



MASTER GARDENER
COLORADO STATE UNIVERSITY
EXTENSION

CMG GardenNotes #612
Pruning Cuts

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A pruning cut may or may not predispose the tree to internal decay and cracking, depending on the type of cut used, technical precision of the cut, size of the branch removed, species, and general health of the tree. For details on tree growth and decay, refer to *CMG GardenNotes* #611, Tree Growth and Decay.

In pruning, there are three primary types of pruning cuts, **removal (thinning) cuts**, **reduction cuts** and **heading cuts**, each giving different results in growth and appearance.

Note: In this publication, the term “trunk” refers to the trunk or parent branch, and “side branch” refers to the adjacent side branch arising from the trunk (parent branch). The same relationship exists between a side branch and secondary side branch.

Maximum Diameter of Pruning Cuts

Sapwood, the living cells in the newer xylem rings active in water transport and storage of photosynthates, is resistant to decay. On branches two inches and less in diameter, sapwood dominates the branch structure making the branch resistant to decay. In a removal type cut, **woundwood** (the callus tissue that grows over pruning cuts or wounds) quickly grows over these small pruning cuts.

Heartwood, the older xylem rings no longer active in water transport, has no resistance to decay. Due to chemical changes in these nonliving cells, heartwood is often darker in color. Depending on species and growth rates, heartwood becomes significant as branches reach two to four inches in diameter. At approximately four inches, heartwood dominates the branch structure, and the branch becomes highly susceptible to decay organisms and internal cracking. [Figure 1]

Figure 1. Cross section of a Douglas-fir. The light colored outer ring of wood is the sapwood. The dark wood in the center is the heartwood.



In an ideal world, all pruning cuts would be two inches in diameter or smaller. This small size is especially important on tree prone to decay (a factor of species and tree vigor). On tree species resistant to decay, with good vigor and without growth limiting factors (such as severe soil compaction or drought stress), the two-inch or less standard may be pushed to 2-4 inches. [Table 1]

Table 1. Tree Species Prone/Resistant to Decay	
Weak Compartmentalizers Prone to Decay	Strong Compartmentalizers Resistant to Decay
<ul style="list-style-type: none"> ○ Beech (<i>Fagus</i> spp.) ○ Birch (<i>Betula</i> spp.) ○ Cherry, Peach, Plum and other <i>Prunus</i> spp.) ○ Crabapple (<i>Malus</i> spp.) ○ Hackberry (<i>Celtis</i> spp.) ○ Horsechestnut and Buckeye (<i>Aesculus</i> spp.) ○ Maples (some <i>Acer</i> spp.): Norway, Silver ○ Oak (some <i>Quercus</i> spp.): Pin, Shumard ○ Poplar, Cottonwood, & Aspen (<i>Populus</i> spp.) ○ Redbud (<i>Cercis</i> spp.) ○ Willow (<i>Salix</i> spp.) 	<ul style="list-style-type: none"> ○ Black Locust (<i>Robinia pseudoacacia</i>) ○ Catalpa (<i>Catalpa</i> spp.) ○ Elm, American (<i>Ulmus Americana</i>) ○ Honeylocust (<i>Gleditsia</i> spp.) ○ Hornbeam (<i>Carpinus</i> spp.) ○ Maples (some <i>Acer</i> spp.): Red, Sugar ○ Oak (some <i>Quercus</i> spp.): Bur, English, Live, Northern Red, White ○ Pine (some <i>Pinus</i> spp.) ○ Walnut (<i>Juglans</i> spp.) ○ Yew (<i>Taxus</i> spp.) <p>Note: Will lose resistance with stress factors such as severe soil compaction, drought, hardscape over rooting area, etc.</p>

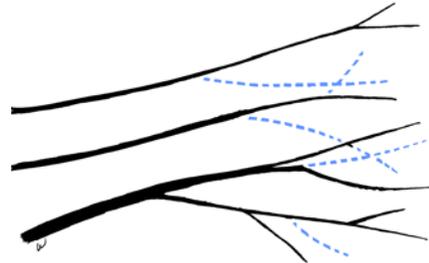
However, we don't live in the ideal world. Sometime larger diameter cuts are needed. Any pruning cut four inches and larger needs to take into account the increased risk for failure and reduced health associated with internal decay and cracking. Cuts on large branches often create new problems with high potential for failure!

Removal Cuts

Removal cuts (also known as thinning cuts or collar cuts) remove side branches back to the larger parent branch or trunk. If the branch union has a branch collar, removal cuts have the advantage of preserving the *branch defense zone*, providing a strong defense against internal decay.

Removal cuts reduce the canopy density but have little influence on height. Thinning with removal cuts allows better light penetration into the canopy, which encourages desired growth of interior branches. This improves trunk taper and increases the general vigor of primary branches and the trunk. Removal cuts reduce the weight on large branches, giving the tree resilience to snow loading. The primary use of removal cuts is in structural pruning of small, middle-aged and older trees and on shrubs.

Figure 2. Removal cuts eliminate a side branch back to the trunk or parent branch.



Two features on the branch, the *branch collar* and the *branch bark ridge*, help identify the proper cut angle. The **branch collar** is the area where the annual growth rings of the trunk fold in between the annual growth rings of the side branch, in a manner similar to shuffling a deck of cards. On some species, the branch collar is readily noticeable, while on other species the branch collar is less obvious. [Figure 3]

The **branch bark ridge** is where the bark from the trunk joins the bark from the side branch. It looks like a dark line or small mountain range extending out from the crotch down both sides of the trunk/branch. It mirrors the angle of attachment of the side branch. [Figure 3]

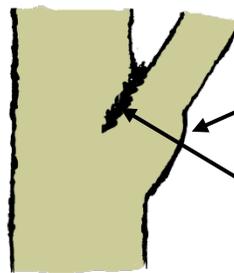


Figure 3. Branch collar and branch bark ridge.

Branch Collar

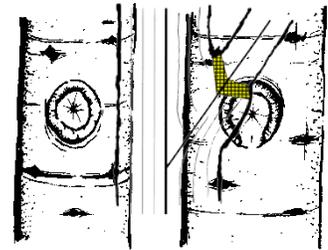
Trunk tissues overlap with side branch tissues

Branch Bark Ridge

Trunk bark meets side branch bark

Within the branch collar is a narrow cone of cells called the **branch defense zone**. These cells activate the growth of **woundwood**, the callus tissue that grows over the pruning cut. With a proper cut, the woundwood grows out from all sides in a donut shape over the wound. If the branch collar is nicked, the woundwood does not grow from that point. It is common to see a pruning cut where the woundwood fills in only from two sides, indicating that the top and bottom of the branch collar were injured. [Figures 4]

Figure 4. Branch Defense Zone – Within the branch collar is the branch defense zone, a narrow ring of cells that effectively initiates a strong reaction in which chemical changes protect the trunk from decay. If the branch collar is cut or nicked in pruning, the defense zone may fail, predisposing the wound to decay.



The branch defense zone also plays an important role in activating a strong reaction zone inhibiting the spread of decay organisms into the trunk. If the branch collar is injured or removed during pruning, the branch defense zone will fail, limiting the growth of woundwood and predisposing the cut to decay. Thus, a primary objective in a correct removal cut is to preserve the branch collar intact.

With a *removal cut*, the final cut should be just beyond the branch collar.

Because the woundwood that grows over the pruning cut originates in the branch defense zone, it is imperative that the branch collar not be cut or otherwise injured in pruning. To eliminate error, cut a little beyond the collar region (i.e., 1/8 inch for small-diameter twigs and 1/4 inch for larger branches). [Figure 5]

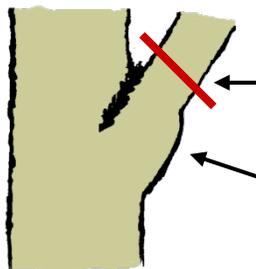


Figure5. Removal Cut

Final Cut made just outside the branch collar, taking care not to nick the branch collar.

Branch Collar

Trunk tissues overlap with side branch tissues

In species where the branch collar is not clearly identifiable, look for the branch bark ridge. Make the final cut at the angle that mirrors (lies opposite) the angle of the *branch bark ridge*. [Figure 6]

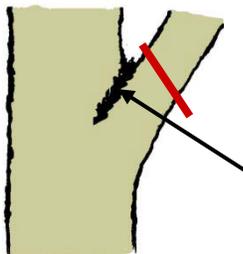


Figure 6. When the branch collar is not clearly identifiable, make the final *thinning cut* at the angle that mirrors the angle of the *branch bark ridge*.

Branch Bark Ridge

When a branch union has no branch collar (the side branch is greater than half the diameter of the adjacent trunk), tilt the angle of the final cut out a little more to minimize the size of the wound. Be aware that in the absence of a branch collar there is no branch defense zone to activate rapid woundwood growth and activate a strong reaction to suppress the potential for decay. (Fig.7.)

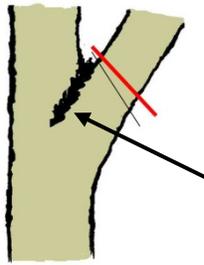


Figure 7. When the branch union has no branch collar (the side branch is greater than half the trunk diameter), tilt the cut angle out a little more to reduce the diameter of the cut wound.

Branch Bark Ridge

When removing a dead branch, the final cut should be just outside the branch collar of live bark tissue. If a collar of live wood has begun to grow out along the dead branch, remove only the dead stub, leaving the collar intact. Do not cut into living tissues. [Figure 8]

Figure 8. When removing a dead branch, do not cut into or otherwise damage the branch collar or woundwood growing around the dead branch.



Reduction Cuts

Reduction cuts remove a larger branch or trunk back to a smaller-diameter side branch. Reduction cuts are commonly used in training young trees. They are also the only type of cut that will significantly lower a tree's height.

However, reduction cuts do not have a *branch defense zone*, leaving the branch with a weak defense against decay. This is not a major concern on young, actively growing branches. However, reduction cuts are discouraged on mature trees and on limbs larger than two inches in diameter. On trees under stress or in decline, avoid reduction cuts as they can accelerate the decline.

In a reduction cut, make the final cut to bisect (split the difference) between the *branch bark ridge* angle and an imaginary line perpendicular to the stem being removed. Alternatively, the angle could be tilted up a little more to perpendicular to reduce the size of the wound. The exact angle is not critical as long as it is not flat on top (water needs to readily run off). [Figure 9]

To prevent undesired suckering at this point, the diameter of the smaller side branch should be at least one-third (preferably one-half) the diameter of the larger branch being removed. If the diameter of the smaller branch is less than one-third the diameter of the larger branch being removed, the cut is considered a heading cut and is generally unacceptable in pruning standards. [Figures 10 and 11]

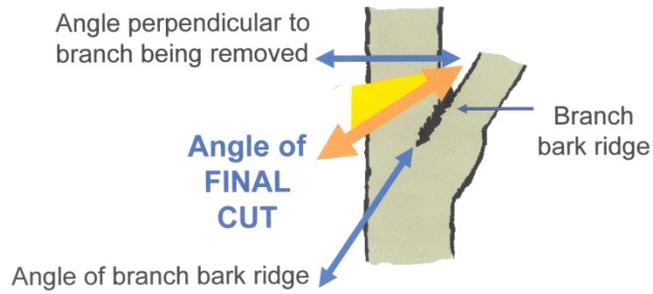


Figure 9. Reduction Cut – When pruning back a larger branch to a smaller branch, the angle of the final cut should split the difference between the angle of the *branch bark ridge* and the angle perpendicular to the branch being removed.

Figure 10. To prevent excessive suckering, the smaller branch should be at least one-third the diameter of the larger branch.

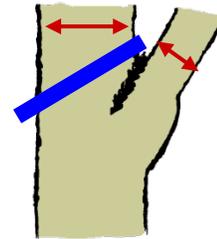
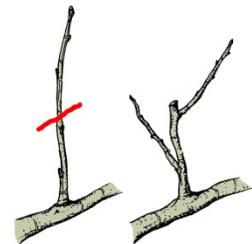


Figure 11. This adventitious sucker growth from a reduction cut is structurally unsound and prone to storm damage as it grows.

Heading Cuts

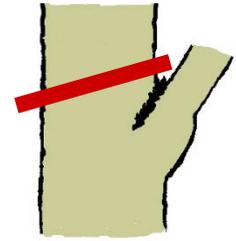
Heading cuts remove the growing tips of branches. This releases the side buds to grow, resulting in more dense growth at the point of pruning. [Figure 12]

Figure 12. Heading cuts remove the growing tips of branches, releasing side buds to grow.



Another type of undesirable heading cut is the removal of a large trunk/branch back to a smaller side branch when the side branch is less than one-third the size of the larger trunk being removed. Structurally unsound water sprouts often emerge along the branch, and the tree may become more unsound than before the pruning. [Figure 13]

Figure 13. Removing a larger trunk or branch back to a small side branch when the side branch is less than one-third the diameter of the adjacent trunk is also considered a heading cut. This leads to structurally unsound growth of water sprouts and is not considered an acceptable pruning cut.



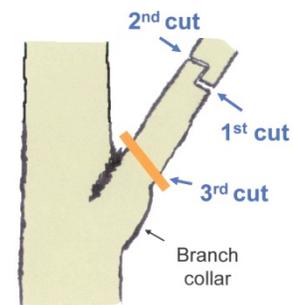
Heading cuts are undesirable for most pruning objectives on shade trees. Topping a tree with heading cuts gives a surge of new branch growth at the tree's top. The new growth is often structurally unsound and prone to storm damage. Growth in the tree's interior thins out from increased shading, decreasing the tree's overall health and vigor.

On shrubs, heading cuts or "shearing" creates a very dense upper/outer canopy that shades out the lower/inner portion, creating a woody base.

Three-Cut Method for Larger Branches

When removing any branch larger than one inch in diameter, use a three-cut method to protect the bark from tearing. [Figure 14]

Figure 14. Three-cut method for any branch larger than one inch.



- Cut 1. Coming out 12 to 15 inches from the branch union (crotch), make an undercut approximately one-third to halfway through the branch.
- Cut 2. Moving a couple of inches out past the first cut, make the second cut from above, removing the branch. This double-cut method prevents the weight of the branch from tearing the bark below the collar.
- Cut 3. Make the third and final cut at the correct pruning point. For example, on a *removal cut*, just outside the branch collar. For *woundwood* growth, take extra caution not to cut into or otherwise injure the branch collar.

Wound Dressings

Wound dressings do not prevent decay organisms from moving in. In fact, the older, tar-type dressings actually interfere with the natural *woundwood* growth and may create conditions favorable for decay organisms. Generally, leave pruning cuts dry and untreated.

Occasionally a thin layer of water-based dressing or paint may be applied solely for aesthetic purposes. Never use an oil-based paint, tar or other materials that contain petroleum solvents. A dark-colored material over a wound may predispose the wound site to winter injury. When managing diseases such as fire blight, a fungicide/bactericide may be used as a wound dressing.

The key to good wound closure is proper pruning, making a smooth cut just beyond the branch collar, and making all cuts on branches less than two inches in diameter. Trees under stress (soil compaction, drought, overly wet soils, insect or disease problems, lawnmower damage to the trunk, etc.) are less capable of fighting the invasion of decay organisms.

Time of Year to Prune

Dead, diseased, and damaged wood can be removed any time of year as needed.

When it comes to removing live wood, there are better times of year for pruning. Light pruning—up to 10% of the foliage—may generally be done any time of year on healthy trees without stress factors.

Late winter—Pruning in the late dormant season (before buds swell) is considered the routine pruning time on many tree species. However, some species are prone to bleeding if pruned in the spring. While this is more of a cosmetic issue than a health issue, most arborists avoid pruning bleeders in the late dormant season. [Table 2]

Table 2.
Examples of Trees Prone to Spring Bleeding

Birch	Kentucky coffeetree
Black locust	Maple
Elms	Mulberry
Goldenchain tree	Poplar
Hackberry	Walnut
Japanese pagodatree	Willow

Spring, during growth flush, is generally considered an undesirable time to prune trees. The bark and cambium tissues are easily damaged. Pruning may stimulate excessive watersprout growth or reduce overall vigor.

Midsummer, following growth flush (as leaves reach full size, harden and turn dark summer green) is considered an excellent time to prune. It is the preferred time for spring bleeders. It may be the best time of year to suppress decay potential.

Late summer to fall is generally considered an undesirable time to prune. It may stimulate canopy growth and interfere with winter hardiness.

Late fall to early winter is generally considered an undesirable time to prune. Extreme cold (below zero) may cause cambium damage near the pruning cut.

Drought – Do not remove live wood from trees in drought stress. This removes stored photosynthates that the tree is living on during the stress.

Pest management consideration – In some insect management programs, pruning may need to be timed before insect flight periods or avoided during insect flight periods.

Pruning Equipment

Hand pruners are used to cut small limbs up to ¼ to ½ inch in diameter (depending on the wood hardness). The bypass or scissor-type pruner (cutting as the blade crosses past the hooked anvil in a scissor action) is considered the best type. The anvil type (cutting as the blade pushes against the anvil) is more prone to tearing and mashing the tissues. The best advice on pruners is to purchase the best pair you can afford. It will last for years. Inexpensive pruners are short-lived.

In using bypass-type hand pruners, place the blade toward the tree with the anvil toward the outside. This allows for a closer cut. For bypass pruners, sharpen only the beveled edge of the blade pointing toward the anvil, never the anvil side of the blade.

Loppers are used for larger branches, generally up to ½ inch in diameter. With long handles, they make quick work of cutting up prunings on the ground.

Pole pruners make poor-quality cuts. They are used to cut small branches out of reach from the ground.

Handsaws are used for branches larger than ½ inch. There are two general types of tree saws. Tree saws with curved blades cut as the saw is pulled and are considered safer to use. Tree saws with straight blades cut as the saw is pushed. To remove the moist sawdust, tree saws have wider teeth spread than lumber saws. In a cut larger than 1 inch, a three-cut method should be used.

Chain saws are extremely dangerous. In the United States 40,000 to 90,000 people have serious injuries, and 40 to 60 are fatally injured each year from chain saw accidents. Most accidents occur to the left leg, the shoulders, and the face. Chain saws should only be used by someone specifically trained in chain saw safety. A common accident occurs when the limb kicks back as the cut is being completed. Personal protective clothing is also needed. Safety glasses and boots are required by law. Helmet, hearing protection, gloves, and leg protection are also recommended.

Authors: David Whiting (CSU Extension, retired), with Alison O'Connor and Eric Hammond (CSU Extension).
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