A homeowner's guide to nutrition and fertilization of landscape trees and shrubs

Bert Cregg, Ph.D., Michigan State University, Departments of Horticulture and Forestry

Introduction

Ensuring adequate levels of mineral nutrients is important to maintaining the health and vigor of trees and shrubs in the landscape. Plants need 17 essential elements for proper growth and development. Three of these elements (carbon, hydrogen and oxygen) are provided by air and water; the remaining elements are provided by soil (Table 1). Each essential element fulfills one or more critical physiological functions in plants. If plants are not able to take up adequate amounts of essential elements, their growth will be reduced and they may show visible signs deficiency such as chlorosis (yellowing) or necrosis (dead areas in leaves).

Proper nutrition is needed for optimal plant growth and color

Nutrient deficiencies may be caused by an inadequate supply of nutrients in the soil or, in some cases, by reduced nutrient availability associated with other factors, often high soil pH. Nutrient elements that are needed in the largest quantities are termed macronutrients. Micronutrients, in contrast, are elements needed in very small or trace amounts. When analytical laboratories run a foliar analysis to determine the chemical composition of leaves, macronutrients are usually expressed as a percent (%) of leaf dry weight, whereas micronutrients are expressed in parts per million (ppm).

Table 1. Essential elements for plant growth and development

Element (Chemical Symbol)	Function in plants
Macronutrients	
Nitrogen (N)	Component of chlorophyll, proteins and enzymes
Phosphorus (P)	Energy transfer reactions
Potassium (K)	Water relations and cold hardiness
Sulfur (S)	Component of proteins, enzymes and co-enzymes
Magnesium (Mg)	Component of chlorophyll, enzyme co-factor
Calcium (Ca)	Cell elongation and division, membrane stability
Micronutrients	
Iron (Fe)	Chlorophyll synthesis, enzyme activation
Manganese (Mn)	Enzyme activation, photosynthesis
Boron (B)	Growth processes
Copper (Cu)	Photosynthetic reactions, chlorophyll stability
Zinc (Zn)	Enzyme activation, N metabolism
Chlorine (Cl)	Enzyme activity
Molybdenum (Mo)	Nitrogen metabolism
Nickel (Ni)	Nitrogen metabolism

Common nutrient problems in landscape trees and shrubs

In general, most soils in Michigan can provide an adequate nutrient reserve to meet the needs of most trees and shrubs. In addition, trees and shrubs that are adjacent to lawns may derive some of their nutrients from lawn fertilization. Nevertheless, depending on soil properties, nutrient deficiencies can occur in trees and shrubs. The most common nutrient problems that homeowners in Michigan are likely to see in trees and shrubs are deficiencies of nitrogen, iron or manganese.

Nitrogen deficiencies may occur in trees since it is the element that is needed in the largest amounts, yet it is lost from the soil over time through leaching. Also, raking and removing leaves each fall interrupts the natural re-cycling of nitrogen that occurs in native forests. Iron and manganese deficiencies are common in specific landscape trees and are associated with alkaline soil pH. In both cases, soils may contain adequate amounts of the element, but availability and uptake are reduced by alkaline soil conditions.

Determining the need for fertilization

As a general rule of thumb, most landscape trees and shrubs can maintain acceptable growth and appearance without fertilization. If plant growth and color are not meeting expectations and a homeowner suspects a nutrient problem, the potential deficiency should be diagnosed based on at least one – and preferably two or more – of the following criteria before applying corrective fertilization.

Visual symptoms. Certain nutrient deficiencies can be identified by characteristic symptoms. Nitrogen deficiencies are often characterized by leaf chlorosis. Leaves deficient in phosphorus may take on a purplish cast. Trees that are deficient in potassium may show marginal necrosis. However, not all nutrient deficiency symptoms are unique and similar symptoms may be caused by different elements. For example, interveinal chlorosis can indicate magnesium, manganese or iron deficiencies. Moreover, some symptoms that resemble nutrient deficiencies may be caused by pest-related issues or other environmental stresses such as drought stress or poor soil drainage. Therefore, visual deficiency symptoms should be viewed as "one piece of the puzzle" when identifying potential nutrient problems and are best used in conjunction with soil or foliar testing

Soil testing. The Michigan State University Soil and Plant Nutrient Laboratory provides a standard soil test and recommendations for trees and shrubs. Soil test kit self-mailers are available for purchase from most county Extension offices, or the MSU Extension Bookstore (www.bookstore.msue.msu.edu), item E3154. Test results include soil phosphorus, potassium, calcium, magnesium, soil pH and soil organic matter. If the test indicates nutrient levels are low, a recommendation for fertilization will be included in the results. Soil pH is especially

Visual symptoms of nutrient deficiencies include poor growth and color (right)

important for trees that are sensitive to alkaline pH and prone to nutrient issues, such as pin oak, red maple and many conifers. Soil pH levels higher than 6.5 can often induce manganese or iron chlorosis in these trees. Soil pH is also critical for acid-loving shrubs and trees including azaleas, rhododendrons, hydrangeas and dogwoods, which may require soil pH levels of 5.5 or lower.

Foliar testing. Occasionally, visual symptoms and soil testing are not enough to fully diagnose a problem. In these cases, determining the concentration of nutrient elements in leaf tissue may be needed. Foliar testing is available through the MSU Soil and Plant Nutrient Laboratory. Leaf samples should be collected from recent, fully-expanded leaves. For deciduous trees and shrubs, leaves should be collected in mid-summer (July-August); conifers should be sampled in early fall (September-October). Consult with the analysis lab before collecting samples for additional directions on how to collect samples and the amount of foliage needed for analysis.

The perils of over-fertilization

For some homeowners, the response to a fertilizer recommendation may be, "If a little is good, more is better." However, it is important to avoid over-fertilizing landscape plants for a couple of reasons. First, applying more nutrients than needed, especially nitrogen and phosphorus, can lead to contamination of water resources due to nutrient leaching or run-off. Second, excessive fertilization can cause nutrient imbalances and even nutrient toxicity.

Fertilizing trees and shrubs

Fertilizing trees or shrubs that are nutrient deficient (as indicated by visual symptoms, soil test or foliar test) can improve their appearance and growth rate. In this bulletin, we take the approach that "less is more" when it comes to tree and shrub fertilization. Our philosophy is to fertilize at a relatively low rate, observe the response and then re-apply if warranted in order to reduce the potential for over-fertilization. If plant growth and color are not adequate, we recommend 0.1 to 0.2 lbs of nitrogen per 100 sq. ft.

Slow release nitrogen sources (at least 50 percent water insoluble nitrogen) are recommended. Fertilize in the spring or in the fall after bud set. Phosphorus and potassium additions should be based on a soil test. Soil pH should be assessed for trees that are pH-sensitive (pin oak, red maple, most conifers) and plants that are acid-loving (azalea, rhododendron, hydrangea, dogwood). If pH is above 6.5, it can be reduced by adding elemental sulfur. Note this pH-reducing effect is transitory and will need to be repeated every two to three years. In some cases, more than one sulfur application may be needed to bring the soil pH into the desired range.

How to fertilize

Professional landscapers and arborists use a variety of techniques to fertilizer trees including liquid soil injection, drill-hole applications, and even direct trunk injection. Most research suggests, however, that surface granular application can produce similar results. Fertilization rates for landscape plants are usually expressed as the amount of fertilizer nutrient per 100 or 1,000 sq. ft. of ground area. For trees and shrubs that are in landscape beds, the area to be fertilized can be determined by measuring or pacing off the bed area. For individual trees, fertilizer should be applied in the area under the crown of the trees. The furthest extent of the tree crown away from the trunk is termed the dripline. The area under the dripline can be estimated by measuring the radius of the tree crown and then calculating the area (Table 2).

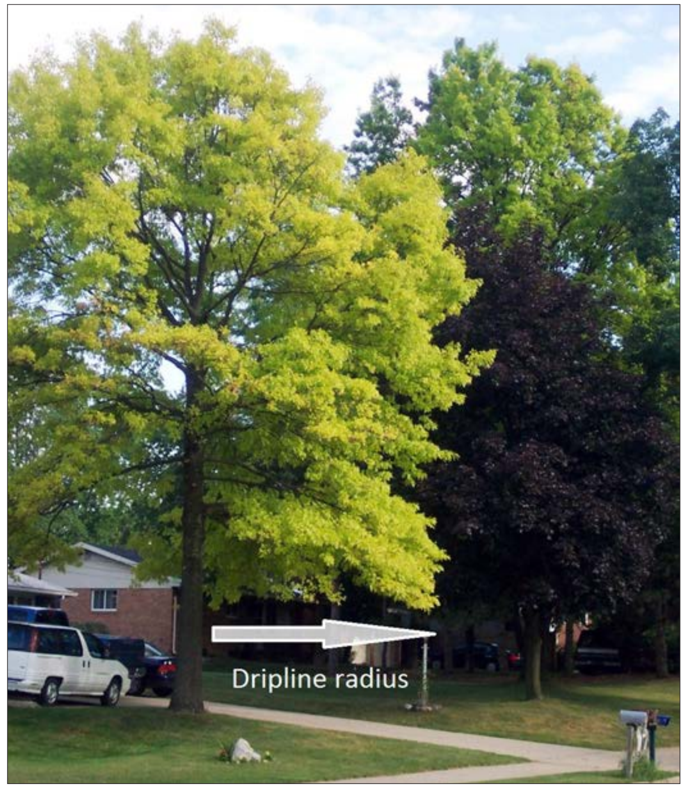
Table 2. Area under tree crown based on radius of the dripline

Dripline radius radius (feet)	Area under tree crown (sq ft.)
3	28
4	50
5	80
6	115
8	200
10	300
12	150
15	700

The amount of fertilizer to be applied can be determined by multiplying the recommended rate by the ratio of actual area to 100 sq ft.

Actual amount = Recommended rate x actual area in sq ft/100 sq ft

For example, if we were fertilizing a 10 ft. x 50 ft. bed at a 0.2 lb/100 sq. ft. rate, the actual amount would be 0.2 lbs x 500 sq. ft./100 sq. ft. = 1 lb.



Dripline radius is the distance from the trunk of a tree to the end of its branches.

Evaluating fertilizer response

Some responses of trees and shrubs to fertilization may occur fairly rapidly. Trees that are deficient in nitrogen, for example, may show improved leaf color within a few weeks of fertilization. Other responses, such as reducing pH to correct iron or manganese deficiencies, may require a full season or longer to show a response. Follow-up soil tests and re-application may be needed.

Interveinal chlorosis of red maples often indicates a manganese deficiency

Interveinal chlorosis of pin oaks often indicates an iron deficiency

Published April 2012

Michigan State University AgBioResearch www.agbioresearch.msu.edu

To contact an expert in your area, visit expert.msue.msu.edu, or call 888-MSUE4MI (888-678-3364).