Marietta Tree Commission

Appendix B

NATIONAL ARBORIST ASSOCIATION Standard for Fertilizing Shade & Ornamental Trees

(Revised 1987)

INTRODUCTION

This standard serves to provide a guide in drafting specifications for the application of fertilizer to shade and ornamental trees as well as a standard of practice. Trees in the forest or commercial nursery, either field or container grown, may have different environmental considerations and are not addressed in this standard.

It is suggested that the entire text be read before specifications are developed. All of the following should be included: soil test. type of fertilizer, fertilizer analysis, rate of application time of year, and method of application.

The purpose of fertilizing landscape plants is to maintain satisfactory vigor, promote healthy growth, assist the plant in overcoming the adverse effects of diseases or insects, or to correct mineral element deficiencies. Plants require at least sixteen chemical elements for proper growth and development. Three of these elements -carbon, hydrogen and oxygen - are provided by air and water; the other essential elements are obtained by the roots from the soil. Nitrogen is used in large amounts by plants, is easily leached and often volatile. It may be necessary to apply nitrogen annually or biennially. Variations in methods and recommendations are expected in different regions. Therefore, it is recommended that soil be tested every two to three years. The test will report quantities of chemical elements: calcium, phosphorus, potassium and magnesium. The test will also provide a pH reading, which is a measure of the acidity or alkalinity of the soil. The actual soil pH influences nutrient absorption and plant growth through the effect of hydrogen ions on nutrient availability. Each essential nutrient is only available to plants within a specific pH range.

The presence of a chemical element (nutrient) in the soil is no guarantee that it is in a soluble form available for plant absorption. The concentration of hydrogen and associated ions affects soil reaction and the formation of soluble and insoluble compounds. All nutrients must be in solution to be available for root absorption.

Foliar analysis for determination of chemical element needs is recommended for trees showing specific nutrient deficiencies. It is possible to have a soil test indicate that adequate levels of all nutrients are present in a soil and still have nutrient deficiency symptoms appear on a plant. The nutrient may occur in a form that is unavailable to the plant. There may also be physical problems within the soil, such as compaction, poor drainage, or poor aeration that can affect nutrient absorption.

SECTION A: TYPES OF FERTILIZER

I. Organic Fertilizer -is that categorized as derived from a plant, animal or synthetic organic source. Nitrogen (N) occurs naturally in organic fertilizers (manures), and gradually becomes available for plant use as the material is reduced by microorganisms. Synthetic organic nitrogen fertilizers are created by coating urea with sulphur or resin-like materials which make the material slowly available for plant use.

Organic fertilizers are characterized by a slow rate of nitrogen release, long residual, low burn and root injury potential, and low water solubility. The higher efficiency of slow release fertilizers means less nitrogen runoff to contribute to pollution of streams and subsurface water. The unit cost of slow release fertilizer absorbed by the plant is actually lower than that of readily available materials.

II. Inorganic (Chemical) Fertilizer -is that derived from chemical sources. These nutrients are readily available in the soil and are rapidly soluble, with a short residual period.

III. Soluble Fertilizer -is mixed with water and applied in liquid form. Soluble fertilizers may be applied to the foliage, to the soil via the deep root feeding method, or as a soil drench treatment. Soluble fertilizers are usually inorganic and readily available, but may be organic and slowly available. Materials with a limited solubility that dissolve slowly are often listed on fertilizer labels as water insoluble nitrogen -WIN (See EXAMPLE I, page 6 for WIN calculations).

SECTION B: FERTILIZER ANALYSIS

I. New Plantings -use a high phosphorus fertilizer to assist in plant establishment, such as those with nitrogen, phosphorus and potash (N-P-K) ratios of 0-20-0, 0-46-0, 4-12-4, or 5-10-5.

II. Established Plantings -use fertilizers with N-P-K ratios of 3-1-2 or 3-1-1 for best response. These formulations may be supplemented with trace elements as local conditions dictate.

Nitrogen fertilizers such as 21-0-0, 38-0-0 or 45-0-0 can be applied if soil analysis indicates no other nutrients are required.

Inorganic (water soluble) nitrogen fertilizers should be applied annually. Very little available nitrogen remains in the soil from year to year, since most of it is either used by plants when available or carried away by water. Synthetic or organic nitrogen (WIN) may be applied biennially due to its slow availability.

Phosphorus and potassium are chemically bound to the soil and become slowly available through several growing seasons. They should be included in fertilizer application in most cases, every 2-3 years in either spring or fall, whichever is more convenient.

In light-textured or sandy loam soils, potassium must be applied annually. Soil tests every 2-3 years *are a must* when using nitrogen fertilizers.

SECTION C: RATES OF APPLICATION

Importance of Proper Rates -the rates suggested in this Standard should only be used as a guideline for fertilizing trees. Specific soils and foliar test recommendations from university or private testing labs should be followed when available. Good judgement is necessary to determine whether frequency, rate, or methods should vary in given situations. Trees of the same species may respond differently to rates of fertilizer due to location in the landscape, soil conditions, rainfall, and other environmental factors. Actual fertilizer rates should be adjusted after considering on-site inspections of foliage color, previous stem or twig growth, general health of the tree, or other environmental factors.

I. Transplanting- fertilization at time of transplanting is recommended to assist in plant re-establishment and to supply phosphorus necessary for root growth because that element moves very slowly in soils. Apply 10 lbs. of phosphate-containing fertilizer, such as 0-20-20, 0-46-0, 4-12-4, or 5-10-5 per cubic yard of backfill. A rate of 10 lbs. of super phosphate per cubic yard is approximately equal to 0.5 lb. fertilizer per bushel of backfill.

II. Established Plantings -

a) Square foot method -For optimum plant growth, it is generally recommended to apply 3lbs of actual nitrogen per 1,000 sq. ft. of area under the branch spread of the tree per year, or 6 lbs every two years. If foliage color, annual growth or general vigor is not normal, increase annual application rate to 5-6 lbs The surface area under the circular branch spread of a tree can be calculated as follows: Surface area = Radius^2 x 3.14. The radius is the distance from the trunk to the edge of the branch spread. As an example, a tree with a total branch spread of 36 feet would have a radius of 18 feet. The area, according to the formula, would equal 18 x 18 x 3.14, or 1,017 sq. ft. Considering the recommendation of 3 lbs of actual nitrogen per 1,000 sq. ft., one would apply about 17 lbs of 18-5-11 fertilizer: 3.0) 0.18 x 16.6 lbs. *Caution: If the area under the circular branch spread contains impervious surfaces, such as walks, drives, and foundations, then judgement should be exercised as to whether to use the square foot method for calculation.* Reduced soil area *does not* diminish a tree's need for fertilizer; however, over-application of fertilizer can cause sod and tree root damage. Alternative fertilizing methods may have to be utilized.

b) Diameter Breast High (DBH) -Measure the trunk diameter at 4½ feet above grade. Generally for optimum growth, apply ¼ lb actual nitrogen per inch DBH to trees under 6 inches in diameter. The rate can be increased to ½ lb N per inch DBH for most trees over 6 inches DBH. Fertilizing trees using the DBH formula results in similar quantities as the surface area method. Using the same 6 inch DBH tree as above and fertilizing with ½lb actual N per inch DBH would require 16.7 lbs of 18-5-11.

6 inches (dia.) x 0.5 lb/inch(rate) = 3.0 lb (amount of N).

3.0 lb (amount of N) + 0.18 (%N in 18-5-11) = 16.7 lbs of 18-5-11.

Caution: With trees growing in restricted areas such as sidewalk strips, planters, etc. the square foot method is preferable to the DBH method.

c) Liquid application -Dilute fertilizer solutions should be applied at the rate recommended by the manufacturer according to operating pressure and flow rate of the equipment to be used. Apply sufficient liquid mixture to supply the required rate of fertilizer as determined by the surface area of DBH method. It is suggested that one apply 150 gallons to each 2,000 sq. ft. of surface area. Inject approximately ½gallon of fertilizer solution per injection at 2½ft spacings.

1. Square foot method: Apply 5lbs of N per 1,000 sq. ft. to trees on the lawn using 32-7-7 formulated fertilizer.
Calculation:

5.0 (lbs N)) 0.32 (% N) = 15.6 (lbs 32-7-7 fertilizer)

15.6 lbs fertilizer x 2 = 31 lbs of fertilizer added to each 150 gal of water.

Each 150 gal of water covers 2,000 sq. ft. if pump pressure is 150 lgs and injection spacing is 2½ft.

The pump can be calibrated by counting the seconds it takes to pump 112 gallon of solution into a bucket. Each operator should calibrate his pump, counting off the seconds, and use this same count and cadence while injecting the probe into the soil.

2. Diameter at Breast Height Method: Apply ½lb of N per caliper inch to trees on lawn using a 32-10-5 formulated fertilizer.

Calculation:

0.5 (amount of N/inch cal.)) 0.32 (% of N in 32-10-5) = 15.6 lb of fertilizer.

15.6lbs. of fertilizer x 2 = 31 lbs of fertilizer added to each 150 gal of water and applied as per grid above in surface application problem.

SECTION D: TIMING OF FERTILIZER APPLICATIONS

All of the following guidelines are subject to regional and climatological differences. Autumn is an ideal time to fertilize, generally l after the first hard freeze and until the moisture in the soil freezes and root activity ceases. In the southern areas of the country where the ground does not freeze, root growth in many cases will continue all winter long. Early spring, *before* budbreak is also an appropriate time. When leaves have fully expanded, fertilizing can continue until early July. However, treatments of readily i available inorganic nitrogen between July and September could promote a late flush of growth which may not harden off before freezing temperatures in autumn, and injury could occur. Mid to late-summer fertilizer applications should be limited to I correcting specific element deficiency problems.

SECTION E: METHODS OF FERTILIZER APPLICATIONS

I. Surface applications -Fertilizer is placed in a spreader calibrated to apply the proper amount of material per 1,000 sq. I ft. Care should be taken to avoid excessive overlapping. The application can be made in either concentric circles or in I linear strips starting 2 or 3 feet from the trunk out to 5 to 10 feet beyond the drip line of the tree.

Only fertilizer sources that contain nitrogen *alone* should be surface applied. Fertilizer should be applied when grass I blades are dry. After the fertilizer has been distributed, it should be washed off the grass blades immediately, using a lawn sprinkler or irrigation system. Fertilizer remaining on grass blades that become wet following a light rain or dew formation occasionally causes burning.

To prevent the soil from becoming deficient in phosphorus or potassium following annual surface applications of nitrogen, it is desirable to add these nutrients as needed according to soil analysis. Without soil reports, the NAA suggests phosphorus at 3.6lbs of phosphoric acid (P_2O_5) per 1,000 sq. ft. and potassium at 6 lbs of potash (K_2O) per 1,000 sq. ft. Phosphorus will not burn grass if used at recommended rates.

Phosphorus should be applied with the drill hole or liquid injection method because it is so insoluble and does not move down to the roots if applied as a surface treatment.

Caution: potassium and nitrogen *may burn* turfgrass when applied at recommended rates. Irrigation of lawn areas should follow surface applications of these fertilizers.

II. Drill Hole Method -The drill holes should be placed in concentric circles in the soil around the tree beginning 2-3 feet or more from the trunk and extending 5-10 feet or more beyond the drip line. Space holes 2 feet apart and drill them 8-15 inches deep, depending upon the tree species, root growth patterns, and type of soil in the root area. The recommended rate of fertilizer should be uniformly distributed among the holes. Depending on the diameter of the hole, it can be filled following fertilization with peat moss, calcine clay, perlite, small crushed stone, sand, or other soil amendment.

If the area beneath the spread of the branches is restricted, reduce the application in proportion to the area or number of holes that cannot be made. Use a suitable measuring device and a funnel to apply the fertilizer in the holes. If desirable in sodded areas, the holes may be closed by pressing from different angles with the heel of the worker's shoe, or by cutting and lifting a plug of grass, filling the hole to within 4 inches of the top, adding soil and replacing the plug. Keep the fertilizer at least 4 inches below the top of the hole in turf areas to prevent burning of the grass by dehydration. Irrigation following fertilizer application will help prevent injury to turf; however, do not flood the area, as dissolved fertilizer may be carried to the surface and cause turf injury.

When fertilizing trees that contain shrub or herbaceous plant beds within the root area of trees, care must be taken not to punch holes closer than 6 inches to the crown of small plants. Azaleas and other plants have been injured or killed by fertilizer in holes placed too close to the plants.

The opening of the soil that results from use of the drill hole method allows for penetration of both water and air. *This increase in soil oxygen supply is often as valuable as the addition of fertilizer.*

III. Liquid Injection Method -Injections using a soil probe or lance should be *2V2* feet apart, and 8-12 inches deep for trees. Begin lance injection 2-3 feet from the tree trunk, and work out 5-10 feet beyond the drip line of the branches.

Use a hydraulic sprayer at 100-200 lbs. pressure and a soil lance designed for liquid fertilizer with a manual shut off valve and three or four horizontal discharge holes at 90 degrees in its point. *Inject* half a gallon of fertilizer solution into each hole. The addition of water to dry soil as occurs during the liquid injection process is an excellent side-benefit.

IV. Foliar Sprays -To correct minor element deficiencies, spraying liquid fertilizer on the foliage should be considered, especially for correcting iron deficiency using chelated iron. This method should not be regarded as an adequate means of providing all the necessary mineral nutrients required by *major* element-deficient plants in the amounts necessary for satisfactory growth. Micronutrient spray applications are most effective when made just before or during a period of active growth, usually from spring to early summer. Response, as indicated by greening of chlorotic foliage and normal growth coming from buds on affected shoots. is usually observed from 2 to 8 weeks after treatment, but response time varies. Factors in response time include the plant species, age of plant and its parts, time of year, severity of the deficiency and soil conditions under which plants are growing. One or two applications during the year will generally prevent or control deficiencies, but under some conditions, it may be necessary to make several treatments annually to maintain healthy growth.

V. Trunk Injections and Implants -These methods are used for specific element deficiencies, particularly iron or manganese, as well as for trees growing where there is restricted soil surface area under the drip line.

Injections or implants should be made as low as possible on the trunk. Normally, this is done with a clean, sharp drill of the appropriate size. Capsules should be implanted beneath the bark and completely into the xylem tissue.

Early spring before growth starts is the best time for trunk implants and injections. Wound closure is most rapid from spring treatment.

Trees under 4 inches in diameter should not be treated with injection or capsule implants. *Do not inject* or implant when soil moisture is low as severe foliar burning may occur.

SECTION F: ADDITIONAL FERTILIZER GUIDELINES

Proper and timely applications of fertilizer will produce beneficial results on most trees. Newly established trees will grow more rapidly following fertilization with a nutrient or combination of nutrients that previously were present in only limited amounts in the soil. The results are shown in increased leaf size, length of current season twig growth, and more rapid increase in height. Slow-growing tree species may also be stimulated to grow faster by fertilizing.

Abnormal leaf color and small leaf size often indicate nutrient deficiencies in the soil. Various colors or patterns of color indicate deficiencies of specific essential nutrients. The leaves of many trees become darker green following fertilization, making them more conspicuous and attractive.

Fertilizing can help maintain mature trees in a vigorous growing condition. A vigorously growing tree is more winter hardy and less susceptible to many diseases and insect pests than is a less vigorous tree. Canker-causing fungi occur more commonly in weakened trees. Also, many of the non-infectious tree diseases develop when soil nutrient, oxygen and moisture conditions are unfavorable. Healthy, vigorous trees tend to resist borers, while those growing under unfavorable moisture or nutrient conditions are more susceptible to attack by these insects.

Established trees weak'3ned by leaf diseases. insect defoliation, mechanical *injury,* soil compaction, drought, or other causes often show reduced twig and trunk growth or dying of branch ends. Fertilizing may stimulate additional growth so that the plant can compensate for the adverse conditions that caused decline.

I. To Prevent Plant Injury -Avoid use of lawn fertilizer/herbicide combinations where the roots of desirable and sensitive vegetation could pick up herbicide. Herbicides for use around trees should be applied separately at the rates suggested on the label.

II. Fertilizing Sensitive Plants -

a) When fertilizing American Beech and broad leaf evergreens, reduce applications of inorganic fertilizers to one-half the label-recommended rates of fertilizer, or use slow-release materials instead.

b) Be aware that over-fertilizing small trees such as flowering crabapples can result in excessive succulent growth. Succulent growth is more prone to fireblight symptoms on susceptible plants such as pear, Jonathan apple and mountain ash.

Fertilize in Moist Soils -Fertilizer should *always be applied to moist soils* to enhance fertilizer uptake, reduce fertilizer injury to plants, and aid in soil injection or drill hole treatments. If soils are not moist, irrigation should precede fertilization to moisten the plant root zone area. The liquid injection method of fertilizing trees and shrubs will help moisten the soil in the root zone while applying desired nutrients. The benefits of water in dry soil will reduce nutrient as well as moisture stress.

IV. Fertilizing Excessively Wet Soils -Avoid fertilizing trees growing in soil that is *excessively wet.* The roots in wet soil are often damaged from lack of oxygen caused by the accumulation of toxic gases. Adding fertilizer in any form may contribute to root *injury.*

V. Read the label- Read the entire label of any fertilizer product before application, and apply per label recommendations.

EXAMPLE I

Slow release fertilizer is measured by the percentage of water insoluble nitrogen, (WIN). Use the following formula to determine the percentage of water insoluble nitrogen in a bag of fertilizer:

$$\frac{\%\ \text{of WIN} \times 100}{\%\ \text{of total N}} = \%\ \text{of N that is slow release}$$

Example for a fertilizer label that reads 32-7-7:

Guaranteed Analysis
Total Nitrogen (N) 32%
Water Insoluble Nitrogen 12.5%
Nitrate Nitrogen 2.0%
Water Soluble Nitrogen 17.5%
Available Phosphoric Acid 7%
Soluble Potash 7%

$$\frac{12.5\%\ \text{of WIN} \times 100\ \text{lbs of fertilizer}}{32\%\ \text{of total N}} = 39\%$$

39% of the available N is slow release

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