Nutrient Management Guidelines for Athletic Fields in Maryland

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Elevated levels of nitrogen (N) and phosphorus (P) have been identified as major contributors to the decline of the health of the Chesapeake Bay. As such, potential sources for the movement of these nutrients into waters impacting the Bay have been identified and goals have been established for the reduction of N and P loads entering the Bay. Potential sources include agricultural production, air pollution, point sources including waste treatment facilities, leakage from sewer infrastructure, septic systems, runoff from impervious surfaces, pet and animal waste, and other urban inputs including fertilization of landscapes.

Nutrient management laws passed by the Maryland Legislature in 1998 required that University of Maryland nutrient management guidelines be followed on state property and commercially managed turfgrass sites. In 2011, additional regulations were enacted that further specify how N and P may be applied to turfgrass in Maryland, including athletic fields, and that require state training and certification of nutrient applicators. These new laws regarding turfgrass fertilizer applications became effective in 2013. The following information serves as a nutrient management guideline for the maintenance of athletic fields in Maryland.

Athletic fields usually require more intense management, including nutrient management, than most other turfgrass uses due to the following factors:

- Fields receive very intensive traffic and wear, often on a year around basis.
- Fields are often used when grasses are not actively growing.
- There is a need for rapid recuperative capacity, both for playability and safety reasons.
- Pesticide use is often limited on county and school system fields. Adequate nutrient programs are essential to minimize weed encroachment and potential disease problems.
- Poorly maintained fields, including inadequate nutrient applications, are prone to soil erosion as well as severe compaction, which can result in significant injury and safety Issues.

NITROGEN APPLICATIONS

Nitrogen applications to athletic field turf are essential to provide sufficient growth to recover from the intense traffic received from use, to minimize the potential for disease incidence, to maintain sufficient turfgrass density to minimize weed encroachment, to minimize surface water runoff and potential soil erosion, and to ensure safe playing conditions. Three areas of N applications to athletic fields that are interrelated need to be addressed in developing a sound N management program that also meets state regulations:

- The source of nitrogen in a fertilizer,
- The rates of application (per application and total annual N applied), and
- The timing of applications during the year.

Intensely used athletic fields that receive inadequate nitrogen fertilization are prone to weed encroachment and soil erosion due to lack of recuperative ability, which can lead to unsafe playing conditions.

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 athletic field 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 the soil, reducing the potential for N movement. Ammonium sulfate can be particularly useful in suppressing diseases such as spring dead spot of bermudagrass.

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. On athletic fields, these conditions include sandy sites (sands and loamy sands) and on turf that is not actively growing. 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 turfgrass 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 through leaching, particularly on sandy soils.

The 2011 Maryland turfgrass fertilization regulations limit the application of water soluble N fertilizers to 0.7 pounds actual N per 1000 ft^2 per application.

Slow Release Nitrogen – Slow release N fertilizers contain N in a form that delays its availability for plant uptake after application. It extends N availability significantly longer than a reference rapidly available nutrient source 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 in the soil to NH_4-N.

Slow release fertilizers are less prone to N leaching and runoff as compared to applications of soluble N fertilizers that are 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 turfgrass fertilization regulations limit the application of slow release N fertilizers to 0.9 pounds actual N per 1000 ft^2 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 turfgrass fertilization cannot contain more than 5% P. Also, natural organic fertilizers that contain P cannot be applied to turfgrass areas that have soil test P levels measuring optimum or excessive. On turfgrass that has 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 be applied at a rate more than 0.25 lbs. of P_20_5 per 1000 ft^2 per application, and cannot exceed 0.50 lbs. of P_20_5 per 1000 ft^2 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 ft^2 be applied in one application, as long as 80% of the annual recommended rate for a given turfgrass species is not exceeded.**

RATES OF NITROGEN APPLICATION

The rates of nitrogen fertilizer application to athletic fields include restrictions on both 1) the rate of fertilizer applied per individual application and 2) the total rate of fertilizer applied on an annual basis.

Rates per Application - The rate per individual application is regulated on the basis of the nitrogen source (the percentage of soluble and slow release N contained in the fertilizer) as described in the previous section "Sources of Nitrogen".

Rates for Establishment and Initial Grow-In Period - When athletic fields are established from seed, sprigs, plugs or sod, it is recommended that a slow release N-source at a rate of 0.9 pounds N/1000 ft^2 (or a soluble source at a rate of 0.7 pounds N/1000 ft^2) be applied to the soil at the time of establishment. This N application is usually adequate for the first 4 weeks.

For the period from 4-8 weeks after seeding, sprigging, or plugging of bermudagrass, it is recommended that ¼ to ½ pound N/1000 ft^2 be applied weekly (or ½ to 1 pound N/1000 ft^2 biweekly) to maximize establishment rate and ground cover. After 8 weeks, rates recommended for maintenance (Table 1) should be followed.

For the period from 4 - 6 weeks after seeding cool season grasses, or sodding either cool season grasses or bermudagrass, rates recommended for maintenance (Table 1) should be followed.

Total Rates for Annual Maintenance Applications - The total amount of N that needs to be provided annually for satisfactory athletic field turf depends on a number of factors, some of which can change from year to year. These include:

1. Turfgrass species
2. Age of turf
3. Length of growing season (lower eastern shore versus western Maryland)
4. Soil type and soil organic matter levels
5. Clipping removal
6. Irrigation intensity
7. Intensity of traffic and use of area
8. Prevalent weed and disease problems.

Thus, total annual N application rates should be continually evaluated, both during a given season and on an annual basis. The ranges of annual N rates that are typically needed for adequate growth and quality on Maryland athletic fields are listed in Table 1. These recommended ranges for N rates take into account the variability in the factors listed above. For example, rates at the higher end of recommended ranges may be appropriate on sites where clippings are removed, irrigation intensity is high (which increases growth rates and nutrient uptake), traffic is intense (such as heavily played county or school fields or practice facilities), and annual grass pressure is high. In some situations, N rates somewhat higher than those listed in Table 1 are needed in an unusual year to meet the specific conditions and needs of a particular field. Rates at the lower end of the recommended ranges are often adequate on lightly or non-irrigated fields that receives less intensive traffic and on older fields. **It is imperative that athletic field managers evaluate annually the conditions and expectations of their own fields to determine appropriate total annual N rates.**

Table 1. Recommended annual nitrogen rates for typical athletic fields in Maryland.

Species	Total Annual Nitrogen Rate	
	Pounds/1000 square feet	Pounds/acre
bermudagrass	2 – 5*	87 – 217*
Turf-type tall fescue	2 – 5*	87 – 217*
Kentucky bluegrass – perennial ryegrass	3 – 5*	130 – 217*

***The high N rate should only be necessary on fields that are intensively used, have clippings removed, and/or are irrigated.**
The lowest N rate will generally only be sufficient on less intensively used fields where clippings are returned.

Sand based fields that are irrigated, have clippings removed, and have high quality expectations may require total annual N rates at the higher end of recommended rates. Lighter but more frequent N applications are generally recommended for these conditions.

TIMING OF NITROGEN APPLICATIONS

The potential for N loss from turfgrass sites primarily occurs when an excessive rate of NO_3-N is applied to turf that is not actively growing. Thus, most of the annual fertilizer requirement should be applied during periods of active shoot (leaf blades, rhizomes, stolons) and/or root growth using NH_4-N based fertilizers.

The primary period for growth for bermudagrass athletic fields is from mid-spring, after dormancy has broken, through mid-fall, when the first killing frost is experienced. Thus, N applications 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 when growth begins. This can be helpful in the recovery from winter damage and spring dead spot of bermudagrass. Applications after September 1 are not generally recommended due to the possible enhancement of bermudagrass winterkill. However, if a bermudagrass athletic field has been overseeded with a cool season species such as perennial ryegrass, up to 0.9 pound N per 1000 ft^2 may be applied after September 1 to enhance performance of the cool season species.

Cool season grasses generally have a longer growth period than warm season grasses in Maryland. They can exhibit growth at virtually anytime during the year if moisture and temperature conditions are conducive. The prime periods for growth on non-irrigated sites are typically from late winter through early summer, and from late summer through late fall.

Under extended hot and dry periods during mid-summer, cool season grasses may experience a period of dormancy until rainfall occurs. If irrigation is available or if rainfall is adequate throughout the summer, however, little dormancy will occur and N uptake will continue. Thus, periodic light applications of N (¼ lb N/1000 ft^2) during the summer (when traffic can be intense due to high use of fields for summer camps and leagues) can be especially beneficial to maximize the recuperative capacity of athletic fields.

Suggest timing of N applications to athletic fields for bermudagrass and cool season grasses are shown in Tables 2 and 3, respectively.

The 2011 Maryland turfgrass fertilization regulations further restrict the timing of application of N fertilizers on athletic fields. Between December 1 and March 1, N fertilizers cannot be applied. Between November 15 and December 1, only 0.5 lb. N/1000 ft^2 can be applied, and a soluble N source must be used.

Table 2. Suggested N programs for Bermudagrass athletic fields

	High N Rate	Medium N Rate	Low N Rate
	Pounds N/1000 square feet		
April 1 – May 1	0.9*		
May 1 – June 1	0.9	0.9	0.9
June 1 – July 1	0.9	0.9	-
July 1 – August 1	0.9	0.9	0.9
August 1 – Sept.1	0.9	0.9	0.5
Sept. 1 - Sept. 15	0.5	-	-
TOTAL ANNUAL N	5.0	3.6	2.3

***any application greater than 0.7 lb N/1000 ft^2 must use fertilizer containing at least 20% slow release N**

Table 3. Suggested N programs for cool season turfgrass athletic fields in Maryland.

	High N Rate	Medium N Rate	Low N Rate
	Pounds Actual N/1000 square feet		
March 1 – April 15	0.9*	0.5	-
May 15 – June 15	0.9	0.5	0.5
August 15 – Sept. 15	0.9	0.9	0.9
Sept. 15 – Oct. 15	0.9	0.9	
Oct. 15 – Nov. 15	0.9	0.9	0.9
Nov. 15 – Dec. 1**	0.5	-	-
TOTAL ANNUAL N	5.0	3.7	2.3

***any application greater than 0.7 lb N/1000 ft^2 must use fertilizer containing at least 20% slow release N**
****a soluble N source must be used during this period**

PHOSPHORUS AND POTASSIUM APPLICATIONS

Adequate soil phosphorus (P) and potassium (K) are essential for satisfactory turfgrass growth and performance. Phosphorus is particularly critical for new sites being established from seed, and for overseeding existing athletic fields during repair or renovation projects. Established turf, however, can generally tolerate relatively low levels of soil P. Potassium is generally more critical on established turf, and may play a role in drought, heat, cold, and wear tolerances.

Whereas K applications are not regulated, **P applications must be based on soil test recommendations.** However, there is one exception to the requirement for a soil test prior to the application of P. A soil test is not required if the application is made for the purpose of establishing turf on bare ground, the fertilizer is incorporated, and the application is made in accordance with the seeding recommendations of the University of Maryland (use the establishment recommendations for medium levels of soil P in Table 4). This exception does not pertain to overseeding existing athletic field turf.

Athletic fields should be sampled every 3 years. Also, sand based fields, which are often used in stadiums, present a unique situation. Due to the very high sand content of these fields, the cation exchange capacity of these soils tends to be exceptionally low and, consequently, the storage capacity for most nutrients is very low. In addition, frequent irrigation (which increases growth rates) and clipping removal result in a fairly rapid depletion of existing nutrients. Thus, soil tests of high sand content athletic fields should preferably be done on an annual or biannual basis to monitor changes in soil P, K, and ph. While soil tests should be taken routinely to monitor soil K levels, experience has shown that K fertilizer rates that are approximately ½ that of the annual N fertilizer rate are generally sufficient to maintain adequate soil K levels. Recommended rates for P and K applications based on soil tests are shown in Tables 4 and 5, respectively.

Table 4. Phosphorus Application Recommendations for Athletic Fields[+]

Establishment	Soil Test Phosphorus Category			
	low	medium	high	excessive
	Pounds P_2O_5 per 1000 square feet			
Broadcast*	2 - 3	1 - 2	0 - 1	0
Incorporated**	3 - 4	1 - 2	0 - 1	0
Overseeding	2 - 3	1 - 2	0 - 1	0
Maintenance	2 – 3[++]	1 - 2	0	0

[+]Any subsequent applications should be based on additional soil tests

[*] Or incorporated into soil up to 2 inches
[**] Incorporated into soil over a 2 inch depth

[++] 3 lb. P_2O_5/1000 ft^2 should only be used on soil testing "very low" for phosphorus

Table 5. Potassium Application Recommendations for Athletic Fields

Establishment	Soil Test Potassium Category			
	low	medium	high	excessive
	Pounds K_2O per 1000 square feet			
Broadcast*	2 - 3	1 - 2	0 - 2	0
Incorporated**	3 - 5	1 - 2	0 - 2	0
Overseeding	2 - 3	1 - 2	0 - 1	0
Maintenance	2 - 4	1 - 3	0 - 2	0

* Or incorporated into soil up to 2 inches
** Incorporated into soil over a 2 inch depth

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 maintain this pH level. If an existing athletic field 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, tracks around athletic fields, or 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.