

Pruning and Training Deciduous Fruit Trees

So where are we going and how will we get there? In a nutshell, fruit tree growing is about striking a balance between vegetative vigor (having enough tree) and fruitfulness. Thus we are headed toward a tree that is size manageable (8-12 feet tall) and has a relatively permanent structure of branches that are mechanically sound and self-supporting. Ideally, the tree carries both a good quantity and quality of fruit each year. Such a tree should fill the space allotted for it (and fill it quickly) but not overflow it.

This idealized tree or set of trees should embody the two critical components of sunlight management: interception and distribution/infiltration. This article addresses how to use pruning and training to achieve this goal, specifically with the Open Center tree form.

INTERCEPTION

Again, the goal is to have enough tree structure with well-spaced branches projected up and outward to support good leaf area. Optimal leaf area intercepts enough direct sunlight to achieve maximum photosynthesis in order to manufacture carbohydrates (mostly sugars) and growth hormones. These carbohydrates and hormones are used to first grow a tree—root, shoot, leaf and branch—and when the tree's structural needs have been satisfied, to make quality fruit. Remember, fruit is produced largely from one source—the sun. So, *fiat lux*—"let there be light."

DISTRIBUTION/INFILTRATION

In order to make and maintain quality fruit buds, 50-80 percent direct sunlight needs to strike all portions of a tree. Sunlight doesn't naturally move more than 3 to 4 feet into a canopy. At 3 feet into a canopy, light can be reduced by as much as 60 percent. Thus, good interior sunlight distribution relies on a tree form that arranges branches so as to create shafts or chimneys of light into the tree's interior. Such forms reinforce that old fruit tree grower's pseudo-haiku/axiom, "The more light you intercept, the more fruit you get."

The path to getting there is to grow trees to articulated, proven forms:

- Open Center
- Modified Central Leader
- Slender Spindle/Vertical Axe
- Espalier, etc.

The primary tools used to achieve this aim are training and pruning.

TRAINING

Tree training is simply the manipulation or bending of a branch. A branch may be moved up, down, or horizontally. Upright growth is vegetatively vigorous. As a branch ages, the weight of wood and fruit bend it toward horizontal. As the branch bends, hormonal processes slow extension growth and increase fruiting.

"Pruning is a useful skill. In that way it's a lot like driving – but if you don't know where you're going and how to get there, it doesn't do you much good..."

– Jim Rider, preeminent Pajaro Valley organic apple grower

FOR THE GARDENER

Lowering or bending a branch towards horizontal using weights or a tie-down (string and stakes) will keep a tree in its allotted space and hasten the time of fruiting. The moving of branches horizontally also spreads and distributes branches evenly around the 360 degrees of the trunk and allows better sunlight distribution within the tree. It is better to think of training and pruning in tandem, in both summer and winter, to achieve balance as per fruiting and growth, and to achieve the optimal tree form.

PRUNING

Pruning can be thought of as a conversation or dialogue with a tree over time. More simply put, pruning is the adjustment (shortening) or eliminating of a branch. The purpose of pruning is to regulate size and form and to direct growth for the purpose of balancing fruiting and vegetative growth. It implies a well thought out, rational, purposeful cutting.

Although there are no strictly right or wrong approaches to pruning, it is important to prune with a plan, a few simple goals, and a clear sense of the trees' intended form. This is important because function (balanced growth and fruiting) follows form. Pruning is a linear, logical process. You should be able to justify every cut you do or don't make. Again, the goal of pruning is to create a logical, permanent branch framework with good branch exposure to sunlight, on which quality fruit is borne.

In order to prune purposefully, it is important to understand the different types of cuts, their effect on tree growth, and when to employ them.

Winter pruning is invigorating and stimulates branch extension in the following growing season. As such, it is used to establish trees and tree forms:

- number of branches
- length of branches
- direction of branches

Summer pruning dwarfs a tree. Thus, it is used to tone down growth once a tree is established. It is also used to induce rapid fruit bud development on lateral branches.

With young trees, the goal of pruning is to shape and establish tree form and structure. As a tree matures, the goals of pruning are to control tree height, canopy volume, and to maintain shafts of light into the center of the tree.

There are two types of pruning cuts: Heading cuts, which stimulate extension growth, and thinning cuts, which eliminate branches (often the 4 Ds—dead, damaged, diseased and disoriented).

There are also 3 categories of heading cuts (in winter pruning):

- heading: creates and stimulates branch growth
- shortening: stops further branch development
- renewing: regrows a branch

Heading Cuts: The term "heading" refers to cutting back a branch a portion of its previous season's growth (1 year old wood). Heading cuts (in winter) stimulate branch growth in the following growing season. The specific nature of the stimulation is: the topmost remaining bud on a branch is stimulated to grow and extend the branch. The next few buds down the branch will break from dormancy and grow as weak/moderate lateral branches ("laterals"). As almost all species of fruit bear almost all of their fruit on laterals, it is easy to quip, "laterals are our friends." On most species, these laterals will grow vegetatively the first year and begin to fruit the 2nd or 3rd year.

When heading back a branch, the magnitude of the growth response is directly proportional to the amount the branch is cut back: the harder the cut, the longer and stronger the response. Note: most species of fruit only bear fruit on two year and older wood. Pruning stimulates new growth, thus delaying fruiting—basically, trees try to grow back what was pruned off in an effort to reestablish root/shoot equilibrium. Your task is to control how much growth, where, and in what direction. As a set of examples:

- An unpruned branch will grow minimally (often only inches) and set up fruit on the limb
- A light pruning cut (less than 25% of the previous season's growth) will generate a weak response (< 1 ft)
- A moderate pruning cut (25%-50% of the previous season's growth) begets a moderate response (> 1 ft)
- A heavy pruning cut (>50% of the previous season's growth) causes a strong growth response (>2 ft)

Pruning with moderate heading cuts begets more overall growth: a longer primary branch with a number of fruiting laterals. It also delays fruiting for at least 2 years. However, when this branch complex does fruit, it will have more fruit than the unpruned branch. Another dividend of pruning is that it thickens and strengthens branches.

In a sense then, there is only one operative question to ask (and answer) when looking at a branch: Do I want it to grow more? If the answer is yes, prune it with a heading cut. If the growth goals are high, head it back a lot. If the growth goals are minimal, head it lightly.

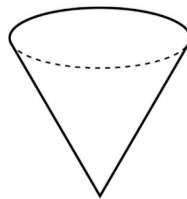
Shortening Cuts: A shortening cut involves cutting back an established branch (> 5 years old) slightly into older wood. This tends to stop further extension growth. It is used when a branch has filled its allotted space.

Renewal Cuts: Another category of heading cut is the renewal cut. It involves cutting a mature branch (>7-8 years old) back radically to a stub (4-10" long). It is used when a branch is too long and is shading other branches. This extreme cut regrows the branch, albeit in a weaker manner over the course of 4-5 years. It should be employed sparingly.

Thinning Cuts: The other basic cut is the thinning cut, which completely removes an entire branch at its point of origin. There should be no regrowth. These cuts are used to eliminate overly vigorous, misplaced, or shading branches as well as exceedingly weak branches. There is no stimulating effect from a thinning cut as there is no branch remaining to grow back. If unexpected new shoots appear, thin them immediately.

OPEN CENTER TREE FORM

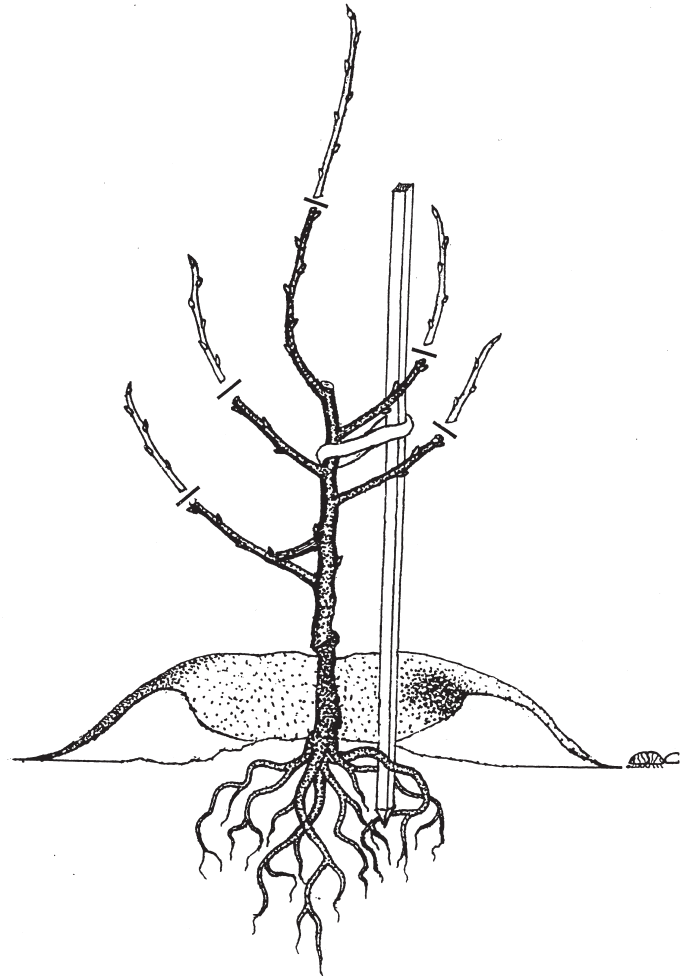
The open center tree form mimics the geometry of a cone, with a wide circular top and a relatively narrow base. For the open center form, think "big sun cup." Fill the cup with sunshine and fill your life with fruit.



In general, this form is a "looser" training system than leader forms (e.g., the modified central leader or vertical axe, mentioned above). It is more about filling space appropriately than adhering to a strict, sculpted form. With open center trees, often more primary branches are retained early in a tree's life and subsequently thinned out as a response to light infiltration within the canopy. Remember: Light does not penetrate more than 3-4' into the canopy, so shafts of light need to be created via pruning and training.

The open center form is usually the form of choice for stone fruits (peaches, apricots, plums, etc.) and can be used with pome fruits (apples and pears) along with the various leader forms. While easy to understand and execute, the open center form has less fruit-bearing surface compared with leader forms. At maturation, the tree tends to "umbrella out," the result being—

- shading the bottom of the tree
- shading neighboring trees, and
- loss of vigor in the top of the tree



Pruning and training a tree to an articulated, proven form will allow more sunlight infiltration, resulting in more fruit. Illustration by José Miguel Mayo.

A well-formed open center tree consists of 3-5 primary branches (multiple leaders) arising from the trunk at 18-30" above the ground. These primaries should grow (or be trained) up and outward at an angle of 60-75° above horizontal. They should be of equal vigor and be spaced evenly, radially around the trunk. They may feature Ys or forks to increase bearing surface.

The last component of form is the lateral, fruit-bearing branch structure. Laterals, or "fruit hangers" as peach growers refer to them, should be short (6-15"), stout/strong (mechanically), moderately flat and weak (as pertaining to vegetative vigor). They should be perpendicular to the primary branch; spaced 6-10" apart, vertically; and summer pruned (not winter pruned) on pome fruits.

The open center tree form facilitates light penetration to all parts of the tree: a young tree (top) and a mature tree with 4 primary branches (see page 4).



Open Center tree. Illustration by Noah Miska.

CREATING THE OPEN CENTER TREE FORM

Select a good caliper (>1/2" diameter) tree, either a whip (unbranched trunk) or branched tree. If using a branched tree, it should have a number of vigorous lateral branches.

If using a whip, after planting, head the whip at 18-30" above the soil level. A number of buds below the cut should "push" and develop into branches. Select 3-5 of these and proceed as per the branched tree. The primary difference between a whip and a good branched tree is generally 1-2 years' worth of growth. The more developed the tree is at planting, the sooner it will become established and start fruiting.

If using a branched tree to create an open center, thin out the leader. Then select 3-5 of the strongest branches as your primaries, thinning all other branches. The primaries you select should be equally distributed around the 360° of the trunk. If they are not, train them into place using nylon string and a well-driven stake. The branches should be growing up and outward at an angle of 60-75° above horizontal.

It is critical that the multiple leaders of an open center tree be of the same vigor and positioned at the same angle. Cut these branches back (head them) 1/4 to 1/2 of their length to an outward (under) facing bud. Think of the top bud on the branch as a directional arrow; the branch will grow in the direction the bud is pointing.

During the first growing season, "micro-manage" multi-leaders by training them slightly up, down, or sideways. Check them monthly. The goal is equal growth at a 60-75° angle. Both narrow and wide branch crotch angles are inherently weak and may cause the mature fruit-bearing branch to snap. The desired crotch angle at the base of a branch is 40-60°. If the angle is too narrow, it can be increased by gently inserting a wooden clothespin, a toothpick, or a 2-3" V-notched piece of lathe.

At the end of the first growing season, (winter-dormant pruning), head back the 3-5 primary scaffold branches about 50% of their season's growth. This should be done proportionally to vigor; the weakest branches are cut back the most and vice versa.

These primaries can be cut back to two opposing buds. As they grow into branches in year two, they will form a Y or fork. Do not allow any other buds to form additional strong branches. This forking can be repeated in years 2-4. The net result of forking is to increase the fruit-bearing surface of a tree. This must not be done at the expense of excluding light from the lower portions of the tree.

The training and winter heading cuts are repeated in subsequent years until the tree has reached the size allotted for it. At that juncture, heading cuts cease and shortening cuts are employed.

The lateral fruit-bearing branches that occur on the primary branches are trained towards horizontal and perpendicular to the primary branch. They are not winter pruned, but rather summer pruned to limit growth (see the "Summer Pruning" *For the Gardener* article).

—Orin Martin

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