or four buds to promote vigorous growth the next year. If poor growth continues, the cause should be investigated and corrected and the tree replaced.

Primary scaffold branches on many fruit trees, like peach and apricot, are headed back during training to insure lateral branching at the desired point. Almonds, however, should usually not be headed back. Heading back or thinning to outside laterals is usually done at 24 to 36 inches from the point at which the scaffolds originate (at the tree's head). In heading back, the topmost scaffold should be left the longest to maintain its vigor. Other upright growth and interfering branches are removed, but a few small lateral shoots are left for early fruiting and shade. Some fruit trees, like plum and pear, produce very upright growth and the scaffolds should be cut back to outside lateral branches to

provide tree spread (Figure 6). Other trees, like many almond varieties, have a spreading growth habit and tend to produce lateral branches without heading. With these varieties it is often necessary to remove flatter-angled branches and leave upright laterals, thus maintaining an upward, outward growth pattern.

Second-year summer pruning is sometimes practiced to cut back scaffolds that bend over because of excessive weight by removing only enough growth to keep the limb upright. Again, one should go through the orchard fairly often in May and June to remove vigorous upright water sprouts arising along the scaffolds and rootstock suckers. At this time, however, one should not attempt detailed pruning and selection of potential fruit wood because as much leaf surface as possible should be retained to maximize tree growth.



Figure 6. So that it would develop an open center, this 1-year-old Japanese plum tree was pruned to leave outside, spreading limbs, and was headed to promote branching at the desired locations.

Second-year dormant pruning. Select two vigorous lateral branches arising 24 to 36 inches from the head on each primary scaffold to serve as secondary scaffolds. These limbs should be well positioned around the tree to fill the tree's eventual circumference (Figures 7 to 12). While two secondaries are usually selected, some primaries may be left with only one secondary and, in a few cases, three may be warranted, because of vigor and placement. If more than two secondary scaffolds are left per primary scaffold, some of the resulting limbs may be weak, may develop less fruit wood and may be apt to break with heavy crops.

Do not overprune while attempting to form a symmetrical tree. Each tree grows differently and few provide the opportunity to develop the perfectly shaped tree. Thus, one must use judgment to train each tree into the best possible framework from the limbs available. The open center system is not a rigid system; rather, it is intended to adequately

provide the expanding fruiting area with structural limbs.

Secondary scaffolds can be headed as were the primaries the previous winter at 24 to 36 inches above their crotch with the primary scaffolds. Again, this depends on the lateral branching character of the species and almonds usually should not be headed. When two secondaries are headed on one scaffold, it is best to leave one somewhat longer than the other. Again, spreading trees should be trained to maintain an upward growth pattern, while non-spreading trees should be trained to an outward growth pattern.

Large, flat-angled (70 degrees and greater) limbs growing from main scaffolds should be completely removed along with upright vigorous shoots in the center of the tree. Allow most of the less vigorous, flatter-angled lateral branches to remain to develop as fruit wood.



Figure 7. Many branches needed to be removed from the vigorous 2-year-old peach tree (left). Low and horizontal limbs were cut off, and vigorous moderately upright limbs were selected for permanent secondary scaffolds and headed at 24 to 36 inches above their crotch with the primaries (right).



Figure 8. This 2-year-old vigorous almond tree (left) had too many limbs. These were removed during pruning to leave two secondary scaffolds on each primary limb (right). Many small lateral branches were left for fruit wood.



Figure 9. The lower and horizontal limbs of this young, moderately vigorous fig tree were removed. Secondary scaffolds were thinned to two or three per primary scaffold and were headed back at about 24 inches above their crotch with the primary scaffolds, where additional branching was desired.



Figure 10. On this moderately vigorous, upright growing Japanese plum tree (left), it was important to remove the interior upright limbs and to leave outside spreading branches (right). The secondary scaffolds, with desirable lateral branches, were headed just above the side branch, while others without side branches were headed at a height where branching was desired (about 24 to 36 inches above their crotch with the primary scaffolds).

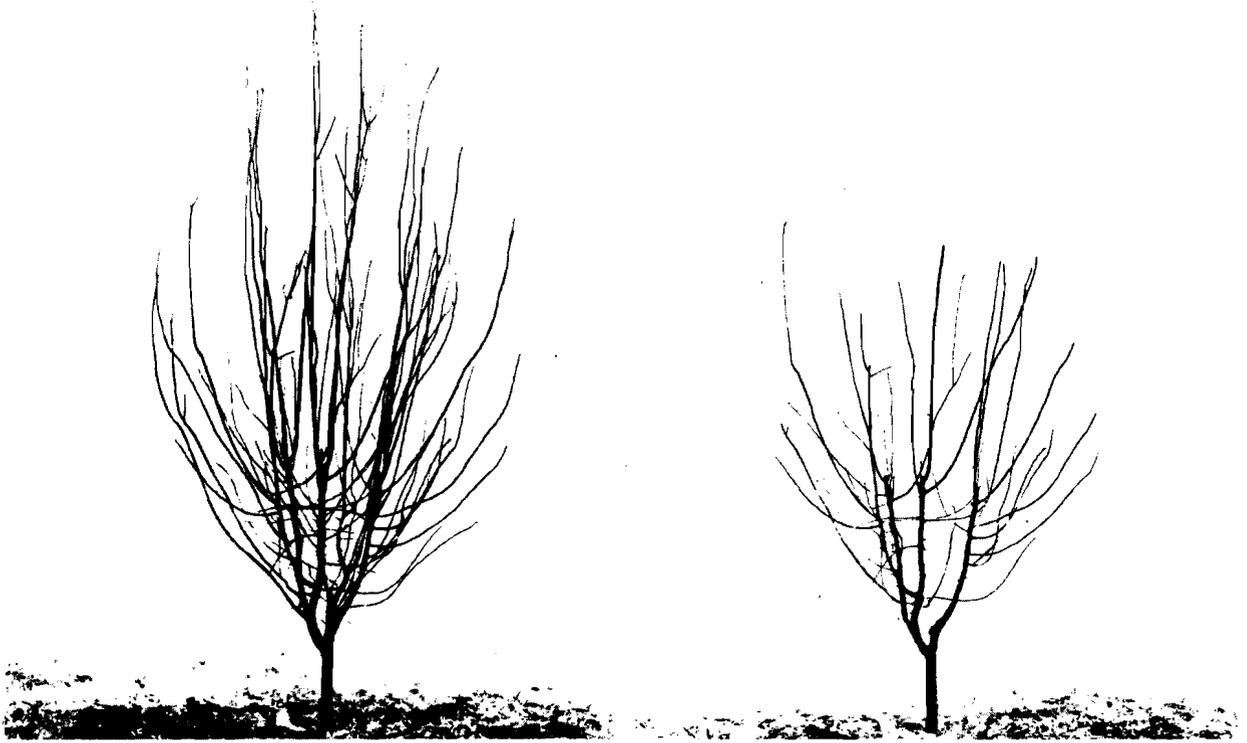


Figure 11. This prune tree was pruned to leave fairly long lateral branches for fruit wood. In later years, these branches may be shortened to reduce overcropping.

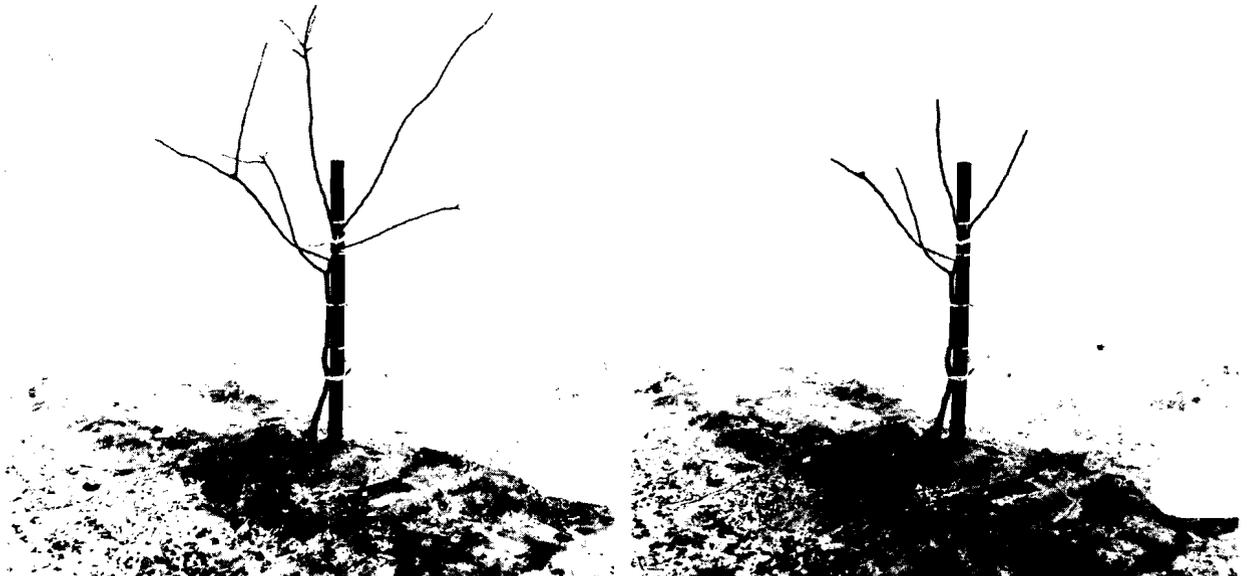


Figure 12. This young pistachio tree was summer pruned to eliminate unwanted branches, and the dormant pruning only consisted of heading back the existing limbs to encourage branching.

Tree training continues in the third and fourth dormant seasons as trees are pruned to grow upward and outward (Figures 13 to 20), while the open spaces are filled with scaffold limbs and fruiting branches. This kind of pruning, including heading as necessary to induce branching and maintain vigor, should be continued until the tree reaches its mature height.

At the end of 4 years of growth a tree should have three to four primary scaffolds at the head with five

to seven secondary scaffolds 4 to 6 feet above the ground. At 7 to 10 feet above the ground additional branches should fill the periphery of the tree top. Less vigorous, flatter fruiting wood was selected and thinned out during the first 4 years of structural training. This wood produces the first crops as the tree enters its bearing phase. The center of the tree should be somewhat open to permit light infiltration to maintain and stimulate further development of fruiting wood.



Figure 13. This 4-year-old peach tree should bear a substantial crop in its fifth year. Fruit wood was thinned out to adjust the crop load and reduce fruit thinning.

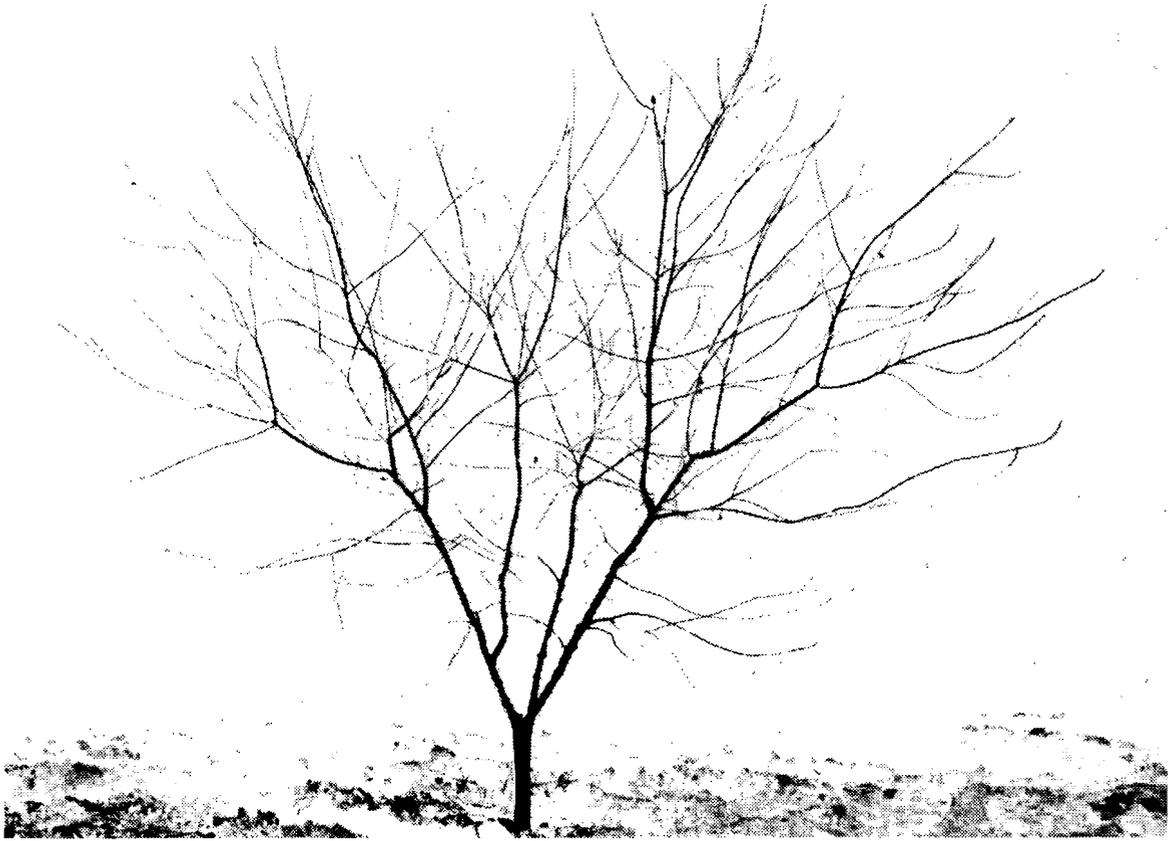
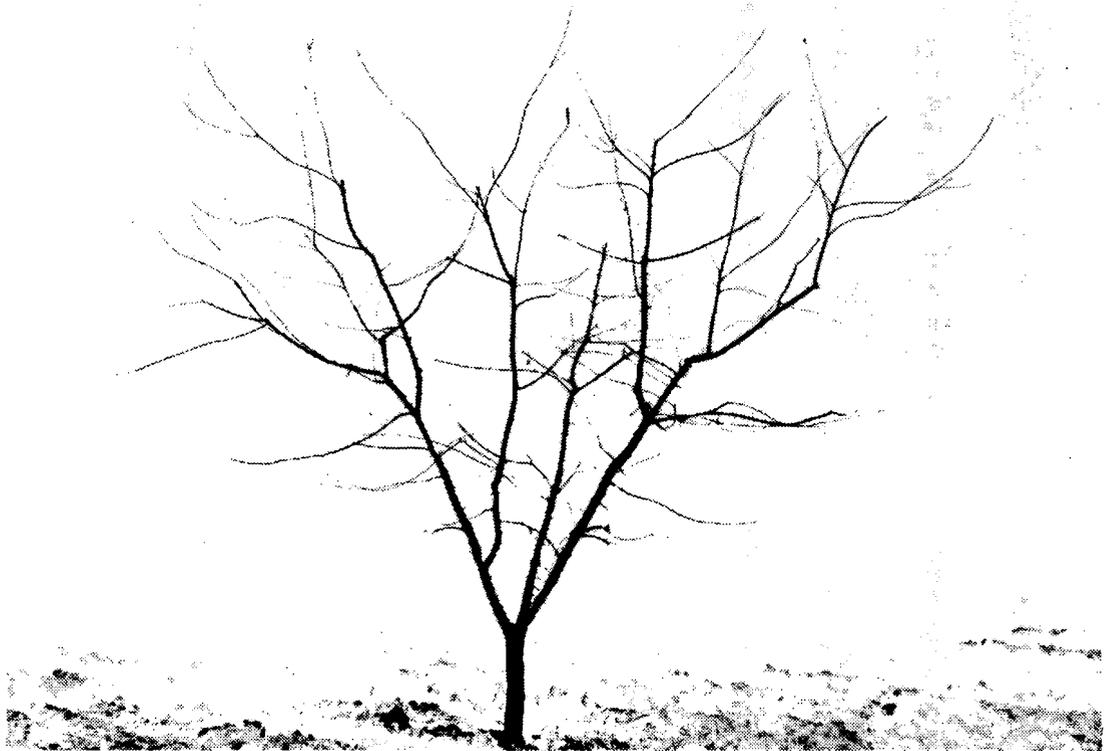


Figure 14. An apricot tree often tends to spread excessively. Train it to grow upward by removing horizontal limbs (below). Scaffold limbs must be headed to maintain desired tree height. Thinning of fruit wood also is necessary.



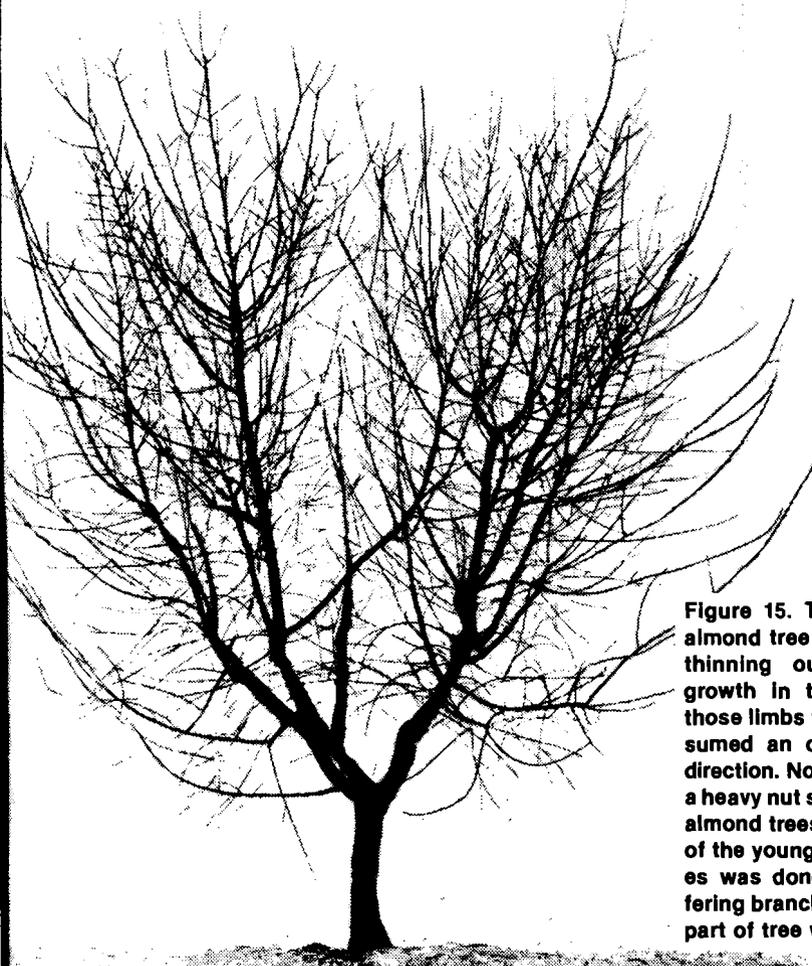


Figure 15. This 4-year-old almond tree was pruned by thinning out undesirable growth in the center and those limbs that had not assumed an outward-upward direction. Note that because a heavy nut set is desired on almond trees, little thinning of the young lateral branches was done. Larger interfering branches in the lower part of tree were removed.

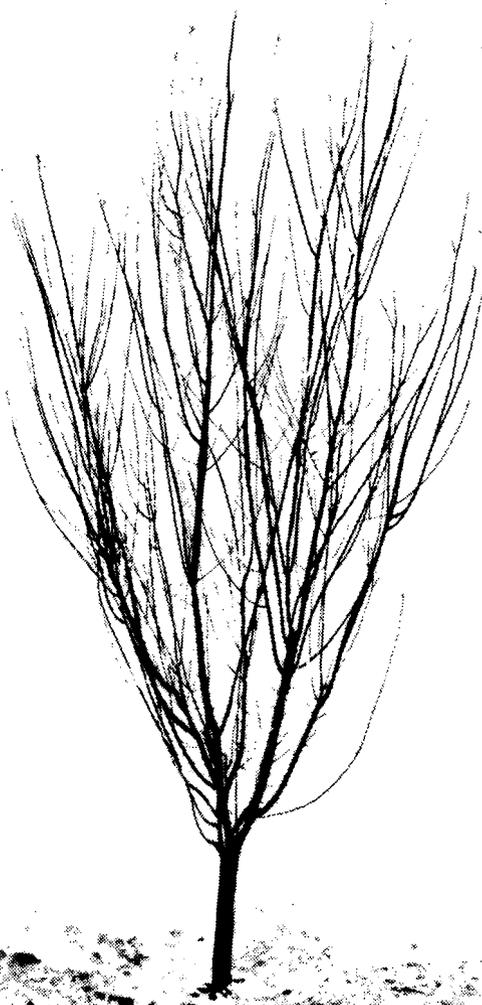
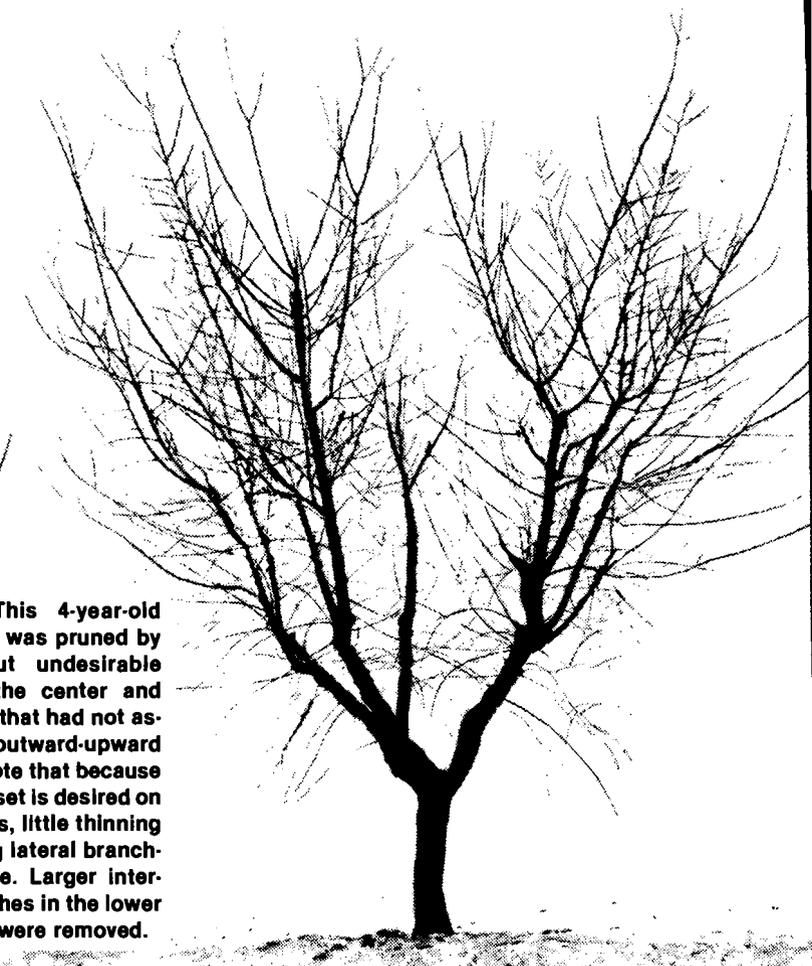
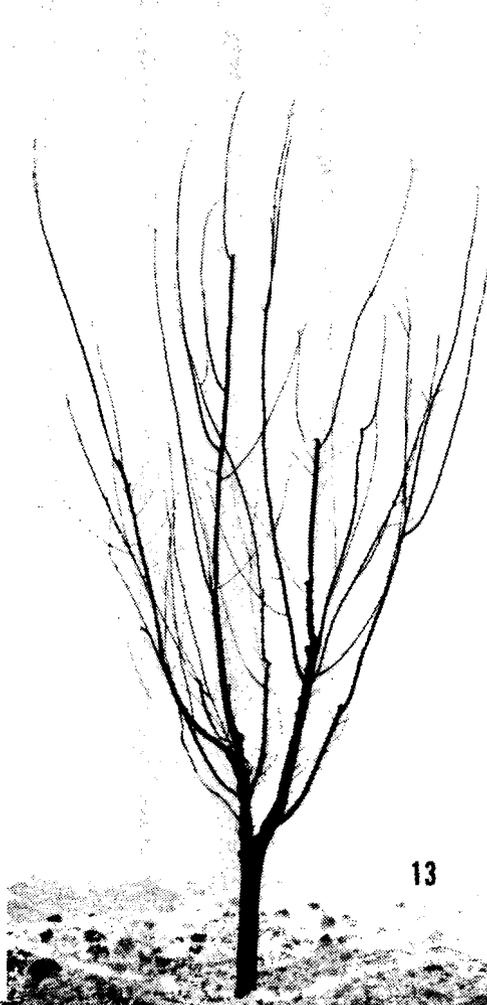


Figure 16. This 3-year-old plum tree was pruned by thinning the tertiary scaffolds to one or two per secondary scaffold. All interfering branches in the center of the tree were removed (right). By pruning to outside branches the weight of leaves and fruit next summer will help spread this naturally upright growing tree.



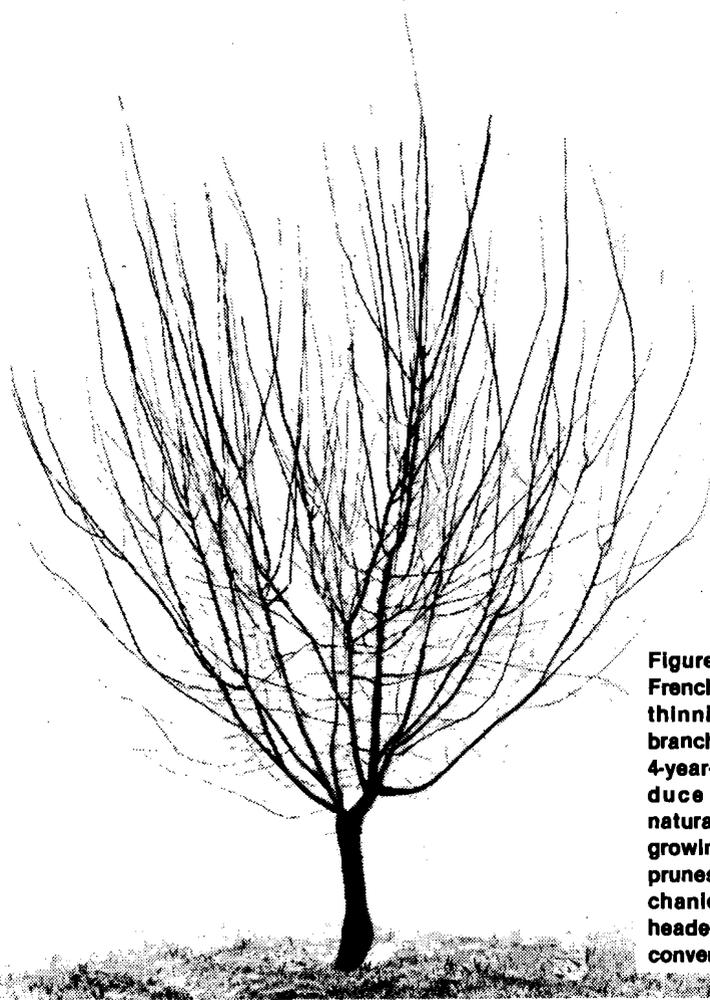


Figure 17. This 4-year-old French prune was pruned by thinning out interfering branches (right). The upright 4-year-old branches will produce lateral branches naturally during the fifth growing season. Because prunes are harvested mechanically, they are not headed to maintain a height convenient for hand harvest.

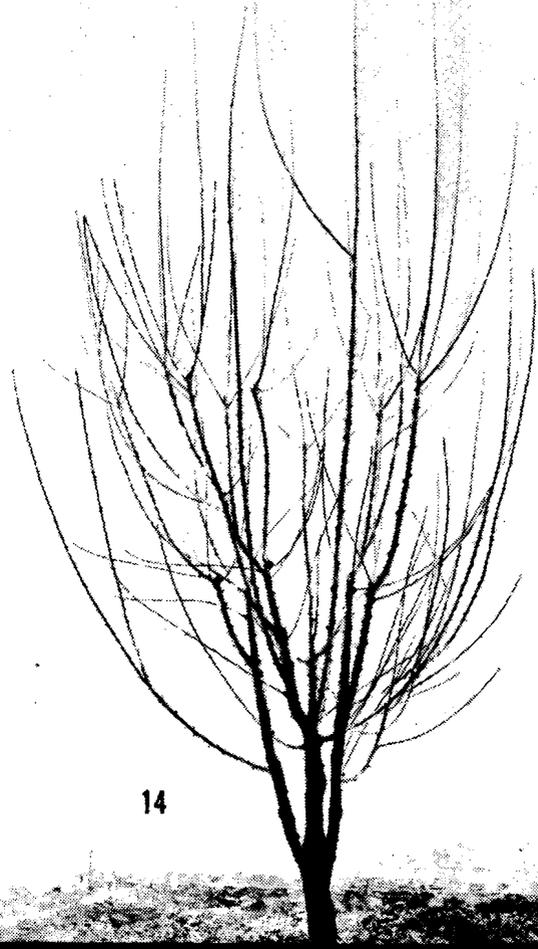
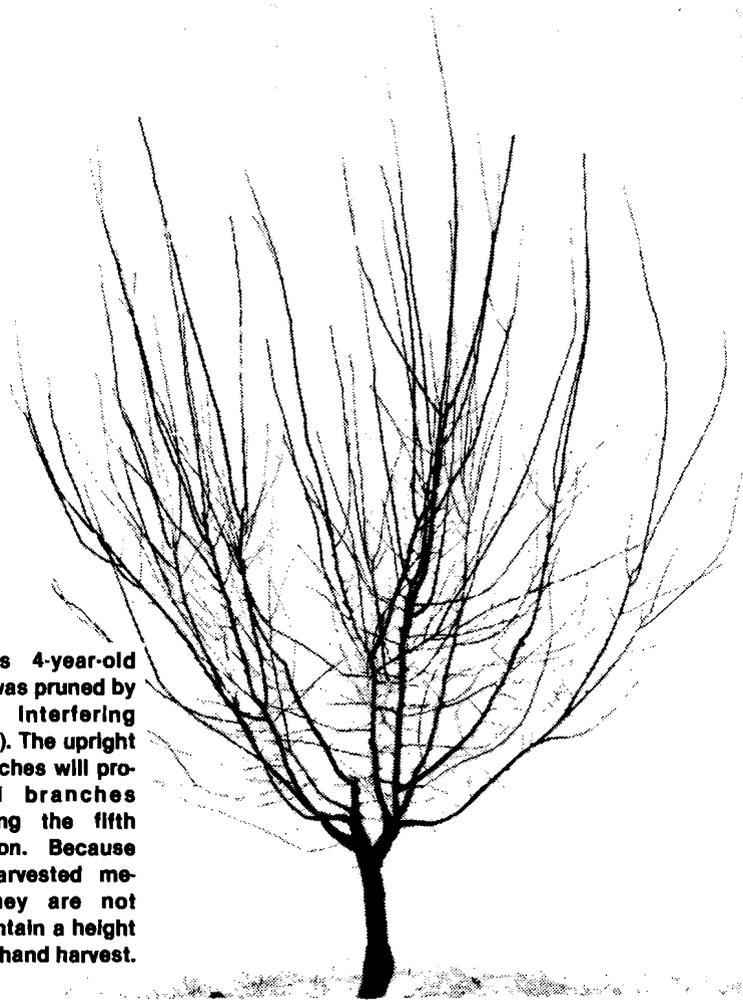
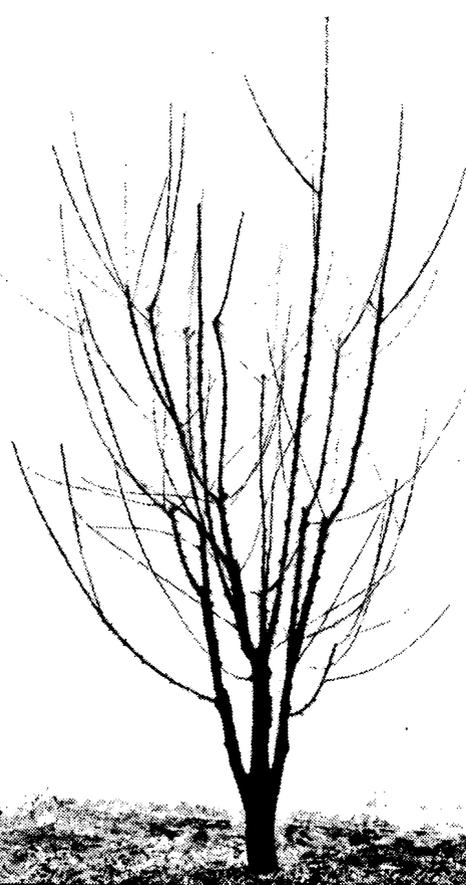


Figure 18. This 4-year-old cherry tree was pruned by thinning out excess growth and by cutting to outside growing lateral branches to encourage tree spread. Some of the tertiary scaffolds were headed back to encourage further branching (right).



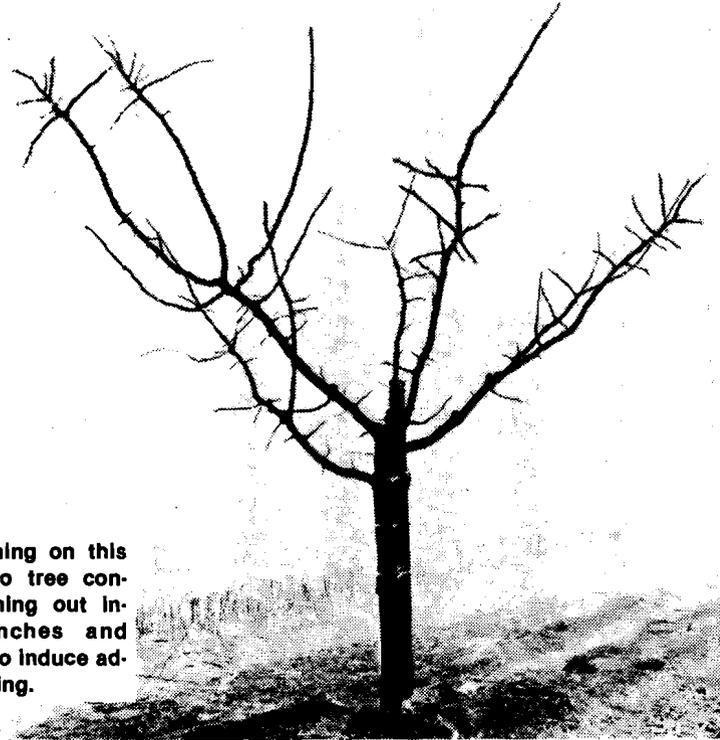
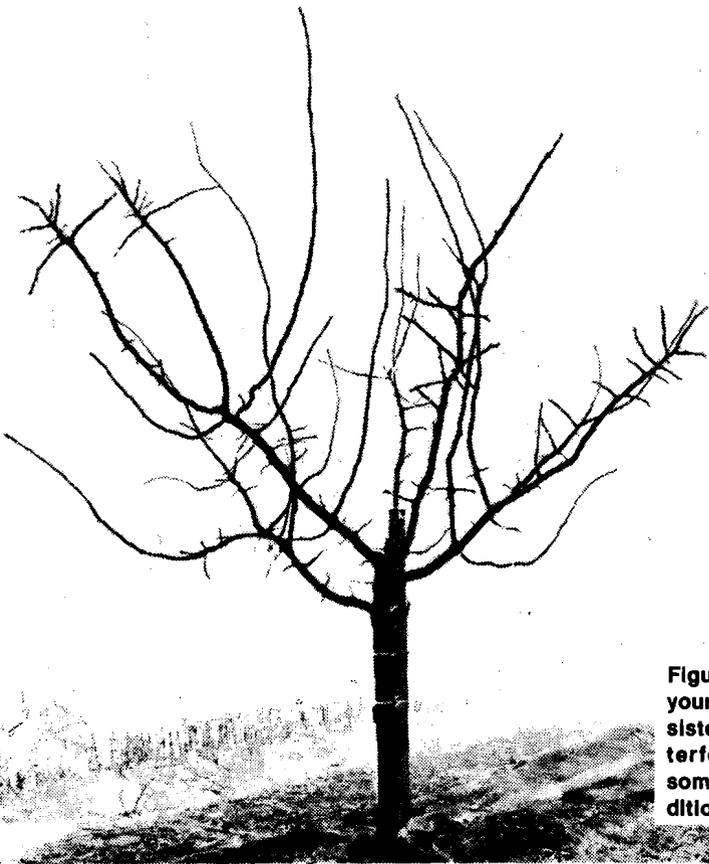


Figure 19. Pruning on this young pistachio tree consisted of thinning out interfering branches and some heading to induce additional branching.

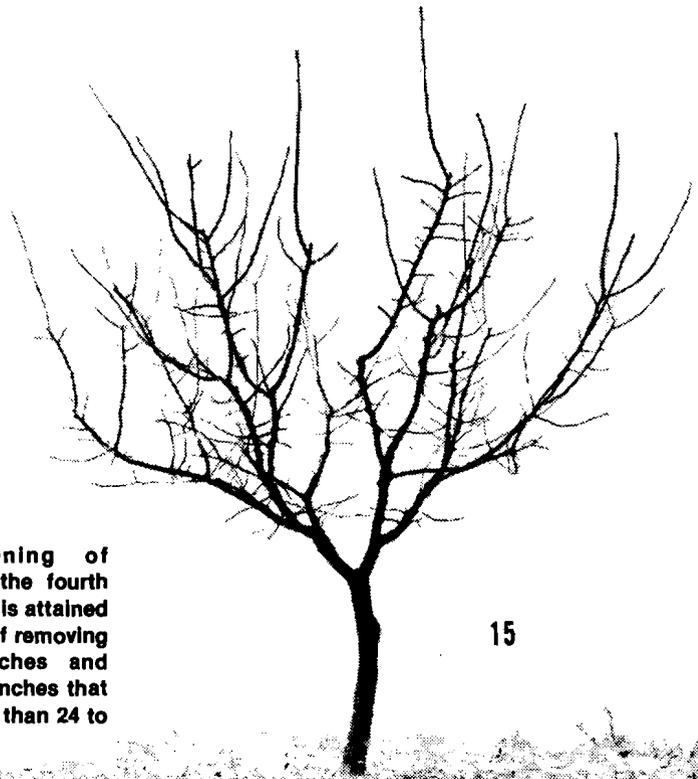
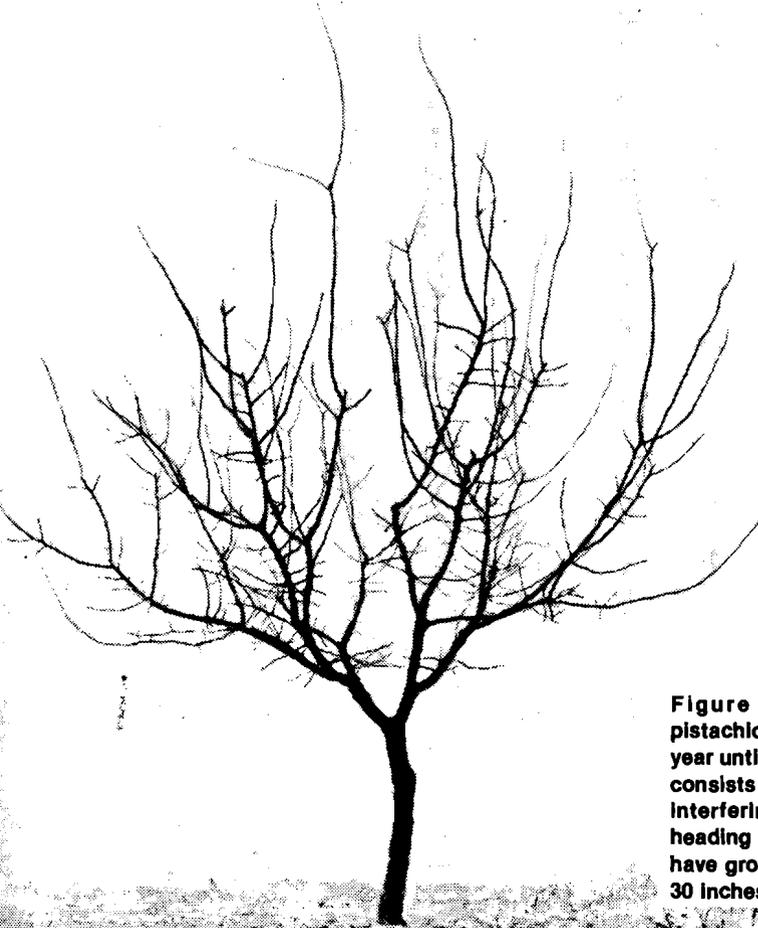


Figure 20. Pruning of pistachios from the fourth year until full size is attained consists mainly of removing interfering branches and heading back branches that have grown more than 24 to 30 inches.

There are a number of variations to the open center system that should be mentioned:

(1) Because light infiltration to tree centers is not a major concern with almond trees, a canopy of foliage is often allowed to develop to partially fill their centers as they mature. Also, they are not topped to contain tree height. Thus, the tree develops an umbrella-like top or canopy. Most fig trees are trained similarly.

(2) Pear trees and some apple trees tend to grow very upright. To increase fruiting area while maintaining structural strength, outside lateral branches are left along major upright limbs (Figure 21). Some growers, however, still place spreader boards horizontally between primary scaffolds to force them to spread somewhat (Figure 22).

(3) Another method of spreading upright trees,

such as Japanese plum, is to stub back vigorous interior branches to 12 to 18 inches and to leave less vigorous outside branches at longer length. The interior stubs force the outside branches to assume a wide angle growth pattern. A year later the stubs are removed completely.

(4) Different varieties of the same species may produce trees with differing growth habits. For example, Nonpareil almond tends to spread, while Mission almond grows upright. Thus, flatter, wide angled limbs are removed from Nonpareil, while upright, narrow angled Mission limbs are removed.

(5) Trees, such as cling peaches, that are to be mechanically harvested on catching frames are trained to a fairly rigid system. Secondary scaffolds must not overlap and all structural branches should be trained to allow freefall of fruit to the catching frame.

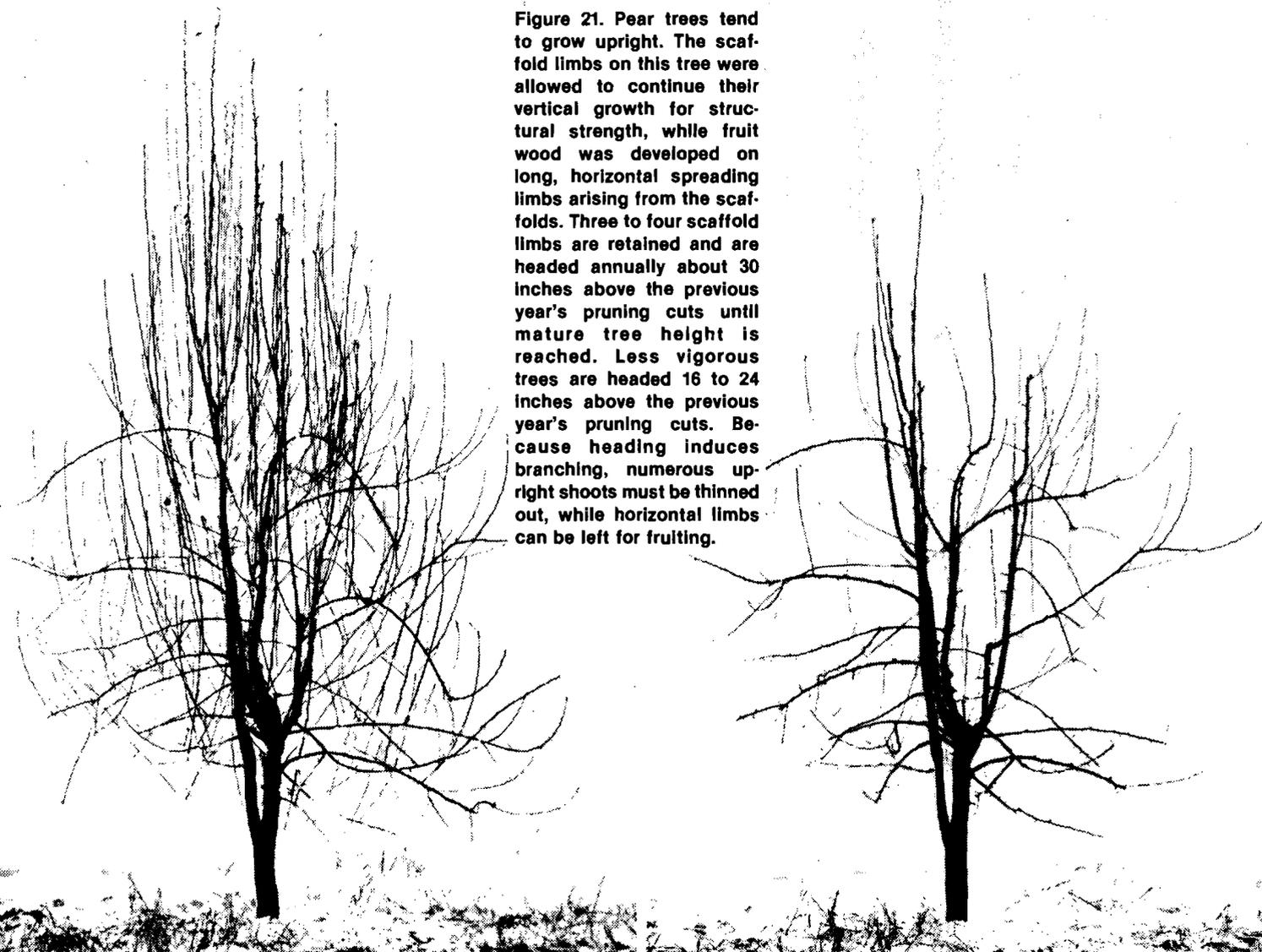
The image shows two pear trees side-by-side. The tree on the left is taller and has a more upright growth habit, with several vertical scaffold limbs extending upwards. The tree on the right is shorter and has a more spreading growth habit, with horizontal limbs extending outwards. Both trees have a central trunk and several main scaffold limbs. The caption explains that the scaffolding limbs on the left tree are allowed to continue their vertical growth for structural strength, while fruit wood is developed on long, horizontal spreading limbs arising from the scaffolds. Three to four scaffold limbs are retained and are headed annually about 30 inches above the previous year's pruning cuts until mature tree height is reached. Less vigorous trees are headed 16 to 24 inches above the previous year's pruning cuts. Because heading induces branching, numerous upright shoots must be thinned out, while horizontal limbs can be left for fruiting.

Figure 21. Pear trees tend to grow upright. The scaffold limbs on this tree were allowed to continue their vertical growth for structural strength, while fruit wood was developed on long, horizontal spreading limbs arising from the scaffolds. Three to four scaffold limbs are retained and are headed annually about 30 inches above the previous year's pruning cuts until mature tree height is reached. Less vigorous trees are headed 16 to 24 inches above the previous year's pruning cuts. Because heading induces branching, numerous upright shoots must be thinned out, while horizontal limbs can be left for fruiting.

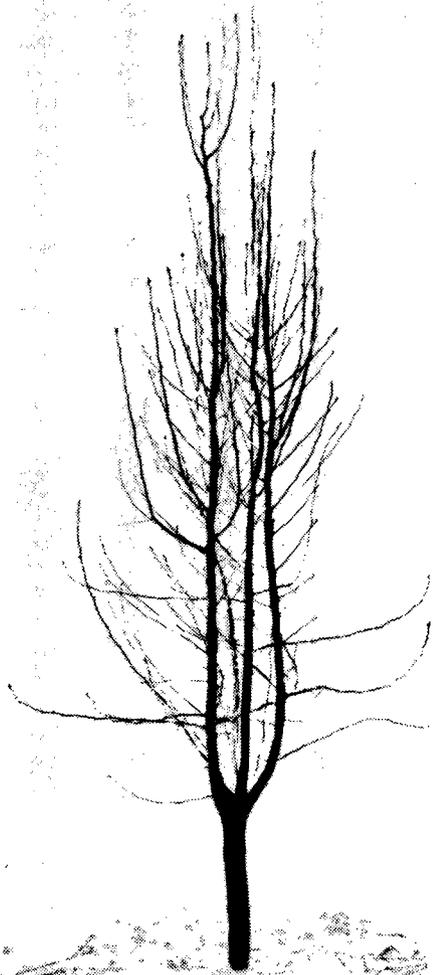
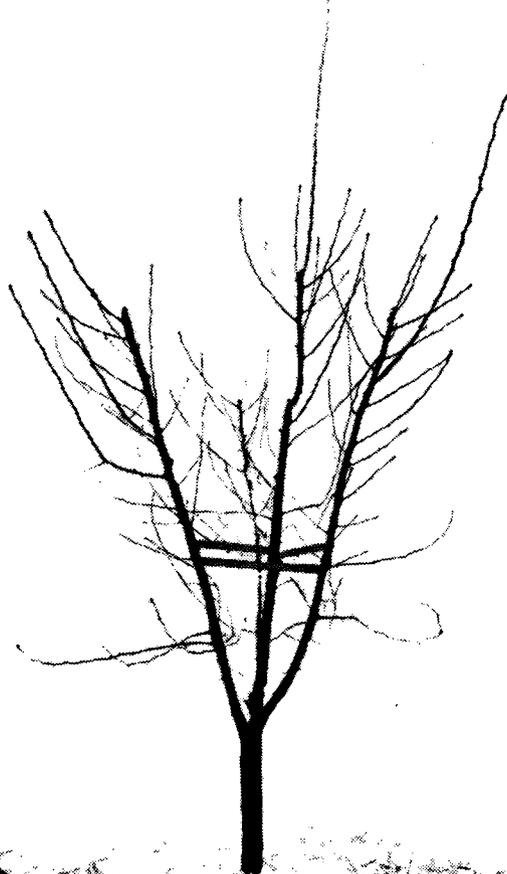


Figure 22. This pear tree developed an upright, narrow shape that cannot be corrected solely by pruning. An open center can be developed by the use of spreader boards. Spreader boards can be made by notching the ends of lath or by inserting finish nails into the ends of 3/4- to 1-inch square sticks. These boards are placed between limbs to spread them. *Be careful not to spread limbs too far apart—they will split at the crotch.* To further reduce splitting of crotches, spread only during the growing season.



Modified Central Leader or Delayed Open Center

The modified central leader system is used mainly on the higher headed nut trees, such as pecan and walnut. With this system, 4 to 6 primary scaffolds are developed from the main trunk before the open center is allowed to develop.

Training is done in the following way:

Pruning at planting. Walnut and pecan trees are severely headed to four to five buds above the graft union (Figure 23). In windy areas a support stake, at least 2x2 inches that extends about 6 feet above the ground, is set next to the tree. During the first summer one shoot is encouraged to dominate by lightly pinching back the other shoots and loosely tying the main shoot to the stake. This shoot (leader) will become the tree trunk.



Figure 23. After the walnut tree (left) was planted, it was headed back to four to five buds above the graft union (center) and was staked (right) to support the new growth which will occur during the first growing season.

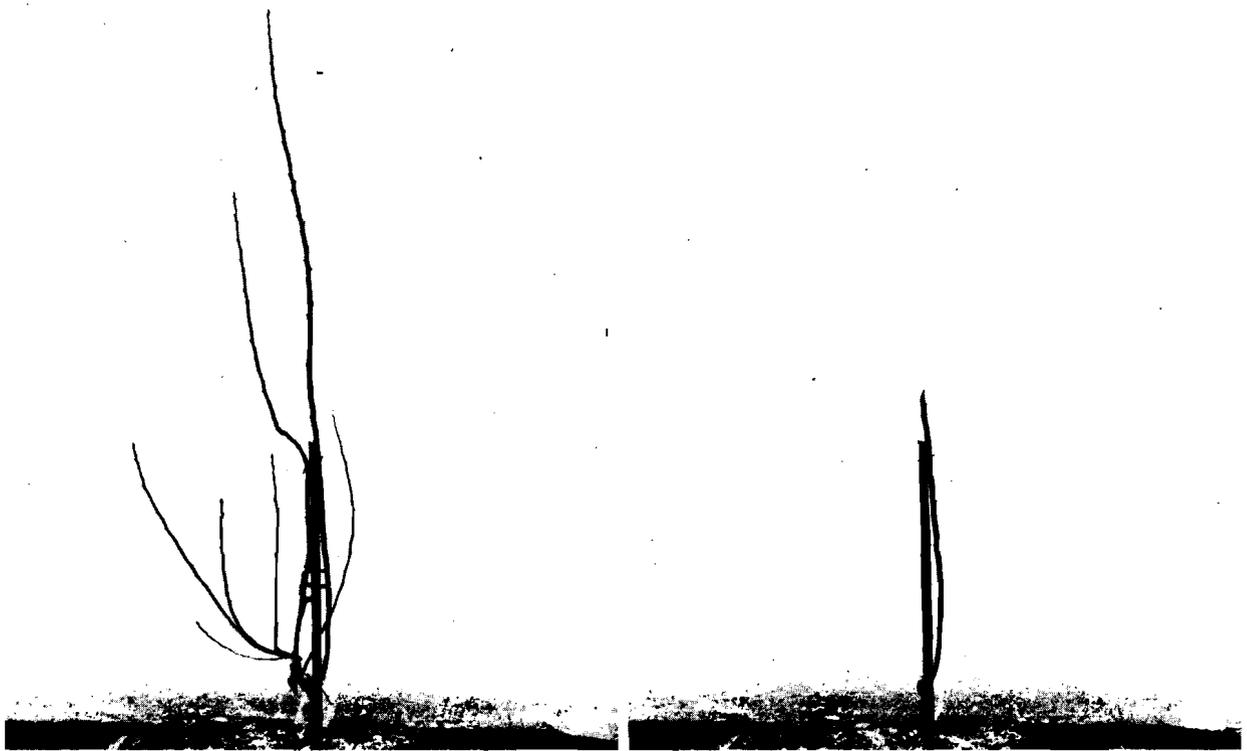


Figure 24. After the first growing season, all lateral branches were removed and the central leader was headed about six inches above the stake.

First winter. Head the staked leader just above the height desired for the lowest scaffold (about 6 feet for pecan and walnut). The uppermost bud continues as the leader for the development of additional scaffolds. Try to leave at least three buds above the stake to avoid interference by the stake (Figure 24). Necked buds (Figure 25) near the top of the leader should be rubbed off, since these will produce narrow angled, poorly attached primary limbs.

If the leader did not reach the minimum height desired for the lowest scaffold, it should be cut back to round, mature wood and continue to be trained up the stake during the second season. Remove all lateral shoots, since they tend to be poorly attached and may eventually break at the crotch.

In the *second growing season* continue to keep the leader tied to the stake if present. Pinch back vigorous shoots along the trunk and rootstock which arise below the lowest desired primary scaffold.



Figure 25. Necked buds (arrow) on walnut are undesirable for scaffold limbs. Secondary buds (below necked buds) will form limbs with strong, wide-angled crotches.

During the *second* dormant pruning select primary scaffold branches by starting with one 5 to 7 feet above the ground that ideally faces the prevailing summer winds. Select additional scaffolds, if present, upward along the leader at intervals of several inches or more, forming a spiral pattern around the trunk (Figure 26). Do not select flat limbs or ones with narrow, weak crotches, such as those arising from necked buds. Completely remove lateral branches just below the lowest scaffold and cut others located lower on the trunk to short stubs. Growth

from these stubs, which may need occasional pinching back, will provide shade for sunburn protection and will help to increase trunk growth. Head back vigorous limbs selected for scaffolds by removing one-fourth to one-half of their length, depending on fruiting potential of the variety (the more fruitful the variety, the more it is headed back). Hartley and other strictly terminal bearing varieties require no heading of scaffold limbs. The leader must be left longest to avoid being choked out by lower branches.

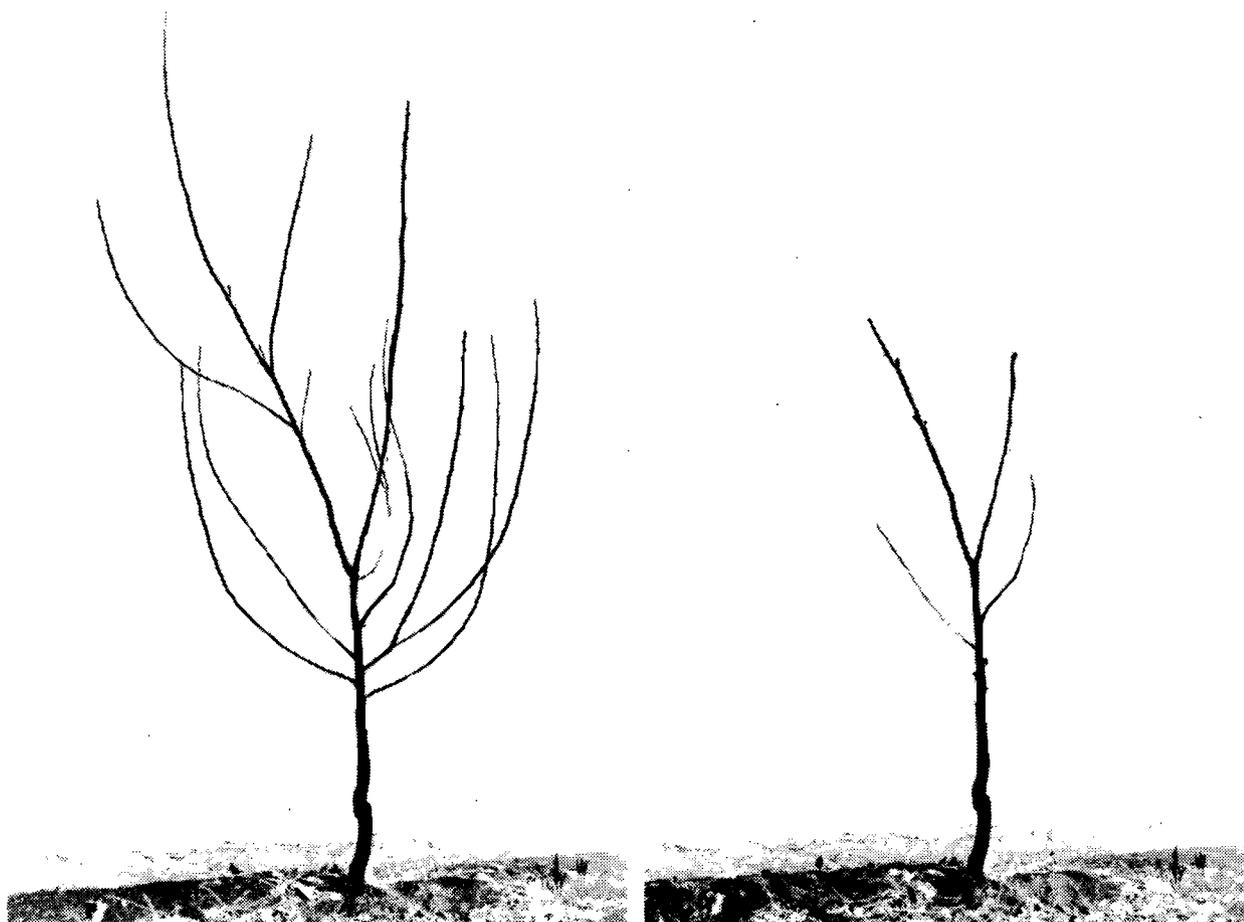


Figure 26. After the second growing season for this walnut tree, three lateral branches were selected and headed back and the central leader headed but left the longest to encourage its dominance. All other branches were removed. In windy locations a stake would continue to be used.

In *subsequent* years continue to select primary scaffold branches from the leader until four to six are present (Figure 27). Then allow the leader to become the topmost scaffold. Continue to head

back scaffolds on very fruitful varieties each winter. Completely remove stubs along the trunk when it is about 4 to 6 inches in diameter at the base.



Figure 27. After the third growing season an additional two or three lateral branches were selected on this walnut tree. The central leader may be allowed to bend outward and become the topmost scaffold or maintained for an additional year to develop more lateral branching.

The Central Leader System

The central leader system is often used in high density or "hedgerow" plantings. Training apple trees to this system is accomplished as follows:

Pruning at planting. Head back the newly planted tree to a height of 24 to 32 inches. Handle lateral branches as described for open center trained trees. During the following spring and summer, check the trees at 4- to 6-week intervals to make sure the uppermost limb (central leader) is dominant. Pinch back any strongly competing limbs and remove any narrow-angled (almost vertical) limbs.

First dormant pruning. Select three to five *wide-angled* lateral scaffold branches along the leader (leaving 18 to 24 inches between the lowest scaffold and the ground). These branches should be distributed as evenly as possible around the tree and

spaced vertically along the leader 2 to 4 inches apart. Remove other large limbs and all upright branches (except the central leader). Head the central leader and scaffold branches to promote branching and maintain vigor (Figure 28). If the tree has good vigor leave some small, flat-angled shoot growth for fruiting wood.

Pruning during subsequent summers. Remove any upright shoots from scaffold limbs and vigorous, narrow-angled branches that compete with the central leader. Thin out branched terminals on each scaffold to a single limb. As scaffold limbs approach their desired length (depending on tree spacing and area to be occupied by limb), and while they can still be easily bent (approximately $\frac{1}{2}$ to 1 inch in diameter at their base), they can be spread to a 45-degree angle with the central leader using spreader boards. Spreading should be done during the growing season to reduce limb breakage.

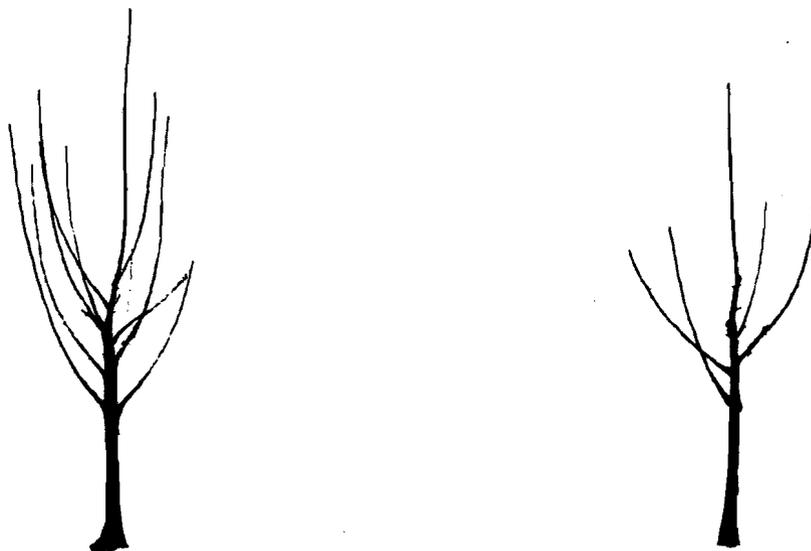


Figure 28. Apple trees are often trained to the central leader system. The first year's branches of this apple tree were thinned out to four scaffold limbs and the central leader was maintained. All scaffold limbs and the central leader were headed back with approximately one-third of last season's growth removed.

Pruning during subsequent dormant seasons. Continue to head back the central leader and main scaffold limbs, removing approximately one-third of last season's growth. Remove narrow-angled branches and any upright branches from scaffolds (the central leader should be the only upright limb in the tree). Two to three feet above the first group of scaffolds a second set of scaffold branches is formed from wide-angled limbs arising from the central leader (Figure 29). A third group of scaffolds may be formed at an additional 2 to 3 feet higher in

subsequent years, depending on tree vigor (Figure 30). During subsequent growing seasons these higher groups of limbs are also spread to about 45 degrees. Always leave at least 2 feet between scaffolds directly over each other. Each higher group of scaffolds should be shorter in length than those below it, giving the tree a pyramid or cone shape. Fruiting wood is developed on the scaffold branches and is thinned out to maintain tree vigor and yet encourage fruiting. Branched terminals are thinned to a single limb.

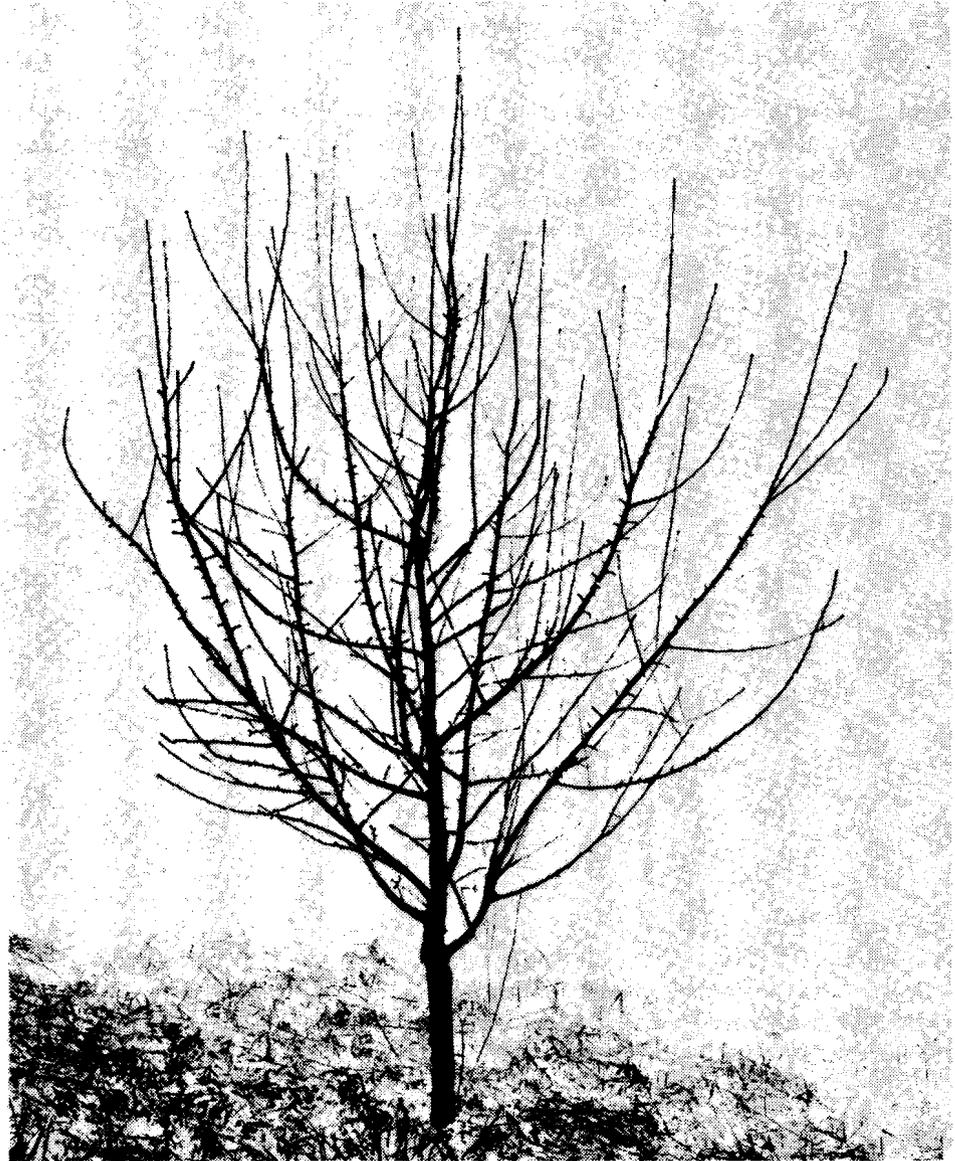
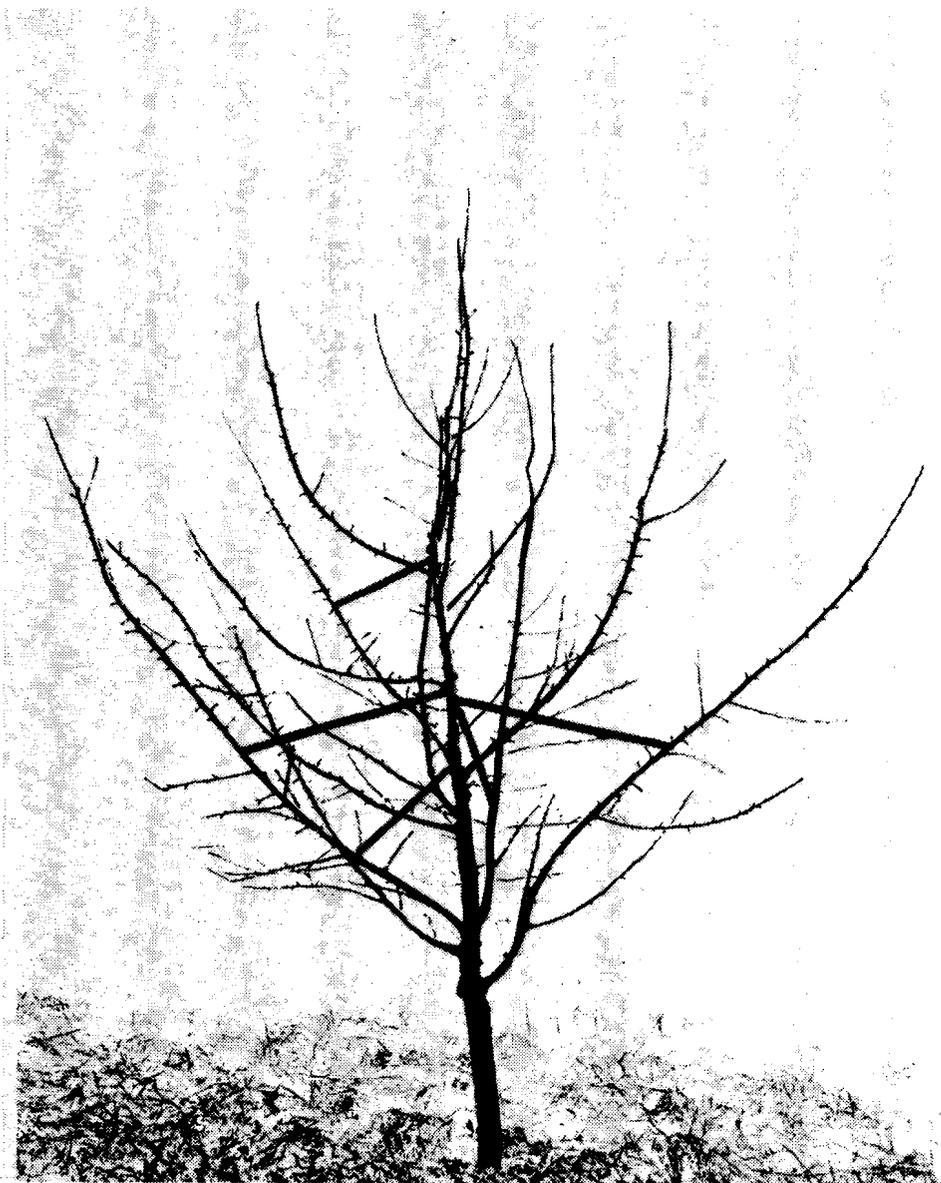


Figure 29. The upright and interfering branches of this 4-year-old apple tree have been continually thinned out and



the central leader maintained. Spreader boards are often used to achieve wider angles of lateral branches.

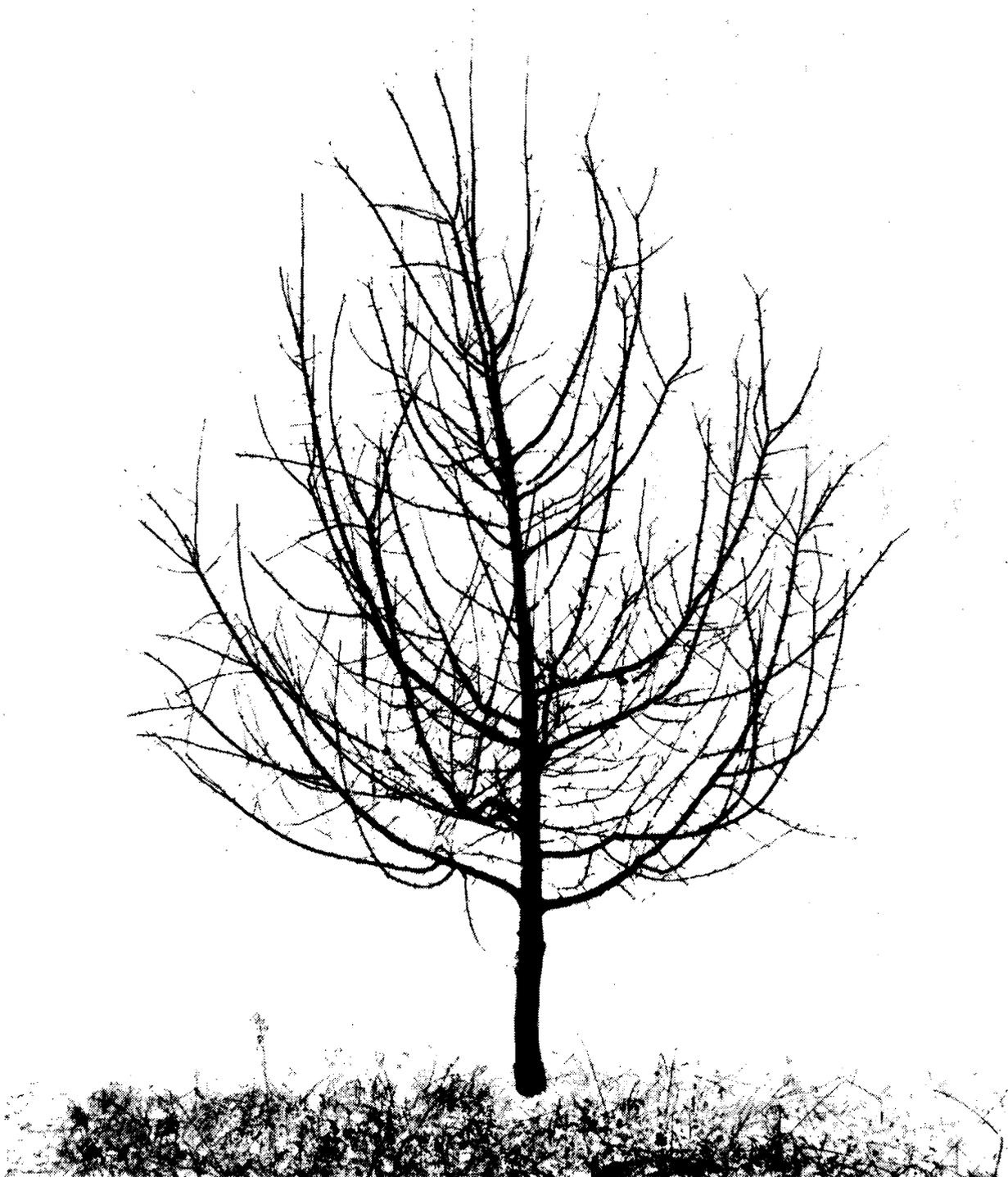
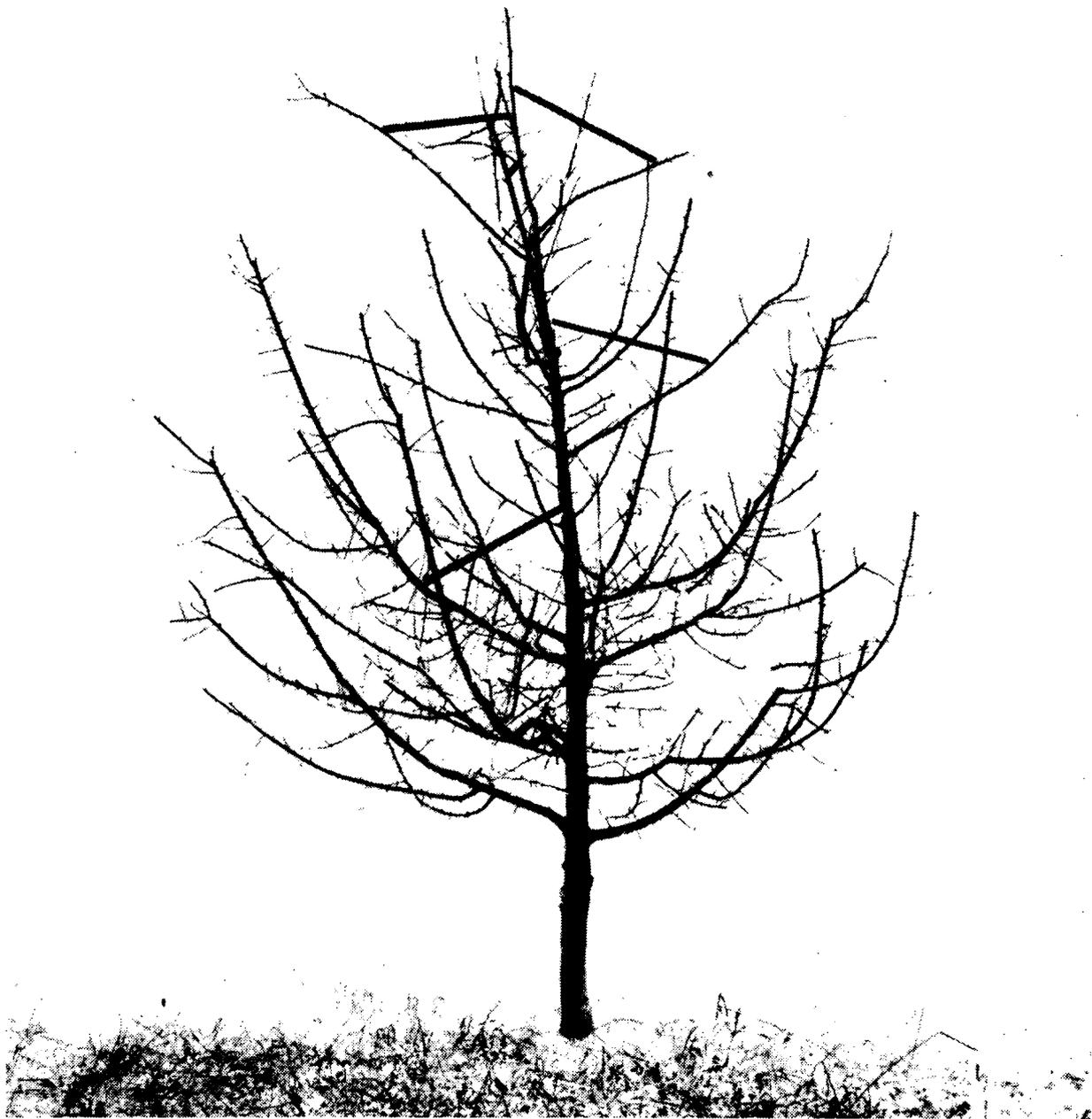


Figure 30. This apple tree illustrates continuation of the process shown in Figures 28 and 29. It can be maintained at a



particular height by annually heading the central leader at that level or by cutting it back to a shorter lateral.

Other Training Systems

Peach and nectarine trees. These have been planted in hedgerow orchards where two training methods have been successful. One is a dual leader system where two scaffolds are trained upward from the

trunk at a fairly upright angle to form a "Y" shape (Figure 31.) The leaders are kept in line with the tree row and are not allowed to branch further. Fruiting laterals arise directly from the main scaffolds. In a second method, the single leader spindle



Figure 31. A dual leader or "Y"-shaped peach tree is pictured after pruning.

system, the trunk is allowed to continue growth straight up as a dominant leader. Flat-angled (horizontal) secondary branches are distributed upward along the leader in a spiral pattern (Figure 32). Lower branches are slightly longer than those im-

mediately above them, giving a Christmas tree shape. Fruit wood arises from the flat-angled limbs and the central leader. Both methods require summer pruning every year to allow sunlight infiltration and maintenance of fruit wood.

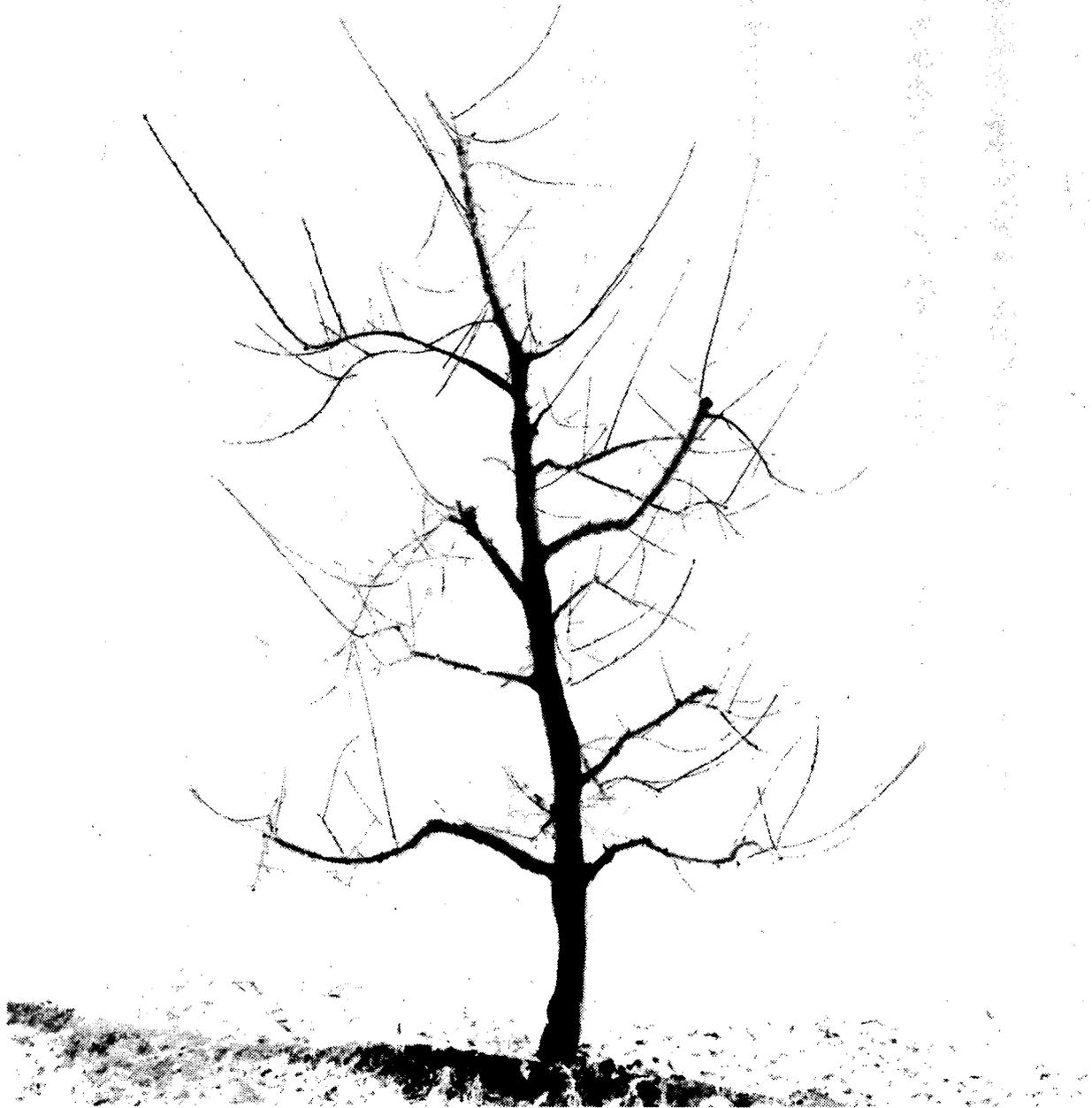


Figure 32. A single leader, spindle system-trained peach tree is seen here after pruning.

Dwarf trees. Genetic dwarf peach and nectarine trees are currently receiving considerable attention as possible candidates for high density, high yielding orchards where ladders are not required. These trees are very compact with short internodes (distances between buds). Final tree size is usually 6 feet high by 6 feet wide. At planting these trees are usually branched and the branches should be thinned out to allow a few to dominate as structural limbs. During the first few years thinning out of crowded limbs should be continued to allow development of a reasonably good tree structure (Figure 33). After the tree reaches full size, annual light thinning out of small branches is recommended to provide space for fruit production (Figure 34).

Olive. At planting only suckers or badly placed limbs are removed. Training involves the selection of three well spaced lateral branches along the trunk from 18 to 30 inches above the ground. This selection takes place during the first summer and the process of removing suckers, watersprouts and undesirable branches continues through subsequent developmental years with just enough trimming to develop a good structural system. Excessive cutting delays the age at which olive trees come into bearing.

During the first few years, little or no wood should be removed from the upper portion of the tree.

After trees come into bearing (at 3 to 5 years old) other pruning is required to develop a secondary scaffold system. This consists of about three permanent branches arising from each of the three primary scaffolds spaced around the tree so as to form a strong supporting framework for the fruiting top and side branches. It is best to develop this secondary scaffold system and to thin out unwanted branches over a period of several years. Heavy thinning out of branches in any one year causes trees to become so strongly vegetative that they stop bearing until fruiting wood again develops.

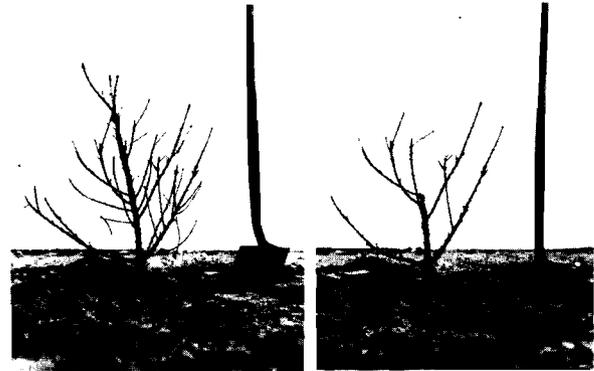


Figure 33. During the first few years, the pruning of genetic dwarf peach and nectarine trees consists of thinning out crowded branches to allow development of a reasonably good tree structure.



Figure 34. After the dwarf tree has reached full size, annual light thinning of small branches is recommended to provide space for fruit production without scarring from limbs rubbing against the fruit.

PRUNING MATURE TREES

A major objective of pruning mature trees is to keep them producing high yields from year to year by renewing and maintaining fruit wood. Other reasons are to adjust potential crop size, remove interfering branches and contain tree height and spread while maintaining adequate vigor. Methods vary between species because of differences in fruit-

ing habits, desired cropping levels, and acceptable tree size.

To prune selectively for crop load it is important to know the age and type of wood that is fruitful for specific species. For instance, almonds, apricots, plums (European and Japanese), prunes and sweet cherries bear most of their crops laterally on spurs (Figure 35). Spur wood is short-shoot growth that



Figure 35. Almond, apricot, prune, plum and sweet cherry trees bear fruit laterally on spurs. The center bud is vegetative and continues the elongation of the spur as it grows. Note the concentration of numerous flower (fruit) buds on a single spur.

grows less than four inches per year. Flower buds are produced laterally on spurs and these give rise to fruit the following season. In contrast, apples, pears and mature walnuts and pecans produce most of their fruit terminally on spurs (Figure 36).

Peaches, nectarines and some figs are fruitful on 1-year-old shoots that are 6 to 24 inches long (Figure 37). Other fruits like persimmon, pomegranate, quince and figs bear fruit on current season's growth.



Figure 36. Apple and pear trees produce fruit terminally on spurs. Note inserts that show (1) a fruit scar (where fruit was produced last year) on a spur and (2) a bud that will flower in the coming season.

At times, large limbs have to be removed from fruit trees. Such cuts should be avoided, if possible, because of the danger of large cuts becoming infected with wood rots, especially on apple trees. When they must be made, however, the limb

should be removed completely with a flush cut at the point where it originates. To avoid splitting the bark below the limb, first undercut the limb about one-third the way through and then finish the saw cut from above.

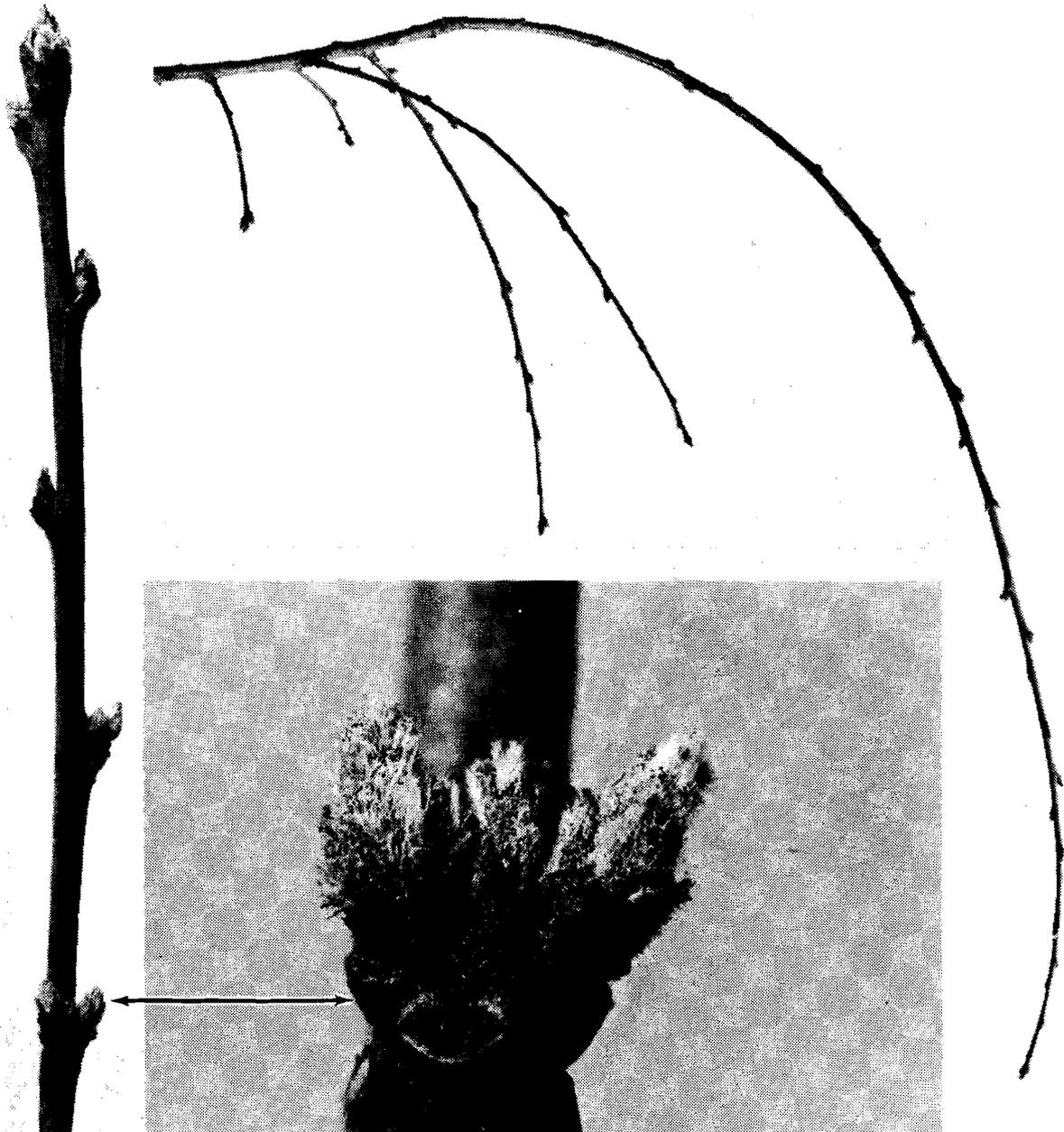


Figure 37. Peach and nectarine trees bear fruit on 1-year-old shoots. Note presence of three buds at a node (insert). The narrow middle bud is a vegetative (leaf) bud while the plumper side buds are flower (fruit) buds.

Fruit Produced Laterally on Spur Wood

Almond trees are grown to produce as many nuts (fruits) as possible. Since nut size is not important, there is no need for crop adjustment at pruning time. Almond trees bear most of their fruit laterally on spurs that live about 5 years. Thus, it is important to do sufficient pruning to stimulate enough new shoot growth to renew about one-fifth of the fruiting wood each year. Water sprouts can be used as renewal wood if they are located where needed. Pruning is accomplished by cutting $\frac{1}{2}$ - to $1\frac{1}{2}$ -inch diameter wood throughout the tree to stimulate new growth. This can at least partially be accomplished by removing interfering and weaker limbs. Always keep in mind that production is based on setting a maximum number of nuts year

after year. It is therefore important to continuously renew fruit wood each year rather than to prune severely every fourth or fifth year. Almond trees are not topped to contain tree height.

Apricot trees produce relatively short-lived spurs that usually die within 3 years. For this reason it is very important to remove lateral branches throughout the tree to cause initiation of renewal spurs. Removing some spurs and shoots reduces flower buds and potential fruit set; this, in turn, lessens fruit thinning requirements later in the year. Selective shoot pruning also allows light to enter into the tree, thereby encouraging development of lower fruiting wood. Mature trees are topped at a specific height for ease of cultural operations, such as hand harvest from ladders. Once a height is established,



Figure 38. Pruning in mature Japanese plum trees consists mainly of removing the 1-year-old shoot growth. Some

all lateral upright shoots arising at that point are cut back each year as closely to their point of origin as possible.

European plums have fairly long-lived spurs. Pruning involves only moderate thinning of lateral fruiting wood and results in a brushier appearance than Japanese plums or apricots. European plums tend toward alternate bearing, and growers often prune lightly following a heavy crop and more heavily following a light crop. Some upright growing varieties, like President, are topped each year while less vigorous varieties, like Standard, are not.

Prunes are European plums that are produced mainly for drying. The French variety is the most important and it should be pruned regularly by thinning out a few fairly large lateral branches to encourage upward and outward growth and to re-

place older fruiting wood. Broken or interfering limbs, frequently a problem, should be removed.

Japanese plum varieties vary widely in crop set. Some varieties set very heavy crops and require extensive pruning of spur wood each year to reduce cropping. Horizontal lateral branches are often headed back after extensive spur growth has developed. Other less fruitful varieties do not require as much fruit wood removal, but thorough pruning throughout the tree is still necessary. Replacement spur fruit wood is obtained by leaving unheaded 12- to 18-inch shoots that develop spurs in their second and third years (Figure 38). Later these can be reduced in length as described previously. Tree topping is always practiced at a constant height by cutting back upright shoots without leaving stubs.



1-year-old wood is left to develop spurs, while some of the old, weak spur wood is removed.

Sweet cherry has very long-lived spurs that remain fruitful up to 10 years. Annual (but minimal) pruning is required to provide some renewal of fruit wood. It is frequently necessary to remove interfering vigorous, upright shoots (Figure 39). Cherry

trees grow very upright, and it is important to leave spreading, lateral branches wherever possible. The topping height of cherry trees may be somewhat higher than some other trees because of the growth habit and height of the fruiting area.

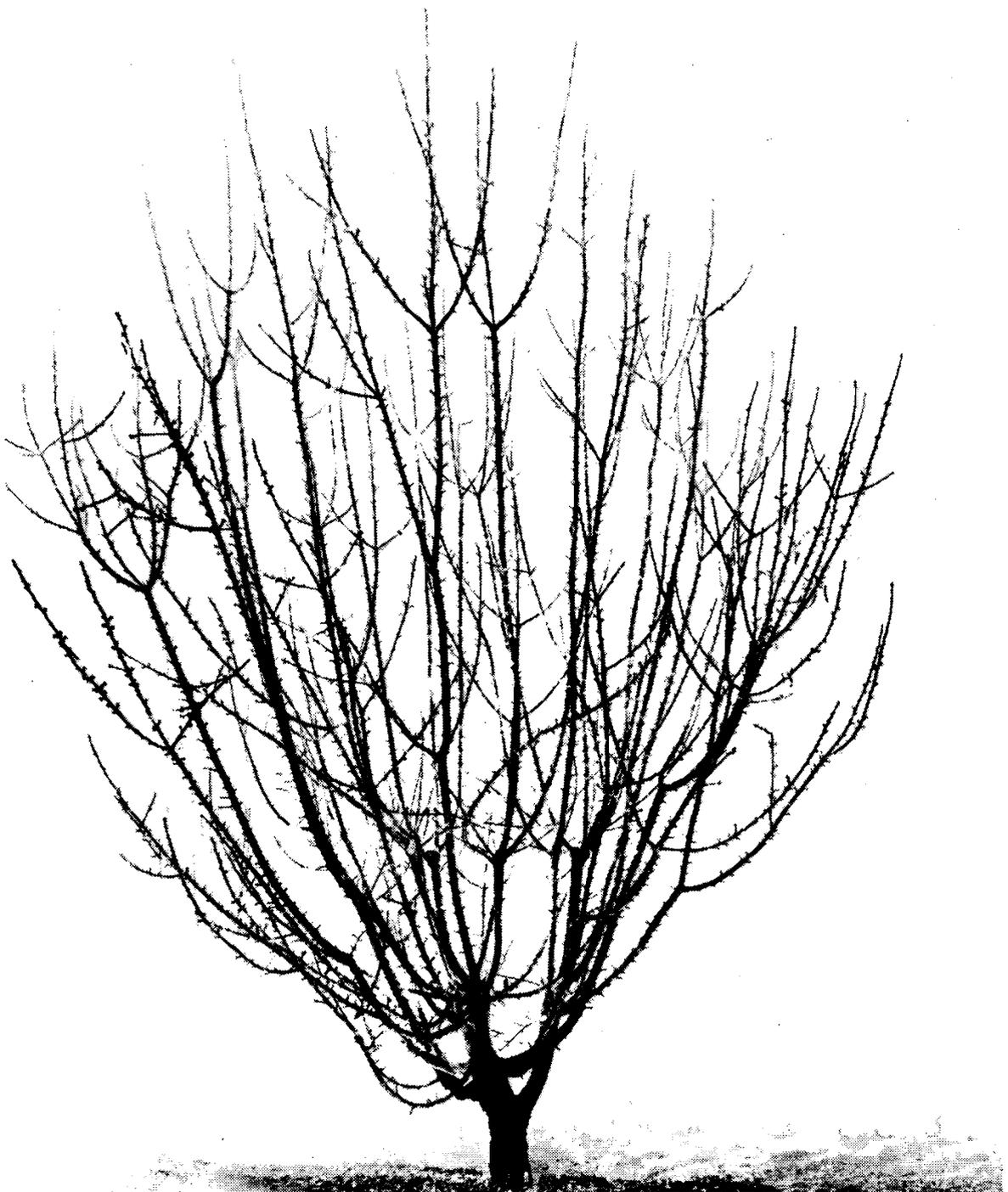
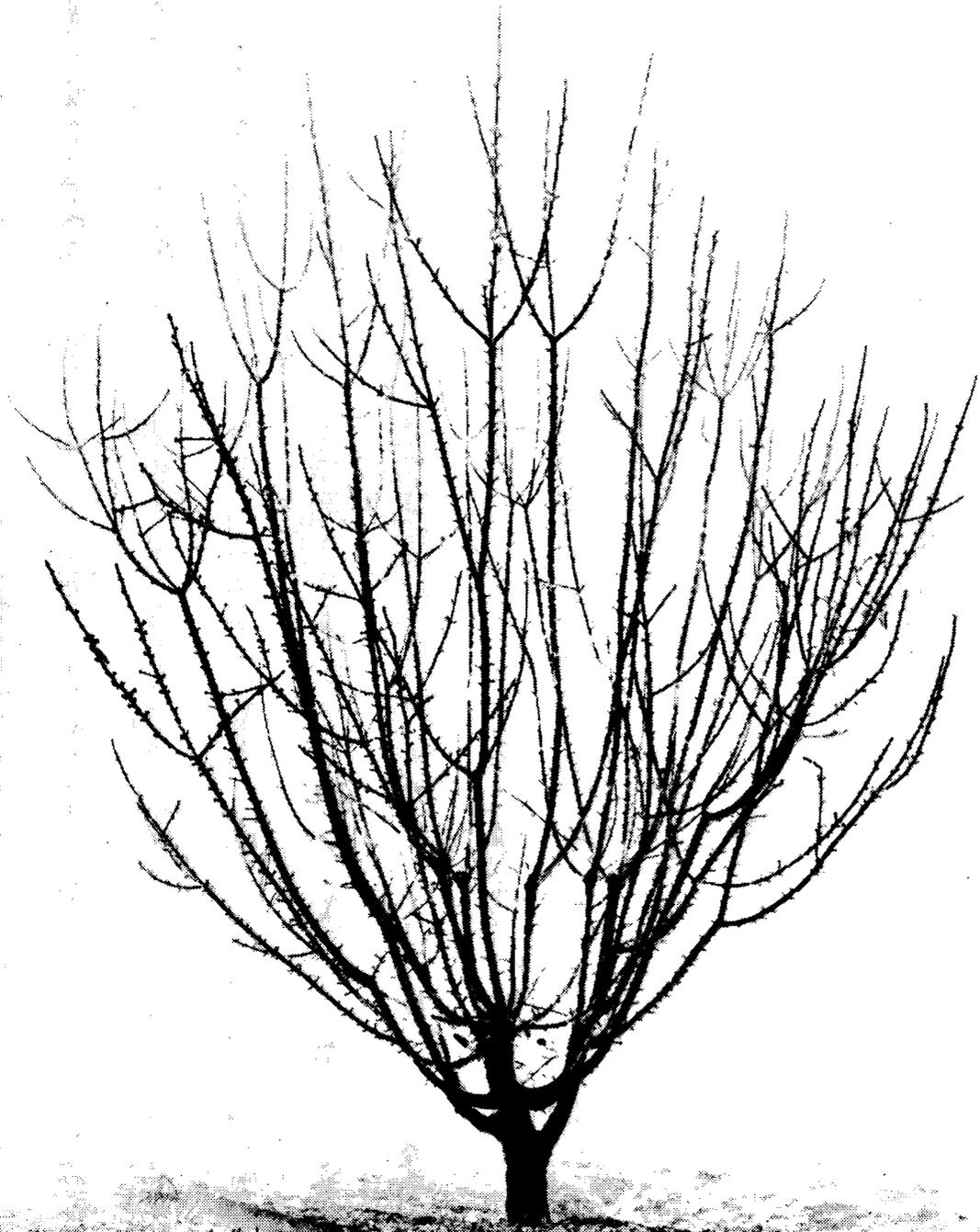


Figure 39. This mature sweet cherry tree was pruned by removing a few interfering



branches. It will eventually have to be topped to maintain tree height.

Fruit Produced Terminally on Spurs

Apple trees produce most of their fruit terminally on spurs located on wood 2 years old and older. Spurs are productive for 5 to 8 years. Branches, especially weak and unproductive ones, should be thinned out to allow sunlight throughout the trees for spur development, regular bearing and devel-

opment of fruit color on red fruited varieties (Figure 40). Since some apples tend to alternate bear, older spurs should be rejuvenated by cutting back, especially following light crop years. Thus, apple trees are pruned to maintain tree vigor, regulate crop and reduce alternate bearing tendencies. Tree height is contained by cutting back upper branches to shorter laterals.



Figure 40. Two examples of mature apple trees after pruning are shown above. Note the upright main scaffolds with



horizontal fruiting branches spreading from them. Fruit wood or spur growth is spaced along these branches.

Pruning mature **pear** trees consists of removing weak wood and upright shoots while thinning branches throughout the tree (Figure 41). Upper branches should be cut back to laterals but lower branches may be weakened if cut. In addition to thinning of shoots and branches, the spurs should be thinned out and older ones renewed by removing older parts of some branched spurs in years when

fruit spurs are numerous. In years of low fruit spur production (following heavy crops) leave terminal spurs on short shoots and lateral spurs on longer branches. Pear trees are topped annually to maintain a constant height by cutting back to laterals.

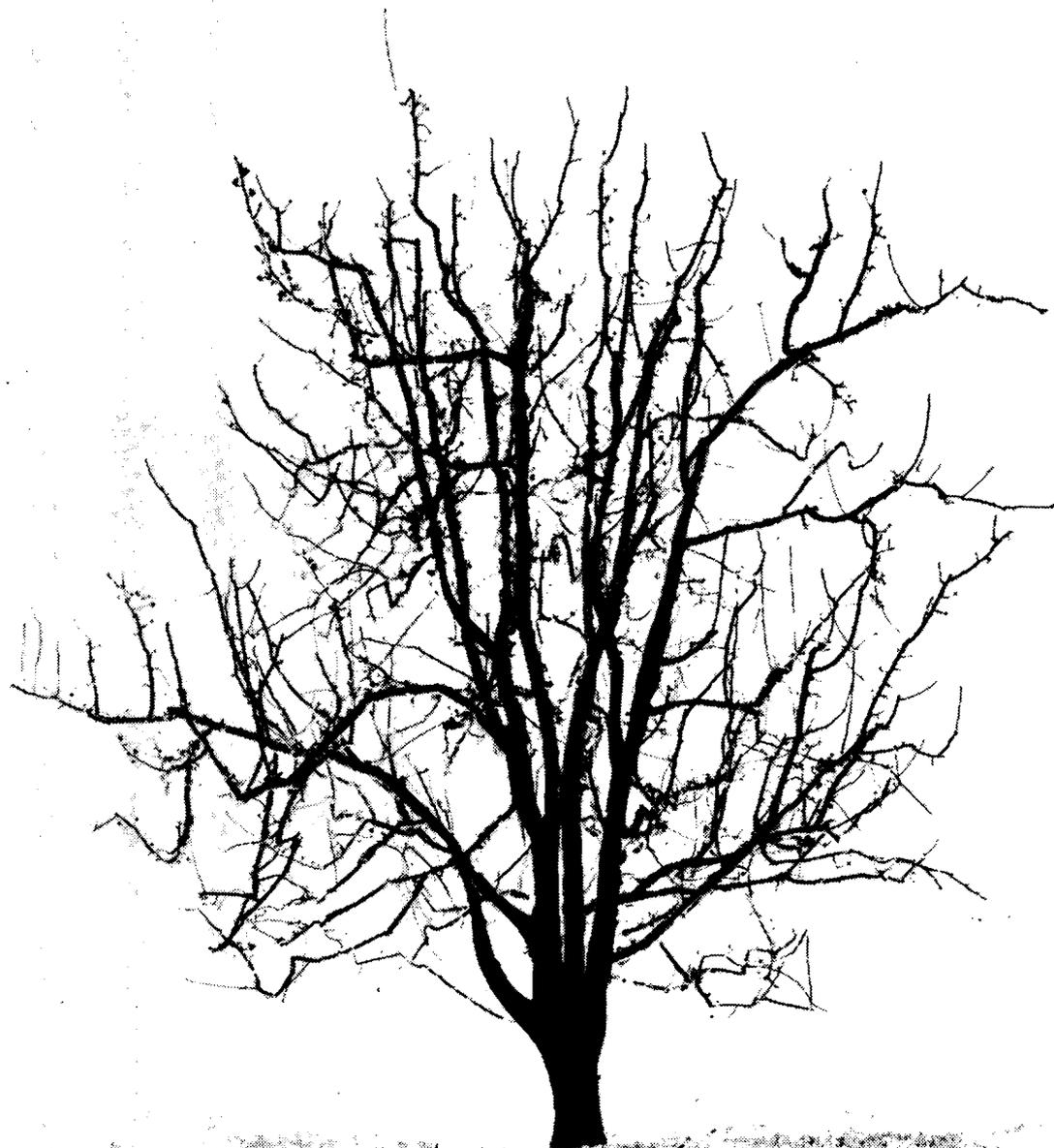
Most **walnut** and **pecan** trees bear terminally on spurs, especially older walnut varieties like Fran-



Figure 41. Because pears bear on long-lived spurs, this mature pear tree was pruned by removing much of the 1-year-old

quette and Hartley and mature trees of more recently developed varieties. However, with these newer varieties, young trees produce vigorous shoot growth and nuts are born from lateral buds on these long shoots. These trees are usually very fruitful as young trees and it is important to maintain vigor and keep these trees growing in an upward and outward direction. This can be accomplished

by heading back shoots to remove 25 to 50 percent of the previous season's growth, depending on variety. Older varieties need not be headed back unless limbs are too flat or growing in the wrong direction. Fruiting branches up to about 1½ inches in diameter should be thinned out annually to invigorate new growth and promote greater light penetration into the tree.



shoot growth. Note that tree height is maintained to facilitate hand harvest from ladders.

Fruits Produced Laterally on Shoots

Peaches and **nectarines** have identical fruiting habits. Varieties produced for fresh shipment are very responsive to proper pruning. Detailed pruning of processing varieties is less critical but still a very important cultural practice. Flower buds and fruit are produced along shoot growth. Shoots

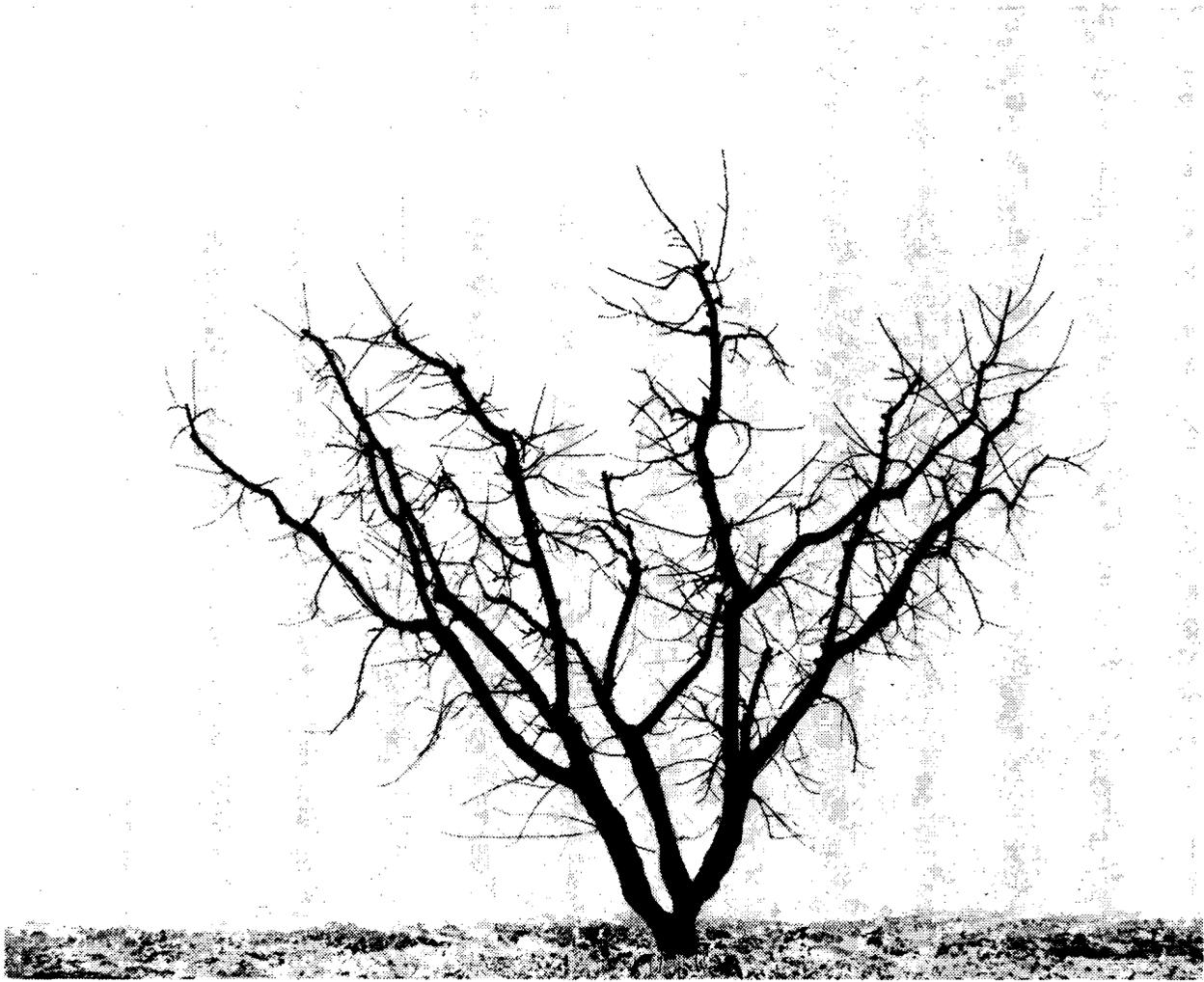
must be thinned and spaced to reduce crop and stimulate shoot growth (fruit wood) for the succeeding crop. Lower shoots are easily shaded out, if light does not reach them. Thus, pruning must allow for sunlight to reach lower fruiting areas without sunburning exposed sections of major scaffold limbs.



Figure 42. Mature peach and nectarine trees (fresh shipment varieties) require thorough thinning out of the 1-year-old

Some fruiting wood should be thinned out by cutting back to lateral branches, while other shoots are completely removed to provide well spaced and evenly distributed fruiting wood along scaffold limbs. Upright, vigorous shoots are also completely removed (Figure 42). Clingstone peaches are often

allowed to develop more shoots and branches, called hangers, than are freestone peaches (Figure 43). This less severe pruning results in shorter shoot growth the following year. All peaches and nectarines are topped every year to maintain tree height.



(bearing) wood. More fruit wood is removed from early maturing varieties than from those maturing later in the season.

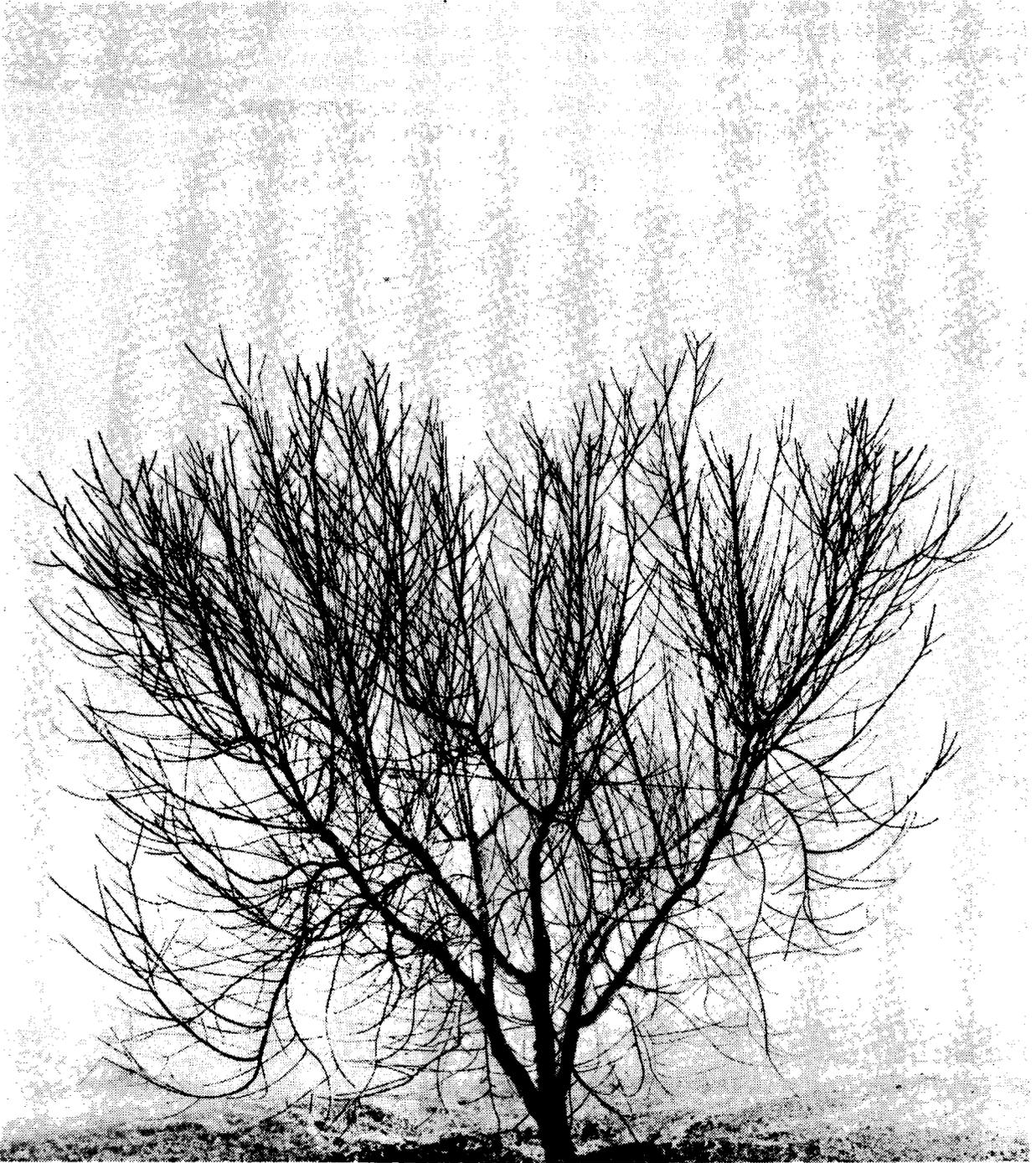
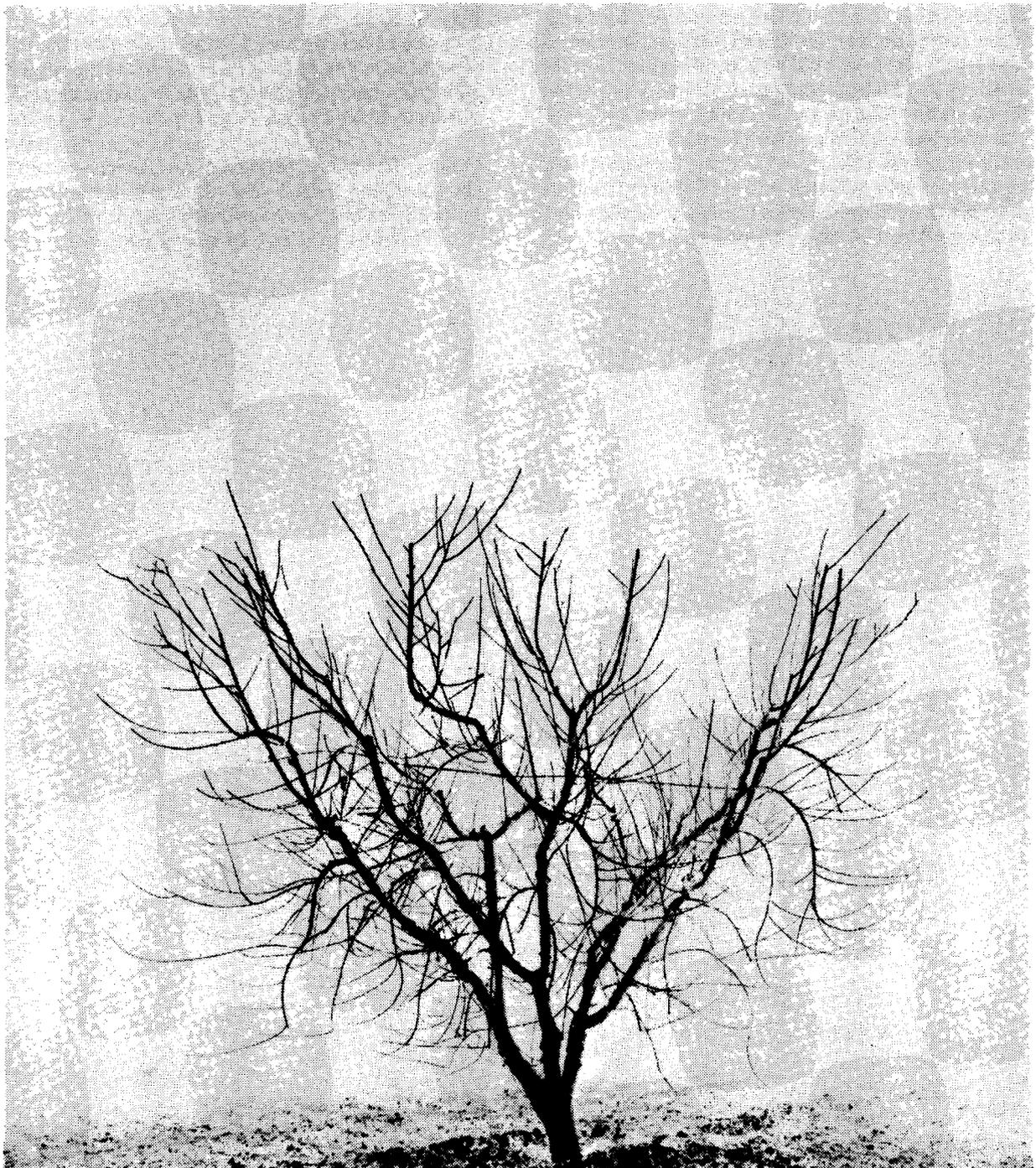


Figure 43. Clingstone peaches ripen later in the season and will therefore size more fruit than many freestone varieties.



More 1-year-old wood is left in the clingstone tree top and more hanger limbs are allowed to develop.

Pistachio trees bear their crops laterally on 1-year-old wood. Some pruning is required to produce adequate shoot growth for next year's crop, but the type and severity of pruning is still being investigated.

Persimmon trees bear on the current season's shoot growth. Pruning consists mainly of thinning shoots

to promote growth for next season's crop. Heavy pruning and leaving stubs results in excessive shoot growth which is less fruitful. Upright shoots or water sprouts should be cut off completely from main scaffolds. Most persimmons are topped each year, but some are allowed to spread into an umbrella shape.

Fig trees bear mainly on current season's growth, but a few varieties, like Black Mission, produce a first crop on 1-year-old wood. Pruning figs for dried fig production consists of thinning out interfering limbs and some heading back of long branches to maintain growth in an upward and outward direction (Figure 44). Long branches that bend down with the crop tend to sunburn. If shoots are headed back on varieties like Black Mission, the first crop is lost or severely reduced.

Figs raised for canning, such as Kadota, are severely headed back with each shoot that grew the previous season having as little as one or two buds left. This stimulates long shoot growth and each shoot produces 10 to 15 figs.

Quince fruits are produced on current season's shoots arising from 1-year-old wood. Even though quince trees bear without much care, it is desirable to stimulate 1 to 2 feet of new growth each year.



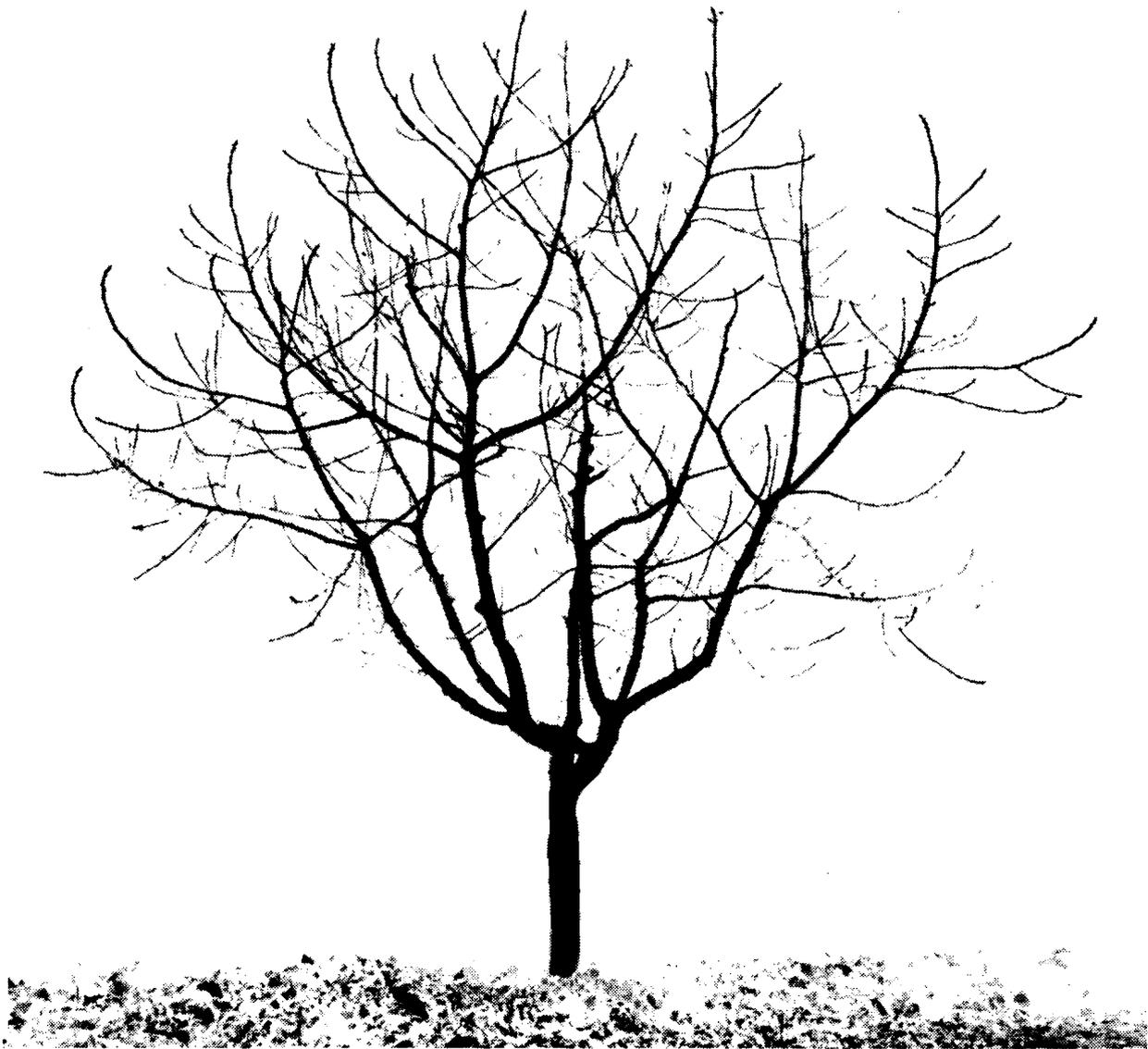
Figure 44. The mature fig tree is pruned mainly by a

This is accomplished by thinning out and heading back last season's shoot growth.

Pomegranates should be pruned by removing suckers, interfering branches and branches bent down by the previous season's crop.

Olive trees are evergreen and do not drop their leaves in winter. Olives usually bear fruit laterally

on the previous year's shoot growth, so pruning is done to encourage new fruit wood for next year's crop and to remove unfruitful wood. Pruning is often done in years of potential heavy crops after fruit set in the spring or early summer to reduce alternate bearing tendencies. Summer pruning also helps avoid disease problems. While thinning fruiting branches to encourage natural spreading and maintain light penetration into the tree is necessary, severe pruning should be avoided.



light thinning out of interfering branches and removal of suckers.

GLOSSARY

Crotch: The point at which two branches join.

Framework: The major limbs that make up the structure of a tree and support its fruiting branches.

Head: That part of trunk from which the primary scaffolds arise.

Heading back: Topping or cutting back a branch or limb, but not completely removing it.

Lateral branch: A small limb growing from a larger limb. Often used for fruit wood.

Leader: A dominant upright branch. The *central leader* is the trunk that extends from the root to the top of a tree.

Necked bud: An undesirable lateral bud that is curved upward and a branch arising from it should not be used later as a structural limb (common in walnut and pecan). See Figure 25.

Primary scaffold limb: One of the major limbs arising from a tree trunk.

Rootstock: The original plant that is now the root system upon which the desired fruiting variety has been budded or grafted.

Secondary scaffold limb: A framework limb that arises from a primary scaffold.

Shoot: Current season's or 1-year-old growth, with or without leaves.

Spur: A short fruiting shoot that usually grows from ½ to 4 inches during a growing season.

Stub: A protruding branch left after pruning, often the result of careless pruning. (A branch cut closely and smoothly to a scaffold will not leave a stub.)

Sucker: A vigorous shoot that arises below the bud union from the rootstock or roots.

Tertiary scaffold: Framework limb that arises from secondary scaffold.

Thinning out: Complete removal of branch or limb at its point of origin.

Topping: Cutting back the top of a tree to maintain an established height.

Water sprout: A vigorous, usually undesirable, shoot arising from the trunk or scaffold limbs.

Most of the above terms are illustrated in the following figures.

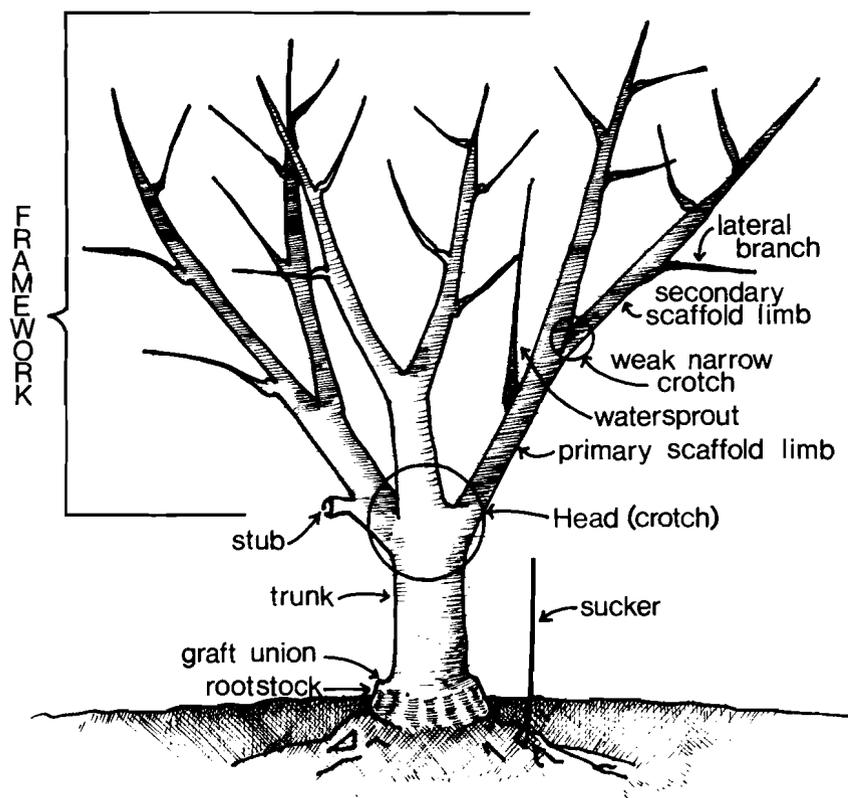


Figure 45. Many terms defined in the glossary are illustrated.

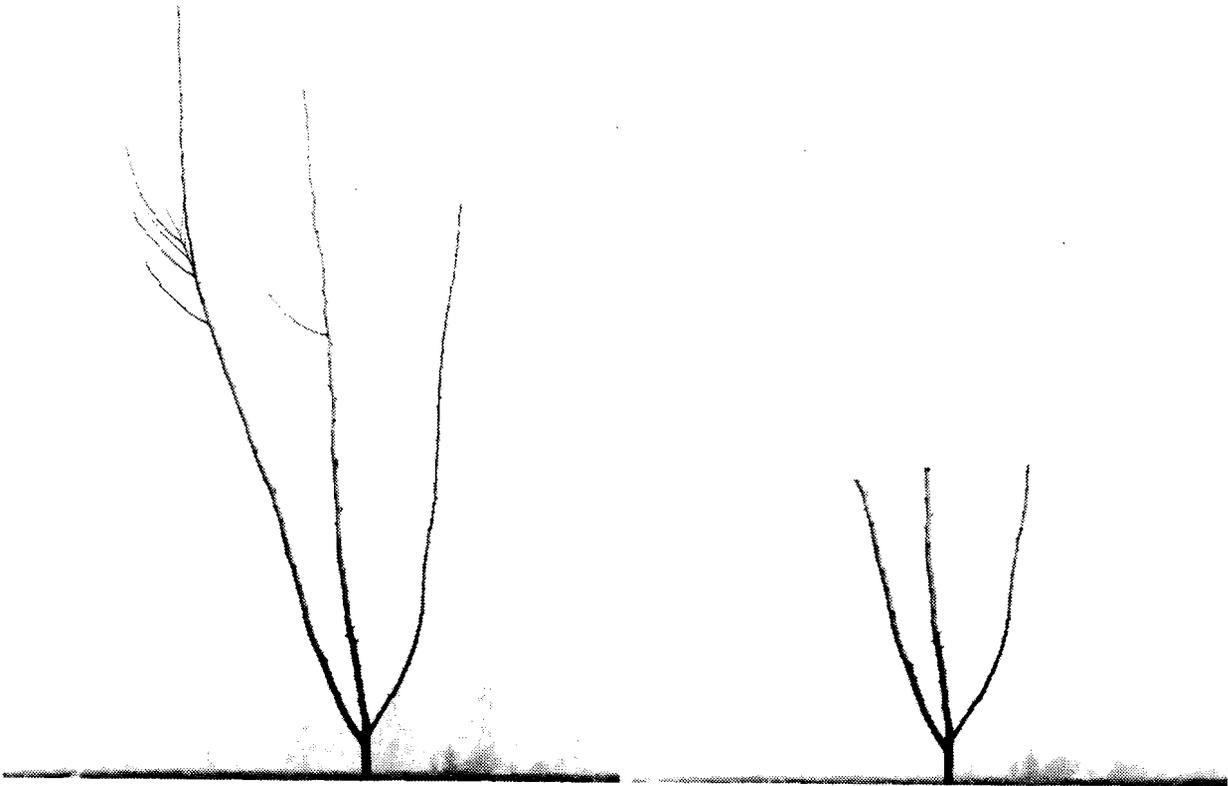


Figure 46. Heading back is shown here: before, left; after, right.

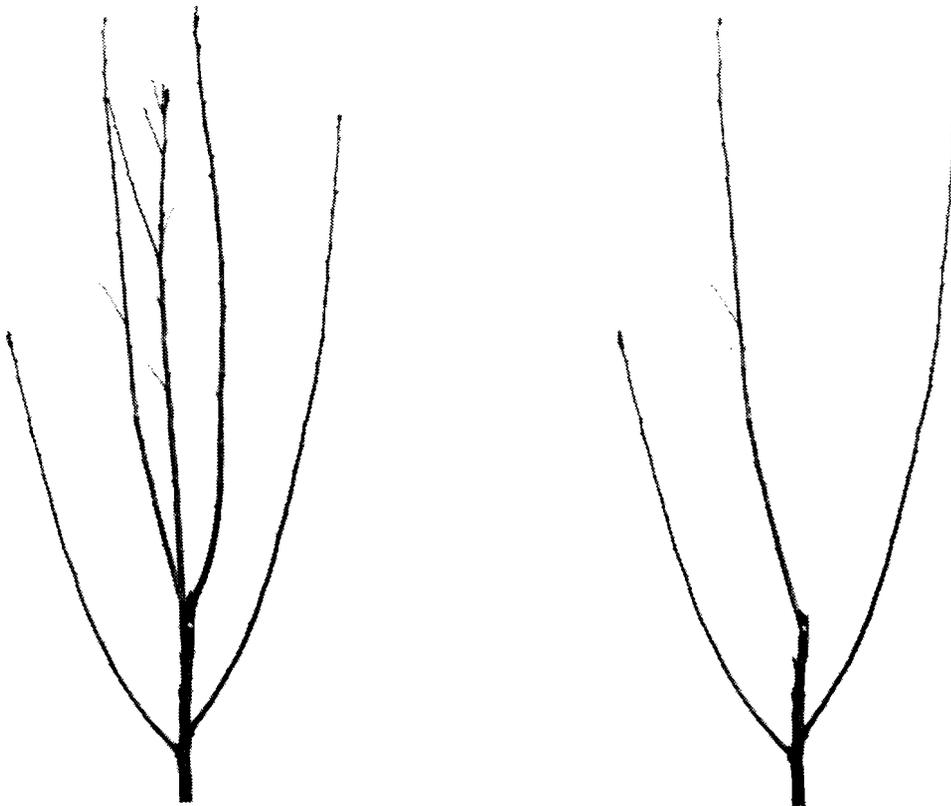


Figure 47. Thinning out is seen here: before, left; after, right.

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