

Pennsylvania Tree Fruit Production Guide Supplement

COOKBOOK GUIDELINES FOR APPLE TRAINING SYSTEMS

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Vertical Axe

At Planting

Remove all scaffolds below 18 inches, flush to the trunk. Trees with less than 3 branches should be headed at 30 inches and all feathers (scaffold branches) removed with a bevel or Dutch cut. Attach trees to the support system as soon as possible. Trees with 3 or more branches offer three options depending upon the vigor of the scion and rootstock. Always remove any scaffolds that are more than 1/2 the diameter of the central trunk. The alternatives in order of low vigor to high vigor are:

Option 1: Head leader 10 to 12 inches above the uppermost branch and all branches by 1/3.

Option 2: Head leader 10 to 12 inches above the uppermost branch and DO NOT head the side branches.

Option 3: DO NOT head leader or side branches.

1st Growing Season

May: Rub off 2 or 3 competing buds below the chosen leader if you headed the tree back at planting.

June: Clothespin new shoots when they are as long as, or just longer than, the clothespin. (Remember to remove clothespins in August.)



Clothespin Training



2nd Leaf

DO NOT head the leader or prune the tree in the dormant season. If additional scaffolds are needed, notch above desired buds in the late dormant season (4 to 6 weeks before bud break) or apply Promalin mixed with latex paint.

June: When 3 to 6 inches of new growth develops on shoots above the main scaffolds pinch the new growth back by 1/3 their length. Position permanent scaffolds horizontally utilizing weights, elastics or string. Position vigorous shoots below horizontal by means of weights, elastics or string.

July: Re-pinch all laterals as outlined above, as needed. If tree is vigorous it may be necessary to pinch the shoots a third time in August.

3rd Leaf

DO NOT HEAD THE LEADER or prune the tree in the dormant season. Tie down vigorous upright limbs below horizontal.

June: When 3 to 6 inches of new growth has developed on shoots in the top 1/3 of last year's central leader, pinch them back by 1/3 to 1/2 their length.

4th Leaf

DO NOT HEAD THE LEADER. Prune out overly vigorous limbs that are of no use.

June / July: Position overly vigorous limbs below horizontal

OR

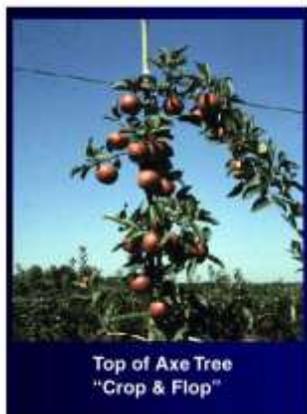
August: Summer prune, removing vigorous limbs, to maintain pyramid shape and improve light interception.

5th and Succeeding Years

DO NOT HEAD THE LEADER. Shorten bottom tier scaffolds by pruning back to a side branch. If desired begin removing / renewing scaffolds by thinning out the ONE most vigorous limb. Leave all weak fruiting wood. Shorten pendulant branches back to a more horizontal position. Summer prune as needed in August to maintain light interception.

Final Leader Height

The ideal situation is that the leader will bend with a crop to restrict the tree height. This is termed the "crop and flop" method. However, in some cultivars the leader does not bend, and the tree continues to grow upward. If this occurs you can cut the leader back to a lower more horizontal branch but only do so after the upper portion of the tree has fruited.



Spindle

At Planting

Remove all scaffolds below 18 inches, flush to the trunk. Trees with less than 3 branches should be headed at 30 inches and all feathers removed with a bevel or Dutch cut. Trees with 3 or more branches should be headed 12 inches above the top-most scaffold limb. Remove any feathers that are 1/2 or more the diameter of the central trunk. Attach trees to the support post or conduit as soon as possible.

1st Growing Season

May / June: Select the most vigorous upright growing shoot that develops below the headed leader. Rub off 2 or 3 competing buds below the chosen leader. Clothespin new shoots that will become future scaffolds or tie down existing shoots to a more horizontal position using string, elastics or weights. (Remember to remove clothespins in August.)

2nd Leaf

Dormant: Head the central leader on weak growing trees by removing 1/2 to 1/3 of previous year's growth. On very vigorous trees (over 20 inches terminal growth) remove the shoot and tie up a weaker leader from a branch below. Alternatively, vigorous leaders can be bent to a 90 degree angle or greater.

June / July: Rub off 2 to 3 competing buds below the leader if the tree was headed in the dormant season. Tie developing leader to the support post. Position overly vigorous limbs and shoots horizontally with weights. Tie up scaffolds that may bend under weight of fruit.

3rd Leaf

Dormant: Head the central leader on weak growing trees by removing 1/2 to 1/3 of previous year's growth. On very vigorous trees (over 20 inches terminal growth) remove the shoot and tie up a weaker leader from a branch below.

June / July: Rub off 2 to 3 competing buds below the leader if the tree was headed in the dormant season. Install clothespins to spread new developing side shoots. Remove any vigorous vertical growing shoots. Position overly vigorous limbs and shoots horizontally with weights. Tie up scaffolds that may bend under weight of fruit.

4th Leaf

Dormant: Remove overly vigorous leaders, and replace each with a suitable side scaffold. Reduce the length of scaffold branches that do not appear capable of supporting a fruit crop by cutting back to a side branch.

August: Summer prune if necessary to maintain pyramidal shape and to encourage light interception. Remove vigorous upright growing shoots.

5th and Succeeding Years

Minimize winter pruning to renew vigorous scaffold limbs in the top half of the tree. Maintain tree height at 6 to 8 feet by cutting the leader to a weak side scaffold as needed to prevent excessive growth in the top of the tree. Remove pendant branches and spur complexes by cutting to a more horizontal shoot or spur system. Shorten bottom tier scaffolds as needed to maintain fruit quality by pruning back to a side branch.

Hybrid Tree Cone (HYTEC)

At Planting

Remove all scaffolds below 18 inches, flush to the trunk. Trees with less than 3 branches should be headed at 30 inches and all feathers removed with a bevel or Dutch cut. Trees with 3 or more branches should be headed 10 inches above the top-most scaffold. Attach trees to the support system as soon as possible.

June: Select one upright growing shoot from just below the headed leader, and rub off the other competing shoots or position them horizontally with clothespins. (Remember to remove clothespins in August.)

2nd Leaf

Dormant: Bend and tie the leader into a horizontal position. OR remove the leader, and bend up a weaker more horizontal shoot.

June: If the leader was left intact and bent horizontally then return to the tree and bend and tie it horizontally in the other direction. Position lower scaffold limbs to a horizontal position with elastics, string or weights.

3rd and 4th Leaf: Repeat either bending or leader removal as outlined in 2nd leaf directions until the tree has reached 10 feet tall. Remove any vigorous upright growing shoots from lower branches.

5th Leaf and Succeeding Years

DO NOT HEAD THE LEADER. Maintain tree height at 10 feet, if necessary by cutting the leader back to a horizontal branch. Do not head the replacement shoot selected. Shorten lower scaffolds that become pendulant by cutting to a side branch. Maintain short fruiting branches above the lower scaffolds by periodic renewal of the limbs.



Dutch Cut



Benefit of Thinning Cuts

Minimally Pruned

At Planting

Remove all scaffolds below 18 inches, flush to the trunk. Trees with less than 3 branches should be headed at 30 inches and all feathers removed with a bevel or Dutch cut. Trees with 3 or more branches should not be headed but must be attached to the support system as soon as possible. Remove any feathers that are 1/2 or more the diameter of the central trunk.

June / July: New, developing shoots should be spread with clothespins when they are about as long as the length of the clothespin. Existing branches that were retained at planting should be bent to horizontal using weights, elastics or string. (Remember to remove clothespins in August.)

2nd Leaf

Dormant: Head the central leader by 1/3, IF it is not growing vigorously (18 inches or more of growth). Remove any upright vigorously growing shoots with a flush cut. Position scaffold limbs to horizontal using weights, elastics or string.

June / July: New, developing shoots should be spread with clothespins when they are about as long as the length of the clothespin.

3rd Leaf

Dormant: Head the central leader by 1/3, IF it is not growing vigorously (18 inches or more of growth). Remove any upright vigorously growing shoots with a flush cut. Position scaffold limbs to horizontal using weights, elastics or string.

4th and Succeeding Years

DO NOT head the leader. Remove any low hanging branches, branches growing back into the center of the tree or vigorous vertical shoots, with a flush cut. Remove any broken branches with a flush cut. If you need to shorten a scaffold branch prune it back to a side shoot. DO NOT make any heading cuts into 1-year-old wood. Retain short fruiting wood in the upper portions of the canopy. If tree height becomes excessive cut the top down to a horizontal branch that has fruiting spurs on it.

Central Leader (Dwarf Trees)

At Planting

Remove all scaffolds below 18 inches, flush to the trunk. Trees with less than 3 branches should be headed at 30 inches and all feathers removed with a bevel or Dutch cut. Attach trees to the support system as soon as possible. Trees with 3 or more branches offer three options depending upon the vigor of the scion and rootstock. Always remove any scaffolds that are more than 1/2 the diameter of the central trunk. The alternatives in order of low vigor to high vigor are:

Option 1: Head leader 10 to 12 inches above the uppermost branch and all branches by 1/3.

Option 2: Head leader 10 to 12 inches above the uppermost branch and DO NOT head the side branches.

Option 3: DO NOT head leader or side branches.

1st Growing Season

May: Rub off 2 or 3 competing buds below the chosen leader if you headed the tree back at planting.

June: Clothespin new shoots when they are as long as, or just longer than, the clothespin. (Remember to remove clothespins in August.)

2nd Leaf

DO NOT head the central leader. Select 3 to 5 first tier scaffold branches of moderate vigor with wide crotch angles, and remove the rest. Care should be taken to attain good spacing of branches around the trunk, both radially and vertically. Scaffold branches that are evenly distributed around the tree will assure even light distribution, and scaffolds that are spaced out vertically will assure that leader dominance is maintained. If additional scaffolds are needed, notch above desired buds in the late dormant season (4 to 6 weeks before bud break), or apply Promalin mixed with latex paint.

June: Position permanent scaffolds at a 50 to 75 degree angle from vertical, utilizing spreaders, weights, elastics or string.

3rd Leaf

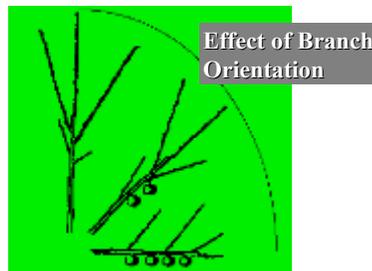
Head the central leader, removing 1/2 to 1/3 of previous year's growth. Thin out overly vigorous limbs that are of no use.

June: Position permanent scaffolds at a 50 to 75 degree angle from vertical, utilizing spreaders, weights, elastics or string. When 3 to 6 inches of new growth has developed in the top 1/3 of last year's central leader, select shoots to be the second tier scaffolds. Pinch out the most and least vigorous shoots leaving 3 to 4 of moderate vigor. Clothespin these second tier scaffolds to obtain wide crotch angles.

4th Leaf

DO NOT HEAD THE LEADER. Prune out only overly vigorous limbs that are of no use.

June / July: Position first tier scaffolds at a 50 to 75 degree angle, and position second tier scaffolds horizontally utilizing spreaders, weights, elastics or string. Position overly vigorous limbs below horizontal.



5th and Succeeding Years

DO NOT HEAD THE LEADER until it has bent over with a crop. Maintain good light distribution by making a minimal number of thinning cuts. Continue to position scaffold limbs with spreaders until this function is replaced by the weight of a crop. Shorten bottom tier scaffolds by pruning back to a side branch. Shorten pendulant branches back to a more horizontal position. Summer prune as needed in August to maintain light interception.

Final Leader Height

The ideal situation is that the leader will bend with a crop to restrict the tree height. This is termed the "crop and flop" method. However, in some cultivars the leader does not bend and the tree continues to grow upward. If this occurs you can cut the leader back to a lower, more horizontal branch but only do so after the upper portion of the tree has fruited.

Tall Spindle

At Planting

Plant highly feathered trees (10 to 15 feathers) at a spacing of 3 to 4 feet by 11 to 12 feet. Adjust graft union to 6 inches above soil level. Remove all feathers below 24 inches using a flush cut. Do not head the leader or the feathers. Remove any feathers that are larger than 2/3 the diameter of the leader.

1st Growing season

At three- to four-inches of growth: Rub off the second and third shoots below the new leader shoot to eliminate competitors to the leader shoot.

May: Install a three- to four-wire tree support system that will allow the tree to be supported to 3 meters. Attach the trees to the support system with a permanent tree tie above the first tier of feathers, leaving a 2-inch diameter loop to allow for trunk growth.

Early June: Tie down each feather that is longer than 10 inches to a pendant position below horizontal.



Use of weights to bend branches Buds formed when branches were weighted down

2nd Leaf

Dormant: Do not head leader or prune trees.

Make sure the leader is securely fastened to the support wires or conduit.



4 to 6 inches growth: Pinch the lateral shoots in the top 1/4 of last year's leader growth, removing about 2 inches of growth (the terminal bud and four to five young leaves).

Early June: Hand-thin the crop to single fruit four inches apart (you should target 15 to 20 fruit per tree).

Mid June: Re-pinch all lateral shoots in the top 1/4 of last year's growth. Tie the developing leader to the support system with a permanent tie.

3rd Leaf

Dormant: Do not head the leader. Remove all broken branches by making a heading back or renewal cut to a spur. Remove overly vigorous limbs that are more than 2/3 the diameter of the leader using a bevel cut.

Late May: Chemically thin according to crop load, tree strength, and weather conditions; then follow up with hand thinning to the appropriate levels to ensure regular annual cropping and adequate fruit size (target 50 to 60 fruit per tree). See Table 1 below.

June: Tie the developing leader to the support system with a permanent tie.

August: Lightly summer prune to encourage good light penetration and fruit color.

4th Leaf

Dormant: Do not head the leader. Remove overly vigorous limbs that are more than 2/3 the diameter of the leader using a bevel cut.

Late May: Chemically thin and follow up with hand thinning to the appropriate levels to ensure regular annual cropping and adequate fruit size (target 100 fruit per tree). See Table 1.

June: Tie the developing leader to the support system with a permanent tie at the top of the pole.

August: Lightly summer prune to encourage good light penetration and fruit color.

Fifth to Twentieth Leaf

Limit the tree height to 90% of cross row spacing by cutting the leader back (after it "crops and flops") to a fruitful side branch. For example if the cross row spacing is 11 feet, $11 \times 0.9 = 9.9$ or 10 feet. Annually, remove at least two limbs, including the lower tier scaffolds that are more than 2/3 the diameter of the leader using a bevel cut. Columnarize the branches by removing any side branches that develop. Remove any limbs larger than 1 inch diameter in the upper 2 feet of the tree. On varieties like Gala, McIntosh, Delicious, and Golden Delicious if shoots start to taper down to smaller than pencil size diameter head them back to where they are pencil size, preferably to a slightly upright growing shoot or spur.

Table 1. Number of Fruit to Leave on Either Biennial or Annual Bearing Cultivars

Trunk Diameter (inches)	No. of Fruit to Leave	
	Biennial	Annual
0.75	11	17
1.00	20	30
1.25	32	48
1.50	46	68
1.75	62	93
2.00	81	122
2.25	103	154
2.50	127	190
2.75	153	230
3.00	182	274

Measure the diameter of the trunk at a distance of 1 foot from the ground. Find the nearest diameter in the table and follow it across to read the number of fruit that should be left.

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