SPECIES, SOIL, LOCATION AFFECT TREE FERTILIZATION

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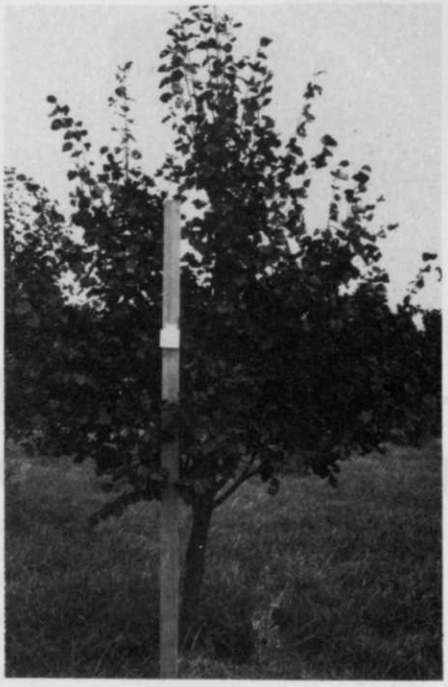
Many factors influence how much fertilizer shade trees need, such as species response, soil variation, and location. Recognizing differences in these factors will lead to proper fertilization and to improved performance of the trees.



Littleleaf Linden *(Tilia cordata)* six years after growth in poorly drained silt loam soil. Upper right: Fertilized. Lower left: Unfertilized.

Species

Are there differences in the fertilizer requirements between tree species and/or cultivars or can we treat most trees in a similar manner? Hopefully, one fertilizer could be applied on all tree species, at one rate, to simplify the process. Fortunately, this can be done, at least, on a local level with a few exceptions.

Trees showing signs of nutrient deficiency, often the case when the homeowner contacts the arborist, landscape or maintenance firm, do not always respond to a complete N-P-K fertilizer. Little leaf Linden, for example, will exhibit signs of nitrogen deficiency with symptoms resembling triazine (simazine, atrazine) herbicide toxicity. A complete fertilizer containing nitrogen will assist that species in restoring to normal foliage color. However, Oak trees with the typical dark green veins and yellow interveinal areas are usually in need of iron. The exact same foliar symptoms on Maples indicate a lack of manganese. A complete fertilizer, even with minor elements added, would quite likely not correct the problem of Oak and Maple. Therefore, it is important to realize that certain trees, particularly when grown out of their native habitat, may have specific nutritional needs.

Soils

Soils, as all professionals are aware, vary from sandy loam to clay loam with most soils, in landscape sites, of the silt to clay loam type. Understanding the differences between sand and clay in respect to fertilizer rates and frequency, cation exchange capacity, and pH are important. Recognizing too, that soils in landscape sites are often subsoil or a subsoil mixture, often heavily compacted from construction equipment and typically poorly drained create a whole new set of challenges for the tree care firm.

It's these variations in soil texture that cause industry representatives to "throw the suggested fertilizer guidelines out the window" and begin a new program.

Sandy loam soils with low cation exchange capacity (a measure of the capacity of soil to hold exchangeable cations: H^+, Ca^{++}, Mg^{++}, and K^+) will need to be fertilized with a low rate of fertilizer but at more frequent intervals.

The pH is a measure of soil acidity or alkalinity and its significance to plant growth is its effect on mineral element availablity. A pH of 6.0-7.0 in mineral soils represents that range in which most mineral elements are available to the largest degree. The most ideal pH range for the majority of trees in the north is 6.0-6.5. A very acid soil pH of 4.0 would result in deficiencies of certain elements

such as N, P, K and Mg and possible toxic levels of Fe, Mn and B. Highly alkaline soils of 9.0 would result in deficiencies of Fe, Mn, Cu, Zn, as well as N. Toxic release of K, S, Ca and Md are possible at such a high pH reading.

Subsoils often have a significantly lower pH than the top soil and industry workers should be alert to these kinds of conditions. Acid soils are likely to have more acid subsoil and alkaline soils, more alkaline subsoil. These variations should be considered when adding limestone or acidifying agents.

Compacted soils arise from equipment during construction or regular foot traffic and these situations are common to the downtown area, new construction sites, parks, college campus grounds, shopping centers and other people concentrated areas. Compacted soils are typically poorly aerated soils, and without an adequate supply of air roots of most trees grow quite poorly. Applying fertilizer via the drill hole method or injection under high pressure are the preferred methods of application in these situations. Fertilizing trees under conditions of adverse site or environmental conditions is one of the keen observation and common sense.

Location

The location of a tree in the landscape may influence its fertilizer practices. A shade tree in the backyard, typically without stress conditions, usually will require less fertilizer and few applications than a tree planted between the sidewalk and street. The root zone area of the latter is reduced, likelihood of soil compaction, exposure to highway salts, road dust or dirt and air pollutants is greater. Each of these conditions contribute to the need to give greater attention to tree care practices including regular fertilizing to maintain healthy growth.

Determining fertilizer needs

As a guide to proper fertilization, a soil test is recommended prior to fertilizing. If for no other reason, commercial growers test fields prior to planting to make certain that they correct the pH and to incorporate phosphorus if either is needed. It's difficult, if not impossible, to change pH or obtain satisfactory distribution of phosphorus after planting trees. Soil testing may not be necessary for every planting job, however, it should be considered when working in a geographic area where the pH is not known, where site conditions may be unusual or on larger jobs that may involve more than one soil type.

After the planting is completed, testing procedures include both soil and plant analysis. Plant analysis will indicate the precise quantity of 10 or 12 mineral elements in the plants the days of sampling. Instructions for sampling soils and foliage are available from local County Cooperative Extension Service offices. Private laboratories have testing services available but for the most part do not have individuals trained in Landscape Horticulture that can make accurate recommendations for the differences that exist in the different kinds of woody ornamentals produced in most states.

Bark splitting, common with young transplants of Littleleaf Linden, can be markedly reduced by proper fertilization.

Although plant analysis is utilized far more to diagnose suspected mineral disorders, both plant and soil analysis should be used as an aid to maintaining a proper nutrition program rather than waiting for deficiencies to occur.

Rates

The purpose of fertilizing trees the first few years following transplanting is to increase height, width and caliper. However, once the trees are established and growing well the function of fertilizer treatments are basically to maintain satisfactory growth and health but not necessarily to produce optimum height or caliper, such as the commercial nurserymen is seeking.

Research in Ohio has shown that approximately 3 lbs. of actual nitrogen, the mineral element most responsible for vegetative growth, per 1000 sq. ft. or 6 lbs. every other year is all that is needed to maintain the health of shade trees in most landscape situations. If foliage color, annual growth or general vigor is not normal, increase the rate to 5 or 6 lbs. N/1000 sq. ft./yr. If soil or foliar test results are available, by all means follow these recommendations, otherwise the suggested rate above could be used as a guide.

As a general rule, trees respond well to fertilizers with a 3-1-2 or 3-1-1 ratio such as 24-8-16, 18-6-12, 18-5-9, 15-5-5, 12-4-4 or similar formulations. In

other words, trees require 3 times as much nitrogen as phosphorus. In many soils the potassium is depleted rather quickly and it should be applied at twice the rate of phosphorus.

The trend in recent years has been to higher and higher analysis in the fertilizer package. Quite often the nitrogen content is 30% or more, and is 4 or 5 times the phosphorus level and these too, although promoted for turf, can be satisfactorily used around trees.

If 3.0 lbs of actual nitrogen is to be used/1000 sq. ft., how much 15-5-5 is needed? To determine the rate of fertilizer, divide the % nitrogen on the fertilizer bag into 3.0. Thus, (3.0 ÷ 0.15 = 20) dividing 3.0, the rate of N, by 01.5 (the % of N on the fertilizer bag with two decimal places as a percent of 100) equals 20 lbs. of 15-5-5 needed to apply 3.0 lbs. of actual N/1000 sq. ft.

Timing fertilizer applications

Greenhouse producers often fertilize their crops with every watering to optimize growth. Commercial nurserymen may fertilize trees 3 or more times/season to obtain the best rate of growth. In the landscape, however, trees are fertilized at much less frequency because optimum growth is not the major objective but, rather maintenance of healthy trees.

Fertilizing once a year is certainly preferable to longer intervals. Although applications twice a year in many situations would be advised. However, many people object to paying for more than an annual fertilization. The best time to fertilize trees is autumn, generally between October and December. The second best time would be early spring prior to growth usually between February and early April. The next choice would be early to mid-summer. If the fertilizer could be split into equal parts and applied in each of 2 or 3 seasons plant response would be superior to one season or alternate year treatment.

Yellowing of the foliage of Eastern White Pine *(Pinus strobus)* and other trees can be prevented by early spring trunk implantation of iron containing capsules. In the pine shown above the capsules were implanted in the main trunk just above the lowest limb.

Methods of fertilizer application

Liquid injection of fertilizer into the soil is rapidly taken in by the roots of trees and is a good method to correct deficiencies of specific mineral elements. Also, the addition of water to dry soil is desirable in the summer.

The major advantage to the drill hole system is opening of heavy compacted soil to provide air. This technique and liquid injection avoid the excess grass growth in turf areas from surface applications.

Surface application is, however, as effective in providing tree response with most species as other methods. It is quick and the least expensive, but should be avoided in quality turf areas.

To correct minor element deficiencies, liquid fertilization to the foliage should be considered, expecially for iron deficiency. This method should not be considered adequate as a means of providing all the necessary mineral elements required by plants.

Tree truck injection and implantation is ideal to apply minor elements such as iron, manganese, zinc, etc. Due to soil pH, moisture relationships and other conditions, this method is often more satisfactory than liquid fertilization of the foliage.

The method selected is dependent on the type of fertilizer being used, the specific purpose of fertilizing, soil conditions, location of the tree, the presence of quality turf, among others. Needless to say, equipment should always be properly calibrated and in good working order.

Summary

To answer the question of how much fertilizer a shade tree needs, the applicator must consider several factors. We must know species differences to more precisely define specific requirements. Soils are variable from the standpoint of textures, pH, and cation exchange capacity. Recognizing these differences will help us to fertilize more accurately for the performance of the trees. The location of trees in the landscape often dictate differences in fertilizer practices particularly if unusual stress factors are involved from humans, autos, pollution, etc. Fertilizer needs of trees can be identified with soil or plant analysis. Where recommendations are not available, based on laboratory tests, fertilize trees at the rate of 3 lbs. actual N/1000 sq. ft./yr. Use a 3-1-2 or 3-1-1 ratio to provide the necessary phosphorus and potassium. Apply the fertilizer annually or more often, if possible, depending on tree growth. Late autumn is a good season to apply fertilizer with early spring a solid second choice. Several methods can be selected to apply fertilizer and the choice depends on several factors.

Fertilizing shade trees to maintain satisfactory health and vigor requires a number of judgments based on keen observations by experienced people.

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