Best Management Practices for Turf and Lawn Fertilization

USING THE RIGHT SOURCE AT THE RIGHT RATE, RIGHT TIME, AND RIGHT PLACE

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Best Management Practices for Turf and Lawn Fertilization

By Dr. Mike Stewart

For centuries, humans have used turfgrasses to enhance their environment and quality of life. Turfgrasses have many benefits that can be separated into functional, aesthetic, and recreational components (Beard and Green, 1994).

Functional benefits of turf and lawn areas include soil erosion control, dust stabilization, enhanced groundwater recharge and improved surface water quality, improved entrapment and decomposition of synthetic chemical pollutants, soil improvement and restoration, heat dissipation and temperature moderation, noise abatement, glare reduction, sequestration of carbon dioxide (CO_2), and several other benefits.

Aesthetic benefits of lawns and other turfgrass areas result in a positive therapeutic benefit that improves mental health and productivity, contributes to social harmony and stability, and generally improves quality of life, especially in densely populated areas.

Recreational benefits of turfgrasses are well known—they provide a relatively low-cost, safe surface that reduces injuries when compared to non-turf areas. Additionally, the upkeep and maintenance of home lawns provide exercise and a diversion beneficial to mental health. Considering the general benefits of turfgrass, it is apparent that the preservation and maintenance of these areas, including home lawns, is an important objective.

Lawn Grasses

The first step in the establishment of an attractive and functional lawn or any other turf area is the selection of an appropriate grass. Since lawns are usually meant to be permanent, selecting an adapted turfgrass species is critical. It is pointless and costly to select a poorly adapted grass that has a low chance of survival.

Turfgrasses are generally divided into cool season and warm season species. Cool season turfgrasses do best at temperatures from 60 to 75 °F (15 to 24 °C), while the temperature optimum for warm season species is 80 to 95 °F (27 to 35 °C). The USA has four general climatic zones of adaptation (**Figure 1**).

Cool season species such as bluegrass, fescue, ryegrass, and bentgrass are best adapted to the cool humid zone and irrigated areas in the cool arid zone. Buffalograss, a warm-season species, is common in the warmer, non-irrigated areas of the cool arid zone.

Warm season grass species are best adapted to the warm arid and warm humid areas. Bermudagrass is a common grass in the warm humid zone. However, it may be subject to winterkill in northern regions of this zone. Other species such as zoysiagrass, carpetgrass, bahiagrass, centipedegrass, and St. Augustinegrass are also common in the warm humid zone. Most of these species will do well in the warm arid zone when irrigated. Buffalograss is well adapted under non-irrigated conditions across much of the warm arid zone. Fall overseeding of warm season with cool season grasses is common in much of the warm climatic zone. Overseeding is often done to promote aesthetics as the warm season turf becomes dormant. It extends turf resiliency and enables a longer period of activity (sports and other recreational activities).

The transition zone is the most difficult region in which to grow grass since no one type of grass will do well in all weather conditions. Consequently, intensive maintenance, grass mixtures, and winter overseeding in these areas is common.

The zones of turfgrass adaptation are broad and boundaries are not absolute. Species selection within a zone should consider tolerance to specific, localized stresses. Several resources are available to help determine the most appropriate grass species for a specific area and function. These include local university extension publications and personnel, lawn care professionals, and nurseries. Several online sources are also available to help evaluate the suitability of lawn grasses for a specific region, including the National Turfgrass Evaluation Program website — **www.ntep.org** (NTEP, 2006).

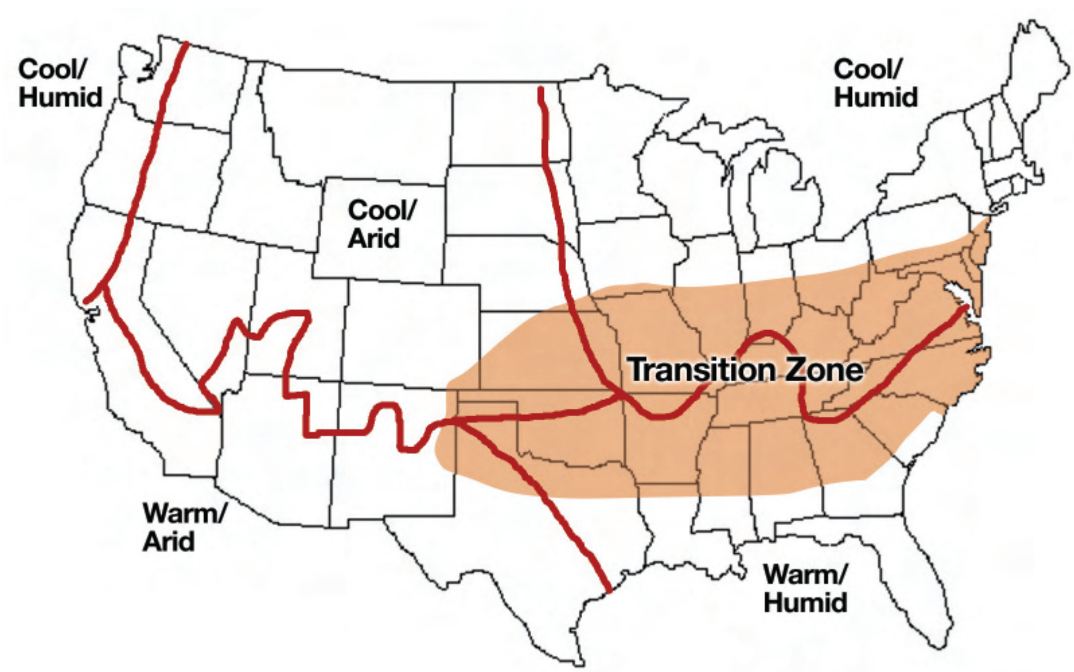

Figure 1. Turfgrass climatic adaption zones of the USA. Source: United States National Arboretum, 2008.

The quality of any turf area is determined by the ability of the grass to serve its intended purpose. Turf areas usually serve one or a combination of three functions... aesthetic, recreational, and utilitarian. Thus, quality can be measured on either a visual or functional scale, or a combination of the two. Lawns or ornamental turf serve mainly an aesthetic purpose, but can also have recreational and utilitarian functions. Visual quality (aesthetics) is determined by turf color, density, uniformity, texture, growth habit, and smoothness. Functional quality (recreational and utilitarian) of turf is determined by factors such as resiliency, recuperative capacity, rooting, rigidity, and elasticity.

Turf quality can be affected by a number of factors, including moisture, temperature, nutrition, shade, traffic, soil type, and pest populations. Cultural practices such as water management (irrigation, drainage, etc.), mowing practices, pest control, cultivation (aeration), and fertilization can all impact the quality of a lawn and other turf areas. An adequate fertilization program is among the most important factors affecting turf quality. Proper fertilization is often the most cost-effective means of achieving an attractive lawn.

Fertilizer BMPs (best management practices) are effectively expressed as the 4 R's: right source, right rate, right time, and right place. An appropriate fertilization program must be combined with proper mowing, watering, and pest management for best results. Following is a review of fertilizer basics and other important points to consider in planning nutrient management for turf.

Fertilizer Fundamentals and Turf Nutrition

Essential Nutrients

Plants, including turfgrasses, need proper nutrition just as humans do. There are 17 nutrient elements that are essential for proper growth and function of plants. An element is considered essential if it is necessary for the plant to complete its life cycle and no other element can substitute for it. Plants obtain the non-mineral nutrients (carbon, C; hydrogen, H; and oxygen, O) from water and air, while the mineral nutrients are mainly taken from the soil. Mineral nutrients required by plants are separated into three categories based on the amount needed. The categories are major, secondary, and micronutrients. The major nutrients are nitrogen (N), phosphorus (P), and potassium (K). Secondary nutrients are calcium (Ca), magnesium (Mg), and sulfur (S). Micronutrients include iron (Fe), boron (B), chloride (Cl^-), manganese (Mn), copper (Cu), zinc (Zn), nickel (Ni), and molybdenum (Mo). Fertilizer materials are plant food designed to supply one or more of these nutrients when available soil supplies are not adequate for optimum growth.

Functions of Nutrients

Each nutrient plays a specific role in turfgrass growth, development, and reaction to stresses. Consequently, specific responses to needed fertilizer application are commonly observed. For example, turfgrass response to N fertilizer is very common and is usually expressed in improved color (darker green, more chlorophyll), density, root growth, stress tolerance, and recuperative potential. Turfgrass response to P fertilizer is often expressed as improved root growth and branching, drought tolerance, water use efficiency, and seedling establishment. Adequate K fertility is associated with increased disease resistance, increased cold and heat tolerance, and improved overall ability to endure and recover from stressful conditions. Although these nutrient response comments are very limited, they clearly illustrate that proper nutrition can greatly impact turf quality and performance. It should be noted here, and will be discussed later, that over-fertilization is possible and can have harmful consequences to turf and the environment.

Proper Fertilization

Several factors should be considered when determining the proper kind and amount of fertilizer to apply to lawns and other turf areas. Following are factors that affect what fertilizer source, rate, timing, and placement are most appropriate. This information is meant for general purposes...local university extension and turf professionals can be helpful in determining proper fertilization practices for specific locations.

Fertilizer Source

Fertilizers can be classified as either organic or inorganic, and can be of synthetic or natural origin. Products for turf, shrubs, greenhouse, and other non-farm areas are often formulated to have slow-release properties and can be called "specialty fertilizers". These materials release nutrients more slowly than more common conventional fertilizers that are usually mostly water soluble. This usually means that with proper rate considerations fewer applications can achieve a similar outcome as more frequent applications of quick release fertilizer.

The question of whether organic fertilizer is superior to inorganic fertilizer is sometimes raised. It is helpful to know that turfgrasses and other plants take-up nutrients in specific inorganic forms, usually ionic forms of the nutrients. For example, N is absorbed into roots in the ammonium (NH_4^+) or nitrate (NO_3^-) ionic forms. Thus, organic fertilizer forms must undergo a decomposition process called mineralization by which the larger organic molecules breakdown into the smaller inorganic-ionic components. Ultimately, in terms of nutrition, the plant does not distinguish or have preference for one source over the other as long as the required amounts and forms of nutrient ions are available.

Every bag of fertilizer has three numbers, often referred to as the analysis, displayed on the label. These numbers, or analysis, represent the percent N, P (as P_2O_5), and K (as K_2O) in the fertilizer material. Percentages of other nutrients (secondary and micronutrients) that the material contains will also be listed on the fertilizer label. An example of a common turf fertilizer is 15-5-10. This material contains 15% N, 5% P_2O_5, and 10% K_2O, or a ratio of 3:1:2. The fertilizer ratio is important because it describes the relative amount of nutrients in a product.

Fertilizer Rate and Time

Factors that affect BMPs include:

- **Objectives and purpose of the turf area.** If a homeowner wants a greener and thicker lawn, then it is likely that more fertilizer will need to be applied than amounts required just to maintain the turf. Also, if the area is subject to significant wear and traffic, it may need a more intensive level of maintenance, including nutrient management, to maintain quality.
- **Grass species.** The turfgrass species that is most appropriate will be determined mainly by the location, as was discussed in an earlier section. Nutrient requirements vary widely among turf species. Generally, the more aggressive the growth, the greater will be the nutritional requirements, particularly N. **Table 1** has some general suggestions for N fertilizer applications for several warm and cool season turfgrass species.
- **Environmental conditions.**
  - o **Soil environment.** Soil type has a big impact on best fertilization practices of turf. Sandy soils are usually more infertile and require more intensive nutrient management than loamy or clayey soils. Soil testing should be used to guide turf management and fertilization decisions, particularly for P and K. For example, some soils are naturally high in P or K and will therefore require less P or K from fertilizer.
  - o **Water and irrigation.** Turfgrass grows more vigorously with adequate water. Therefore, proper irrigation and/or adequate rainfall increases turfgrass nutrient requirements. On the other hand, excessive rainfall can cause N leaching, may contribute to undesirable N loss in runoff, and result in turf N deficiency.
  - o **Shade.** Shaded areas should generally not be fertilized as much as non-shaded areas. Grass in shaded areas usually has a lower rate of growth and therefore lower nutrient requirements. Also, turf in shaded areas tends to have a weaker root system and to be more succulent.
- **Clipping management.** Whether or not clippings are left behind is an important consideration.

Table 1. Approximate N requirements for warm-season and cool-season turfgrass species per growing month[a] (after Carrow et al., 2001).

Common name	N requirement[b] Pounds N per 1,000 ft² per growing month: General Turf	Recreational	General N requirement
Warm-season turfgrass			
Bahiagrass	0.0-0.2	0.1-0.5	Low
Bermudagrass			
*Common types	0.2-0.4	0.4-0.7	Low-Med.
*Hybrid types	0.4-0.6	0.6-1.5	Med.-High
Blue grama	0.0-0.2	0.2-0.4	Very Low
Buffalograss	0.0-0.2	0.2-0.4	Very Low
Carpetgrass			
Centipedegrass	0.0-0.3	0.3-0.4	Very Low
Kikuyu	0.2-0.3	0.3-0.6	Low-Med.
Saltgrass	0.0-0.2	0.1-0.4	Very Low
Seashore paspalum	0.2-0.4	0.4-0.8	Low-Med.
St. Augustinegrass	0.3-0.5	0.4-0.6	Low-Med.
Zoysiagrass			
*Common	0.1-0.3	0.3-0.5	Low-Med.
*Improved	0.2-0.3	0.3-0.6	Low-Med.
Cool-season turfgrass			
Alkaligrass	0.0-0.2	0.2-0.4	Very Low
Annual bluegrass	0.3-0.5	0.4-0.8	Low-Med.
Canada bluegrass	0.0-0.2	0.2-0.4	Very Low
Colonial bentgrass	0.3-0.5	0.4-0.8	Low-Med.
Creeping bentgrass	0.3-0.6	0.3-1.0	Low-High
Fine Fescues			
*Chewings	0.2-0.4	0.3-0.5	Low
*Creeping red	0.2-0.4	0.3-0.5	Low
*Hard	0.2-0.4	0.3-0.5	Low
*Slender	0.2-0.4	0.3-0.5	Low
Kentucky bluegrass			
*Common	0.1-0.3	0.2-0.6	Low-Med.
*Improved	0.3-0.4	0.4-0.8	Medium
Perennial ryegrass	0.2-0.4	0.4-0.7	Low-Med.
Rough bluegrass	0.2-0.4	0.4-0.7	Low-Med.
Tall Fescue	0.2-0.4	0.3-0.7	Low-Med.
Velvet bentgrass	0.3-0.5	0.4-0.8	Low-Med.
Wheatgrass	0.1-0.2	0.2-0.5	Low

[a] Growing month is when the grass is actively growing and not dormant or semidormant.
[b] Nitrogen requirement rates per month are for determining total N needs based on the number of growing months per year. General turf = lawns, amenity turf, general grounds; Recreational turf = grasses used for golf courses, bowling greens, and sports.

Where lawn clippings are removed, fertilizer requirements will be higher since nutrients are being removed with each mowing. Consider that the concentration range in healthy turfgrass shoot tissue is 2.8 to 3.5% N, 0.20 to 0.55% P, and 1.5 to 3.0% K. In some cases, half or more of the seasonal N needs can be met by decomposing clippings (Kopp and Guillard, 2002).

- **Lawn age.** A new lawn will usually require more fertilizer, and a different analysis of fertilizer than an established lawn. Soil testing is especially important to guide the type of fertilizer needed for new lawns.

Fertilizer Placement

- Avoid off-target applications and do not leave fertilizer materials on impervious surfaces such as streets and driveways since this provides a direct path to storm drains.

- Leave a low-to-no-fertilizer buffer strip around water bodies such as lakes or streams.

Other Fertilizer Application Considerations

Several other items should be considered before selecting and applying lawn fertilizer.

- **Lawn area.** It's always a good idea to know how much area is to be fertilized so the proper amount of fertilizer can be applied evenly over the area. With lawns and other turf areas, this is usually expressed in terms of 1,000 sq. ft. Once the proper type and rate of fertilizer has been determined, the area will determine the total fertilizer purchase. Area can be easily estimated for most any turf situation, regardless of its shape.

- **Spreader calibration.** Granular fertilizer spreaders are either rotary or drop type. Most spreaders come pre-calibrated with specific gauged markings. Similarly, most lawn fertilizers will have suggested settings for recommended application rates for specific spreaders listed on the label. This is all done for the sake of convenience. It is possible, however, to specifically calibrate an individual fertilizer spreader so that you know exactly the rate of application. Some university extension and industry resources provide instructions on fertilizer spreader calibration.

- **Water after application.** Watering immediately after, or at least shortly after, fertilization is generally a good idea. Irrigating after application insures that fertilizer does not "burn" leaf tissue, it reduces the risk of run-off with later rainfall events, prevents volatilization loss of urea-containing fertilizers to the air, and moves the nutrients into the soil where the turf roots can absorb them.

Consider the Environmental Effects

While some might think the environmental effects of turf fertilization are strictly negative, there are indeed many positive aspects to be considered as well. In the introduction, we discussed some of the benefits of turfgrasses. Just about anything we do to make healthier turf, including appropriate fertilization, will enhance these benefits. Additionally, a healthy, vigorous, and properly fertilized lawn will absorb rain better...resulting in less runoff...and will serve as a filter to protect groundwater.

The major environmental concern with fertilization has to do with nutrient enrichment and impairment of surface water (lakes, streams, etc.) quality. Where nutrient levels, particularly P, in water are excessive the result is algal blooms that deplete oxygen levels. This has led some municipalities to enact ordinances limiting P concentrations in lawn fertilizers.

Some simple precautions and practices can minimize the potential for loss of fertilizer nutrients from lawn areas. Among these are soil testing to determine nutrient needs and avoidance of off-target applications.

Following the principles of the "4 R's" — right source at the right rate, right time, and right place — is the foundation of fertilizer BMPs for turf.


Potassium nutrition is a key in resisting some turf diseases. Brown patch is shown here on tall fescue (left) and bentgrass.

Incidence of dollar spot shown here in hybrid bermudagrass may be reduced by proper fertilization.

Conclusion

Lawns and other turf areas provide many benefits to humans. These benefits can be divided into functional, recreational, and aesthetic components. Everyone enjoys a lush, green lawn; however, there are many benefits that go beyond the apparent. Among these are specific environmental benefits such as erosion control, dust stabilization, and improved recharge and groundwater quality. There are several factors and practices that go into the establishment and maintenance of a quality lawn, including appropriate and adequate nutrition through application of BMPs and the principles of the "4 R's" — right source, at the right rate, right time, and right place. ■

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