

Fertilizer Recommendations for Landscape Trees and Shrubs (For Professional Grounds Managers and Landscape Contractors)

Background Information

Grounds managers play an important role in creating and maintaining a healthy environment in Maryland. Studies reported by the Chesapeake Bay Program indicate that nutrients, sediments, and toxic substances are polluting Maryland's ground and surface water. Grounds managers can help reduce their contribution of nutrients, sediments, and toxins by using environmentally sound practices while still making a profit.

Events in the late 1990s led Maryland officials to take an even closer look at our state's water quality. As a result, the Maryland General Assembly passed the Water Quality Improvement Act (WQIA) of 1998. The WQIA specifies that all agricultural operations with annual incomes above \$2,500, that apply nutrients, whether in the form of commercial or organic fertilizers and/or manure, must comply with this legislation. Farmers must now have a nitrogen- and phosphorus-based plan, which must be implemented by December 31, 2002, or July 15, 2005, depending on the type of nutrients applied. In addition,

grounds managers and persons hired to apply nutrients (fertilizer) to land not used for agricultural purposes that is cumulatively 10 or more acres, or land that is state-owned and of any size, are also included in the WQIA. The 10 acres "cumulative" should be interpreted as including several small lots (each lot under 10 acres) that together add up to 10 acres or more. Although grounds managers are not required to have nutrient management plans, they are required to apply fertilizer according to University of Maryland Cooperative Extension recommendations, take soil tests, and keep records of those applications for 3 years.

Records must include

- soil test results,
- management objectives,
- total nutrients applied to the whole landscape,
- date applied and rate of each application(s),
- location of application(s), and
- the nutrient content of any fertilizer applied.

Record keeping requirements and the regulations regarding them became effective May 30, 2000. See the Maryland Department of Agriculture COMAR (Code of Maryland) recommendations for a summary of penalties.

University of Maryland Fertilizer Recommendations

Following the practices suggested in this publication should assure compliance with the nutrient management law and prevention of nutrient runoff.

The University of Maryland Cooperative Extension (MCE) recommends analyzing the soil prior to any fertilizer application. Analysis reveals any nutrient deficiencies. Once nutrient deficiencies are determined, apply a fertilizer high in water insoluble nitrogen (WIN).

Test Soil

The goals of tree and shrub fertilization include overcoming obvious visual deficiencies that are confirmed by soil tests, increasing resistance to specific diseases and maintaining tree health. Before fertilizing, conduct a soil test to determine if any nutrients are deficient. With many horticultural plants MCE suggests that a foliar analysis be run in combination with a soil test to help determine which nutrients are deficient and the degree of deficiency. Currently, there is little published data on the ideal foliar nutrient levels for all of the species of shade trees and landscape plants. Soil test results should be used to determine the fertilizer needs of landscape woody plants until further data is available on foliar analysis. Soil tests should be run a minimum of every 3 years to determine the nutrient needs of the landscape plants.

Secondary and micronutrient deficiencies are closely related to soil pH. The pH should be corrected, if necessary, before the deficient nutrient is applied to the soil. Correcting the pH will make nutrient availability optimal. Recent findings suggest that the optimum pH for turf in Maryland is between 5.8 and 6.2. Most trees will perform well in this pH range.

In general, young trees in good condition produce approximately 8 to 12 inches of growth on the main branches yearly. A soil test will indicate whether elements are in short supply. Fertilizer applications should be based on the results of this test. If the soil test shows optimum or excessive levels of phosphorus or potassium, no additional phosphorus or potassium needs to be applied. Keep in mind that the yearly rate of new twig growth for a tree varies depending on the species, soil conditions, rainfall, and general environment. However, as trees mature, the growth may be only half as much and yet they are still healthy.

Select the Proper Fertilizer

There are many types of fertilizers available for use. Each one has specific properties that make it different from another. A complete fertilizer contains nitrogen, phosphorus and potassium, major nutrients required for plant growth. A commonly used complete fertilizer for trees and shrubs has a ratio of 3:1:1, 3:1:2, or 3:1:3. An incomplete fertilizer lacks at least one of the three elements, N, P or K. These incomplete fertilizers are sometimes used to supply exact amounts of a specific element when necessary. Secondary and microelements may also be included in some fertilizers. These elements will be listed under "guaranteed analysis."

Slow-release fertilizers are preferred over quick-release or water-soluble types for nutrient management purposes. Another term for 'slow release' is water-insoluble nitrogen (WIN). Slow-release fertilizers provide nitrogen more slowly than water-soluble sources. The result is more uniform growth. Slow-release fertilizers are longer lasting and have a lower impact on the environment. Quick-release fertilizers, or water-soluble nitrogen, are good for restoring leaf nitrogen content with resulting green-up and should be used in moderation. The technical data sheet or label on the fertilizer bag should show that a minimum of 50 percent of the nitrogen source is water insoluble (WIN) and the salt index is less than 50. (Note: Salt index is relative to sodium nitrate, NaNO_3 , which has a salt index of 100.)

Slow-release fertilizers should be applied at a rate of between 1 to 4 pounds of actual

nitrogen per 1,000 square feet per application. Apply no more than a total of 4 pounds of actual nitrogen per 1,000 square feet annually. Quick release fertilizers should only be used when the objectives of fertilization cannot be met with a slow-release fertilizer. When using quick-release fertilizers, rates should be between 1 to 3 pounds of actual nitrogen per 1,000 square feet per application and shall not exceed 3 pounds of actual nitrogen per 1,000 square feet annually. The combination of slow and quick release fertilizers should not exceed the maximum recommendation of 4 pounds of actual nitrogen per year. All of the fertilizer does not need to be applied at one time. Split applications of two more applications, at lower rates, may be more beneficial and reduce the chance of runoff. Terms such as IBDU, sulfur-coated urea, resin-coated urea, and nitroform indicate slow-release fertilizers.

In order to avoid movement into streams or groundwater, it is usually best to choose a slow-release form of nitrogen. Fertilizers, with at least 50 percent of their N as WIN are considered slow-release.

Calculate Fertilization Area and Application Rate

Fertilizer should be applied where shrub and tree roots are present. The root spread varies with plant species and with several species the roots extend beyond the dripline of the plant. Knowledge of the plant species and its root growth habits will help in directing the fertilizer application. In the absence of information on the root habits, direct fertilizer applications within the dripline area of the plant. The dripline is defined as the area directly below the canopy of the tree.

Define the area to be fertilized prior to application.

Consider root accessibility and location, fertilization objectives (rate of growth desired), and plant species (e.g., ericaceous, broadleaf, or deciduous) when determining the target area to be fertilized.

The target fertilization area for trees and shrubs is generally the area within the dripline of the plant. For some aggressively rooting plants such as Norway maple and pin oak, an area 1.5 times the dripline area can be considered the target area to be fertilized. Inaccessible and paved surfaces should not be included in the target area. If one target area overlaps a second target area, use the shared area only once when calculating the total area to be fertilized.

The area, or square footage, of some common shapes is listed in the chart below. The area is always written as square feet (ft²).

Shape	Area	Formula
Square or Rectangle	Length X Width	$A = L \times W$
Triangle	$\frac{1}{2}$ Base X Height	$A = \frac{1}{2} B \times H$
Circle	3.14 X Radius Squared	$A = \pi r^2$ ($\pi=3.14$)

Fertilizer Application Rates	
Status	Rate/Year
Newly planted (1-2 years) <i>(New transplants in poor soil, as is common at construction sites, may respond to slightly higher rates of N.)</i>	0-1 lb. N/1,000 ft ² /year
Established plants <i>(Trees that have not yet reached full potential size)</i>	2-4 lb. N/1,000 ft ² /year
Maturing trees <i>(Trees that have generally reached full size for the species)</i>	1-3 lb. N/1,000 ft ² /year

Calculation of area for fertilizer application

Example:

How much 36-12-12 fertilizer is needed to fertilize a 20-foot diameter spread, established red maple? See Figure 1.

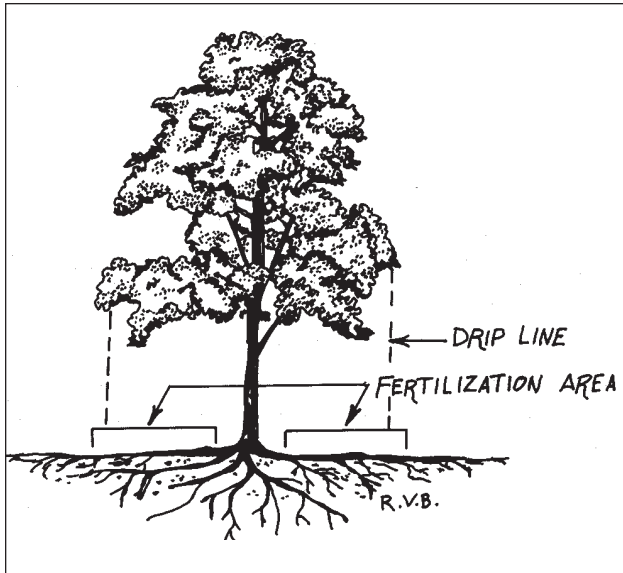


Figure 1. Example of dripline and fertilization area.

Solution:

This is a three-step problem. The first step is to determine the area to be fertilized. The second step is to calculate the amount of actual nitrogen needed. The third step is to convert the amount of actual nitrogen needed into the amount of fertilizer needed.

Step 1.

Since the diameter of the tree is 20 feet wide, the radius is one half the diameter ($r = \frac{1}{2} D$)

$$r = \frac{1}{2} \times 20 \text{ feet} = 10 \text{ feet}$$

Now that the radius is known, it is possible to calculate the area.

$$A = \pi r^2 \quad (\pi=3.14)$$

$$A = \pi r^2$$

$$A = 3.14 \times 10 \text{ ft}^2 = 31.4 \times 10 \text{ feet} \times 10 \text{ feet} = 314 \text{ sq. ft.}$$

Step 2.

Since this tree is established, we are using the lower fertilization rate of 2 pounds of nitrogen per 1,000 sq. ft. per year.

$$\frac{X \text{ lbs. of actual N}}{314 \text{ ft}^2} = \frac{2 \text{ lbs. of actual N}}{1,000 \text{ ft}^2}$$

$$X = \frac{314 \text{ ft}^2 \times 2 \text{ lbs. of N}}{1,000 \text{ ft}^2}$$

$$X = \frac{628 \text{ lbs. of N}}{1,000}$$

$$X = 0.628 \text{ lbs. of actual N}$$

Therefore, .628 lbs. of actual nitrogen is needed to fertilize a 20-foot diameter established tree.

Step 3.

To determine how much fertilizer is needed to deliver the 0.628 lbs. of actual nitrogen per sq. ft., use the following formula.

$$\text{Total Product Needed} = \frac{\text{Application Rate (lbs. of N)}}{\% \text{ N in Product (expressed as a decimal)}}$$

$$\text{Total Amount of 36-12-12 Needed} = \frac{0.628 \text{ lbs. of N}}{.36}$$

$$\text{Total Amount of 36-12-12 Needed} = 1.74 \text{ lbs.}$$

Therefore, it takes 1.74 pounds of a 36-12-12 fertilizer to fertilize a 20-foot-wide established red maple.

How often to fertilize

How much and how often to fertilize shade trees depends on your landscape goals and the current nutrient status of the soil. Small trees, where rapid growth is desired, should be fertilized annually. Split applications (spring, early summer) may have less chance of causing runoff.

Established trees typically are fertilized once every 3 to 4 years, although most arborists prefer an annual application of a low level (1-2 lbs N/1,000 sq. ft./year) of nutrients because infrequent, high rates (3-4 lbs N/1,000 sq. ft./year) tend to contribute more to environmental contamination.

Technically, fertilizer can be applied and is absorbed by plants any time during the year as long as the soil is not frozen or too dry. The best time of the year to fertilize shade trees with slow-release fertilizer runs from the fall through the late winter, before growth appears in the spring. If you are using quick-release nitrogen sources, then spring to early summer is the best time for applications of fertilizer. Avoid applications during the period between late summer and when deciduous trees drop their leaves. Roots absorb fertilizer during the winter months as long as soil temperatures are above 40°F. Most N uptake is driven by leaf growth active flushes. The nitrogen that is fall applied in slow-release form will be available for root uptake with the spring flush of growth. If turfgrass growing in the root zone of the tree is receiving regular fertilization, then in many cases no additional nutrients may be required.

Fertilizer application methods

For surface application all fertilizer should be uniformly distributed within the defined area of fertilization. Broadcast the fertilizer in the area under the tree, beginning near the trunk to the dripline. Broadcasting on slopes greater than 5-8 percent should be avoided. **Surface application should not be made where surface runoff is likely to occur.**

Where runoff is likely or turf or ground cover exists, subsurface fertilization should be the preferred method of fertilization.

For subsurface liquid fertilizer injection, the injection sites should be evenly distributed within the fertilization area. For liquid injection systems, the pressure should not exceed 200 pounds per square inch. Fertilizer should be evenly distributed between holes. See Figure 2.

For subsurface dry fertilization, holes should be evenly spaced within the defined fertilization area. Holes should be 2 to 4 inches in diameter, spaced 12 to 36 inches

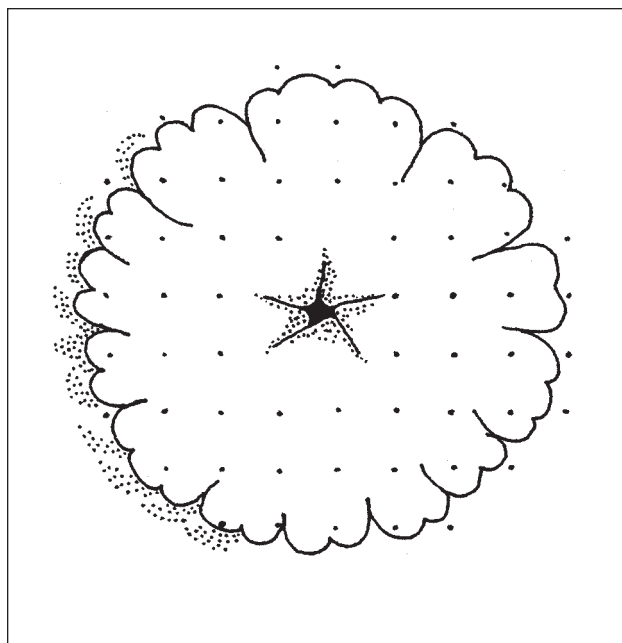


Figure 2. Example of guide to positioning fertilizer application holes beneath the tree canopy.

apart, and 4 to 10 inches deep. See Figure 3. The fertilizer should be evenly distributed among the holes. The fertilizer should not be closer than 2 inches to the soil surface.

Foliar applications, injections, or fertilizer implants should only be used when soil application of fertilizer is impractical or ineffective in achieving fertilization objectives.

An excessive concentration of fertilizer can burn the foliage. This damage is usually caused by ammoniacal N or urea N. Foliar fertilization is a common way to apply

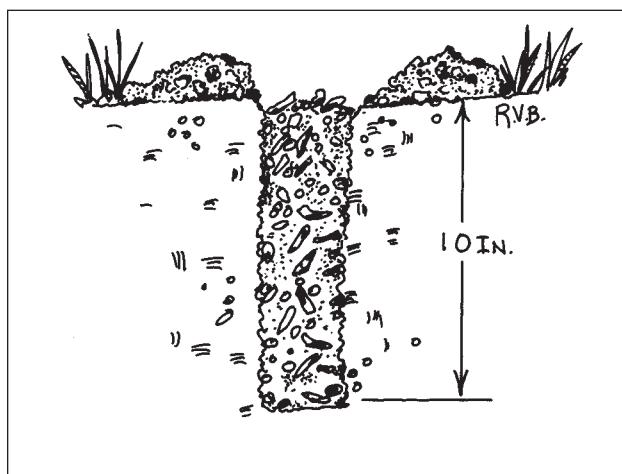


Figure 3. Example of subsurface fertilization holes.

chelated iron to plants suffering from iron chlorosis. The benefits of foliar application of nutrients are often only seen for one season for many of the micronutrients.

Fertilizing Evergreen and Deciduous Shrubs

Broadcast a granular fertilizer (slow-release is preferable) uniformly on the soil under the shrub and a little beyond its dripline. Use an application rate of 2 to 3 pounds of actual nitrogen per 1,000 square feet. A lower rate of nitrogen fertilizer is used around foundation plantings to reduce excessive growth and the resultant need for pruning and trimming.

Ericaceous evergreens such as rhododendrons, azaleas, camellias, mountain laurel, pieris, and leucothoes perform best in an acidic soil. They require a soil pH range of 4.5 to 6.0. Fortunately, many undisturbed Maryland soils are already acidic enough to grow these plants well. Soils in regions of the state with a limestone base are not suitable for these plants unless special procedures are used to lower the soil pH.

Two Prevalent Nutrient Problems in Landscape Plantings

Iron chlorosis:

A symptom of a soil with a high pH problem is iron chlorosis. Chlorosis is an interveinal yellowing of new leaves. This deficiency can be temporarily corrected by applications of chelated iron to the foliage or the soil. The soil pH should be corrected or the symptoms will gradually recur. If the pH is too high (alkaline), sulfur and/or iron sulfate are applied to the soil to lower the pH. Follow the directions based on the results of a soil pH analysis. If chlorosis persists, have the soil tested for manganese (Mn). Always test first to avoid misapplications. Keep in mind, chlorosis is also a secondary symptom of root rot or death of roots. Some conditions that can cause root death and chlorosis include poor soil drainage, over-watering, over-mulching, planting too deeply, magnesium deficiency, root nematodes, or a root injury.

Magnesium deficiency:

In very sandy soils, magnesium deficiency can also be a serious problem with acid-loving plants. These symptoms generally appear as chlorosis of older leaves and short, unhealthy new growth. Soil, or foliar, testing is the only accurate method to determine this deficiency. The deficiency can easily be corrected by applying 4 to 16 ounces of magnesium sulfate (Epsom salts) per 100 square feet and irrigating thoroughly.

Problems Caused by Excessive Fertilizer

Fertilization can be beneficial to plants with a deficiency. However, very high fertilizer concentrations can cause root damage to the plant.

“Burn” is a term describing visual symptoms of salinity due to over-application of fertilizer. Symptoms resemble those of drought damage because plants are injured by lack of water, even though sufficient water may be present in the soil. Fertilization in droughty times of the season is more likely to burn roots.

Excessive use of fertilizer in the landscape can contribute to the nitrogen and phosphorus contamination of groundwater, streams, and ultimately the Chesapeake Bay. Most runoff problems are due to surface applications on slopes and paved surfaces. Groundwater problems may result from fast-release fertilizers on sandy soils. It is very important to select the correct analysis fertilizer, use slow-release whenever possible, and always read the label instructions.

Summary

University of Maryland Cooperative Extension Recommendations

1. Test soil to determine nutrient deficiencies, then fertilize accordingly.
2. Use a fertilizer containing at least 50 percent WIN.
3. Apply no more than 4 pounds of nitrogen per 1,000 square feet per year to trees and shrubs.
4. Remove granular fertilizer from paved surfaces.

References

- American National Standard Institute. 1998. *Tree, Shrub, and Other Woody Plant Maintenance Standard Practices (Fertilization)*. New York, New York.
- American National Standard Institute. 1995. *A300 Standard for Tree and Shrub Fertilization*. New York, New York.
- Chesapeake Bay Program. 1999. *1999 State of the Chesapeake Bay: A Report to the Citizens of the Bay Region*. www.chesapeakebay.net/pubs/sob/index.html
- Gouin, F.R., Link, C.B., *Fertilizing Ornamental Trees and Shrubs*. (Revision by R.V. Bosmans, S.A. Gill, 1995.) University of Maryland.
- Harris, R.W. 1992. *Arboriculture—Integrated Management of Landscape Trees, Shrubs and Vines*. Prentice-Hall, Inc.
- Lloyd, J. 1997. *Plant Health Care for Woody Plants*. International Society of Arboriculture, Savoy, Illinois.
- Maryland Department of Agriculture, Nutrient Management Regulations COMAR 15.20.06.
- Pirone, P.P. 1988. *Tree Maintenance*. Oxford University Press.



**Fertilizer Recommendations for Landscape Trees and Shrubs
(For Professional Grounds Managers and Landscape Contractors)**

By

**Stanton Gill, Regional Specialist,
University of Maryland Cooperative Extension,
Central Maryland Research and Education Center**

**Raymond Bosmans, Region I Extension Director,
University of Maryland Cooperative Extension**

**Wanda MacLachlan, Extension Educator,
University of Maryland Cooperative Extension,
Central Maryland Research and Education Center**

Technical reviewer

**E. Thomas Smiley, Ph.D.,
Plant Pathologist/Soil Scientist,
Bartlett Tree Research Laboratories,
International Society of Arboriculture**

University of Maryland reviewers

**John Lea-Cox, Ph.D., Assistant Professor,
University of Maryland**

**David Clement, Ph.D., Regional Specialist,
University of Maryland Cooperative Extension**

Industry reviewers

**Robert Mead, President MAA,
Maryland Arborist Association**

**Jeffrey Topley, President LCA, MD/D.C./VA,
Landscape Contractor's Association**

**Stephanie DeStephano, President PGMS-D.C. VA,
Professional Ground Maintenance Society**

**Mark Schlossberg,
Pro-Lawn-Plus, Inc.**

Issued in furtherance of Cooperative Extension work, acts of May 8 and June 30, 1914, in cooperation with the U.S. Department of Agriculture, University of Maryland, College Park, and local governments. Thomas A. Fretz, Director of Maryland Cooperative Extension, University of Maryland.

The University of Maryland is equal opportunity. The University's policies, programs, and activities are in conformance with pertinent Federal and State laws and regulations on nondiscrimination regarding race, color, religion, age, national origin, sex, and disability. Inquiries regarding compliance with Title VI of the Civil Rights Act of 1964, as amended; Title IX of the Educational Amendments; Section 504 of the Rehabilitation Act of 1973; and the Americans With Disabilities Act of 1990; or related legal requirements should be directed to the Director of Personnel/Human Relations, Office of the Dean, College of Agriculture and Natural Resources, Symons Hall, College Park, MD 20742.

P2001

