Fertilizer Recommendations for Commercially Maintained Lawns and Turfgrass in Maryland

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Nutrient management laws passed by the Maryland Legislature in 1998 require that University of Maryland nutrient management guidelines be followed on state property and commercially managed turfgrass sites. These laws affecting turfgrass fertilization were part of an overall effort to regulate the impact of the agricultural industry on the water quality of the Chesapeake Bay. In 2011, additional regulations were enacted that further specify how nitrogen (N) and phosphorus (P) may be applied to turfgrass in Maryland, and what fertilizer formulations may be sold at the retail level. These new laws regarding turf fertilizer application become effective in 2013. The following information is intended to serve as a nutrient management guideline for the maintenance of commercially maintained turfgrass sites in an efficient, effective, and environmentally sound manner, and to meet state regulatory requirements. Nutrient management recommendations for the establishment of turf, and for sod production, golf courses, and athletic fields are addressed in separate publications.

Turf-type tall fescue fertilized and maintained following Uninversity of Maryland recommendations. Following fertilizer recommendations helps maintain high turf density that reduces soil erosion, improves water infiltration, reduces water runoff, prevents nutrient movement, and greatly reduces weed encroachment.

TURFGRASS AND WATER QUALITY

Properly managed turfgrass has been shown to be an environmental asset. Turfgrass has significant cooling effects during the summer and traps significant amounts of the dust and dirt that is released each year into the atmosphere. Turfgrass absorbs carbon dioxide, ozone, sulfur dioxide, and other gases while releasing oxygen. Turfgrass intercepts nutrient pollutants running off of the vast amount of impervious surfaces found in urban and suburban areas.

Water runoff from properly managed turfgrass areas is greatly reduced and water infiltration increased compared to most other agriculture and plant systems. Once turfgrass is established, soil loss from erosion is negligible. Also, turfgrass is an efficient organic matter producing system. Thus, little N or P is lost from turfgrass sites if sound nutrient management and cultural practices are followed.

Nitrogen - Onsite monitoring and numerous research studies have shown that N loss from turfgrass sites is minimal if current recommendations are followed. However, research has also shown that improper N applications on specific types of sites can result in excessive nitrate (NO_3) leaching. This problem is very specific and has occurred as follows:

1. Very high rates of N were applied using soluble NO_3-N containing fertilizers (e.g. ammonium nitrate [NH_4NO_3]),
2. The fertilizer was applied to dormant turf, such as bermudagrass during the winter,
3. Soils were predominantly sand or were disturbed soils, and
4. The sites had high water tables or movement of N was measured over a short distance in the soil profile.

Phosphorus - Loss of P from turfgrass sites is also minimal if current recommendations are followed. Phosphorus movement is 1) generally due to soil erosion, which is greatly minimized by properly fertilized turfgrass, and 2) by over application of P fertilizers on soils already high in P. Phosphorus should only be applied as recommended by soil tests.

SOME KEY POINTS of 2011 TURFGRASS FERTILIZER REGULATIONS REGARDING NITROGEN APPLICATIONS

Do not apply more than 0.7 lb. of soluble N per 1000 ft^2 in any one application.

If fertilizer contains 20% or more slow release N, do not apply more than 0.9 lb. of total N per 1000 ft^2 in any one application.

Do not apply N after December 1. Between November 15 & December 1, use only a soluble N source and don't apply more than 0.5 lb. N/1000 ft^2.

Do not apply N before March 1.

SOME KEY POINTS of 2011 TURFGRASS FERTILIZER REGULATIONS REGARDING PHOSPHORUS APPLICATIONS

Phosphorus cannot be applied for maintenance unless a soil test indicates a need.

Beginning October 1, 2013, natural organic fertilizers or products containing P can only be used if not exceeding .25 lbs. P_2O_5/1000 ft^2 per application, and not exceeding .50 lbs. P_2O_5/1000 ft^2 annually.

Products containing P, including natural organics, cannot be used on established turf where soils test have determined that soil has "optimum to excessive" levels of P.

NITROGEN FERTILIZER RECOMMENDATIONS

Proper nitrogen fertilization is essential in maintaining dense turf that prevents soil erosion, increases water infiltration, and reduces water runoff. Proper nitrogen fertilization is also essential in maintaining turf that is resistant to weed encroachment, has reduced disease problems, is tolerant of stresses, and is able to recover from traffic damage. It should be stressed that the recommendations for N applications are not made to promote a dark green turf. They are made to maximize density, root growth, and the overall health of the turfgrass stand.

Current N recommendations are based on extensive research and are dependent on a variety of factors such as turfgrass species and cultivars, age of turf, soil type, management practices being used (irrigation, clipping removal, pest control programs), weather conditions, use of area, length of growing season, and the need for recovery from pest damage, adverse environmental conditions, and traffic.

The professional turfgrass manager must take into account all these factors in devising an appropriate N fertilization program. The program may vary from year to year as these conditions change. Three major factors must be considered in developing an N application plan: 1) what types of N-fertilizer are applied, 2) how much N should be applied per application and annually, and 3) when should N be applied?

Inadequate attention to each of these factors increases the potential for thin turf that is more prone to pest and stress problems. Thin turf also results in sites which are more prone to soil erosion. Additionally, the potential for leaching and/or runoff of N increases if guidelines are not followed.

Sources of Nitrogen

A wide range of N-containing fertilizers are available to the turfgrass manager. These fertilizers generally fall into one of two broad categories: 1) fertilizers that contain only soluble, quickly available N, or 2) fertilizers that contain some N in a slowly available form, which is not immediately available for plant use. The amount of N fertilizer that can be applied in any single application is dependent on the type of N fertilizer. Following are the main categories of N fertilizers as defined by the Maryland regulations:

Water Soluble Nitrogen - Fertilizers that contain N that can immediately go into solution, and thus have N that is rapidly available for turf uptake, are categorized as water soluble N fertilizers. These fertilizers, while quickly available for turf use, have the most potential for leaching if used improperly.

The most common water soluble forms used for lawn fertilization contain N in the ammonium form (NH^{+4}). Soluble N fertilizers that contain ammonium N include urea, ammonium sulfate and ammonium chloride. These fertilizers can produce excellent quality turf without leaching or runoff problems if used properly. The ammonium N can be adsorbed by soil, reducing the potential for N movement.

Some water-soluble N fertilizers contain N in the nitrate (NO^{-3}) form. Leaching and runoff potential is much higher for NO_3-N. Thus, where conditions exist that are conducive to leaching or runoff, fertilizers that contain significant amounts of NO_3-N should not be used. These conditions include sandy sites (sands and loamy sands) with high water tables when turf is not actively growing, and sites that are highly sloped. Fertilizers high in NO_3-N include ammonium nitrate, potassium nitrate, and calcium nitrate. Fertilizers that contain predominantly NO_3-N should only be used on sites not prone to runoff or leaching, where very rapid response is essential, and on turf that is actively growing. Turfgrass uptake may occur within a few days with NO_3-N containing fertilizers compared to 7-10 days with NH_4-N fertilizers. Generally, fertilizers containing significant amounts of NO_3-N are not recommended for home lawn fertilization.

Excessive rates of soluble N per application can result in excessive growth of turf (which can eventually affect tolerance to environmental stress and pest resistance) and can increase the potential for N loss on some sites. **The 2011 Maryland lawn fertilization regulations limit the application of water soluble N fertilizers to 0.7 pounds actual N per 1000 square feet per application.**

Slow Release Nitrogen – Slow release N fertilizers contain N in a form that delays its availability for plant uptake and use after application. It extends N availability significantly longer than a reference rapidly available nutrient such as urea. Slow release N fertilizers include sources such as sulfur coated urea (SCU), polymer coated ureas, ureaformaldehyde (UF), methylene ureas, isobutlyidene diurea (IBDU), and natural organics. To be considered a slow release N fertilizer, the fertilizer must contain at least 20% water insoluble or controlled release N. The N in all slow release fertilizers used for turfgrass maintenance, including natural organics, is ultimately converted to NH_4-N.

Slow release fertilizers are less prone to N leaching and runoff as compared to applications of soluble N fertilizers applied in excess of recommended rates. While varying considerably in individual characteristics and release patterns, slow release N fertilizers typically provide more even turfgrass response and provide N for turfgrass uptake over a longer period of time. The use of slow release fertilizers should particularly be considered on sites that are prone to leaching or runoff, and when an N application needs to be made to turfgrass during non-optimum growing conditions.

The 2011 Maryland lawn fertilization regulations limit the application of slow release N fertilizers to 0.9 pounds actual N per 1000 square feet per application.

Natural Organic Nitrogen – Natural organic fertilizers are a type of slow release N fertilizer that is derived from either a plant or animal product and do not contain synthetic materials. They have not been altered from their original state except by physical manipulation (drying, cooking, chopping, grinding, shredding, or pelleting). Most natural organic fertilizers contain P, and thus have additional regulations imposed on their application. Natural organic fertilizers for lawn fertilization cannot contain more than 5% P. Also, natural organic fertilizers that contain P cannot be applied to lawns that have soil test P levels measuring optimum or excessive. On lawns that have low or medium soil P levels, natural organic fertilizers cannot be applied in excess of the amount of P recommended by the soil test, cannot apply more than 0.25 lbs. of P_20_5 per 1000 square feet per application, and cannot exceed 0.50 lbs. of P_20_5 per 1000 square feet annually.

Enhanced Efficiency Nitrogen – Enhanced efficiency N fertilizers are a type of slow release N fertilizer that further decrease the potential of nutrient loss to the environment and release less than 0.7 lb. N/1000 ft^2 per month. If a turfgrass fertilizer is classified as an enhanced efficiency N fertilizer, **Maryland regulations allow up to 2.5 pounds of actual N per 1000 square feet be applied in one application, as long as 80% of the annual rate for a given turfgrass species is not exceeded.**

Rates of Nitrogen

There are two primary issues regarding rates of N fertilization: how much N can be applied in any one application, and how much total N can be applied annually. As previously described, the maximum amount of N that can be applied in one application is dependent on the amount of soluble N in the fertilizer. The 2011 Maryland turfgrass fertilizer regulations stipulate that no more than 0.7 lb. soluble N/1000 ft^2 can be made in any single application. If the fertilizer contains slow release N, up to 0.9 lb. total N/1000 ft^2 may be applied in any single application, as long as no more than 0.7 lb. soluble N/1000 ft^2 is applied. In addition, if an enhanced controlled release fertilizer is used, up to 2.5 lb. N/1000 ft^2 can be applied in a single application. However, the application of an enhanced controlled release fertilizer cannot exceed the 80% of the total annual N recommendation for a given species listed in Table 1.

As previously discussed, the total annual turfgrass requirements for N vary considerably depending on a variety of conditions. The first factor to consider, however, is turfgrass species. The annual N requirements for maintaining established stands of the most common turfgrass species grown in Maryland generally fall into the ranges listed in Table 1.

Table 1. Standard Total Annual Nitrogen Rate Recommendations for Commercially Maintained Turfgrass

	Years 1-2 after establishment	Subsequent Years
Cool Season Grasses	**Pounds actual N/1000 square feet**	
Fine Fescue	**1.0 - 2.0**	**0.0 – 1.5**
Turf-type tall fescue	**2.5 – 3.5**	**2.0 – 3.0**
Kentucky bluegrass	**3.0 – 4.0**	**2.0 – 3.5**
Perennial ryegrass	**2.5 – 3.5**	**2.0 – 3.0**
Warm Season Grasses		
Zoysiagrass	**1.0 – 2.0**	**0.0 – 2.0**
Bermudagrass	**2.0 – 4.0**	**2.0 – 3.0**

Numerous factors influence whether moderate adjustments to these rates may be warranted. For example, if clippings are returned to the site when it is mowed, reductions in the annual N rates (as well as P and K) may be possible as the lawn matures. Maintaining a healthy root system through good cultural practices is not only important for overall turfgrass quality, but can help reduce the need for fertilizer. Also, if the site receives little traffic and thus does not need higher growth rates to recover from wear, lower N rates may be adequate. Other means of possible reductions in the total N requirements include the use of iron (if turfgrass color is an issue), increasing the height of mowing, and careful selection of cultivars when seeding, overseeding or sodding. Additionally, a turf stand that has been maintained for approximately 10 years or longer may require less N due organic matter buildup.

Conversely, several factors may warrant a moderate increase in annual rates to tall fescue, Kentucky bluegrass, and bermudagrass. These include 1) heavily used sites that need high recuperative rates and/or that are mowed lower than recommended due to use requirements, and 2) sites that have been damaged from adverse environmental conditions or pests. Also, on sites where pesticide use is not economically feasible or is not permitted (such as some school systems in Maryland), somewhat higher N rates can be important in minimizing many pest problems, particularly weeds and diseases. For these aforementioned conditions, moderately higher rates than the standard rates in Table 1 will help maintain turfgrass density and thus help minimize water runoff, soil erosion, and weed encroachment. Rates much higher than those recommended, however, can have the opposite effect and would not be warranted either agronomically or environmentally. If moderately higher rates than those typically recommended are used, they should be reviewed on an annual basis to determine if they can be reduced in subsequent seasons.

Key Points For Long-term Reductions in Total Annual N Applications

- **Correct soil pH, P, and K according to soil tests**
- **When establishing turf, improve soil conditions with the incorporation of organic matter**
- **Use recommended turfgrass species and cultivars**
- **Don't mow turfgrass too short**
- **Return clippings when mowing**
- **Don't try to grow turfgrass where it is not adapted, such as heavy shade or where there is severe tree root competition. Applying N will not help turf on these locations.**
- **Promote healthy root system through proper cultural practices.**
- **Established turf that is older than 10 years may require 30 to 50% less N fertilizer than younger turf.**

Timing of Nitrogen Applications

The primary potential for N loss from turfgrass sites is when excessive rates of N, particularly NO_3-N, are applied to turf that is not actively growing. Thus, most or the entire annual fertilizer requirement should be applied during periods of active shoot (leaf blades, rhizomes, stolons) and/or root growth.

Warm Season Grasses

The primary period for growth of warm season grass species (zoysiagrass and bermudagrass) is from mid-spring, after dormancy has broken, through mid-fall, when the first killing frost is experienced. Thus, N applications to warm season grasses should generally be restricted to these periods. However, fertilizer that contains primarily NH_4-N can be applied up to a month before dormancy is typically broken in the spring so that N is available for plant uptake at this time. Applications after September 1 are not generally recommended due to the possible enhancement of winterkill, particularly with bermudagrass. However, if bermudagrass has been overseeded with a cool season species such as perennial ryegrass, up to 0.9 lb. N/1000 ft^2 may be applied in September to enhance its performance.

Cool Season Grasses

Cool season grasses (tall fescue, Kentucky bluegrass, perennial ryegrass, and fine fescues) have a longer seasonal growth period in Maryland than the warm season species. They can exhibit growth at virtually any time during the year if moisture and temperature conditions are conducive. The prime periods for growth are typically from late winter through early summer and from late summer through late fall. Research would indicate that 2/3 to 3/4 of the total annual N should be applied during the latter period to maximize cool season turfgrass performance and quality.

Although research has shown some benefits to late fall fertilization, **the 2011 Maryland turfgrass fertilizer law prohibits homeowners from applying N fertilizers between November 15 and March 1. Professional applicators may apply 0.5 lb. N/1000 ft^2 (using soluble N fertilizers only) between November 15 and December 1, but may not apply N fertilizers between December 1 and March 1.**

Under extended hot and dry periods during mid-summer, cool season grasses may experience a period of dormancy until rainfall occurs. Nitrogen fertilizer should not be applied at this time. If irrigation is available or if rainfall is adequate throughout the summer, little dormancy will occur and N uptake of cool season grasses may continue. Although not generally needed, applications of $^1/_4$ to $^1/_2$ lb. N/1000 ft^2 can be made to these sites during this period if growth is not adequate to meet the demands of the use of the site.

Phosphorus and Potassium

Phosphorus (P) is critical in the establishment of turfgrass. Inadequate soil P will result in very poor seedling vigor, slow establishment of grass, and a stand with very poor density and root growth. Thus, soil will be much more susceptible to erosion. Weed encroachment will also be much more severe due to the lack of competition from the thin turfgrass stand. Thus, it is essential that sufficient P be added to the soil at the time of seeding if soil levels are inadequate (*refer to University of Maryland Turfgrass Technical Update TT-116 – "Nutrient Management Guidelines for Commercial Turfgrass Seeding" for current recommendations*). Although not as critical as during establishment of turfgrass, soil deficiencies of P in mature turf can result in poor spring greenup, reduced vigor, reduced density, and reduced drought tolerance. Light applications of P are generally sufficient to overcome soil P deficiencies in mature lawns.

Potassium (K) is not as critical as N or P during the initial establishment phase of turf. However, K can have an impact in mature turf regarding rhizome production and tolerances to heat, drought, and cold. Thus, sufficient K needs to be available for turfgrass to ensure that quality turf will be obtained during and after summer and/or winter stresses. Severe deficiencies of K will result in thin, chlorotic turf that may also exhibit a lack of vigor.

Soil Testing

Whereas N fertilizer application recommendations cannot currently be obtained from soil tests, applications of P and K and adjustment to soil pH must be based on recommendations obtained from soil tests from a laboratory approved by the Maryland Department of Agriculture. **Phosphorus may not be applied for maintenance of turfgrass unless recommended by a soil test. In addition, P may not be applied between November 15 and March 1.** While K has not been identified as a problem regarding water quality, it is recommended that not more not more than 2.0 lb. K_2O per 1000 ft^2 be applied for maintenance of turf if a soil test has not yet been taken.

Sites having different soil types, sites with different use or management histories, and/or sites having substantially different fertility levels as determined by previous soil tests should be sampled separately. Conversely, sites having similar soil types, having similar use and management histories, and having similar fertility levels as determined by past soil tests may be lumped together into one sample. For example, a single sample may be sufficient for a town house development that has had similar management over a period of time and has a relatively uniform soil type. After the initial soil test at a specific site, subsequent sampling every 3 years is generally sufficient to monitor soil P and K levels.

Table 2. P and K Maintenance Recommendations for Commercially Maintained Turf

Soil Test Category

	low	medium	optimum---excessive
	Lbs. P_2O_5 or K_2O/1000 ft^2		
Phosphorus	2.0	1.0	0
Potassium	2.0 - 4.0	1.0 - 2.0	0 - 1.0

Soil Reaction

Maintaining soil pH in an optimum range is important for maximizing the efficiency of nutrient use, and can be important in reducing weed and disease problems. Turfgrass can withstand a rather broad range of soil pH, but a soil pH 5.8 to 6.4 is generally considered ideal. Wide deviations from this range can result in reduced P and micronutrient availability, and can interfere with soil N metabolism and availability. Depending on turfgrass species, problems in turf may start to occur at soil pH above 7.8 and below 5.6. Thus, to maximize the efficiency of nutrient availability and use, soil tests should be taken as previously recommended to determine soil pH. Recommended limestone applications to achieve a soil pH of about 6.4 will be obtained from the soil test.

If the disease spring dead spot of bermudagrass is of concern or is a problem, maintaining lower soil pH (5.6-5.9) may be desirable, and either no or reduced rates of limestone should be applied to achieve this level. If an existing lawn is to be overseeded, it is recommended that limestone be applied approximately one month or more before overseeding to minimize potential P availability problems and the potential for volatilization loss of applied N.

Additional Fertilizer Application Recommendations and Requirements

- Fertilizer cannot be applied to impervious surfaces such as walkways, driveways, and roadways. If fertilizer does land on impervious surfaces, it must be removed or returned to the turf (such as by sweeping or blowing).
- Fertilizer containing N or P cannot be applied to frozen ground, even if the date is before December 1 or after March 1.
- Delay scheduled fertilizer applications if heavy rain is forecast.
- Do not use fertilizers as a de-icer.
- No fertilizer can be applied with 15 feet of waterways. If a drop spreader, a rotary spreader with a deflector, or a targeted liquid spray is used for applications, then fertilizer can be applied no closer than 10 feet of waterways. Waterways include:
  1. surface water subject to the jurisdiction of the State,
  2. the Chesapeake Bay and its tributaries,
  3. a pond, lake, river, stream, public ditch, or tax ditch within the State
  4. A public drainage system within the State other than those designed and used to collect, convey, or dispose of sanitary sewage.

It should be emphasized that the information presented within this publication for N, P, K, and limestone applications is meant only as a guideline. If the proper species and cultivars for a specific site are selected, and sound management practices such as recommended mowing heights are implemented, these fertilizer recommendations should result in satisfactory turfgrass quality in most situations. However, there are many factors that could impact whether moderate modifications of these recommendations are warranted for a specific site.

Related Publications:

University of Maryland Turfgrass Technical Update TT-116 – "Nutrient Management Guidelines for Commercial Turfgrass Seeding"

University of Maryland Turfgrass Technical Update TT-118 – "Nutrient Management Guidelines for Maryland Golf Courses"

University of Maryland Turfgrass Technical Update TT-77 – "Recommended Turfgrass Cultivars for Certified Sod Production and Seed Mixtures in Maryland"