NC STATE UNIVERSITY

College of Agriculture & Life Sciences
Department of Horticultural Science

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PRUNING TREES

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In order to properly prune a tree, a basic understanding of tree structure is needed. A cross section of a tree trunk reveals it is composed of many layers. Each year a tree essentially grows a new "coat of wood" over the older wood. The outside layer of the tree is dead bark which provides protection from the environment. The inner bark layer is composed of live tissue that transports food downward. Between the bark and wood is the cambium layer which is responsible for increases in tree diameter (by creating annual rings) and responds to injury by producing callus tissue and wound wood.

The annual rings of wood are composed of large pores that carry water up to the leaves. Each annual ring is essentially a vertical cylinder. The outer annual rings (sapwood) are usually light colored. Wood in the center of a large tree (centerwood, former sapwood) is composed of dark colored, dead cells. Ray cells cut across the annual rings; they store and distribute food to living cells.

Branches are attached to the tree trunk by interlocking branch and trunk tissue. A new layer of interlocking tissue is produced each year over the previous layer. A branch collar, produced by the trunk, holds the branch base. When the branch/trunk union has a narrow angle, the branch and trunk bark become overgrown and is referred to as included bark (Figure 1). This results in a weak union that is likely to split.

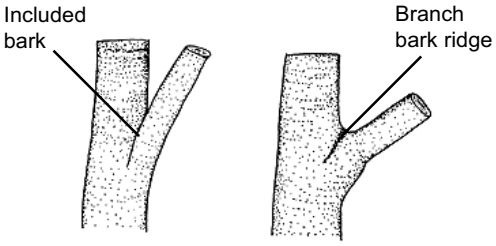

Figure 1. V-shaped crotches can lead to included bark.

Tree Wound Response

Trees have a natural defense response to wounds and pruning cuts. They form four types of walls to compartmentalize the area thus preventing the spread of decay organisms (Figure 2). The decay or injury remains but is sealed off and does not increase in size if the walls are stronger than the decay organisms. The storage capacity and function of the injured wood is lost forever.

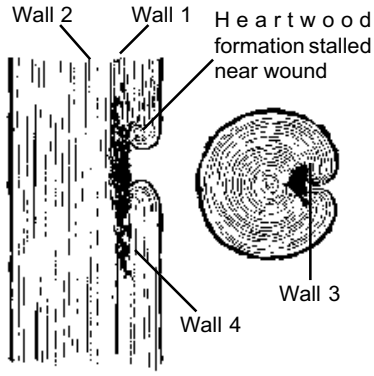

Figure 2. Wall 1 resists vertical decay, wall 2 resists inward spread, wall 3 resists lateral spread, and wall 4 controls spread to wood formed after the wounding.

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Following an injury, Wall 1 is formed by plugging the vertical vessels of the vascular system above and below the injury. This is the weakest wall but can slow the vertical spread of decay. Wall 2 is formed at the outer edge of a growth ring. It is a stronger barrier and provides some resistance to inward spread of decay. Each growth ring is subdivided into compartments by the rays (Wall 3). Rays provide resistance to lateral spread by way of a maze of physical obstacles and a chemical barrier. Wall 4 is formed by cambium growth after an injury. It is the strongest of the four walls. Internally, it separates the wood present at the time of injury from new wood formed after the injury. Externally, wood develops around the injury and should eventually cover it by growing over the dead wood at the site of the injury.

Some tree species seal off wounds very rapidly and contain them so effectively that the amount of decay is limited. When a tree responds slowly or the walls are weak --- infection can damage a large volume of wood.

A tree branch has a branch bark ridge, which denotes where the upper side of the branch meets the tree trunk (Figure 3). The bark collar is the swelling located at the base of a branch where the lower side of the branch joins the trunk. The natural decay of a dead branch usually does not spread beyond the collar. When pruning a dead branch, do not create a new wound by cutting into the color of live wood that forms around the dead branch.

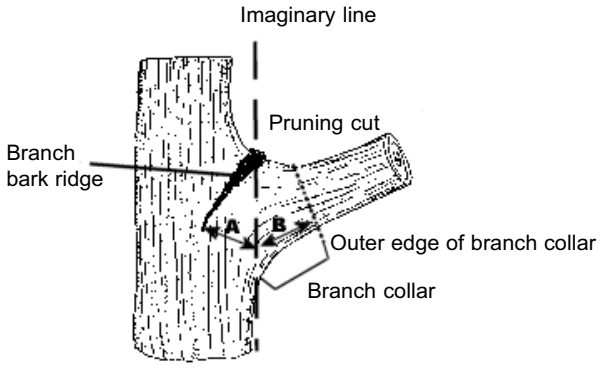

Figure 3. The angle created by the branch bark ridge and an imaginary line with the tree trunk is the approximate angle at which to make the pruning cut.

Pruning Trees

The old practice of pruning tree branches was to cut flush with the tree trunk. When this is done the ability of the tree to stop decay is greatly decreased. Flush-cut pruning cuts into the wood of the trunk cause a wound that can allow decay organisms to infect the main trunk of the tree. The current recommendation is to prune the branch to just outside the collar. Properly pruned branches will have a circular closure around the wound. When the branch is cut too close to the trunk, the closure will be oval or distorted.

When to Prune

Pruning and training should start when trees are quite young. This will prevent many serious problems before they develop. Older, neglected trees are more difficult, dangerous, and expensive to prune. Most of the pruning on older trees should be done when they are dormant; there is less weight on the limbs. At this time, it is easier to see the framework of the branches. Pruning of young trees should be done when problems can be observed.

Some trees, such as birch, dogwood, elm, honey locust, maple, and walnut exude excessive sap from the wound when pruned in late winter or early spring. Sap flow does not hurt the tree. Prune these trees in late spring, summer, or fall to minimize sap flow.

The time of pruning should take into account the life cycle of insects and diseases. Plants in the genus Prunus (flowering cherry, cherry laurel) are prone to develop bacterial cankers. The spores for the diseases, which are released in fall and early winter, can enter plants through fresh pruning cuts and wounds. Prunus trees do not initiate new cankers during late spring or summer. Dogwood borers are most active in May, June, and July. Thus, dogwoods should not be pruned during these months.

Treating Pruning Cuts

Historically wound dressings have been mistakenly applied to pruning cuts to block out microorganisms, keep moisture in or out, and speed the "healing" process. However, research has shown that treated wounds do not close quicker than untreated wounds. In most cases, sealed wounds actually give wood inhabiting microorganisms an environment favorable for growth and decay development. Some wound dressings kill cambial cells and cause the wound to remain open for years longer than if no treatment had been applied.

Pruning Young Trees

The training of a young tree should begin the first year after transplanting. Training should take place gradually over several years and no more pruning should be done than is necessary to enhance the natural shape or structural strength of the tree. The objective in the first few years is to identify and correct problems with the main framework of the tree. Lower branches should be left on the trunk to manufacture food and to shade the lower bark. The height of a branch does not increase as the tree grows but remains at the same height for life. With time some of the lower branches will need to be removed as they increase in length, create unwanted shade, and/or interfere with gardening activities or traffic.

Most trees are grown with one central leader (the top most vertical branch). Exceptions are trees, such as crapemyrtle and river birch, that are grown for their interesting bark color and have been pruned to develop multi-trunks. A tree that will grow to more than 40 feet should have a single trunk well up into the canopy, but the trunk does not have to be perfectly straight. When a young tree has competing leaders, the weaker ones should be removed. If they are essentially equal, either can be removed. Trees with several trunks often develop included bark in the crotch that can cause one of the trunks to split from the rest of the tree during a storm.

Scaffold branches (primary branches that will make up the tree's framework) emerging from the trunk should have a 45 degree angle of attachment (Figure 4). Generally, branches with less than 45 degree angles becomes weaker as they grow longer and increase in diameter. Branch angles of less than 30 degrees result in a high percentage of limb breakage while those between 60 and 70 degrees have a small breakage rate.

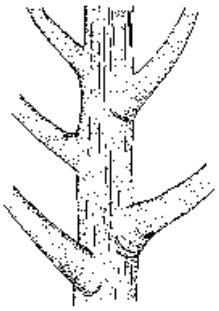

Figure 4. Optimum angle of attachment of scaffold branches.

Scaffold branches should look like ascending spokes around a central axle (Figure 5). This will provide a structurally strong tree that is attractive, balanced, and allows sunlight to penetrate and wind to pass through the canopy. Major scaffold branches should have at least 8 inches and preferably 20 inches of vertical separation. Closely spaced scaffolds will produce less lateral branches than widely spaced branches. The result will be long, thin branches with poor structural strength. Good radial spacing prevents one limb from overshadowing another. Branch arrangement and spacing is more critical for large shade trees than for small flowering trees.

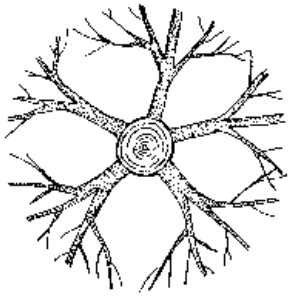

Figure 5. Radial arrangement of scaffold branches.

Laterals that have grown taller than the terminal leader or beyond the canopy of the tree should be headed back. Laterals that have grown inward towards the center of the tree should be removed back to their origin. Branches that are less than half the diameter of the trunk have a stronger branch/trunk union than those that grow larger than half the trunk diameter. Water sprouts that result from extensive pruning should be removed because they are structurally weak and can lead to overly dense growth in the interior of the tree.

Pruning Large Trees

In many parts of the state, trees are topped (also called sheared, headed back, or dehorned) because of the perceived fear that the tree is too large and could damage property during a storm. The practice of topping trees should not be undertaken. This type of tree abuse involves cutting back main branches and the central leader to a specific height without regard to the location of lateral branches. The result is wounds that do not close, thus, allowing decay organisms to enter the tree. New growth from cuts usually have weak angles and are easily damaged during storms. Thinning would be a possible way to reduce wind resistance without damaging the tree.

Thinning - will not significantly reduce the overall size of a tree but will open up its canopy to allow more sunlight to penetrate the interior of the tree and to reach plants growing below (Figure 6). Thinning can be used to reduce resistance to wind and to reduce stress during drought periods or following construction damage.

Figure 6. Thinning will open up a tree canopy.

Dead, broken, weak, or diseased branches should be removed. Then, selectively remove limbs from the perimeter of the canopy, especially those growing close together or beyond the desired canopy size. Also, remove branches with narrow angles of attachment. Branches should be taken back to their point of origin or to laterals that are at least one-third the diameter of the limb being removed. Trees vary in the amount of thinning they can tolerate without creating undesirable effects. An over-thinned tree will respond by producing numerous watersprouts and suckers. Sunscald can occur on trees with thin bark. Never remove more than 25 percent of the total foliage at one time.

Heading back - will reduce the overall size of a tree. Cut back to good lateral branches and possible head the tips of the laterals (Figure 7). Its best to cut back over several years than to attempt dramatic pruning in one year. When cutting back to an intersecting lateral branch, choose a branch that forms an angle of no more than 45 degrees with the branch to be removed. Also, the branch that is cut back should have a diameter at least half that of the branch to be removed.

Figure 7. Head back branches by pruning to a lateral at least half the diameter of the branch being removed.

When cutting branches over 1 inch in diameter, use the three-cut method (Figure 8) to avoid tearing the bark of the trunk. Make the first cut on the underside of the branch, 1 to 2 feet out from the trunk and about half-way through the branch. The second cut is made on the top of the branch, about 3 inches further out from the first cut. As this cut is made, the weight of the branch will cause it to break between the two cuts. If there is danger of the branch damaging other limbs below or objects on the ground, it must be properly roped and supported, then carefully lowered to the ground after the second cut. The remaining stub can then be cut back to the branch bark ridge.

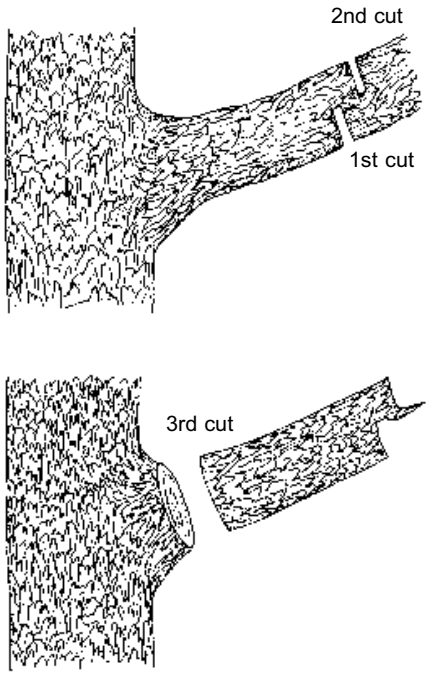

Figure 8. Use the three cut method to prune limbs over 1 inch in diameter.

Make slanting cuts when removing limbs that grow upward; this prevents water from collecting in the cut and speeds closure. Large branches should be removed just outside the collar ---- not flush with the trunk.