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Training and Pruning Apple and Pear Trees

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Prepared by Robert L. Stebbins, Extension horticulture specialist, Oregon State University, in consultation with Extension horticulturists at Washington State University and the University of Idaho.

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Training and Pruning Apple and Pear Trees

This publication describes the most important concepts in training and pruning of apple and pear trees. It is intended to help the pruner who already has some experience, to improve his skill. Judgments about the kind and amount of cuts that should be made in any particular tree or orchard should be based on its current condition relative to the desired objectives. This publication is not intended to provide all the information required to decide which kind of training or pruning to use or how much wood to remove. Primarily, it provides information on how to accomplish certain objectives.

You should recognize that there are a number of ways to train and prune trees successfully, but they require an understanding of the characteristics of tree growth. Pruning that ignores these characteristics may result in broken trees, low yield, excessively tall trees and reduced fruit size and quality.

The most important tree characteristics are; 1) its need for sunlight well distributed through the tree, 2) the dominant influence of the shoot apex or terminal on the buds and shoots below, 3) the tendency of pruning to stimulate shoot growth at the expense of flower formation, and 4) the influence of the weight of the fruit on the position of shoots and limbs.

Both apple and pear trees benefit from careful annual pruning but they differ in their response to pruning. Different varieties of pear or apple of the same variety grown on a different rootstock respond differently to pruning. To become a masterful pruner, it is necessary to prune and carefully observe the results on the same trees over a period of years. This publication first gives a few facts about tree response, an understanding of which is basic to all pruning, then describes the general procedure to follow for the two most common systems of training. The last section tells how to prune bearing trees and contains advice on solving certain specific problems.

Tools for Training and Pruning

Proper tree training involves cuts into small wood, which can be accomplished using hand shears. Starting about the third or fourth season,

you will find long-handled pruning shears, often called "loppers," useful in reaching the higher limbs. Do not use power pruners, especially mowers to train apple and pear trees. The cuts made by power tools will be too numerous and often too large. Sharpen pruning tools often to make the work faster and easier.

You'll need a ladder or some kind of man-positioning machine to position yourself for the work. Since ladder falls are the most frequent and costly source of injury in orchards, make sure you have a good ladder, the right size for the tree, and that you know how to set it properly. Before operating a man-positioning machine, be sure that you have been thoroughly instructed in its use and daily maintenance.

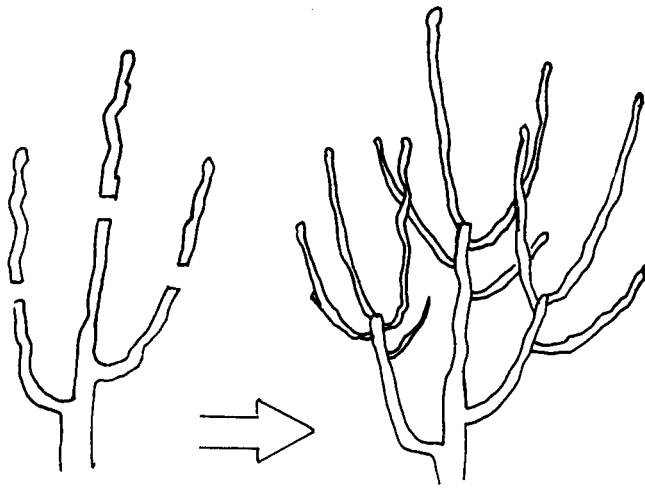
Power saws sometimes used in pruning may be electrical, small gasoline chain saws, pneumatic, or hydraulic. Power shears are either hydraulic or pneumatic. There is a tendency, when using power tools, to make too many large cuts. Do not let the tools you use influence your judgment in pruning. Do not leave stubs, as they often give rise to unwanted shoots and provide an entry point for wood rots.

Training

In contrast to *pruning*, the purpose of *training* is not to increase shoot growth but to direct growth into a well-designed tree structure.

Usually, unbranched "whips" are planted and "headed" (cut off) at the height where the lowest branches are to form. One way of obtaining wide crotch angles, called "delayed heading" is to head about six inches higher than desired at planting time and then rehead about six inches lower when the first branches are about six to eight inches long. The shoots that form below the second heading will be at a wider angle than the first ones were. Such double-headed trees will be smaller at the end of the first growing season. Double-heading is not needed when early limb spreading is used. Trees are usually headed at about 24 to 30 inches height. Higher heading adds to the tree height, increases the likelihood of leaning, and results in a slower growing tree.

There are two basic kinds of cuts which can be made in training or pruning; heading back and



heading back

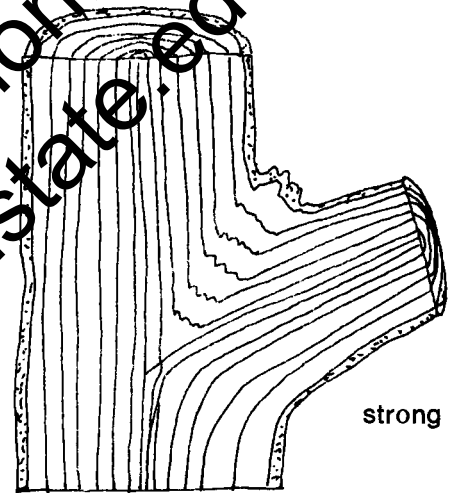
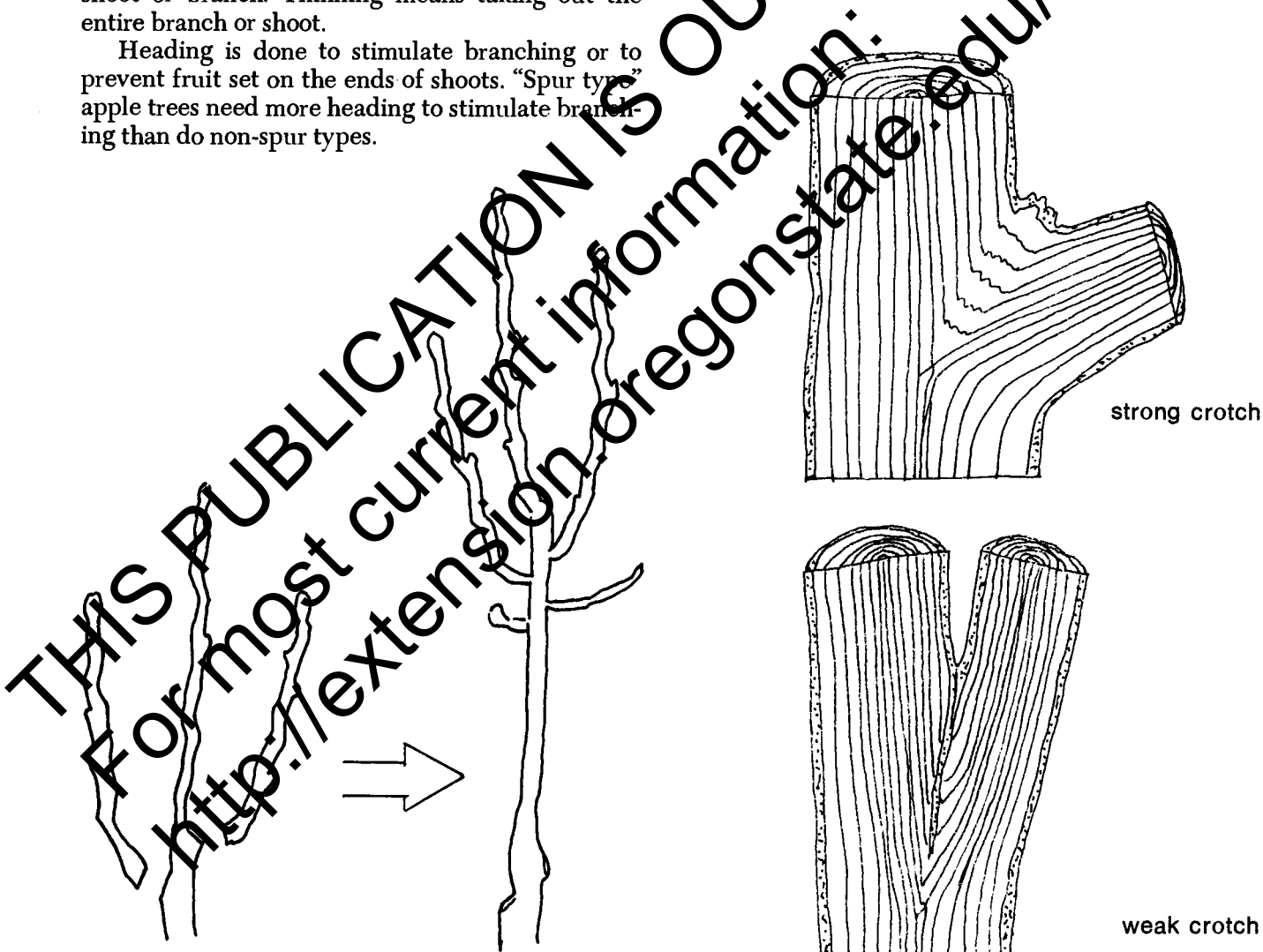
thinning out. Heading means cutting off part of a shoot or branch. Thinning means taking out the entire branch or shoot.

Heading is done to stimulate branching or to prevent fruit set on the ends of shoots. "Spur type" apple trees need more heading to stimulate branching than do non-spur types.

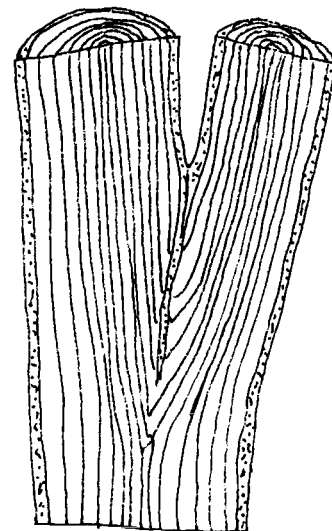
Heading may be done either early in summer, in which case branching is achieved the same season, or in winter. Summer heading often stimulates the formation of flower spurs. Cut off four to six inches of shoot when 18 to 24 inches of new growth has been made.

The more severe the heading cut the greater the stimulation of new shoot growth. Removal of $\frac{1}{4}$ to $\frac{1}{2}$ of the shoot stimulates branching and often allows flower "spur" formation. More severe heading may stimulate excessive growth and prevent flower bud formation.

Shoots that form a narrow angle with the other shoot on a young tree will become main limbs with narrow angles. Narrow crotches include bark and consequently are weak and split easily. Ice forming in the narrow crotches in winter expands and may split the trunk. Avoid narrow crotches by selecting shoots that form wide angles with the trunk or other branches.



strong crotch



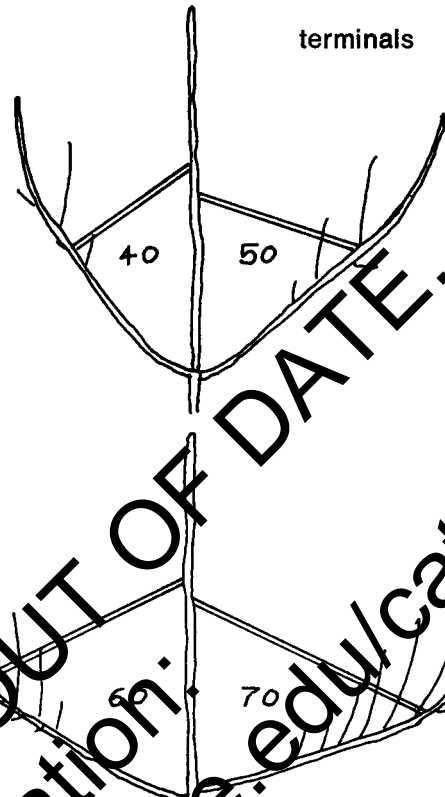
weak crotch

Terminal dominance is the most important phenomenon to understand in tree training. It is the influence of shoot tips higher in the tree on lower buds and shoots. The growing shoots produce a hormone which moves downward. Depending on its concentration, it will partially or completely suppress the growth of lower buds and shoots. Due to the influence of the hormone, shoots which grow on the same side of the tree below rapidly growing shoots will be weak and have wide crotch angles. Buds which have been suppressed by terminal dominance can be forced to grow by removal of the terminals ("heading"), by making a cut or notch through the bark above the bud, or by bending the terminal so that it is no longer above the bud. Notching above buds is a useful technique for stimulating development of a branch on the bare side of a trunk but the shoot thus formed will have a narrow crotch angle and will require spreading to widen it.

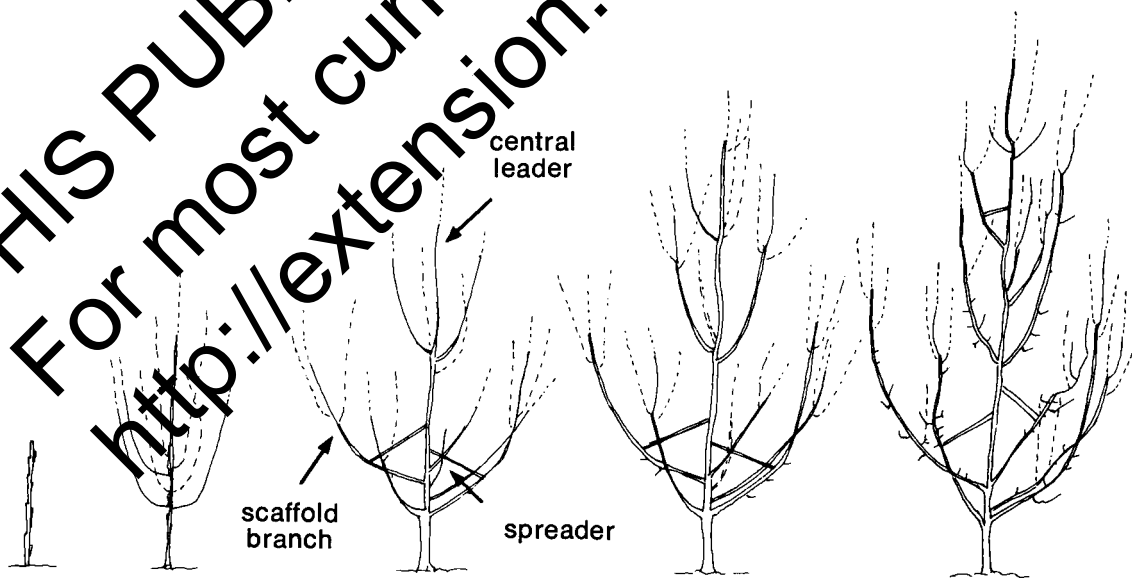
Limb spreading or bending is frequently practiced both to increase crotch angle and to stimulate the formation of flower buds. Spread limbs in the first three growing seasons while they are still flexible. Spreading beyond about 60 degrees from vertical may release too many buds on the upper sides of branches and cause too many shoots to form. The same result can occur from bending due to fruit load on a young branch. Spreading tends to reduce the growth rate of the spread branch.

Because pruning for training except for moderate

late summer heading always delays blossom bud formation and reduces fruit production in the early years, most of the training should be accomplished in the first two or three seasons when it can be accomplished with a few small cuts.



Training to a Central Leader



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Because they have strong terminal dominance, it is easy to train pear and apple trees to a central leader. First, establish the dominant position of the central leader by removal or spreading of competing shoots and head it. Maintain it the same way following subsequent headings or when the weight of fruit tends to pull it off-center. The problem of fruiting can be solved either by removal of the fruit or by supplying artificial support for the central leader, whichever is the better economically. The central leader makes spreading of young scaffold branches much easier since there is always the one central shoot to support the spreader. Spread scaffold branches just before pruning. Thin the ends of scaffold branches to a single shoot and head it. Heading is usually required to prevent fruit formation near the ends of scaffold branches. Head only those shoots where

branching or stiffening is desired, removing about $\frac{1}{4}$ to $\frac{1}{2}$ of the shoot. If unheaded and fruit is not thinned off, the branches would be bent too low and lose vigor. Delicious apples, especially the spur types, usually need limb spreading. In vigorous central leader trees, the top limbs tend to outgrow the lower ones. They must be suppressed by bending and pruning. Remove or suppress by heading excess branches as they appear. Remove all vertical shoots on the upper side of scaffold branches.

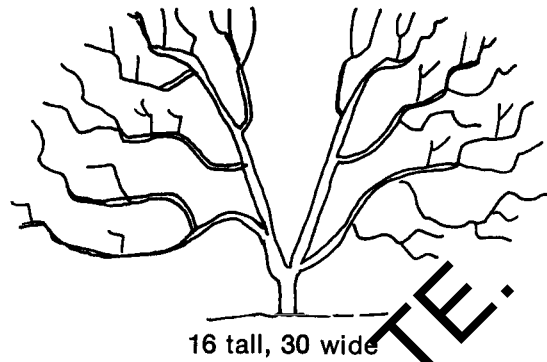
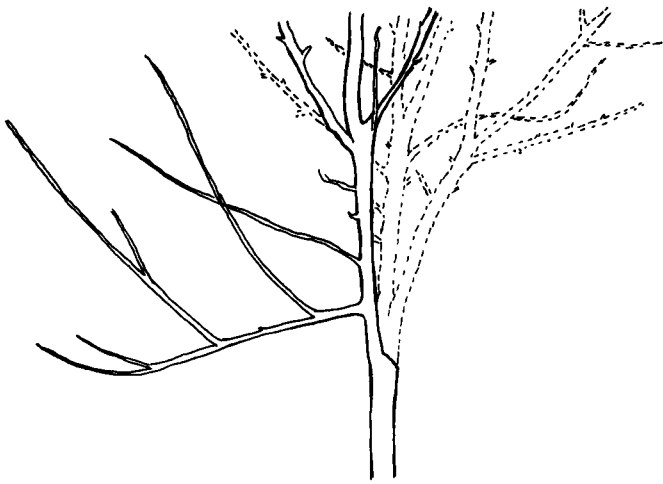
Pears: The risk of fire blight killing the central leader is a serious drawback to central leadered pear trees. While Anjou, Comice, and Bosc pear trees are easily trained to a central leader, the scaffold branches of central leadered Bartlett trees tend to spread too far under the weight of fruit and rapidly lose vigor.

Training to a Multiple Leader.



From three to six primary scaffold limbs are selected around the trunk and headed as required to stimulate branching. They should branch about two feet up from the trunk. Space these at least eight inches apart vertically. Select limbs with strong notches and spread these against one another or tie the limbs out with strings fastened to clips in the ground. Thin out the ends of the scaffold limbs to a single shoot and head it lightly. Depend on the weight of fruit to further spread the tree.

If a young tree is neglected in the first few seasons, severe pruning usually is required to correct a weak framework. If there are so many scaffold limbs in one place that none can develop vigorous secondary limbs close to the trunk, remove some by sawing them off flush with the trunk. Do not leave a stub. Remove only one or two big limbs per year. Paint the wound with "water base" polyvinyl acetate wound paint soon after the cut is made to prevent rotting of heart wood.



If trees are much wider than they are tall, the limbs will not be able to support the crop without props, straps, or ties of some kind. The limbs will be nearly horizontal and therefore will be prone to suckering. Heavy growth on tops of low, wide trees limits light penetration to lower limbs. Fruit on shaded limbs is small and poorly colored. The limbs become weak and may die.

To avoid these problems, space trees about as far apart as their final height will be. Keep the primary scaffolds fairly upright and the secondary scaffolds short.

Maintain ladder holes between the scaffold systems for more convenience in picking and pruning.



top view
"clover leaf system"

General Rules for Pruning

You may begin pruning as soon as the leaves are off in districts with mild winters, but in the colder districts, postponement until after January 1 reduces the risk of damage to pruned trees from extreme cold. Do not prune trees when the temperature is below 25°F.

Pruning generally increases the vigor of new shoot growth made, especially near the cuts. Prune trees which have made excessive shoot growth lightly and primarily with thinning cuts. Severe pruning stimulates too much new shoot growth and reduces fruit production. Pruning is one way to restrict tree size but if too much size restriction is attempted, fruit yield and quality will be adversely affected. Bitter pit of apples and cork of pears can be induced by over-pruning. Heading

stimulates more new shoot growth than does thinning.

Prune young bearing trees, ages 5 to 15, much less severely than older trees. Trees that are just beginning to bear can easily be shifted away from bearing by excessive pruning. They generally do not need stimulation of new growth. *Pear trees which are growing excessively rapid are more susceptible to fire blight.* Prune young trees to improve fruit quality by reducing limb rub, to control tree height and to prevent excessive spreading of limbs under the weight of fruit. Any corrective pruning required on young trees, such as removal of excess limbs, balancing leaning trees or reduction of height, should be done gradually over several seasons so as to minimize the stimulatory effect.

Once the branches have spread enough under the weight of fruit, do not "bench cut" to outside shoots in order to spread the tree. *With Anjou and Comice pears, fruit set may be increased by heading shoots near flower spurs.* Sometimes it is desirable, especially in young "spur type" apple trees, to head a long shoot to stimulate branching rather than removing it altogether. Do not routinely head all shoots, as this will stimulate excessive growth at the expense of fruiting. *Lightly head long shoots of Bartlett pear to prevent fruiting on the ends but thin out or leave unheaded, all shoots a foot or less in length.*

The objective of pruning mature, bearing trees is to obtain maximum yield per acre of fruit of desirable quality, on trees that are economical to manage. Before starting to prune, study the trees to answer the following questions: Should the trees spread more to fill the space or be more upright to avoid crowding? Are they too tall? Too bushy? Is the new growth well distributed or all in the top and back side of scaffold limbs? Lower limbs in mature trees should grow about 8 to 12 inches annually. Growth in the tops will be about twice as long. Is the tree poorly balanced due to wind? Is there a need for fruit wood renewal evidenced by old, non-productive spurs? Does light reach the center of the tree? Is too much of the fruiting wood out on the ends of limbs causing an excessive need for propping?

Then select three, or at most four, kinds of cutting to be done, such as thinning out shoots and shortening hanging spur systems, and follow these consistently from tree to tree as long as the trees are reasonably uniform. Give yourself or your pruners only a few simple decisions to make and the work will proceed rapidly and easily. Someone may want to go ahead of the regular pruners and make certain corrective cuts.

Make relatively few cuts into younger wood if the tree is growing more than is desired or if there are few flower buds due to a heavy crop the previous season or freeze damage has occurred. Prune overly vigorous trees mainly by mild thinning out, not heading.

Trees that have not been pruned for several years are overgrown and bushy. Restore the balance of vigor and fruitfulness in trees by making many light thinning cuts throughout the tree with emphasis on the upper, outer portions. Do this over a period of several years. Remove no more than one or two large limbs per year, if required.

Many growers follow a particular system such as "mold and hold," which is used for apples, or "the Long System," the "scaffold renewal," the "four leaf clover," or "central leader," which are used for pears and apples.

The "mold and hold" system primarily consists of making a large number of heading cuts on shoots and spurs throughout the tree. Spur-type apple trees are easier to handle this way than non-spurs. In this system, the tree is kept short and open to sunlight. The tree is pruned to be stiff so that each limb remains in its place. "Mold and hold" pruning should not begin until the tree has settled into bearing and is not growing rapidly. Slowly remove big wood as necessary to maintain tree height. During the first heading, confine cutting to one-year-old wood and eliminate about $\frac{1}{2}$ of a given terminal shoot. But if the headed branch has been fruiting for several years, go back into two-year-old and in extreme cases—three-year-old wood. Most lateral branches or twigs are cut. Unless the tree is low in vigor, with shoot growth less than six to eight inches on the average, such extensive heading will cause excess vigor, too many new shoots, and excessively large fruits which are poorly colored and likely to develop bitter pit. The system is costly because of the large number of cuts that must be made. When tree vigor was initially low enough, excellent results have been obtained using "mold and hold" pruning for apples.

The "scaffold renewal" system is the opposite of "mold and hold" in that the tree is pruned by making a few large cuts to remove selected scaffold limbs, often using a saw. Limbs to be removed are those that have fruited for three to five years and are horizontal or drooping. This system is economical but may leave the rest of the tree too bushy and with weak spur systems.

The "long" or "High Renewal" system falls between these two extremes. It begins with thinning the top of the tree to improve light penetration and follows through with spur renewal and thinning or heading of shoots as required. The ends of all scaffolds are thinned to a single upright shoot, which is usually headed. Branched, upright "risers" are pruned on the inside, with thinning cuts but no heading, so that they become unbalanced and pull over under the weight of the fruit. The "four leaf clover" system is similar except

that the tree is trained and pruned with four balanced main sections of equal size, with distinct ladder holes between sections.

The overall shape of a well-pruned, mature central leader tree is conical. The limbs are nearly horizontal due to early spreading. There is productive fruiting wood from near ground level to the tree top. It may be necessary to tie some limbs to the central leader to prevent excessive spreading and loss of vigor. Vertical "risers" on the upper side of scaffold limbs are removed completely every year.



In a well-pruned, mature multiple leader tree, the sides taper inward from bottom to top. The lower limbs are nearly horizontal, while the upper ones are nearly vertical. There is productive fruiting wood from near ground level to the tree top. Strapping or wiring between the major scaffold limbs may be needed to prevent excessive spreading by the weight of the fruit.

The central leader pruning system is a continuation of the procedure used in training except that spreading is no longer needed, but tying up of horizontal branches may be. All upright shoots on upper sides of scaffold limbs are removed entirely. The ends of scaffolds and the central leader are thinned to a single shoot. Depending on tree vigor and variety, some shoots may be headed leaving three-fourths to half of their original length. Weak spur systems are removed or thinned out.



Multiple-Leader Trees

First prune out limbs extending into the ladder holes, then start the detailed pruning from a position in the top of the tree high enough to look down on the whole scaffold system. If the tree is too tall to do this, either get a taller ladder or cut the tree top out, always cutting to a lower limb, to the point where it can be reached easily for pruning. Remove or cut back horizontal or downward hanging branches in the upper-outer portions of the tree. Thin the shoots around the ends of all main and secondary scaffold limbs to a single upright shoot. Do not leave forks on branch ends. This will, 1) encourage development of spurs and shoots further back on the branch by increasing light penetration, 2) discourage excessive spreading by removing the weight from ends of branches, and 3) prevent development of excess unwanted shoots through maintenance of terminal dominance.

Move downward through the tree, pruning more lightly as you go. Preferentially, remove the thinner spurs underneath limbs. Renew old spur systems by cutting them part way or just knocking them off to favor newly formed spurs. Keep replacement leaders coming on the sides of scaffold limbs and cut back to them as the outer portions become too horizontal or drooping. Thin out shoots to desired spacing and lightly head the longer ones.



Special Problems

Excessive suckering may be due to loss of terminal dominance on nearly horizontal limbs, excessive pruning and/or excessive use of fertilizer. Suckers or "water sprouts" should be removed in June or while they can be pulled off easily by hand. Water sprouts taken out in this way in the early summer are not so likely to return the next season

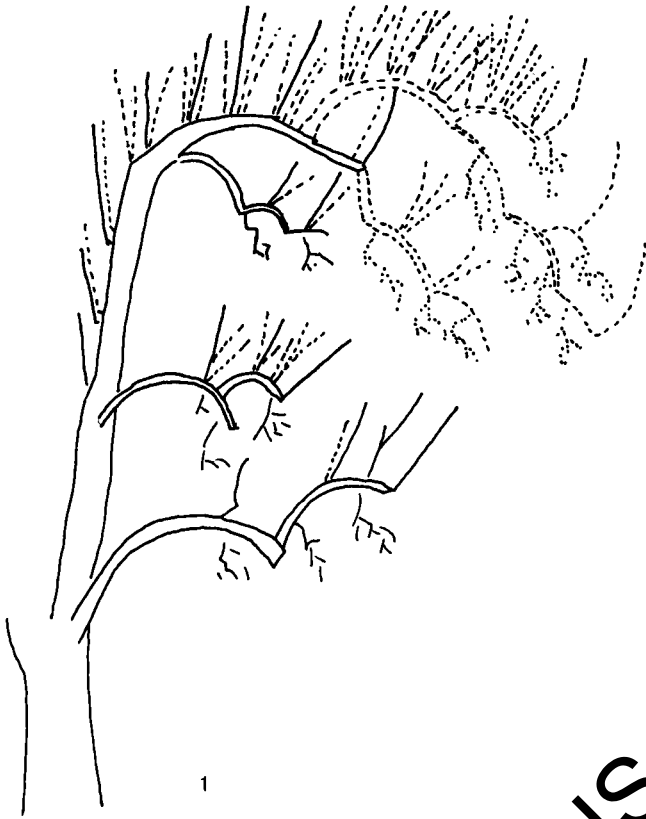
as those pruned off during the dormant season. Regardless of when it is done, it is well to leave a few of the smaller suckers well spaced out so that, by terminal dominance, they will suppress the growth of suckers below them. These may be headed in June to stimulate branching. Try to determine the cause of excessive suckering and correct it.



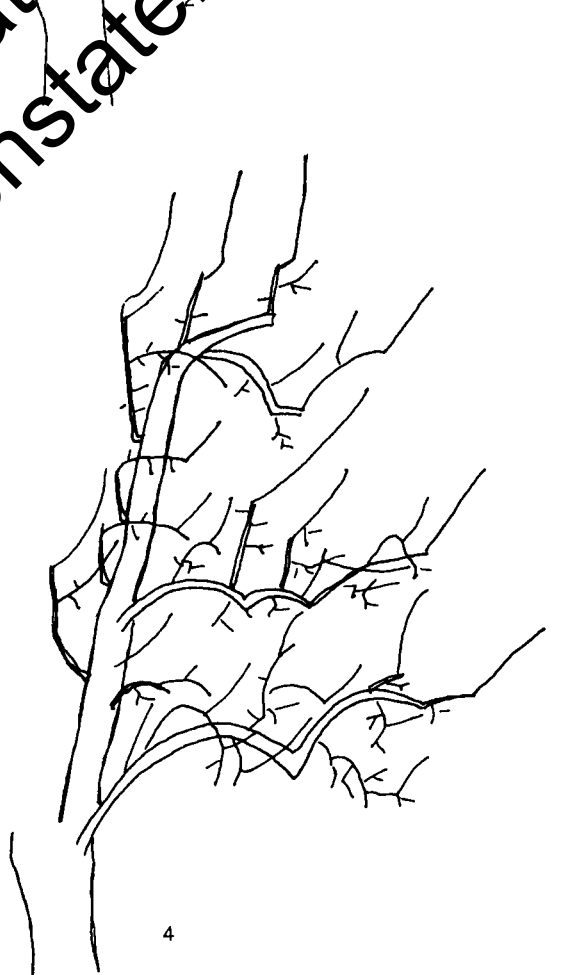
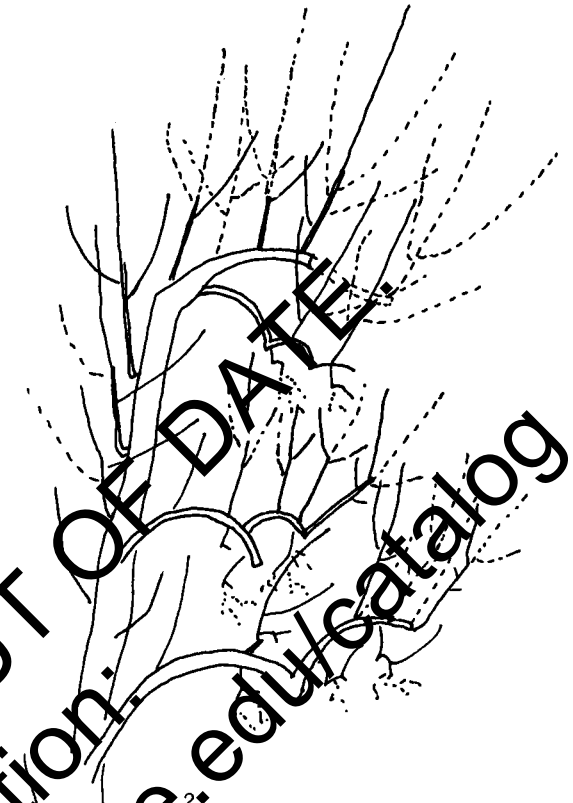
In a well-pruned tree, the shoot growth is evenly distributed through the bearing limbs from bottom to top. Most spur systems have some new shoot growth. Even growth is maintained by making many cuts into thin wood throughout the tree. There are few suckers to remove because cuts are evenly distributed and terminal dominance is maintained.



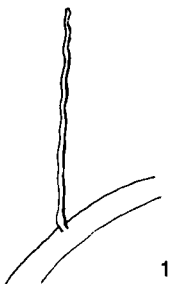
The "umbrella-shaped tree" is a common result of always pruning to outside wood. New growth consists primarily of suckers in the tree top. Lower limbs are weak and shaded. There is little new growth in the weak, devitalized spur systems. Much time and effort is expended annually in the removal of suckers and in placement of props.



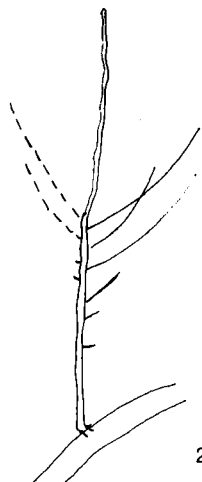
The pruning of "umbrella-shaped trees" can be reversed gradually if they are not too old. Yield will decline temporarily during the conversion.



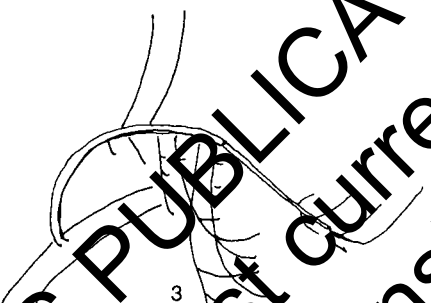
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1
One-year apple shoot with no flower buds, left unheaded.



2
Same shoot after second season, with flower buds



3
Same after fruiting in third season.

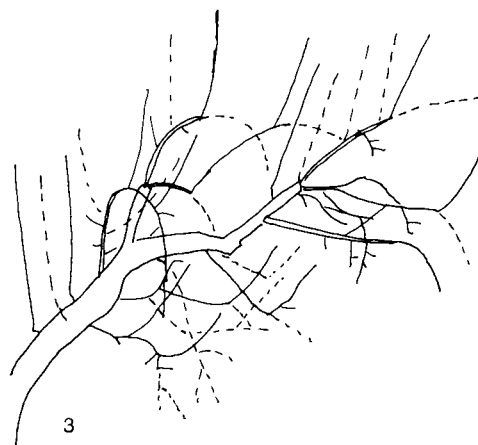
Usually, apple shoots do not form flower buds in the first season, but will branch and form flower buds in the second season. Pear shoots often will form a terminal flower bud in the first season. While apple shoots often will not fruit and bend over until the third season, pear shoots, if left unheaded, often will fruit and bend over in the second season. Depending on tree vigor, lightly headed shoots sometimes form flower spurs and bend over.



1
The top limbs in an old "umbrella tree" have many suckers that shade the lower portion of the tree.

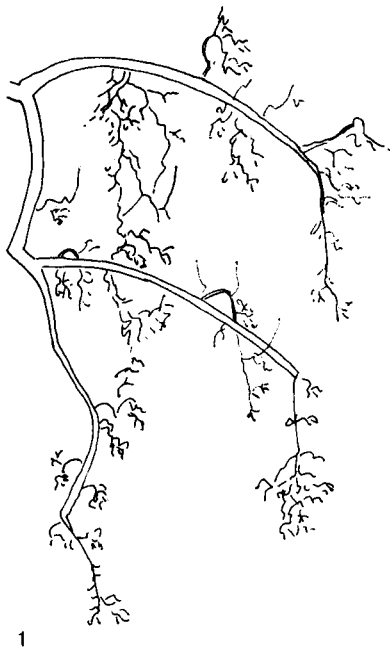


2
Thin the suckers and do not head those left. Remove most of the downward hanging fruiting wood in order to allow light onto the lower limbs and to prevent further spread.



3
The unheaded suckers will fruit and bend over in the third year.

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The weak, pendulant spur systems of "umbrella trees" have little new shoot growth.

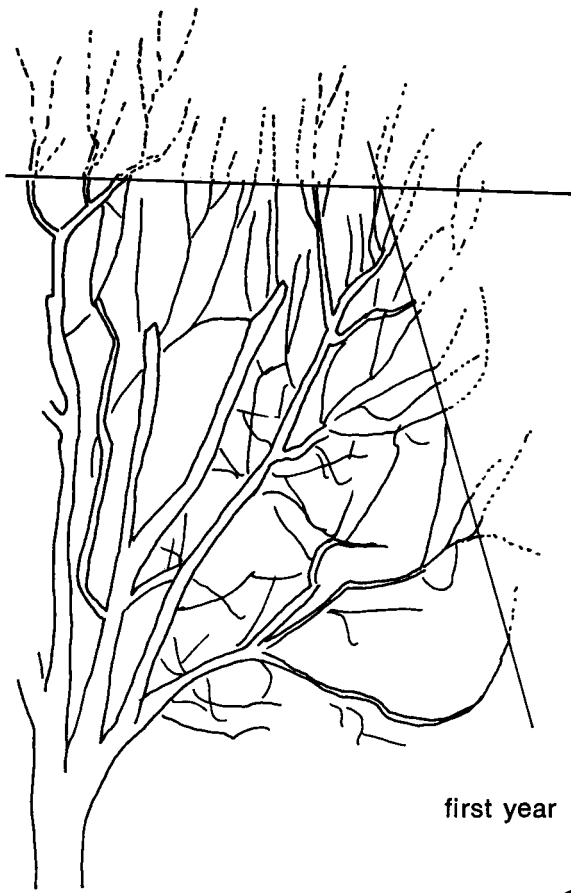


Removal of the lowest hanging spurs and thinning the others stimulates shoots growth near the spurs.



Continue to remove hanging ends of branches to promote bearing on stout wood which can hold a heavy load of fruit.

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first year



following year

Mechanical topping and hedging is sometimes used in an attempt to reduce labor costs. If misused, it can so reduce yield and fruit quality that a serious net loss occurs even though some savings were made in pruning costs. Masses of new shoots form along the plane of cutting and lower, inner wood is weakened or dies due to shading. Mechanical pruning is best used to confine the tree to its

allotted height and spread before hand pruning commences. Do not reduce the height or spread of trees with mechanical pruning more than about two feet in a single season. Always thin out the excess shoots formed by the previous season's mechanical pruning. Prune by hand throughout the tree to stimulate growth away from the area of topping or hedging.

Differing Requirements of Varieties

Fruit set in Anjou and Comice pears is increased by heading or "stub pruning" near the flower buds. Since fruit set is usually the factor most limiting yield with these varieties, detailed heading increases their yield.

Bartlett and Bosc usually set well without stub pruning. Heading all shoots of Bartlett pear trees reduces total yield, fruit size, and tree growth. Bartlett trees tend to set fruit on the ends of a few of the previous season's shoots. Fruit which forms on the end of long shoots hangs over and sways in the wind and becomes damaged and worthless. Long shoots in Bartlett trees should be headed but medium and short ones may be left unheaded. Bartlett trees have flexible limbs which spread excessively under the weight of fruit and, therefore, should be pruned to be upright. Bosc, Anjou and

Comice are more naturally upright and so should be pruned to be more spreading. Bosc needs less pruning than other pear varieties.

Even slight excess pruning causes most strains of Delicious to become overly vegetative and less productive, whereas Golden Delicious is not as sensitive to pruning. The wood of Golden Delicious is particularly brittle and long limbs may break under the weight of the fruit. Newtown, Gravenstein and Mutsu apples are exceedingly vigorous and should be pruned by judicious thinning. Overpruning Gravenstein or Golden Delicious will make the fruit susceptible to bitter pit. Rome Beauty and Tydemans Red trees tend to bear on the ends of thin, drooping branches. They should be pruned by thinning out working inward from the ends of the limbs.

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