RUTGERS CORNER - Soil pH and Use of Lime

By Brad Park

Unfortunately, lime is often applied annually to sports fields for no other reason than, "We've always done it that way." Conversely, some sports field managers are reluctant to apply lime or skeptical of the benefits of applying lime because turfgrass will not show an immediate response to a lime application, in contrast to the rapid growth associated with the application of a soluble nitrogen fertilizer. This article will discuss the concept of soil pH and describe how to utilize liming materials to correct low pH soils.

The basics of soil pH

All soils can be classified as acidic, neutral, or alkaline. Acidity and alkalinity are defined in terms of the hydrogen ion (H+) concentration found in pure water. If the soil solution contains more hydrogen ions than are found in pure water, the soil is considered acidic. In contrast, if the soil solution contains fewer hydrogen ions than are in pure water, the soil is considered alkaline. The degree of acidity or alkalinity can be described by a pH range from 0 to 14. Any value below 7.0 is considered acidic; a value of 7.0 is neutral; a value above 7.0 is considered alkaline.

In humid, high-rainfall regions such as New Jersey, soils become acidic through natural processes and human activities. Rainfall will leach elements from the soil such as calcium and magnesium deep into the soil profile and replace them with hydrogen ions from the water. Additionally, use of ammonium-based fertilizers and acid rain contribute to the creation of acidic soils.

Soil pH affects turfgrass health by influencing the availability of plant nutrients as well as elements that can be detrimental to turfgrass vigor. Soil pH can also affect the susceptibility of turfgrasses to certain diseases. Strongly acidic soils (pH < 5.5) may lead to deficiencies in calcium, magnesium, or phosphorous and increase the availability of elements such as aluminum to levels that are toxic to turfgrasses.

In strongly alkaline soils (pH > 8.5), phosphorous can be unavailable to the plant. Interestingly, research has shown that soil pH values above 6.5 appear to enhance summer patch disease development. Kentucky bluegrass is a widely used cool season turfgrass for sports fields in New Jersey and many varieties are susceptible to summer patch. Annual bluegrass (*Poa annua*), while generally considered a weed, is often a species found on sports fields and is also susceptible to summer patch. Repeated annual liming can potentially predispose Kentucky bluegrass (and annual bluegrass) sports fields to summer patch, which can devastate a turfgrass playing surface.

Continued on page 8

RUTGERS CORNER -

Seed and fertilizer: How much was applied?

By Brad Park

Sports field and grounds managers may be either unaware of how much seed/fertilizer they are applying on a 1000 sq ft basis or believe they are applying a particular amount but in actuality are only applying a fraction.

The responsibility of fertilizer and seed applications are often left to a contractor. When asked how much seed/fertilizer was actually applied to a sports field, managers are often unaware of the amount. He or she may present a fertilization plan developed by an application contractor with no certainty as to what rates were actually made.

One way of sifting though all of this confusion is to simply know how much area requires treatment and the number of bags of specific material required to treat that area. Using seed as an example, a typical overseeding recommendation for perennial ryegrass is 6.0 lbs seed per 1000 sq ft. To seed the area between the hash marks on a high school football field (approximately 16200 sq ft) at this rate, approximately 97 lbs of seed are required ([6.0 lbs x 16200 sq ft] / 1000 sq ft = 97.2 lbs). Seed is typically sod in 50.0-lb bags; therefore two (2) 50.0-lb bags of seed are required for order to complete this overseeding operation.

Applied fertilizer amounts can be calculated in a similar manner. Assume 0.75 lbs nitrogen (N) per 1000 sq ft specified to be applied to an entire football field and the material to be used has an analysis of 35-0-0. This fertilizer contains 35% N; 0% phosphate (P_2O_5); and 0% potash (K_2O). A football field (including endzones) is 57600 sq ft. To apply 0.75 lb N per 1000 sq ft using a material that contains 35% N, 2.1 lbs of this fertilizer must be applied per 1000 sq ft (0.75 lbs N / 0.35 lbs N per 1.0 lb fertilizer = 2.1 lbs fertilizer). To treat the football field at the desired rate, 121 lbs of the 35-0-0 fertilizer must be applied to the field ([2.1 lbs x 57600 sq ft]/1000 sq ft = 123 lbs). Fertilizer is typically sold in 50.0-lb bags; hence, 3 (three) 50.0-lb bags will be required for order and approximately two-and-one-half (2.5) bags will be required to treat the field at the 0.75 lbs N per 1000 sq ft rate.

One way of exercising oversight on contracted work is to request to see the number of fertilizer and/or seed bags used to treat a sports field. Knowing the specified application rate, the area to receive the application, and, in the case of fertilizer, either the specified analysis or the analysis utilized by the contractor, one can calculate the amount of material required.

Brad Park is Sports Turf Research & Education Coordinator, Rutgers University; SFMANJ Board Member; and Editor, SFMANJ Update

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Continued from page 5

RUTGERS CORNER - Soil pH and Use of Lime

To lime or not to lime ...

To determine whether or not to apply lime to a sports field a soil test must be performed. Soil testing kits may be purchased from a Rutgers Cooperative Extension county office. Each kit includes an information sheet, a questionnaire, and a mailing bag or envelope. The information sheet provided with the soil testing kit describes proper sampling procedures.

In a standard soil test, the plant nutrients boron, calcium, copper, magnesium, manganese, phosphorus, potassium, and zinc are quantified to determine their availability to a crop, in this case turfgrass. Fertilizer and lime requirements recommended by the Rutgers Soil Testing Laboratory are based on soil nutrient levels, pH, and in some cases, crop management and site conditions.

Conducting a soil test to determine soil pH and a lime requirement (if any) is essential in order to decide whether a lime application is needed.

Optimally, lime should be applied as part of the turfgrass establishment process, prior to finish grading and turfgrass seeding. Lime should be tilled to a 6-inch depth based on soil test recommendations. In the case of established turfgrass, lime should not be applied in excess of 100 pounds per 1000 square feet.

Very simply, if the results of soil testing determine that a lime application is needed - apply a liming material. If no lime is required – don't apply lime.

Choosing a liming material

When a lime material is applied to soil, it has the effect of neutralizing soil acidity. Calcitic limestone is often referred to as "regular" limestone and is nearly pure calcite or calcium carbonate ($CaCO_3$). Dolomitic limestone is a mixture of calcium carbonate and magnesium carbonate and can be used when pH is determined to be low and deficient levels of magnesium exist.

Ground agricultural limestone can be used to correct soil pH in turfgrass areas. Depending on the fineness of the material, it may be difficult to spread ground agricultural limestone using a drop spreader because finely ground particles may bridge over the application holes in the spreader. Spinner-type spreaders can be used to apply ground agricultural limestone, however bridging problems

Continued on page 14

Continued from page 8

RUTGERS CORNER - Soil pH and Use of Lime

may also occur if the hopper is not properly agitated. Because of application problems, pelletized limestone is often applied to turfgrass. Pellitized lime is calcitic or dolomitic ground agricultural limestone that has been aggregated into larger particles to allow for easier spreading through conventional drop and spinner-type spreaders.

Note that the particle size of a liming material will strongly influence the rate in which the material neutralizes soil acidity. While all liming materials are relatively insoluble, materials with finer particle sizes (greater surface area) have an increased dissolution rate in soils, and therefore will have the effect of neutralizing acidity more quickly than a coarser grade lime source.

Burned lime and hydrated lime are other liming sources. These materials are not generally recommended for use in turf because of their caustic properties for applicators and their potential to cause burn on turfgrasses.

Calcium carbonate equivalent (CCE)

The lime requirement given in the soil test results by the Rutgers Soil Testing Laboratory and other labs is based on the use of pure calcium carbonate, which is assigned a relative neutralizing value of 100%. Therefore, a liming material that has the same neutralizing potential as pure calcium carbonate is said to have a calcium carbonate equivalent (CCE) of 100%. If, however, the CCE of the liming material chosen does not have a CCE of 100%, the amount of material to be applied must be adjusted to raise the soil pH to the desired level.

For turfgrass sites, lime requirements made by the Rutgers Soil Testing Laboratory are based on pounds of limestone (CCE=100%) required on a 1000 square foot basis necessary to raise soil pH to 6.3.

Based on the CCE of the material being used to lime a turfgrass area, the amount of material needed can be calculated in the following manner: Liming material needed = (Soil test recommendation/CCE of liming material) X 100

Tying it all together

An example of a soil test recommendation for the establishment of a sports field based on a determined soil pH of 5.35 is as follows:

The soil test indicates a strongly acidic soil, of which the pH is below the best range for the growth of most turfgrass. This soil should be treated with 95 pounds per 1000 square feet of limestone. Spread uniformly on the surface, then mix thoroughly to a 6 inch depth by shoveling or tilling.

Continued on page 17

Dr. Henry W. Indyk

Graduate Fellowship in Turfgrass Science

As many of you know, the turfgrass industry lost a dear friend and colleague in September 2005. We will all miss Henry very much and would like to insure that his legacy lives on. The Indyk family would like to establish a memorial fellowship to support graduate students interested in applied turfgrass science. This fellowship is being created to help assure that tomorrow's graduate students have the financial resources to get an advanced degree in turfgrass science at Rutgers University. To fund a full graduate assistantship each year in Henry's name, we will need to raise a total of $400,000. Your generous support at this time will bring us closer to reaching this goal.

To make a tax-deductible contribution today, please send a check payable to the Rutgers University Foundation, 7 College Avenue, New Brunswick, NJ 08901. Be sure to indicate "Indyk Fellowship, Turfgrass" in the memo portion of your check. If you desire, you may provide a donation in the form of a pledge payable over several years.

For information on other ways to support this fellowship, please contact

Dr. Bruce B. Clarke, Director – Rutgers Center for Turfgrass Science
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Continued from page 14

RUTGERS CORNER - Soil pH and Use of Lime

In the case of this example, if the liming material available for use has a CCE of 85%, then the actual amount of material needed to be applied per 1000 square feet based on the lime recommendation is: (95/85)X100 = 112 lbs liming material per 1000 square feet.

In the case of established sports fields and other turfgrass sites, lime requirements are often specified such that the amount of lime required is applied over multiple applications.

This article was adapted from the following publications and provide additional reading on the subject of soil pH and liming:

Carrow, R.N., D.V. Waddington, and P.E. Rieke. 2001. Turfgrass soil fertility and chemical problems. Sleeping Bear Press, Chelsea, MI.

Landschoot, P. 1994. Liming turfgrass areas. Penn State Col. Of Ag. Sci., Ag. Res. and Coop. Ext. Extension Circular 415.

Murphy, J. and J. Heckman. Managing soil pH for turfgrasses. Rutgers Coop. Ext. FS 635.

Plaster, E.J. 1992. Soil science and management. Delmar Publishers, Inc., Albany, NY.

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Continued from page 15

Athletic Field Grading

flow drainage in 2 directions (toward the foul lines) compared to sheet flowing the entire length of the field. 3) Using a cone shape. This is where you start from the pitchers mound and radiate from there sloping away from the mound with as much 2.0% slope. All bases are the same elevation in the infield and the slope continues through the outfield which is consistent with infield. This creates a cone shape and is becoming a more popular design. These methods are acceptable for all new fields.

Grading plans for existing fields and sites often specify slopes in a certain direction because of permanent objects such as buildings, parking lots or fences. Applications like this require balancing the soil in place. By shooting the grades on the field you can approximate the slope and grade of the field to maximize drainage and safety. Budgeting money for a field that has already been constructed but is not performing adequately is always an issue. Native soil fields are typically either worn-out from overuse or suffer from poor drainage, heavy textured soils, etc. Starting a field project with a solid plan and agronomic knowledge of local conditions is the start of a successful project. You have to marry the concept that all components going to into a project will complement each other. Strong technical specifications about procedures, products, materials and machine control laser grading will make your next project successful.

Sean Connell is Owner and Primary Project Manager, Georgia Golf Construction, Woodbine, NJ; and SFMANJ Treasurer