Sports Turf Fertility & The Nitrogen Factor

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Maintaining competitive and safe playing surfaces has long been the goal for all sports turf managers. Many cultural practices are used to promote proper growth and health of the turf which is important to prevent injury to players. Sports turf managers core cultivate, topdress with sand, and apply fertilizers to grow an optimum playing surface. Often times however, fertility can be a puzzling matter. Considerations must be made to the location, amount of traffic, and disease and pest incidence in order to apply correct amounts of nutrients. Over-applications of nutrients are wasteful and potentially harmful to the environment, not to mention the extra labour and money involved. So, where does a sports turf manager begin when creating a fertility program suitable for his or her field?

Soil Testing

The first step to creating a fertility program is to determine the actual amount of nutrients currently available in the soil. In order to do this, samples need to be sent to a soil testing or university extension lab for analysis. Soil sampling is a simple procedure. Randomly select 10 to 12 locations on the field. At each location, remove the sod and take a sample at least six inches in depth. All samples should then be mixed well in a bucket. From this mixture, fill a soil sampling box or a 4x7 inch bubble envelope and mail (Puhalla *et al*., 1999).

The soil testing lab will send back a report that tells the amount of available phosphorus, potassium, calcium, magnesium and zinc. Phosphorus should be maintained at levels ranging from 30 to 120 pounds per acre. Potassium should be maintained at much higher levels ranging from 300-500 lb per acre (Puhalla *et al*., 1999). Generally, potassium should be applied depending upon nitrogen levels. Low levels of nitrogen decreases the amounts of potassium used by the plant.

A Closer Look at Nitrogen

Typically, soil test reports also make recommendations for fertilizer applications based upon nutrient requirements. Soil testing is a cheap and effective way to prevent over- and under-applications of nutrients, which saves both time and money. However, soil analysis does not measure the level of nitrogen, which is likely the most limiting factor in turfgrass growth and vigour (Puhalla *et al.*, 1999).

Determining actual levels of nitrogen in the soil is pointless due to the volatile and mobile nature of the nutrient. A soil sample sent off to a soil testing lab will likely have a different amount of nitrogen when it arrives at the lab than it did before it was taken (Puhalla *et al*., 1999). Instead, nitrogen applications must be determined individually based upon geographic location, root zone mix, deficiency symptoms, turfgrass species selection and the expected quality of the turf.

Applications should be made only during months of active turfgrass growth. Tissue analysis does, however, determine actual amounts of nitrogen and other nutrients in the plant. Leaves for tissue analysis should be taken at random and sent to a lab for testing. Optimum levels for nitrogen in plant tissue should be 3-5% of the total dry weight (Turgeon, 1996).

1. Location & Growing Period

Geographic location determines the number of months for active growth and aids in the selection of a suitable turfgrass species. Growing months for turf can differ by several months between various locations. Therefore, the total amounts of nitrogen to be applied per year must be adjusted for location. For instance, a bermudagrass sports field in Tennessee may only need 6-9 lb of nitrogen (per 1,000 ft^2) per year compared to the exact same field in Florida that needs more than 9 lb per year, with the difference being the length of the growing season.

2. Root Zone Composition

The make up of the root zone also affects the amounts of nitrogen to be applied. Fields consisting of high silt and clay contents require different application procedures versus a sand-based field. Root zones consisting predominantly of silt and clay have lower percolation rates, helping to prevent the loss of nitrogen through leaching. Therefore, applications of nitrogen can be limited to a monthly basis using a fertilizer consisting of both fast and slow release nitrogen sources.

Sand-based root zones require applications to be applied more often with less total nitrogen per application. These root zones promote drainage, which reduces the holding capacity for nutrients like nitrogen. To ensure the availability of nitrogen for the plant, it should be applied every 10 to 14 days at half the normal rate depending on irrigation and precipitation levels. Sand-based fields have other nutrient retention problems as well. The lack of cation exchange capacity of sand allows other nutrients such as potassium, which normally is found at acceptable levels in native soils, to potentially leach out (Turgeon, 1996). Therefore, sand-based athletic fields should receive applications of potassium and phosphorus, as well as other micronutrients, more frequently than native soil athletic fields. As stated earlier, soil testing will also help determine these nutrient requirements.

Table 1. Nitrogen applications (lb/1,000 ft^2) for bermudagrass fields, southern US. Note that May through October are actively growing turf months and Jan-April and Nov-Dec are overseeding periods.

*Total amount of nitrogen/year

Month	Sand-Based Fields		Native Soil Fields	
	Slow Release	Fast Release	Slow Release	Fast Release
January	-	-	-	-
February	-	-	-	-
March	1	05-1	-	0.5
April	1	1	1	1
May	2	1	2	1
June	-	1	-	1
July	2	1	2	1
August	-	1	-	1
September	2	1	1	1
October	-	1	-	-
November	1	1	1	0.5
December	-	-	-	-
Total* (no overseed)	**6**	**6**	**5**	**5**
Total* (overseed)	**9**	**9**	**7**	**7**

3. Turf Quality

Another way to determine nitrogen needs is by assessing overall turf quality. Turfgrass growing under low nitrogen levels will exhibit chlorosis. Chlorotic plants appear yellowish-green to yellow (Emmons, 1995). However, yellowing turf does not necessarily mean that levels of nitrogen are inadequate, but proper nitrogen fertility will correct any deficiencies. Other environmental stresses can produce the same effects. Density is another turfgrass quality that can be used as an indicator for nitrogen deficiencies. Often, turfgrass areas infested with weeds can indicate a lack of nitrogen available to the plant (Emmons, 1995). Weeds are not the cause of bad turf. Rather, weeds are caused by bad turf. Low nitrogen fertility reduces the competitive nature of the turf, which allows invasive weeds to take over.

Nitrogen differences on Kentucky bluegrass.

4. Species Selection

Turfgrass species selection also affects the amounts of nitrogen needed. Bermudagrass, Kentucky bluegrass and perennial ryegrass generally require more input of nitrogen per year than any other turfgrasses being used on athletic fields. These grasses are vigorous and aggressively growing plants that require high nitrogen fertility. Increased rates of nitrogen must be applied in order to keep the plant healthy and able to recuperate from wear. Bermudagrass can receive rates of nitrogen per 1,000 ft^2 of 6-15 lb per year depending on geographic location and field usage.

Table 2. Nitrogen applications (lb/1,000 ft²) for Kentucky bluegrass/perennial ryegrass athletic fields. Note that June-July applications are optional, slow release fertilizer recommended.

Month	Sand-Based Fields		Native Soil Fields	
	Slow Release	Fast Release	Slow Release	Fast Release
January	-	-	-	-
February	-	-	-	-
March	-	-	-	-
April	0.5-1	1	1	1
May	1	0.5-1	-	0.5
June	1	0.5	1	0.5
July	-	0.5	0.5	-
August	0.5	0.5	-	0.5-1
September	1	1	1-1.5	1
October	-	-	-	-
November	-	-	-	-
December	-	-	-	-
Total N per year	**4-4.5**	**4-4.5**	**3.5-4**	**3.5-4**

Kentucky bluegrass can receive rates ranging from 3-6 lb per year.

5. Type of Venue

Quality requirements for sports fields differ between little league parks and professional stadiums. Typically, city operated fields will not be mowed as many times or as low as in professional stadiums. This difference changes nitrogen needs. Lower mowing frequency and higher mowing heights requires less nitrogen input. Lastly, fields that collect clippings will need to have more nitrogen applied than fields that mulch clippings.

General Rules

Despite all of the conditions described above, there are some generalized rules for producing a fertility program that is right for you. First, nitrogen should be applied at least one time per active growing month. Amounts of nitrogen will differ, but applications should be made every growing month to ensure sufficient amounts. Figures 1 and 2 describe application timing of fast and slow release fertilizers on Kentucky bluegrass, perennial ryegrass and bermudagrass. Highly used fields should receive one pound of nitrogen per month of active growth while low use fields will only need as little as half a pound of nitrogen.

The more applications made per month the better. Try splitting applications in half every 14 days. Applying fertilizers more frequently aids in keeping nitrogen available to the plant at all times (Calhoun *et al*., 2002). Use fertilizers with both fast release and slow release nitrogen forms. One type of fertilizer is not sufficient for an entire season. Fertilizers with different nitrogen forms and percentages should be used to maximize growth (Puhalla *et al*., 1999).

Recommendations of applying phosphorous and potassium by a soil analysis report should be followed. However, some turfgrass managers apply potassium at a one-to-one rate with nitrogen (Emmons, 1995). This is significant to managers with sand-based root zones. Potassium aids in stress tolerance of the plant, but is readily leached from sand root zones (Turgeon, 1996). Finally, applications of nitrogen and potassium should be given at the end of each growing season when shoot growth slows. During this time, the plant is storing carbohydrates, rebuilding damaged roots, and preparing for harsh environmental conditions (Emmons, 1995). For some sports field managers, nitrogen applications do not end with the induction of dormancy at the end of the growing season, but continue with the overseeding of ryegrass for play in the winter season. Fields overseeded with ryegrass need to be fertilized continually throughout the cool season growing months.

Tables 1 and 2 describe examples of fertility programs for sports fields. These examples are meant to be modified and adapted to fit the needs of individual fields. Table 1 describes nitrogen applications for bermudagrass fields in the southern United States. Amounts of nitrogen in pounds per 1,000 ft^2 are given in terms of slow release and fast release fertilizers in either native soil or sand-based athletic fields. In addition, Table 1 describes a continuance of the fertility program for overseeded turf. Table 2 describes applications for fields with Kentucky bluegrass and perennial ryegrass. Nitrogen amounts are also given in pounds per 1,000 ft^2. Application amounts are given for both fast and slow release, as well as for native soil versus sand-based athletic fields.

EDITOR'S NOTE

The rates of application of nutrients provided are somewhat higher than those for Canadian conditions, however the principles remain the same. Sports turf managers should be aware of these differences in the rates of nutrient application to different species in the regions of North America.

Guidelines for creating a fertility program are useful, yet, keep in mind that they are only guidelines. Each individual field requires its own specific fertility program based upon the needs of the sports turf managers, players, owners and others who enjoy the field. Finding what works for you is not an easy task, so be patient and do not be afraid to try new things.

Figure 1. Cool season fertility fast and slow release timing.

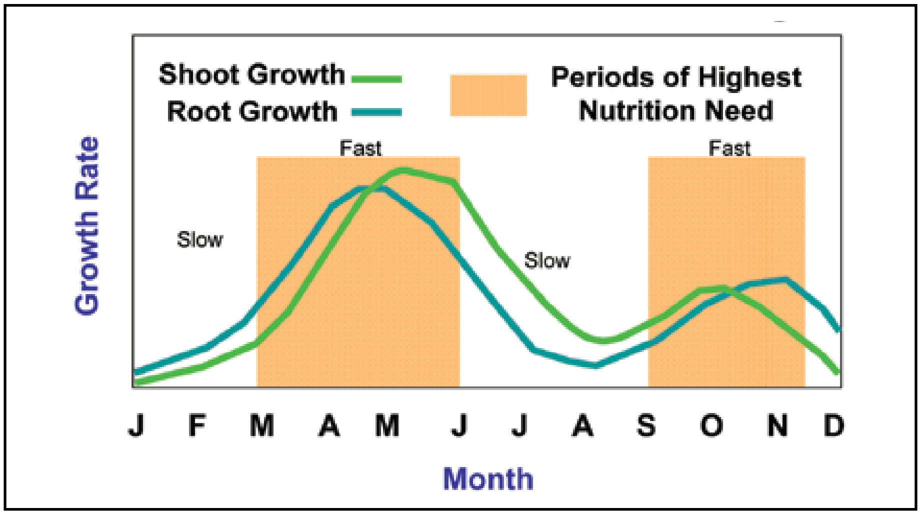
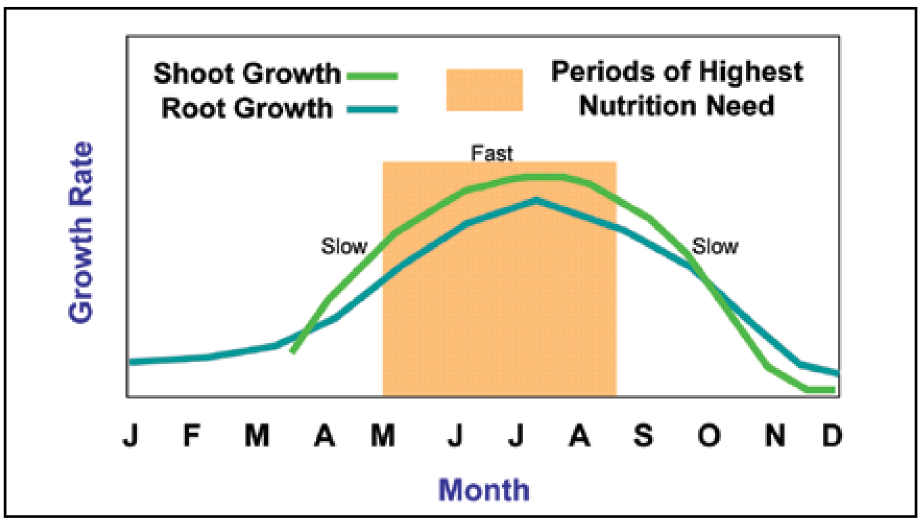


Figure 2. Warm season fertility fast and slow release timing.



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