TREE DENSITY, ORCHARD DESIGN, AND TRAINING SYSTEMS

David W. Lockwood
Department of Plant Science & Landscape Systems
University of Tennessee
Knoxville, TN 37996

Stephen C. Myers
Department of Horticulture & Crop Science
Ohio State University
Columbus, OH 43210

TREE DENSITY

Maximum sustainable yields of high quality fruit at the lowest cost of production should be the goal of every fruit grower. Yield and quality are functions of the number of trees per acre, training system, and annual productivity practices such as pruning, fertilization, and pest management.

The productive lifespan of a peach orchard is not long, especially on old peach sites. It behooves the grower to use a tree-training system that returns significant yields early in the life of the orchard. Increasing the number of trees per acre increases yields, up to a point, in young orchards. However, as trees mature, too many trees per acre results in crowding and shading with commensurate declines in yield and fruit quality and increases in pest problems. Ideal tree density will vary, depending on soil type and topography, varieties, rootstocks, training systems, the presence of irrigation, and the grower's management capabilities.

In previous years, it was common to set an orchard "on the square," in which the distance between trees in-a-row equaled the distance between-rows. Oftentimes, the orchard floor was kept free of grasses and weeds by cultivating down the rows and across rows. High fruit quality could be attained because mutual shading was not a problem. Yields were low to moderate because a relatively high percentage of the orchard space was devoted to drive areas and, hence, not covered with fruiting wood.

Planting trees close enough in the row that they almost touch at maturity and leaving an extra eight feet between rows to accommodate equipment movement results in more trees per acre, which promises potentially higher early yields plus greater yield potential in the mature orchard. With proper management, fruit quality remains high. An orchard floor management system consisting of permanent sod between rows and a continuous vegetation-free strip down tree rows accomplished through the use of herbicides works well with this orchard layout.

In the southeastern United States, a relatively low-density, open-centered vase system has predominated. Among high-density systems, the perpendicular V system appears to be the best to date. In it, trees are set six feet apart in the rows. Between-row spacing should remain the same as in conventional orchards. When orchards are planted on flat ground, rows should be oriented north to south to maximize sunlight within the canopy. Table 1 shows the number of trees per acre at several different spacings in perpendicular V and conventional plantings. In the perpendicular V system, each tree has only two scaffold limbs — one on each side of the trunk facing the row middles and growing perpendicular to the row. No subscaffolds are allowed to develop. The perpendicular V system can give higher yields early in the life of the orchard. However, at maturity it has no yield advantage over conventional systems.

Table 1. Trees per acre at various in-row and between-row spacings.

In-Row	Between-Row	Square Feet Per Tree	Trees Per Acre
6	18	108	403
10	18	180	242
14	18	252	173
18	18	324	134
6	20	120	363
10	20	200	218
14	20	280	156

18	20	360	121
6	22	132	330
10	22	220	198
14	22	308	141
18	22	396	110
6	24	144	302
10	24	240	181
14	24	336	130
18	24	432	101

ORCHARD DESIGN

Optimal orchard design will vary with site. Consider the following points when setting an orchard:

(1) Leave adequate room at the ends of rows for equipment to turn. At least 30 feet will be needed.
(2) Long rows allow for greater efficiency in maintaining the orchard than many short rows. Less time is spent turning at the ends of rows.
(3) Planting across a slope is preferable to planting up and down. Installation and operation of irrigation systems are simpler. Pesticide application is more precise because it is easier to maintain a uniform ground speed and constant PTO speed. The sod row middles serve as deceleration and diffusion strips for runoff water which lessens the erosion potential. Planting on a true contour is not necessary except where slopes are uneven and steep. True contour planting may result in multiple short rows and the distance between rows may not always be uniform.
(4) Uniform-shaped fields mean fewer short rows.
(5) Leaving open spaces in low areas of rows planted across slopes enhances air drainage out of the orchard, which lessens frost and disease pressure and provides an area to turn equipment.

OPEN CENTER TRAINING SYSTEMS

GROWTH AND FRUITING HABIT

Growth Habit

A peach shoot is made up of a terminal bud, called the apex, and lateral buds along the shoot (Figure 1). Lateral bud growth is influenced by the terminal bud through action of auxin, a naturally occurring growth regulator. Auxins move downward in shoots from actively growing terminal buds, suppressing lateral bud growth, a phenomenon called *apical dominance*.

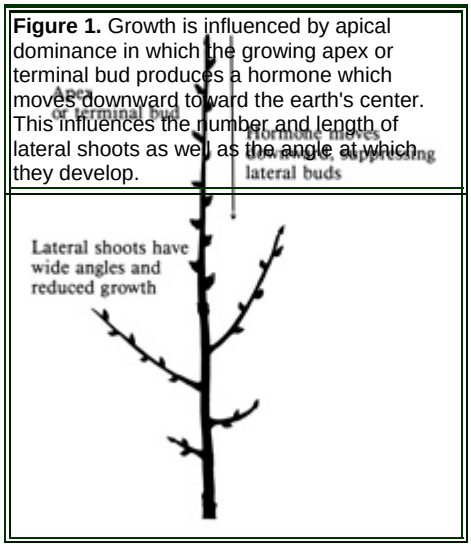

Figure 1. Growth is influenced by apical dominance in which the growing apex or terminal bud produces a hormone which moves downward toward the earth's center. This influences the number and length of lateral shoots as well as the angle at which they develop.

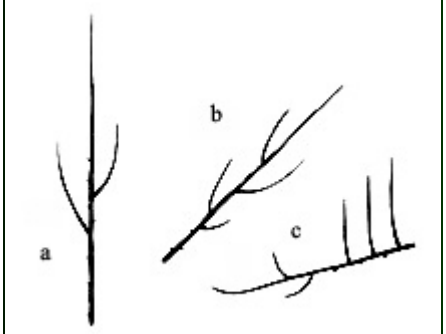

Figure 2. Limb orientation influences apical dominance. On vertical limbs (a), shoot growth near apex is most vigorous with sparse lateral shoots away from apex. On limbs at 45° to 60° (b), vigor of shoots near apex is reduced while number and length of lateral shoots farther away from apex are increased. On horizontal or below horizontal limbs (c), apical dominance is lost and watersprouts develop.

Peaches develop lateral shoots on current season's growth. The degree of apical dominance is shown by growth habit. Orientation or angle of shoots and limbs influences apical dominance (Figure 2). Apical dominance is strongest in vertical shoots and limbs. In vertical limbs, lateral shoot growth is lacking near the distal end of the shoot; shoot growth near the base of the stem is present but sparse. Orientation at a 45° angle moderates apical dominance, reduces vigor of growth near the apex, and increases both lateral shoot number and length along the limb further from the apex. On horizontal or flat limbs, apical dominance is lost. Without apical dominance to suppress their growth, lateral buds on the upper side of flat limbs develop into watersprouts. Thus, limb orientation at 45° aids in managing vigor and reducing watersprouts.

Fruiting Habit

Light is critical for fruit wood and flower bud development. Under shaded conditions, flower bud formation is reduced, and, under extreme conditions, fruit wood will weaken and die back. With time, fruiting wood will move up and out from the tree center due to shading.

Peaches are produced on one-year-old wood from flower buds formed the previous growing season. New growth is required annually for cropping. Flower bud initiation begins in mid-summer and extends for several weeks. If vigorous shoot growth occurs after flower bud initiation, there is potential for reduced flower bud numbers. The total number of flower buds per shoot increases as shoot length increases, to around 25 inches. Above 25 inches, flower bud numbers typically decline, often as a result of excess vegetative vigor from too much nitrogen or heading cuts. In cases of excessive vigor, reduced flower bud numbers result from blind nodes, inhibition of flower initiation, and excessive lateral shoot development.

BASIC PRUNING CONCEPTS

Effects of Pruning

Pruning reduces tree growth. That is, the total new growth on an unpruned tree will exceed that of a pruned tree. Pruning allows you to determine where new growth will occur and to invigorate shoots in the vicinity of the pruning cut.

Pruning stimulates regrowth close to the pruning cut. Heading back a shoot removes the terminal bud and eliminates apical dominance in that shoot, thus invigorating growth of lateral buds (Figure 3). Regrowth occurs closest to the cut on vertical limbs. Regrowth on limbs at 45° to 60° angles develops farther away from the cut. Pruning horizontal limbs too hard aggravates watersprout problems. Heavy pruning removes leaf area and promotes excessive, localized regrowth at the expense of total root growth and tree growth. Early in the tree's life, excessive pruning decreases tree size and root growth compared to light pruning. Trunk diameter and early yields are reduced by heavy pruning. Vigorous shoot growth brought on by heavy pruning inhibits flower bud formation. Reduction of early yields will vary with pruning severity and time of pruning. Light pruning, as practiced in proper summer training techniques, appears to have a minimal effect on young tree growth.

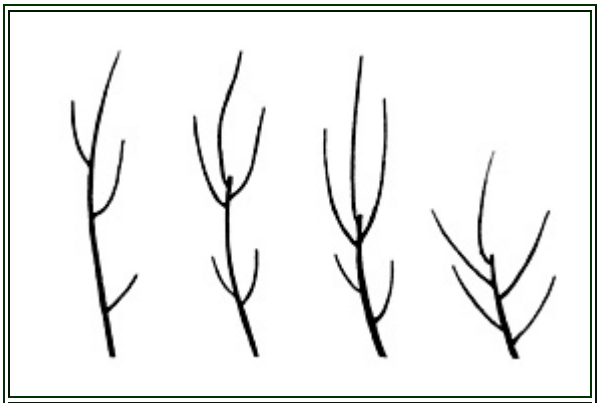

Figure 3. On unpruned limbs (left), apical dominance is intact. Pruning removes apical dominance, stimulating lateral shoot growth near the cut. The more severe the pruning (left to right), the greater the resulting regrowth.

Types of Cuts

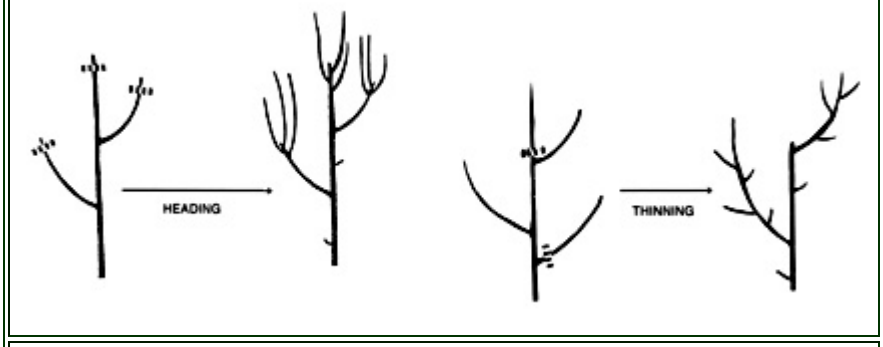

Figure 4. Heading (left) removes a portion of the shoot or limb, stimulating branching below the cut. Heading is most useful for stimulating branching at specific locations when training young trees. Thinning (right) removes an entire shoot or limb to its point of origin or to a side limb. Thinning is the least invigorating type of cut with the least effect on reducing fruit production. Thinning cuts are most useful for promoting fruit production and for maintenance pruning.

There are two basic types of pruning cuts: heading and thinning (Figure 4). Heading cuts remove the terminal portion of shoots or limbs, leaving a stub, thus stimulating regrowth near the cut. Heading cuts should be used to induce branching at specific points, as in establishing scaffolds and lateral shoot growth at specific locations. However, heading is extremely invigorating and should be used with care.

Thinning cuts remove entire shoots or limbs to their points of origin from a main branch or limb. With thinning cuts, some terminal shoots are left, apical dominance remains, and the stimulation is more evenly distributed among remaining shoots. Thinning cuts are useful to shorten limbs, improve light penetration, and direct growth of limbs.

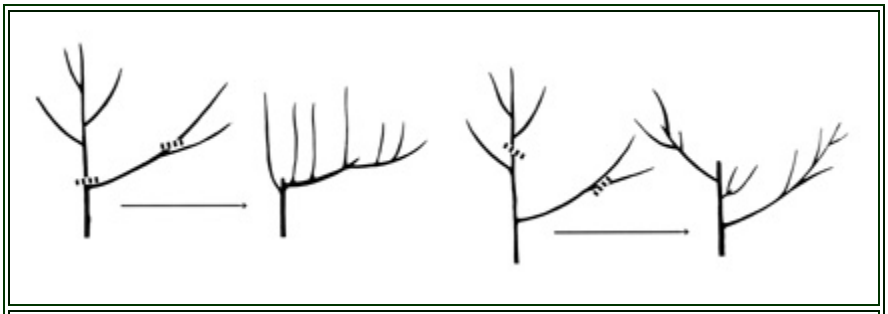

Figure 5. Bench cut (left) is formed by pruning a vigorous, upright limb to a more horizontal limb. Due to loss of apical dominance in the horizontal limb, vigorous water sprouts develop at the "bench." Correct method is to thin to limbs that are more similar in angle (right) to maintain some apical dominance. Scaffolds should be trained to a 45° angle in early years to minimize need for severe bench cuts.

One misused type of thinning cut is the "bench cut," which prunes an upright limb to a horizontal or flat limb (Figure 5). Watersprouts develop in the area of bench cuts, especially following large cuts, owing to the absence of apical dominance on the flat limb. Bench cut areas are weak and the flat limb is apt to break at the cut. Benched limbs are also subject to sunburn, winter injury, and infestations of lesser peachtree borer. More correctly, maintain some apical dominance by thinning to limbs at angles of about 45°. If limbs are trained flat, growth can be trained back toward the tree center from flat areas to "absorb" vigor and reduce sunburn. Make pruning cuts when limbs are small, particularly during summer training. Scaffolds should be trained as close as possible to a 45° angle to minimize need for severe bench cuts later.

TRAINING AND PRUNING IN PRACTICE

The goal of tree training is to promote favorable growth patterns. Training involves spreading or tying up limbs, staking, and making as-needed cuts (pruning) to direct the growth in certain areas. Training is used to bring trees into production earlier, to develop a strong structural framework that will support heavy crop loads without breaking, to promote good sunlight penetration throughout the canopy, and to make the trees easier to manage. Primary tree training should be accomplished during the first three or four years of a tree's life.

Pruning involves making cuts to:

(1) eliminate unproductive or marginally productive wood;
(2) encourage the growth of new shoots for future production;
(3) remove insect-infested and disease-infected wood;

(4) promote light penetration throughout the canopy to maintain fruitfulness of the lower and interior shoots, maintain fruit quality, lessen pest pressure (good light penetration is associated with air movement and spray penetration throughout the canopy); and
(5) maintain the tree within desirable size limits.

Pruning should be conducted annually throughout the life of the tree.

OPEN CENTER SYSTEM

The open center or vase system is most commonly used for training peach trees. Open center trees are relatively low with all or most of the crop reachable without the use of ladders. Fruit quality is fairly uniform throughout the canopy and the system is easy to understand so workers can be taught to use it with minimal difficulty. The open center system is a modification of the peach's natural, rounded bush shape. It generally consists of three or four scaffold limbs well placed both vertically and around the trunk. Several different methods for training peach trees to the open center system exist, beginning with the newly set tree and continuing through the training years.

Developing the Open Center Training System for Peach Trees

The ideal open center tree shape involves:

(1) 3 or 4 scaffold limbs uniformly spaced around the trunk, arising within a 6-inch vertical distance from each other, with the lowest branch being 18 to 24 inches above-ground and growing outward from the trunk at a 45° angle;
(2) subscaffolds on either side of each scaffold limb
a) no subscaffolds within 36 to 48 inches of the base of the scaffold limb;
b) select subscaffolds on alternate sides of the scaffold limb and spaced 24 to 48 inches apart;
c) growing outward from the scaffold limb at a slightly upward angle;
d) never extending further out of the canopy than the scaffold limb; and
(3) maintaining the center of the tree largely free of watersprouts or vigorous shoots that grow back toward the center of the tree.

Depending on tree growth rate, the scaffold limbs should be selected within the first year of tree growth. Subscaffolds will be selected and developed over the next two to three years.

Annual pruning includes:

(1) removal of dead, diseased and insect-infested wood;
(2) removal of watersprouts, vigorous shoots growing in toward the center of the tree, and removal of hangers (shoots growing on the undersides of scaffolds and subscaffolds);
(3) removal of wood that fruited the previous year; and
(4) thinning out new wood for current year's crop and to promote the development of new shoots for the following year's crop.

At Planting

Head trees back immediately after planting to establish the height of the primary scaffolds. Scaffold limbs usually develop within eight inches of the heading cut. Therefore, the tree should not be headed over eight inches above the desired height for the first scaffold limb. Although the scaffold limbs should be close to the ground at the point where they originate on the trunk, adequate room should be left for weed control next to the trunk and to apply trunk borer sprays. Small trees (3/16 to 3/8 inch in diameter) usually have few laterals on their trunks and those that may be present are usually weak. Remove them completely. Larger trees (1/2 inch diameter or more) usually have pencil-size branches along their trunks. Remove those that are too low and that have narrow crotch angles where they arise from the trunk. Retain laterals that are in a desirable location for permanent scaffolds unless the terminal of the lateral is broken or dried up. Such laterals should be cut back to within 1/4 inch of the trunk. The bud at the base of the lateral should grow and give rise to a new scaffold candidate.

Variations of how to start an open center tree include:

(1) Head the tree below the height desired for any scaffolds and remove all laterals below this point. A new shoot will be trained up from below the heading cut and all the scaffolds will be developed from laterals arising from the new shoot.

(2) Head the tree six to eight inches above the height desired for the scaffold limbs. Cut all laterals in the desired height range back to within 1/4 inch of the trunk. New scaffold candidates will arise from buds at the base of these stubs. Entirely remove laterals that are below the height desired for scaffolds.

(3) The "side leader" method entails heading the trunk just above a good lateral having a wide crotch angle and arising at the desired height for scaffold branches. This lateral should be pointed into the prevailing wind. Entirely remove all remaining laterals. Head the remaining lateral back to within 10 to 12 inches of its base. All scaffold limbs will arise from buds on the sides and lower part of this lateral.

First Summer

Shoots within a few inches of the heading cut tend to be upright in growth habit and very vigorous. They will have narrow crotch angles. Shoots arising lower on the trunk tend to have wider crotch angles and make better scaffold limb candidates. Early in the growing season, pinch the tips out of the vigorous, undesirable shoots to temporarily stop their elongation. If they have grown a lot before summer training is done, these shoots may need to be broken in half to stop their growth (Figure 6).

Select three or four shoots to be developed into scaffold limbs. They should have wide crotch angles growing out at about a 45° degree angle from the trunk. These shoots should not be tipped, rather they should be allowed to grow throughout the summer. Oriental fruit moths can destroy the growing point on a shoot and thus lessen the desirability of the shoot as a scaffold limb. If the terminal growing point is destroyed, a lateral bud will break and give rise to a shoot that will take over as the dominant growing point, sometimes destroying the symmetry of the limb.

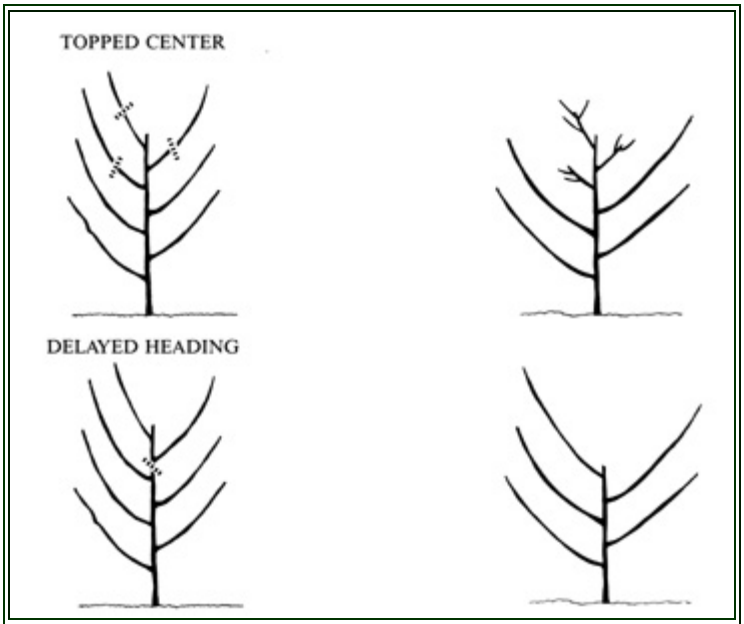

Figure 6. Methods to train first-summer trees. Topped center (top) involves cutting the top 2-3 shoots in half early to mid-season to form a "bush" in the tree center. Delayed heading (bottom) involves complete removal of the top two to three shoots below the initial heading cut. Both methods direct growth into more desirable scaffolds. Topped center method is preferred because "bush" acts to force scaffold out and up, maintaining more ideal angles.

First-Year Dormant Training

Complete selection of scaffold limbs if necessary. Select branches that are uniformly distributed around the trunk and that arise within six inches of each other vertically. Avoid upright limbs having a narrow crotch angle, as these limbs are weakly attached to the trunk. Their upright growth habit makes them too vigorous, and when a limb having a narrow crotch angle splits off the trunk (and it will split off), it tears down the trunk, doing tremendous damage. Limbs that have very wide crotch angles and that are almost flat in their growth habit give rise to many watersprouts. If necessary, flat scaffolds can be tied up early in their life to develop a more desirable growth habit. As previously mentioned, scaffold limbs growing at about a 45° angle are most desirable.

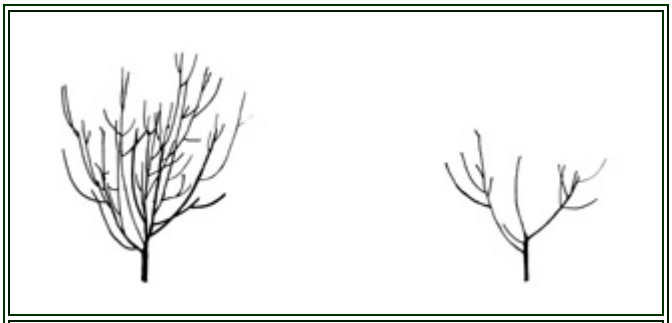

Figure 7. One-year old tree before (left) and after (right) first-year dormant pruning. Select three to four well-spaced primary scaffolds, ideally spaced several inches apart vertically. Prune primary scaffolds to laterals (which form secondaries) at around two to three feet from the crotch. Thin out vigorous upright shoots in center but leave some weaker laterals.

As the scaffold limb grows, develop subscaffolds on each side starting about three feet from the crotch (Figure 7). If necessary, “thinning cuts” can be used to force subscaffold development. Develop subscaffolds on both sides of the scaffold branch to give balance to the limb. Avoid leaving too much structural wood, as light levels may get too low for development of fruiting wood. Like the scaffold limbs, subscaffolds should also grow outward and upward at a 45° angle. Avoid making bench cuts on the scaffold limbs to force subscaffold development.

If the tree has grown well and scaffold limbs are well developed, the center of the tree above the highest scaffold can be opened up. Retain some laterals along scaffold limbs to lessen chances for sunburn and for early production. Remove shoots arising from the trunk below the scaffold branches.

Second Year — Summer

Continue scaffold and subscaffold limb development. Summer pruning and tying up or down of scaffolds to approximate a 45° angle may be necessary. Remove watersprouts arising along scaffold branches.

Second Year — Dormant Pruning

Continue subscaffold selection and development (Figure 8). These limbs should be well positioned around the tree to give a full canopy, but not so full that shading inhibits development of fruiting wood. Remove watersprouts and hangers (fruiting wood that grows on the underside of limbs) and thin out fruiting wood along scaffolds and subscaffolds.

Figure 8. Two-year old tree before (left) and after (right) the second-year dormant pruning. Select secondary scaffolds at two to three feet from the crotch. Thin out low and horizontal shoots and excessively vigorous shoots growing toward the center. Maintain scaffolds at a 45° angle, minimizing the use of severe bench cuts.

Third and Fourth Year — Summer Pruning

Remove watersprouts and other limbs with undesirable angles. Retain weaker shoots for fruit bud development and to protect limbs against sunburn.

Third and Fourth Year — Dormant Pruning

Continue to develop subscaffolds if necessary. Develop subscaffolds at approximately two- to four-foot distances. At the end of the third to fourth year, a tree should have three to four primary scaffolds with six to eight secondary scaffolds four to six feet above-ground. At a seven- to 10-foot height, additional limbs fill the tree periphery. If excessive structural limbs develop, remove them before shading becomes a problem.

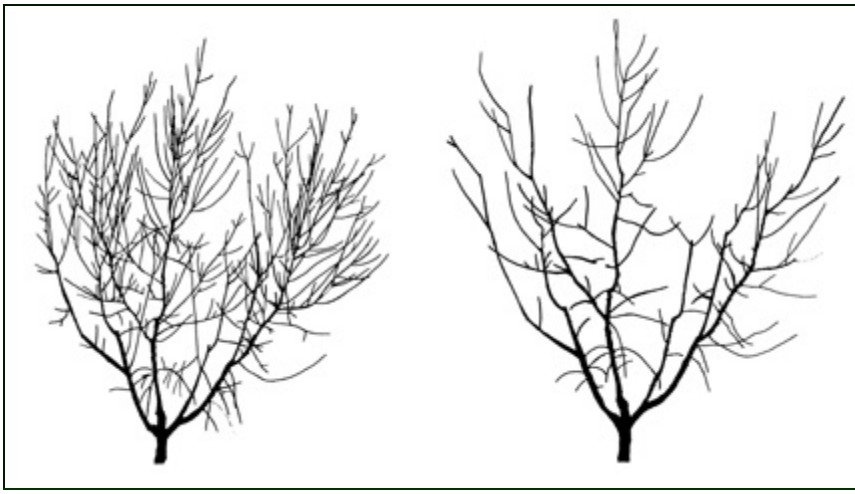

Figure 9. Four-year old tree before (left) and after (right) pruning in the dormant season. Fruiting wood is thinned out to reduce the crop load. Health of fruiting wood is maintained throughout the tree by adequate light penetration. Thin branches back towards scaffolds to encourage new shoot growth close to scaffolds. Light summer pruning may be useful to maintain light penetration in tree centers, maintaining health of fruiting wood throughout the tree.

Remove watersprouts, excessively vigorous shoots, hangers, and shoots growing back across the center of the tree. Prune fruiting wood back toward the scaffolds and subscaffolds using thinning cuts to encourage annual shoot growth close to these limbs and to increase light exposure for the remaining wood (Figure 9).

Maintenance of Mature Trees

Detailed pruning throughout the tree is critical in maintaining high yields of quality fruit. Fruiting shoots must be thinned out and spaced to adjust the crop load and promote the development of new shoot growth for the following year's crop (Figure 10). The amount and spacing of fruiting wood left in trees will depend on variety and tree height and vigor. Fruiting branches should not get too old or far away from the scaffold or subscaffold limbs. To prevent this, prune fruiting branches back to lateral shoots near the scaffolds to encourage new growth close to scaffolds. Remove hangers; they produce small fruit and shade out more desirable fruiting wood.

Figure 10. Mature tree before (left) and after (right) dormant pruning. Fruiting wood is thinned out to adjust the crop load depending on variety. Branches are thinned back towards scaffolds to encourage new shoot growth close to scaffolds. Vigorous upright shoots are removed from the center but some weaker shoots are left to afford sunburn protection. Some annual summer pruning may be necessary to maintain light penetration in tree to keep interior fruit wood healthy.

As trees reach the desired height and fill their in-row and between-row spacing, prune to maintain tree size. This is most easily accomplished by annual pruning, consisting of a summer and a dormant pruning. Ultimate tree size (height and width) must be determined by the grower. At a minimum, trees should be tall enough so that the top of the tree is almost out of reach by pickers. Higher yields can be attained by allowing trees to grow taller, although use of ladder harvesting will be necessary for part of the crop.

Maintenance pruning should largely involve thinning cuts. Vigorous, upright growth (often called watersprouts) that develops inside the tree and at the ends of scaffolds and subscaffolds (crow's feet) should be completely removed (thinning cut) to prevent shading of productive fruiting wood. Leave only one growing point at the end of each

structural limb. Otherwise, crow's feet shade out fruit wood. Severe pruning, particularly misuse of heading cuts, will unnecessarily invigorate the tree, resulting in shading in the tree center and reduced fruit color (Table 2). Nitrogen fertilization should be adjusted, along with pruning, to the tree's needs based on fruit quality, shoot growth, and foliar analysis.

Table 2. Effect of pruning methods on light penetration and fruit color in Elberta peach trees. (Westwood and Gerber 1958)

Pruning Method	Light in Tree (% full sun — Aug.)	Red Blush Color (%)	Undercolor Rating (2 = green to 4 = yellow-amber)
Corrective	60	54	3.6
Thinning out	60	58	3.7
Conventional	55	42	3.3
Severe	35	26	3.2
Corrective pruning: removal of crossing and broken limbs			
Thinning out: moderate pruning using thinning cuts			
Conventional pruning: thinning out shoots plus heading remaining shoots in half			
Severe pruning: 50%-75% shoots removed plus severe heading of remaining shoots			

Pruning bearing trees during the growing season (summer pruning) can greatly complement the overall pruning program, but should never be considered as a substitute for dormant pruning. The development of excessively vigorous, upright growth is apparent in some trees by mid-season. Remove vigorous upright growth several weeks before harvest to increase light penetration within the tree. Light has a positive effect on development of red color of fruit. Moderate removal of vigorous growth also helps maintain health of fruiting wood. However, excessive summer pruning before harvest can invigorate the tree, delay maturity, and reduce fruit color and size. Vigorous regrowth after heavy, late-summer pruning (July — August) reduces flower bud set. Summer pruning should consist of thinning cuts made within the tree canopy that open up areas to light penetration. Removal of some, but not all, vigorous watersprouts within the tree center will keep fruiting wood healthy but not subject the tree to sunburn.

Avoid or minimize heading main scaffolds and subscaffolds until after they have attained their final size. Heading a limb lessens the basal portion of the limb's ability to bend. Heading cuts can also create a weak area at the site of the cut. By not heading, limbs remain more flexible and will bend with increasing loads rather than breaking. If a subscaffold branch threatens to outgrow the main scaffold, it is often best to remove it entirely rather than head it back. Once the scaffold fills its allotted space, if it bends too much, it can be headed to maintain the proper growing angle (45°). Likewise, if the scaffold outgrows its space, it can be headed to re-establish the proper spacing.

Modifications

Several modifications to the open center system may be worthy of consideration. A multiple scaffold vase system may have promise. It involves developing eight to 10 scaffold limbs spaced around the trunk and arising within about 12 inches vertically. These scaffolds are not tipped and no subscaffolds are allowed to develop. Fruiting is restricted to shoots that develop directly off the upper part of the scaffold (as opposed to the sides and bottom of the limb). During dormant pruning, shoots that fruited the previous growing season are removed. Vegetative shoots that did not fruit the previous growing season are retained for fruiting. With this system, the loss of one or two scaffolds will have relatively little effect on yields.

The "perpendicular V" system was briefly described in the section on tree density. This is a free standing, high-density system with trees planted six to eight feet apart in the row and with rows spaced at the normal distance apart. Ideally, rows should be oriented in a north-south direction to reduce mutual shading from adjacent trees. Yields early in the life of a perpendicular V orchard will be higher than with conventional systems. At maturity, no yield difference should be expected between trees on the perpendicular V system as compared to the conventional system unless wide tree spacing is being used.

With the perpendicular V system, one scaffold limb is developed on each side of the trunk facing the drive area between rows. The scaffold limbs may be selected and developed as previously discussed, except there will only be two scaffolds, one on each side of the trunk adjacent to the drive areas. Attention should be paid to selecting limbs having

wide crotch angles to assure that they are firmly attached to the trunk. The ideal angle for scaffold limb growth is 45° from the vertical orientation. More vertically oriented limbs tend to be too vigorous and flatter-growing limbs have a lot of watersprout development on the upper side.

Because perpendicular V trees have only two scaffolds, limb breakage is very detrimental to yield. By not heading the scaffolds until they have attained their final length, the scaffolds will be more apt to bend instead of break with the weight of the crop. Once the scaffolds have reached their desired length, heading is typically needed. With unheaded scaffold limbs, problems are sometimes encountered when winds turn one of the scaffolds back over the center of the tree. Watersprouts should be removed during the summer. Annually renew fruiting wood to keep the crop on shoots arising directly from the scaffold branches. No subscaffolds should be developed on perpendicular V trees.

SPECIAL CONSIDERATIONS

Mechanical Topping

Mechanical toppers may be used to maintain tree height. Mechanical toppers prune in an efficient, but non-selective fashion. Topping should be complemented by detailed hand pruning. Topping makes non-selective heading cuts. Vigorous growth occurs immediately below cuts, forming “crow’s feet.” Follow-up, detailed hand pruning is necessary to clean up crow’s feet or shading will occur.

Toppers are often used in the summer to increase light penetration in the tree center. However, if done too early in the season, vigorous regrowth from topping can actually increase shading problems.

Topping does not reduce over-all costs and, in some cases, may actually increase them.

Methods to Support Crop Load

Many varieties, when grown using good cultural practices, are capable of sizing more fruit than the scaffold limbs can physically support. This is especially common when young trees are heavily cropped. To take advantage of early cropping and heavy yields, many growers employ various methods such as tying, strapping, or banding scaffolds to support the crop. .
As the weight of fruit increases and one, some, or all of the scaffolds begin to droop, the twine distributes the weight of the fruit load throughout the tree. If all scaffolds are heavily burdened with fruit, the circle formed by the twine bears the weight and keeps scaffold breakage to a minimum. Avoid encircling or wrapping entirely around scaffolds as girdling can occur. When circling the tree, be sure the major fruiting area is within the circle. Always leave 15 to 18 inches of slack when tying the ends together to allow for limited limb bending. If the string is tied too tight, it may break under the weight of a fruit load.

Tying, if needed, should begin as the tree develops its first sizable crop (third or fourth year), and continue according to the needs of mature bearing trees. Tying should be done before harvest time when limbs begin to spread. Less expensive, short-lived materials can be used on young trees, whereas long-lasting materials are more practical once trees have reached maximum size. An alternative is to leave enough slack to adjust the tying as the tree increases in size.

Pruning Time and Method

In the Southeast, research has shown that tree mortality is increased by pruning in late fall through early winter, October through January (Figure 11). If winter pruning is practiced, late winter is preferred over early winter. Prune the oldest and/or worst orchards first and prune the youngest orchards last. A combination of summer and dormant pruning may reduce the need to prune during undesirable periods. In northeastern areas, recommendations for Cytospora canker (Valsa) control (particularly in young blocks) include delaying pruning until growth begins in spring, after bloom but before the shuck-split spray. However, research in West Virginia found that pruning method affected Cytospora infection, but found no difference between trees pruned in winter, spring, or summer. Pruning cuts that left a raised collar resulted in less Cytospora infection compared to flush cuts.

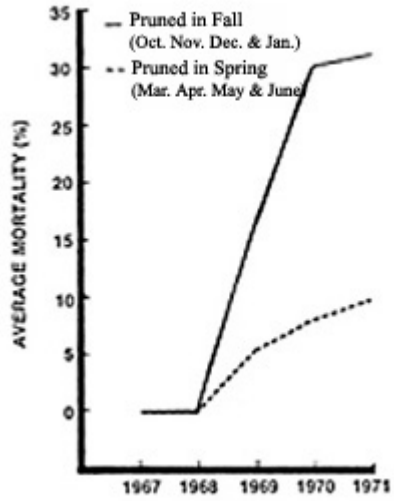

Figure 11. Effect of pruning time on mortality of Loring peach trees in a replant site at Fort Valley, Georgia.

REFERENCES

Armstrong, W. D. 1965. A long useful life for peach trees. American Fruit Grower 12: 13-15.

Christ, E. G. 1985. Control peach canker. American Fruit Grower 6: 26-27.

Daniell, J. W. 1973. Effect of time of pruning on growth and longevity of peach trees. J. Amer. Soc. Hort. Sci. 98: 383-386.

DeVay, J. E., M. Gerdts, H. English, and R. L. Lukezic. 1974. Controlling cytospora canker in 'President' plum orchards of California. California Agriculture, December: 12-14.

Erez, A. and J. A. Flore. 1986. The quantitative effect of solar radiation on 'Redhaven' peach fruit skin color. HortScience 21: 1424-1426.

Forshey, C. G. and D. C. Elfving. 1976. Training and pruning apple trees. Cornell University Cooperative Extension Information Bulletin 112.

Marini, R. P. 1985. Vegetative growth, yield and fruit quality of peach as influenced by dormant pruning, summer pruning, and summer topping. J. Amer. Soc. Hort. Sci. 110: 133-139.

Marini, R. P. and D. Rossi. 1985. A partial economic analysis of three pruning treatments on mature peach trees. HortScience 20: 242-243.

Marshall, R. E. 1931. The fruiting habit of the peach as influenced by pruning practice. Mich. Agri. Exp. Sta. Tech. Bul. 116.

Micke, W., A. A. Hewitt, J. K. Clark, and M. Gerdts. 1980. Pruning fruit and nut trees. University of California Cooperative Extension Service Leaflet 21171.

Myers, S. C. 1985. Summer pruning effects on canopy development of newly planted peach trees. Proceedings Cumberland-Shenandoah Fruit Workers Conference 61: 1-4.

Puls, E., Jr. 1983. Tree training and pruning. In Peach Growers Handbook, M. E. Ferree and E. E. Bertrand, eds., The University of Georgia Cooperative Extension Service Handbook No. 1.

Richter, R. 1986. Louisiana peach grower increases fruit size, volume. Fruit South, December-January: 18-25.

Savage, E. E. and F. E. Cowart. 1942. The effect of pruning upon the root distribution of peach trees. Proc. Amer. Soc. Hort. Sci. 41: 67-70.

Stebbins, R. L. 1980. Training and pruning apple and pear trees. Pacific Northwest Extension Publication 156.

Tufts, W. P. 1941. Pruning deciduous fruit trees. University of California Agricultural Extension Service Circular 112.

Ulmer, V. E. 1976. Fruitfulness in pome and stone fruit. Translated from German. Washington State University Cooperative Extension Bulletin 665. 32 pp.

Westwood, M. N. and R. K. Gerber. 1958. Seasonal light-intensity and fruit-quality as related to the method of growing peaches. Proc. Amer. Soc. Hort. Sci. 81: 103-107.

Wilson, C. L., S. S. Miller, B. E. Otto, and B. J. Eldridge. 1984. Pruning technique affects dieback and Cytospora infection in peach trees. HortScience 19: 251-253.