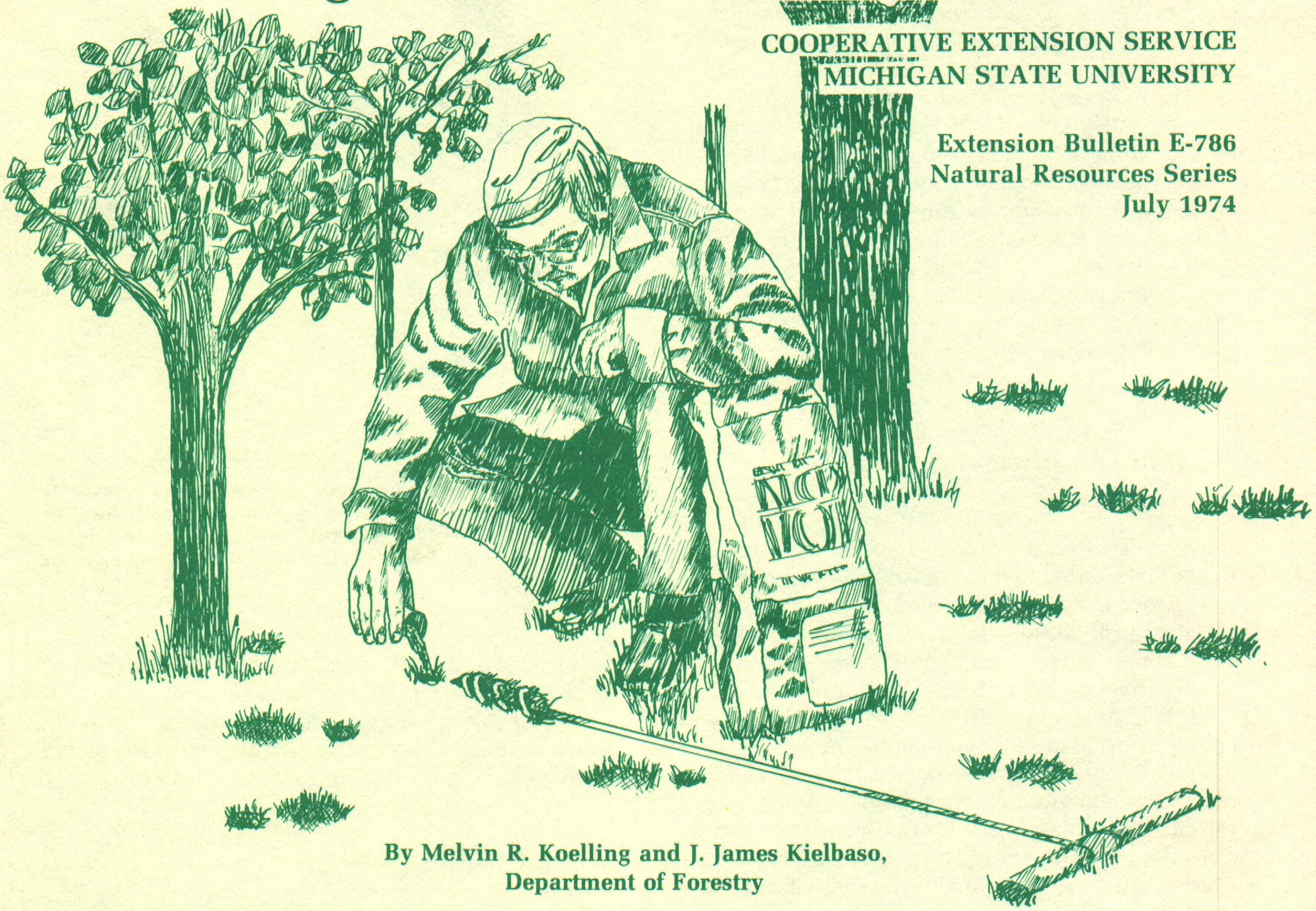
# Fertilizing Shade and Ornamental Trees



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Shade and ornamental trees can be greatly improved through regular tree care. Fertilizer application is one of a number of practices available to the homeowner.

Many of us are aware of the need for fertilizing our garden and lawn, but too frequently forget trees also benefit from fertilization. Like all plants, trees are dependent on sunlight, water, air, and certain mineral nutrients present in the soil for normal growth. Under forest conditions, the annual fall of leaves and twigs, and their eventual decomposition provides a fresh source of nutrient materials. However, when trees are growing in lawns or similar areas they are usually denied this source of soil enrichment as most homeowners gather up these leaves each fall. Over a prolonged period of time, this practice can lower the fertility of the soil.

Infertile soils often result around new houses when the soil removed for the basement is spread during filling and leveling operations. Normally, it has poor physical properties and may be lacking in adequate amounts of the necessary mineral nutrients. The addition of fertilizer materials will benefit such soils and improve the growth of trees planted on these areas.

Trees growing on good soils will also benefit from fertilization. This is especially true where the soil is compacted or where normal root growth may be restricted by sidewalks, driveways or building foundations. Fertilizer additions are also helpful in developing good leaf color, recovering from insect, disease or other injury, and in stimulating general vigor of the tree.

## Need for Fertilization

There is no single indicator that will tell a homeowner his trees need fertilization. However, some specific conditions may indicate the need for certain fertilizers. These include: leaves of smaller than usual size, presence of light green or off-color foliage, ends of branches containing dead twigs, very short elongation of branches during the growing season and a general lack of thriftiness or vigor. If any of these conditions are present, the tree will likely benefit from fertilizer additions. Similarly, if the tree has been injured or has sustained severe defoliation by insects, hail, etc. fertilization will be helpful.

Some nutrient deficiencies may exhibit specific discoloration in the foliage and as such can be recognized. The most common condition of this type is the development of a light, yellow-green color, especially in the areas between the veins (Figure 1). This condition, called chlorosis, is most often associated with a lack of available iron. Other essential nutrients including nitrogen, phosphorus and potassium also exhibit deficiency symptoms; however, such symptoms are not as apparent as those of iron.

## What are Fertilizers?

Many kinds of materials may be added to the soil to improve fertility, however, some are more effective than others. Organic residues such as peat moss, manure, wood chips, etc. are beneficial in improving the physical properties of the soil, but unless added in large amounts over a number of years, they will not greatly increase the nutrient content of the soil.

Most commercial fertilizers consist of inorganic compounds blended together to provide a given amount of one or more essential nutrients. The three most common ingredients include nitrogen, phosphorus and potassium. Plants, including trees, require larger amounts of these three nutrients than others. Nitrogen is obtained principally from the atmosphere, phosphorus and potassium by mining rock deposits high in these elements. These nutrients are then converted to an available form, combined with an organic or inorganic carrier and formed into the familiar fertilizer granule.

Manufactured fertilizers differ in the amount of nutrients they contain (Figure 2). This difference is apparent when one looks at the expressed analysis (grade). Fertilizer analyses are commonly expressed with three numbers, e.g., 10-6-4. The first number (10), in this example refers to the percentage of elemental nitrogen (N) present, the second number (6), to the phosphorus (P) content expressed as percentage $P_2O_5$ (phosphate) and the third number (4), to the percent potassium (K) in the form of $K_2O$ (potash). Since many different analyses are available, it is important to understand that a fertilizer with a grade of 16-8-8 contains 60 percent more nitrogen, 33.3 percent more phosphorus ($P_2O_5$) and 100 percent more potassium ($K_2O$) per pound of fertilizer than a pound of 10-6-4. This difference can be made more meaningful by realizing that 37.5 pounds of 16-8-8 would be required to apply nitrogen at the rate of 6 pounds per 1000 square feet of soil surface in contrast to 60.0 pounds if 10-6-4 were the formulation used to provide the same level of application. This explains why some fertilizers are more expensive than others.

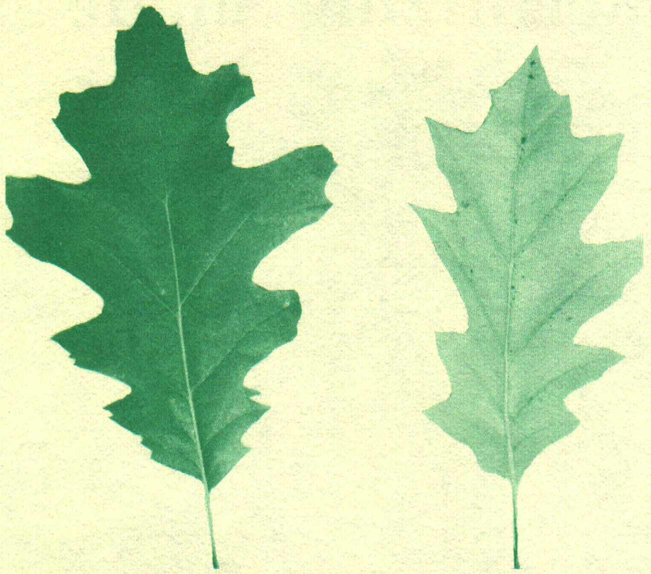

**Figure 1. Yellowish-green color between the veins and along the margins (edges) of leaves may be an indication of chlorosis (right). This condition is most often associated with a lack of available iron in the soil. Note normal leaf on left.**

## When to apply

To be of greatest value to the tree, fertilizer should be applied in the spring as soon as the soil is free of frost. In Michigan, this usually occurs in late March in the southern portion of the state and in early to mid-April in northern areas. Fertilizer which is applied in early spring is available for the tree to use as soon as growth resumes. Since root growth will begin before leaf development, fertilizers should be applied as early as possible.

Fertilizer can be applied in the fall — after the current growing season is over. In Michigan, this is usually after the middle of September. Since root growth may continue until early December or later, fertilizers will be available and beneficial to the tree. Any fertilizer which is not used at this time will be available when growth resumes in the spring.

Trees are usually not fertilized in mid-summer, although in some instances, such as where injury or defoliation has occurred, some benefit could be expected. However, a precaution regarding summer fertilization is in order. Fertilizers should not be applied to trees in late summer as flushes of new growth may result. Such tissue may not harden-off sufficiently before fall, resulting in winter injury. Apply fertilizers after the middle of September to avoid this danger.

## How to apply

To be effective, nutrient materials in fertilizers must be transferred into the sap stream of the tree. While most transfer occurs through absorption by the roots, some uptake may take place by absorption through the leaves (fertilizer solutions sprayed on foliage) or as a result of direct injection of fertilizer materials into the trunk of the tree. Because of these several means of uptake by the tree, many different methods of applying fertilizer have been developed. These include (1) application directly to the soil surface, (2) application (dry or liquid form) in holes in the soil, (3) foliar sprays and (4) injections (dry or liquid) into the trunk of the tree. No one method may be considered as best, even though all are available and used by commercial arborists. Often, depending on fertilizer needs, a combination of methods is used.

The application methods we suggest are based on the results of current research and are designed to consider the requirements of a tree for nitrogen, phosphorus, and potassium. The size of the tree and the environment (lawn area) in which it is growing are considered in determining the application method. We are recommending a method based on the soil surface area around the tree in contrast to the traditional approach of relating fertilizer needs to trunk diameter. We do not believe diameter is a good indicator of fertilizer needs.

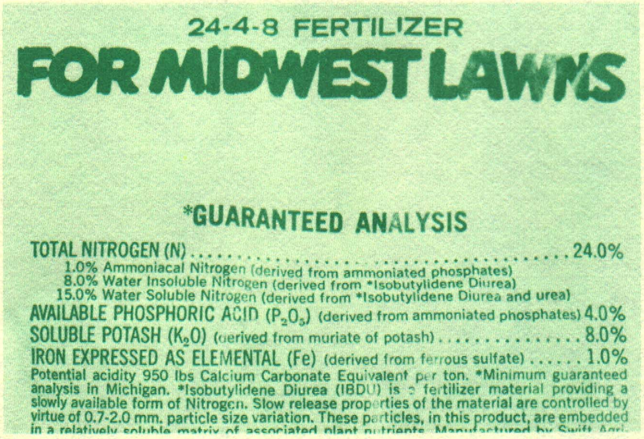


**Figure 2. The amount and form of nutrient materials in a manufactured fertilizer are expressed on the package. Other information regarding the effectiveness of the fertilizer is also included.**

The frequency of fertilizer applications will depend on the material and methods used. For example, nitrogen is required in larger amounts than phosphorus or potassium. And, fertilizer compounds applied to the soil surface or in holes in the soil can be expected to provide a longer lasting effect than materials applied as foliar sprays. Because of differences in requirements by the tree, nitrogen fertilizers should be applied annually, and phosphorus and potassium, at intervals of 3 to 5 years. The method of application will vary according to the amount and type of grass beneath the tree. This is related to differences in nitrogen requirements between bluegrass which is common in sunny lawns and fescue which is frequently planted in heavily shaded areas. We will consider application methods for nitrogen, phosphorus and potassium in several different situations.

**SITUATION I — Small (less than 25 feet high) open-branched tree which casts light shade, or any tree with lowest branches 12 feet or more from ground; bluegrass growing satisfactorily beneath tree.**

a) Annually apply nitrogen on the surface when grass is dry at rate of 6 pounds per 1,000 square feet of soil surface beneath the tree, Make 3 applications of 2 pounds each at 2-week intervals to avoid damage to lawn. If non-burning fertilizers are used (i.e. ureaformaldehyde), make a single application (6 pounds per 1,000 square feet). Refer to page 5 for calculation methods. Do not apply fertilizers within 3 feet of the trunk.

b) At 3- to 5-year intervals, apply a complete fertilizer such as 10-6-4, 16-8-8, or 12-12-12 in holes at rate equal to 6 pounds of nitrogen per 1000 square feet.

**SITUATION II — Trees which cast heavy shade, or trees in clumps beneath which fescue or other shade tolerant grasses are growing.**

a) Surface application at recommended rate of nitrogen would be harmful to grass. Recommended procedure is to apply nitrogen annually in soil holes at rate of 6 pounds of actual nitrogen per 1000 square feet (see page 5 for calculations).

b) For phosphorus and potassium, follow same procedures as for Situation I.

**SITUATION III — For ornamental flowering trees and other small fruit trees.**

Unless definite need of fertilization exists do not fertilize. Heavy applications of nitrogen may tend to reduce flowering. If fertilization is necessary apply complete fertilizer such as 10-6-4 or 12-12-12 in soil holes in the spring at rate of 3 pounds of nitrogen per 1,000 square feet.

**SITUATION IV — Evergreens**

For large trees follow recommendations as for Situations I and II. For small trees and shrubs, use complete fertilizer (such as 12-12-12) at rate of 3 pounds of actual nitrogen per 1,000 square feet.

Surface application of nitrogen fertilizers to the soil is quick, practical and inexpensive. Since nitrogen will readily leach into the root zone, it is quickly available for use by the roots of the tree, In contrast, potassium, and particularly, phosphorus, do not move readily within the soil and should be placed in the root zone. Nitrogen-containing fertilizers may be conveniently spread on the soil surface with a lawn fertilizer spreader (Figure 3). These spreaders distribute the material evenly and when properly calibrated will accurately deliver the amount required. [1] Apply fertilizer to the surface only when the grass is dry. It is usually advisable to water the area thoroughly following application.

When fertilizer is placed in the soil, make small holes either by using a punch bar, or soil auger (Figure 4). Holes should be 1-1/2 to 2 inches in diameter and about 12 to 15 inches deep. Diameters larger than this are not recommended since the fertilizer will fall to the bottom of the hole rather than be distributed throughout its length. Make the hole at a slight angle slanted towards the trunk for best distribution.

Holes should be made in concentric circles around the trunk of the tree. The first circle should be no

**Figure 3. Nitrogen fertilizers can be applied to the soil surface with a lawn fertilizer spreader. The spreader should be calibrated to insure accurate delivery.**

**Figure 4. Use a soil auger to make holes beneath the tree for fertilizer. Holes should be approximately 1½ to 2 inches in diameter and about 12 to 15 inches deep.**

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[1] To calibrate a spreader, consult the manufacturer's instructions or do it as follows. First determine how much fertilizer of the analysis you are using is needed to deliver the rate desired. (Refer to page 5 for assistance in calculations.) Once this has been determined, convert this amount to that needed to treat a 100 square foot area. (Divide both numbers by 10.) If a 10-6-4 analysis fertilizer is to be applied at a rate of 6 pounds of actual nitrogen per 1,000 square feet, then following the calculations on page 5, 60 pounds of fertilizer will be required per 1,000 square feet, or 6 pounds for 100 square feet. Weigh out 6 pounds of fertilizer and place in the spreader. Then on a hard surface, such as the garage floor or driveway, mark out a 10 x 10 foot square (100 square feet or 1/10 of 1000 square feet). Begin spreading the fertilizer within the marked area and make the necessary adjustments so a setting is found that will result in all the fertilizer being uniformly spread over the area. This is a trial and error procedure and will probably require readjustments of the spreader, sweeping up the fertilizer and starting over. When the correct setting has been obtained multiplying the amount spread (6 pounds) in our example) by 10 will equal what must be spread over 1000 square feet to achieve the desired rate of 6 pounds of actual nitrogen. If other application rates are desired, or if fertilizers of other analyses are used, follow the same procedure, remembering to first convert to the amount needed for 100 square feet.

closer than 3 feet from the trunk with successive circles at 2 foot intervals. Distances between any two holes on each circle should be 2 feet (Figure 5). The circular pattern of holes should extend for a few feet beyond the drip line or edge of the crown. The amount of fertilizer placed in each hole will depend on the total amount being applied to the tree. Ideally, this amount is determined by dividing the number of holes into the pounds of fertilizer required for the rate being used.

To avoid uneven grass growth, do not place fertilizers within 2 to 3 inches of the soil surface. After the prescribed amount of fertilizer is placed in each hole, the hole may be filled with peat or other organic materials. Do not replace the original soil on top of the fertilizer unless it is of good quality.

To assist in application of fertilizers we will go through a few simple calculations. For ease of determination, the circular area beneath the tree may be considered to be a square or rectangle (Figure 5). The sides of this rectangle are the length and width of the tree's crown, remembering where possible to extend the distances for 10 to 15 feet. If a part of this area is covered by sidewalks, driveways, streets, etc., the total area and therefore the amount of fertilizer should be proportionally reduced.

How many pounds of 10-6-4 fertilizer will be required to apply nitrogen at the rate of 6 pounds per 1,000 square feet to a tree whose crown dimensions are 40 by 50 feet (2,000 square feet)? We are aware that 10-6-4 contains 10 percent available nitrogen. Since the recommendation is for 6 pounds of nitrogen per 1,000 square feet, we need 2 x 6 or 12 pounds of actual nitrogen.

Knowing that 100 pounds of 10-6-4 contains 10 pounds of actual nitrogen, we can use the proportion 10/100 = 12/X, and find that X = (100 x 12/10) or 120 pounds. This relationship may be used for most fertilizers if we remember to change the percentage figures accordingly. (i.e., 12-12-12 should be 12/100 = 12/X; 16-8-8 would be 16/100 = 12/X, etc.) If we had made 150 holes in the area to be treated, the amount to be placed in each hole would be 120/150 or 0.8 pounds or about 12 ounces. A 6-ounce can (e.g. frozen fruit juice) makes a convenient measuring container (Figure 6).

## Other fertilizer needs

Thus far we have considered tree fertilization as related to nitrogen, phosphorus and potassium requirements. While these nutrients are required in the largest amounts, there are several other mineral nutrients which all green plants require. These include: calcium, magnesium, sulfur, iron, manganese cop-

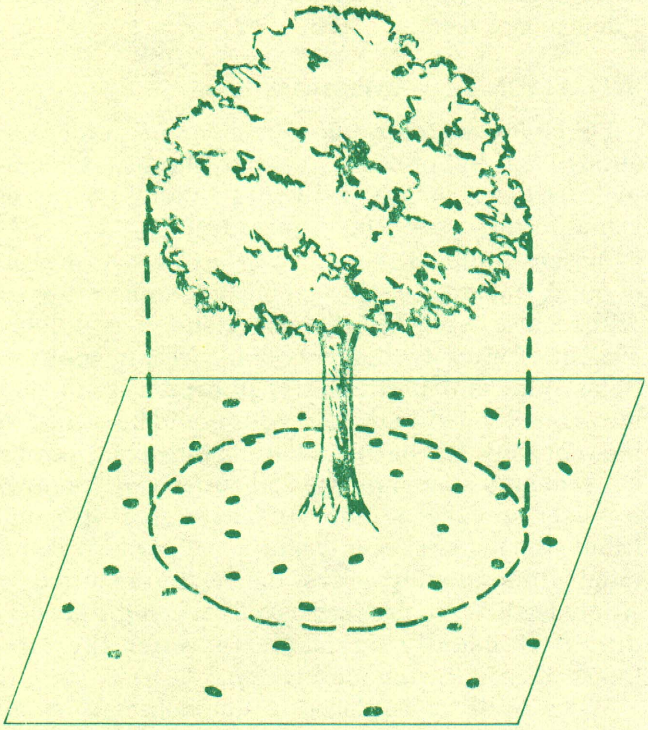

**Figure 5. Fertilizer applications of potassium and phosphorus should be applied in holes both inside and outside the drip line of the tree. Holes should be approximately 2 feet apart and 12 to 15 inches deep.**

**Figure 6. After pouring the fertilizer in the hole, fill the hole with peat or other organic material.**

per, boron, zinc, and molybdenum. Most soils contain adequate amounts of these materials. However one or more are occasionally deficient. Iron deficiency is perhaps the most common, especially in alkaline soils or where lime has recently been added. In such soils, iron may indeed be present, but is unavailable for absorption by the roots due to the alkaline soil. Lack of iron is commonly responsible for a condition known as chlorosis which is characterized by development of a light yellow-green color in the foliage of affected trees. Pin oak is particularly sensitive to iron deficiencies.

Correction of chlorotic conditions in trees consists of increasing the acidity of the soil solution through additions of acidic materials such as powdered sulfur. It should be effective in increasing soil acidity when applied at the rate of 1-3/4 to 2 pounds per 100 square feet of soil surface. Successive treatments may be required to obtain a satisfactory acidity level. An approach which provides more immediate correction is the use of iron chelates, a form of iron fertilizer. These compounds provide an immediate supply of available iron which is unaffected by the soil reaction. They may be applied to the foliage (Figure 7) but for longer lasting benefits, soil applications are preferred. When using iron chelates be sure to follow the manufacturer's recommendations.

In some parts of Michigan, manganese deficiency has been observed in maple trees growing on highly alkaline limestone soils. Manganese sulfate or manganese chelate foliar sprays have produced improved foliage color and general appearance. When using these or similar compounds, be sure to follow manufacturer directions.

Other nutrient deficiencies may be present in local situations. The use of soil tests and foliar analysis will be most helpful in identifying these conditons. For more information, contact your County Cooperative Extension Service Office.

**Figure 7. Foliar sprays containing iron in an available form are often effective in correcting chlorosis. Longer lasting treatments for preventing lime-induced chlorosis involve soil applications of iron chelates.**

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