MINNESOTA EXTENSION SERVICE
UNIVERSITY OF MINNESOTA
AG-FO-2421—Revised 1989

Tree Fertilization

A Guide for Fertilizing New and Established Trees in the Landscape

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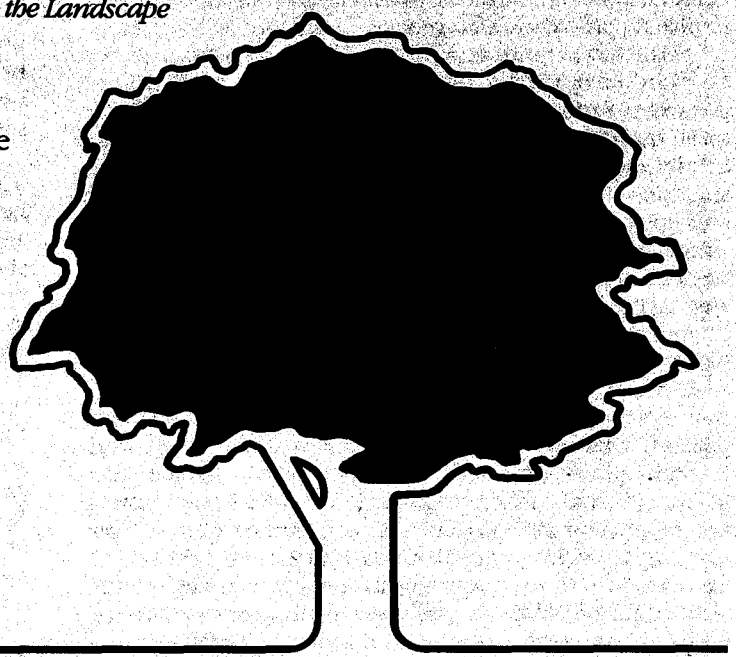

Nitrogen (N), phosphorus (P), and potassium (K) are the three important and primary macronutrients, essential for plant growth. The secondary plant nutrients: calcium (Ca), magnesium (Mg), and sulfur (S), are needed in lower quantities than the primary nutrients and, except for acid sandy soils, are usually not deficient in Minnesota soils. The micronutrients, iron (Fe), manganese (Mn), zinc (Zn), copper (Cu), boron (B), chlorine (Cl), and molybdenum (Mo), are required in very low quantities and are not generally deficient in Minnesota except in extremely sandy, acid, or alkaline soils. All fertilizer containers have the analysis of N, P, and K on the label. The analysis is expressed as percent by weight or as the weight of nutrients per 100 pounds of product; for example, a fertilizer marked 10-8-6 contains 10 pounds of total nitrogen in various forms (e.g., NH_4—N, NO_3—N), 8 pounds of phosphate as P_2O_5, and 6 pounds of potassium as K_2O (potash) per 100 pounds. Fertilizers containing N, P, and K are referred to as complete fertilizers.

Both organic and inorganic forms of fertilizer are used for plant nutrition. Inorganic fertilizers are usually more soluble, higher in analysis, and more rapidly available to the plant than organic forms. Some fertilizers are combinations of organic and inorganic forms. These function similarly to a time-release capsule and extend the length of time when nutrients are available to the plant.

NEED FOR FERTILIZATION

Trees in urban and suburban landscapes are often under stress. Low moisture and fertility levels, soil compaction, competition from nearby trees, diseases, insects, damage from vandalism, and other factors can have a negative impact on tree growth. Under stress situations or poor soil conditions, fertility problems may increase. If growth is minimal, then it is necessary to determine the cause and whether fertilizer will improve plant growth. Stress conditions often predispose trees to other problems; thus with good cultural methods, such as watering and fertilizing, trees are more likely to resist certain insect and disease problems. Fertilizer applications can ameliorate but may not eliminate environmental stress. As a general guide, terminal twig growth should be 6 to 24 inches per year on a young, healthy, deciduous tree and 4 to 12 inches per year on conifers. Growth is less on mature trees. A tree under nutrient stress may show a slow or stunted growth rate; reduced leaf, flower, or fruit size; a pale green or yellow green coloration of the foliage; or early fall defoliation.

Soil type is important in determining the need for fertilizer. A fine-textured, clay-loam soil will hold more nutrients than a coarse-textured sandy loam. However, a tree growing in a heavy, compacted soil may still be stunted because of restricted root growth and the lack of soil oxygen to facilitate nutrient uptake. Light, sandy soils will be low in nutrients, and may also restrict growth because of low moisture levels. Soils with a pH greater than 7.0 (alkaline) may cause deficiencies of micronutrients such as iron and manganese in Pin Oak, River Birch, Red Maple, Silver Maple, and other susceptible species. Deficiencies in these micronutrients, as well as nitrogen deficiencies, produce a condition known as "chlorosis," or a yellowing of the foliage. Low soil oxygen caused by excess water or compaction can also cause chlorosis.

Soil type, nutrient levels, and acidity or alkalinity (pH) can all be determined by a soil test. Your county extension office can provide information and containers for soil testing. Most homeowner soil tests are difficult to interpret due to the severe disturbance of the soil around the house during con-

struction. Therefore, soil tests for trees and shrubs in the home landscape are primarily recommended only when a particular problem such as pH or high salts is suspected. Normally, the trees and shrubs will benefit from an application of fertilizer, particularly nitrogen.

Fertilizers require moisture and oxygen to dissolve and be absorbed by the plant. If excess moisture or a lack of oxygen exists, nutrient uptake cannot take place even with adequate nutrients available. Continued fertilization under such conditions will result in excess fertilizer levels. Then as the soil dries or becomes aerated, excess uptake may occur. Excess uptake will stimulate excessive succulent growth that is structurally weak, less likely to produce flowers, and more susceptible to diseases and insects, such as fire blight or aphids. The high soluble salt concentrations of excessive fertilizer may also damage the tree causing root or leaf burn. Newly planted trees generally should be fertilized at planting time, providing that certain precautions are followed. Fertilization at this time allows deep placement of phosphorus and potassium. Because these nutrients do not move readily in the soil, deep placement will make them immediately available to the new plant to enhance root and top growth. It is extremely important, however, that the fertilizer be mixed into the backfill and not placed in direct contact with the roots. A slow release fertilizer is most desirable for mixing with the backfill. Slow release fertilizers supply only small amounts of nutrients at any one time, so the possibility of root damage is minimized and a longer term response is obtained.

WHEN TO FERTILIZE

Most trees in Minnesota have a single flush of growth in the spring and spring is the time when trees have the greatest need for nutrients. Early spring, consequently, is the time when nutrients must be available. Fall application is the easiest and probably the most effective, because the ground is easier to work and the nutrients will be available to the tree very early in the spring when growth begins. Fertilizer may be applied from late September until about mid-November. Spring applications may be made as soon as the ground is workable until late April or early May. If soil conditions are extremely dry, water the soil prior to and after fertilization. Nitrogen should be applied to sandy soils only in the spring or much of it can be leached out in the late fall and early spring.

If a tree is showing symptoms of deficiency, fertilizer may be applied at any time during the growing season to correct the problem. Care must be taken, however, to provide sufficient water for absorption of the nutrients by the plant and prevent fertilizer burn of the roots. During periods of hot, dry weather, two to three inches of water should be applied every two to three weeks to wet the top 12 to 18 inches of an average soil. Heavy clay soils require more water at less frequent intervals, while light, sandy soils require less water at more frequent intervals. Do not apply fertilizer in late August as plants may force a new flush of growth in early September. Likewise do not allow plants to go into the winter under a nutrient stress as this will also increase winter injury.

WHAT TO APPLY

Of the nutrients in a complete fertilizer, nitrogen gives the most pronounced effect. Phosphate and potassium, on the other hand, generally produce little visible growth response unless soil levels are extremely low. Since certain soils may be deficient in these two nutrients, and since phosphorus is essential for root growth, it is usually beneficial to use a complete fertilizer (N, P, K).

The recommended rates of fertilization are four pounds actual nitrogen (N) per 1,000 square feet per year. When needed, 3.6 pounds of phosphate (P_2O_5) per 1,000 square feet and six pounds of potassium (K_2O) per 1,000 square feet should be applied every two to four years. These quantities of fertilizer cannot be applied to the turf under trees. It must be applied to a non-turf area or placed in holes drilled in the soil around the tree. The recommended rate for turf is 1 lb N/1,000 ft² at one time and any rate greater than two pounds of nitrogen per 1,000 ft² in one application will result in injury to the turf. Table 1 indicates some common fertilizer analyses and rates of each formulation that will give the recommended rates for application. Products that combine fertilizers and herbicides ("weed and feed") should not be used on or around trees and shrubs. Such products will injure or kill trees in the same way that they kill weeds.

HOW TO APPLY

Apply a complete fertilizer (N, P, & K) at the time of planting. Extreme care must be taken to ensure that it is thoroughly mixed with the backfill at the rates listed in table 1. Do not apply fertilizer of any type directly to the roots.

After planting, the easiest and most convenient method of applying nitrogen fertilizers is to spread the fertilizer on the soil under the tree canopy with a standard lawn spreader. Remember that two pounds of nitrogen per 1,000 ft² is the maximum rate that can be applied to turf in this manner. Higher rates must be incorporated into the soil. The surface application method will not adequately supply phosphate and potash because these two nutrients do not readily move down to the tree's root zone. Determine the area under the tree to be fertilized by marking off a square that encompasses the spread of the tree several feet past the dripline (see figure 1). Multiply the length by the width to give the area in square feet. The spreader should be calibrated to deliver the recommended amount of fertilizer per 1,000 square feet; for example, if the area under the tree is 40 feet by 40 feet or 1,600 square feet, about three pounds of nitrogen are needed (two pounds per 1,000 square feet). As shown in table 1, 12 pounds of ammonium nitrate will supply four pounds of nitrogen. Therefore, six pounds of ammonium nitrate (two pounds of nitrogen) should be spread over the 1,600 square foot area. This must be repeated two times at two to three week intervals to obtain the 4 lb/1,000 ft² rate. This surface application should be done when the grass blades are dry and then followed with a deep watering. Note that much of the fertilizer applied to the surface will benefit the grass rather than the tree. If chips or gravel cover the entire area to be treated, the total four pounds can be applied in a single application.

Even two pounds of nitrogen per 1,000 square feet may burn grass, especially fescue turf which is often planted in shady areas. In such situations, or if phosphate and potash are

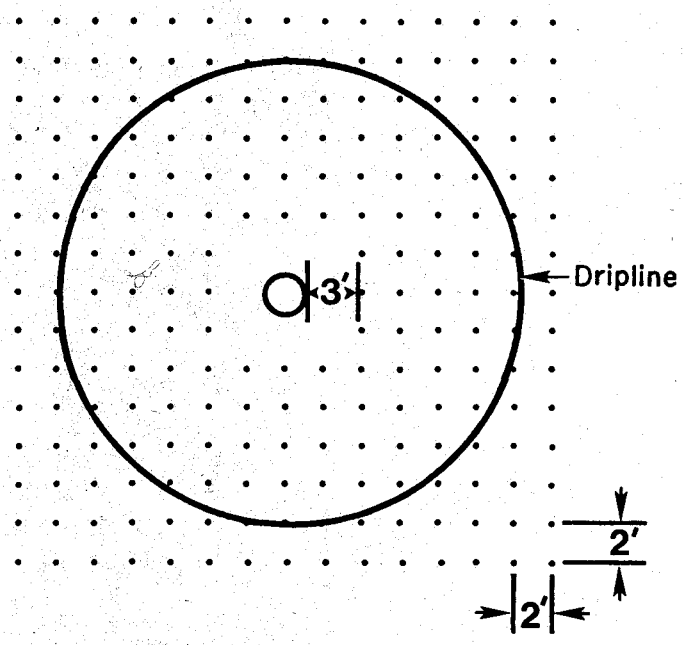

Figure 1. Determination of surface area to fertilize and distribution of holes for fertilizer incorporation. Fertilize to the dripline or farther.

to be added, use another method of application. Figure 1 illustrates one alternative. In this case, holes are drilled two feet apart with a soil auger in a series of parallel lines under the spread of the tree and extending past the dripline (or farther if the tree has an upright or columnar form). The holes should be 1½ to 2 inches in diameter and 12 to 18 inches deep. No hole should be within three feet of the trunk to prevent damage to the root collar. Avoid damaging major roots when drilling. Too much nitrogen close to the turf will cause spotty turf growth.

Place the recommended amount of fertilizer (table 1) in each hole, water it in, and refill the holes with the original soil or with sand if original soil is a heavy clay. In addition to getting phosphorus and potassium down into the root zone, this method has an added advantage because holes help decrease soil compaction and increase air and water penetration, both of which are essential for nutrient uptake by the tree.

Liquid injection root feeders are also acceptable provided that recommended application rates are maintained. This treatment effect may be less persistent than that of a dry fertilizer and, of course, costs increase with the use of specialized equipment and fertilizers.

Large slow-release pellets or spikes of fertilizer are available. They do provide nutrients to the tree but the nutrient distribution may be somewhat limited compared to soil incorporation.

Fertilizers may be injected directly into the trunk of the tree either as a liquid or slow release capsule. This is most common for micronutrients. Repeating the injections over many years will cause some damage to the tree trunk. Micronutrients also may be applied to the soil or foliage using a "chelate" formulation. A chelate is a chemical that combines with a nutrient element to make it available to the plant under a wider pH range. Various chelates are available at most garden supply stores. Follow label instructions for proper application. Soil applications of iron chelates are effective, but annual applications are necessary. Foliar applications of all nutrients are effective for a short term, but usually have to be repeated several times during the season.

Incorporation of sulfur and/or acid peat into the soil to lower the pH before planting may alleviate most micronutrient problems on high pH soils. The best way to avoid micronutrient deficiency problems is to avoid planting sensitive tree species in high pH soils.

Trees are easily stressed from fertility deficiencies or excesses. Apply appropriate amounts of the right nutrient at the right time to provide for optimum growth and vigor of the tree.

Table 1. Fertilizer nutrient analysis and application rates for trees

Product Analysis	Chemical Name	Amount to apply for 4 lb N/1,000 ft²		Amount to mix with backfill at planting time (Hole size = 3 ft³)
		Pounds Product per 1,000 sq ft	Amount per hole**	
45-0-0	Urea	9	1.5 Tbsp (15 g)	⅛ lb
38-0-0	Urea form*	10	2.0 Tbsp (18 g)	¼ lb
33-0-0	Ammonium Nitrate	12	2.0 Tbsp (21 g)	⅛ lb
21-0-0	Ammonium Sulfate	18	2.5 Tbsp (33 g)	⅓ lb
18-6-12	Osmocote*	22	3 Tbsp (38 g)	1¼ lb
14-14-14	Osmocote*	28	4 Tbsp (50 g)	1½ lb
12-12-12	————	33	4.5 Tbsp (58 g)	⅓ lb
10-10-10	————	40	5.0 Tbsp (70 g)	½ lb
14-3-3	Woodace Briquettes*	Follow label directions		

*Slow release.

**Amount per hole when properly spaced 2 feet apart regardless of number of holes.

***The fertilizer analysis cited provides examples only. If the analysis on the fertilizer bag is different from those in the table, divide 1,050 by the analysis of N to get grams per hole. For example if you had a 16-8-8 fertilizer: 1050 ÷ 16 = 65 grams or about 5 Tbsp. Use only fertilizers with phosphorus and potash analysis less than or equal to the nitrogen analysis.

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, Patrick J. Borich, Dean and Director of Minnesota Extension Service, University of Minnesota, St. Paul, Minnesota 55108.