

CMG GardenNotes #615

Pruning Mature Shade Trees

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When to Hire a Professional Certified Arborist

Pruning large trees is a safety issue beyond the training and experience of home gardeners. Hiring a bonded professional is the best approach for most tree pruning jobs. Look for arborists with certification from the *International Society of Arboriculture, ISA*. Many are listed in the phone book yellow pages and a list of ISA Certified Arborists working in the area can be found on the ISA web site at www.isa-arbor.com. Also, ask about liability insurance coverage.

This *CMG GardenNotes* is written to help the home gardener understand issues around pruning of mature trees and help with communications with their certified arborists.

General Pruning Guidelines

Limitations on Diameter of Cut

Ideally, all pruning cuts are two inches in diameter and smaller. On tree species resistant to decay, the standard could be pushed to two to four inches, maximum (depending on actual vigor and growth of the tree). These small wounds minimize the potential for internal decay. The two-inch diameter and smaller branch is primarily *sapwood* (newer xylem rings of living cells active in water transport and storage of photosynthates) that is not prone to decay.

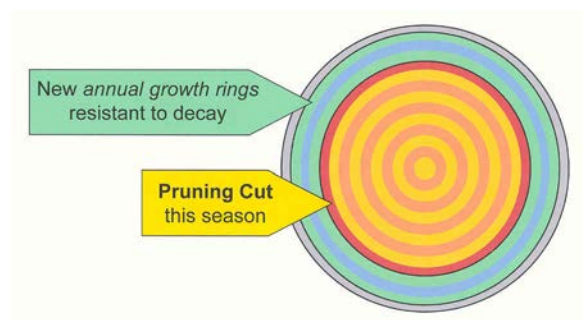
Unless there is a strong justification, (taking into account the potential for a decay column and internal cracking) avoid removing branches larger than four inches in diameter. At approximately four inches, *heartwood* (older xylem rings of non-living cells no longer active in water transport) dominates the branch structure. The branch becomes prone to decay as heartwood has no resistance to the spread of decay and is prone to internal cracking. (Note: Due to chemical changes in the cells, heartwood is often darker in color.) [Figure 1]

Figure 1. Cross section of Douglas-fir. Light colored outer rings are sapwood. The dark wood in center is the heartwood.



When a pruning cut or other injury opens a branch to decay, the decay column will take the current season of xylem ring and everything older. Decay creates a pipe-like structure in the branch. The healthy, undecayed wood will be the xylem rings that grow in future years. [Figure 2]

Figure 2. When injury (such as improper pruning cuts) leads to decay, it takes the current season's xylem ring and everything older (inward). New growth (xylem rings that grow in future years) will be resistant to decay. Decay creates a pipe-like structure.



For example, if a branch with eight-inch diameter xylem (wood) is pruned back to a trunk with 12-inch diameter xylem (wood) and decay results, the decay column in the trunk will be 12 inches wide (that is, the diameter of the trunk wood at the time the injury occurred). The tree would have to add six inches of healthy new growth to meet the minimum standards for structural strength (33% shell). If annual growth rings were ¼" wide, this would take 12 years! For additional information on tree decay and percent shell, refer to *CMG GardenNotes* #611, Tree Growth and Decay. [Figure 3]

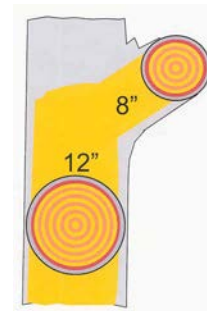
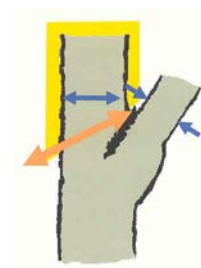


Figure 3. The diameter of the decay column will be the diameter of the current season's xylem ring for the year that injury occurred and inwards. Structural weakness from the decay is offset by the growth of new wood (xylem rings) in future years.

Limitations on Size Relationship with Reduction Cuts

Pruning often involves subordinating side branches or secondary trunks to a more dominant leader. This can only be achieved with **reduction cuts** (removing a larger trunk/branch back to a smaller side branch). In reduction cuts, the diameter of the side branch must be at least one-third the diameter of the trunk/parent branch removed. If the side branch is smaller, it becomes a **heading cut**. [Figure 4]

Figure 4. In reduction cuts (removing a larger trunk/parent branch back to a smaller side branch), the side branch must be at least one-third the diameter of the trunk/parent branch removed. If the side branch is less than one-third the trunk diameter, it is a heading cut. Heading cuts are not acceptable in pruning standards.



A common mistake in lowering branch height is the use of heading cuts, which release waterspout (sucker) growth from the pruned branch. The regrowth will be structurally unsound, resulting in trees that may be more prone to storm damage than before pruning occurred. When pruning maturing trees, heading cuts are not acceptable in pruning standards!

For additional details on reduction cuts refer to *CMG GardenNotes* #612, Pruning Cuts.

Dosage: Maximum Amount of Live Wood / Foliage to Remove

Do not indiscriminately remove branches with live foliage as this can add stress to the tree. **The amount of live wood and foliage to remove per season depends on the actual growth rate of the tree.** Young, actively growing, trees are rather tolerant of a heavy pruning dose. As trees become mature, they become intolerant of heavy pruning. Look at six to 12 branches around the tree to assess growth rates. Look for what is the typical growth rate for most branches, not the fastest or slowest growing branches.

- **Trees under severe stress putting on insignificant annual growth** – Limit pruning to *cleaning* (removal of dead and damaged branches). Live wood should not be removed on trees under severe stress (including drought stress). Heavy pruning simply removes the stored photosynthates that the tree is living on during the stress period!
- On **mature trees** (greater than 75% mature size for the site), pruning dose should be limited to 5% to 10%, based on actual growth and vigor of the tree.
- On **medium aged trees**, the dosage really depends on actual growth. Typical range would be 10% to 25% depending on actual growth and vigor of the tree.

In situations where trees are pruned annually (the ideal situation), the appropriate pruning dose would be on the lighter side. However, in real world situations, trees are often pruned only once every several years. Here the appropriate pruning dose may be heavier. In situations where heavy pruning is needed, complete the work over a period of years.

Excessive pruning can lead to watersprouts (upright, sucker-like shoots emerging on the trunk or branches). Watersprouts, a common response to over pruning and storm damage, are structurally unsound.

Excessive pruning also creates a hormone imbalance between Auxins (produced in the terminal buds of the canopy) which stimulates root growth and Gibberellins (produced in the root tips) which stimulates canopy growth. This puts the root system into a multi-year decline, resulting in a multi-year decline in canopy growth.

Storm damage may take off excessive amounts of live wood leading to heavy canopy growth and watersprouts the first year due to high Gibberellins. The natural root generation declines the first year due to low Auxins. This decline in root regeneration leads to a multi-year decline in root and canopy growth. The storm damage counts into the dosage of live wood removed. When storm damage takes off more than the appropriate dosage for the trees actual growth, limit pruning to cleaning (removal of dead and damaged) until the tree rebalances and resumes normal growth rates.

Removal of dead wood does not count into the dosage.

Other General Guidelines

- To maintain trunk taper resilient to winds, at least one-half of the foliage should be in the lower two-thirds of the tree. The lowest limb should originate in the bottom one-third of the tree's height.
- Pruning should maintain the tree's natural shape.
- Avoid "lion-tailing" where the small twiggy inner foliage is cleaned-out on the lower scaffold branches and secondary trunks. This shifts weight to the ends of branches and reduces the damping effect on the branch; increasing the potential for wind damage. It reduces the taper (widening of the branch/trunk as it moves downwards) increasing the potential for branch/trunk failure. It

also reduces the stored photosynthate reserves in the lower branching structure decreasing resilience to stress factors.

- Avoid topping a tree. Topping opens the tree to internal decay and cracking. Regrowth of watersprouts (adventitious shoots) is structurally unsound.
- Written specification for any pruning job should include the following:
 - Clearly state which tree(s) will be pruned.
 - Clearly indicate the objectives for pruning (why prune), such as reduce risk of failure due to wind damage or snow loading, manage health, improve aesthetics, provide clearance, improve view.
 - Specify pruning methods (how to prune) to meet the objectives, such as structural pruning, cleaning, thinning, raising, reducing, restoration pruning.
 - State the size specification for the minimum and/or maximum branch size to be removed. For example, “*Cuts should be made on branches two inches and less in diameter*” and “*In a reduction cut, the side branch pruned back to should be at least one-third the diameter of the branch removed.*”
 - Specify the dosage (maximum amount, by percentage, of live wood/foliage to be removed per season). For example, “*Pruning should not remove more than 15% of the live crown.*”
 - In writing pruning specifications, the word “should” refers to a practice that is routine and recommended. The word “shall” refers to a practice that is mandatory.
 - Include these generic safety statements to reduce the homeowner’s and pruning crew’s liability. “*All work shall be performed in accordance with American National Standards Institute A300 Pruning Standards and Z133.3 Safety Standards.*” “*All work shall be performed under the supervision of a licensed, International Society of Arboriculture certified arborist.*”

Pruning Objectives

Pruning should be based on pruning objectives (why to prune). Do not indiscriminately remove branches. Pruning objectives determine methods (how to prune) to be used, which in turn determine the type of pruning cuts made. Table 1 lists common objectives, methods and types of pruning cuts.

Table 1. Objectives and Methods for Pruning Maturing Trees

Objectives (Whys)	Methods (How)	Pruning Cuts
Reduce risk of failure (wind and snow)	Structural	Removal cut
Improve structure	Cleaning	Reduction cut
Maintain health	Thinning	Heading cut
Improve aesthetics	Raising	
Provide clearance	Reducing	
Improve view	Restoring	
Reduce shade	Pollarding	
Influence flowering and fruiting		

Pruning Methods

Structural Pruning

A common pruning objective with maturing trees is to reduce the potential risk of failure from wind and snow loading. Significant wind damage occurs on structurally weak trees with wind gusts of 60 to 75 mph. Even structurally sound trees may fail with wind gusts above 95 mph.

In Colorado (and other snowy climates), most significant storm damage is due to codominant trunks (trunks of similar size). Structural problems of this type should have been corrected while the tree was in the early growth stage. Arborists have a limited potential to correct structural defects on middle-aged and mature trees without predisposing the tree to internal decay, cracking, and creating an unsightly shaped tree. [Figure 5]



Figure 5. Codominant trunks (adjacent trunks of similar size) account for the majority of storm damage in Colorado landscapes.

Structural pruning centers around developing a dominant trunk with subordinate side branches and secondary limbs. To be most effective, it requires annual pruning over a period of years, rather than an occasional one-time pruning.

Written pruning specifications for structural pruning of maturing trees should include the following:

- Identify branches where work will be done (for example, “*codominant trunk on south side of tree*”).
- Identify the methods to be used in pruning (for example, “*the secondary trunk on the south side should be reduced by 10 feet*”).

Subordinate Pruning Considerations

Structural pruning of maturing trees is often referred to as ***subordinate pruning***, where secondary trunks (and side branches) with weak branch unions are subordinated to a dominant trunk. To avoid removing too much foliage/live wood in one season, subordinate pruning generally requires work over a period of years.

In evaluating how to prune the maturing tree, take into account the following considerations:

What Is the Purpose for Pruning the Tree?

Structural pruning (subordinating weak side branches to a more dominant trunk) is more effective in reducing failure potential than general crown reduction or crown thinning. With general crown reduction or thinning, regrowth simply replaces what was pruned off in a few years.

Wind loading – To reduce potential of failure due to wind loading, the height of secondary trunks and side branches with weak branch unions must be lowered. This is done with reduction cuts, and proper reduction cuts may not be possible on many maturing trees without introducing decay and internal cracking, and structurally unsound waterspout growth.

For example, many cottonwood and poplar trees will not have side branches of adequate size for proper reduction cuts (side branch prune back to must be at least 1/3 the diameter of the trunk removed).

A slight reduction in secondary trunk/branch height will not achieve the objective. To significantly reduce the risk of failure, reduction may need to be 1/3 or more of the branch length. On maturing trees, this may be into branches too large for pruning by pruning standards. Not all branches can be effectively reduced.

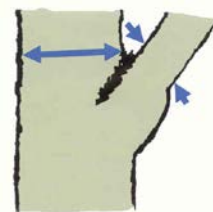
Snow loading – To reduce potential of failure due to snow loading, the snow catching volume of the branch needs to be reduced. This is best achieved with structural pruning of weak branches.

What Is the Structural Integrity of the Branch Union?

To evaluate the structural integrity of the branch union (crotch) look at the **Aspect Ratio** (that is the diameter of the side branch to the diameter of the trunk). Any side branch with an aspect ratio larger than 1 to 2 (diameter of side branch greater than 1/2 the diameter of the trunk) will be structurally weak due. For example, if the diameter of the trunk is four inches, all side branches should be less than two inches.

A structurally strong branch union has a **branch collar** (where the annual growth rings of the trunk wrap around the annual growth rings of the side branch). For a branch collar to develop, the side branch needs to be less than one-half the diameter of the adjacent trunk. Less than one-third is preferred. Branch unions with branch collars are also more resistant to the spread of decay. For more details on branch collars, refer to *CMG GardenNotes* #611, Tree Growth and Decay. [Figure 6]

Figure 6. To evaluate the structural strength of a branch union, compare the diameters of the trunk and side branch. A branch union is structurally strong when it has a branch collar. For the branch collar to develop, the diameter of the side branch needs to be less than one-half the diameter of the adjacent trunk.



Branch unions can also be compromised with narrow crotch angles, leading to **included bark** (bark against bark) and multiple branching originating in the same area.

What Is the Aesthetic Value of the Branch?

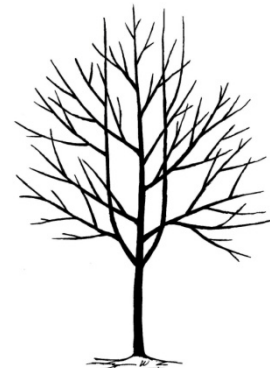
Is the branch in question important to the tree's balance and appearance? If the branch were removed, would its removal create a major gap in the canopy?

Where Should the Pruning Cut Be Made?

If the three previous questions lead to the conclusion that a secondary trunk or branch needs to be pruned, several considerations are needed to determine where to make the actual cut. Sometimes none of the options meet pruning guidelines, and the better of the bad options is chosen.

For illustration, look at the tree in Figure 7. It has three trunks. If the branch unions do not have branch collars (that is, the secondary trunks are more than half the diameter of the primary trunk), the tree is prone to storm damage.

Figure 7. As drawn, the tree has three trunks. Evaluate the need for subordinate pruning by comparing the diameters of the secondary (left and right) trunks to the center trunk. To be structurally strong with branch collars, the left and right trunk need to be less than half the diameter of the center trunk.



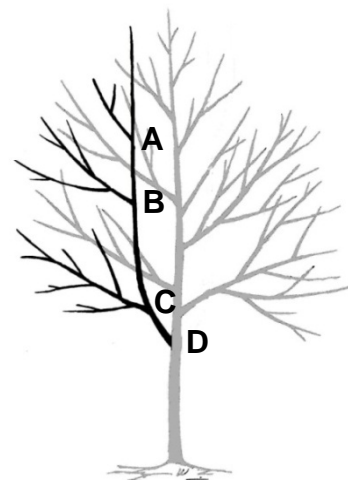
Considerations for the Secondary Trunk on the Left

As drawn in Figure 8, there are four sites where pruning could occur to lower the height of the secondary trunk (wind loading) and reduce the snow loading potential.

Figure 8. As drawn, there are four locations where pruning could occur.

Considerations for locations A, B and C with reduction cuts (removing a larger trunk back to a smaller side branch)

- If location A has a 2-inch trunk with a 1-inch side branch, it meets the pruning guidelines for both size (decay potential) and reduction cut (waterspout growth). However, as drawn, it may have little potential to minimize storm damage, as the height is not significantly lowered (wind loading), and the total potential for snow loading has not been significantly reduced.
- If location A has a 2-inch trunk with a half-inch side branch, it does not meet the reduction cut guideline (waterspout growth), as the side branch is one-fourth the size of the trunk being removed. Due to the size relationship, this becomes a heading cut. Watersprouts regrowth on the trunk could make it more prone to storm damage than before pruning!
- If location B has a four-inch trunk and a 3-inch side branch it violates the size (decay) guideline because the trunk is too large, predisposing the trunk to decay and internal cracking. This is typical when pruning maturing trees, as branches will be too large except in the outer canopy. The 3" side branch is within the reduction cut (waterspout) guideline, making it a reduction cut.



- If location B has a 4-inch trunk and a 1-inch side branch it violates both the size (decay) and the reduction cut (waterspout) guidelines.
- If location C has a 6-inch trunk and a 3-inch side branch it violates the size (decay) standard. The 3-inch side branch is within the reduction cut (waterspout) standard.

Considerations for location D with a removal cut (removing a smaller side branch back to a larger trunk/parent branch)

- Is the branch important to the aesthetics of the tree? As drawn, the removal of the entire branch would create a gap in the canopy.
- Removal of the left side secondary trunk plus additional pruning on the right side to aesthetically balance the tree would remove too much of the tree's foliage/live wood in a single season.
- If location D has an 8-inch trunk with a 6-inch side branch (secondary trunk), it violates the size (decay) guideline. Being a removal cut (removing a smaller side branch back to a larger trunk/parent branch); it does not have a reduction cut standard. Without a branch collar, the branch union is prone to decay.

Better of the Bad Options

In reality, it is common that none of the potential cuts meets acceptable pruning guidelines, and the arborist looks for the better of the bad options. Due to the diameter of the limbs, large trees have few acceptable options based on the size guideline (potential for internal decay and cracking). It is common that secondary trunks may not have any side branches of an acceptable size relationship for a reduction cut.

- If the tree species is prone to decay, avoid compromising on the size (decay) guideline, opening the tree to decay and internal cracking.
- If the tree is in a stressed site (including limited water or root spread potential) avoid compromising on the size (decay) guideline, as the tree is more prone to decay.
- If the tree is vigorously growing or the total amount of foliage/live wood being removed is at the maximum allowed in pruning standards, avoid compromising on the reduction cut (waterspout) guideline, as the tree is more prone to waterspout growth. With growth, the tree may become more prone to storm damage than before pruning. If the tree will be pruned each year (dealing with the waterspout growth) this becomes less of an issue.
- If tree failure would not cause injury or significant property damage, no pruning may be the better option.
- If tree failure would cause injury or significant property damage, it may be better to accept limited decay and work with resulting structural issues from regrowth than to leave the tree at high risk for storm damage.

- Storm failures are more common on young and medium-sized trees as the co-dominant and secondary trunk reach 3-4 inches in diameter. Old, mature trees are actually less prone to storm damage, having had their weakness tested in previous mega storms.

Illustrations of Subordinate Pruning Situations

Medium-Aged Tree with Codominant Trunks

With codominant trunks, one trunk is subordinated to a dominant trunk. Figure 9 illustrates this. It may require annual pruning over a period of years.

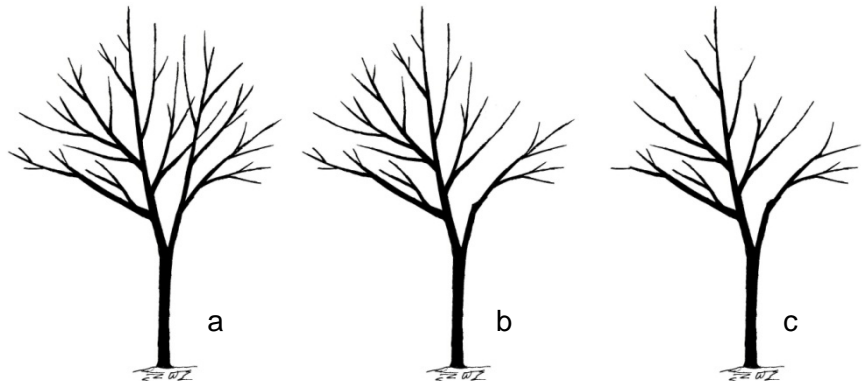


Figure 9. Before and after pruning with codominant trunks.

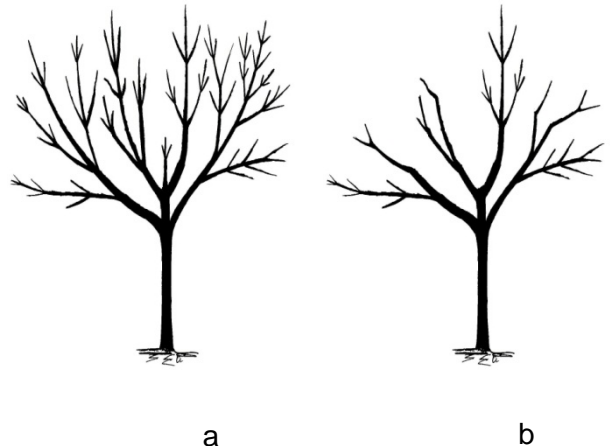
- Tree before pruning.
- Codominant trunk on right subordinated to trunk on left.
- Tree balanced with other, more upright growing branches on left subordinated to the dominant trunk.

Vigorously Growing Branches Choke-Out the Central Leader

On species with opposite branching patterns, vigorously growing lower branches often choke-out the central leader. Figure 10 illustrates the pruning approach. It may require annual pruning over a period of years.

Figure 10. Before and after views of a tree who's vigorously growing branches choke-out the central leader.

- Before pruning
- Desired look after pruning



Young Tree Rounded with Heading Cuts

Trees should never be rounded with heading cuts. Figure 11 illustrates the pruning approach. It may require annual pruning over a period of years.

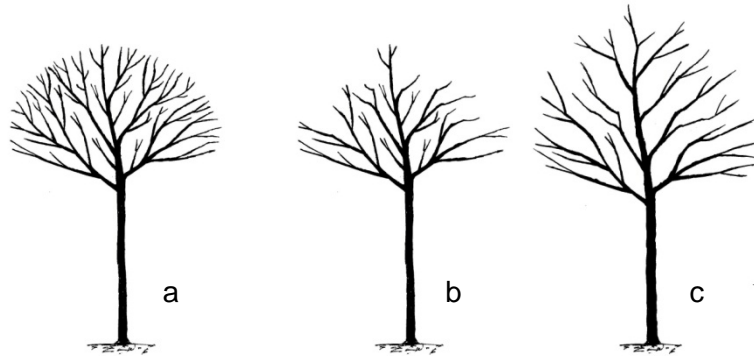


Figure 11. Before and after views of a young tree rounded with heading cuts.

- a. Before pruning
- b. Desired look after pruning, subordinating side branches to a dominant trunk.
- c. Tree with growth.

Upright Growing Trees with Numerous Upright Growing Branches

Some species of trees (including Callery pear and some crabapple cultivars) have numerous upright growing branches. Figure 12 illustrates the pruning approach. It may require annual pruning over a period of years.

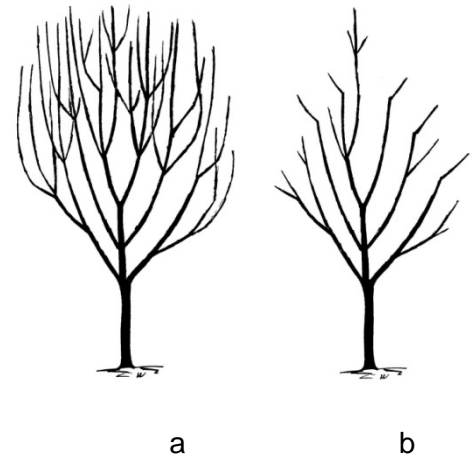


Figure 12. Before and after views of an upright growing tree with numerous upright growing branches.

- a. Before pruning
- b. Desired look after pruning

Cleaning

Cleaning is the removal of dead, diseased, cracked, and broken branches. This type of pruning is done to reduce the risk of branch failure, improve tree appearance, and to reduce the spread of insects and diseases. Most pruning of middle-aged and mature trees falls into this type. Trees under stress or declining trees may need cleaning every few months to ever few years. All dead wood may be removed at one time. It does not count in the total of live wood/foliage removed. In cleaning, do not remove healthy branches and live foliage. Do not clean out healthy growth in the tree's interior. [Figure 13]

Figure 13. This old cottonwood needing cleaning to remove dead branches and reduce the risks associated with branch failure.



Removing dead branches – To minimize risk if the branch were to fail, it is advisable to remove any dead branch larger than a two-inch diameter and higher than 30 feet. Dead branches may also become a source of insect and disease pressure in the tree.

Remove the dead branches using the three-step pruning technique. For details refer to CMG GardenNotes #612, *Pruning Cuts*. Do not cut into the branch collar, which would open a high potential for decay to spread into the trunk. If live wood has begun to grow out along the dead limb, cut just beyond the live wood being cautious not to nick the live tissue. Never “flush cut” the dead branch. [Figure 14]

Figure 14. When removing dead branches, do not cut into the living tissues.



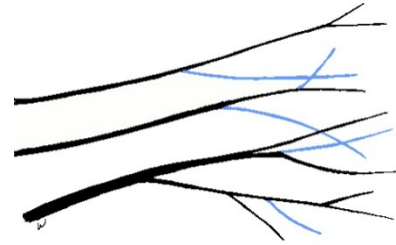
Written specifications for cleaning should specify the minimum size of dead branches to be removed. For example, “*Clean branches one inch diameter and larger*” or “*Clean branches two inches in diameter and larger that are 30 feet and higher above the ground.*” The location of the branch to be removed should be specific if the entire crown is not going to be cleaned.

Thinning

Thinning is the selective removal of smaller branches (½ inch to 2.5 inches in diameter) to reduce crown density. Because the majority of small branches are in the outer canopy, thinning focuses in this area. Thinning should retain crown shape and size, and provide an even distribution of foliage throughout the crown. Removal cuts are primarily used. [Figure 15]

Because thinning is in the upper/outer canopy, it requires a trained arborist with a high level of skill. Thinning is expensive, often running \$500 to over \$1,000 per large tree when done correctly.

Figure 15. Thinning is the selective removal of small branches, growing parallel to each other, in the leafy upper/outer tree canopy.



Thinning can include removal of suckers from the base of the tree and some waterspouts on the interior. Excessive removal of waterspouts at one time often promotes growth of additional waterspouts, and should be avoided.

Benefits of Thinning

- Thinning is a method to minimize potential damage caused by snow loading, a primary situation leading to tree failures in Colorado. Thinning can reduce limb weight in order to compensate for structural defects.
- Thinning increases light penetration into the tree interior. This can invigorate the tree and help retain the tree's natural shape. Thinning may adequately reduce shade for shade tolerant under story plants below the tree. However, thinning middle-aged and mature trees will not adequately promote growth of sun loving plants like Kentucky bluegrass.
- Thinning is a technique to partially open a view without removing or structurally influencing a tree. This is often referred to as *vista pruning*.
- On a tall tree, thinning may not be an effective technique to reduce wind sail and potential for breakage in strong winds. Reducing is the most effective way to deal with wind loading issues.

Effectiveness of Thinning

- Researchers are questioning the overall effectiveness of overall tree thinning. Depending on growth rates, the tree may simply regrow the removed branches in a few years. **Current thought in reducing storm loading is that structural pruning will be more effective than general thinning.**

Clarification on Thinning

- As a point of clarification, *thinning* is done on relatively small branches in the leafy upper/outer canopy. *Thinning* is not removing large lower branches, which could create gaps in the crown and encourage watersprouts. Thinning is not removal of the small twiggy branches in the inner canopy. Thinning will not significantly lower a tree's height. [Figure 16]

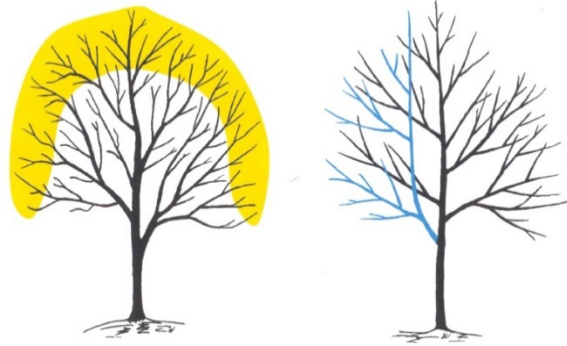


Figure 16.
Left – Thinning focuses on small branches in the upper/outer tree canopy.
Right – Thinning does NOT remove large branches, creating a gap in the tree canopy.

- Avoid *lion-tailing* which is the removal of the live small leafy twigs down in the tree's interior. Never clean out these lower branches and twigs on maturing trees. These small interior branches are critical to the trunk's structural integrity and vigor. They also serve to dampen tree sway in wind. Lion-tailing shifts the wind loading to the outer canopy increasing the tree's potential for wind damage. [Figure 17]

Figure 17. Do not "lion-tail" trees as in the photo. Removal of the smaller twiggy wood in the inner tree canopy decreases vigor on the major branches and trunk and shifts the weight to the top increasing the potential for wind damage.



Written specifications for a thinning job should specify the following:

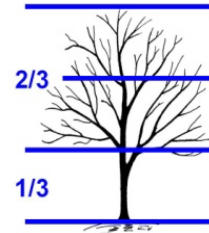
- Clarify the dosage (percent of the tree's canopy may be removed). For example, "*Pruning should not exceed 15% of the total live canopy.*"
- Clarify where in the tree the pruning will occur. For example, "*Pruning should occur in the outer third of the crown.*"

- Clarify size of branches to be removed. For example, “*Pruning should remove branches up to 2½ inches in diameter.*”

Raising

Raising is the removal of lower branches to provide clearance for people, traffic, buildings, or a view. When removing lower branches, maintain at least one-half of the foliage in the lower two-thirds of the tree. The lowest branch should originate in the bottom one-third of the tree’s height (live crown ratio). [Figure 18]

Figure 18. When removing lower branches, maintain at least one-half of the foliage in the bottom two-thirds of the tree. The lowest branch should originate in the lower one-third of the tree.



Raising should be part of the tree’s structural training while young. Ideally raising would be done before branches to be removed exceed a two-inch diameter. The potential for decay is high when the branch removed is larger than four inches or when a two-inch and larger branch is greater than half the diameter of the adjacent trunk (no branch collar to suppress decay).

On many trees, lower branches make-up a significant portion of the tree’s entire canopy and cannot be removed without significantly influencing tree health and appearance. When the branch to be removed is larger than two inches, consider other alternatives. Can the clearance required be achieved with removal and reduction cuts out along the branch rather than removing the entire branch? Leaving some small diameter branches on the lower trunk for a year helps close pruning wounds and lessens the potential for trunk cracking. [Figure 19]

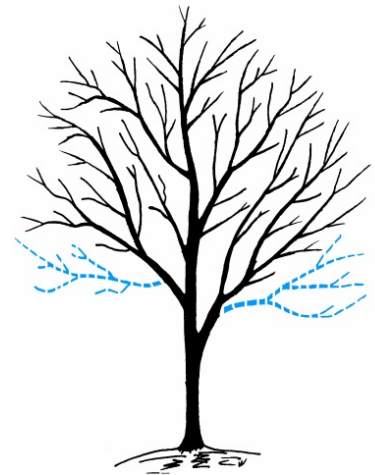


Figure 19. In raising branches on maturing trees, consider if required clearance can be achieved with removal and reduction cuts out along the branch rather than removing large branches entirely.

Excessive removal of lower branches increases the potential for tree failure by decreasing trunk taper, causing trunk cracks and decay, and transferring weight to the top.

Written specification for raising should include the following:

- Clarify the clearance required. For example, “*The tree’s crown will be raised to seven feet.*”

- Clarify what branch(es) will be pruned and the type of pruning cuts (removal or reduction cut) to be used. For example, “*The lowest branch on the south side shall be removed back to the trunk with a removal cut. The lowest branch on the north side will be reduced with a reduction cut at the branch five feet out from the trunk and a removal cut to the lowest side-branch.*”
- Clarify what size of branches will be pruned. For examples, “*All cuts shall be two inches in diameter and smaller.*”

Reduction

Reduction is the selective removal of branches to decrease the height and/or spread of a tree. It requires the use of *reduction cuts*, which remove larger branches back to smaller side branches. [Figure 20]

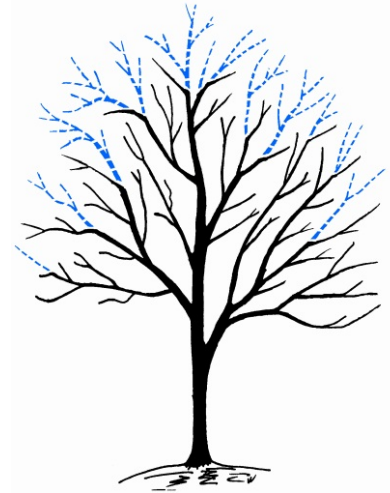


Figure 20. Reducing is the selective removal of branches to decrease a tree's height and/or spread. Just being tall does not indicate that a tree is structurally weak and prone to storm damage.

Reduction is a method to reduce potential wind loading on large trees with structural defects. Reducing and thinning both decrease potential failure from snow loading. However, researchers are questioning the effectiveness of overall tree reduction. Depending on growth rates, the tree may simply regrow the removed branches in a few years. **Current thought in reducing storm loading is that selective structural pruning on weak secondary trunks will be more effective than general tree reduction.**

Not all trees can be reduced without predisposing the tree to decline and death. Crown reducing requires the extensive use of *reduction cuts*, which can predispose the branch/trunk to internal decay. On older trees showing stress or decline, *heading cuts* can accelerate decline and death. [Figure 21]

Figure 21. Not every tree should be reduced. Notice the dieback associated with the previous reduction on this old cottonwood. On old trees and trees showing stress or decline, heading cuts may accelerate the decline cycle.



In a proper *reduction cut*, the side branch pruned back to will be at least one-third the diameter of the trunk/parent branch removed. Under American National Standards Institute (ANSI) pruning standards, if the side branch is less than one-third, it is considered a *heading cut*, which is generally unacceptable. For additional details on proper reduction cuts, refer to *CMG GardenNotes #613, Pruning Cuts*.

It is very difficult to use crown reducing to permanently maintain a tree at a small size without causing tree decline. Ideally, trees were selected with adequate space for their mature size. Where size control is necessary, it is best to begin reduction pruning as the tree reaches acceptable size, rather than when the tree becomes overgrown.

In crown reducing, first visualize the new outer edge of the smaller canopy. Then prune the tree back to appropriate branch unions for a proper reduction cut or removal cut. Some branches will be left taller than the visualized outer edge while others will be cut back below the visualized canopy edge. Do not make heading cuts and avoid rounding off the tree canopy. [Figure 22]

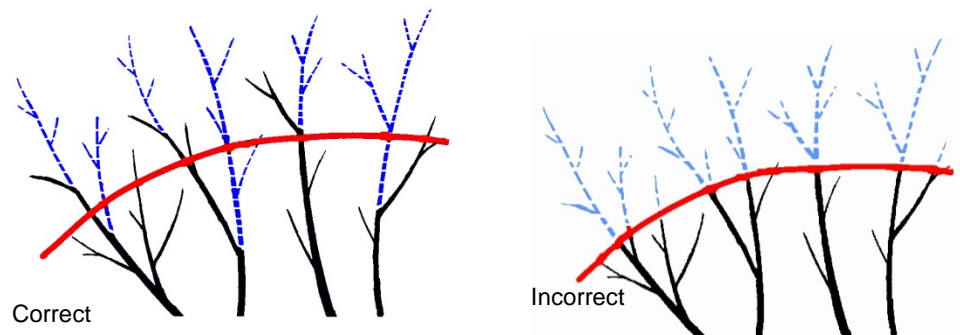
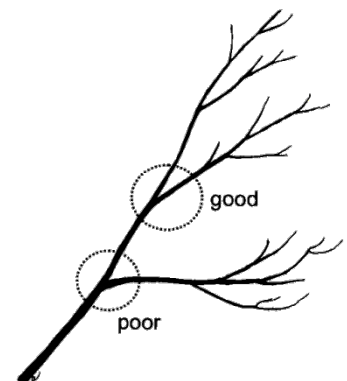


Figure 22.

Left – In reduction, visualize the new outer edge of the smaller canopy. Prune back to branch unions that make proper reduction and thinning cuts. Some branches will be taller than the new outer edge, some shorter.
 Right – This tree is incorrectly rounded off with heading cuts.

In shortening primary upward growing trunks/primary branches to a lateral branch, a side branch that is somewhat upward growing with a narrow branch union angle may be stronger than a branch union with a wide angle. [Figure 23]

Figure 23. In shortening a main upward growing branch, pruning back to a narrow branch union may be stronger than a wide branch union.



Just because a tree is tall does not indicate that it is structurally unsound. Potential risk of failure should be evaluated by an experienced arborist based on branching structure, branch union integrity, signs of internal decay, and previous damage.

Written specifications for reduction pruning should include the following:

- Clarify the desired reduction in height/spread.
- Specify criteria for reduction cuts. For example, “*All cuts should be made on branches less than two inches in diameter. Diameter of the side branches pruned back to should be at least one-third the diameter of the branch removed.*”
- Clarify the dosage (percentage of live wood/foilage to be removed). For example, “*Pruning should not exceed 10% of the total canopy.*”

Restoration

Restoration is the selective removal of branches, sprouts, and stubs from trees that have been damaged by improper pruning, vandalism, and storms. The objective is to restore the trees structure, form, and appearance to the extent possible.

Restoration generally requires annual pruning over a period of years.

Actual pruning procedures vary with the situation. When dealing with situations of excessive watersprouts, a rule to thumb is to remove one-third and reduce one-third with each annual pruning. Removing all of the watersprouts at one time often stimulates the growth of more watersprouts.

Pollarding

Pollarding is a training system that involves creating “heads” on secondary branches were small tertiary branches arise. The small tertiary branches are all removed back to the head every one to three years (depending on growth rates).

Pollarding started as a method to produce shoots for fuel, shelter, and products made from the young shoots. Today, it is used as an art form. Pollarding is common in some parts of Europe to keep tree small and shaped as living screens. Pollarding is not topping and should not be considered a routine method to keep large trees small. Due to annual labor involved, it is uncommon in the United States.

Frequently Asked Questions About Pruning Mature Shade Trees

What About Topping a Tree?

Shade trees should **never** be topped. The regrowth of a topped tree is structurally unsound. Topping required by utility right-of-way pruning is starkly obvious and sets an unfortunate community standard followed by others. Instead of topping, use *cleaning*, and/or proper *structural pruning* methods. [Figure 24]

Figure 24. Never top a tree, the regrowth is structurally unsound, making it very prone to wind and storm damage.



What About Utility Right-Of-Way Pruning?

Pruning for utility line clearance does not always follow desirable pruning techniques regarding appearance and health of the tree. In this situation, the needs of the utility right-of-way take priority over the tree.

When a tree under a power line requires frequent reduction, consider having the tree removed. Utility companies are generally eager to accommodate. In planting trees, selection criteria (i.e., size and placement) should be followed so that a tree's health and appearance will never be compromised by the need for utility pruning.

I Am Concerned About My Tall Tree Breaking in Storms, But I Really Do Not Want to Lose the Shade. Do I Really Need to Have the Tree Pruned or Removed?

This is a two-part question. First, does the tree show signs of being highly susceptible to storm damage, (i.e., previous storm damage, dieback or dead branches, structural problems such as codominant trunks, weak branch unions or internal decay)? This should be evaluated by an experienced ISA Certified Arborist.

Second, if yes, what would the tree or branch hit should it fail? If it would cause significant property damage or threaten life, the tree should be pruned or removed as a preventive measure.

Cleaning and *structural pruning* may reduce the potential storm hazard without compromising the shade. In some situations, the risk of failure cannot be reduced without removal. Remember that healthy structurally sound trees are generally windfast even when mature.

Storm damage is usually, but not always, related to structural problems that could have been addressed with proper structural training when the tree was young. Codominant trunks account for the majority of tree failures in Colorado. The hazard of wind damage is higher on the regrowth of trees that have been "topped". Consult an ISA Certified Arborist for additional details.

How Should Storm-Damaged Trees be Pruned?

First, focus on *cleaning* (removing broken and damaged limbs) keeping in mind the structural integrity of the tree. Realize that you may have to accept less than ideal pruning techniques by "Mother Nature".

Second, focus on *structural pruning* to restore the tree's structural integrity and shape to the extent possible. This may take place over a period of years.

The maximum amount of tree canopy that can be removed without putting the tree and its root system under stress includes the live wood/foliage removed by the storm. When Mother Nature removes too much live wood/foliage, limit pruning to cleaning.

On storm damaged trees where excessive live wood and foliage were removed by storm damage, wait until the roots and crown stabilize (as measured in canopy growth) before doing thinning, reducing, or other structural pruning. This may be a multi-year period.

Keep the tree if it can be pruned back to structurally sound wood and will be esthetically pleasing. Often when one side of the tree is gone, the best option is to remove the entire tree. [Figure 25]

Figure 25. Keep storm-damaged trees when they can be pruned back to structurally sound wood and has an acceptable appearance. This yard would look better if the tree was removed.



How Should Trees With Root Damage be Pruned?

Focus on *cleaning*. Avoid removing live wood and foliage as this could speed the decline. Removing live wood lowers the *auxin* content, which is the hormone that promotes root growth. Removing foliage reduces photosynthesis and levels of stored carbohydrates that the tree is living on during the recovery period. Trees in a construction site with damaged roots may require cleaning every 3-12 months for five plus years.

How Should Declining Trees be Pruned?

Focus on *cleaning*. Avoid removing live wood and foliage as this could speed the decline. Removing live wood lowers the *auxin* content, which is the hormone that promotes root growth. Removing foliage reduces photosynthesis and levels of stored carbohydrates that the tree is living on. Old declining cottonwoods and poplars may warrant cleaning every one to five years.

Authors: David Whiting (CSU Extension, retired), with Alison O'Connor and Eric Hammond (CSU Extension). Artwork by David Whiting; used by permission.

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Revised October 2014