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Fertilizing Landscape Trees

Hubert P. Conlon
Area Extension Specialist
Ornamental Horticulture

Wayne K. Clatterbuck
Assistant Professor
Forestry, Wildlife & Fisheries

Trees in residential and commercial landscape plantings are often fertilized to keep them healthy and attractive. Over-fertilization is common, causing excessive growth, especially on young nursery stock. Trees growing in lawn areas usually receive some nutrients when the turfgrass is fertilized. This is usually sufficient to maintain most trees in fertile soil. However, fertilization may be needed on altered soils where unconsolidated fill material has been added or the topsoil has been removed. Managed urban areas where fallen leaves are removed may also require a fertilization regime to enrich soil and replenish nutrients.

Fertilizer (plant nutrition) is no substitute for environmental factors, such as sunlight and water, which must be in balance if a tree is to develop its full potential. Trees that are healthy and growing vigorously are less susceptible to attack by insects and diseases. An application of fertilizer may, in some instances, improve the tree's resistance to further infestations of certain pests. For example, maple trees will recover from mild cases of Verticillium wilt following applications of nitrogen fertilizer.

Soil Test

Eighteen nutrients are required by plants: carbon, oxygen, hydrogen, nitrogen, phosphorus, potassium, calcium, magnesium, sulfur and nine trace minerals: iron, boron, copper, manganese, molybdenum, zinc, cobalt, nickel and chlorine. Carbon, oxygen and hydrogen function in the formation of plant cells and food manufacture, the first two provided from the atmosphere and the latter obtained from water absorbed by roots.

A soil test provides specific information on the potential for plant response to agricultural limestone and to phosphorus and potassium fertilizers. It also provides an objective basis for determining how much of those materials to add when they are found to be deficient. A representative soil sample may be a challenge to obtain, since most nutrient-absorbing roots of trees are in the upper 6 inches of the soil and may extend two or three times beyond the radius of the crown. Therefore, in determining the nutritional needs of trees, it is also necessary to consider soil and moisture conditions; the species, age and vigor of the tree(s); and previous fertilization.

Nitrogen

Nitrogen, the most commonly deficient soil nutrient, provides the greatest growth response. Unfortunately, soil tests or analyses for available nitrogen are not very reliable. Nitrogen is present in several forms (e.g. nitrate, ammonium, urea) and these forms can change rapidly in the soil. However, overall tree growth, particularly root and shoot elongation, leaf color and leaf size, can be enhanced with additions of nitrogen. A modest recommendation is to apply 1 to 2 lbs. of nitrogen per 1000 ft^2 (Coder 1997). Be careful not to overfertilize with nitrogen. Do not overcompensate with higher amounts of nitrogen when fertilizing both turf and trees. Nitrate leaches readily from many soils and can cause water pollution problems.

Whether to Fertilize

Several factors should be considered when deciding whether to fertilize. Note the general vigor of the plant and the color of the foliage. Abnormally small leaves and short new twig growth generally indicate a need for fertilizer. Yellow (chlorotic) leaves may be another symptom of a lack of soil nutrients. Damage by insects or disease can sometimes mimic nutrient deficiency symptoms and should be properly diagnosed before applying fertilizer in an effort to correct a lack of soil fertility.

The yearly rate of new twig growth varies with the tree species, soil conditions and environment. Young healthy trees produce approximately 8 to 12 inches of new growth on the main branches each year. As trees mature, their rate of growth may be only half as rapid yet they may still be healthy.

When to Fertilize

The best time to fertilize trees extends from late fall, after the leaves have fallen, through the winter and into early spring before active new growth occurs. Fertilizer applied in the fall has a longer time period to penetrate the soil enabling the roots to more efficiently absorb it. The fertilizer is absorbed by the roots during the winter and is available to the plant for growth in the spring.

In Tennessee, nitrogen fertilizers should not be applied to trees between August 1 and November 15. The nutrient will promote new late season growth prone to low temperature injury and reduce the winter hardiness of the tree. Similarly, heavy nitrogen feeding may increase winter injury in many other landscape plants.

Trees that are rapidly growing should be fertilized yearly. Well-established, mature trees usually need to be fertilized once every three to four years.

Rate, Formulation and Coverage of Fertilizer

The recommended rate of fertilizer application will be determined for most mineral nutrients (other than nitrogen) by a soil test. If the tree(s) have symptoms of nitrogen deficiency, such as yellowing leaves, short shoot elongation or small leaves, then nitrogen should be added. Since nitrogen provides the greatest plant growth response, select a fertilizer that supplies a higher level of nitrogen. Standard fertilizer ratios of 4:1:2 or 3:1:2 for N, P_2O_5 and K_2O (see sidebar) are recommended for most trees where nitrogen is deficient. Fertilizer is sold in many formulations. Several chemicals can also provide the elemental sources of a particular nutrient. For example, nitrogen can be added in the form of nitrate and ammonium. Make sure to use the form with the correct rate per acre as recommended.

Most of the feeder roots of trees are located in the upper 6 inches of the soil and can extend well beyond (two or three times) the crown radius. The popular belief that roots go down as far as the aboveground portion of a tree is a myth. Ordinarily, the roots go down only a third to a fifth of the height of the tree. Since the majority of the roots are in the upper few inches of the soil, deep feeding (e.g. below 6 inches) with nutrients or water is unnecessary. The surface area to be fertilized should begin at the outer two-thirds of the branch spread and extend at least 50 percent beyond the crown radius (Figure 1). No fertilizer should be applied within 12 inches (for small trees) to 18 inches (for large trees) from the trunk, since injury to the root collar and trunk base area is possible.

Method of Application

The most practical and efficient way to fertilize large trees is to broadcast granular fertilizer on the surface of the soil and allow rain or irrigation water to move the nutrients down to the roots. Uniformly broadcast the fertilizer over the area to be fertilized - that area covering the outer two-thirds of the distance between the trunk and the drip line and extending at least 50 percent of the crown radius beyond the dripline.

An alternative method is to place *granular fertilizer into holes* in the soil that are 4 to 12 inches deep. These holes are made in a regular pattern at 2- to 3-foot intervals, in the same area as broadcast fertilizer is applied. Apportion the fertilizer among the holes. This technique does not insure uniform coverage to all feeder roots, especially in the upper few inches of the soil surface where the majority of the roots occur. High concentrations of fertilizers in these holes can also injure roots located adjacent to the hole.

A frequently used commercial method is to inject *liquid fertilizers* into the soil. A special injection rod or probe is used and the fertilizer solution is injected under pressure. A similar probe device called a “root feeder” is sold at most garden centers. The long probe attaches to a garden hose and water-soluble fertilizer cartridges deliver nutrients and water directly into the tree root zone. The tip of the injection needle should be inserted 4 to 12 inches into the soil at 2- to 3-foot intervals. Liquid injection system pressure should not exceed 200 psi. Fertilizers suitable for liquid injection are usually more expensive per unit of nutrient and are often more difficult to apply than granular fertilizers.

Compressed fertilizer “spikes” are another option for tree fertilization. These are driven into the soil with a heavy hammer and can only be used effectively when the soil is moist. The spikes do not evenly distribute fertilizer around the tree’s major feeder roots. Tree spikes are an expensive alternative. Their popularity is based on simplicity and ease of application.

Foliar feeding is a short-term solution when a nutrient deficiency has been diagnosed. The leaves, buds and green wood are capable of some nutrient absorption. Foliar nutrient sprays are applied with a pressure sprayer or siphon sprayer attached to a garden hose. The green-up from foliar spraying is fairly rapid but not long lasting. Usually deficiencies of micronutrients including iron, boron or manganese are corrected by seasonal foliar applications.

Micro-injection is the direct injection of essential nutrients into the trunk of the tree. It is a standard commercial practice for relieving or invigorating trees showing stress or decline symptoms. Nutrients can also be placed in gelatin capsules and implanted in holes in the tree trunk. Micro-injection research is relatively limited and results are often conflicting. Boring holes, implanting or injecting fertilizer and sealing holes can lead to trunk disfiguration and decay.

Table 1. Selected acid-loving trees.

Botanical Name	Common Name
Abies spp.	Fir
Chamaecyparis thyoides	White-cedar
Chionanthus virginicus	Fringe-tree
Cladrastis lutea	Yellowwood
Franklinia alatamaha	Franklin tree
Halesia carolina	Silverbell
Ilex opaca	American holly
Magnolia spp.	Magnolia
Oxydendrum arboreum	Sourwood
Picea spp.	Spruce
Pinus spp.	Pine
Quercus palustris	Pin oak
Quercus phellos	Willow oak
Stewartia malacodendron	Stewartia
Tsuga canadensis	Eastern hemlock

Foliar applications, injections or implants should only be used when soil application of fertilizer is impractical. These procedures are considered short-term cures for nutrient deficiencies and pest infestations. Ultimately, the proper soil and foliar applications must be employed for a long-term cure.

Fertilizing Newly Planted Trees

Newly planted trees usually do not require fertilizer during the first growing season. Most transplanted trees grown in the nursery have high levels of nutrients that last through the first growing season. Excessive fertilization during the first year can damage the tree and reduce its rate of growth. After the first year, nitrogen applied at the rate of 0.05 to 0.25 lbs. (1 to 4 ounces) in a 3 ft^2 area around each tree will ensure an adequate supply for continued growth (Harris and others, 1999). Do not apply fertilizer within 12 inches of the stem of the tree because fertilizer can burn and injure young stem tissue.

Fertilizing Acid-Loving Trees

Some tree species such as pin oak, sourwood, eastern hemlock and hollies prefer a mildly acid soil. The first step is to plant them in soils that are naturally acidic, approximately pH 5.5-6.2, and to incorporate liberal quantities of peat, milled composted pine bark or organic matter into the soil before planting. Table 1 lists some commonly used landscape plant species that require more acid soils for optimum growth.

The rates of application for acidic fertilizers are based on the existing soil pH. Obtain a soil test to determine the pH. The soil test results will then give recommendations on how to lower soil pH, if needed. With new plantings, acidic fertilizers should be thoroughly worked into the soil, along with some organic matter, before planting. Lowering the soil pH to the desired level should be done over a period of years. Never exceed the recommended rates of acid fertilizers containing iron chelates or iron sulfate. Refer to UT Agricultural Extension Service publication SP 534, **Nutrient Deficiencies in Trees**, for information on the relationship between soil pH and the availability of nutrients.

Recommendations

1. Newly planted trees do not require fertilizer during the first growing season.

2. Obtain a soil test to determine nutrient needs.

3. The best time to apply fertilizer is during the dormant season (e.g. December through mid-March).

4. The rate of application and the fertilizer formulation should be determined by soil test.

5. The most practical way to fertilize is to broadcast granular fertilizer over the soil surface. Apply when the surface is dry and allow rain water or irrigation water to move nutrients into the root zone. Use of a granular fertilizer is just as effective as other application methods that are more costly and time-consuming.

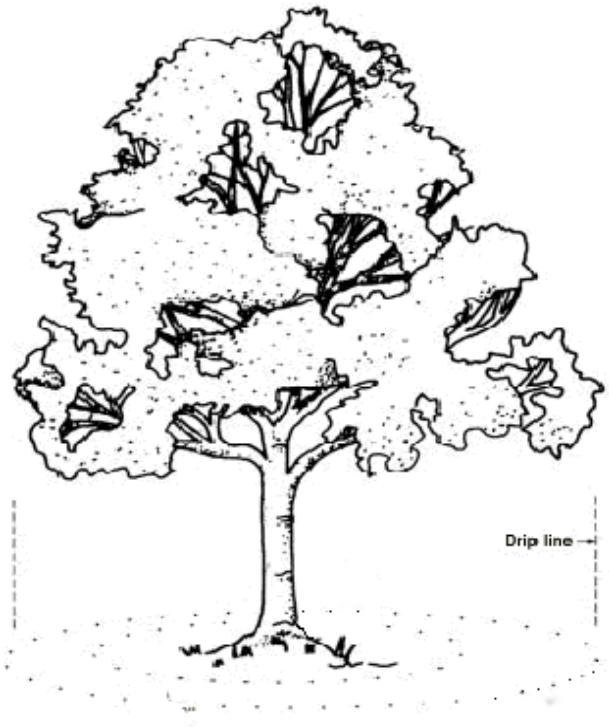

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Figure 1. Fertilizer application area should be extended beyond the drip line.

10-10-10

The fertilizer package has three numbers. They represent, respectively, the percentage by weight of nitrogen (N), available phosphorus (P_2O_5) and water-soluble potash (K_2O). These figures help you choose the right fertilizer and determine how much to apply.

For example, a fertilizer labeled as 10-10-10 contains 10 percent N, 10 percent P_2O_5 and 10 percent K_2O. The remaining 70 percent is usually inert filler.

A product that contains all three nutrients (N, P and K) is called a "complete" fertilizer. Not all conditions require all three nutrients. If one of the three nutrients is absent from the mix, a 0 is listed in that spot.

A soil test (please refer to UT Agricultural Extension Service PB 1061 for soil testing procedures) can easily determine nutrients that are lacking and should be added. Fertilizer formulations are often grouped according to their N-P_2O_5- K_2O ratio. For example, 5-10-10, 8-16-16 and 10-20-20 fertilizers have a 1-2-2 (N-P_2O_5- K_2O) ratio. They should give the same results when applied in equivalent amounts. For example, 10 pounds of 10-20-20 furnishes the same amount of N, P and K as 20 pounds of 5-10-10. Compare the cost of fertilizer recommendations on a nutrient basis (cost per unit nutrient) to determine fertilizer value.

For more information concerning fertilizers — formulation, rate of application and cost comparisons — contact your local county Extension office or retail nursery/garden center.

Selected References for Further Information

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Wayne K. Clatterbuck

Many formulations of fertilizer are available commercially.

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