Training and Pruning **Fruit Trees**

North Carolina Cooperative Extension Service

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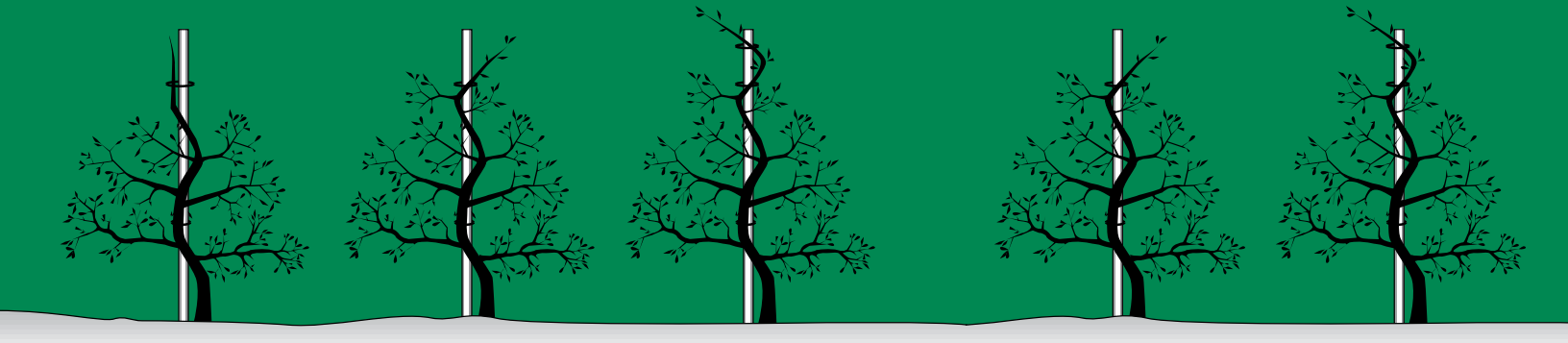

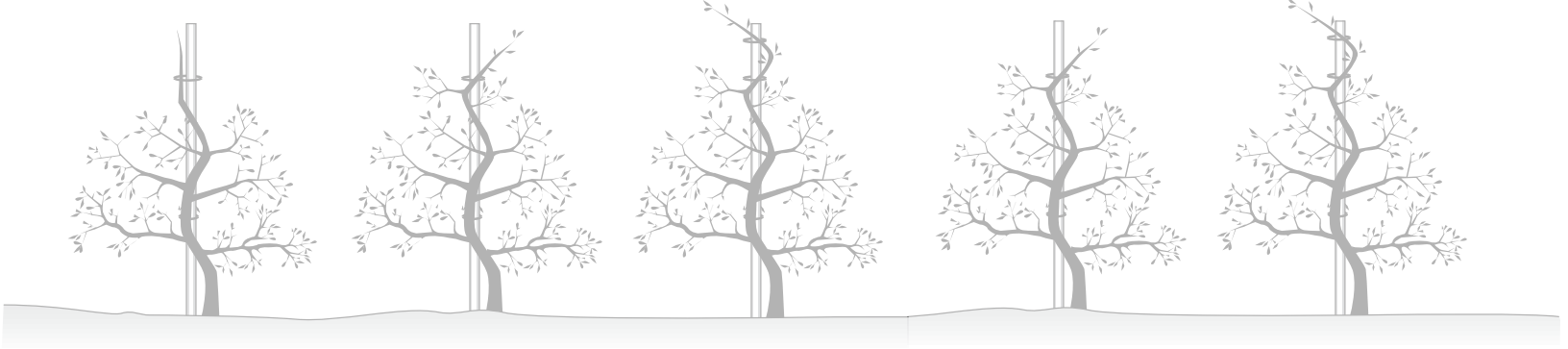

Training and Pruning Fruit Trees

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Many fruit-growing enthusiasts neglect the annual training and pruning of fruit trees. Without training and pruning, however, fruit trees will not develop proper shape and form. Properly trained and pruned trees will yield high-quality fruit much sooner and live significantly longer.

A primary objective of training and pruning is to develop a strong tree framework that will support fruit production. Improperly trained fruit trees generally have very upright branch angles, which result in serious limb breakage under a heavy fruit load. This significantly reduces the tree's productivity and may greatly reduce its life. Another goal of annual training and pruning is to remove dead, diseased, or broken limbs.

Proper tree training also opens up the tree canopy to maximize light penetration. For most deciduous tree fruit, flower buds for the current season's crop were formed the previous summer. Light penetration is essential for strong flower bud development and optimal fruit set, flavor, and quality. Although a mature tree may be growing in full sun, a very dense canopy may not allow adequate light to reach 12 to 18 inches inside the canopy. Opening the tree canopy also permits air movement through the tree, which promotes rapid drying to minimize disease infection and allows thorough spray penetration. Additionally, a well-shaped fruit tree is aesthetically pleasing, whether in a landscaped yard, garden, or commercial orchard.

Pruning vs. Training

Historically, fruit tree form and structure have been maintained by pruning. Tree training, however, is a much more efficient and desirable way to develop form and structure.

Pruning is the removal of a portion of a tree and is used to correct or maintain tree structure. *Training* is a practice that allows tree growth to be directed into a desired shape and form. Training young fruit trees is essential for proper tree development. It is more efficient to direct tree growth with training than to correct it with pruning.

Pruning is most often accomplished during the winter, commonly referred to as *dormant pruning*. Training includes summer training and summer pruning as well as dormant pruning. The goal of tree training is to direct tree growth and to minimize pruning and removing a portion of the tree, although dormant pruning is always going to be needed.

Dormant Pruning vs. Summer Pruning

Trees respond very differently to dormant and summer pruning. Dormant pruning is an invigorating process. During the fall, energy (as carbohydrates) is stored primarily in the trunk and root system to support the top portion of the tree. If a large portion of the tree is removed during the winter while the tree is dormant, the tree's energy reserve is unchanged. In the spring, the dormant pruned tree with fewer growing points responds by producing many new vigorous, upright shoots, called *water sprouts*, which shade the tree and inhibit proper development. Heavy dormant pruning also promotes excessive vegetative vigor, which uses much of the tree's energy, leaving little for fruit growth and development.

Historically, much of the vigorous, upright vegetative growth has been removed during the dormant season. But heavy dormant pruning results in a yearly cycle with excessive vegetative growth and little or no fruit production. It's best to limit dormant pruning to cuts that remove damaged, diseased, and dead wood and those that develop the tree's desired shape. Summer pruning can be used to remove upright growth when 6 to 10 inches long in early summer, allowing optimal light penetration, and to minimize shading without the invigorating effect of dormant pruning.

The timing of dormant pruning is critical. Pruning should begin as late in the winter as possible to avoid winter injury. Apple and pecan trees should be pruned first, followed by cherry, peach, and plum trees. A good rule to follow is to prune the latest blooming trees first and the earliest blooming last.

Another factor to consider is tree age. Within a particular fruit type, the oldest trees should be pruned first. Younger trees are more prone to winter injury from early pruning.

Summer pruning eliminates an energy or "food" producing portion of the tree and may result in reduced tree growth. Summer pruning can begin as soon as the buds start to grow, but it is generally started after vegetative growth is several inches long. For most purposes, summer pruning should be limited to removing the upright and vigorous current season's growth; only thinning cuts should be used. To minimize the potential for winter injury, summer pruning should not be done after the end of July.

Types of Pruning Cuts

Thinning Cut

A thinning cut removes an entire branch back to a side shoot branch. Thinning cuts do not invigorate the tree near the cut in comparison to some of the other pruning cuts.

Heading Cut

A heading cut removes only the terminal portion of a branch. This type of cut promotes the growth of lower buds with the greatest vigor just below the cut. When lateral branches are headed into one-year-old wood, the area near the cut is invigorated. The headed branch is much stronger and rigid, resulting in lateral secondary branching for approximately 12 to 15 inches. Older trees can be held in their allotted space by "mold and hold" cuts, which are devigorating heading cuts made into at least two-year-old wood. Young trees and branches where heading cuts are made are referred to as "headed."

Bench Cut

A bench cut removes vigorous, upright branches back to side branches that are similar in diameter to the branch being pruned but are less upright and outward growing. Bench cuts are used to open up the center of the tree and spread the branches outward. This is a major cut and should be used only when necessary.

When making pruning cuts, it is important to use techniques that will allow the cut surface to heal quickly. Rapid healing minimizes the incidence of disease and insect infection. Pruning cuts should be close to the adjacent branch without leaving stubs. Also, when large horizontal cuts are made, they should be slightly angled so that water does not sit on the cut surface, allowing the growth of rot and disease organisms.

Compounds are available as wound dressing or pruning paints, but the best treatment is to make proper

pruning cuts and allow the tree to heal naturally. If preferred, tree paints and wound dressing may be used for aesthetic reasons, but they will not promote healing.

Training Systems

One of the most frequently asked questions is, "To what shape should I train my fruit trees?"

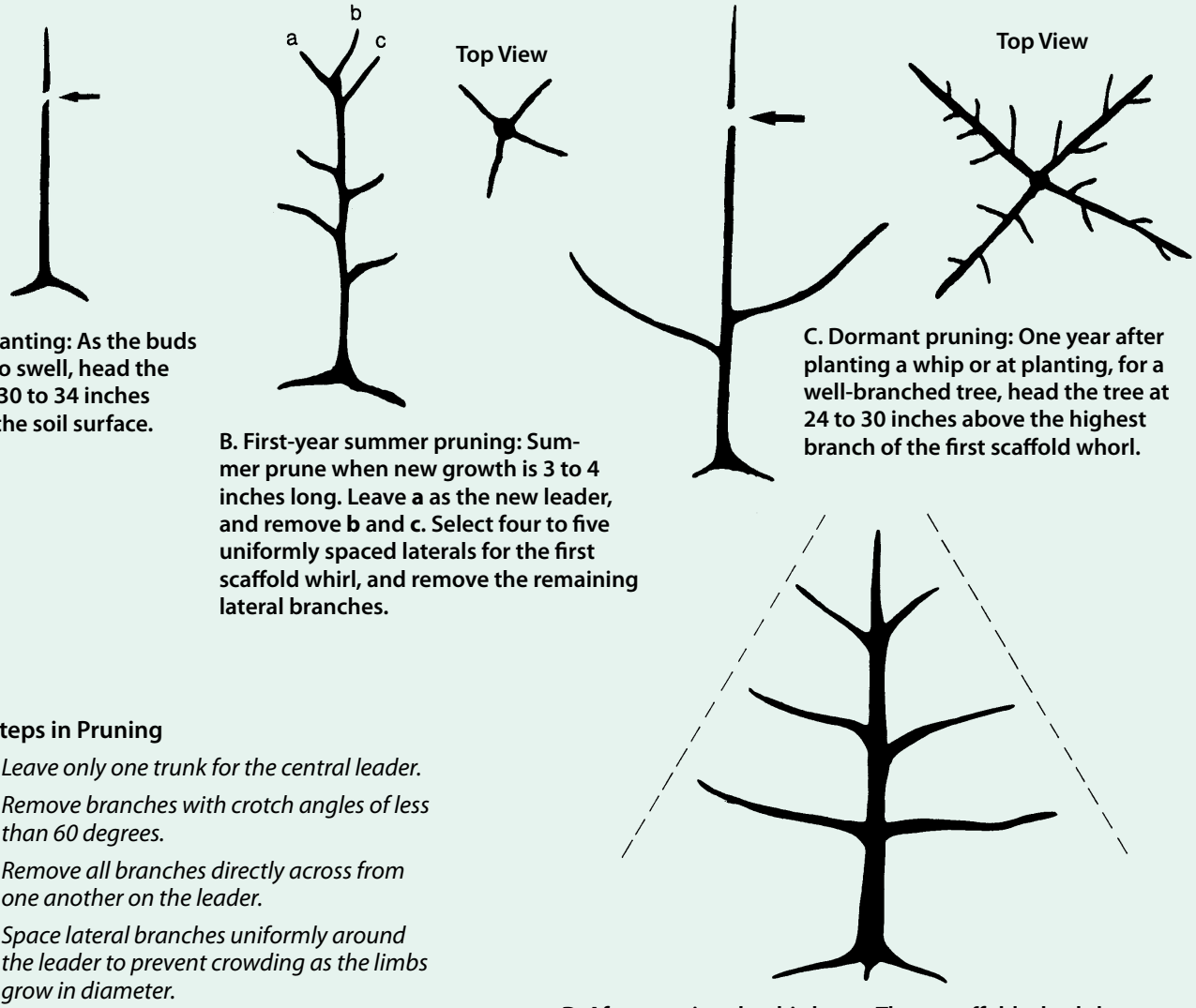
It is difficult to give one answer. You can choose from many different training shapes and forms with multiple variations on each form. This publication focuses primarily on the central-leader and open-center training systems. A list of fruit trees conventionally trained to each system is also included. However, a fruit tree may be trained to any system. Depending on the form and function of the desired shape, you may want to train a tree to a nontraditional system.

Whatever system is chosen, keep in mind that the objectives of training and pruning are to achieve maximum tree life, productivity, and optimal fruit quality.

Central-Leader Training — Apple, Pear, Pecan, Plum

A central-leader tree is characterized by one main, upright trunk, referred to as the *leader*. Branching generally begins on the leader 24 to 36 inches above the soil surface to allow management practices under the tree.

Figure 1. Pruning a semi-dwarf or larger central-leader tree when planted as an unbranched whip



A. At planting: As the buds begin to swell, head the tree at 30 to 34 inches above the soil surface.

B. First-year summer pruning: Summer prune when new growth is 3 to 4 inches long. Leave a as the new leader, and remove b and c. Select four to five uniformly spaced laterals for the first scaffold whirl, and remove the remaining lateral branches.

C. Dormant pruning: One year after planting a whip or at planting, for a well-branched tree, head the tree at 24 to 30 inches above the highest branch of the first scaffold whorl.

Steps in Pruning

- *Leave only one trunk for the central leader.*
- *Remove branches with crotch angles of less than 60 degrees.*
- *Remove all branches directly across from one another on the leader.*
- *Space lateral branches uniformly around the leader to prevent crowding as the limbs grow in diameter.*

D. After pruning the third year: Three scaffold whorls have been developed with three to four branches uniformly spaced around the tree in each whorl. A light slot of 18 to 24 inches is left between each scaffold whorl. Note the Christmas-tree shape that allows light penetration to the lower branches and interior of the tree.

Branching may begin higher on the tree if more space is required under the tree for management or aesthetic purposes. The first year, four or five branches, collectively called a *scaffold whorl*, are selected. The selected scaffolds should be uniformly spaced around the trunk, not directly across from or above one another. For semi-dwarf and larger trees, above the first scaffold whorl, leave an area of approximately 18 to 24 inches without any branches to allow light into the center of the tree. This light slot is followed with another whorl of scaffolds. Alternating scaffold whorls and light slots are maintained up the leader to the desired maximum tree height. *See Figure 1.*

The shape of a properly trained central-leader tree is like that of a Christmas tree. The lowest scaffold whorl branches will be the longest, and the higher scaffold whorl branches will be progressively shorter to allow maximum light penetration into the entire tree.

Developing a central-leader trained tree — Semi-dwarf and larger

- **At planting**
  Fruit trees are frequently purchased as whips, which are unbranched trees ranging from ½- to ¾-inch in diameter. The tree should be planted in early winter with the graft union at least 2 inches above the soil surface. Just before the buds start to grow in the spring, the tree should be headed. The height at which the tree is headed depends upon where you want the first whorl of branches. Once the tree is headed, permanent branches will be selected from buds growing within 4 to 12 inches below the heading cut. See *Figures 1 and 2.* Trees may also be bought with lateral branches, which are called *feathered trees*.

Figure 2. Newly planted apple tree headed back

Figure 3. After heading, choose a central leader.

A. Heading an apple tree at planting results in several vigorous competing shoots below the cut.

B. For a central-leader tree, a single leader needs to be selected by removing the undesired competing shoots.

- **Summer pruning**

After the new vegetative growth has reached 3 to 4 inches in length, summer pruning should begin. The first step is to select one upright branch near the top of the tree to be the leader. After selecting the leader shoot, remove all other competing branches for approximately 4 inches below it; re-head the tree above the selected leader if necessary. *See Figures 3 and 4.*

At this time, side branches (laterals) should be spread out to form a flatter angle between the leader and the side shoot. This angle is referred to as the *branch* or *crotch angle*. Branches that do not have a wide branch angle are overly vigorous and have a weak point of attachment to the leader. These branches frequently break under a heavy fruit load. Spreading the lateral branches will also slow the growth of the branches to a manageable level and promote the development of secondary or side branches on the scaffolds. When growth is only 3 to 4 inches long, toothpicks or spring clothespins can be used to spread branches. *See Figure 5*. Toothpicks and clothespins need to be in place for only five to six weeks to develop a proper crotch angle. However, leaving them in for the entire season is not a concern.

Figure 4. Central-leader plum trees must also have competing shoots removed.

Figure 5. Central-leader apple trees (before and after). Toothpicks are used to spread the lateral branches outward during the first growing season.

During the first year, minimize further summer pruning. Limit it to the removal of shoots growing upright. Summer is the optimal time to select the leader and scaffold branches and remove undesirable upright growth. A young orchard or tree should be summer trained and pruned once or twice to remove unwanted upright growth and to properly orient young branches. Summer pruning can greatly reduce the amount of dormant pruning needed.

Failure to summer prune the first year may result in an improperly trained tree, and drastic dormant pruning will be required to correct tree structure.

- **Succeeding years**

Managing and maintaining the central leader is one of the most important aspects of dormant pruning in ensuing years. The leader should be headed at approximately 24 to 30 inches above the highest whorl of scaffolds to promote continued branching and scaffold whorl development. Dormant pruning should also eliminate dead, diseased, and damaged wood. Unwanted growth—such as downward growing branches, upright growing branches, and laterals with narrow crotch angles—not removed during summer pruning should also be removed at this time. Unbranched lateral branches should be headed back

Figure 6. Wooden limb spreaders can be made from wood and finishing nails in various lengths.

Figure 7. Well-trained apple trees. Note the branch angles and the development of scaffold whorls.

by approximately one-fourth of their length to encourage side branches and to stiffen lateral branches.

Summer pruning in succeeding years should eliminate competing branches where dormant heading cuts were made (on the central leader and laterals) as in the first year. Summer is also the optimal time to remove unwanted side branches and excessive upright growth. All laterals should have a wide branch angle, and spreading of lateral branches is essential for many varieties. Lateral branches will need to be spread for about the first five years, using a larger spreader each year, until fruit forms to help pull branches downward.

Spreaders can be made with 1-inch-square wood pieces with a finishing nail driven in the ends and cut off at an angle. Spreaders are frequently made in lengths of 6, 12, and 18+ inches. *See Figure 6.* Spreading branches in later years reduces vigor and promotes fruit development on the lateral branches. The reduced growth rate and the weight of the crop load will also help pull the branches down to a proper angle. However, it is important that the young tree is not allowed to crop too early where the weight of the fruit pulls the branches below horizontal. A general recommendation is to defruit the trees for at least the first two growing seasons. Once the branches are below horizontal, they are weak and nonproductive and need to be removed and replaced.

Another objective of dormant pruning is to control the length of the lateral branches. In order to maintain the Christmas-tree shape (*Figure 1*), lateral branches need to be cut back. Once the tree has reached its desired height and lateral spread, it will be necessary to "mold and hold" the lateral branches and the central

Figure 8. Mature apple (A) and pecan trees (B)

A. Mature, well-trained apple trees

B. Pecan trees. Note that the distance between branches needs to be increased for larger trees.

leader with heading cuts. This can be done by cutting the laterals and leader back into at least two-year-old wood to a side-growing branch. It is a good rule to cut back to a side branch that is close to the same diameter as the lateral or leader being cut.

- **Mature trees**
  Mature trees that have been properly trained and summer pruned will require minimal pruning. The first step would be to remove dead, diseased, and damaged wood and then upright shoots and shoots below horizontal. To prevent shading, it is important to maintain the Christmas-tree shape by heading lateral branches with "mold and hold" cuts. *See Figures 7 and 8.* For quality fruit production, it is also essential that the light slots between the scaffold whorls be maintained.

  Mature fruit trees that have not been properly trained frequently do not have a true central-leader shape. For those trees, the objectives of training and pruning as discussed earlier must be considered. In many cases, too many lateral branches and upright limbs (some may be 4 or more inches in diameter) have been left and need to be removed to allow proper light penetration. This pruning needs to be accomplished during the dormant season.

  Neglected trees often have overgrown tops that act as an umbrella, shading the rest of the tree. The tops of these trees need to be cut back or removed. Remember, if the principles of pruning are followed, there are no perfect cuts and no incorrect cuts. However, do not remove more than 30 percent of the tree to avoid shifting the tree into an excessively vegetative state with little fruit development.

- **Pecan tree considerations**
  In North Carolina, pecan trees should be trained to a central leader. The potential for tropical storms and hurricanes in September and October is high, and a central-leader tree has a greater probability of surviving with minimal damage. The lateral branches, however, should be spiraled up the leader. Approximately 12 to 15 inches should be left between branches for adequate light penetration initially. As the tree matures, it will be necessary to remove branches to prevent crowding and allow light penetration. *See Figure 8B.*

Multi-Leader Training

A multi-leader tree is a modification of the traditional central-leader tree and an option for pear varieties that are susceptible to fire blight. With a multi-leader tree, if one leader is infected with fire blight, it may be removed without loss of the major portion of the tree. *See Figure 9.*

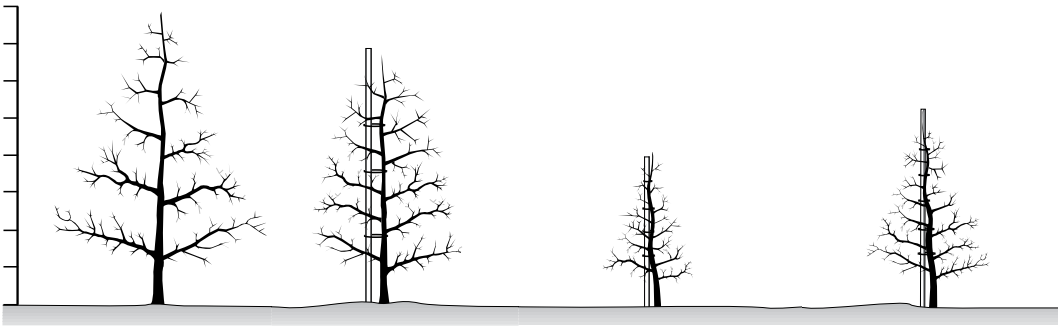
Figure 9. An apple tree trained to a multi-leader system. This would be an ideal training system for pear trees in North Carolina where fire blight is a threat.

The multi-leader tree uses the same concept as the central-leader tree except there are several leaders in the center of the tree. Each leader is maintained the same as an individual central-leader tree. There is only one difference in training a multi-leader from the central leader. In the first and second year, instead of removing the competing leaders, several should be left and maintained. For example, on the tree in *Figure 1*, it would be necessary to leave shoots **a**, **b**, and **c** for a multi-leader tree. However, it would be necessary to put spreaders between the selected leaders to get the shape of the tree in *Figure 9*.

High-Density Central-Leader Training

In the apple industry, trees are now grown and sold on size-controlling or dwarfing rootstocks. Many different rootstocks are available with varying degrees of size control. Historically, apple trees were very large trees that required a significant amount of work using ladders. These large trees took many years to reach maximum production. With size-controlling rootstocks, most or all of the maintenance can be completed from the ground or with short ladders. And the trees begin producing fruit much sooner after planting. Because

Table 1. Characteristics of High–Density Training Systems Compared to a Central–Leader Conventional System



Characteristic	Freestanding Central Leader	Vertical Axis	HYTEC (Hybrid Tree Cone)	Slender Spindle
Tree height (feet)	12 – 14	10 – 14	9 – 11	7 – 8
Tree spread at the base (feet)	9 – 11	5 – 7	5 – 7	3 – 5
In–row spacing (feet)	10 – 15	5 – 6	5 – 6	4 – 5
Between–row spacing (feet)	15 – 22	13 – 15	11 – 14	10 – 12
Density (trees/acre)	132 – 290	500 – 700	500 – 900	700 – 1,000
Rootstocks	M.7, MM.106, MM.111	M.9, M.26, M.7	M.9, M.26	M.9
Support system required	No	Yes	Yes	Yes
Yield expectations, years 2 – 4	Low	Medium to high	High	High
Yield expectations, years 5 – 10	Medium	High	High	High
Central leader pruning	Headed annually	No pruning	Removed to a weaker lateral; may head or snake depending on tree vigor	Remove to a weaker lateral

many more trees are planted per acre in commercial orchards, the term used to describe these orchards is *high density*. The increased use of dwarfing rootstock and the need to maximize fruit production have led to a shift in the training and pruning of the smaller trees. High-density trees are trained and pruned differently, but basically they are modified central-leader trees with branches continually along the central leader to the top of the tree. Light penetration is not a problem as the maximum height of the tree is limited to approximately 8 to 12 feet, with a canopy spread of 3 to 4 feet outward from the leader.

There are many other types of high-density training systems, some with elaborate trellis systems. A slender spindle-type tree is the most popular high-density training system. High-density training systems are covered in more detail in *High Density Apple Orchard Management* (AG-581).

Table 1 illustrates four major high-density training systems, including the central leader, vertical axis, hybrid tree cone (HYTEC), and the slender spindle. The diagram of each tree type is accompanied by the characteristics of each training system and its maintenance. Note that each tree has a central leader and all the training systems involve modifications of the central leader. The major differences among the systems are tree height, density (spacing), and the way the leader is managed. Many trellis systems using high-tensile wire and posts are also used as well.

None of these high-density training systems leads to a significant difference in productivity in the first three years *unless* the trees are pruned heavily. Early heavy pruning will reduce production. Light interception, which depends on tree density (trees per acre), is the factor that affects early production. The training system is a greater factor later in the orchard's life when training can affect light distribution within the tree canopy. Allowing branches to remain in the top of the tree will shade lower branches and reduce light interception. This shading results from a lack of limb removal, improper limb placement or orientation, or all of these together. The ratio of the tree height to the distance between tree rows also affects light interception. In general, tree height should be no more than twice the distance between rows of trees to maximize light interception.

For the Southeast, no specific training system is recommended. Rather, the best approach is to develop a tree that has specific characteristics. The characteristics of the recommended tree type in the Southeast are those of a slender spindle-type tree. The tree will resemble the slender spindle tree, but it will be taller: 8 to 10 feet tall. The trees will be spaced 5 to 7 feet apart within rows, with

rows spaced 12 to 16 feet apart. The leader needs to be managed to encourage lateral branching—with practices such as bagging, bending, heading, leader renewal, or notching. (See the "Leader Management Techniques" on page 12.) Research in North Carolina has found that vertical axis trees, where the leader is not manipulated, do not have continuous branching along the leader, which is required for a productive and profitable tree. These trees have lower branches, an area of 2 to 4 feet of unbranched or "blind" leader growth, and branches at the top of the tree. Therefore, the leader must be manipulated in some manner to ensure continuous branching along it.

All lateral branches with wide crotch angles should be maintained for the first three to five years to maximize early fruit production. A lower whorl of scaffolds should be identified as permanent, and others should be removed as shading becomes a problem. There may also be a second semipermanent whorl approximately 12 inches above the first that should also be identified and removed if shading becomes a problem. Permanent whorls are maintained in the lower portion of the tree because there are concerns about a lack of vigor and light in that area of the tree for re-growing lateral branches. The permanent whorls should be spread out to approximately 85 degrees from vertical to encourage lateral branching and floral initiation. Above the second whorl of scaffolds, all branches should be renewed every three to four years. These lateral branches will be cropped for several years.

As the diameter of the lateral approaches 50 percent of the leader's diameter, the lateral is removed by a cut at a downward angle, referred to as a *Dutch cut* (Figure 10). This cut allows latent buds on the bottom of the stub to grow, giving rise to lateral limbs with wide crotch angles. It is also imperative to maintain the conical shape of the tree to allow optimal light distribution within the canopy. In the first three to four years, however, minimal pruning should be done and tree-training techniques, such as bending and spreading branches during the growing season, should be maximized.

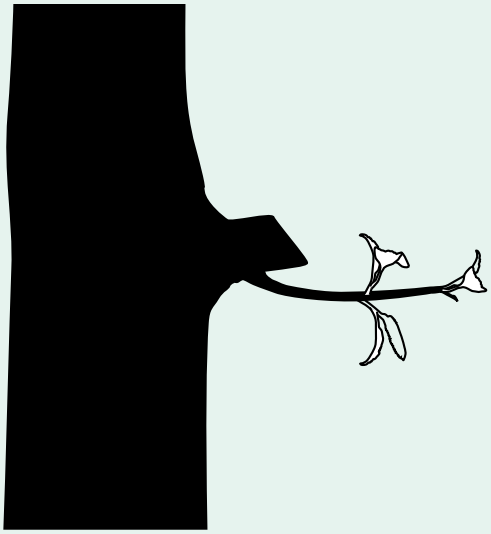


Figure 10. A Dutch cut is a technique used to cut lateral branches to an angled stub, allowing latent buds at the bottom to grow. (Note wide crotch angle.)

High-density training techniques for the Southeast

Characteristics of and requirements for slender spindle–type trees follow:

- Create a pyramid-shaped tree that resembles a central-leader type tree (*see Figure 1, page 5*).
- Maintain height at 8 to 10 feet.
- Maintain a maximum width of tree limb spread of 5 to 7 feet.
- Space lateral branches continuously along the central leader.
- Use summer training and pruning to control tree vigor.
- Establish one or two permanent whorls of lateral limbs in the lower portion of the tree, providing limb diameter doesn't compete with leader diameter.
- Manage the leader to encourage lateral branching. This will promote fruiting wood and increase the number of growing points to control vigor.
- Spread lateral shoots to control vigor and encourage fruiting. This positioning is also necessary to stimulate secondary branching.
- Unbranched or blind areas of the leader are areas of lost fruit production. Thus, successful leader management is directly related to early and total fruit production potential.
- Each tree must have a permanent support system (stake or trellis) for its total height, to which the leader is attached every 15 to 18 inches. This support holds the tree stable in the soil and supports the fruit load because dwarf trees bear fruit very early in their life span. If tree vigor is limited by inadequate soil moisture or groundcover competition, tree vigor and growth will be reduced and training techniques will not be as effective.
- **Tree establishment**
  Tree training for high-density orchards begins at planting. If an unbranched or whip tree is purchased, head the tree at 30 to 34 inches. If a well-branched (feathered) tree is planted, remove all branches within 24 inches of the ground and head the leader 10 inches

above the top (usable) lateral branch. Feathered trees will increase early fruit production.

Once 3 to 4 inches of new growth has occurred, select one vigorous terminal shoot as the new leader and remove all other upright shoots that originate within 3 to 4 inches of the base of the selected new leader.

On more vigorous trees (larger caliper, well-branched trees with a good root system intact at planting), the bagging techniques described below can be used at planting on 18 to 24 inches of unbranched leader.

- **Leader management techniques to encourage branching**

Bagging (*Figure 11*) is done by placing a polyethylene (plastic) sleeve (usually 3 mil)) over the previous year's unbranched growth. Bagging is effective on 30 to 32 inches of leader, thus longer leaders should be cut off to 32 inches. Bags should be applied 4 to 6 weeks before anticipated bud break (early- to mid-February). The ends of the poly sleeve must be closed tightly with clothespins, tape, or ties that can be removed easily. The sleeves must remain closed and in place until new lateral growth is 1 to 2 inches long (usually about bloom time). Immediately upon bag removal, apply a foliar application of 250 ppm of Promalin (1 pint per 10 gallons of water plus surfactant) and an anti-desiccant to the previously bagged portion.

Snaking (*Figure 12*) is done during the growing season by bending each 18-inch section of new leader growth to a 45-degree angle and securing it to the tree's support system. Each successive bend is done in the opposite direction to form a zig-zag leader shape. The 45-degree angle is held by tying or taping the new growth to the support system. This technique reduces leader extension and results in lateral branches that grow in the current season and some branches that grow the following spring. Make sure laterals that develop right at the bend don't get too vigorous and compete with the leader. This technique is useful with very vigorous leader growth where some devigoration is appropriate and you want to try and use the extended leader growth rather than cut it off (as with weak-leader renewal).

Weak-leader renewal (*Figure 13*) is used where leader growth is excessive with minimal lateral branching. To balance tree vigor, cut the leader off to a weaker (but still vigorous) lateral that can be encouraged to branch. Tie the lateral to the support post to form a new leader and encourage lateral branching on the new leader. Do this in the dormant season.

Spot treatment of blank areas with notching (*Figure 14*) is a remedial technique that can be used on trees with blind wood. Use a hacksaw blade ($^1/_{16}$- to $^1/_8$-inch wide) to place a notch above each node in the unbranched region of the leader two to three weeks before bloom. Each notch should extend approximately one-third of the way around the tree. Be careful to cut only through the bark (phloem) and not the structural wood beneath the bark. Approximately 50 to 60 percent of the notched buds should grow to avoid having to head the tree and eliminate the higher branches, which would reduce early fruit production. Because this procedure is time consuming, use it only to fill in unbranched areas. *To minimize the potential for fire blight, avoid days with rainfall or high humidity.*

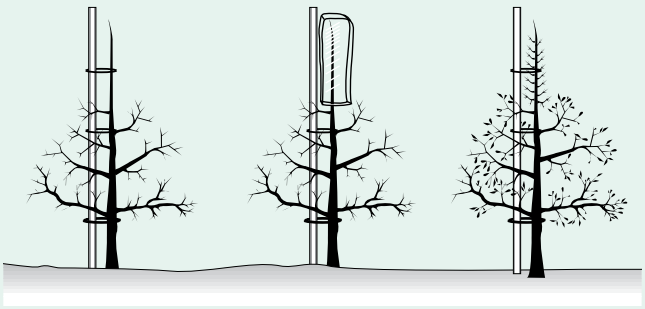


Figure 11. Leader branching by bagging

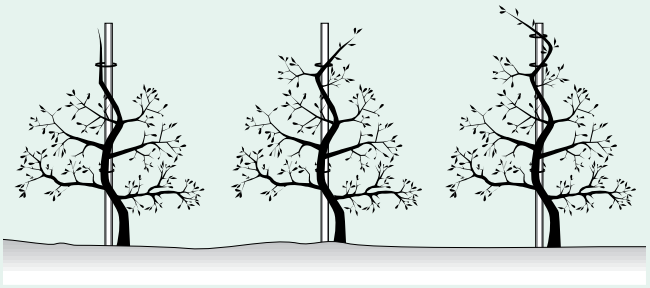


Figure 12. Leader branching by snaking

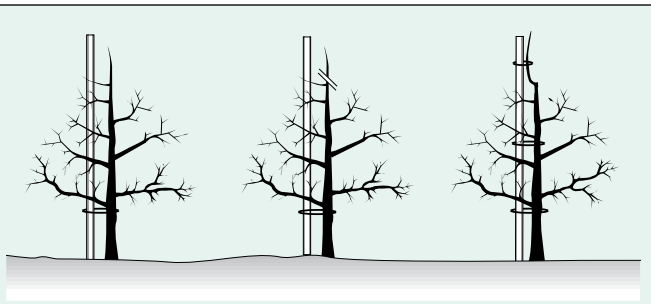


Figure 13. Leader branching by weak-leader renewal

- **Lateral branch management**

When new laterals are 3 to 6 inches long, spread them out horizontally or nearly horizontal with a clothespin or toothpick.

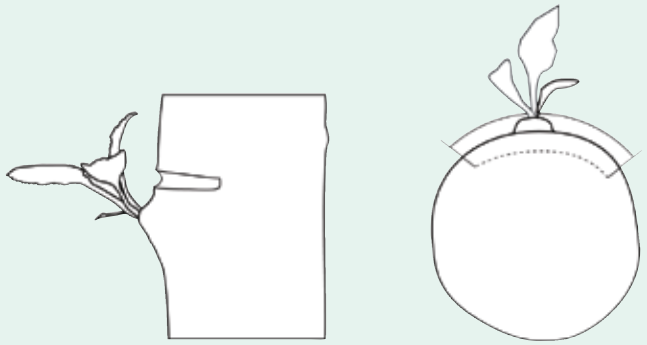


Figure 14. Leader branching by notching

When lateral growth turns up with extension growth, laterals should be weighed or tied down to nearly horizontal. This timely positioning will usually release upright secondary branching along the top of laterals.

As secondary uprights get strong enough to weigh or tie over, some need to be horizontally positioned and some removed by thinning out. Generally the strongest ones are removed and more moderately vigorous ones are positioned to horizontal. (Positioning of lateral shoots and secondary branches a couple times during the summer may be necessary. This will pay off in increased fruiting potential and reduced pruning required in the first three to four years.)

Leader branching techniques and lateral branch management must be repeated each season until the tree reaches the maximum desired height.

Open-Center or Vase Training — Peach, Nectarine, Plum

With the open-center system, the leader is removed, leaving a "vase-shaped" tree with upright growth removed from the center. Instead of having a central leader, the open-center tree has three to five major limbs, called scaffolds, coming out from the trunk. This training system allows for adequate light penetration into the tree, which minimizes the shading problem prevalent in higher-vigor trees, such as peach trees.

At planting

Peach trees should be planted so that the graft union will be 2 inches above the soil surface after the soil has settled from planting. As the buds begin to swell, the unbranched trees (whips) are generally headed. The work that needs to be done under the tree determines the appropriate height for branching, which is usually 24 to 32 inches. As discussed with the central-leader system, new branches will come primarily from the buds that are 4 to 12 inches below the heading cut.

Figure 15. Pruning young peach trees

A. Well-branched peach tree to be trained to an open-center system.

B. Three to five well-spaced scaffolds are selected, and the tree is headed above the highest scaffold.

C. Tree after heading. Branches lower than 24 inches are also removed.

D. Top view of uniformly spaced scaffolds. One or two scaffolds still need to be removed.

Trees that are branched at planting are handled differently than the whips. Remove branches that are too low. If there are three or four uniformly spaced branches around the tree that can be selected as scaffolds, the tree is headed just above the highest selected scaffold. Any remaining branches not selected as scaffolds should be removed. *See Figure 15, page 13*. However, if there are less than three scaffolds, the tree should be cut back to a whip and the side branches removed, leaving a short stub for axillary buds to grow the following spring. *See Figures 15A and 15B.*

Summer pruning

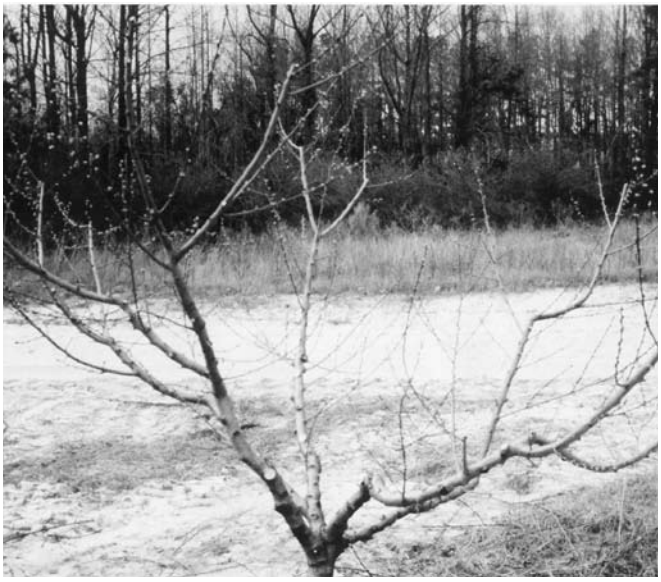
After the new vegetative growth is approximately 3 to 4 inches long, it is time to select the branches that will become the major scaffolds. The lowest scaffold should be 24 to 32 inches above the soil surface to avoid interfering with cultural work under the tree, such as harvesting and weed control. It is best to select three to four scaffolds that are uniformly spaced around the tree, with wide branch angles, and not directly across from another scaffold. *See Figure 15*.

Figure 16. Dormant pruning a mature open-center peach tree

A. Tree before pruning

B. Removal of vigorous upright shoots in the center of the tree

C. Heading a scaffold to an outward growing shoot



D. Tree after pruning

During the summer, branches should be selected that are growing outward at a 45- to 60-degree angle. All other vigorous upright growth in the center of the tree can be removed to minimize shading the primary scaffolds and lateral branches.

Succeeding years

After the first year of growth, the primary scaffolds should be selected and properly trained outward. Scaffolds should be headed during the dormant season of the first two years to promote continued lateral branching and to stiffen and strengthen the scaffolds. Heading scaffolds to outward-growing shoots similar in angle to those being removed is recommended.

During the dormant season of the third year, the primary scaffolds can be pruned so that two (forked) secondary scaffolds arise from each primary approximately 3 feet from the trunk. These secondary scaffolds should be pruned to outward- and upward-growing laterals if needed to maintain the tree's open-center system.

On each secondary scaffold, approximately 3 feet from the first split, another split may be required to form tertiary scaffolds. Lateral branching from all the scaffolds is to be encouraged for fruit production. One of the problems with peach trees is that lateral branching from the scaffolds closer to the trunk is eliminated because of excessive shading. This shading can result in lateral fruiting wood only on the ends of the scaffolds, which results in broken scaffolds under a heavy fruit load. It is best to keep the fruiting wood on the scaffolds as close to the tree trunk as possible to reduce tree breakage and to produce the highest quality fruit. This problem can be eliminated with summer pruning. During the dormant season, all vigorous upright shoots not removed during summer pruning should be removed along with the shoots growing downward.

By the fourth year, the basic framework of the tree should be completed. Prune moderately to eliminate damaged, dead, and diseased wood, such as cankers. Shriveled and dried fruit from the previous season, called "mummies," should also be removed from the orchard to reduce disease pressure for the coming season.

Peach trees will suffer from reduced yields if pruned too severely. Also, remember that moderately pruned trees bear sooner than heavily pruned trees. However, allowing trees to bear excessive crop loads before establishing the tree's framework can stunt the tree as well as destroy its shape. Bench cuts should be avoided. *See Figure 16, page 14.*

During summer pruning, undesirable upright shoot growth can be removed as soon as it is 4 to 6 inches long. Summer pruning can also be used to direct scaffold growth outward to the desired growing points instead of waiting until the dormant season.

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10,000 copies of this public document were printed at a cost of $4,859, or $0.48 per copy.

Published by
NORTH CAROLINA COOPERATIVE EXTENSION SERVICE

COLLEGE OF
AGRICULTURE & LIFE SCIENCES
ACADEMICS ▲ RESEARCH ▲ EXTENSION

NC STATE UNIVERSITY

(Revised) AG-69

10/08—10M—BS/KEL
E08 50325