

Pruning Basics

Fruit growers are constantly manipulating tree canopies to maximize fruit production. This is done in two ways: by pruning to remove limbs or shoots or by bending limbs or shoots in specific orientations.



Pruning and training are two different aspects of modifying naturally occurring growth patterns. Training involves tree development and form, whereas pruning involves tree function and size.

Pruning and training are horticultural manipulations done to modify naturally occurring growth patterns within plants. The primary processes being modified are apical dominance (see below) and the natural flowering and/or fruiting characteristics of the trees.

The first point to remember is that pruning is a dwarfing process.

A pruned tree will always be smaller than a same-aged tree that was not pruned. For pruning to be effective, however, it must be practiced with an understanding of how trees respond to branch or shoot removal and of how those removals affect future tree growth.

The second point to remember is that training affects primarily tree form, while pruning affects mainly function.

Training determines the general character and even the details of the plant's outline and its branching and framework. Pruning is meant to determine how and when the tree will fruit. Therefore, training and pruning are two different aspects

of modifying naturally occurring growth patterns. Training involves tree development and form, whereas pruning involves tree function and size.

Training takes place in the first 4-5 years of the tree's life. Pruning is conducted for the entire life of the tree. In a tree's early productive years, the goal of pruning is to contain excessive vigor. During declining years, pruning's emphasis shifts to promoting vigor and allowing maximum sunlight to penetrate the tree canopy.

Types of pruning cuts

There are two types of pruning cuts, "heading" and "thinning". Thinning refers to removing a limb or shoot at its point of origin along an older branch. Thinning cuts do not induce vegetative growth near the pruning cut and are usually preferred for minimizing tree size and for removing excess shoots. Thinning cuts are also used in older trees as a method of fruiting shoot renewal. When a shoot that fruited the previous season is removed there are buds imbedded in the bark in the collar of the shoot that are released from dormancy and may develop into desirable fruiting shoots for the next year. Heading cuts remove the terminal buds that produce plant hormones that normally inhibit shoots from developing from buds below the terminal bud. Heading a one-year-old section of a shoot encourages shoot development from the two or three buds below the cut. Heading older branches encourages shoot development from buds imbedded in the bark within several inches below the cut. Heading cuts are used to shorten and stiffen branches and to induce branching. Heading cuts are usually limited to the year of planting to induce branches from which scaffolds will be selected. "Bench cuts" are a special type of heading cut where terminal section of a branch is removed just above a side branch. Bench cuts are sometimes necessary to redirect upright-growing branches to the outside, but should be avoided if possible because watersprouts will develop on the flat branch section below the bench cut.



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Impact of flower position

The difference in how a tree or plant responds to these two cuts is the basis for the different training systems. Concurrent with knowledge of how a tree responds to these two cuts is knowing where the particular species produces flowers and fruits. Every bud on a tree is regarded as a potential flower bud; therefore, flowers can occur in many areas. In general, however, they occur (a) terminally on long or short growths, (b) laterally in the axils of the current or past season's leaves, and (c) adventitiously from any point on the exposed bark of limbs, trunks, or roots (rarely).

As a rule, the position of the flower or inflorescence on the shoot relative to the current season's growth is characteristic of the species or cultivar and does not change much. In apples fruit buds are borne terminally, unfolding to produce leafy shoots that terminate in flower clusters. Most of these terminal flowers are on short 2 year and older shoots called spurs. However, they can occur at the ends of long shoots, especially in the "terminal bearers" such as Rome Beauty, Granny Smith and Cortland. Flowers may occasionally also be found as laterals arising on last year's wood. In most instances, in Pennsylvania and the Mid-Atlantic areas, these flowers do not set fruit. When the lateral flowers do set fruit, the resulting apples are usually small and of poor quality. The proportion of spur growth and flowering sites to terminal long shoot flowers is characteristic of a given cultivar and must be assessed when pruning in the field.

Flowering position differs for stone fruits. In peaches and nectarines flowers are borne laterally on the previous season's growth. On healthy trees there are usually 2 single flower buds per node with a single leaf bud in between. The most productive shoots are those that are approximately pencil size in diameter and 12 to 18 inches long. Cherries, plums and apricots produce flowers terminally and laterally on one year old wood and in spurs on older wood.

Apical dominance

Regardless of basic growth habit, all trees respond similarly to a given type of pruning cut. Heading cuts remove the growing point and developing leaves if applied during the summer and the terminal bud if applied during the winter. This operation severely changes the shoot's hormonal balance and forces the plant to react accordingly. The tendency for suppression of the lateral bud break is referred to as the apical dominance of the terminal bud.

This young growing point or terminal bud is the site of manufacture of the class of plant hormones known as auxins. Removing either the shoot tip or the young growing leaves stimulates the growth of lateral buds immediately below the cut into side shoots because of the removal of that site of auxin manufacture. The lateral buds are inhibited in growth by auxins produced in the young meristematic tissues contained in the shoot tip and transported back downward. This effect must occur when the leaves are very young because removing young, developing leaves can stimulate lateral bud break; but removing fully expanded leaves cannot stimulate growth.

There are two ways to overcome this apical dominance effect from shoot tips. One is to remove the shoot tip as in a heading cut and the other is to bend a shoot tip to a more horizontal position. The latter works because auxins generally move in response to gravity.

Research has suggested that the inhibition of flower bud formation can be explained by the alteration of three plant hormones: cytokinin, auxins, and gibberellins. All three occurred in higher concentrations in the conductive tissues of trees that were pruned. Cytokinin-like substances were doubled in the conductive tissues at the very beginning of growth in the spring. In mid-June, after a month of growth, auxin levels were much higher in pruned trees than in nonpruned trees. This was followed by higher levels of gibberellins from the middle of June to the end of July in the pruned trees, compared to controls.

Trees given no pruning

When growth begins, the terminal and subterminal buds are usually the first to start; in most deciduous trees and vines (less so in shrubs) they produce the longest and strongest shoots, although shoots may grow from many of the lower buds. However, seldom do all the lateral buds start, and as a rule the largest percentage of those remaining dormant are on the basal portion of the shoot.

Response to heading cuts

The result of a heading cut is the loss of apical dominance as mentioned above, with the removal of the inhibiting effect on the lateral buds. The net result is an increase in total shoot growth. Both shoot number and length are affected, but the impact is affected by shoot age, severity of cut, growth habit, and shoot orientation.

Shoot age

The stimulation of shoot growth is most pronounced when heading cuts are made into 1-year-old wood. Such cuts usually result in very vigorous shoots from the three to four buds immediately below the cut. These shoots can develop very narrow angles. Heading cuts made near the top of these shoots induce the top five to seven buds to grow, usually within 6 to 9 inches below the cut (although this will also vary by severity of cut and orientation of the branch).

Severity of cut

Severity can be long, medium, short, or very short (with a very short cut removing the most wood). Regrowth is related to the severity of cut in a bell curve response and time of season that pruning is done. Strong shoots have well-developed buds along the upper three-fourths of the shoot. At the shoot base, however, the buds normally are not as well developed. This difference may explain why the strongest regrowth usually occurs when shoots are headed by one-half to three-fourths their length. At the same time, heading back close to the annual ring (where growth began or very short will likely lead to less regrowth. The results of dormant shoot heading thus are influenced by the condition of the bud that becomes uppermost after heading. Heading cuts made in the dormant season stimulate the most regrowth, while those made late in the summer stimulate less regrowth.

Heading into older wood is not as invigorating as cuts made in 1-year-old wood. Nevertheless, it still increases total shoot growth.

Growth habit

Researchers have classified apple cultivars into four general growth and flowering habits. They use the terms acropetal or acrotonic to describe cultivars that we call tip bearers, such as Rome Beauty or Granny Smith. At the opposite end of the spectrum are basipetal or basitonic cultivars. These produce mostly spur growth and are typified in the extreme by Redchief, the Campbell strain of Delicious. Lightly heading back basitonic cultivars (spur Delicious types) does not generate as much vigorous shoot regrowth as heading back those that do not have a strong spur growth habit. Heading back the acrotonic (weeping) growth habit cultivars increases regrowth to a greater extent and also reduces flower bud formation.

Shoot orientation

Regrowth response is also affected by a shoot's orientation from the horizontal. The more upright the shoot, the greater the regrowth. Generally, heading cuts into upright shoots in the 2-4 buds immediately below the heading cut produces shoots that have a very narrow angle and that are very vigorous. These vigorous shoots create undesirable shade and have very low fruiting potential.

Not all heading cuts are detrimental to a tree, however. In some instances heading cuts are needed to stimulate growth to keep a tree in balance. They should be used to stimulate lateral growth and branching. Heading cuts should also be made to shorten and to stiffen branches. These cuts are necessary when a cultivar tends to produce too much fruit on the end of branches. In peaches, owing to the site of flower production, heading cuts are a necessity.

Response to thinning cuts

Thinning cuts primarily are used for two purposes: (1) to increase light penetration and (2) to remove competing or crowding shoots or limbs. Vigorous shoot growth may develop in the immediate vicinity of the pruning cut, but the effect on adjacent parts of the tree is minimal. Thinning cuts do not change the relationship of various parts of the shoot or branch to each other as heading cuts do, because either the entire shoot or the branch is removed or left intact. The ratio of terminal to lateral buds is largely undisturbed, and as a result, thinning cuts do not increase shoot growth as much as heading cuts. Thinning cuts also reduce flower formation less and can increase flowering when better light penetration is achieved. Yield is reduced only to the extent that the bearing surface is removed and is not reduced because of invigorating buds to form shoots rather than flowers.

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Contact Information

Robert Crassweller

Professor of Tree Fruit

rnc7@psu.edu

814-863-6163

extension.psu.edu

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