

## Establishment and Care of Woody Ornamentals

Christopher Starbuck, Associate Professor  
Emeritus, Division of Plant Sciences

Trees and shrubs add beauty and value to residential and commercial properties. Well-placed plants can provide color, movement and interesting textures and also reduce energy costs. However, success with woody plants requires care in plant selection, planting and maintenance.

### The right plant in the right place

To develop a good landscape plan, gardeners should select plants that are well suited to the climate and microclimate and avoid plants with characteristics that will create maintenance problems. Planting trees and shrubs that are appropriate for the site will ensure that the landscaping will develop quickly into an asset. In addition to visual qualities, factors that should be considered in plant selection include cold hardiness, preferences for light and moisture, ultimate plant size and pest resistance.

The more you know about a plant, the better you can anticipate potential problems and find ways to reduce or eliminate them before, during or after planting. For example, although Douglas fir grows vigorously in Oregon, it struggles in the Midwest because of frequent droughts and high nighttime temperatures.

### Temperature

Generally, cold hardiness is the first characteristic to consider in plant selection. The U.S. Department of Agriculture (USDA) Plant Hardiness Zone Map provides information on the average minimum winter temperature of different locations in the United States. Missouri climates range from zone 5A (-15 to -20 degrees F) in the north to zone 7A (0 to 5 degrees F) in the tip of the Bootheel. Planting a 'Burford' holly in an unprotected location in Kirksville in northern Missouri (zone 7) would not be a wise decision because of the species' inability to tolerate cold temperatures. The American Horticultural Society (AHS) Plant Heat Zone Map indicates the average number of days when the temperature exceeds 86 degrees F. Most of Missouri is in heat zone 7 (60 to 90 days above 86 degrees). Eventually, plant catalogs and books will list both cold hardiness and heat zones to help gardeners select plants adapted to their locations (see websites listed on page 8).

### Low-temperature injury

Woody plants can be injured by low temperature in many ways, ranging from freezing of flowers and new shoots, to winter desiccation of evergreen foliage, to trunk cracks and root freezing. Damage often results when the temperature changes abruptly from one extreme to another. Dormant plants can withstand much lower temperatures than those that are actively growing.



## Weather extremes

Many problems of woody ornamentals are due to rapid changes from one extreme of moisture or temperature to another.

There have been two notable catastrophic freeze events in the Midwest during the last century. Both occurred on the same calendar date, Nov. 11.

On the first event, in 1911 (11/11/11), many Midwestern hunters froze to death when a giant storm dropped the temperature from 82 degrees F to 13 degrees F within 24 hours.

Then, 29 years later on Nov. 11, 1940, the Armistice Day blizzard hit. Within a few hours, temperatures plunged from near 60 degrees F to about 10 degrees F over much of the region and continued dropping to below zero by the morning of Nov. 13. The precipitous temperature drop, along with warm fall temperatures until that point, caused massive damage to woody plants all over the Midwest. In Missouri, most of the state's fruit trees were destroyed in a single night.

Such extreme events illustrate woody plants' vulnerability to freezing injury in the fall and the spring. Horticulturalists should do what they can to encourage woody plants to develop dormancy and the added cold hardiness associated with it.

A warm period in January will tend to bring trees and shrubs out of dormancy, which can cause freezing injury when temperatures return to normal lows. Avoid cultural practices such as pruning or fertilizing in late summer or early fall because they may stimulate growth and interfere with development of dormancy and cold tolerance. Careful selection of a site that provides winter wind protection will benefit most evergreens by preventing desiccation injury, also known as winter burn.

Trunk cracking is often the result of extremely low winter temperatures. Although such cracking is usually not fatal, it disrupts vascular tissue and provides an entry point for canker-forming fungal organisms and stem-boring insects. Trees in the genus *Prunus*, such as plums and cherries, seem to be particularly susceptible to this type of freezing injury. In some cases, freezing injury causes only the outer layer of bark on trees such as Bradford pear and redbud to slough off and the trees are able to regenerate new bark. In other cases, trees are injured so severely that they eventually die.

Sunscauld, also known as southwest injury, is a type of winter injury that occurs when the sun warms the bark of a tree on the southwest side in late afternoon. When the sun sets, the temperature drops quickly, leading to cell death in the heated area. Wrapping the trunk with a light-colored material or painting it with white latex paint can eliminate this problem. Wrapping with a dark-colored material can actually promote sunscauld.

Roots of woody plants are generally much less cold tolerant than the tops of the same plants. The stems of a boxwood or cotoneaster may tolerate 20 degrees F, but its roots may be damaged by a temperature of 25 degrees F. However, the roots of some plants, such as junipers, are much more cold tolerant. Plants in planters or containers are especially vulnerable to root-freezing injury. To protect them, cover their roots with mulch during winter rather than leaving them exposed.

## Light

Because plants vary greatly in their light preferences, microclimate selection is crucial. Even shade-tolerant plants such as yews, azaleas and rhododendrons need a certain amount of light to remain healthy and perform well in the landscape. Without enough light, many plants will develop large, thin leaves and will flower poorly. Red-leafed plants may remain green. Many plants, such as junipers, which prefer full sun, will survive in shade for some years but will grow slowly and will be more susceptible to diseases and insects. In such cases, landowners may be able to provide more light by pruning overhanging branches nearby.

Conversely, if light intensity is too high, some plants will bleach out, develop leaf scorch or wilt frequently. Providing late afternoon shade will often greatly improve the performance of plants such as oakleaf hydrangea. Azaleas and rhododendrons planted on the east or north sides of buildings usually grow better than those planted to the south or west.

## Moisture

Woody plants also vary widely in their moisture requirements and their ability to tolerate moisture extremes. Evergreens in general and plants in the genus *Prunus* are intolerant of excess soil moisture and should not be planted in poorly drained soils or low spots. Junipers and pines prefer dry soil and can be killed by even short periods of waterlogged soil. Long periods of soil saturation are particularly damaging when temperatures are high. Because roots require oxygen to take up water, the symptoms shown by plants growing in waterlogged soil are usually the same as the symptoms of drought stress.

Many plants can adapt to soils that are moderately dry or overly wet. However, a common problem in the Midwest is that periods with excessive precipitation are often followed quickly by high temperatures and drought.

During a long period of excess soil moisture, plants' root systems become more shallow. Plants in this condition are less able to withstand drought than they normally would and may go into decline. Problems caused by soil moisture extremes can be minimized by careful plant and site selection, soil improvement, grading, irrigation, and increasing subsurface drainage.

Woody plants vary considerably in their drought tolerance. Some plants, including hemlocks, azaleas and clematis, require fairly consistent soil moisture. Junipers, hackberry, most oaks and some pines can tolerate fairly extreme drought conditions. Other plants, such as river birch, tolerate drought by shedding leaves to reduce water loss. Dogwoods, especially those recently planted, commonly develop leaf scorch during drought if their root systems are not adequately established to supply moisture to the foliage. However, trees with leaf scorch can recover and eventually become established if carefully watered.

Automatic lawn or turf irrigation is a common cause of plant death. Excess water may collect in the planting holes of newly planted trees and shrubs, which is particularly damaging when air temperatures are high.

### ***Pest resistance***

Pest resistance is another important factor for landowners to consider as they select plants that will adapt well to a landscape site. Plants with serious pest problems can require frequent maintenance and can detract from the landscape's visual appeal. For example, only plant crabapple cultivars resistant to apple scab and cedar apple rust fungal diseases. Plants such as Alberta spruce that are susceptible to mite injury should not be planted where conditions favor mites, such as against a wall under the eaves of a building. Red maple trees can tolerate considerable leafhopper damage but may grow slowly and have less visual appeal than another tree species with no serious pest problems. Scotch pine should not be planted as an ornamental in this region because it is highly susceptible to pine wilt disease caused by the pine wilt nematode.

### ***Size and habit***

One of the most common landscape mistakes is to plant trees and shrubs in spaces too small to accommodate their ultimate sizes and growth habits. Planting a fast-growing tree like silver maple too close to a building will later create the temptation to top the tree to reduce the likelihood of building damage during windstorms. Planting a white pine 10 feet from a sidewalk creates a long-term pruning problem that will destroy the tree's natural shape. Always look up for power lines and envision the mature size (and shape) of a tree planted nearby. Allowing adequate room for your planting may mean that the landscape looks sparse for the first few years, but the extra space will enhance the beauty and health of the plants as they mature.

In summary, intelligent selection of plants suited to a site's climate and microclimate requires time and knowledge. However, it will pay big dividends in enjoyment and labor savings as the landscape develops.

## Planting and transplanting

Trees and shrubs require special care during the critical period after they are planted in the landscape and before they are established. A tree or shrub must develop roots that can adequately supply its top with water to meet the demands placed on the leaves by environmental conditions. When a tree is dug from the nursery, 50 to 90 percent of its roots are left behind. It may take several years for the plant to regenerate a root system that is similar in size to what it had developed originally. Planting and maintenance techniques are the main factors that determine survival and speed of establishment.

The objective to keep in mind when planting a tree or shrub is to place a plant with good root growth potential into a soil environment conducive to root growth. Root growth potential is influenced by plant health and vigor as well as the time of year. Roots will grow much faster in a loose, well-drained soil with optimal moisture and moderate temperatures than in a compacted, heavy clay soil with high or low temperatures.

heavy clay soil with high or low temperatures.

### Importance of timing

Timing of planting is important for several reasons. First, roots grow in periodic flushes that alternate with phases of top growth. You can take advantage of these periods of natural root growth. Pines, for example, tend to put on an extensive flush of root growth in late summer when the top growth has hardened. Planting at this time will increase the chance of rapid establishment.

Timing will also be influenced by the soil environment. If planted in February or March, roots may regenerate slowly because the soil is cold and wet. Planting in spring's warmer soil conditions is most crucial for plants that tend to regenerate roots slowly, such as scarlet oak, dogwood and hawthorn.

### The planting process

Because transplanting is such a stressful event in the life of a woody plant, it should be done carefully. Prevent the roots from drying out during the time between harvest at the nursery and planting in the landscape. If planting must be delayed, the plant can be "heeled in" (the roots covered temporarily

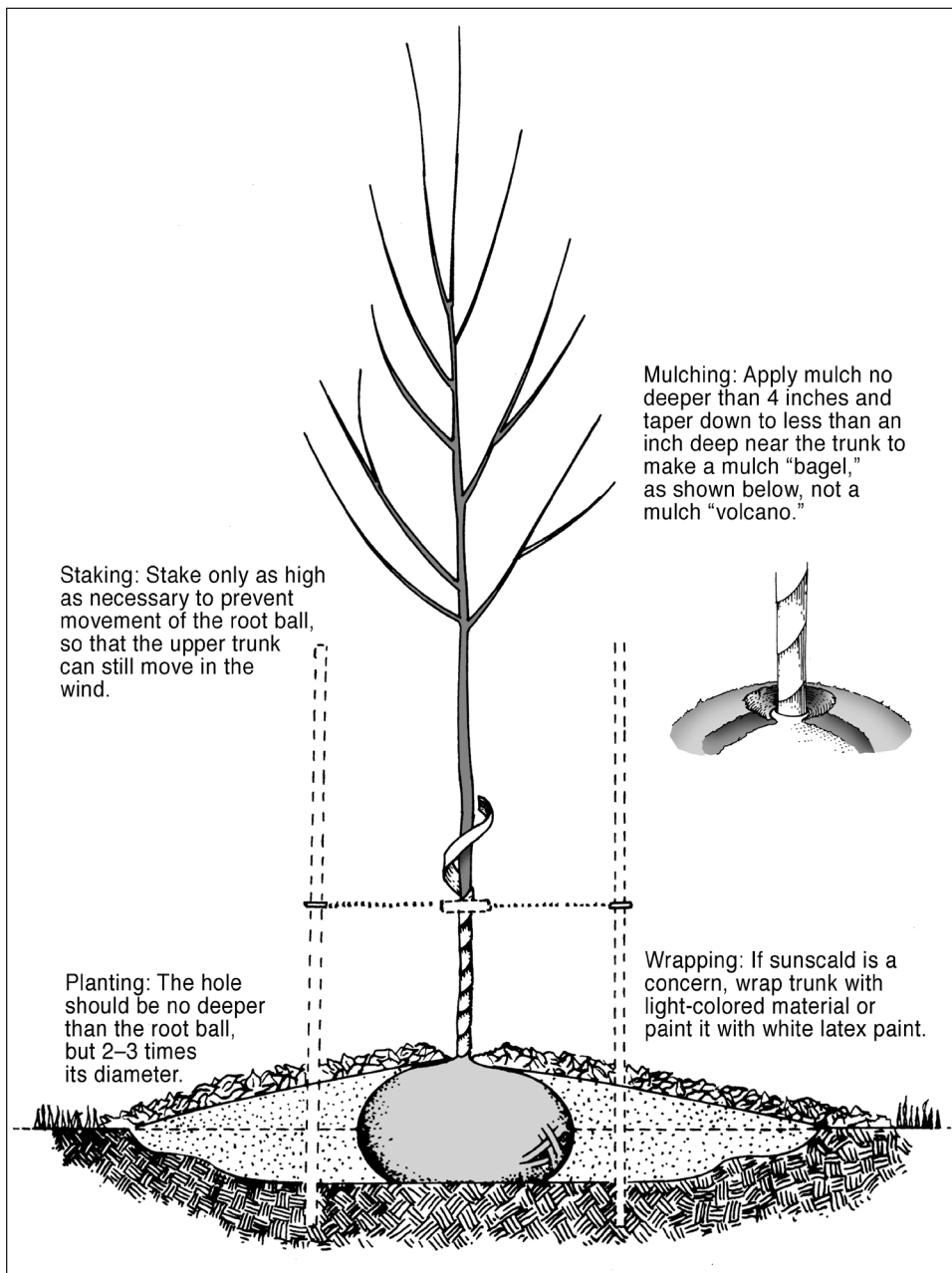


Figure 1. Proper tree planting and maintenance methods.

with soil in preparation for planting) or the soil ball can be covered with mulch. Bare-root plants should have their roots rehydrated after purchase by soaking them in water for a few hours. Do not leave them in water for more than 12 hours as this may actually reduce root growth potential.

Any necessary site modifications, such as amendment with organic matter, fertilization or pruning of overhanging branches, should be done before planting. Because phosphorus (P) does not readily move downward in the soil, the best time to correct phosphorus deficiency is before planting, when the phosphorus-containing material can be incorporated into the soil. If drainage is a problem, consider running subsurface drain tiles or French drains away from planting holes to prevent waterlogging. Even on sloping ground, water running on the surface tends to collect in the loosened soil of a new planting hole during wet periods.

The shape and dimensions of the planting hole are very important (Figure 1). The hole should be no deeper than the soil ball, but two to three times its diameter. If the soil is particularly heavy, most nursery professionals recommend planting in a hole shallower than the root ball and building up a slight mound to cover the root ball. Amending the backfill soil with organic matter such as peat moss or compost can improve the soil structure, but it is generally best to add no more than about 20 percent of the soil volume. Excessive organic matter can increase the “bathtub” effect of planting in heavy clay soil, where water accumulates and does not drain readily. Also, because volume is lost as the organic matter decomposes, the plant may become unstable.

When planting azaleas and other species that prefer soils with high organic matter content but will not tolerate poor drainage, it is generally best with most Missouri soils to create raised beds so that excess moisture cannot collect in planting holes.

Consider planting groups of trees and shrubs in large, mulched planting beds rather than planting each in its own hole. Such groupings simulate conditions in which most plants grow naturally, with shared root zones (Figure 2).

### ***Other cultural practices during planting***

Many large-balled and burlapped trees are sold with wire baskets securing their root balls. There is debate about whether the wire should be removed at planting. Based on the limited research available, most tree-care professionals recommend removing the top ring of wire. This wire can be removed after the root ball is placed in the planting hole. Because most of the roots of a tree are found within a foot of the soil surface, they tend to grow over the wire. Attempting to remove the entire basket may destroy the root ball.



**Figure 2.** Idea for landscape plantings. Consider planting groups of trees and shrubs in large, mulched planting beds. Such groupings can be attractive and simulate natural conditions.

Other important details of the planting process include cutting any rope or twine, including sisal twine, wrapped around the trunk and making certain that no burlap extends above the soil surface to wick moisture away from the root ball. Certain trees with dark-colored bark, such as Norway maple and littleleaf linden, are prone to sunscald and should have their trunks wrapped with a light-colored trunk wrap during the first growing season.

Staking has both advantages and disadvantages. The main advantages are that the tree stays vertical and that new roots growing from the soil ball into the backfill soil are not broken off as the ball moves in the soil. However, rigidly staking a tree can reduce growth in the diameter of the trunk (caliper growth), often making the plant unstable after the stakes are removed. It is best to stake a tree only as high as necessary to keep the root ball steady, still allowing the upper trunk to move in the wind.

### **Minimize pruning**

Most species establish faster if pruning is minimal. Because pruning has an invigorating effect on plants, major pruning should be done in the spring, not in the fall.

### ***Pruning and fertilizing at planting***

In the past, it was generally recommended that newly planted trees be pruned back by about 30 percent to compensate for root loss. However, although certain plants such as peaches respond well to severe pruning, most species establish faster if pruning is minimal. Excessive pruning removes growing points that produce root-stimulating plant growth hormones. Pruning also reduces photosynthetic leaf surface area; sugars from photosynthesis are required for root growth. When planting, however, do prune to remove dead or broken branches and to correct serious structural problems such as narrow branch angles or forked leaders.

Use moderation when fertilizing a newly planted tree or shrub. Excessive nitrogen fertilization can stimulate the growth of rank, water-inefficient foliage at the expense of root growth and thus make the new plant less drought tolerant. Moderate fertilization encourages root growth and can speed establishment. A good approach would be to surface apply fertilizer, one month after planting, with enough material to equal 1 pound of actual nitrogen (N) per 1,000 square feet. This approach assumes that any phosphorus (P) deficiency in the soil has been corrected by incorporating P into the backfill. Mulching with compost or leaf mold may eliminate the need to fertilize.

### **Leaf mold**

Leaf mold is a type of compost made entirely from tree leaves. Often referred to as cold composting, the decomposition process is slow and relies greatly on the action of fungi rather than bacteria.

### ***Maintenance after planting***

It is crucial that the limited root system of a newly planted tree or shrub have enough water to meet the needs of the plant as water is lost by its foliage. Once the plant has regenerated a root system that is in balance with the top, it may require little or no irrigation. However, until roots grow out of the original soil ball, the plant is entirely dependent on the moisture in the ball itself. The water content of the soil 1 inch from the soil ball is of little benefit. A new tree or shrub usually requires small amounts of water applied frequently. For example, a new 2-inch-caliper maple tree might require 10 gallons of water twice a week during July. However, excessive watering should be avoided. Application of 30 gallons of water every two weeks may prove fatal.

The best way to water a new tree or shrub is usually with some form of drip irrigation that delivers a measured amount of water slowly to the root ball. If nothing else is available, a leaky 5-gallon bucket will work well. Nurseries and garden stores often carry drip irrigation tubing and the other components to install a simple drip system. An important part of the system is a timer to turn water off after the desired amount has been applied.

Mulching new plants is extremely important. When done correctly, mulching has many benefits. It can help moderate soil temperature and moisture, reduce surface evaporation, and reduce weed and turf competition for moisture. It also prevents damage from lawn mowers, weed trimmers and other cultural practices that might damage the base of the tree.

Applying mulch too deeply or piling it around the trunk can cause problems, however. In some cases, a deep mulch “volcano” can become hydrophobic, shedding water so effectively that a newly planted tree dies of drought stress. In other cases, roots develop rapidly in deep, moist mulch and are then killed when drought conditions develop. Mulch piled deeply around a tree trunk can limit gas exchange, encourage canker diseases, and serve as habitat for rodents that can girdle the trunk. Another problem with mulch against a tree trunk is that the mulch may absorb solar energy, radiating it back toward the trunk and reducing the cold hardiness of the lower trunk. In general, it is best to apply mulch no more than about 4 inches deep and taper it down to less than an inch deep near the trunk. In other words, make a mulch “bagel” rather than a volcano (Figure 1).

### **Watering established plants**

A woody plant is considered established when the watering cycle can be extended to two weeks during warm weather. This may take two growing seasons in plant hardiness zones 5–7.

## **Caring for established plants**

### **Watering**

As noted previously, established woody plants may require little or no irrigation until drought conditions develop. To estimate how much and how often to water an established tree requires information on the evaporative demand of the atmosphere and the water-holding capacity of the soil. For example, suppose a plant is known to have lost a quarter of an inch of water to the atmosphere on a hot, windy July day. If our landscape plants are growing in a clay loam soil that holds 4 inches of water in the top 18 inches, then we need to irrigate when half of this water is gone. During such conditions, it may take only eight days to deplete the 2 inches of water available in the soil. In this simplified example, we would irrigate with about 2 inches of water every eight days to prevent drought stress. In practice, any amount of water applied to trees and shrubs during drought conditions will be beneficial. It will usually be too costly and impractical to apply the amount of water required to completely eliminate stress.

### **Fertilizing**

The objectives of a landscape nutrition program are to maintain plant health and vigor and to manage plant size and visual appeal. Woody plants differ from agronomic crop plants in that they are perennial, they store nutrients in their stems and roots for long periods, and their “yield” is measured in visual appeal. These features make it a challenge to know when, how much and how often to fertilize trees and shrubs. In general, the color of the foliage and the length of new shoot growth are good indicators of nutritional status. Often, it is advantageous to fertilize young trees and shrubs annually to hasten their development. A mature tree that is putting on 8 to 10 inches of new shoot growth per year may not need fertilization.

Timing is important. For best results, fertilizer can be applied to trees any time from late September through early April. The second-best time to fertilize is in March or April. Avoid late-summer application of high-nitrogen fertilizer that may interfere with the development of cold tolerance.

The type of fertilizer to use depends on soil test results and the age, type and size of plants. For example, if a soil test indicates that the soil in an azalea bed has a pH of 6.8, it would be advisable to use a fertilizer with most of its N in the ammonium form to lower the pH. Regular soil testing will help determine trends and correct problems before they become severe.

It is impossible to cite ideal soil nutrient levels for all of the hundreds of species of plants used in Missouri landscapes. However, most plants will do well if the soil has a pH of 5.5 to 6.5 and contains 35 pounds of phosphorus (P), 1,600 pounds of calcium (Ca), 250 pounds of magnesium (Mg) and 150 pounds of potassium (K) per acre.

### **Drip line**

The drip line marks the outer edge to which a tree’s (or other plant’s) branches spread. It usually indicates a change in microclimate where the area under the tree receives less precipitation, sunlight and wind and may be subject to greater competition from the tree’s roots.

## Suggested soil test levels of nutrients for most woody ornamentals

pH	Pounds per acre			
	Phosphorus (P)	Calcium (Ca)	Magnesium (Mg)	Potassium (K)
5.5–6.5	35	1,600	250	150

### For further information

#### MU Extension publications

*extension.missouri.edu*

G6805 *Selecting Landscape Plants: Flowering Trees*

G6850 *How to Plant a Tree*

G6865 *Fertilizing Shade Trees*

G6866 *Pruning and Care of Shade Trees*

G6879 *Irrigating Trees and Shrubs During Summer Drought*

G6881 *Leaf Scorch of Ornamental Trees and Shrubs*

G6885 *Preventing Construction Damage to Trees*

#### Related reading and websites

Dirr, M.A., 1998. *Manual of Woody Landscape Plants*. Champaign, Ill.: Stipes Publishing.

Harris, R.W. 1999. *Arboriculture*. Englewood Cliffs, N.J.: Prentice Hall.

Pirone, P.P., J.R. Hartman and M.A. Sall. 2000. *Pirone's Tree Maintenance*. New York: Oxford Press.

Missouri Department of Conservation. "Common Plants and Animals," <http://mdc.mo.gov/discover-nature/common-plants-and-animals>

Missouri Department of Conservation. "Forestry," <http://mdc.mo.gov/your-property/professional-forest-management>

National Arbor Day Foundation, <http://www.arborday.org>

Ohio State University. "PLANTfacts," <http://plantfacts.ohio-state.edu>

U.S. Department of Agriculture. "USDA Plant Hardiness Zone Map," <http://planthardiness.ars.usda.gov/PHZMWeb>

American Horticultural Society. "AHS Plant Heat Zone Map," <http://www.ahs.org/gardening-resources/gardening-maps/heat-zone-map>

There are several practical methods of applying fertilizer. The easiest method is surface application. For trees, calculate the area of a circle with a diameter 1.5 times the diameter of the "drip line," and then apply fertilizer on a pound-per-1,000-square-foot basis. Surface-applied N moves readily into the root zone. If turf in an area is fertilized

regularly, trees and shrubs may not need additional fertilization.

If leaves and grass clippings are removed from the landscape, it may be advisable every three or four years to use the "hole" method of fertilization. This practice helps ensure that the nutrients P and K are placed where they can be accessed by the woody plants' roots. Using a soil auger or a heavy-duty drill, bore 1-inch-diameter holes 6 to 12 inches deep and 2 feet apart over the area being fertilized. Start the holes 2 to 3 feet from the trunk. Distribute the fertilizer that would have been applied by the surface method among the holes.

### Mulching

Mulching is nearly as important to the health of woody plants after they are established as it is during the establishment period. Perhaps the most important benefit is that it reduces competition with turf roots. As organic mulches decompose, they create a layer of organic matter at the soil surface similar to that found on a forest floor. This layer of organic matter allows tree and shrub roots to grow near the surface where they have ready access to moisture and minerals.

As noted previously, mulching correctly — with compost or leaf mold — provides nutrients to the roots of woody plants, often eliminating the need to fertilize. On the other hand, mulch can be used in ways that cause problems. For example, if woody mulches are tilled into the soil, they can immobilize nitrogen as soil microbes decompose the high-carbon material. If the same mulch is left on the surface, this problem is usually minimal. In some cases, organic mulch, such as hardwood bark, is stockpiled in high-moisture conditions that lead to fermentation. This fermentation can cause the mulch to give off phytotoxic volatile organic compounds (chemicals that are harmful to plants).

### Managing chlorosis

A common problem with certain plants such as hollies, pin oak and azaleas is chlorosis. This condition, usually characterized by a yellowing of plant leaves, happens when iron in the soil is converted to an unavailable form because of high soil pH (about 7.0 or greater). It can result from irrigation with alkaline water. Correcting chlorosis is difficult. It may take up to 100 pounds of sulfur per 1,000 square feet to lower the pH of a clay loam soil from 7.5 to 6.5. Because sulfur is slow-acting, it is most effective if incorporated before planting. In established landscapes, a more practical approach may be to apply iron sulfate (often sold as "copperas" in garden stores) at about 30 pounds per 1,000 square feet. It can be mixed into water and applied as a suspension to holes bored in the soil as described in the fertilizing section. It should be watered in thoroughly.

Reviewed in February 2016 by David H. Trinklein, Division of Plant Sciences