1986 GUIDE TO:

TURF, TREE & ORNAMENTAL FERTILIZATION

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TURF FERTILIZATION

Frequently overlooked in determining a fertilizer program are nutrient influences on carbohydrate reserves, root growth and the plant's ability to tolerate disease and environmental stress.

Time of application

Good timing of fertilizer applications builds carbohydrate reserves and promotes root development. The response of warm-season and cool-season turfgrasses differs.

The major cool-season turfgrasses (bluegrass, perennial ryegrass, fescue, and bentgrass) initiate and develop root systems in the early spring and fall. Fall nitrogen applications will increase 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), a 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 around the time of the season's last regular mowing.

Nitrogen applied at this time aids the photosynthetic production of carbohydrates. These carbohydrates are stored for use the following growing season, providing earlier spring green-up and an energy source for turfgrasses to recuperate from stresses.

Another reason for late fall fertilization is to reduce the need for high amounts of spring-applied nitrogen. Too much spring fertilization can actually reduce carbohydrate reserves and root development by inciting rapid shoot growth. This is because growing shoots take priority over roots for carbohydrate use.

Both spring and summer fertilization is used to maintain the color and density produced by 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.

Potassium applications contribute to the plant's hardiness and help "temper" the stimulating effects of nitrogen applications.

In contrast, most root growth in 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 early spring applications should be used in areas where warm-season grasses go dormant in winter.

The roots of bermudagrass and St. Augustinegrass die in the spring following green-up. Heavy fertilization in early spring may result in more stress during this critical survival period.

Like cool-season turfgrasses, warm-season grasses accumulate carbohydrate reserves in the fall when shoot growth slows. Care must be taken with the timing of fall fertilization since it may decrease low temperature hardiness if applied late.

Maintaining proper potassium levels in the fall will increase tolerance to low temperatures. As with cool-season turfgrasses, too much summer nitrogen fertilization can increase injury of warm-season grass subjected to stresses.

Maintaining adequate soil potassium levels will help warm-season

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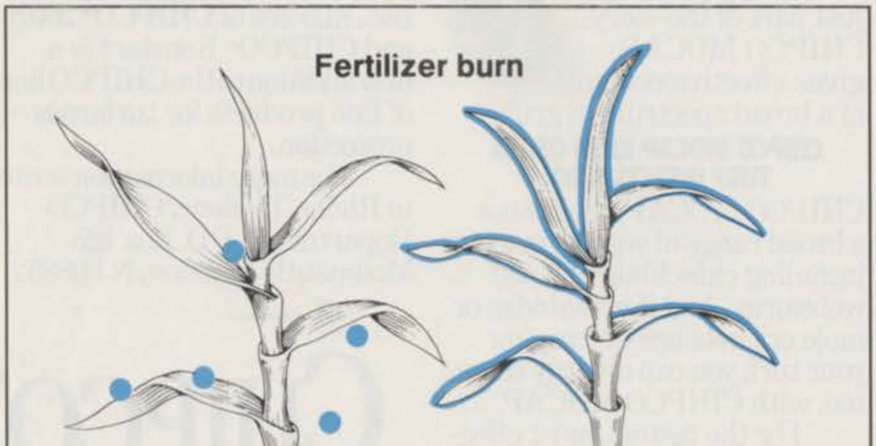
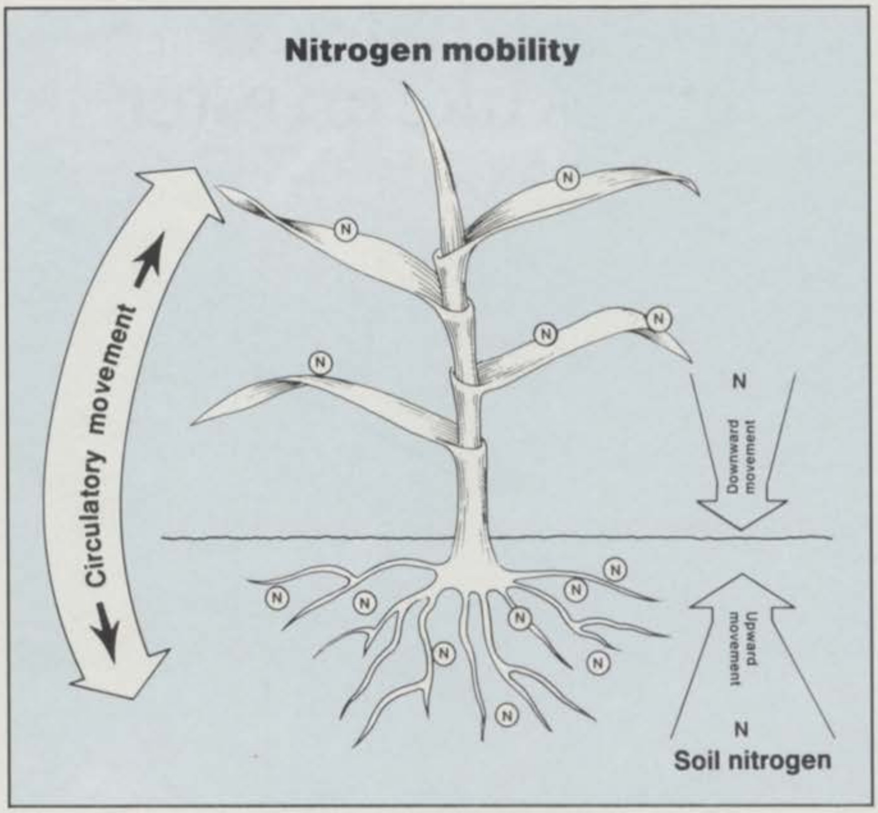


Granular fertilizers may fall to the ground; liquids coat the plant, thus increasing burn.



Circulatory movement: upward in the xylem, downward in the phloem.

turf's tolerance to heat, cold, mowing and wear stresses, and reduce susceptibility to turfgrass diseases.

Rate of fertilization

To determine annual nitrogen requirement (pounds per 1,000 sq. ft.), several factors should be considered: length of growing season, degree of quality desired, purpose for which the turf is used, and the species and cultivars present.

Growing season length (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 growing season's length, the more nitrogen is needed to maintain turfgrass quality.

The rate of fertilization can be tailored to meet different expectations in quality. 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.

The turf's purpose, whether for aesthetics or recreation, will also influence the nitrogen fertility level. The fertilization rate of bentgrass, for instance, can vary from four to 10 pounds of nitrogen per 1,000 sq. ft. Lower rates may be used for a pleasing appearance on a home lawn while higher rates can maximize a putting green's playability.

Research shows turf response is equal regardless of the method of (fertilizer) application with sources like urea.

Turfgrass species and cultivars can vary in amount of nitrogen needed for maximum quality. 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 need more nitrogen than common bermuda.

Cultural practices like irrigation and clipping removal may require more nitrogen per year to keep the desired turfgrass quality. Supplemental watering will increase the rate at which nitrogen is leached from the root zone. Losses can be substantial when quick-release nitrogen sources are applied to sandy soils.

Clipping collection following mowing has been estimated to remove about 20 percent of the nitrogen applied to turfgrass. Using more nitrogen may be necessary to maintain quality when collecting clippings.

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 levels in the soil.

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

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

Quick-release nitrogen sources (for example, ammonium nitrate and urea) are commonly limited to no more than one pound of nitrogen per 1,000 sq. ft. This rule of thumb is followed in spring and fall to avoid excessive shoot growth. For this same reason, summer applications using quick-release sources are often limited to no more than one-half pound of nitrogen per 1,000 sq. ft. Lower rates of quick-release sources also minimize the possibility of fertilizer burn.

Method of application

Fertilizers can be applied in either dry or liquid forms. Research shows turf response is equal regardless of the method of application with nitrogen sources like urea. The application method then may be determined by the turf manager's perception of productivity and personal preference.

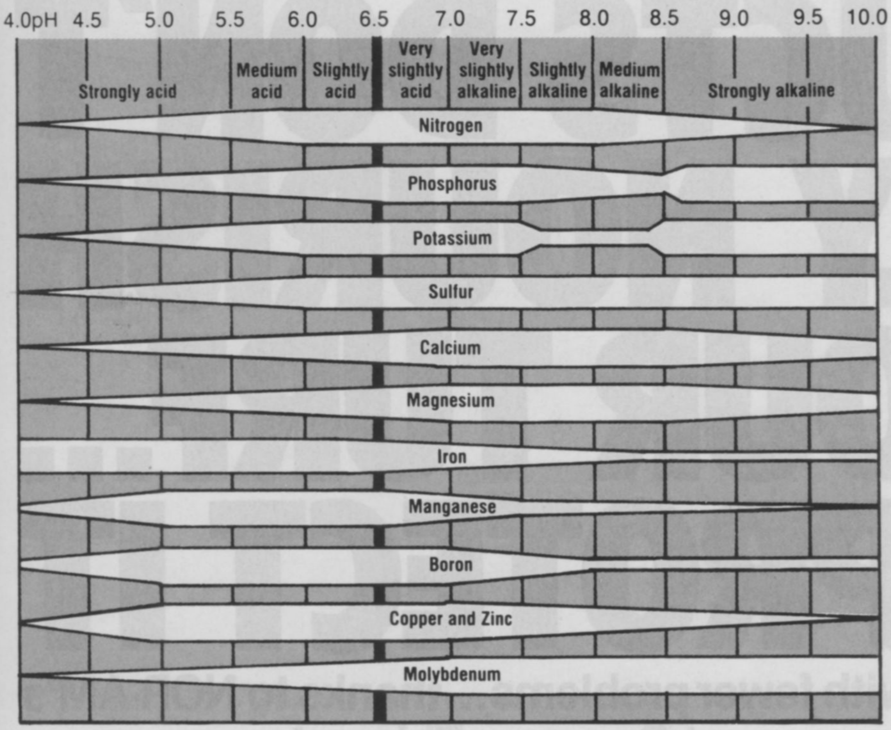
Two types of spreaders are used to apply granular (dry) fertilizers: gravity and centrifugal.

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 in defined swaths.

The centrifugal (broadcast) 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 with the fertilizer falling through a hole (or series of holes) onto a spinning disk which propels fertilizer ahead and to the

Maximum nutrient availability

Maximum availability is indicated by the widest part of the bar



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 normally varies from one to five gallons per 1,000 sq. ft.

Spray equipment can be broadly classified into either low pressure spray booms or high pressure (hydraulic) sprayers. Both types feature a tank, pump, pressure regulator, strainers or screens, and nozzle(s).

Low-pressure spray booms, as the name implies, are operated at pressures in the range of 15-60 lbs. per sq. in. (psi) and deliver one gallon or less of spray per 1,000 sq. ft. They are designed to be driven over large areas delivering the spray from a series of nozzles in distinct swaths. They are often used on golf course fairways.

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

TREE AND SHRUB FERTILIZATION

Landscape trees and shrubs are often subject to adverse soil and environmental conditions. Compacted soils, poor drainage, restricted root areas, highway salts, air pollutants and com-

Exact fertilizer needs are difficult to judge in interiorscape maintenance without measuring light at strategic locations.

petition from turfgrass contribute to plant stress, thus increasing the importance of regular fertilization.

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

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

Plants often respond to nitrogen applications with dramatic improvements in shoot growth and leaf color. Because nitrogen is transitory in soils and relatively large amounts are used 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 they do not produce a visible response except on young or newly-transplanted trees and shrubs.

Results from field studies also 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 use a complete fertilizer on all trees and shrubs.

Since arborists must be concerned with trees and shrubs in a wide variety of soil conditions, the most practical approach to fertilization is to provide an effective formulation for trees and shrubs in 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, but more potassium and/or micronutrients may be advisable in sandy or alkaline soils, particularly for ericaceous or other so called "acid-loving" plants.

Application rates

Most fertilizer recommendations are based on the size of 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 plant damage if the root system is restricted by paved areas, foundation walls, or other obstructions.

Three pounds of actual nitrogen per 1,000 sq. ft. per year, or six pounds every other year, will keep deciduous trees and shrubs healthy and vigorous. If leaf color, annual growth or general vigor is unacceptable, six pounds of nitrogen per 1,000 sq. ft. may be applied annually.

Broadleaf evergreens, small shrubs, flowering trees and recently-transplanted or declining trees are more sensitive to fertilizer salts. These plants 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 per 1,000 sq. ft. of root area can be calculated by dividing the percent nitrogen on the fertilizer bag into the desired nitrogen

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Spray systems such as the one shown above are used to apply nutrients to turfgrass.

NITROGEN FERTILITY LEVELS

lbs./growing month/1,000 sq. ft.

HIGH .5-1.5	
Kentucky bluegrass	bermudagrass
creeping bentgrass	
MEDIUM .4-1.0	
zoysiagrass	colonial bentgrass
tall fescue	velvet bentgrass
perennial ryegrass	St. Augustine-grass
annual bluegrass	
LOW .2-.6	
carpetgrass	red fescue
chewings fescue	
VERY LOW .0-.4	
blue grama	bahiagrass
buffalograss	centipedegrass

per 1,000 sq. ft.

For example, to determine the amount of 30-10-10 fertilizer required to apply six pounds of nitrogen per 1,000 sq. ft., divide .30 into 6, which equals 20 pounds.

Application timing

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

Fertilization is most effective when supplemental nutrients are available during 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 nitrogen source's solubility. The application timing of these fertilizers may not be a major concern.

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 sq. ft. from a controlled-release source. However, since turfgrasses in the application zone may be injured or respond with undesirable succulent growth, sub-surface applications are often used on trees and shrubs in quality lawns.

Fertilizer with 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 dividing the recommended amount of fertilizer equally among drilled holes in the ground. For trees, holes should be 12 to 18 inches deep and 18 to 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 at 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. A hydraulic sprayer operated at 150-200 psi and an injector probe inserted about 12 inches into the soil are needed. The injections are normally in a grid pattern about three feet apart within and slightly beyond the tree canopy.

Soil injection can mean 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 limits of liquid soluble fertilizers, suspension fertilizers for soil injection are becoming popular. Ureaformaldehyde is particularly effective as a controlled-release nitrogen source in soil injection systems. Its release rate is not greatly affected by particle size. Suspended in water, powdered ureaformaldehyde can be injected into the soil by hydraulic pressure.

Two recent introductions, soluble methylol and methylene ureas, have a lower burn potential than urea or other soluble nitrogen sources.

Other methods

The aerofertil technique injects dry fertilizer by blasts of air into drilled holes in the soil. This method is similar to drill hole application, but provides additional aeration by breaking up 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 enough fertilizer, 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, not all of which comes in contact with the root system since there is little lateral distribution within the root

Annual Nitrogen Requirement of Turfgrasses*

Species	Length of Growing Season, Months	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, N.Y.

zone of most soils.

Foliate sprays, trunk injections and implants can supply limited nutrients to woody plants. They are recommended for micronutrients 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

Growing 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, can leach excessively and 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 1.0 ounce of nitrogen per 10 sq. ft. of container soil surface is usually used. However, because of the wide selection in plant material and variations in container design and growing media, fertilizer needs are best determined by soil and tissue analysis.

Container plants can be fertilized by dry, foliar, and liquid application.

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

Foliar fertilization is effective where soil conditions may slow root absorption or where a quick response is needed. The spray should be contained, 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 distribute evenly because of the small amount needed per container. Liquid applications of soluble or suspension fertilizers provide a uniform dosage and fast and easy distribution, but more frequent applications may be needed because they may leach from container soil.

FERTILIZING INTERIOR PLANTS

During production, the foliage plant growth is quickened by using high rates of nutrients. These same plants grown indoors, however, usually get less light, and neither need nor will tolerate the amount of fertilizer they received in production.

Exact fertilizer needs are difficult to judge 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 more nutrients are 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 highest growth periods, for most plants, spring and summer, when natural light is strongest.

Micronutrients are seldom recommended but may be needed 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. However, over-applications of micronutrients can cause toxicity problems.

Nutrient levels are determined by plant species. Plants normally grown under low levels of fertility include many ferns and fleshy plants such as Peperomia. Plants needing high nutrient levels include rapidly-growing species and large-leaf plants such as Ficus and Schefflera.

Salt, both from fertilizer and irrigation water, can build up 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 over-watering, the soil should be tested for soluble salts. **WT&T**