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# PRUNING AND TRAINING FRUIT TREES

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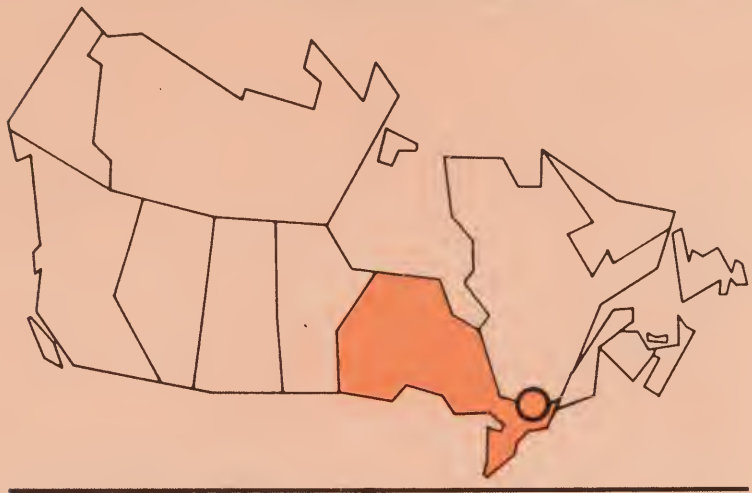

## CANADA / ONTARIO

### PRUNING AND TRAINING FRUIT TREES

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## INTRODUCTION

Pruning goes back several thousand years as a horticultural practice, but the science of pruning originated in the early 20th century when experimental work began to reveal certain definite effects. Since growth and fruiting habits differ among kinds and varieties of fruit trees, different pruning treatments are necessary. Although specific practices may differ among growers, the basic principles of pruning should be understood and strictly followed.

Pruning should be distinguished from training, even though the two terms are commonly interchanged. During the first years of its life, the fruit tree should mostly be trained to grow in certain patterns. Once the main framework of the tree has been established to a predetermined shape, annual light pruning is carried on to encourage good fruit production. However, some training must be continued to control tree size and shape. To produce fruit abundantly is a natural habit of the tree. Pruning is also a natural process. The tree prunes itself when limbs die and drop off, usually as a result of excessive shading. Proper pruning balances fruit and shoot production, thereby increasing the size and quality of both. By correct training and pruning, we can construct and maintain a tree capable of bearing a maximum crop of top-quality fruit.

## PRINCIPLES

1. **Pruning the young tree delays fruit bearing.** It tends to force the growth of long, succulent shoots which grow late in the season. Thus, manufactured food does not accumulate and formation of fruit buds may be prevented. Keep in mind that light pruning results in early bearing and a spreading tree (Figure 1).

2. **Pruning invigorates, but also dwarfs the tree.** Pruning reduces the number of growing points, thus stimulating growth at the remaining points. However, in proportion to its severity, pruning reduces the total growth and total leaf surface of the tree. (Trees should be invigorated when necessary by the wise use of fertilizer.)


Fig. 1. *Effect of early fruiting on shape and growth of tree* These 6-year-old Melba trees, which were the same size when planted, received the same cultural and pruning treatments, the latter very light. (A) was prevented from fruiting by removal of blossoms each year. (B) has yielded 99 lb of fruit (45 kg) and, as a result, is smaller and more open. The background screen is 15 ft high (4.60 m).

3. **The pruning effect is localized.** Removing or cutting back the laterals of a branch reduces the branch's growth. There is growth response in the immediate area of the cut. The response decreases as the distance from the cut increases. This means the pruning cut should be made where the response is wanted. The response may be new growth as from a heading cut, or a dwarfing effect on a branch or stem from removing or cutting back the laterals.

4. **Pruning too heavily has adverse effects.** Excessive pruning stimulates growth of suckers and watersprouts. Fruit coloring and maturity are delayed. Succulent growth increases the hazard of fireblight in apple and pear, canker in peach, and winter injury in all species.

5. **Clean, flush cuts heal more readily.** The pruning cut should be flush with the branch or bud that is left to grow. The cut should be made to expose a wound of the smallest diameter. Protruding stubs never heal and they decay, increasing the risk of infection entering and spreading to the main trunk. Clean, flush pruning cuts are particularly important with peach, as canker may enter where healing is delayed (Figure 17).

6. **Narrow-angled crotches are weak.** They do not become stronger as the tree grows because bark trapped in the narrow angle between trunk and branch prevents normal development of wood in this area. The tissues in these crotches are slower to mature in the fall and may be injured by low temperatures in severe winters (Figure 2). Narrow crotches are usually weakened further by water, ice, rot organisms, and canker. Thus, limbs which make sharp angles should be removed early to avoid the possible loss of a large part of the tree later due to breakage from weight of fruit.

## PRUNING EQUIPMENT

Good pruning requires suitable tools and equipment (Figure 3) in the hands of an experienced workman. Clean, flush cuts can be made quickly and easily if the tools are kept sharp and properly adjusted.

### HAND TOOLS

A sharp, properly set saw is required for the larger cuts, and will do a better job for any size of cut than even the best pruning shears. Therefore, it should be used wherever possible.

Long-handled pruners will speed the pruning job but they tend to leave stubs. Because of this, they should be used with caution, and mainly in older orchards. Hand pruners should be light, sharp, properly set and of good quality. The choice of tool is largely a matter of personal preference.

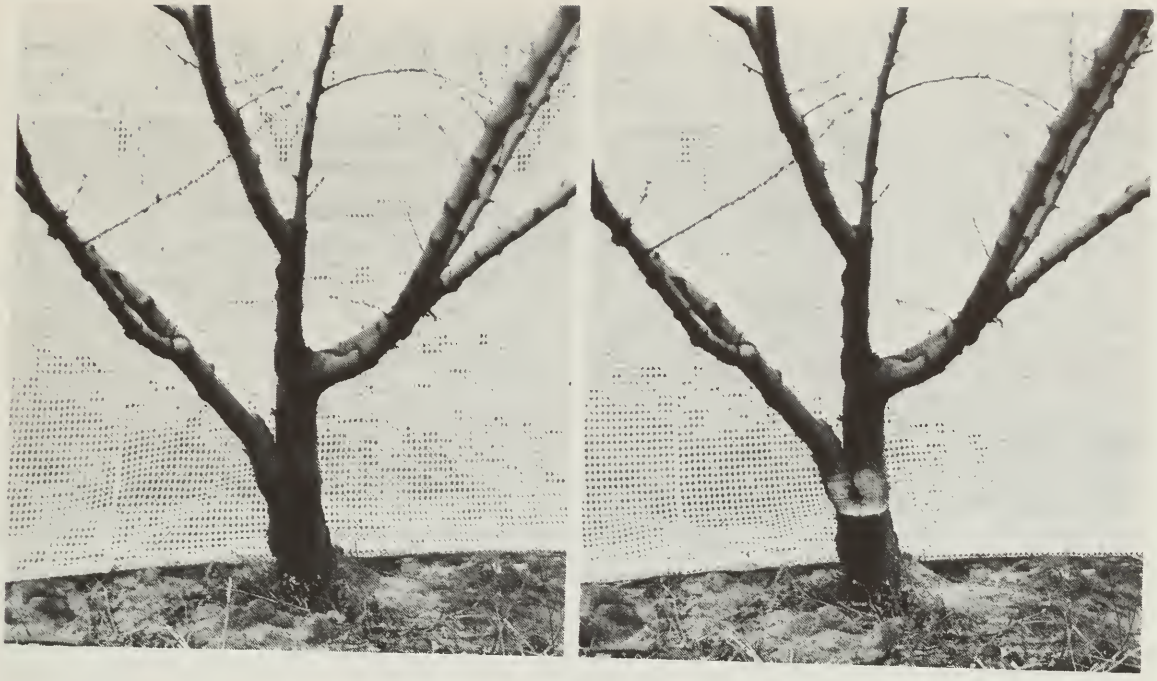

Fig. 2. *Narrow crotch angle on a peach tree.* The branch at left makes a sharp angle with the trunk and should not have been saved as a permanent branch. At right, the crotch has been further weakened by canker which has been cut away.

Fig. 3. *Good types of pruning tools.* Aluminum tubing handles of various lengths may be attached to saw blade at top.

### POWER TOOLS

Several types of power-operated pruning equipment and tools are available and studies have shown that such equipment will reduce labor costs in pruning. However, it is costly and its use is justified only where there is a considerable orchard acreage. Power tools should be used only by men experienced in pruning, who can make the correct decisions without hesitation.

## TIME OF PRUNING

### DORMANT

Most pruning is done when trees are dormant. Dormant pruning stimulates new wood growth. The ideal time is early spring, just before the buds swell. The size of the orchard may make it necessary to start sooner, but because of the danger of severe freezing it is advisable to delay winter pruning as long as possible. The likelihood of damage from infection and drying of tissues increases with the length of time pruning wounds are exposed during the dormant period. Because of the prevalence of peach canker in some areas, it is especially important that peach trees should not be pruned before late winter or spring. The older trees should be pruned first, the younger ones last. Winter injury, induced or aggravated by pruning too early, is usually unnoticed at the time, and may not show up for several years.

It is not advisable to prune trees while the wood is frozen. If a severe freeze causes winter injury in the form of shoot die-back, wood discoloration or crotch injury, it is preferable to wait until late spring when growth has started and then prune back to healthy tissue. This treatment allows for the greatest possible leaf surface, and ensures quicker recovery from the injury.

### SPRING

Early spring is generally the best time to prune and it may be continued until blossom time. After the buds have begun to swell, extra care is needed to avoid loosening the bark of young limbs or damaging buds and spurs. It is recommended, especially with newly planted peach trees, that a second pruning be given in June for the removal of dead wood. The cuts are made in healthy tissue where healing will proceed rapidly. However, it should be remembered that the later the pruning, the more the tree will be dwarfed. Severe pruning in late spring can seriously affect the tree's vigor.

### SUMMER

Summer pruning has a pronounced dwarfing effect on fruit trees. This effect is greatest in early summer, decreasing toward midsummer and during August. Summer pruning can be used to repress vigorous vegetative growth by cutting back terminals by one-third to two-thirds in the latter part of July. In late summer, pruning back the new shoots controls growth and may also

improve the color of the fruit by reducing shade and increasing the buildup of carbohydrates in the fruiting wood.

### FALL

Fall pruning is not recommended because of the increased hazard of winter injury.

## DISPOSAL OF PRUNINGS

Prunings up to 1 inch (25 mm) in diameter can readily be shredded with a rotary brush cutter and left as a mulch or incorporated into the soil to help maintain organic matter. Larger limbs and whole trees are usually piled and burned, or taken to a municipal dump.

Large brush piles left year after year are a fire hazard, and can contribute to orchard pest control problems by harboring insects, disease organisms and rodents. Burning of brush piles should be done with extreme caution and only after a check has been made of municipal regulations concerning open fires and air pollution. Wood chippers are available for chipping large limbs but their limited use on most fruit farms may not justify the high purchase price. There may be a place for custom wood chipping in the future.

## PRUNING AND TRAINING AT PLANTING TIME

It is most important that the tree be properly pruned at planting time. All broken, ragged, withered or dead roots should be cut back to live, healthy tissue. This promotes quick healing of wounds and early development of branch roots.

Normally the top of the tree is severely pruned at planting time, to reduce water loss, to establish the height of head, and to start training the tree.

### REDUCTION OF WATER LOSS

The top of the tree must be reduced to balance root loss in transplanting. The remaining root system is better able to supply adequate water and nutrients to fewer growing points in the tree.

### HEIGHT OF HEAD

The height to which a newly planted tree should be headed back depends on the method of training to be followed. In general, the height of head will range from 2 1/2 to 4 feet (75 cm to 1.20 m). Lowheaded trees are cheaper to prune, thin and pick. Details of training the different kinds of fruit trees are given under the appropriate headings.

### BUILDING A STRONG FRAMEWORK

Pruning at planting and for the next 2 or 3 years is mainly a training process. The aim is to build a strong framework that exposes the tree's fruiting surfaces to the maximum amount of light. Training and pruning should give the desired tree shape with a minimum of wood removal.

There are many pruning and training systems. Most are variations of central leader training which utilizes the tree's natural growth habit.

## THE MODIFIED CENTRAL LEADER

The modified central leader is the preferred type of orchard tree (Figure 4). During the first few years a dominant shoot or leader is developed. Three to five main branches are selected that are distributed vertically and spirally around the leader. The spacing between the scaffold branches will vary with the rootstock and expected height of the tree.

### DEVELOP WIDE BRANCH ANGLES

A dominant central leader with numerous growing points down the stem results in wide angles on the framework branches. Wide branch angles at the trunk ensure a strong tree that will carry a heavy load of fruit.

### MODIFYING THE LEADER

With most early apple varieties, and terminal bearers such as Golden Delicious and Idared, the central leader will flatten out from weight of fruit; making heading or leader removal at the desired height unnecessary. With apple varieties such as Delicious and Spy, and most other fruits, it is advisable to prune the leader to a side branch after the first heavy crop.

The average 2-year, or older, nursery tree is difficult to train to the modified central leader. It is much better adapted to the less desirable open-center type of tree, and this is one reason why so many orchard trees are of this form. One-year trees held in the nursery until they are 2 years old should be topped at 40 (100 cm) instead of 30 inches (75 cm). A much better tree should result.

## TRAINING YOUNG APPLE TREES TO THE MODIFIED CENTRAL LEADER

After planting, the 1-year whip is cut back to a height of 30 to 36 inches (75 to 90 cm). The lower heading is favored, especially for dwarf and semi-dwarf trees. Side branches or feathers are generally removed but with high density dwarf trees, these should be left for early fruiting.


Fig. 4. A — *Typical modified central leader tree* of Delicious on M. 26, 10 years after planting as a 1-year whip. B — *Modified central leader, semi-dwarf tree* of Delicious on M.VII, 10 years old.

Two or more shoots usually arise just below the heading-back cut. In the second year, all but one of these must be removed if they crowd each other with sharp angles (Figure 5).

In addition, four to six good scaffolds should be selected. They should be well distributed around the tree and spaced at least 4 to 6 inches (10 to 15 cm) apart up the trunk. A central leader should be retained. It must be cut back by at least one-third. Usually, the selected scaffolds are also cut back by one-third to one-half (Figure 5). In high density plantings of over 500 trees per acre on M.IX, only the leader should be headed in the second year. All other branches, except those making narrow crotches, may be left for early cropping.

Often, after the third growing season, only the leader is cut back. In dwarf and semidwarf trees, it is important to cut the leader back by about half each

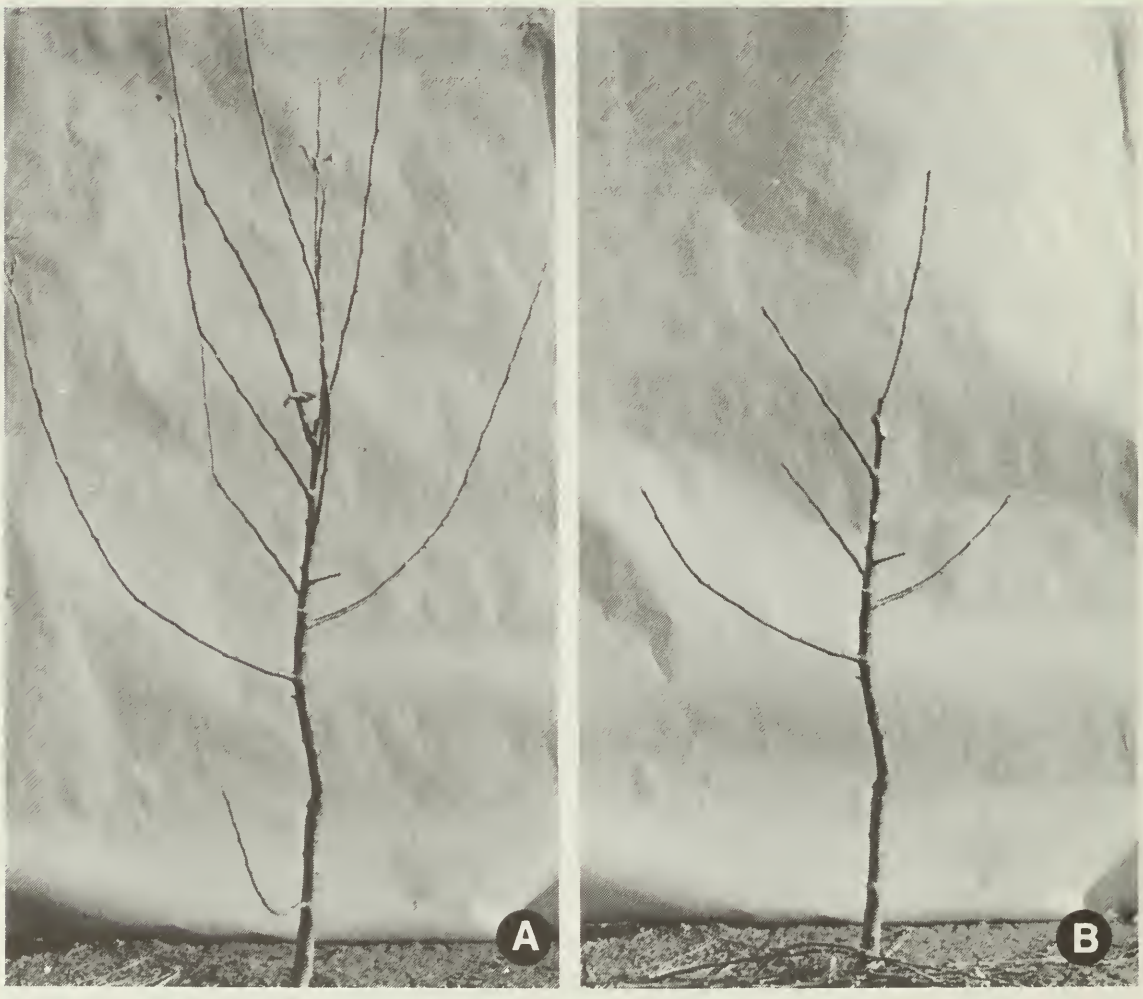


Fig. 5. *Training to modified central leader — First year.* (A) Delicious on MM.106 1 year after planting as a 1-year whip, headed at 30 inches (75 cm). (B) The same tree, pruned, ready for second growing season. Four scaffolds were selected and a new leader. The leader was pruned back a third, the laterals to about a half.

year (Figure 6). This serves two purposes. It tends to direct more growth into the lateral branches, keeping bearing area low, and keeps the leader strong by preventing overfruiting in this part of the tree.

Common mistakes often occur in developing the modified central leader tree:

1. The central leader is not modified (Figure 7, left). It remains too strong, making a tree that is too high and, consequently, costly to prune, spray and pick. The lower branches are shaded out by main fruiting wood that is too high.

2. Too many scaffolds are left in some trees. They compete with and shade each other. Sometimes a whorl of branches is allowed to grow at one


Fig. 6. *Training to modified central leader — Third year.* Golden Delicious on M.26, 3 years after planting as a 1-year whip, trained to modified central leader before (A) and after (B) pruning. Note that pruning in the 2 years since planting has been mainly to modify the central leader. Laterals have been left untipped for early cropping.


Fig. 7. (A) *Central leader tree with unmodified leader.* Only 5 years old, this tree's main bearing surface is already too high. The lower scaffolds are underdeveloped and shaded out. The leader should have been modified each year by pruning to a weaker lateral. (B) *Pyramid tree* 7 years after planting. Each year the central leader was modified by cutting to a weaker lateral. The scaffolds were similarly modified. Note that the main bearing area is easily reached and has good light exposure.

point on the leader or scaffold, tending to choke out the growth of the leader and compete with it.

3. A 2-year nursery tree tends to develop into an open-center type of tree in the orchard. This form is related to low heading after the first year in the nursery. An open-center or vase-shaped tree provides good light exposure but is structurally weak.

In general, a well-grown, 1-year whip is better than a 2-year tree, as it is easier to train to the various systems. Most nurserymen are producing well-grown, 1-year whips.

# SPECIAL TECHNIQUES IN TRAINING

## APPLES

To improve light exposure and control tree size, the central leader tree may be modified to a pyramidal or Christmas tree shape. One method of attaining the fir tree shape is the 'head-and-spread' system.

### Head-and-spread

This system is particularly useful for semidwarf or larger trees of upright-growing varieties such as spur and standard types of Delicious (Figure 8), Spy (Figure 9) and Spartan. The head-and-spread system uses the natural central leader habit of growth.


Fig. 8. *Head-and-spread training system in the fourth year.* Spur-type Delicious on MM.111, 4 years after planting as a 1-year whip, before spreading and pruning (A). (B) After spreading and pruning, using five, 1-foot (30 cm) wood spreaders on the lower tier of scaffolds, spreading them about 60 degrees from the main trunk. Four shorter wire spreaders were used on the smaller upper stage of branches. Leader and all laterals were tipped, removing about a quarter of the 1-year wood. Spreading could have been started a year or two earlier.


Fig. 9. *Head-and-spread training system in the fifth year.* (A) Northern Spy on seedling rootstock, 6 years after planting, unspread. (B) Northern Spy on seedling rootstock, 6 years after planting, spread and pruned at 5 years. Now spreaders should be used again as required. Pruning should consist of selecting and tipping terminals and removal of suckers and upright "risers".

## Use of spreaders

Scaffold branches are selected and spread to intercept maximum sunlight. Spreaders made of wood or wire may be used to position and brace the scaffolds out from the central leader. Alternatively, the branches may be pulled down with plastic twine or wire hooks.

Short wire spreaders made from 9- to 12-gauge wire, cut sharp at each end, are useful for spreading 1-year shoots. Longer spreaders are made in several lengths from 1-inch-square wood pieces with a nail in each end. The protruding point of the nail must be sharp to prevent the spreader from slipping.

Pruning and training with the head-and-spread system is the same at planting and after the first year, as described previously for the modified leader.

In the second or third winter, or before dormant pruning, the 2-year branches are spread out to an angle of about 45° from the leader. Wire spreaders may be used. If the tree has sufficient height, one or more new scaffolds are selected. They should be 18 to 24 inches (45 to 60 cm) above any branch that is directly beneath. The leader and the tips of all scaffolds are headed back by one-quarter to one-third. Shoots competing with the leader are removed. Strong shoots on the upper or lower side of the scaffolds are removed, if they have not been pinched back the previous summer. Side shoots in the horizontal plane on the scaffolds are headed to encourage further branching.

## Subsequent training

During each growing season, some pinching back of strong shoots competing with the leader or laterals may be done. Otherwise they will have to be removed at the next dormant pruning.

After the third and subsequent growing seasons, the spreading procedure consists of the same routine. Each horizontal branch should be kept shorter than the one beneath it to reduce the amount of shade on the lower limbs.

Once a branch has grown to the desired length, the heading cut is replaced by a thinning cut. That is, instead of removing only part of the 1-year shoot to invigorate it, the whole shoot is cut back to a small lateral in the 2-year wood. Outward growth is thereby checked.

About the fifth or sixth year, or just before the tree bears its first heavy crop, the angle of spread of the branches should be increased to 60 to 75°. This is done by adjusting the spreaders.

When the tree has reached the desired height, check its growth by heading the terminal shoot to a short 1-year stub. A growing terminal shoot should always be maintained. At maturity, it may be necessary to renew the leader from time to time by cutting back to a new shoot. It should be kept short.

## Other pyramidal forms

Normally semidwarf trees of McIntosh, Golden Delicious, Idared and Mutsu do not need spreading. If the trees are too closely spaced to train to modified central leader, they may be trained as pyramids. A 7-year-old McIntosh on M.VII trained as a pyramid is shown in Figure 7 (B). The extension shoot of the leader is replaced each year by a weaker one, resulting in a zigzag pattern in the leader. Likewise, each scaffold is pruned to a weaker shoot. Traditionally, the pyramid is pruned in summer to maintain a permanent structure of fruiting spurs.

The modern spindle bush and the dwarf version, the slender spindle, are often induced to fruit early by tying down laterals and later renewing them. The leader is modified each year as described for the pyramid but the laterals are left untipped. A branch that becomes too strong, producing too much shade, is removed entirely.

## Dwarf apple

Dwarf apple trees on M.IX require support because the roots are brittle. This support is often provided by means of a wire trellis. The following are three common types of training on wires.

1. Modified central leader tied to two wires spaced 2 and 4 feet (60 cm and 1.20 m) from the ground (Figure 10).

2. Eight-arm espalier trees trained to four wires (Figure 11). Each pair of arms is tied down in a horizontal position starting with the bottom wire. Heights of wires are usually 2, 3, 4, and 5 feet (60, 90, 120 and 150 cm) but the distance between wires may be more. Excellent fruit color is obtained with this system when the trees are young. The system's chief fault is that as trees get older, new growth tends to concentrate above the top wire, causing excessive shading of the lower areas. This shade, plus the horizontal position of the lower arms, reduces vigor and fruit color in the lower parts of the tree.


Fig. 10. *Modified central leader trained on two wires.* Young dwarf trees of Delicious/M.IX supported by two wires. (A) After pruning. (B) In fruit.

Fig. 11. *Espalier trained on four wires*. Upper — Orchard of dwarf Delicious on M.IX, 12 years old. Lower — Close-up of 12-year-old dwarf N. Spy on M.IX. Note how horizontal bending of arms tends to concentrate new growth above the top wire.

3. Palmette. There are several modifications of this system of tree training. One of the simplest is shown in Figure 12.

The basic principle is training and tying the successive pairs of arms at a 60° angle with the trunk. This growth pattern tends to spread the vigor over the whole tree. With less brushy growth to be removed at the top of the tree, the yield and color of fruit is better than with the eight-arm espalier.

Pruning and training young palmettes is basically the same as for the head-and-spread system except that the first scaffolds are started lower (about 8 inches (20 cm) below the first wire), and all are trained in two directions only.

The palmette system is also useful for training trees on M.26 or even M.VII. Once trees on these stronger rootstocks are trained and established, the wires may be removed.

Spacing of palmette trees may range from 12 by 10, to 12 by 14 feet (3.00 X 3.65 to 3.65 X 4.25 m). Spacing between the wires may vary from 1 to 2 1/2 feet (30 to 75 cm). The ultimate height may vary from 6 to 12 feet (1.80 to 3.65 m), depending on the rootstock and size of trees. The width of the hedge may vary from 2 1/2 to 6 feet (75 cm to 1.80 m).

Fig. 12. *Palmette trained on five wires.* Delicious on M.IX, 9 years after planting. Vigor of new growth is well distributed over the whole tree.

In general, the smaller trees are preferred for good exposure to light and ease of performing orchard operations.

## DWARF PEAR

The method for pruning and training dwarf pear trees on quince rootstocks is similar to that for dwarf apple. More severe cutting-back of the terminal growth may be required in pear than in apple to develop the framework. This procedure also prevents the young tree from becoming stunted from over-cropping. Deflowering or defruiting should also be practiced for the first 2 or 3 years after planting.

## ONE-YEAR SWEET CHERRY

Usually there are no wide-angled, lateral branches on these trees at heights suitable for use as a main framework. Therefore, remove all laterals (Figure 13). Cut the main trunk at the desired height ((36 to 40 inches) 90 to 100 cm). When the buds are nearly ready to burst, remove all but a dozen of

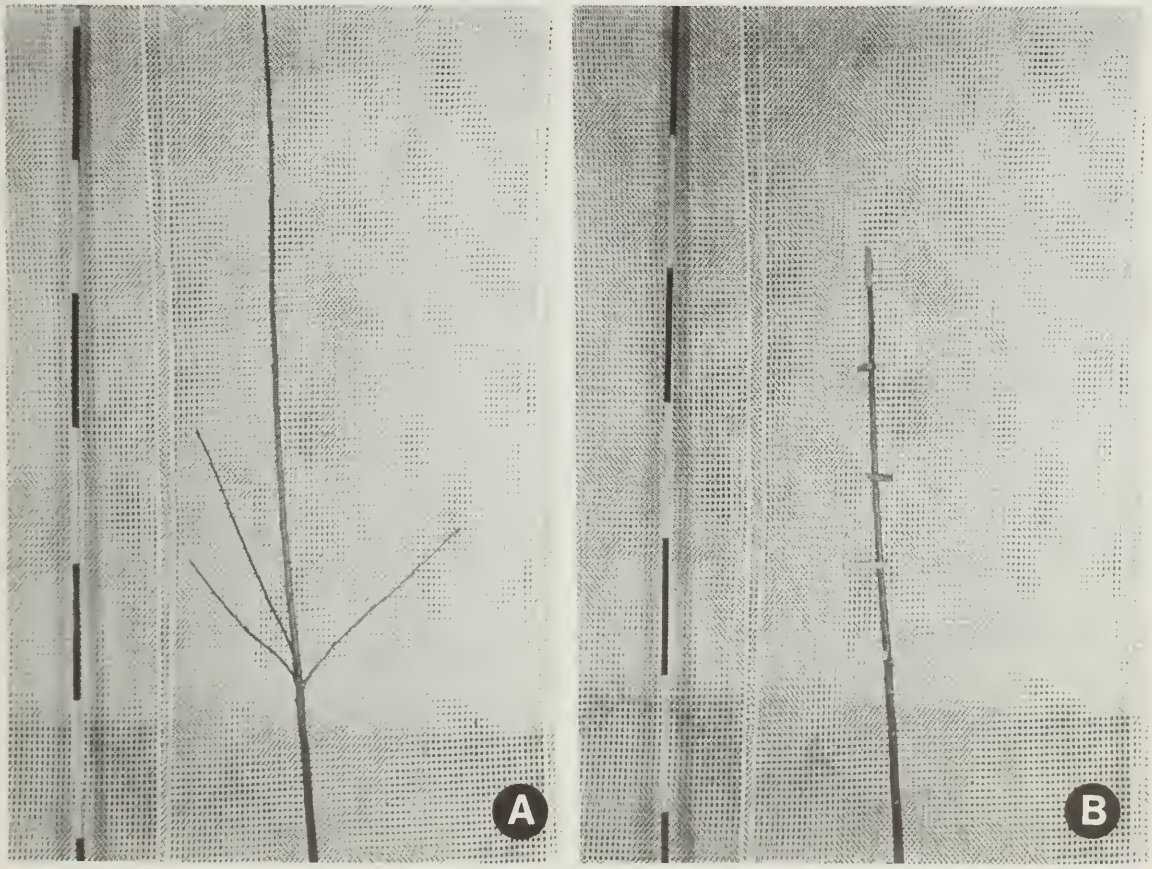


**Fig. 13.** *One-year sweet cherry tree before* (A) *and after training* (B). Clothes pegs mark the points from which branches are desired.

them, leaving three at each of the four points where branches are desired. Excess buds may be flipped off very easily at this time with a knife blade. Care should be taken to remove the heart of the bud, or secondary buds may arise later and develop into branches. Keeping three buds at each point prevents excessively sharp angles from developing on any of them. Remove all but one branch at each point one year later.

## TRAINING CHERRY TREES FOR MECHANICAL HARVEST

The use of limb and trunk shakers is now standard practice for harvesting sour cherries. More recently, sweet cherries for brining have also been widely harvested mechanically. The kind of mechanical harvesting equipment available has generally dictated the pruning method used on the young trees.

Sour cherries planted for mechanical harvest should be headed back to 30 inches (75 cm) and sweet cherries to 36 inches (90 cm) from the ground. At least 24 inches (60 cm) of main trunk is desirable when trunk shakers are employed. Four to five branches are sufficient to start the head. They should be well spaced around the tree trunk so that no branch is directly above a lower branch. In general, vertical branches shake better than horizontal ones; stiff branches better than willowy ones; and outward-thrust branches better than pendulous ones.

Preliminary observations indicate that sour cherry trees may be planted at distances varying from 12 to 20 feet (3.65 to 6.00 m) in the rows, but the rows should be 20 or more feet (6.00 m or more) apart to facilitate movement of machinery. A modified leader type of training appears best for strong, long-lived trees and for flexibility in adapting trees to mechanical harvesting.

## ONE-YEAR PEACH

Only 1-year peach trees are recommended for planting. A strong tree, over 4 feet in height (1.20 m), is desirable. Immediately after planting, reduce the height of the tree to 42 to 48 inches (105 to 122 cm) (Figure 14) leaving two-bud stubs where necessary to supplement the buds coming directly from the trunk. Cut the stubs as closely as possible to the second bud. Remove all buds and branches below a level of 20 to 30 inches (50 to 75 cm) (this establishes the height of the lowest limb), but leave all buds above it. An abundance of buds at this time means plenty of choice in wide-angled branches a year later.

Branches arise only from visible and uninjured buds. If all buds are injured or removed, the tree will die. In June, examine all trees and remove dead stubs by cuts made flush with the trunk. Dead or dying wood at the top should also be removed at this time by cutting close to the highest good shoot.

Do no more pruning until the spring of the following year. At that time, select four branches of about equal size having wide crotch angles uniformly distributed around the trunk (Figure 15). A vertical spacing of about 6 to 8 inches (15 to 20 cm) is desirable. Remove all other branches and spurs, cutting as closely as possible to the trunk. If some of the selected branches are larger than others, dwarf them by removing the least desirable laterals.

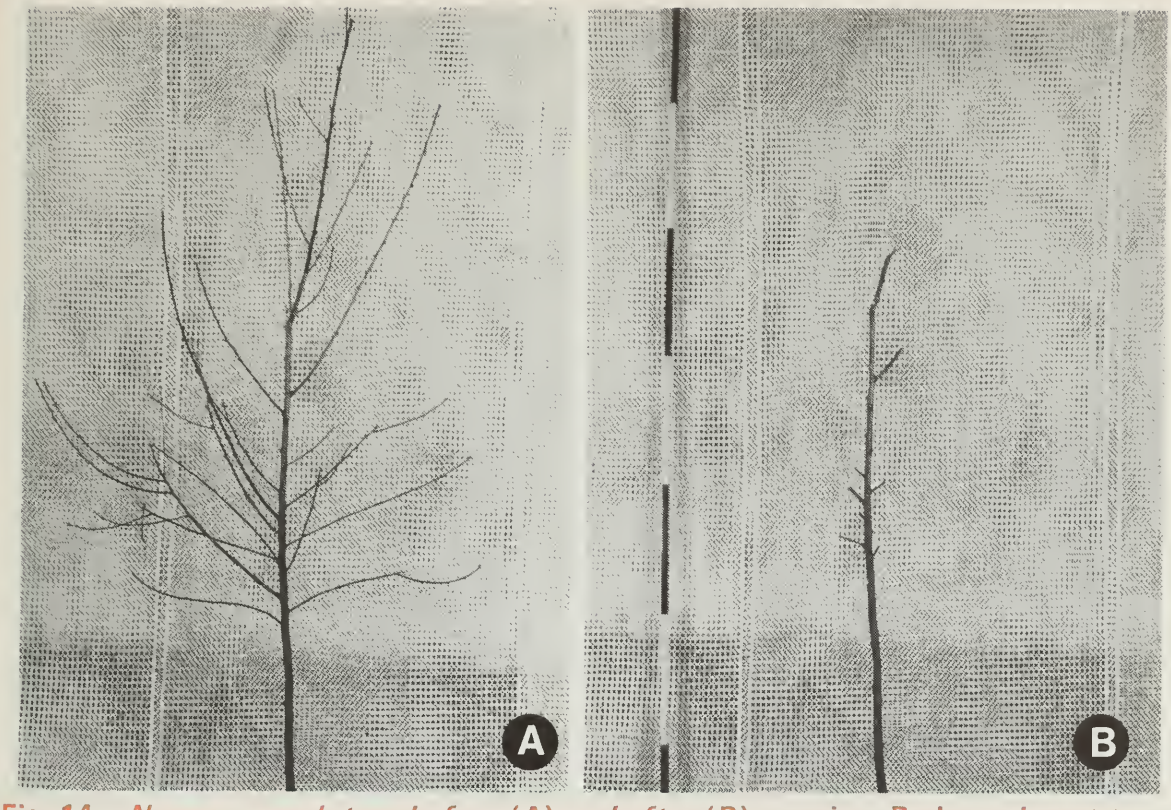


Fig. 14. *Nursery peach tree before* (A) *and after* (B) *pruning*. Reduce almost to a whip, 42 to 48 inches in height (105 to 122 cm). Remove weak and narrow-angled branches entirely. Cut the others to two buds. Sometimes these two buds are present at the junction of branch and trunk.

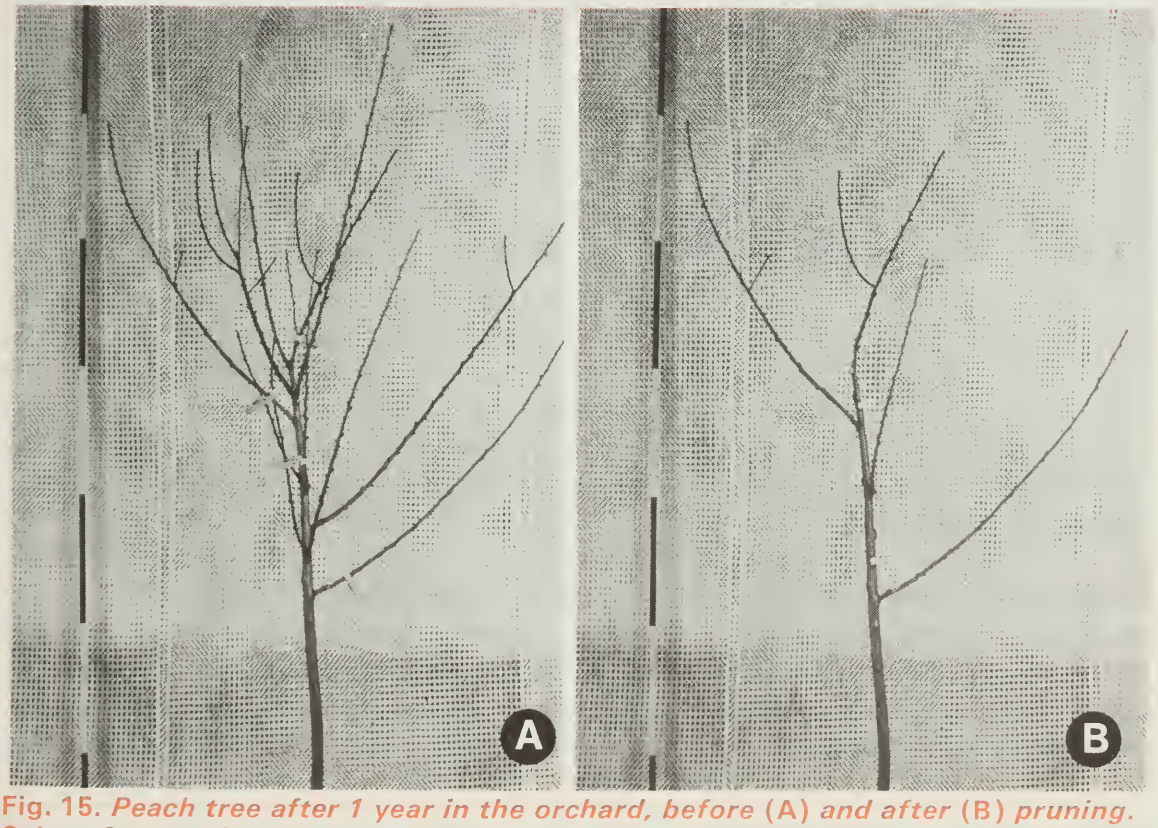


Fig. 15. *Peach tree after 1 year in the orchard, before* (A) *and after* (B) *pruning*. Select four or five branches with good angles, well distributed vertically and spirally. Remove all others with flush cuts at the main trunk.


Fig. 16. *Keeping a tree balanced*. 3-year-old peach tree before (A) and after (B) pruning. The branch at the left, considerably larger than the others and almost as large as the main trunk, can be dwarfed by removal of the lower laterals. This is all the pruning necessary for this tree at this time. Note the well-spaced branches and wide crotch angles, resulting in a strong tree.

In addition, prune away all secondary branches having sharp angles (less than 30°) with the main branch. In peaches, sharp crotch angles are almost certain to result in costly breakages, winter injury and canker in later years.

## PRUNING BEARING TREES

The pruning that can be done while standing on the ground should be completed first. A ladder, elevator or platform is then used to reach the upper parts of the tree.

A regular annual pruning is much preferred to a heavy pruning every 3 or 4 years. A heavy pruning upsets the balance of the tree, which is indicated by an abnormal growth of suckers (Figure 17). It may partially throw the tree out of fruiting condition. In cutting out suckers, the cuts should be made flush with the parent limb; otherwise, a second crop of suckers may arise from the same point next year.

Fig. 17. *Improper and proper methods of making cuts.* A stub may encourage a crop of 'suckers' at this point, or, in the absence of buds, a dead end. Both results are undesirable. Flush cuts heal quickly and safely.

## APPLE

Apples generally bear their fruit from terminal buds on short spurs which form on 2-year-old wood. They may remain productive for several years depending on the light they receive and the health and vigor of the tree. Occasionally some varieties blossom and set fruit on the terminal shoots of the previous season. As fruiting wood becomes less productive because of age or shading, it must be replaced by new wood.

If the tree has been properly trained, only light annual thinning is required in the early years of bearing (Figure 4). Proper soil management, not pruning, should be used to keep the trees vigorous. Somewhat heavier pruning is justified in orchards where pruning has been neglected for a few years.

Trees of most early varieties, if they have a good bearing record, seldom grow too high for profitable management. Heavy crops have a marked flattening-out effect on tree form. However, some varieties such as McIntosh, Delicious and Spy do become too tall for easy management, and heading back is then justified. This should not be done until there are large horizontal laterals to head back to (Figure 18).

Heavy pruning that reduces height and width by several feet can result in increased fruit size and improved grade with little decrease in yield. Such reduction in tree size should be attained over a period of 2 or 3 years. A heavy pruning in a single year upsets the balance of the tree, resulting in apples with poor storage quality. It may also result in excessive sucker growth, which is

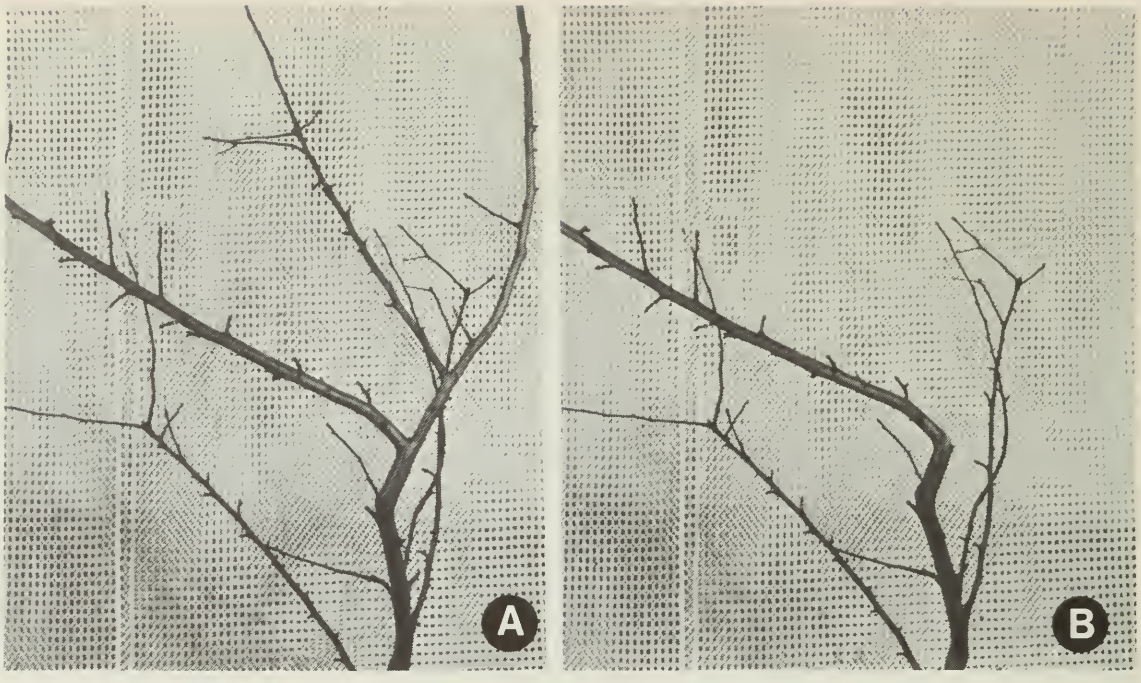


Fig. 18. *Proper method of heading back.* Before (A) and after (B) pruning. Make the saw cut in line with an outward growing lateral.

a problem at later prunings. A heavy heading may also lead to sunscald the following year. Do not head back the top or sides until required. As trees get older and more crowded, relatively heavier pruning will be required to get annual crops of goodsized fruit.

A good guide to the amount of pruning that should be done is the percentage of bearing area removed. It is seldom desirable to remove more than 10% of the bearing area in any one year. Removal of less than 5% is probably insufficient for healthy, bearing apple trees.

## PEAR

Like apples, pears bear their fruit from terminal buds on short spurs, on 2-year and older wood. These fruit spurs can be commercially productive for 6 to 8 years. Pruning keeps these spurs and fruiting wood in a healthy and vigorous state with plenty of sunlight and air. It also helps prevent overbearing, and encourages new growth.

Of the common deciduous tree fruits, pears require the least pruning. They produce few laterals and, consequently, do not produce a dense growth of branches. Nevertheless, pear trees should be given a light annual pruning, mainly to thin them, to facilitate spraying and reduce limb-rub damage to the fruit (Figure 19). In thinning out the branches, remove the topmost vertical branches after the first full crop and leave those tending to a horizontal position. In the lower part of the tree, cut the horizontal and drooping branches


**Fig. 19.** ***Poor and good training, pruning of pear trees.*** **(A) This poorly trained Kieffer tree has narrow crotches and crowded limbs. Corrective pruning will thin out crowded branches. The top has been 'hedged' resulting in thick sucker growth. (B) This 10-year-old Bartlett shows the result of early training and good pruning.**

when they interfere with movement in the orchard. Heavy pruning at any time may render the tree more susceptible to fireblight disease. Suckers growing from the trunk or main branches should be removed early in their first season because fireblight may work down through them and into the main framework where it may seriously weaken or even kill the tree. If fruit size is unsatisfactory even with good soil management, heavier pruning is required, particularly to remove weak wood.

The most common mistake in pruning pear trees is to head back the young, nonbearing trees. This practice stiffens the branches, making them more rigid and the tree more upright. The result is that cropping is delayed and when the tree does bear fruit, the branches are not flexible enough for the weight of the crop to open out the tree.

## PEACH

Unlike apple and pear, the peach does not have a spur system of fruit bearing. It depends on fruit bud development on wood of the current season.

Therefore, the tree must make good terminal growth each year to have a good fruit-bearing area. For bearing trees, an average terminal growth of between 8 and 16 inches seems to give good results. However, pruning is only one of several factors essential in attaining this growth. Soil management, spraying, and fruit thinning are equally important. Probably from 10 to 20% of the bearing area should be removed each year by pruning; the higher percentage for the older trees (Figure 20).

With six varieties from 3 to 14 years old at Vineland, heavy annual heading reduced yield every year compared with light pruning. In addition, the total time required per pound of fruit for pruning, thinning, and picking was greater for heavy than for light pruning. With 12-year-old Elberta trees, a single heavy heading reduced yield slightly the first year but increased it the next 3 years. Heading back is justified with older peach trees as it is with large mature apple trees. Nitrogen fertilizer applications should be reduced in the year of heading.

Planting trees 10 to 15 feet (3.00 to 4.50 m) apart often leads to crowding in an orchard and a problem in pruning. The trees grow upward toward the light and conventional pruning tends to cause more growth just below the cuts. This leads to increased shading in the lower parts of the tree. Good light penetration is essential for the development of fruit color and strong fruiting wood for the next year. At a 10- by 20-foot (3.00 to 6.00 m) spacing it may become necessary to remove every other tree.

Recent observations indicate that by cutting back young trees in the period after blossom to mid-June, much of the invigorating effect of dormant pruning is lost, thus controlling tree size. This heading back should not be done until the young trees are touching or overlapping, and then 2-year-old wood should be headed back to a lateral branch.

The long-term effect of this practice is not known. However, it would seem reasonable to adjust the time and amount of pruning to the vigor and size of the tree.

## APRICOT

The fruiting habit and pruning requirements of the apricot are quite similar to that of the Japanese plum (see Plum, below). The apricot produces most of its fruit on short-lived spurs. Slightly heavier pruning should be practiced with apricot than with plum for renewal of the spur system.

The branches of the apricot, although often heavier and larger than those of peach, tend to become too long and willowy unless headed back to desirable laterals. The trees become too thick unless a certain amount of thinning-out is practiced. Pruning should be aimed at maintaining a sufficient number of strong spurs to produce a satisfactory crop and enough new growth to produce spurs for future fruit production.

## PLUM

In general, the plum bears most of its fruit laterally on vigorous spurs on wood 2 to 8 years old and on short shoots. Fruit spurs on European plum

Fig. 20. *Six-year-old peach tree.* It is shown before (top) and after (bottom) light pruning to remove poor bearing wood, most of it in the lower portion of the tree. This tree is not yet too high, and it would be a mistake to remove wood from the top where the best peaches are produced.

are frequently branched and are longer and more slender than those of Japanese types.

Plums, particularly Japanese types, tend to overbear. As good fruit size is essential, it is necessary to prune the bearing trees rather heavily each year to induce growth of sufficient new wood. A thinning out of 10% of the bearing area every year is not too severe. Prune so that 10 to 20 inches (25 to 50 cm) of new wood growth annually is secured on young bearing trees, and 10 to 12 inches (25 to 30 cm) on older trees. Many small cuts are more effective than a few large cuts.

### CHERRY

Cherries develop most of their fruit buds on short spurs on 2- and 3-year-old wood. Some fruit buds are borne singly on 1-year-old wood in the sour cherry, but very few buds are borne on wood over 3 years of age on either sweet or sour varieties.

Sweet cherry trees require very light pruning until they become too high for convenient management. Then they should be reduced in height over a 2- or 3-year period. Cutting to a horizontal lateral will reduce subsequent sucker growth. Suckers should either be rubbed off as they arise or removed with a flush saw cut the following spring. If fruit size is too small on older trees, increase the amount of pruning and at the same time, improve the nutrition of the trees.

Sour cherry trees require relatively heavier pruning than do sweet cherry trees. Weak wood should be removed every year. This is the wood that bears small, poorly colored fruit. It will amount to 5 to 10% of the bearing area each year. In some orchards, heading back may be necessary after several years of cropping. To induce high annual yields, it is necessary to maintain fruiting branches with many terminal growths of 12 inches or more (30 cm or more) where fruiting spurs develop.

## SUMMARY OF RECOMMENDATIONS FOR PRUNING BEARING TREES

The pruning of every tree, trained or not, calls for sufficient pruning to keep it open and to encourage moderate new growth every year. The following suggestions will serve as a guide:

1. Cut out broken, dead or diseased branches.

2. Where two branches closely parallel or one overhangs the other, remove the least desirable, taking into account horizontal and vertical spacing.

3. Prune on the horizontal plane. Leave those laterals growing horizontally or nearly so on the main branches, and remove those that hang down or grow upward. This cannot always be done, but where possible it should be followed.

4. All varieties should be thinned out enough to permit thorough spraying and exposure to sunlight and air.

5. Where it is desirable to reduce the height of tall trees, cut the leader branches back moderately, to a well-developed horizontal lateral.

6. The lower branches of broad-headed or drooping varieties should be pruned to ascending laterals.

7. Varieties tending to produce numerous twiggy, lateral growths, should have some of these removed to prevent overcrowding.

8. Make close, clean cuts. Stubs encourage decay and canker, thus providing a source of injury to the parent branch or trunk. Cover large wounds ((over 1 1/2-inch diameter) 38 mm) with a suitable tree dressing, such as emulsifiable asphalt.

9. Prune moderately. Very heavy pruning is likely to upset the balance between wood growth and fruitfulness, and generally should be avoided.

10. Prune regularly. Trees that are given some attention each year are more easily kept in good condition than trees that are pruned irregularly.

11. Prune the part of the tree where more growth is required. This is particularly important with old trees. New growth will be stimulated only in those parts that were pruned. Reduce pruning to an absolute minimum where growth is already excessive.

12. Do not remove a branch unless there is a very good reason for doing so. Remember that the leaves of a tree are the food-manufacturing organs. If the leaf area is reduced unnecessarily, the tree will be reduced in growth or fruitfulness, or both.

## CONVERSION FACTORS FOR METRIC SYSTEM

| Imperial units | Approximate conversion factor | Results in: | |
|---|---|---|---|
| **LINEAR** | | | |
| inch | x 25 | millimetre | (mm) |
| foot | x 30 | centimetre | (cm) |
| yard | x 0.9 | metre | (m) |
| mile | x 1.6 | kilometre | (km) |
| **AREA** | | | |
| square inch | x 6.5 | square centimetre | ($cm^2$) |
| square foot | x 0.09 | square metre | ($m^2$) |
| acre | x 0.40 | hectare | (ha) |
| **VOLUME** | | | |
| cubic inch | x 16 | cubic centimetre | ($cm^3$) |
| cubic foot | x 28 | cubic decimetre | ($dm^3$) |
| cubic yard | x 0.8 | cubic metre | ($m^3$) |
| fluid ounce | x 28 | millilitre | (mL) |
| pint | x 0.57 | litre | (L) |
| quart | x 1.1 | litre | (L) |
| gallon | x 4.5 | litre | (L) |
| **WEIGHT** | | | |
| ounce | x 28 | gram | (g) |
| pound | x 0.45 | kilogram | (kg) |
| short ton (2000 lb) | x 0.9 | tonne | (t) |
| **TEMPERATURE** | | | |
| degrees Fahrenheit | (°F-32) x 0.56 or (°F-32) x 5/9 | degrees Celsius | (°C) |
| **PRESSURE** | | | |
| pounds per square inch | x 6.9 | kilopascal | (kPa) |
| **POWER** | | | |
| horsepower | x 746 | watt | (W) |
| | x 0.75 | kilowatt | (kW) |
| **SPEED** | | | |
| feet per second | x 0.30 | metres per second | (m/s) |
| miles per hour | x 1.6 | kilometres per hour | (km/h) |
| **AGRICULTURE** | | | |
| gallons per acre | x 11.23 | litres per hectare | (L/ha) |
| quarts per acre | x 2.8 | litres per hectare | (L/ha) |
| pints per acre | x 1.4 | litres per hectare | (L/ha) |
| fluid ounces per acre | x 70 | millilitres per hectare | (mL/ha) |
| tons per acre | x 2.24 | tonnes per hectare | (t/ha) |
| pounds per acre | x 1.12 | kilograms per hectare | (kg/ha) |
| ounces per acre | x 70 | grams per hectare | (g/ha) |
| plants per acre | x 2.47 | plants per hectare | (plants/ha) |