PRUNING

TREES & SHRUBS
Before the Cut

Pruning is one of the most important management activities in urban and suburban environments. Sadly, it is often the most improperly implemented. Why?

Improperly pruned trees and shrubs seldom die immediately. Years later when the plant begins to decline, it is hard for us to recognize the link between the bad pruning and the plant's death. If you are going to prune, proper timing, proper location of the cut, and proper technique are critical to plant health.

This first of four publications in the "Pruning Trees & Shrubs" series (AG-780) introduces basic pruning concepts and key terms. Subsequent publications in the series provide more information on woody plant biology, necessary tools, and pruning guidelines for general purposes and specific species.

Definition of Pruning

Pruning describes the removal of plant parts to manage plant growth. Pruning is a science and an art. The biology of plant growth is the basis for the science, while the art comes in when you choose which branches to remove and how to shape certain plants. Getting the art right may take years of practice. But with enough practice and paying attention to the science, you will become proficient. The aim is to make a cut that minimizes plant injury, encourages quick wound closure, and redirects plant growth. **Remember**, pruning inflicts wounds on a plant. Learning as much as you can about plant biology will help you perfect your pruning technique.

Before pruning, ask yourself a few questions: What function is the plant serving in the landscape? Why am I pruning? Why am I removing this particular branch or portion of the plant? How will the plant respond to this pruning? Knowing the answers to these questions will help guide all your pruning activities.

Oklahoma redbud (*Cercis* 'Oklahoma')

Why Prune?

There are five main reasons to prune: (1) training plants for strong structure; (2) maintaining plant health for a long life, including foliage and stem health; (3) controlling growth for clearance, improving the view, and aesthetic value; (4) encouraging flowering and fruit production.

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Training Plants for Strong Structure

Training young plants, particularly trees, is by far the most important type of pruning and often the one most overlooked. Training should start once plants are established in the site. The establishment period depends on the size and health of the plant material, weather conditions, and quality of site preparation. Here in the Southeast, it takes about six months per *caliper* inch (caliper is measured at 6 inches above the rootball) for a tree to establish, as long as the tree is properly watered and the soil is conducive to good root growth. The first step directly after planting is to remove any dead or damaged branches. If you won't be able to get back to this tree within a year or two, take out any *codominant* leaders (branches that will later contribute to poor form or could fail) or rubbing branches. Don't overdo this first step, as the plant needs the photosynthates produced by leaves to help reestablish the root system.

Once established, you can begin an annual or biannual plan to address the plant's structural issues. For trees, it is important to begin to build a strong *scaffold* (permanent branch framework). This will reduce the need to remove large branches later in the life of the tree that may result in larger wounds. In addition, building structure in a young plant reduces long-term costs because it is much more costly to prune larger trees. Pruning young trees also reduces the chance for potential hazards such as branch failure as the tree matures.

You must know the type of plant you are pruning to determine when and how to prune. Always work with the plant's growth habit to emphasize its natural form. While size describes the ultimate height and width a plant can obtain, form describes its shape (sometimes referred to as habit). Excurrent form or pyramidal trees have a central main leader or stem, such as sweet gum, cedar, and some oaks (when young). *Excurrent* form trees may need little pruning to maintain a strong structure. You may need to remove or shorten any branches competing with the central leader. If there is a codominant stem, you must remove it—the sooner the better. You may also need to remove lower limbs to obtain necessary clearance. *Decurrent* form or vase-shaped trees have a rounded *crown* with no central leader and may be upright or vase-shaped forms. Trees with a decurrent form, such as maple, ash, and lacebark elm, may benefit from shortening or removing extremely vigorous branches to maintain the shape. These forms tend to develop branches with weak unions and bark inclusions, thereby requiring regular pruning to develop strong structure. Lightly *thinning* the *canopy* helps all forms of plants develop a healthy structure.

Depending on the plant's function in the landscape, you may need to remove the lower limbs to a specific height so people can walk under the plant, drive by, or have lawn mower access. For example, you may have to maintain

Figure 1.1. On the left is a young southern red oak (*Quercus falcata*) illustrating excurrent or pyramidal growth, and on the right is Chinese pistache (*Pistacia chinensis*) showing decurrent or vase-shaped growth.

Figure 1.2. Branch angles are wide and branches properly spaced for mature growth. Included bark (at arrow in directly adjacent tree) likely contributed to failure of this branch.

street trees with a clear trunk of at least 8 feet on the sidewalk side and 14 feet along the street. Experts refer to this type of pruning as either crown lifting or crown elevation. When maintaining a hedge or screen, however, you do not want to remove lower branches because a hedge provides privacy and a boundary. But you do want to prune for strong structure on large shrubs, such as crape myrtle.

To develop the greatest strength, branches selected for permanent scaffolds should have a wide, U-shaped angle where they attach to the trunk. Relative branch size, however, is more important than the angle of attachment. The diameter of *lateral* branches should be less than three-fourths that of the parent branch or trunk. Prune to slow growth of large, potential scaffold branches to ensure strong attachment and reduce competition with the leader. You can accomplish this by thinning about 15 to 20 percent of the foliage on these branches or trimming off some of the *terminal* growth during young-tree training. The earlier you begin training the tree, the better. If you must make a choice, select scaffolds with wider angles of attachment and growth that is more horizontal (Figure 1.2). These tend to have less vigorous growth. In some decurrent species, the lowest branches often surpass the growth of the trunk and upper branches. As you work to train the tree, make sure

Figure 1.3. Included bark on callery pear

to keep an eye on these branches so they do not outgrow the leader. There may be no need to remove them initially; you may be able to subordinate them by *heading* back the terminal to a smaller branch or bud. Remove branches with *included bark* (see Figure 1.3) to their point of attachment because included bark indicates a weakness.

Maintaining Plant Health

Any time of year is always the right time to remove dead or broken branches. Maintaining health means you will remove weak or damaged, crossing, crowded, or diseased branches. Opening the crown to light and increasing air circulation will potentially help reduce the incidence of

flowering cherry (*Prunus* sp.)

Figure 1.4. Maintain lower limbs while a tree is young to help build taper.

disease, help minimize interior *dieback*, and reduce possible losses in storm events. This does not mean you should remove every interior branch. Remove only those that will negatively affect good structure. Be light-handed with young trees, leaving more branches now than the tree will ultimately retain as it matures. Do not prune if you do not know why the tree needs pruning. Much of the current arboriculture research indicates the tree will develop better form over time and will be less prone to failure if individual branches are retained while the tree is young (especially in the nursery) to help build good *taper*. Once you select the lowest permanent branch, consider those remaining below that as temporary. You will remove these temporary branches over time as the tree grows and builds the needed taper. You may need to tip-back overly vigorous temporary branches to keep them from competing with the leader or potential permanent branches. Later in this publication, we cover specific details regarding where and how to remove branches.

Controlling Growth (For clearance, improving the view, and aesthetic value)

This is the most common type of pruning. Often the reason we must control growth is that we placed a plant in the wrong place. If you must prune a plant every year or every few years to control size, then it is the wrong plant for that site! The first step to minimizing the need for growth control is to select plants that can grow to their mature size in the allotted space. Doing so means understanding the mature height and width of each selection. Many plants come in a variety of heights and widths; select the *cultivar* that fits the available space.

That said, on occasion you will want or need to control the size of a plant and the direction in which it grows. For example, directional pruning can minimize interference with hardscapes, overhead wires, or other plants and minimize the need for severe pruning in the future.

In particular, pruning shrubs to control size is a common management tool. Rejuvenation is a type of pruning that you can use to control growth and to invigorate stagnating plants. *Shearing, espalier, topiary, pleaching*, and *pollarding* are all means of controlling plant growth. Most of these require consistent, yearly pruning to maintain the desired shape and size.

In certain communities, residents are prohibited from removing trees to improve their view of a lake, mountain, or other amenity. In such cases, however, residents are allowed to reduce the height of trees or shrubs by performing a crown reduction. Crown reduction removes terminal branches back to laterals of sufficient size to take over production of photosynthates for the branch lost.

Later in this publication, we will discuss particular types of pruning cuts to help you direct growth, thin, head back, or reduce plant size.

Encouraging Flowering and Fruiting

Pruning affects the balance between vegetative growth and flower bud formation. Timing is critical when pruning for flow-

flowering azalea (*Rhododendron* sp.)

Figure 1.5. Winterberry holly (*Ilex verticillata*, top) and beautyberry (*Callicarpa* sp.) are grown for their colorful fruit. So do not prune off the flowers, as they produce the fruit!

er production. Prune spring bloomers after bloom, and prune summer or fall bloomers in either late fall or early spring.

For guidance on pruning fruit trees, such as apple, peach, cherry, and other common fruit species, check out *Training and Pruning Fruit Trees* by Dr. Michael Parker (NC Cooperative Extension publication AG-29).

How Will the Plant Respond?

Before you begin any pruning, you must know why you are pruning the plant or removing a particular branch, and you must be able to predict how the plant will respond. Here are some important tips.

Young Plants

Invigoration of growth is the most common response to pruning. Removing a moderate amount of leaves or leaf buds has two possible effects: invigoration of individual shoots or dwarfing the entire plant. Removing foliage and buds allows roots to supply more water and nutrients to the remaining branches. Therefore, individual shoots will grow more quickly, producing larger, potentially darker-green leaves to replace

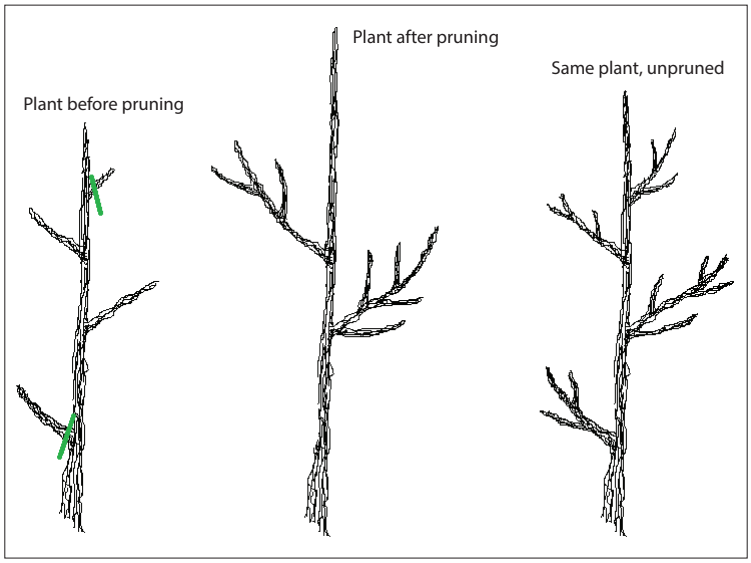

Figure 1.6. The plant on the left was pruned at the green lines. The plant immediately to its right represents the growth response. The plant on the far right shows how the plant would have grown had it not been pruned. The terminals and laterals on the pruned plant grew more directly after pruning. However, the unpruned plant put on more total growth by the end of the next dormant season.

the leaf surface lost. If you severely prune a plant, however, it will have larger leaves but less total leaf area because it will have fewer shoots and thus less capacity to photosynthesize. So the ultimate impact will be dwarfing. Dwarfing occurs because pruning reduces total leaf area and number of buds. Shoots on these plants grow later into the season, using up most of the photosynthates produced by the larger leaves. Once shoot growth stops, the plant will not have time to store any extra carbohydrates or make enough energy for other growth activities. A total reduction in growth occurs, including less caliper growth. Heavily pruning a young plant will result in smaller volumes of roots and shoots than if the plant had not been pruned, and the plant will store less energy. If you want to encourage growth in young shoots, prune lightly or not at all. But if you want to subordinate an overly vigorous branch (or one that is competing with the leader), then prune more heavily.

To encourage young shoots, prune or remove branches that shade or compete with the one you are trying to encourage. Removing dead, weak, or heavily shaded branches will have little or no effect on growth, however, compared to the removal of healthy branches.

Plants that flower on year-old growth

Keep pruning to a minimum and withhold nitrogen fertilizer to encourage more flower bud production and blooming at a younger age. Pruning concentrates nutrients (particularly nitrogen) into fewer shoots, encouraging vigorous growth and reducing flower production (reducing flower buds).

Border forsythia (*Forsythia ×intermedi*a) flowers on year-old growth.

Plants that flower on current season growth

Pruning prior to the growing season will invigorate the plant and encourage more flower buds on lateral stems. Plants that flower on terminals will produce larger flowers or flower clusters. Keep in mind, that whatever you do to encourage flower production also encourages fruit, unless you prune heavily before fruit develops.

Mature Plants

In mature plants, pruning is not likely to lead to dwarfing. In addition, you cannot as easily encourage invigoration in older plants as is possible in younger plants. When you prune an established plant during the dormant season that flowers heavily on year-old wood, the plant will typically produce greater shoot growth and leaf area by the end of the growing season. You will be removing both leaf and flower buds, and no new flower buds will form in the spring. Shoots will grow from remaining leaf buds, however, and produce more growth than if you had not pruned. There will be more leaf and shoot buds than flower and fruit buds. If you prune severely enough, you can encourage substantially more vegetative growth in the future and increase fruit size (though there may not be as many fruits). Pruning a stagnating plant can stimulate new growth and increase overall biomass.

The only pruning you should need to do on mature plants, trees in particular, is thinning. Thinning cuts remove branches at the *branch collar*, using the *branch bark ridge* to guide the cut and achieve the correct angle. *Topping* is a type of heading cut. It removes large portions of biomass and leads to an increase in stem development.

Topping done on mature trees is an unacceptable practice that negatively affects tree health. Main branches are cut back to stubs at random locations. After topping, numerous *epicormic* sprouts grow very quickly from *latent* buds below the pruning wound. This regrowth may be dense, vigorous, and upright. The new shoots are weakly attached to the stem, held on only by the most recent growth ring. Because the cuts are made on larger branches without regard to the branch collar, it will be difficult for the tree to close the wound. It is likely that fungal organisms will cause decay to form in these wounds, thus this vigorous sprout growth is weakly attached to decaying wood and becomes a potential safety concern. Aside from the unattractive nature of topping cuts, the more serious concerns are an increased failure potential and decreased tree health. DON'T TOP PLANTS! (including crape myrtles). It is unprofessional, unattractive, and destructive.

So, before you ever pick up the pruning tools, follow these easy steps:

Blue mist spirea (*Caryopteris ×clandonensis*, right) and Formosa firethorn (*Pyracantha koidzumi)* flower on current season growth.

Figure 1.7. Topped trees may seem healthy for many years after topping because they produced such vigorous growth. This growth however, is often attached to decayed wood and will eventually lead to tree decline and death as shown here on these oak trees.

- Know why you are pruning and how the plant will respond. Have a good reason for removing live branches.
- Know the plant you are pruning. Understand its function in the landscape so that you may better prune it.
- Learn everything you can about woody plant biology so you understand the science of pruning, and take time to perfect the art of pruning. It does take practice.
- Pick the right plants for your site to allow your plants to reach their genetic potential and beauty. This will "cut down" your need for pruning!
- Understand how plants change in time, and adjust your pruning methods and timing accordingly.

Have fun pruning, and check out the rest of the publications in the "Pruning Trees & Shrubs" series to learn more:

- *Tools to Make the Cut* (AG-780-02)
- *General Pruning Techniques* (AG-780-03)
- *How to Prune Specific Plants* (AG-780-04)

This series is a revision of a previous publication: Powell, M.A. (1998.) *Pruning Trees & Shrubs: A Guide for Grounds Managers* (AG-071). Raleigh: NC State University, NC Cooperative Extension. Available from: http://www.ces.ncsu.edu/depts/hort/consumer/agpubs/ag-071.pdf

Figure 1.8. A well-made thinning cut, preserving the branch collar.

Important Terms

Know these terms before making the first cut. Many of these terms occur throughout this publication and others in the "Pruning Trees & Shrubs" series. All of these terms will help you with your plant biology studies.

adventitious growth—Buds that develop from places other than a shoot apical meristem, such as on stem internodes, roots or leaves, and have no pattern to their development.

apical dominance—Natural tendency for the strongest growth to occur on the highest buds (most terminal) on a stem or branches of a plant; hormones control this growth and suppress the growth of lateral buds and branches lower on the stems.

apical control—Refers generally to the suppression of one elongating branch by a higher more vigorously growing branch; often associated with plant form.

bleeding—The oozing of sap through a pruning or other wound.

branch collar—The wood at the branch base that turns abruptly downward to wrap around trunk wood where a branch with a small aspect ratio joins with a larger parent stem.

branch bark ridge—A layer of bark (mustache-like) located on the upper side of a branch, in the branch crotch.

caliper—The diameter of a tree's trunk; measured 6 inches from the ground on trees up to and including 4 inches in diameter and 12 inches from the ground for larger trees.

cambium—A thin area of cells that accounts for growth of girth; it is located beneath the bark.

cane—A generalized term referring to a plant stem; in grapes and brambles it refers to a stem that made its growth the previous year.
canopy—The total area of the branches of a tree or large shrub (crown).
codominant stem or branch—A stem or branch growing at about the same rate and nearly of the same diameter as another stem or branch; both branches originate from the same union; does not have the same structure as a true branch.
crotch—The angle between two branches or between a branch and the trunk.
crown—Refers to either the area of the main stem that is just underground or the total area of the branches of a tree or large shrub (canopy).
crown reduction—Removing terminal branches back to laterals of sufficient size to take over production of photosynthates for the branch lost.
crown thinning—Removing crowded growth from the crown of a tree or shrub to allow more light in and promote healthy growth.
cultivar—A variety of plant that was produced from a natural species and is maintained under cultivation.
deadheading—Removing spent flowers from a plant to make it tidier, promote continued bloom production, or prevent fruit and seed production.
decurrent growth habit—Round-headed and spreading crown; has no main leader.
dieback—The death of tips of shoots or branches, typically spread down the stem and caused by stress, disease, or damage.
elevation (crown lifting)—The removal of low branches to produce a taller clear trunk that increases access under the canopy.

Ginkgo (*Ginkgo biloba*) as an espalier on a wall at the National Arboretum in Washington, D.C. (worth a trip to see this, the bonsai collection, landscapes, and many other natural wonders!)

Crabapple (*Malus* sp.) pleached into informal screen.

epicormic—Shoots that develop from latent buds under the bark; often arise close to pruning or other wounds and from old branches or the trunk; watersprouts and suckers are epicormic shoots.
espalier—A plant trained through pruning to grow in a formal two-dimensional form.
excurrent growth habit—Main stem or leader outgrows and subdues lateral branches; a cone-shaped crown.
girdling—Removing a strip of bark around a branch or main trunk; girdling can lead to death.
heading cut—A pruning cut that removes only a portion of a stem, often at an intermodal area (cut made between two buds or nodes).
included bark—Bark developing between two codominant stems; weakens the union between the branch and trunk and can be a factor in branch failure.

Properly pollarded tree. You may not prefer this type of pruning, but it is a valid means of controlling size.

latent bud—A bud that fails to develop in the season it was formed but remains dormant; its growing point is near the bark surface, and it may later be stimulated into growth; if a terminal is lost, a branch breaks, or is removed just above a latent bud, the bud will likely develop a new shoot (epicormic) to replace the lost wood.

lateral—Bud or branch located along the length of a stem or branch.

leader—A stem that forms the main axis of a woody plant; a plant may have one or many leaders.

node—Point on a stem where a leaf (bud) was or is attached.

phloem—Wood cells that move photosynthates ("food" produced in leaves) throughout plants.

pinching—Nipping out the tip of a growing shoot with your fingers.

pleaching—Informally weaving together tree branches to form a living wall or fence.

pollarding—heading back all annual (or biannual) growth to the same point on a branch (scaffold branches typically), creating a knobby growth called the pollard head that will sprout again the following year; not to be confused with topping that removes branches to a different point on the branch each year.

renovation—Revitalizing a plant, often through rejuvenative pruning back to nearly ground level; can be accomplished in one year or over several years depending on the species.

scaffold branch—Major branches that will make up the primary crown of a tree.

shearing—Tip pruning without selecting individual laterals or buds (topiary or hedge maintenance).

spur—A stubby flowering branch that grows very little each year and is where fruit is produced on many trees.

sucker—An epicormic shoot that arises at or below ground level from a plant's root or underground stem; on grafted plants any shoot that arises below the graft union (from the root stock).

taper—A decrease in trunk diameter with height; building taper is important in the development of a strong trunk that will be able to withstand winds.

terminal bud—Bud located at the end of a stem.

thinning cut—Removing branches at the branch collar, typically done to open the canopy to air movement and increase light penetration.

tip pruning—Pinching out or cutting back the growing tip of a shoot either to encourage side-shoots or to remove damaged growth.

topiary—Practice of pruning a shrub or tree to create a shape or living sculpture; typically accomplished with shearing or heading-back cuts.

topping—Heading a large branch or trunk leaving large stubs; removes natural form of plant and can lead to internal decay and extensive sprout development.

V-crotch—A very sharp, narrow branch angle that may be more prone to breakage and likely formation of included bark.

watersprout—A vigorous vertical shoot growing from a branch above the ground or graft union; mainly from latent buds along trunk or older branches and often stimulated by over-pruning or some other stress.

xylem—Wood cells that move water and dissolved nutrients through the plant.

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