Contents
Tools for pruning ................................................................. 3
When to prune ................................................................. 3
Tree response ................................................................. 3
Pruning young trees ......................................................... 5
Growth and fruiting habit ................................................... 5
  Spur types ................................................................. 6
  Semispur types ........................................................... 6
  Middle type ............................................................... 7
  Tip bearers ................................................................. 8
Central-leader trees ......................................................... 8
Multiple-leader trees ....................................................... 10
  Summer pruning .......................................................... 10
  Timing for summer pruning .......................................... 11
  Tree size, vigor, and summer pruning .............................. 11
  Pruning to improve fruit color ...................................... 11
  Pruning neglected mature trees .................................... 12
  Mechanical pruning ..................................................... 13
Glossary ........................................................................... 14

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Pruning Apple Trees in Commercial Orchards
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This publication describes the most important concepts in pruning apple trees. It's intended to help the experienced pruner to improve pruning skills. It provides information about the advantages and disadvantages of various pruning cuts when applied to trees of various growth habits, and it tells how to accomplish certain objectives.

It doesn't describe special systems for high-density dwarf plantings, such as "spindle bush" and "central axis."

Base your judgments about the kind and number of cuts to make in any particular tree on its current condition relative to your desired objectives.

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

The glossary (page 14) defines terms used in pruning.

Tools for pruning

Proper pruning requires the use of appropriate tools. Long pruning shears, often called loppers, are the most useful. Hand shears are helpful when you prune small trees or work in close quarters on a ladder. Power hand shears or loppers may speed the work by reducing worker fatigue. Frequent sharpening of pruning tools makes the work faster and easier.

However, don't use mowers to prune apple trees. The cuts made by mowers will be too numerous and often too large.

You'll 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.

When to prune

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 districts with mild winters, you may begin pruning 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.

For summer pruning, see page 10.

Tree response

These facts about tree response apply no matter what pruning system you follow:

1. Severe pruning of a young tree reduces the quantity of fruit produced in the early years. In general, it's best to prune young trees lightly and older trees more severely (figure 1).

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.

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Figure 1.—Training of this central-leader tree is completed after 4 years, and it has begun to produce. To encourage cropping at this stage, pruning should be minimal.
3. Although pruning stimulates growth primarily near the pruning wound, other parts of the tree may grow more because of improved light distribution.

4. **Apical dominance** is the term used to describe the influence the terminal (or "apical") bud exerts on the growth beneath. It influences the number of shoot-forming vegetative buds, the lengths of the shoots formed, and their angles with the limb they emerge from (figure 2). A knowledge of apical dominance will help you choose which pruning cut to use, heading or thinning.

5. The overall shape of the tree influences its productive efficiency and the quality of fruit produced through its effect on the distribution of sunlight throughout the tree (figure 3).

6. Cuts made just outside the "branch collar" with the limb heal quickly, but large stubs left don't heal. The "branch collar" is at the point of insertion of the limb, and it has a slightly wider diameter than the limb.

7. Two basic kinds of cuts in pruning are heading back and thinning out. Heading means cutting off part of a shoot or branch. Thinning means taking out the entire branch or shoot.

8. Heading stimulates branching, stiffens limbs (allowing them to be extended further), or prevents fruit set on the ends of shoots. The total response increases with heading severity until about 70% of the shoot is removed (figure 4).

9. Thinning improves light penetration, promotes more fruiting wood, redirects limbs, and shortens branches (figure 5).

To become a masterful pruner, you must prune and carefully observe the results on the same trees for several years. Certain terms essential to pruning are defined in the glossary (page 14); some are illustrated in figure 6 on page 6.

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**Figure 2.**—Apical dominance means that some buds nearest the growing shoot tip may be inhibited from producing a shoot, shoot angles are wider, and shoot growth is reduced progressively down the leader.

**Figure 3.**—A tree with overall conical shape (right) has a more even light distribution throughout the canopy than a tree (left) that's broadest in the top, or "umbrella" shaped.
Pruning young trees

Finish training for basic tree shape by the fifth season. Prune young trees:

- to control tree height and spread;
- to improve fruit quality, by reducing limb rub and maintaining exposure to light; and
- to prevent excessive spreading of limbs under the weight of fruit.

In young trees, the equilibrium between fruiting and growth is easily tipped in the direction of growth by too much pruning. Too much pruning gives excessive growth and small crops of large fruit that are subject to bitter pit or cork.

Obtain greater production by light pruning combined with strapping, wiring, or propping to keep the fruit from breaking limbs—rather than by heavier pruning to further increase limb strength.

Make relatively few cuts on the tree, removing 1-year shoots if the tree is growing more than is desired, if there are few flower buds because of a heavy crop the previous season, or if there's freeze damage.

Do any corrective pruning required on young trees—removing excess limbs, balancing leaning trees, or reducing height—gradually, over several seasons, to minimize the stimulatory effect.

Growth and fruiting habit

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

- carriage—stiff upright to weeping;
- crotch angles—narrow to wide;
- branching—many to sparse;
- location of branches—start of a year's growth and/or bourse shoots (see figure 7 on page 6); and
- presence and degree of "blind wood" (a bare sectional branch).

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

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close to the trunk or rapidly evolving toward the extremities of scaffold limbs.

Most apple varieties can be classified as one of the following types according to growth and fruiting habit. Unfortunately, because the distinctions are a matter of degree, it's not always easy to place a variety into one of these types. Most varieties are either semispurs or middle types.

**Spur types**

These are characterized by Starkrimson Delicious. Spur-type trees tend to be stiff-upright with narrow crotches and sparse branching (figure 8). They branch little at the start of a year's growth, and have few or no bourse shoots (figure 9).

Fruiting occurs on numerous short spurs that are long-lived. The zone of fruiting tends to remain close to the trunk. Tree vigor is strong low down. Many varieties that are named Spur-are in fact only semispurs.

Since spurs are long-lived, it's not as necessary to prune this type to renew fruiting wood as it is with trees with other growth habits. If the tree is growing vigorously, make a few large cuts to remove whole limbs back to 6- or 7-year-old wood.

Usually a vigorous shoot forms near the cut, which (if left alone) will serve as a replacement limb. Make a few cuts low on the tree. Remove all upright shoots on upper sides of scaffold limbs.

On trees with "dead bud" disorder (a disease that results in the death of spurs) or on spur-type trees that lack vigor, extensive heading is needed to maintain tree vigor and to renew spurs.

**Semispur types**

Semispur types, such as Braeburn and Fuji, have a much greater tendency to branch at the end of the previous year's growth and are slightly less upright than spur types. The lower portion of the tree remains most vigorous. They have few (if any) bourse shoots, and little or no blind wood (figure 10).

This type of tree will usually branch enough without heading. Use thinning cuts to leave only those branches that will be well-exposed to light and won't go into a ladder bay or cross another branch. Make well-distributed lopper cuts to remove downward-hanging limbs that have 5- or 6-year-old spur systems.

Always cut at a branch point to avoid leaving a stub. Where you need to shorten a limb, it's best to cut to a short side limb or into 2-year-old wood than to head into last year's wood. Remove extra limbs that have been left in the tree to increase early-year cropping before such limbs begin to crowd.
Avoid severe cutting to an outside limb. Such "bench cutting" leads to weak limbs and an umbrella-shaped tree. Strong scaffolds and a cone-shaped tree are developed without bench cutting. Occasional bench cutting is useful to direct minor secondary and tertiary scaffold limbs (figure 11 on page 8).

Pruning limb ends to more upright shoots helps maintain a good equilibrium of fruiting/shoot growth. If you prune the tree to horizontal or hanging branches, apical dominance will be lost, the equilibrium will be shifted toward shoot growth, and the tree will produce many suckers.

**Middle type**

This type (figure 12 on page 8) is characterized by ("standard") Golden Delicious and includes Gala, Elstar, Jonagold, and many other varieties. They tend to be spreading with wide crotches and frequent branching, both at the start of a year's growth and as bourse shoots.

Sometimes, they also bear laterally on last year's shoots, but these fruits are generally small (figure 13 on page 8). The fruiting zone tends to move rapidly away from the trunk to the outside of the tree. Horizontal branches may need to be tied up.

More frequent cutting further from the trunk is required to keep a majority of spurs in the 1- to 3-year-old class. On semidwarf trees, by leaving branches that have an overall aspect at least slightly above horizontal, you can avoid excessive suckering on the tops of branches and reduce shading of lower branches by upper ones.

On fully-dwarf trees, if short limbs with a downward aspect are developed, the flower-tipped bourse shoots they produce can be annually productive.

Never head shoots of middle types. Leave them or remove them entirely.

Certain varieties, such as Criterion, bear only on spurs on 2-year-old wood. The older parts of branches tend to be bare. Force new growth near the leader by heading a few limbs, which have fruited once, at 4 to 5 inches from the leader.
leader. When you do this annually, there'll always be some productive 2-year-old wood close to the trunk.

**Tip bearers**

The "tip bearers," characterized by Rome Beauty and Granny Smith, tend to have upright main scaffold limbs with narrow crotches and frequent branching (figure 14). They bear much of the crop on the ends of the previous year's shoots.

There's a strong tendency for the lower half of the shoots to be without leaves or fruit—that is, "bare" or "blind," especially if the tree is vigorous. There's a strong tendency for the fruiting wood to move toward the extremities of the branches with tree spreading as a result.

The tip bearers require less pruning than the other types, especially if they're on a dwarfing rootstock.

Downward-hanging branches that have a lot of short shoots with terminal flower buds will be annually productive. They require only removing weak spurs and short shoots underneath branches.

More vigorous trees with a lot of blind wood need heading into blind wood to maintain flowering closer to the trunk and scaffolds. Never head shoots in tip-bearing trees. To shorten branches, cut into 2-year-old or older wood.

**Central-leader trees**

Especially for semidwarf trees planted at high densities, central-leader training of some kind—either Pacific Northwest "conventional" central leader (McKenzie system) or "central axis system" (French axe)—is the only kind of training used.

It's important to control tree height, so that you can reach the top from an 8- or 10-foot ladder. Pruning the leader as soon as it reaches the desired height, without regard to whether it has fruited, may make the tree too vegetative and unfruitful.

If the tree is more productive and the leader is allowed to grow "out of reach" for a year or two until fruiting bends it over. Pruning to control height after it has fruited helps to keep the tree balanced toward fruitfulness.

[Figure 11. Limbs of two adjacent semidwarf trees that were extended without severe bench cutting and are well-furnished with fruiting wood. They've bent out under the weight of fruiting.]

[Figure 12. A middle-type tree.]

[Figure 13. Terminal bloom on shoots of middle types such as Golden Delicious, shown here, or Gala produce much larger fruits than lateral bloom.]
Figure 15.—Note the overall conical shape of this central-leader Golden Delicious tree immediately after pruning. Limbs will move toward the horizontal under the weight of crops.

To maintain the vigor and productivity of lower limbs, maintain the overall conical shape of the tree by pruning (figure 15). Don't allow strong lateral limbs to remain in the top ½ of the trees. Leave only the weaker, more horizontal ones.

If all the limbs in the top are upright and vigorous, reduce fertilization and score the central leader through the bark but not into the wood, all the way around, at ½ to ¾ of the distance from the ground. Do this within 2 weeks after bloom. Bend or tie the limbs down to get them fruiting. Scoring sometimes stresses the tree, leading to nutrient deficiency and/or damage from winter cuts.

When the vigor of the top is in control, limit tree height by thinning to an upright lower shoot or limb, which will become the new leader. By maintaining apical dominance, this will limit the amount of new shoot growth in the top.

Maintain good light distribution to all limbs by clearing spaces around them. The longer the limbs, the greater the vertical space required between them for good light penetration. The widest vertical spaces between limbs should be at the bottom of the tree, since limbs there are the longest.
The best quality fruits are produced on spurs extending laterally from the branch, rather than over the top or underneath. One way to improve fruit quality on a tree that has more than enough fruiting wood is to remove spur systems underneath limbs, and over the top (figure 16 on page 9).

**Multiple-leader trees**

These trees are generally wider than they are tall, and have a greater tendency to spread, closing the space with the adjacent trees. More than central-leader trees, they need attention to control tree spread and maintain open ladder bays in them. Other aspects of pruning are about the same.

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. There are few suckers to remove because cuts are evenly distributed and apical dominance is maintained by keeping limbs with an overall aspect horizontal or above and ending in an upright shoot. Maintain even growth by making many thinning cuts throughout the tree (figure 17).

First, prune out limbs extending into the ladder bays; 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 out the tree top. Always cut an lower limb to the point where you can reach it easily for pruning.

Remove any back down-hanging branches in the upper-outer portions of the tree. Tie the shoots around the ends of primary and secondary scaffold limbs to a point 3 moderately upright shoot.

Eliminate forks on branch ends by removing one side. This will encourage spur and shoot development further back on the branch by increasing light penetration. Discourage excessive spreading by removing some fruiting wood from ends of branches.

Move downward through the tree, prune more lightly as you go. Renew old spur systems by cutting them part way or by 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 bend below horizontal (figures 18 and 19).

**Summer pruning**

This term actually covers pruning at any time from the start of shoot growth in spring until leaf fall.

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**Figure 17.**—Apical dominance reduces suckering when the limb has an overall aspect slightly above horizontal, and is terminated by an upright shoot.

**Figure 18.**—Before (left) and after (right) pruning one side of a semispur multiple-leader tree. Ends of branches were thinned at a shoot. Most long shoots were removed entirely to improve light penetration.
Pruning before the end of shoot growth almost always results in growth of shoots from buds in the axils of leaves in the same season. This regrowth usually is weak and spindly.

Pruning after the terminals have stopped growing, generally in August, often doesn’t stimulate regrowth the same season. Pruning at this time removes leaf surface that would have increased root growth and produced root starch for growth the following season, with the result that the dwarfing effect of pruning is much increased.

Pruning in autumn is less weakening than summer pruning, but not advisable where freeze damage can occur.

**Tree size, vigor, and summer pruning**

Tree vigor, as determined by rootstock, soil type, variety and strain, and growing conditions, is an important determining factor in a tree’s response to summer pruning. In trees that are growing too strongly in the tops, a large cut in June can help restore balance between the vigor of the lower and upper part of the tree. Cut the leader into 2- or 3-year-old wood at a branch. Tie up the branch to create a new leader, if required (figure 20).

Summer pruning can restrict the size of mature trees. Make cuts into wood 2 years or older in late July or early August, preferably next to strong growing shoots. Be careful not to expose fruit to sunburn. Summer pruning the tree tops may strengthen flower buds below.

This kind of pruning replaces dormant pruning in the parts of the trees that are summer-pruned, and makes the trees more susceptible to damage in an early freeze. Pruning in mid-August or later further increases the risk of freeze damage. If regular summer pruning is required to control tree size, consider thinning the orchard.

**Pruning to improve fruit color**

The amount of red color of many varieties can be increased by removing shoots that shade the fruit about 3 to 4 weeks before harvest. Earlier summer pruning will result in smaller fruit, while pruning closer to

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**Figure 19.** Keep replacement leaders coming to renew fruiting wood that has become pendant.

**Figure 20.** The top of this tree was removed in June, and a lower limb was tied up as a replacement.
harvest may have less effect on fruit color. The number of pickings required in a multiple-picked variety can be reduced through summer pruning.

Removing "water sprouts" or "suckers" in June or July may reduce the amount of regrowth in comparison with dormant season pruning. It will reduce competition between shoots and fruit for calcium.

Pruning Neglected Mature Trees

Trees that haven’t been pruned for several years are overgrown and bushy. Restore the balance of vigor and fruitfulness in trees by making many thinning cuts throughout the tree with emphasis on the upper, outer portions.

Cut into wood that’s several years old at an upward-growing branch or shoot. Do this for several years. Remove no more than one or two large limbs per year. Too much pruning at one time may cause the tree to stop producing. It may be helpful to use weights to bend remaining upright shoots toward the horizontal (Figure 21).

The tops of adjacent trees in an overgrown orchard tend to close together, reducing light to lower limbs. Prune to allow several feet of space between branches in the tops of adjacent trees.

Excessive suckering may be caused by the loss of apical dominance on nearly horizontal limbs, excessive pruning, and/or excessive use of fertilizer. Suckers or water sprouts may be removed in summer.

The "umbrella-shaped tree" has two causes: failure to cut into older wood, and always pruning to outside wood. New growth consists primarily in suckers in the tree top. Lower limbs are weak and shaded. There’s little new growth in the weak, devitalized spur systems. Much time and effort is expended annually in removing suckers and in placing props.
Mechanical pruning

Mechanical topping and hedging is sometimes used in an attempt to reduce labor costs. If misused, it can reduce yield and fruit quality so that a serious net loss occurs, even though there might have been some savings in pruning costs.

Masses of new shoots form along the plane of cutting; and lower, inner wood is weakened or dies because of shading. Mechanical pruning best confines the tree to its allotted height and spread before hand pruning commences.

Don’t reduce the height or spread of trees with mechanical pruning more than about 2 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 by topping or hedging.

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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 buds forming shoots, 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 central axis).

Flower bud
In apple, 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.

Pruning
Cutting off parts of the tree.

Rootstock
Apple 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 apple trees can be divided into two kinds of wood: fruited 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.

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

Spur system
A cluster of “spurs” that originated 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.

Water sprout
The same as a sucker but always arising from trunk, or main scaffold branch (used interchangeably with sucker).

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