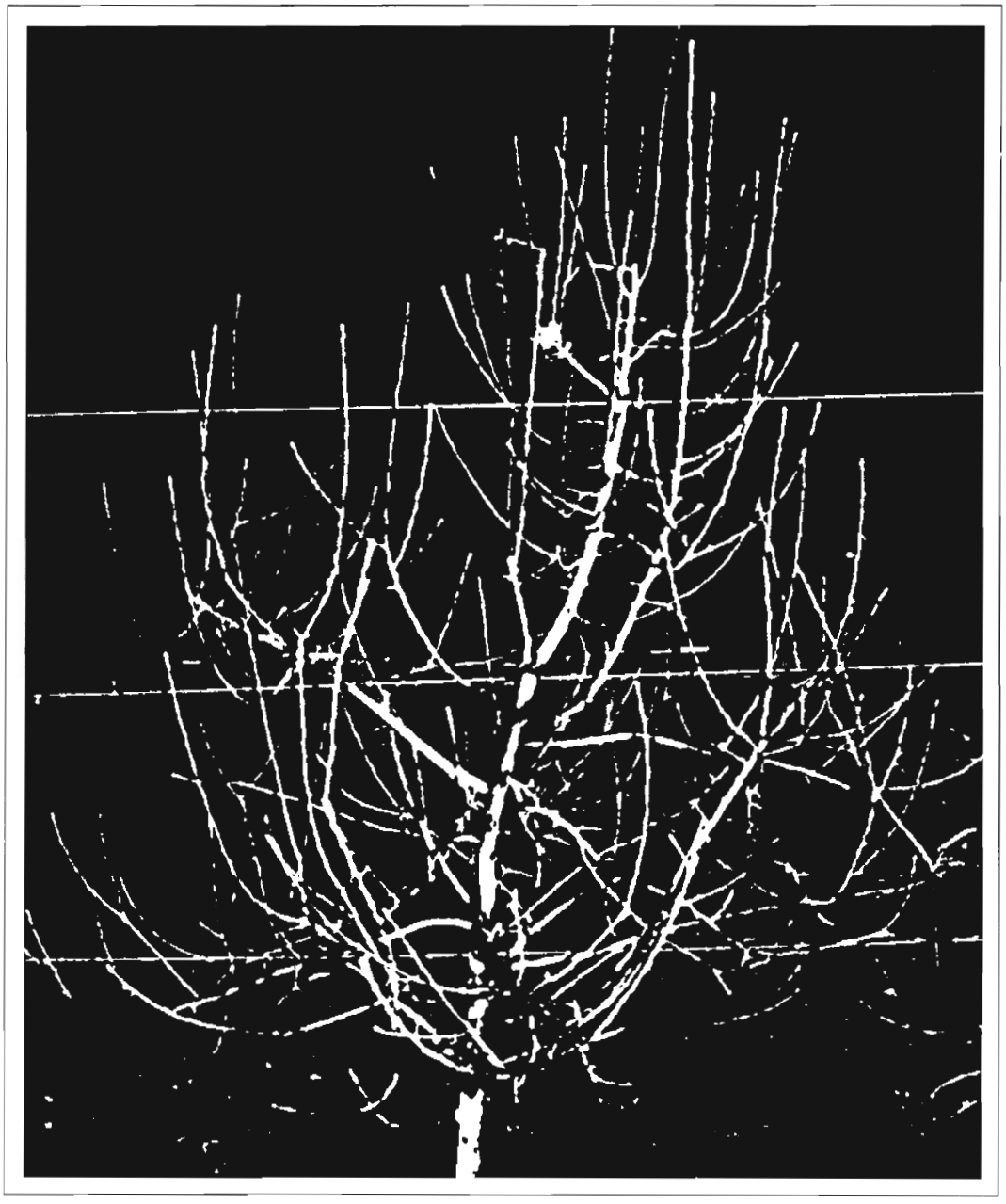
TRAINING PEAR TREES

IN COMMERCIAL ORCHARDS



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Training Pear Trees in Commercial Orchards

R.L. Stebbins

This publication describes the most important concepts in training pear trees. It's designed to help experienced trainers improve their training skills. It provides information about the advantages and disadvantages of various training systems and how to accomplish certain objectives.

Base your judgments about limb positioning or pruning for training in any particular tree on its current condition relative to your desired objectives.

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

Pear trees, especially Anjou and Comice, are notoriously slow to begin production. Trees on precocious rootstocks respond to proper training with much earlier production.

This publication first discusses a few facts about tree response (understanding this is basic to all training), defines terms used in training, and then describes the principal systems used for tree training.

Tools for training and pruning

Proper tree training involves cutting into small wood with hand shears. About the third or fourth season, long-handled pruning shears, often called *loppers*, are useful in reaching the higher limbs and in removing large wood. Frequent sharpening of pruning tools makes the work faster and easier.

You may need a ladder for the work. Since ladder falls are the most frequent and costly source of injury in orchards, make sure that:

- you have a *good* ladder,
- it's the right size for the tree, and
- you know how to set it correctly.

Tree response

These basic facts about tree response apply no matter what training system you follow.

1. Pruning a young, nonbearing tree always delays the onset of production and reduces the quantity of fruit produced in the early years. Training by limb positioning with little pruning leads to more early production. It leaves more potential fruiting wood. Branches tied toward the horizontal are often more fruitful than if left upright.
2. Pruning stimulates growth near the cut; however, the net effect of pruning is to reduce the overall size of the tree and the relative size of the pruned limb. Thus, pruning results in longer shoots, but less total growth.
3. *Apical dominance* is the term used to describe the influence the terminal bud exerts on the growth beneath. It influences the number of buds forming shoots, the lengths of the shoots formed, and their angles with the limb they emerge from (figure 1).

Robert L. Stebbins, Extension horticulture specialist, tree fruit and nut crops, Oregon State University.

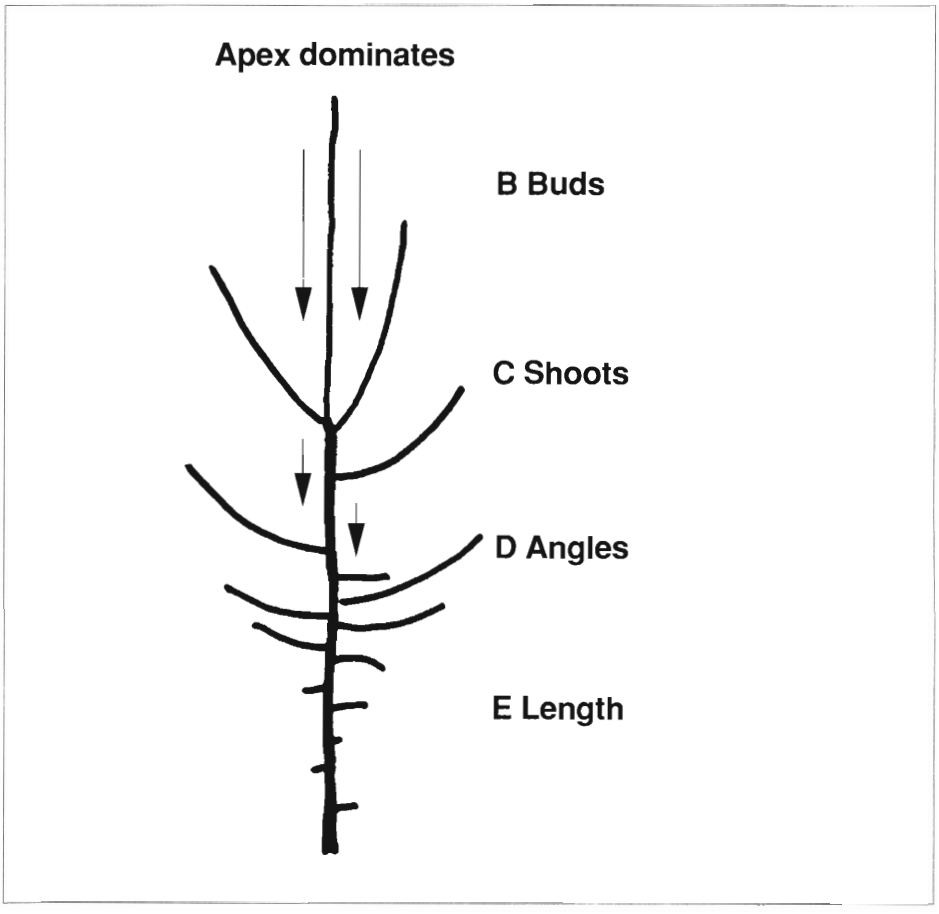


Figure 1.—*Apical dominance* is the term used to describe the influence the terminal (or "apical") bud exerts on the growth beneath.

4. The roots also influence the growth habit of the top. Restricting the roots, whether by drip irrigation into an otherwise dry soil, or by allowing only a limited amount of soil for the root zone, may increase branching, flower formation, and fruit set in young pear trees.
5. The overall shape of the tree influences productive efficiency and fruit quality by affecting light distribution throughout the tree (figure 2). Light distribution is more even in a conically-shaped tree than in one which is broader across the top than at the base.

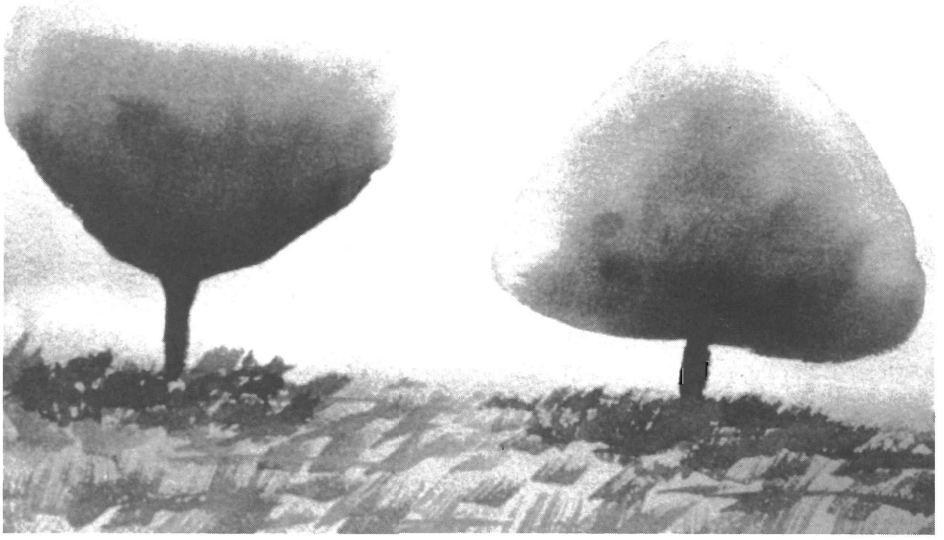


Figure 2.—Overall tree shapes

Effects of limb spreading

1. The unspread upright limb produces the longest shoots near its apex.
2. Moderate limb spreading, 45 to 60° from vertical, reduces the vigor of shoots near the apex while increasing the number of shoots formed and the length of those farther away from the apex (figure 3).
3. Spreading lower limbs reduces their vigor and increases growth of the central leader.
4. Spreading limbs may increase the number or flowers formed and the number of flower buds which set fruit, but only if limbs are spread very wide. Spreading to 45° isn't effective, but spreading to 75° from vertical, which is nearly horizontal, can be very effective.

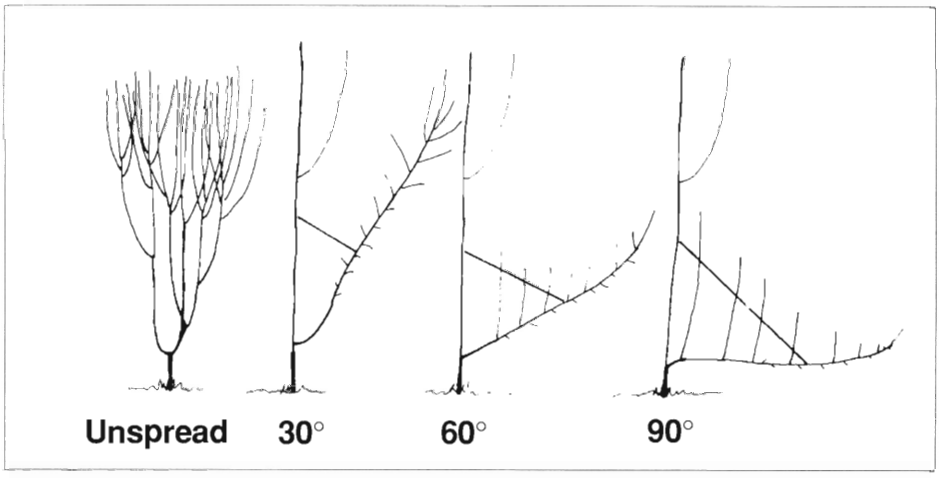


Figure 3.—The effect of spreading

Figure 4 shows the effect of limb spreading throughout the tree-training period until production has begun.

There's a strong interaction between spreading wide and rootstocks. For example, in research at Oregon State University, wide spreading of trees on seedling, or on OH x F clones 40, or 217, had little or no effect in the fifth year from planting; but wide spreading of trees on OH x F 87, 69, 361, or 333 greatly increased blossom formation and fruit set of Anjou, a variety that's notoriously slow to begin producing.

Two basic cuts

Heading back means cutting off part of a shoot or branch. *Thinning out* means taking out the entire branch or shoot back to a larger branch or to the trunk.

Heading back

Heading back, especially into 1-year-old wood, stimulates branching, stiffens limbs, or prevents fruit set on the ends of shoots (figure 5). It reduces the number of flower buds formed.

In figure 6, the high limb on the left was headed severely and not spread; the limb on the right was headed more lightly and spread moderately. Note the increased branching of the limb on the right.

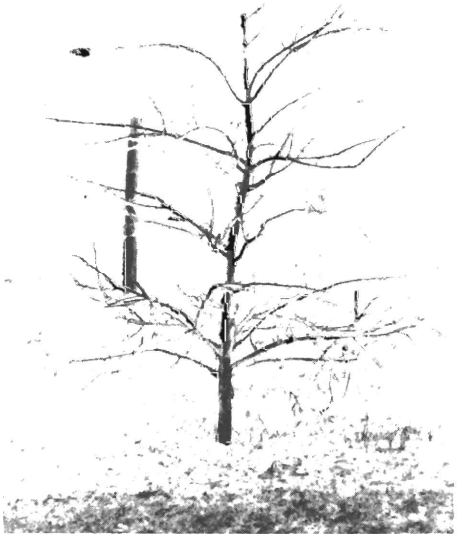


Figure 4.—A tree with limb spread wide begins bearing early.

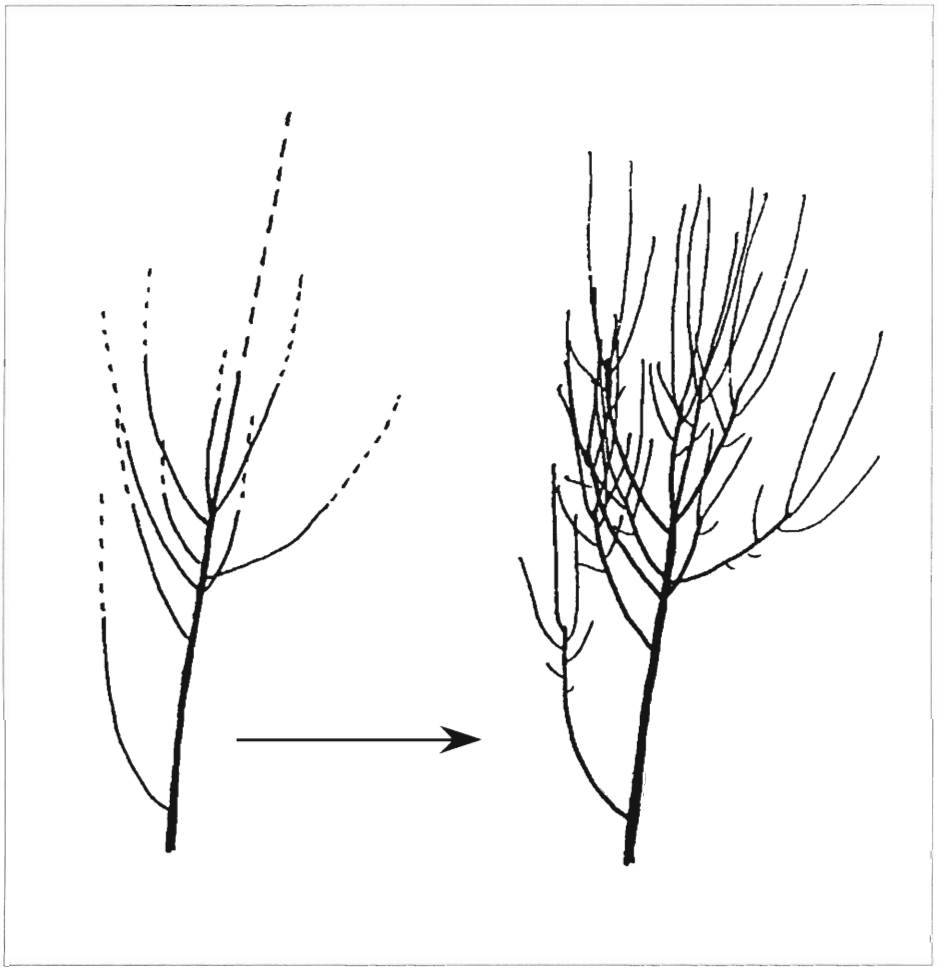


Figure 5.—Heading *increases* branching.

Thinning out

Thinning out improves light penetration, redirects limbs, and shortens branches (figure 7 on page 6). All pruning reduces flower bud formation, but thinning reduces it less than heading does.

Shoots that form a narrow angle with the trunk of a young tree will become main limbs with narrow angles. Narrow crotches include bark, are weak and split easily, and are more susceptible to cold injury. Winter ice forming in the narrow crotches expands and may split the trunk.

Avoid narrow crotches by selecting shoots that form wide angles, such as 45 to 60°, with the trunk or other branches, or by artificially spreading the young shoots as they form (figure 8 on page 6).

Figure 6.—Heading with and without moderate spreading

When to prune for training

Training can begin in late spring or early summer to direct growth into wanted shoots rather than into unwanted suckers.

Fall or early winter pruning can increase the susceptibility of trees to damage in a sudden freeze within 2 weeks after they're pruned. In cold districts, delay pruning for training until after the threat of very cold weather has passed.

In districts with mild winters, you may begin pruning for training as soon as the leaves fall. In the colder districts wait, until after January 1 to reduce the risk of damage to pruned trees from extreme cold.

Growth and fruiting habit

Different varieties of pear or the same variety grown on a different rootstock respond somewhat differently to training. To become a masterful trainer, you must prune and carefully observe the results on the same trees for several years.

Growth habit refers to the overall growth pattern of the tree and includes:

- carriage—stiff upright to spreading;
- crotch angles—narrow to wide;
- branching—many to sparse; and
- location of branches—start of a year's growth and/or bourse shoots.

A *bourse shoot* is one that originates from the enlarged portion of stem that bears a fruit (figure 9 on page 7).

Fruiting habit refers to the overall pattern of fruiting and includes:

- fruiting on the ends of long or short shoots,
- age of spurs that produce most of the crop, and
- production relatively close to the trunk or rapidly evolving toward the extremities of scaffold limbs.

Most pear trees tend to be narrow, upright, with narrow-angled crotches and long, unbranched annual shoots. Anjou and Comice have strong wood and seldom bear fruit on the ends of

long shoots. Bartlett and Bosc have weak, flexible wood. Frequently, Bartlett sets fruit terminally on shoots.

When to train

The purpose of training is to direct growth into a well-designed tree structure. To avoid heavy cutting, which would reduce early yields, most training should be done in the first two or three seasons, when you use only a few small cuts.

Newly planted trees

All pear trees must be headed in the first spring so that the lower trunk and branches will be strong enough to resist wind and to stimulate formation of shoots lower on the central leader, which will develop a stronger lower tier of limbs.

Dormant heading increases the need to spread limbs to develop wider crotches.

Low heading, about 24 inches or lower, stimulates fewer but longer shoots on unbranched whips. Heading higher than 24 inches usually results in more but shorter shoots. Figure 10 on page 7 shows low vs. high heading.

Delayed heading—after the terminal shoot bud has opened but before much growth has been made—produces framework shoots with wider angles than does a single heading cut at planting time.

If you can get nursery trees with a good set of branches, they can be brought into production sooner than unbranched whips. In northwestern Europe, pear orchards are usually started with trees having 2-year-old tops that are well-branched.

Feathers

If the nursery stocks arrive with unbroken branches called *feathers*, you can use some of these to develop a lower whorl of limbs, provided they're not too low, and that they're thinner than the main leader. In very close plantings, head feathers to develop branches and spurs closer to the central leader. If there are less than three feathers, remove them.

Under some conditions (injured nursery stock, infrequent irrigation, or other stresses) feathered trees may not grow well.

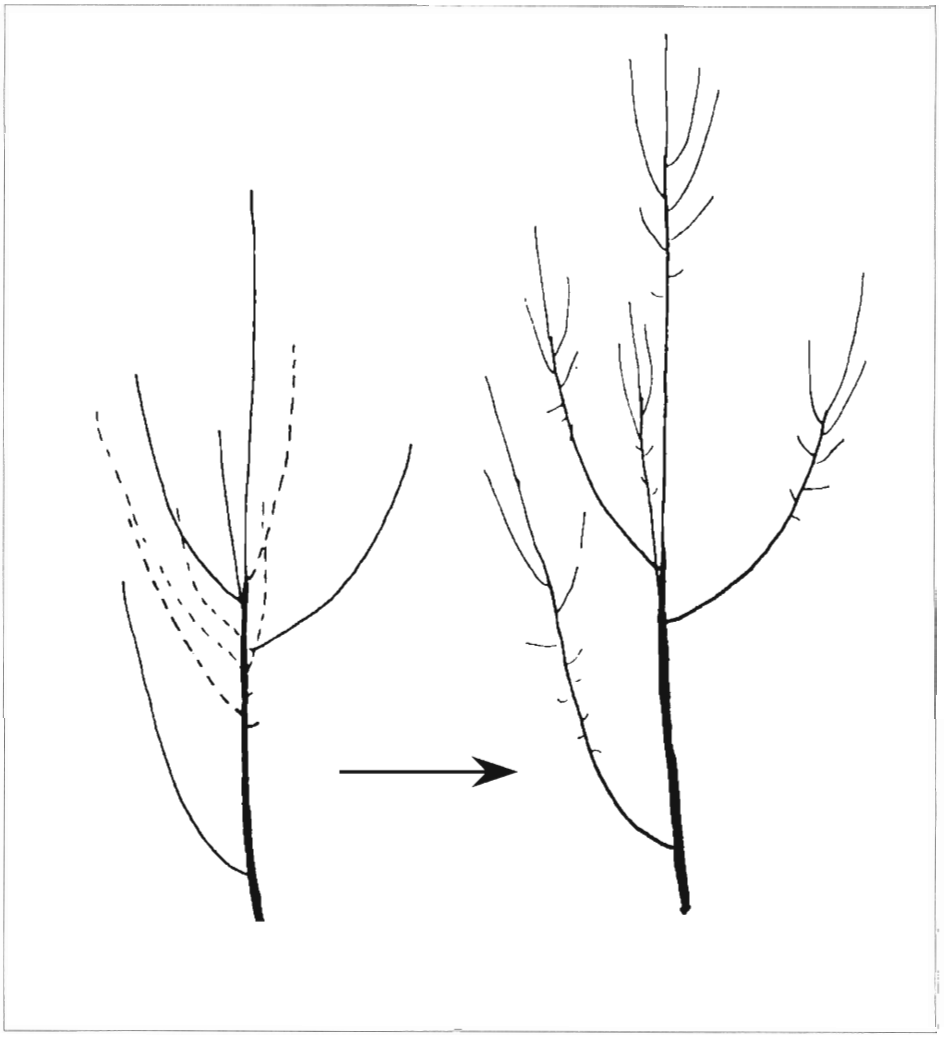


Figure 7.—Thinning *limits* branching.

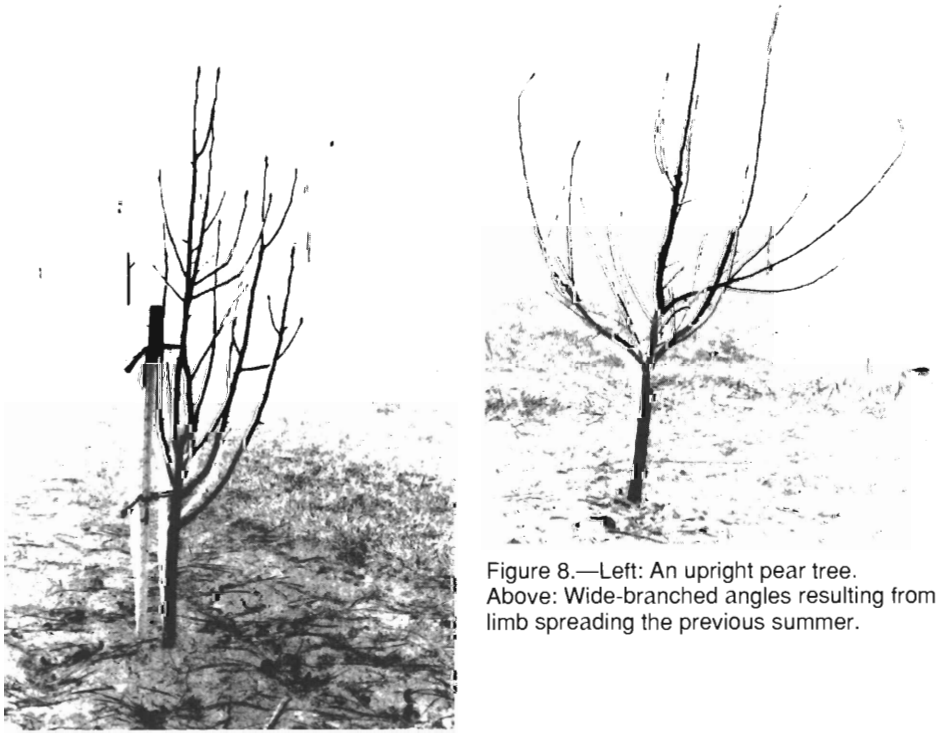


Figure 8.—Left: An upright pear tree. Above: Wide-branched angles resulting from limb spreading the previous summer.

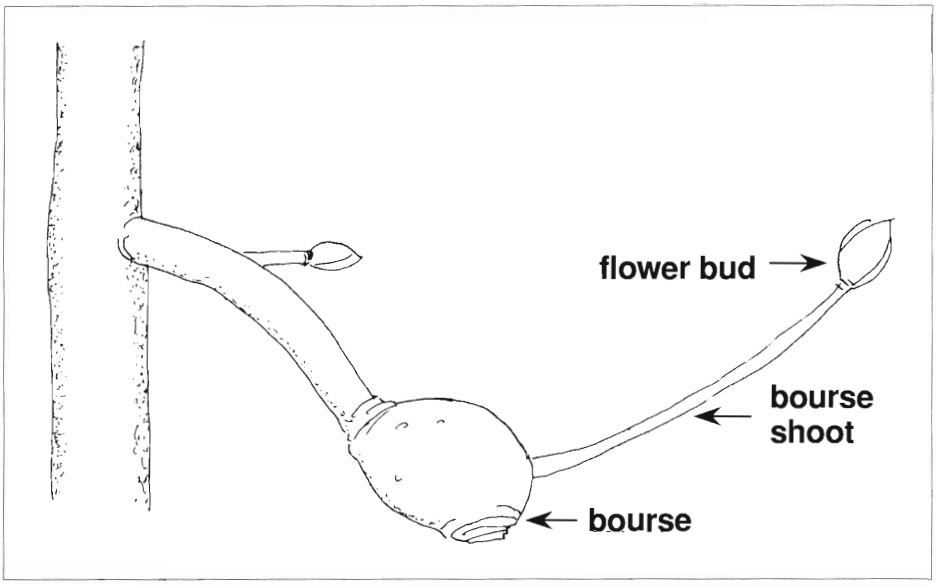


Figure 9.—A bourse shoot

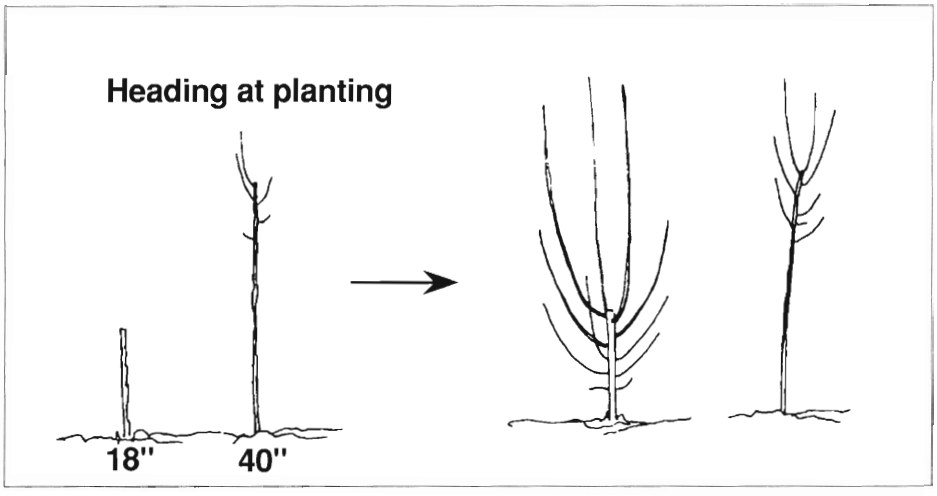


Figure 10.—High vs. low heading

Figure 11.—Tree trained to a central leader

Figure 12.—Increased branching and wider angles on a delay-headed tree

Remove all feathers closer to the ground than 20 inches. The presence of very low branches greatly complicates mowing and chemical weed control.

Kinds of training

There are three general kinds of training used for pear trees: central leader (or axis), modified central leader, and multiple leader (or vase).

Training to a central leader

Because it produces a narrow tree that occupies less space in the orchard, central-leader training has become popular for high-density pear plantings (figure 11). However, fire blight (a serious bacterial disease) may progress rapidly down the leader, killing most of the tree.

This system is used because such losses are offset by the much higher tree densities possible. At high densities, each tree lost represents a much smaller percentage of the productive surface on an acre than at lower densities.

Use central-leader training in pear orchards with tree spacings 10 to 15 feet or closer in the rows and 20 to 22 feet between rows, where tree height is confined to not more than 12 feet. It's difficult to position a ladder to gain access to the tops of central-leader-trained trees that are more than 12 feet tall.

Because of a tendency for strong apical dominance, it's easy to train most varieties of pear to a central leader, provided you follow certain rules.

First spring. First, delay-head the central leader (figure 12). Varieties differ widely in their tendency to branch and to form wide crotch angles naturally.

Varieties with narrow angles should be spread with toothpicks or spring-type clothespins when the shoots are 5 to 8 inches long, during the growing season.

When you develop a central-leader tree, any branch that's too thick relative to the leader will compete with it, destroying the balance and symmetry of the tree.

Therefore, *when a lateral on the leader is more than ½ the thickness of the leader (where it's attached), remove it.*

This is referred to as the "one-half rule" (figure 13).

There's a temptation to keep too-strong limbs in order to get early fruiting, but this can be a trap, especially in sparse-branching varieties. Remove those too-strong limbs in the dormant season, or when you see them in spring or summer.

First summer. Let the tree invest in wanted shoot growth only. Pinch any potential shoot growth when 6 to 8 inches long so they'll form weak side branches. These may form fruiting spurs. Don't let long, vertical "suckers" develop unchecked.

First dormant pruning. If you were able to select a basic set of limbs (first whorl) at 24 to 30 inches height, using feathers from the nursery, there should be little to do in the first dormant season.

1. Continue to select branches for the lowest set, if needed.
2. Delay-head the leader at 36 inches above the highest branch. Delay-head side branches at 18 inches to an outside bud if thicker than a pencil. Don't head thin branches.
3. Remove any laterals that are ½ or more times as thick as the leader.
4. Remove or spread any laterals that are too upright.
5. Remove any vertical suckers. The aim is to have 5 to 8 shoots at the end of the first growing season from which you can select the future side scaffold branches.

Second spring and summer. Continue to spread limbs as required; delay-head the side branches 18 inches beyond the previous year's heading. Keep the leader dominant and head it at 36 inches above the highest side limb.

If too few branches have been formed, score above a bud at bloom time to stimulate formation of a branch (figure 14).

Second dormant season. Continue to follow the instructions for the first dormant season. Handling the side branches depends on the distance between trees. Develop 4 or 5 limbs if the distance is over 10 feet, more than 5 if less than 10 feet.

Remove branches that arise directly over others on the leader, unless they're 2 feet apart.

One way to develop a shorter tree and slow down the leader is to cut the leader back to a side branch, leaving a short stub and tie to it (if the tree isn't staked), and tie a lower limb up to replace what you cut off. The leader becomes somewhat zigzagged, which slows growth and which may also stop blight from spreading downward so fast.

Figure 13.—A limb with a diameter more than ½ that of the central leader should be removed. The highest limb on the right is too thick and should be removed.

By the end of the second dormant season, most training should be completed—or you should have set a pattern to follow from there on.

Once the young tree has reached the desired maximum height, establish a renewal point on the leader by pruning to a weak side shoot each year.

Windy sites. It's difficult to develop a well-balanced central-leader tree on a windy site. Using an artificial support to hold the tree into the wind may enable development of the tree without excessive pruning. Tie the trunk and as the tree grows larger tie some limbs into the wind. Supplement this effort by pruning to buds that are pointing into the wind.

Sites with deep snow in winter. When the deep snows of winter melt and shrink, they can tear the limbs off of young trees. Where this is a potential problem, tie the limbs up close to the central leader before the snows begin.

Training to a modified leader

The idea of this system is to develop a strong basic tree structure by starting with central-leader training but finishing with a multiple-leader tree.

A temporary central leader helps obtain wide-angled crotches both by the hormonal influence and by affording a place to insert spreaders. It helps you select the main scaffold limbs, spaced about a foot apart on the trunk, which also contribute to tree strength.

The modified-leader system is used primarily for pear trees whose ultimate height will be 14 feet or taller with an equal or greater spread. Start the tree in the same manner as with central-leader training.

After 5 or 6 years, take out the central leader. If you remove it too soon, all the side limbs will turn upward, eliminating the spreading effect of the leader.

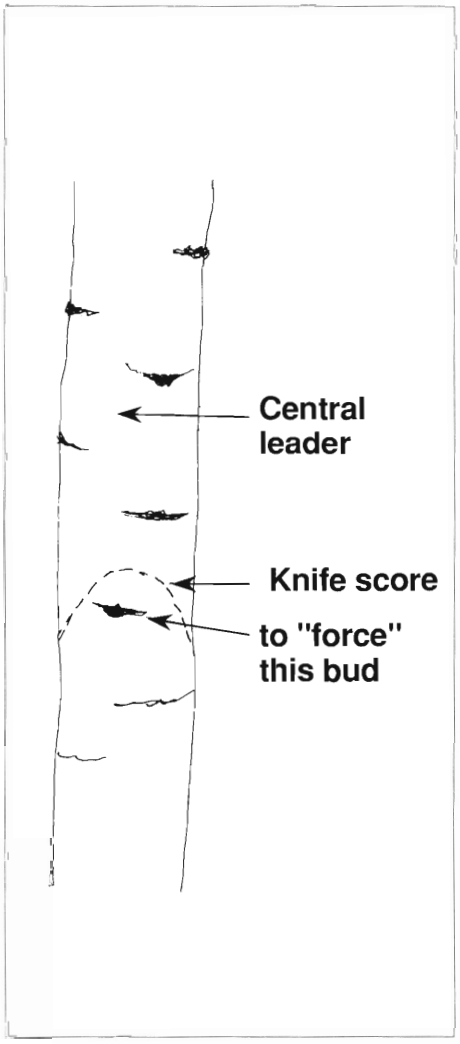


Figure 14.—Scoring to stimulate branch formation

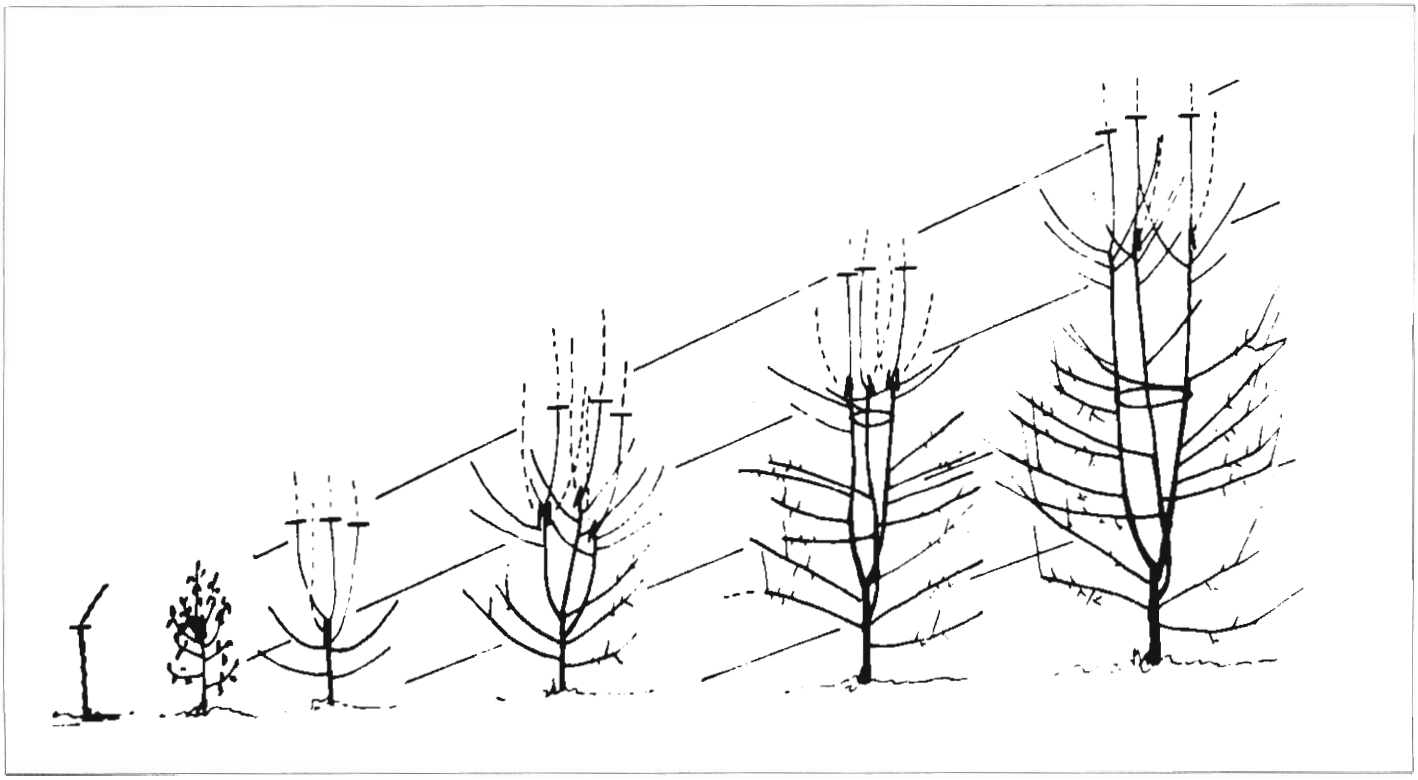


Figure 15.—Stages in development of a 3-leader pear tree

Training to multiple leaders

Multiple-leader training is best for large pear trees where central leader training isn't desired because of fire blight or tree size.

Advantages over central leader include:

- more but shorter side limbs,
- more fruiting wood in the upper portions of the tree in the early years,
- no requirement for spreaders, and
- ease of ladder placement to work in the top.

Leaders are strapped together to prevent excessive spreading or breakage. Trees trained this way won't come into production as quickly as those in which all limbs are tied nearly horizontal.

At planting, head at 18 to 24 inches, depending on the size of the nursery stock. In the first summer, select three shoots when all are 6 to 10 inches long, and spread them with cocktail-style toothpicks. Remove or severely head-back all other shoots except those that are under the lowest selected leader shoots.

In the first dormant season, delay-head the leaders at 30 inches. Leave all other shoots unheaded.

In the second dormant season, delay-head the leaders at 24 inches above the highest side branches. Remove shoots which form narrow angles with leaders, and leave all others unheaded.

In the third dormant season, delay-head the leaders again, a little closer to the lower whorl of side limbs than last time. Remove any shoots that are competing with the leader. If the leaders are spreading too wide, encircle them with twine. Don't head side shoots.

Follow the same procedure in the fourth dormant season, except head side shoots to flower buds where they appear.

The main purpose of scaffold-limb spreading in a multiple-leader tree is to obtain strong crotch angles. Excessive spreading will open the center of the tree too much, stimulate unwanted inside growth, and make it difficult to maintain an overall conical tree shape. Good light penetration depends on conical shape more than openness of center.

Figure 15 shows the stages in the development of a three-leader pear tree.

Glossary

Apex
The end of a shoot most distant from its base.

Apical dominance
Where the growing shoot tip produces hormones that move toward the roots, influences the number of shoots forming buds, the lengths of the shoots formed, and their angles with the limb they emerge from.

Bourse shoot
A shoot arising from a fruiting spur in the summer it is bearing a fruit.

Central leader
The central limb in the tree from which all other limbs arise and which also forms the highest part of the tree; also called *central axis*.

Delayed heading
The practice of heading a shoot in spring, shortly after the terminal bud has started to grow. This is done to increase the number of vegetative buds which form shoots, and to obtain shoots with wider angles.

Feathers
The 1-year-old shoots that are found on some trees arriving from the nursery.

Flower bud
In pear, buds that contain flower primordia also contain leaf primordia and could also produce up to two shoots.

Heading
Cutting off part of a shoot or branch not at a branching point.

Productive efficiency
The amount of fruit produced relative to the amount of space occupied by the tree. In young trees, it's the yield divided by the cross-sectional area of the trunk.

Pruning
Cutting off parts of the tree.

Rootstock
Pear trees are compound plants, with different genetic makeup in the roots. The selection of rootstock clone greatly affects tree size, bloom, and fruiting.

Scaffold limbs
The woody parts of pear trees can be divided into two kinds: fruiting wood and structural or "scaffold" wood. Fruiting wood is replaced periodically by pruning, but scaffold wood is more or less permanent.

Shoot versus spur
The term *shoot* refers to the past season's growth in winter or a current season's growth in summer.

Spindle bush
A special training system for trees not over 8 feet tall, usually planted at high densities. Details of this system are not described in this publication.

Spur
A very short shoot that usually terminates in a flower bud. A

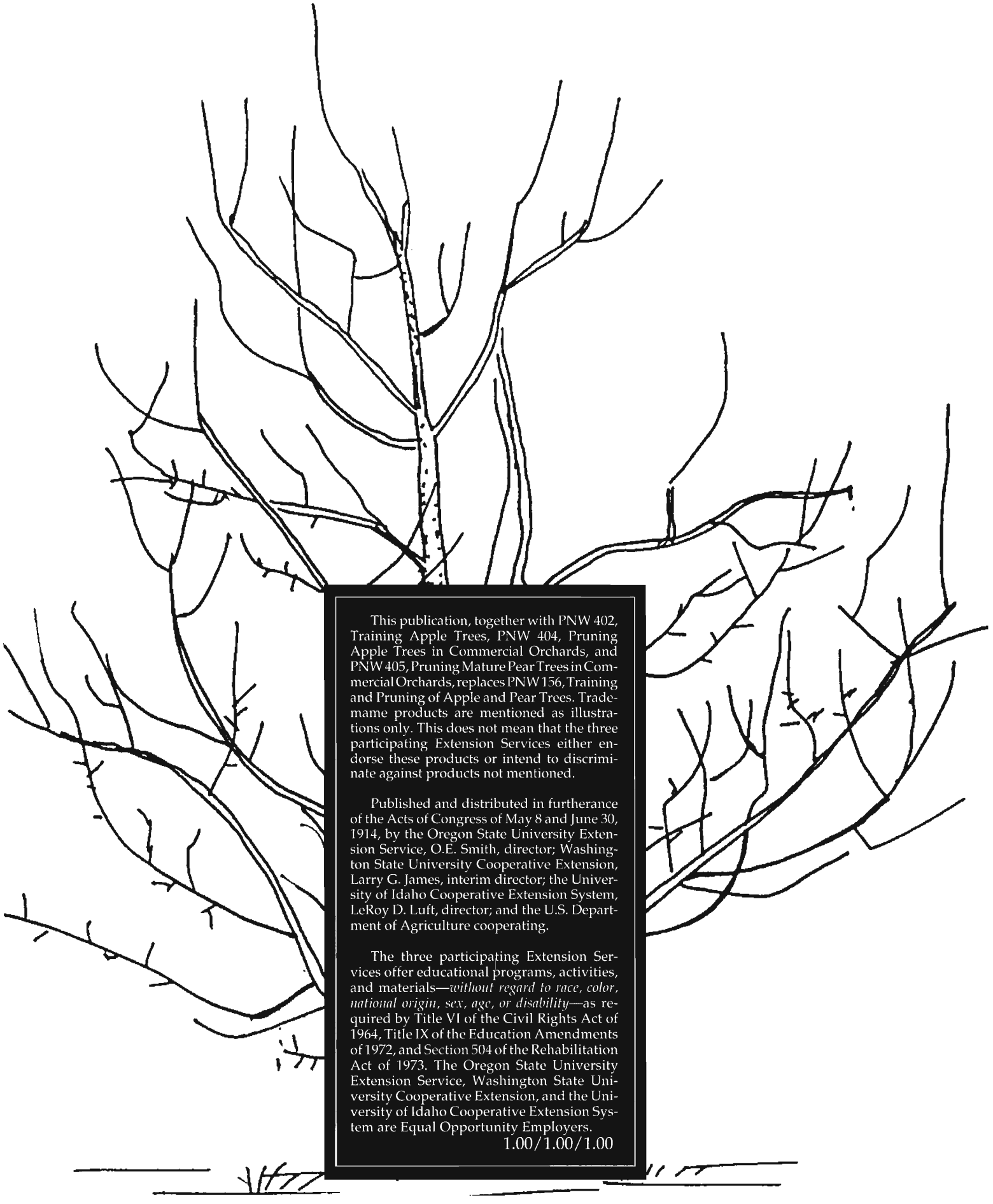
Spur system
A cluster of spurs that come from a single shoot.

Sucker
A vigorous, usually vertical shoot, usually arising from the roots, trunk or main scaffold branches. Used interchangeably with *water sprout*.

Thinning
Taking out the entire branch or shoot back to a larger branch or to the trunk.

Training
The shaping of a tree to a preconceived configuration through pruning and limb (shoot) positioning.

Water sprout
The same as a sucker, but it *always* arises from the trunk or a main scaffold branch.



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