# FERTILIZING Landscape Trees

MOST HOMEOWNERS understand the need to fertilize their lawns, vegetables, and flowers. They sometimes forget that landscape trees also need adequate nutrition. Trees depend on sunlight, water, air and nutrients for growth. Under natural forest conditions, the annual decomposition of leaves, needles and twigs provides a fresh source of minerals for tree use. However, when landscape trees are grown in lawns, along driveways, walks, or similar areas, they are often denied a portion of this nutrient source.

The type of soil a tree grows in affects its nutrient needs. Topsoil — the surface layer or layers of a normal or undisturbed soil — is more favorable for tree growth than the underlying subsoil. Original topsoil has a higher organic matter content, higher fertility and increased soil tilth, compared to subsoil, which helps supply nutrients needed for plant growth.

Subsoil has lower organic matter content, lower fertility, and less favorable soil structure than topsoil. Exposed Topsoil is commonly found near houses. Top soil is often removed during building or landscaping operations, or covered by subsoil removed during excavation for a basement or foundation. Fertilizer and organic matter will improve the growth and vigor of landscape trees growing in subsoil.

Beyond the topsoil/subsoil issue, two important soil physical properties – soil texture and soil structure affect the nutrient management of landscape trees. Soil texture refers to the percentage of various-sized particles that make up the soil. These particles consist of sand, silt and clay. Soil structure refers to the physical arrangement of soil particles. Soil structure affects aeration, pore space, root development, tilth, and water-holding capacity. Soil structure and soil texture influence amount of water, air, and nutrients held in the soil.

Clayey soils have a high percentage of fine particles. These soils tend to compact and restrict water and air movement into and through the soil. Sandy soils, in contrast, contain many coarse particles, and create large soil pores with little capacity to store water and nutrients. Soil texture is difficult to modify even in a small area by mixing large amounts of sand, silt or clay into an existing soil. A better approach for homeowners with a high percent of sand or clay is to add copious amounts of organic materials. Organic materials must be thoroughly mixed into the soil. Organic materials improve soil structure and reduce the effects of poor texture. Repeated applications of organic matter may be needed depending on the amount applied and the stage of decomposition or type of the organic matter used.

MICHAEL COLT, TERRY TINDALL, DAN BARNEY, AND BOB TRIPEPI

## NUTRIENT DEFICIENCY SYMPTOMS

No single symptom tells you that trees need additional fertilization. Some symptoms can indicate the need for certain nutrients. Similar symptoms, however, can also be caused by herbicide damage, inadequate or excess irrigation, diseases, or other problems. Nutrient deficiency symptoms include leaves smaller than usual, light green or off-color leaves, dead leaves and twigs on the ends of branches, little branch elongation during the growing season, or general lack of vigor. If any of these symptoms are present, trees may benefit from fertilization. Similarly, trees that are injured or stressed by insects, disease, hail, chemical damage from pollutants and pesticides, competition from nearby trees, or other problems, fertilization may speed recovery. Nutrien ts will not improve growth unless these factors are corrected first.

The amounts of shoot or twig growth depend on the individual species or cultivar and the site where the tree is growing and, it is difficult to know how much growth to expect. You can check the vigor of several twigs by measuring down from the tip of the twig to the first ring (bud scale scar). This branch section is the current season's growth. (Fig 1). Young shade trees usually have twig growth of 9 to 12 inches per year, and mature trees usually grow of 6 to 8 inches per year. A tree under nutrient stress may have a slow growth rate, small leaves, fewer flowers, and smaller fruit. The foliage may also be pale green or yellow (chlorotic) with mottling between the leaf veins. Proper tree nutrition improves growth, increases leaf size, improves leaf appearance and color, increases wood strength, and encourages development of a more extensive root system.

**Iron Chlorosis** On alkaline calcareous soils (soil pH greater than 7.0) leaves may become yellow or, yellow-green color in the areas between the veins, usually causing the leaf veins to be a darker green color. This condition, called "iron chlorosis," is associated with a lack of available iron and is common in southern Idaho. The chlorosis may affect only on a single branch or may affect the entire tree.

Excessive irrigation increases chlorosis problems. Iron absorption by tree roots is limited under waterlogged conditions. Before fertilizing, make sure your soils are well drained and not over watered.

Iron chlorosis can be corrected by adding available iron or by increasing the soil acidity. Iron sulfate or chelated iron compounds can provide an immediate supply of available iron. They may be applied to the foliage or soil.

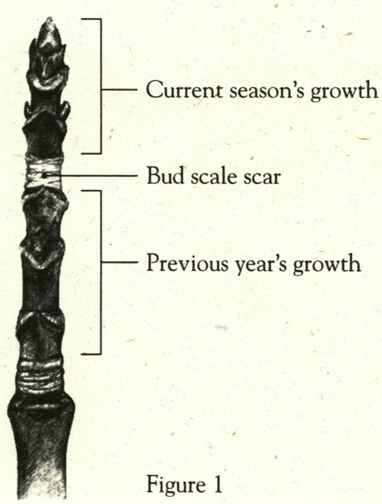


Figure 1



On calcareous soils where iron chlorosis most frequently occurs, adding iron to the soil is usually ineffective. Under these conditions, foliar-applied iron chelates applied directly to leaves are more effective. When using iron chelates, be sure to follow the label directions. First test the chelate product on a few leaves or branches and check for leaf damage from the compound before spraying the entire tree. If the tree grows continually through the summer or grows again after the first foliar application, then the iron chelate will need to be applied again because iron is rarely translocated from old tissue to new foliage in plants.

You can lower your soil pH by applying powdered sulfur or other acid-producing material. These treatments are usually only cost effective for small areas, such as a yard or garden. Apply at the rate of 2 to 4 pounds per 100 square feet depending on soil texture and alkalinity. You may need to repeat the treatments to maintain a satisfactory soil pH. For additional information on iron chlorosis, refer to CIS 1042 "Controlling Iron Deficiency in Idaho Plants."

**Determining nutrient deficiencies by soil testing** Soil testing is the basis for many fertility recommendations on annual crops but has less application on perennial plants such as landscape trees. The most valuable information revealed through the soil test is soil pH. It also gives a measurement of the levels of potassium, phosphorous, and minor nutrients such as zinc. However, no standards of the relationship between soil fertilizer application and tree responses exist. Although nitrogen is the most important component of many fertilizers, the soil test does not provide information about nitrogen because nitrogen can be rapidly lost through leaching (carried away by soil water) or removed by plants.

**Determining nutrient deficiencies by leaf tissue analysis** Leaf tissue analysis is a useful technique to assess the nutritious status of fruit trees such as apples and peaches because the leaf samples are taken at terminal bud set about August 1 and these results are then compared to the crop produced. However, there are no standards established of how much of a given nutrient needs to be added to soil to adjust the leaf tissue levels to a particular point. Soil applications are adjusted based upon the fruit growers experience. With ornamental trees, the tables of interpretative values are being developed but the preciseness of the numbers is still limited because of the vast numbers of individual species and cultivars and the lack of standardization when the samples are taken.

## FERTILIZER COMPOSITION

Fertilizers are added to the soil to supply one or more of the 16 elements needed for plant growth. Many kinds of materials are used as fertilizers.

**Organic Fertilizers** Peat moss, sawdust, and woodchips have little nutritive value and may actually tie up nutrients, particularly nitrogen. Manures supply substantial amounts of nutrients if applied at sufficient rates. Compost is well decomposed organic matter, and contains many nutrients. Nutrients from compost and manures become available more slowly than from inorganic fertilizers.

**Inorganic Fertilizers** Most commercial fertilizers consist of inorganic minerals, either alone or blended together, to provide one or more essential elements. The three most common nutrients include nitrogen (N), phosphorus (P) and potassium (K).

Manufactured fertilizers differ in the amount of available nutrients they contain. State laws require that amounts and forms of each nutrient present in fertilizers be printed on the package. The fertilizer grade is commonly expressed with three numbers, e.g., 9-12-8 (Fig. 2). The first number, 9, in this example, refers to the percentage of elemental nitrogen present. The second number, 12, is the available phosphorus expressed as the percentage of $P_2O_5$. The third number, 8, is the available potassium expressed as percentage of $K_2O$. A 100 lb. sack of 9-12-8 will contain 9 lb. of N, 12 lb. of P and 8 lb. of K.

Because many different mineral combinations are available, homeowners need to understand that a pound of fertilizer labeled 12-12-5 contains twice as much nitrogen, 20 percent more phosphorus, and 25 percent more potassium than a pound of 6-10-4. This difference means you must apply twice as many pounds of 6-10-4 than 12-12-5 to obtain the same amount of nitrogen. This difference in mineral content is why some fertilizers are more expensive than others.

Note: Be careful when using lawn fertilizers that contain weed killers, often called "weed and feed" fertilizers. The herbicides in these fertilizers can severely injure or kill trees and shrubs if the formulation is not applied according to specific label directions. If you employ a lawn care professional or company, be sure you understand their lawn care program.

Figure 2. The amount and form of nutrient materials in a manufactured fertilizer are listed on the package. Other information regarding the composition of the fertilizer is also included.

Net wt 20 pounds, 9 - 12 - 8

**GUARANTEED ANALYSIS**

| | |
|---|---|
| Total Nitrogen (N) | 9.0% |
| 9.0% Ammoniacal Nitrogen | |
| Available Phosphoric Acid ($P_2O_5$) | 12.0% |
| Soluble Potash ($K_2O$) | 8.0% |

Potential acidity 875 lb. Calcium Carbonate equivalent per ton. Derived from ammonium sulfate, ammoniated phosphates, and muriate of potash.

**Timing fertilizer applications**

Because root growth begins in the spring before leaf development, apply fertilizers as soon as the soil temperature rises above 40°F at 2 inches below the soil surface, usually during March or April. Fertilizer applied in early spring with adequate moisture to move it into the root zone becomes available for the plant use as soon as root growth resumes. Avoid fertilizing in summer and early fall. Late fertilization with nitrogen produces succulent tree growth that does not become winter hardy. Landscape plants can also be fertilized in fall after the plant shoots become dormant but soil temperature is above 40°F and adequate moisture is present. Evergreens store nutrients in their leaves, stems, and roots, whereas deciduous plants store nutrients in their stems and roots. Stored nutrients are readily available when shoot growth resumes in spring.



## Fertilizer application methods

Many different application methods have been developed for tree fertilization. Methods include:

- Application directly to the soil surface. (broadcast or topdress)
- Application (dry or liquid form) in holes in the soil beneath the canopy and extending beyond the dripline.
- Foliar sprays.
- Trunk injection (best left to a certified arborist) should be used only for minor elements.
- Tree spikes and slow release pellets.

Fertilizer compounds applied to the soil surface or in holes in the soil provide longer lasting effects than foliar sprays. Foliar sprays are best used to supply nutrients plants use only in trace amounts, such as iron, zinc, and manganese. Tree spikes and slow release pellets may delay the development of winter hardiness.

Fertilization frequency depends on the application method and the amount and form of material applied. For example, nitrogen plays a key role in plant growth. Idaho soils often contain about three times as much nitrogen as phosphorus or potassium. Because more nitrogen is required than phosphorus or potassium, nitrogen fertilizers should be applied annually. Phosphorus and potassium can be applied every 3 to 5 years. Potassium is usually abundant in most Idaho soils except in northern Idaho forest soils. Phosphorous is often deficient in the acidic, volcanic ash soils in northern Idaho.

Water will readily move nitrogen from the soil surface into the root zone, making it available for use by tree roots. In contrast, both potassium and phosphorus move slowly in the soil and are best applied in the root zone by making holes with a punch bar or soil auger. Holes should be up to 12 inches deep and 1 to 2 inches in diameter. Larger holes are not as effective. Make holes in concentric circles around the tree trunk with the first circle no closer than 3 feet from the trunk. Make successive circles at 2-foot intervals. Distances between adjacent holes on each circle should be at least 2 feet. Extend the circular pattern of holes for a few feet beyond the drip line or edge of the crown. The amount of fertilizer placed in each hole will depend on the total amount being applied to the tree and the number of holes. To determine this amount, divide the total amount of fertilizer required for the tree by the number of holes.

To avoid uneven grass growth, place fertilizers at least 2 to 3 inches below the soil surface. After adding fertilizer, fill each hole with peat, compost or sand. These materials allow good water penetration into the fertilizer material.

**Determining fertilizer quantities**

Recommended fertilizer rates are calculated using the ground area under the tree canopy. This approach is more accurate than using trunk diameter to calculate fertilizer rates.

The amount of fertilizer to add depends upon the fertilizer composition. Rates are usually calculated using desired nitrogen rates and nitrogen content in the fertilizer (Table 1).

Table 1. Quantities of common fertilizers needed to provide equivalent amounts of nitrogen. Application rates expressed pounds of fertilizer material per 100 square feet of ground area.

| Fertilizer analysis1/ | 0.4 lb N per 100 sq. ft. | 0.25 lb N per 100 sq. ft. |
|---|---|---|
| 2-3-2 | 20.0 | 12.5 |
| 4-10-4 | 10.0 | 6.2 |
| 6-10-4 | 6.8 | 4.2 |
| 8-10-8 | 4.8 | 3.0 |
| 10-10-5 | 4.0 | 2.5 |
| 12-12-5 | 3.2 | 2.0 |
| 14-10-0 | 2.4 | 1.5 |
| 16-20-0 | 2.2 | 1.4 |
| 20-16-0 | 2.0 | 1.3 |
| 21-0-0 | 2.0 | 1.3 |
| 33-0-0 | 1.2 | 0.8 |
| 45-0-0 | 0.8 | 0.5 |

1/The fertilizer analysis is shown on all containers. The first number shows percent total nitrogen (N); the second, percent available P2O5; the third, percent water-soluble K2O. A 2-3-2 analysis contains 2 lb N, 3 lb P2O5 and 2 lb K2O per 100 lb of fertilizer. A 16-20-0 analysis contains 16 lb N, 20 lb P2O5 and no K2O per 100 lb of fertilizer. A 45-0-0 analysis contains 45 lb N and no phosphorus or potassium per 100 lb of fertilizer. Ammonium sulfate (21-0-0) contains 24 percent sulfur and 16-20-0 contains 15 percent sulfur. Other mixes may contain zinc and other micronutrients. Check the label.

Nitrogen rates range from 0.2-0.4 pounds N per 100 square feet. Excess nitrogen can be detrimental to plant growth.

Here are examples of fertilizer application rates in several different situations:

**Small deciduous tree (less than 25 feet high)** a. Apply nitrogen (such as 21-0-0) annually at the rate of 0.2-0.4 pounds of actual nitrogen per 100 square feet of soil surface beneath the tree.

b. At 3- to 5-year intervals, apply a nitrogen and phosphorus fertilizer such as 15-10-0 or a complete fertilizer, such as 6-10-4 or 12-12-5 into holes around the tree. Use a rate equal to 0.2-0.4 pounds of nitrogen per 100 square feet of soil surface beneath the tree. The amount of fertilizer varies with tree size and the extent of the root system.

To calculate the surface area under the tree canopy: Surface area = Radius$^2$ x 3.14. (The radius is the distance from the trunk to the edge of the branch spread or dripline.)

For example, a tree with a total branch spread of 36 feet would have a radius of 18 feet. According to the formula, the area would equal $18^2$ x 3.14, or 1,017 square feet. In this case, add about 2 to 4 pounds of actual nitrogen.

To make your computations easier, consider the circular area beneath the tree's crown to be a square or a rectangle. The sides of this rectangle are the length and width of the tree's crown. Remember where possible to extend the distances a few feet beyond the tree's drip line.

If a sidewalk, driveway or some other obstacle blocks the area beneath the tree's crown, reduce the total amount of fertilizer applied to the tree should be reduced to match only the surface area that fertilizer can be applied to. Do not apply excessive amounts of fertilizer to only one side of the tree. Apply smaller and more frequent fertilizer applications in this situation. Where rooting is limited, such as when trees have been planted in containers, special practices are required. Apply fertilizers frequently in small amounts. Liquid or water soluble fertilizers work best for plants in containers. Always follow label directions.

The rate of fertilizer is similar to that recommended for blue grass lawns but this amount of fertilizer would be applied to the tree in a single application and to lawn in 3 applications or more. This rate would damage an average lawn.

**Flowering ornamental and other small fruit trees** Excess applications of nitrogen may reduce flowering and fruiting. If fertilization is necessary, apply N and P fertilizer such as 15-10-0 or a complete fertilizer such as 6-10-4 or 12-12-5 in soil holes in the spring at the rate of 0.25 pounds of N per 100 square feet.

**Large trees (deciduous and evergreen)**

At 3 to 5-year intervals, apply a nitrogen and phosphorus fertilizer such as 15-10-0 or a complete fertilizer such as 6-10-4 or 12-12-5 in holes at a rate equal to 0.4 pounds of N per 100 square feet of soil surface beneath the tree's crown.

For a fertilizer with an analysis not listed in Table 1, select the closest analysis and apply that rate. To convert rates to larger areas, first divide square feet of ground area to be fertilized by 100 square feet. Then multiply times the rate given for 100 square feet (Table 1).

## Sample Calculations

1. Given: Area = 20 ft x 20 ft; fertilizer analysis = 10-10-5; N application rate 0.4 pounds N per 100 sq ft

Desired: Fertilizer application rate (Table 1), 4 pounds of 10-10-5 fertilizer material per 100 sq ft of ground area.

Calculations: 20 ft x 20 ft = 400 sq ft = 4.0
100 sq ft

4.0 x 4 lb (rate of application) = 16 pounds.

Conclusion: 16 pounds of a 10-10-5 fertilizer applied to 20 ft x 20 ft area under tree canopy. (Most dry fertilizers weigh about, 0.5 pounds per cup 1 pound per pint and 2 pounds per quart.)

2. Given: Area = 8 ft x 12 ft; fertilizer analysis = 4-10-4; N application rate = 0.25 pounds per 100 sq ft

Desired: Fertilizer application rate (Table 1), 6.2 pounds of 4-10-4 fertilizer per 100 sq ft of ground area.

Calculations: 8 ft x 12 ft = 96 sq ft = 0.96
100 sq ft

0.96 x 6.2 = 5.24 pounds.

Conclusion: 5.24 pounds of 4-10-4 fertilizer material applied to 8 ft x 12 ft area under tree canopy.

**About the authors** W. Michael Colt is an Extension horticulturist at University of Idaho's Parma R&E Center. Terry Tindall is a former Extension soil scientist at UI's Twin Falls R&E Center. Danny L. Barney is an Extension horticulturist at UI's Sandpoint R&E Center. Bob Tripepi is an associate professor in UI's Department of Plant, Soil, and Entomological Sciences.

College of Agriculture
University of Idaho

Cooperative Extension System
Idaho Agricultural Experiment Station

Issued in furtherance of cooperative extension work in agriculture and home economics, Acts of May 8 and June 30, 1914, in cooperation with the U.S. Department of Agriculture, LeRoy D. Luft, Director of Cooperative Extension System, University of Idaho, Moscow, Idaho 83843. The University of Idaho provides equal opportunity in education and employment on the basis of race, color, religion, national origin, age, gender, disability, or status as a Vietnam-era veteran, as required by state and federal laws.

1,000 10-97 Produced by Ag Communications CIS 1068 $1