1985 GUIDE TO: TURF, TREE & ORNAMENTAL FERTILIZATION

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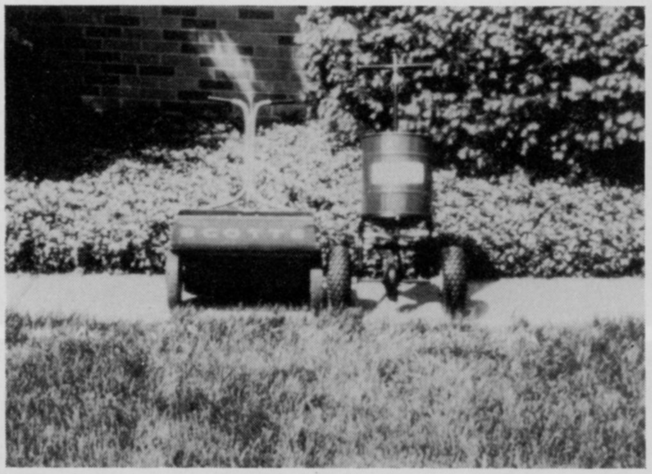
Traditionally, turfgrass managers apply fertilizer in spring and fall using color and the amount of leaf growth as guides to the rate and frequency of application.

Promoting good color and stimulating shoot growth are primary objectives, but nutrient influences on carbohydrate reserves, root growth, and the plant's ability to tolerate disease and environmental stress are often overlooked. Understanding these factors refines a fertilizer program.



Granular fertilizer and pesticide *formulations are normally applied to turfgrass with either a gravity (left) or centrifugal (right) spreader.*

Timing applications

An objective in timing fertilizer applications is to build carbohydrate reserves and promote root development. The response of warm-season and cool-season turfgrasses differs.

The predominant **cool-season** turfgrasses (bluegrass, perennial ryegrass, fescue and bentgrass) initiate and develop root systems in the early spring and fall. Fall application of nitrogen is needed because it increases carbohydrate reserves and root growth. It also improves turf density by promoting greater rhizome and tiller growth.

In addition to regular fall fertilization (September-early October), the relatively new concept known as **late fall** or late season fertilization is being included in many maintenance programs. Late fall fertilization is applied when shoot growth slows or approximately at the time of the last regular mowing of the season.

Nitrogen applied at this time greatly enhances the photosynthetic production of carbohydrates. These carbohydrates are stored for use the following growing season, providing earlier spring greenup and an energy source for turfgrasses to recuperate from environmental and mechanical stress.

Another advantage of late fall fertilization is that it reduces the need for high amounts of spring-applied nitrogen. Excessive **spring** fertilization can actually reduce carbohydrate reserves and root development by stimulating rapid shoot growth. This is because growing shoots take priority over roots for carbohydrate utilization.

Both spring and summer fertilization is used to maintain the color and density produced with fall and late fall fertilization the previous year. Fertilization at these times should not produce succulent plant tissue which can increase the severity of turfgrass disease and reduce the plant's ability to withstand heat, drought, mowing or wear stress.

Applications of **potassium** contribute to the hardiness of the plant and help "temper" the stimulating effects of nitrogen.

In contrast, most of the root growth in the **warm season grasses**—such as Bermuda, zoysia, and St. Augustine—occurs in spring and summer. Fertilization during these periods stimulates root growth. However, only moderate applications should be used in early spring in areas where warm-season grasses experience winter dormancy.

Bermudagrass and St. Augustinegrass experience **spring root dieback** following greenup. Heavy fertilization in early spring may result in additional stress during this critical period.

Like cool-season turfgrasses, warm-season grasses accumulate carbohydrate reserves in the fall when

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Annual Nitrogen Requirement of Turfgrasses*

Species	Length of Growing Season	Nitrogen per Season lbs./ 1,000 sq. ft.	Variations in Management
Cool-Season:			
sheeps & hard fescue	4- 8	0- 3	low maintenance; roughs
red fescues	4- 8	1- 3	low maintenance to good care
Kentucky bluegrass	5-12	2- 8	lawns, fairways
bentgrasses	4- 8	1- 4	medium care, lawn, fairways
bentgrass, greens	5-12	6-15	clippings removed, forced growth
Warm-Season:			
zoysia	6-10	1- 6	adequate cover
common bermuda	7-12	2- 8	most variable
St. Augustine, Bahia	10-12	2- 8	warm areas, lawns
bermudagrass, fairways and tees	5-12	4- 9	good management
bermudagrass, greens	8-12	8-20	may rest over winter

* Adapted from Turf Managers' Handbook by William H. Daniel and Raymond P. Freeborg, published in 1973 by Harvest Publishing Company, New York, NY.

shoot growth activity slows. Care must be taken with the timing of fall fertilization since it may decrease low temperature hardiness if applied late. Maintaining adequate potassium levels in fall increase tolerance to low temperatures. As with cool-season turfgrasses, indiscriminate use of nitrogen fertilization in the summer can increase injury of warm-season grass subjected to disease or environmental stress. As mentioned previously, maintaining adequate soil potassium levels will aid warm-season turfgrass in their tolerance of heat, cold, mowing and wear stresses, and reduce their susceptibility to turfgrass diseases.

Rate of fertilization

The annual nitrogen requirement (pounds per 1,000 square feet) for turfgrass should be determined by considering several factors, including the length of growing season, degree of quality desired, purpose for which the turf is used, and the species and cultivars present.

The **length of growing season** (time between the last killing frost in the spring to the first in the fall) varies. Along the Gulf of Mexico and in certain areas of Arizona and California, it exceeds eight months. Portions of Maine and Minnesota, however, have as little as three and a half months. The longer the length of growing season, the greater the amount of nitrogen needed to maintain turfgrass quality.

Because of the **level of quality** desired is subject to human interpretation, the rate of fertilization can be tailored to meet the expectations of the user. A home lawn maintained for aesthetic purposes, for example, can range from a weed-free turf of acceptable color and density to a season-long turf of premium appearance.

An objective in timing fertilizer applications is to build carbohydrate reserves and promote root development.

The **purpose** for which the turf is used, whether it be for aesthetic or recreational function, will also influence the nitrogen fertility level. The rate of fertilization of bentgrass, for instance, can vary from four to 10 pounds of nitrogen per 1,000 square feet. Lower rates may be used to provide a pleasing appearance on a home lawn while higher rates may be applied to maximize the playability of a putting green.

Turfgrass species and cultivars can vary in amount of nitrogen required to maximize quality. Within the cool-season grasses, sheeps, hard and red fescues require a low level, Kentucky bluegrass a medium level, and bentgrass a high level of fertility. Improved cultivars of bermudagrass require more nitrogen than common bermuda.

Cultural practices such as irrigation and clipping removal may require the use of higher annual nitrogen rates to maintain the desired turfgrass quality. Supplemental watering of turfgrasses will increase the rate of which nitrogen is leached from the turfgrass root zone. Losses can be substantial when quick-release sources of nitrogen are applied to sandy soils.

Collection of clippings following mowing has been estimated to remove approximately 20 percent of the nitrogen applied to turfgrass. Additional nitrogen should be factored into the yearly total of these areas.

Phosphorus and potassium have been routinely applied along with nitrogen using fertilizer with ratios such as 3:1:2, 5:1:2 or 4:1:1. These ratios are based on the relative amounts of nitrogen, phosphorus and potassium found in turfgrass clippings but do not take into consideration the inherent levels found in the soil.

Their use should be based on a **soil test**. Many turfgrass soils contain high levels of phosphorus and little, if any, response is obtained by putting down more.

Two factors to be considered in making individual nitrogen applications are the source of nitrogen and the time of year.

Quick-release sources of nitrogen (for example ammonium nitrate, urea) are commonly limited to no more than one pound of nitrogen per 1,000 square feet. This rule of thumb is observed in spring and fall to avoid overstimulating shoot growth. Summer applications using quick-release sources are frequently limited to no more than one-half pound of nitrogen per 1,000 square feet. Low rates of quick-release sources also minimize the potential to cause fertilizer burn.

Applications of controlled-release nitrogen sources (such as U.F., IBDU, sulfur coated urea) are generally made at rates from one to three pounds of nitrogen per 1,000 square feet. The longer residual of these nitrogen sources reduces the need for more frequent applications, saving

Liquid soil injection *can disperse either soluble or suspension fertilizers throughout the root zone of trees.*

turfgrass managers labor and time.

Method of application

Fertilizers can be applied in either dry or liquid forms, the subject of controversy in the lawn care industry. Research shows turf response is equal regardless of the method of application when considering a source of nitrogen such as urea. The application method then may be decided on the turf manager's perception of productivity.

Two types of spreaders are used to apply **granular (dry) fertilizers**: gravity and centrifugal. With the **gravity (drop) spreader**, fertilizer is held in a trough and agitated by a mixing bar connected to the wheels. The fertilizer is dropped through a series of slots to the turf below and spread in swaths.

The **centrifugal (broadcast)** type of spreader is commonly used by commercial turf managers because it applies a wider swath of material and can treat large areas more quickly. It features a hopper from which the fertilizer falls from a hole (or series of holes) onto a spinning disk which propels fertilizer ahead and to the sides of the spreader.

With a liquid application method fertilizer is either solubilized or suspended in water and sprayed on the turf.

The amount of water used normally varies from one to five gallons per 1,000 square feet. Equipment used can be broadly classified into either low pressure spray booms or high pressure or hydraulic sprayers. Both types feature a tank, pump to build pressure, pressure regulator, strainers or screens, and a nozzle.

Low-pressure spray booms, as the name implies, are operated at low pressures, generally in the range of 15-60 pounds per square inch (psi) and deliver one gallon or less of spray per 1,000 square feet.

They are designed to be driven over large areas delivering the spray from a series of nozzles in distinct swaths. They are often used by golf course superintendents on fairways.

High-pressure sprayers can create spray pressure of several hundred pounds or more and use a hose and hand-held nozzle for directed application and are used by lawn care companies.

FERTILIZATION OF TREES AND SHRUBS

Landscape trees and shrubs are often subject to adverse soil and environmental conditions. Compacted soils, poor drainage, restricted root areas as well as highway salts, air pollutants and competition from turfgrass contribute to plant stress and increase the importance of regular fertilization.

Vigorous trees are more resistant to insects and disease, more attractive and a greater asset to properties.

When trees are fertilized, only nitrogen, phosphorus and potassium are normally applied. However, supplemental micronutrients such as iron and manganese may be necessary for certain species growing in alkaline or sandy soils.

Plants often respond to applications of nitrogen with dramatic improvements in shoot growth and leaf color. Because of nitrogen's transitory nature in soils and the large amount extracted by plants, soil analysis is not particularly useful. Heavy applications of nitrogen alone may stimulate shoot growth more than root growth, disturbing the natural root/shoot ratio.

The need for supplemental phosphorus and potassium is more difficult to determine since phosphorus and potassium normally do not produce a noticeable, visible responseexcept on young or newly transplanted trees and shrubs. Also, results from field studies have been inconsistent because of differences in soil, age, condition and location of test species, and the timing and method of application. Where reliable soil tests are not available for phosphorus and potassium, most arborists fertilize all trees and shrubs with a complete fertilizer. Since arborists are concerned with the health of individual trees and shrubs growing in a wide variety of soil conditions, the most practical approach to fertilization is to provide an effective fertilizer formulation for trees and shrubs within a geographic area.

Specific soil/plant deficiencies may be addressed, if necessary, on an individual basis. In most cases a 3:1:1 (or similar) ratio is satisfactory for landscape plants although additional potassium and/or micronutriets may be advisable in sandy soils. Additional micronutrients may also be necessary in alkaline soils particularly for ericaceous or other so called "acid-loving" plants.

Iron deficiency chlorosis is common on oaks, rhododendron and pine grown on alkaline soils and has been reported on sweet gum, ginko and birch as well as many other woody ornamentals. **Manganese deficiency chlorosis,** also induced by alkaline soils, is a common problem with maples.

Application rates

Most fertilizer recommendations are based on the number of square feet in the **growing area** for shrub beds or the **branch spread** for individual trees and shrubs.

Fertilizer recommendations based on trunk diameter can result in over fertilization and damage to plants if the root system is restricted by paved areas, foundation walls, or other obstructions.

Three pounds of actual nitrogen per 1,000 square feet per year or six pounds every other year is satisfactory to maintain the health and vigor of deciduous trees and shrubs. If leaf color, annual growth or general vigor is unacceptable, six pounds of nitrogen per 1,000 square feet may be applied annually.

Broadleaf evergreens, small shrubs, flowering trees and recently transplanted or declining trees are more sensitive to fertilizer salts and should receive only about one-half the recommended rate, particularly when quick-release fertilizers are applied. The risk of injury to sensitive plants may be reduced by splitting the recommended annual amount into two or more applications.

The amount of fertilizer to be applied per 1,000 square feet of root areas can be calculated by dividing the percent nitrogen on the fertilizer bag into the desired nitrogen per 1,000 square feet.

For example, to determine the amount of 30-10-10 fertilizer required to apply six pounds of nitrogen per 1,000 square feet, divide .30 into 6, which equals 20 pounds (6/.30 equals 20).

Application timing

Although the roots of woody plants may elongate throughout the growing season, active root growth most often occurs in early spring and late fall when soil temperatures are cool and there is little competition from leaves for water and nutrients.

Fertilization is most effective when supplemental nutrients are available during these periods of optimum root growth. Soluble nitrogen fertilizers, because of their short residual in soils, should be applied between October and December and/or between February and April. Controlled-release nitrogen ensures availability in the root zone for a relatively long period, depending upon the solubility of the nitrogen source. The application timing of these fertilizers may not be a major concern.

The longer the length of growing season the greater the amount of nitrogen needed to maintain turfgrass quality.

Application techniques

Supplemental nutrients can be supplied to landscape plants through foliar sprays, trunk injections or applications on or beneath the soil surface. Though each method has advantages in specific situations, woody plants in most cases respond best to soil applications.

Surface applications

Nitrogen fertilizers can be applied to the soil surface since nitrates are highly mobile and will move downward into the root zone. When fertilizing woody plants in sodded areas, surface application should be limited to no more than three pounds of nitrogen per 1,000 square feet from a controlled-release source. However, since turfgrasses within the application zone may be injured or respond with undesirable succulent growth, trees and shrubs in quality lawns are often fertilized with subsurface applications.

Fertilizer containing phosphorus should not be applied to the soil surface. Phosphorus is bound to soil particles and does not move downward to contact the absorbing roots. Surface applications of phosphorus may also stimulate annual bluegrass which is undesirable in home lawns.

Drill hole technique

Fertilizer can be placed in the root zone by drilling holes in the ground and dividing the recommended amount of fertilizer equally among the holes. For trees, holes should be 12-18 inches deep and 18-24 inches apart, beginning two to three feet from the trunk and going two to three feet beyond the drip line.

To prevent turfgrass injury, fertilizer should be a least four inches below the soil surface. Calcined clay, perlite or other soil amendments can be used to fill the top of the hole or, in quality lawns, a plug of grass can be removed before drilling and replaced after adding fertilizer.

Soil injection

Liquid soil injection is a fast, economical alternative to the drill hole technique. The injection equipment consists of a hydraulic sprayer operated at 150-200 psi and an injector probe sticking about 12 inches into the soil. The injections are normally in a grid pattern about three feet apart within and slightly beyond the tree canopy.

Soil injection provides more thorough nutrient distribution than the vertical hole technique and generally can be done in about one-fourth the time.

Unfortunately, most soluble fertilizers have a high burn potential and soluble nitrogen may leach from the root zone. It may remain in the root zone for as little as six weeks.

Because of the limitations of liquid soluble fertilizers, suspension fertilizers are gaining acceptance for soil injection. Ureaformaldehyde is particularly effective as a controlled-release nitrogen source in spraying systems since the release rate is not greatly affected by particle size. Suspended in water, powdered ureaformaldehyde can be injected into the soil and dispersed laterally by hydraulic pressure.

Soluble methylol and methylene ureas, recently introduced, have a lower burn potential than urea or other soluble nitrogen sources.

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Other methods

The **aero-fertil** technique injects dry fertilizer by blasts of air into drilled holes in the soil. This method is similar to drill hole application and provides additional aeration by fracturing heavy or compacted soils.

Fertilizer stakes or spikes are driven into the ground at intervals beneath the drip line of trees and shrubs. Although they contain satisfactory fertilizer materials, spikes are expensive and not as effective as other fertilization methods. One or two spikes per inch of trunk diameter provide only a small amount of fertilizer, little of which comes in contact with the root system since little lateral distribution occurs within the root zone of most soils.

Foliage sprays and trunk injections and implants can supply a limited amount of nutrients to woody plants and are recommended for micro-nutrients whose availability is reduced by alkaline soils. These methods are most effective when a single micronutrient is deficient.

FERTILIZATION OF TREES AND SHRUBS IN CONTAINERS

The growing of trees and shrubs in landscape containers is common where plants are desirable but suitable planting sites limited.

They need careful attention because the reservoir of available growing media—minerals and water—is much smaller. Container soils, often wet and poorly aerated, are subject to excessive leaching and require a regular fertilization program.

In general, recommended fertilizer rates for landscape plants based on square footage have been successful in maintaining container grown plants.

A complete fertilizer applied at an annual rate of 0.5 to one ounce of nitrogen per 10 square feet of container soil surface is commonly used. However, because of the wide selection in plant material, and variations in container design and growing media, fertilizer requirements are best determined through **soil and tissue analysis.**

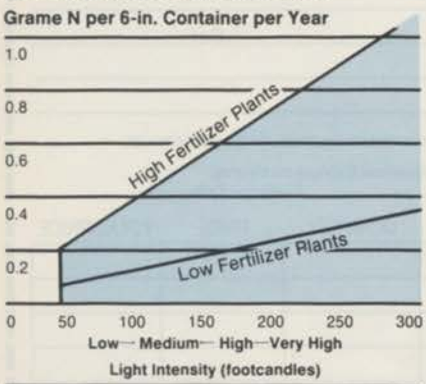
Container fertilization includes dry, foliar, and liquid application.

As with landscape plants, foliar applications are usually limited to micronutrients.

Foliar fertilization should be considered where soil conditions may inhibit root absorption or where a quick response is desirable. Care should be taken to contain the spray since some micronutrient sources can stain.

Dry fertilizers may be applied either in controlled release or quick-release form. High analysis fertilizers may be difficult to evenly distribute because of the small amount required per container. Liquid applications of soluble or suspension fertilizers provide a uniform dosage and fast and easy distribution, but may require more frequent applications because they may leach from container soil.

Suggested Fertilizer Rates for Plants in Interior Landscapes



FERTILIZING INTERIOR PLANTS

During production, the growth of foliage plants is accelerated by using considerable quantities of nutrients. These same plants grown indoors, however, usually receive less light, and neither require nor will tolerate the amount of fertilizer they received in production.

Precise fertilizer requirements are difficult to predict in interiorscape maintenance without measuring light at strategic locations.

Light varies from one side of a room to another, often within a few feet. Usually, the stronger the light under which foliage plants are growing, the greater the amount of nutrients needed. Recommended annual fertilizer rates can vary from as low as 0.3 grams of nitrogen per square foot for low light intensities to 3.0 grams for high intensities.

A complete fertilizer with a nitrogen/phosphorus/potassium ratio similar to those recommended for landscape plants is suitable for indoor plants. The highest levels of nutrients should be applied at optimum growth periods, for most plants, spring and summer when natural light is strongest.

Micronutrients are seldom recommended but may be necessary when growing sensitive plants in media other than soil. The rubber plant (Ficus elastica) and the Areca palm (Chrysalidacarpus lutescens) are both sensitive to boron deficiency.

In addition, the Areca palm can also become zinc deficient. Beware of overapplications of micronutrients because of toxicity problems.

The proper amount of nutrients is also determined by plant species. Plants normally grown under low levels of fertility include many ferns and fleshy plants such as Peperomia. Plants requiring high nutrient levels include rapid growing species and large leaved plants such as Ficus and Schefflera.

A build up of salts, both from fertilizer and irrigation water, is possible unless the root area is periodically flushed with excess water which is allowed to drain away. This is true when plants are over-fertilized during periods of low light and/or little growth.

Since visual symptoms such as stem rot and leaf necrosis in new growth are similar to those of overwatering, the soil should be tested for soluble salts. **WT&T**

Circle the number on the enclosed reader information card for more information on fertilizer products mentioned in this article.

American Pelletizing Corp. (201)
The Andersons (Tee-Time) (202)
Canadian Industries Ltd. (SCU) (203)
Ciba Geigy (Sequestrene) (204)
W.A. Cleary (Fluf) (205)
CP Chemical (Nitro-26) (206)
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