MASTER GARDENER
COLORADO STATE UNIVERSITY
EXTENSION

CMG GardenNotes #651

Fertilizing Shade Trees

Outline:

When gardeners fertilize lawns, they see a quick response as the lawn greens up within days. The response is different with trees; it happens over a period of months as a re-balance of canopy and root growth. When growth-limiting nutrients (nitrogen) become available through fertilization, the tree shifts more resources into canopy growth and correspondingly less into root growth.

Nitrogen is the nutrient most limiting to tree growth. Symptoms of nitrogen stress in woody plants are unlike those in lawns and herbaceous plants. Trees with nitrogen stress simply slow canopy growth rates, but do not show the characteristic yellowing of older leaves like lawns and herbaceous plants.

Nitrogen should be applied to trees only in a controlled release/slow release form.

A tree's need for phosphorous and potassium is rather low. Colorado (western) soils are typically adequate in phosphorous and potassium. Phosphate fertilizers have not been shown to increase tree growth even on soils marginal low in phosphorus. Excessive levels of phosphorus can aggravate an iron chlorosis problem.

Iron is a common deficiency in some tree species. Iron chlorosis is usually aggravated by spring- time overwatering and by trunk girdling roots (tree planted too deep).

Fertilizer Application Rates

The need for fertilizer varies with the tree's growth phase.

Establishment phase - recently planted trees

During the root establishment phase, the growth objective is root growth. Nitrogen fertilizer increases canopy growth with a corresponding decrease in root growth, which is undesirable in this phase.

As a rule-of-thumb for Hardiness Zone 4-5, the establishment phase for recently transplanted trees lasts one year for each inch of trunk caliper (measured at 6" above ground level). In other words, the establishment period for a one inch caliper tree is typically one year, and three years for a three inch caliper tree. The establishment phase may be longer on sites with poor soil tilth, limited irrigation, and with poor planting techniques.

Unlike herbaceous plants, woody plants do not respond to "rooting fertilizers" (water soluble fertilizers) applied at planting. During the root establishment phase, fertilizer applications should be kept to a minimum, as follows:

- If the soil organic content is moderate to high (3-5% organic matter), no additional fertilizer is warranted.
- If the soil organic content is low (1% or less), a light application of a controlled release (slow release) nitrogen may be beneficial. Application should not exceed 0.1 pound actual nitrogen per 100 square feet (based on the area off the planting hole). Do not apply fertilizer on a site with growth limiting factors such as a limited irrigation.

Growth phase

Significant branch growth indicates a shift from the root establishment phase into the growth phase. In this growth phase, fertilization can encourage faster growth if desired. Application rate is based on several factors:

1. Natural growth rate of the tree – Use higher rates on faster growing species if rapid growth is desired.
2. Growth limiting factors such as limited irrigation, severe soil compaction, or limited root spread potential – Do not force growth. Heavy fertilization can push canopy growth that the roots cannot support in summer heat and wind.
3. Soil organic content
4. Desired growth rate. If rooting and/or canopy space will be limited for the maturing tree, you may not want to push growth.

The table on page 3 illustrates rate adjustments based on these factors.

Mature maintenance phase

As trees reach a mature size and growth slows, the need for nitrogen drops. In the maturing maintenance phase the standard maximum rate is 0.2 to 0.4 pounds

nitrogen per 100 square feet over a 4-year period. It may be applied annually or with multi-year applications using controlled release fertilizers. Over fertilization may push canopy growth that a limited rooting system cannot support in summer heat and wind, leading to early decline. The table below shows rate adjustments based on soil organic content.

Application rate based on growth phase and soil organic content

The fertilizer application rate should be adjusted according to soil organic content as indicated in the table below.

Tree fertilizer rates based on growth phase and soil organic content

Soil organic content	Nitrogen application rate[1 & 4] (Pounds nitrogen per 100 square feet) Low (0-1%)	Medium (2-3%)	High (4-5%)
Establishment phase	0 to 0.1 lbs/year	0	0
Growth phase			
Faster growing species[2]	0.2 to 0.4 lbs/year	0.1 to 0.2 lbs/year	0
Routine rate	0.1 to 0.2 lbs/year	0.05 to 0.1 lbs/year	0
Mature phase[3]	0.2 to 0.4 lbs / 4 years 0.1 to 0.2 lbs / 2 years 0.05 to 0.1 lbs / year	0.1 to 0.2 lbs / 4 years 0.05 to 0.1 lbs /2 years 0.025 to 0.05 lbs / year	0

1 Do not exceed lower rates to trees with growth limiting factors (such as limited irrigation, severe soil compaction, or limited root spread potential).
2 Use high rate only on fast growing species without any growth limiting factors where rapid growth is desired.
3 For multi-year applications, use controlled/time release products.
4 In lawn areas, do not apply more than 0.1 pounds nitrogen per 100 square feet per application. When higher rates are needed, split the application.

Time of year

The best time of year to fertilizer is early spring (4-6 weeks before bud break) or late fall after leaves drop (and soil temperatures are above 40^{o}). Avoid late summer and early fall fertilizations as they may interfere with winter hardiness.

Area to fertilize

Fertilizer application rate is based on the area of the ***Tree Protection Zone, TPZ***. To calculate a tree's TPZ area, first determine the ***Critical Root Radius,*** CRR, and then calculate the area in the TPZ using the CRR. The CCR typically extends a little beyond the drip line. The TPZ area is typically about 40% larger than the area in the drip-line for mature trees.

Calculating the CCR by the circumference method

1. Measure the circumference (inches around the tree) at 4.5 feet high.
2. Divide the number by 2.

3. Express the results in feet. This is the critical rooting radius.

Example:

1. Circumference = 24 inches
2. 24/2 = 12
3. CRR = 12 feet

Calculating the area (square feet) in the TPZ

To calculate the area in the TPZ, use the formula:

$CCR^2 \times 3.14 = TPZ$

Example: 12 feet x 12 feet x 3.14 = 452 square feet

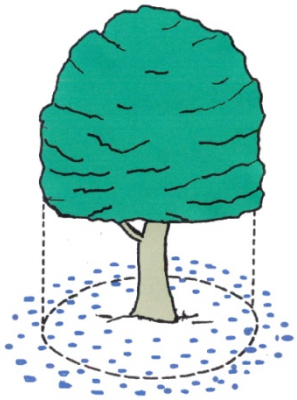
Unrestricted rooting area – For trees with an unrestricted rooting area (i.e., open lawn area) base the fertilizer application rate on the ***Tree Protection Zone, TPZ.*** This is the area where the fertilizer will be applied.

Trees with confined root zones – Calculate the fertilizer rate based on the **open** area within the TPZ, (i.e., the TPZ area not covered with sidewalks, driveways, streets, buildings, etc).

Fertilizer Application Methods

Broadcast applications are quick and easy. However, an actively growing turf takes up most of the soluble fertilizer within 48 hours.

An alternative is to apply the fertilizer in a series of holes or plugs drilled into the soil around the TPZ. Use caution to avoid hitting sprinkler lines and underground utilities.



Make plug holes:

- 1 ½ to 2 inch diameter
- 4-6” inches deep
- 2 foot intervals
- 2-5 rings around TPZ area
- Backfill with sand, compost, or vermiculite

Trees in Turf

In full sun, a healthy lawn has 20 to 400 times more root length than woody plants. The lawn will absorb most of a water-soluble nitrogen fertilizer applied within 48 hours. The following table summarizes the relationship to lawn fertilizer and tree fertilization.

	Tree Grow Phase	
Lawn Quality	**Growth Phase**	**Mature Maintenance Phase**
Routinely fertilized, actively growing, thick	**L**awn fertilization adequate for trees If rapid growth is desirable on faster growing species, supplemental vertical fertilization may be beneficial. Do not force growth when limiting factors exist, such as limited water, severe soil compaction or limited root spread potential.	**L**awn fertilization adequate for trees
Thin	Before fertilizing, evaluate why the lawn is thin and how this affects potential tree growth.	High nitrogen rates could push undesired tree canopy that roots cannot support in summer heat and wind.

Fertilizing Stressed Trees

When plants appear stressed, a common reaction is to fertilize. However, this can actually aggravate stress. Before fertilizing a stressed tree, evaluate whether or not a push of canopy growth with the corresponding decrease in root growth is desirable.

Nitrogen fertilization shifts the tree's balance of growth, favoring the canopy. If the stress is root related (i.e., soil compaction, restricted root spread, construction damage, extensive storm damage), this shift will aggravate it. Do not apply high levels of fertilizer to trees with root problems.

The tree invests energy reserves to take up nutrients. Thus, the short-term effects of a heavy fertilization will be an immediate reduction in a tree's carbohydrate levels, aggravating stress. If the tree shows severe stress, do not apply high levels of fertilizers. Work to alleviate stress factors to the extent possible.

Author: David Whiting, Extension Consumer Horticulture Specialist (retired), Department of Horticulture & LA, Colorado State University. Revised by Mary Small, Colorado State University Extension. Artwork by David Whiting; used by permission.

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