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NebGuide

University of Nebraska–Lincoln Extension, Institute of Agriculture and Natural Resources

Know how. Know now.

G1466
(Revised March 2004)

Determining the Need to Fertilize Landscape Trees and Shrubs

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This NebGuide explains how to determine if fertilization of established trees and shrubs is required and how to apply the needed amount.

Most Nebraska soils are fertile enough to support tree and shrub growth without applying fertilizer. However, when woody plants exhibit poor growth or reduced vigor, yet have had adequate moisture and are not experiencing pest problems or other environmental limitations, the proper application of fertilizer may be necessary.

Landscape trees and shrubs are occasionally subject to adverse soil and environmental conditions. Redistribution and compaction of the original soil profile during home construction, poor drainage, removal of twigs and leaves that normally decompose to provide nutrients, heavy grass sod competition, and extreme pH levels are some factors that contribute to nutrient deficiencies. Supplemental nutrients may sometimes be needed to help trees maintain vigor.

Most trees and shrubs will not require fertilization. Vigorous growth is a good indication that a tree or shrub is receiving a sufficient nutrient supply. Less vigorous plant growth and poor color usually indicate an insect or disease problem, environmental stress, poor root development or damage, moisture deficiency, or other factors not related to fertility. Being familiar with normal growth for a specific tree or shrub species and the associated site conditions will help determine the need for fertilization.

Determining Whether to Fertilize

Trees obtain nutrients for plant growth from the soil through their roots. The major nutrients include nitrogen, phosphorus and potassium. Of these, nitrogen is the most likely to be deficient. When needed and applied properly, nitrogen will give the most immediate growth response.

There may be a combination of symptoms apparent in a nutrient-deficient plant. Some of the more easily identified symptoms are: general lack of vigor or growth; presence of small, stunted or off-colored (usually yellow) foliage; dead twigs on small branches; and stunted twig growth.

Generally, new twigs should grow 6 to 12 inches annually on young, established trees; 4 to 9 inches on middle-aged trees; and less than 4 inches on mature trees. Individual tree size must be compared to what is typical of that tree since growth will also depend on site characteristics. When using these guidelines, keep in mind the non-fertility-related reasons for poor plant growth that were stated earlier, such as moisture deficiency, compaction and poor drainage.

A current year's twig growth is measured from the tip of the twig to the first ring of bud scale scars located back down the twig. The previous year's growth can be obtained by measuring from one ring of bud scales back to the next and

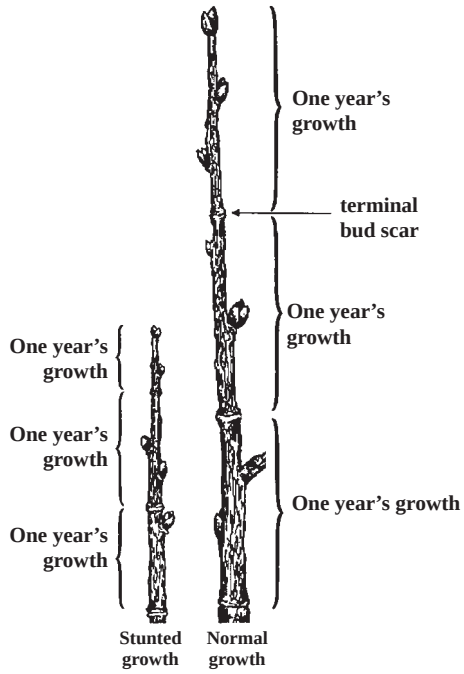

Figure 1. Growth comparisons of a twig sample from a stressed tree with a twig sample from a healthy tree.

so on (*Figure 1*). Soil tests can provide additional evidence of nutrient deficiencies where tree growth is slower than expected.

It is recommended that two soil samples be taken, one from the 0 to 6 inch depth, and the other from the 6 to 18 inch depth. If the average nitrogen concentration of the two samples is less than 10 parts per million (ppm), then the plant may respond to nitrogen fertilization. Phosphorus and potassium should be applied on soils that test very low for both depths. Unfortunately, since the relationship between soil nutrients and landscape plant growth has not been well documented, specific guidelines for the amounts of many nutrients needed by trees and shrubs are not available.

Reading the Fertilizer Label

Most fertilizers for trees and shrubs are a composition of three major nutrients: nitrogen (N), phosphorus (P_2O_5) and potassium (K_2O)*. The amount of each nutrient present in the fertilizer is listed on the fertilizer container by three percentages representing nitrogen, phosphorus and potassium, respectively *(Figure 2)*.

For example, a fertilizer with the analysis of 10-6-4 has 10 percent nitrogen, 6 percent phosphorus and 4 percent potassium. This means that 10 pounds of 10-6-4 fertilizer will contain 1 pound of nitrogen, the same amount of available nitrogen as 5 pounds of 20-6-4 fertilizer (10 percent of 10 lbs.=1 lb.; 20 percent of 5 lbs.=1 lb.).

To prevent plant injury, avoid using fertilizer-herbicide or "weed-and-feed" combinations. Herbicides should be applied separately at the rates suggested on the label. Some soil-active herbicides that control weeds can damage trees if not properly used.

Figure 2. Sample fertilizer bag showing composition of three major nutrients (nitrogen, phosphorus and potassium).

* Phosphorus and potassium are recommended and sold on the basis of pounds of P_2O_5 and K_2O. For a complete explanation, see NebGuide G90-945, *A Gardener's Guide for Soil and Nutrient Management in Growing Vegetables.*

Fertilizer Application Techniques

Fertilizers can be applied to landscape plants through foliar sprays, trunk injections or applications on or beneath the soil surface. The method selected depends on the type of fertilizer being used, the specific purpose for fertilizing, soil conditions, tree location, the presence of quality turf, ease of application, equipment used and cost.

Foliar sprays, trunk injections and trunk implants are limited in the quantity of nutrients they can supply to woody plants. They are recommended for applying micronutrients like iron or manganese when availability from the root zone is reduced due to soil pH, moisture relationships or other conditions. Trees under moisture stress should not be treated with trunk injections or foliar sprays.

Woody plants take up nutrients through the root systems and, in most cases, respond best to soil applications of fertilizers. Recommended soil application methods include surface broadcast, drilled hole technique and soil injection.

Nitrogen

Research indicates that surface-applied nitrogen is as effective as nitrogen applied below the surface. Nitrate nitrogen will move through the soil to the roots as water moves downward. Due to the potential damage to grass under trees, surface applications for woody plants where good grass cover is present should not exceed 1.5 pounds of actual nitrogen per 1,000 square feet of ground area per application. This will reduce the risk of "burning" the grass. Homeowners who fertilize nearby turfgrass do not need to apply additional fertilizer for their trees.

Fertilizer can be applied with a spreader calibrated to apply the recommended amount. Start 2 to 3 feet from the trunk and move outward in concentric circles to 2 to 3 feet beyond the drip line (end of branches). Care should be taken to avoid overlapping. Immediately irrigate to move fertilizer into the soil profile. This method is quick and inexpensive but may cause excess grass growth or burning of quality turf areas.

Phosphorus and Potassium

Most soils in North America contain enough phosphorus and potassium to satisfy the needs of trees and shrubs. Deficiencies of these two nutrients typically occur only in areas where much of the surface soil has been removed. If a soil analysis indicates the phosphorus level is less than 6 ppm (Bray #1) or 4 ppm (sodium bicarbonate), or potassium is below the range of 75 ppm (extractable K), then applications of one or both of these to bring the nutrients to these respective levels would be beneficial for tree and shrub growth. Levels of these nutrients above their respective ranges should be avoided because of the negative effects excessive amounts can have on the uptake and utilization of other nutrients.

Work sheet for Determining Nitrogen Fertilizer for Trees

A. Determine need

1. Nitrogen rate: 1.5 lbs. actual N/1,000 sq. ft. if soil N from several soil samples at several depths is less than 10 ppm or 24 lbs. per acre.

2. Phosphorus rate: 1 lb. P_2O_5/1,000 sq. ft. if soil test very low (Bray #1 less than 6 ppm or Sodium bicarbonate less than 4 ppm) (See "Note" below)

3. Potassium rate: 1 lb. K_2O/1,000 sq. ft. if soil tests low (Extractable K less than 75 ppm) (See "Note" below)

4. Square ft. under tree

   i. Distance from trunk to drip line _____ ft.

   ii. Total square feet under tree _____. (*See Table I*)

   iii. Adjust for areas not in soil or grass
   Total square ft. - area in pavement = _____ adjusted sq. ft.

B. Determine actual amount N needed

1. Total N needed

$$1.5 \text{ lbs. N/1,000 sq. ft.} \times \frac{\text{Area to fertilizer (A.4.iii)}}{1{,}000} = \_\_\_\_\_ \text{ total N needed}$$

2. Adjust for N concentration in fertilizer

   i. Percent N concentration in fertilizer = _____

   ii. Convert to fraction %/100 = _____

   iii. $\frac{\text{Total N needed (B.1)}}{\text{Fraction N in fertilizer (B.2.ii.)}}$ = _____ lbs. fertilizer needed

NOTE: Most soils will not need phosphorus or potassium. Generally you have to buy mixtures of nitrogen-phosphorus-potassium. You will have to use the mixture that has the closest ratio of nitrogen-phosphorus-potassium that is needed. If you determine that phosphorus and potassium are not needed, select a fertilizer formulation that has low amounts of these nutrients.

When phosphorus or potassium applications are recommended, vertical holes or injections into the soil profile work best. These nutrients are less mobile in the soil and therefore need to be applied near the roots. The drilled hole technique requires the most time, but can also be the most efficient, especially with nutrients that are less mobile. Use a soil probe or auger to dig 1- to 2-inch diameter holes 12 to 18 inches deep and 2 feet apart. These holes should be no closer than 2 to 3 feet from the trunk and should extend at least 2 to 3 feet beyond the drip line of the tree or shrub. Approximately 250 holes are needed per 1,000 square feet, or 4 square feet/hole.

Distribute the recommended amount of complete fertilizer equally among the drilled holes. To reduce turfgrass injury, keep the fertilizer level in each hole at least 4 inches below the soil surface. Depending on the size of the hole, the top can be filled back with soil or, if possible, by pressing the hole shut with the heel of one's shoe. If one uses a soil probe, the grass plug can be replaced. Irrigation following fertilizer application will help to prevent injury to turf, but do not flood the area because dissolved fertilizer may burn turf. An advantage of the drill-hole method is that in compacted soils, the holes may help increase water and air distribution into the soil profile.

Liquid, or soluble, injection is an alternative to the drill-hole method. However, since equipment costs are high, it is best done commercially.

Root feeders may be effective for applying phosphorus and potassium if they are inserted 12 inches or less in the soil and if the recommended fertilizer rates are used. They are convenient, but the cost of nutrients in water soluble form is usually higher than dry granular fertilizers. Due to the higher cost, there is a tendency to cut back on the amount of fertilizer applied.

Regardless of the method of fertilization, irrigation following the application will help prevent injury to turf. Again, do not flood the area since dissolved fertilizer may burn turf.

Fertilizer Application Rates

Calculating fertilizer rates based on surface area is the recommended method for Nebraska. The amount of fertilizer recommended is based on the number of square feet in the growing area beneath the crown spread of an individual woody plant. This method accounts for situations where the root system is restricted by paved areas, foundation walls or other obstructions in the soil. Application rates greater than recommended amounts can make trees more susceptible to insect and disease problems and drought injury.

The worksheet in this NebGuide shows how to calculate the amount of nitrogen fertilizer needed. First, the square feet under the plant is determined, then the actual pounds of fertilizer are calculated based on the product's concentration. If nutrients are needed, the recommended rates are 1.5 pounds of actual nitrogen, or 1 pound of actual phosphorus or potassium per 1,000 square feet of area under the tree's drip line or a shrub's bed area.

The formula for finding the square feet area is: square feet of circle, (area) = $\pi \times \text{radius}^2$ = 3.14 x radius × radius. The radius is the distance from the trunk to the end of the branches *(Table I)*. The formula for pounds of "actual" N fertilizer needed = 1.5 lbs of "actual" N × (area/1,000 square feet). Then, fertilizer mixture needed = (lbs. of "actual" N/% of N in the fertilizer) × 100.

In an example with a radius equal to 20 feet, the formula would be the following: Area = $\pi\ (20)^2 = 3.14 \times 20 \times 20 = 1{,}256$ square feet. Actual nitrogen needed would equal $1.5 \times 1{,}256/1{,}000 = 1.9$ pounds of N. If the fertilizer had a 34 percent N composition, the amount of fertilizer needed would then be 1.9/.34 = 5.6 pounds of fertilizer.

Table I. Areas under drip lines based on radius measurements.

Distance From Trunk to Drip Line (feet)	*Area Under Drip Line (Square Feet)*
4	50
6	100
9	250
13	500
15	750
18	1,000
22	1,500
25	2,000
31	3,000
35	4,000
40	5,000

Application Timing

Fertilization is most effective when the nutrients are available to the tree or shrub during periods of maximum growth. The best time for fertilizing is in the spring, just after trees have fully leafed out. This allows the tree to maximize the amount of fertilizer taken up by the roots and used by the growing tree. Care should be taken with early season applications of fertilizer since turf can be damaged. Fall applications (once leaf senescence begins and before the ground freezes) are less desirable than spring but are an acceptable way to fertilize trees. However, considerable amounts of nitrogen may be lost to leaching during the winter months.

Fertilizers should not be applied in late summer since this may promote growth flushes that are very succulent and could be easily damaged by the freezing temperatures of early autumn. In addition, it is usually not recommended to fertilize trees during the first year of planting since this can create an unbalanced top-to-root ratio. For large transplanted trees, it may be best to wait several seasons for a root system to become re-established before fertilizing.

As stated earlier, most Nebraska soils contain adequate nutrients for healthy tree growth. In addition, if trees are surrounded by fertilized turfgrass, they generally do not need additional nutrients. However, severely eroded soils, very sandy soils or locations around new construction (where topsoil may have been removed) may be deficient in nutrients. Fertilizer applications to trees should be made in moderation and based on need.

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