W161-G

Turfgrass Maintenance

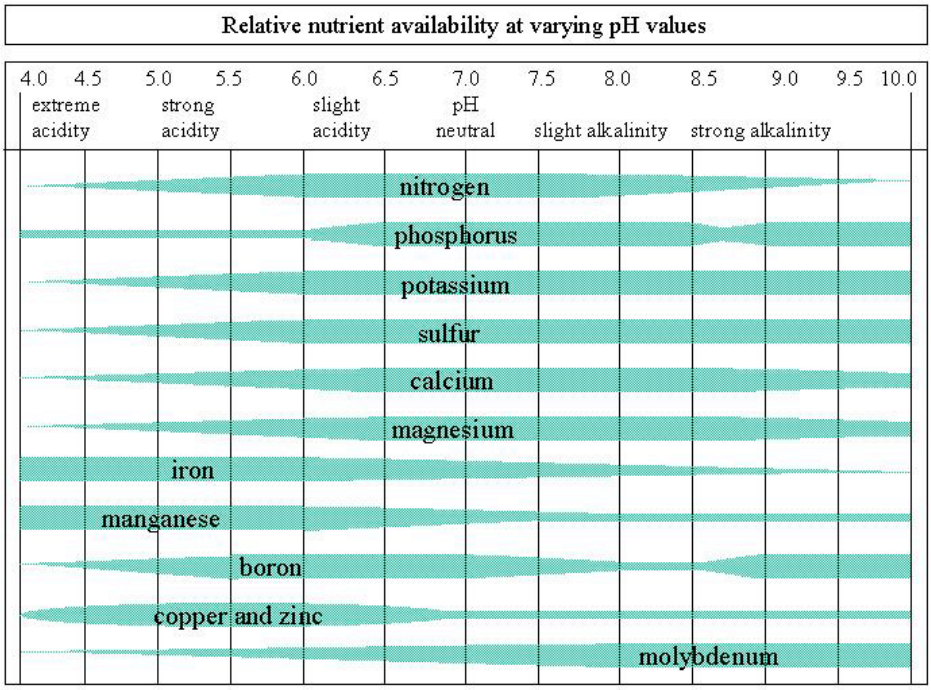
Liming

Tom Samples, Professor, and John Sorochan, Associate Professor, Plant Sciences
and Hugh Savoy, Associate Professor
Biosystems Engineering and Soil Science

Many turfgrasses grow best in slightly acid soils. Soils become acidic as calcium (Ca), magnesium (Mg) and potassium (K) are removed by plants or move in water below the turfgrass root zone and are replaced by hydrogen (H) or aluminum (Al). Applying certain nitrogen-containing fertilizers including ammonium nitrate, ammonium sulfate, diammonium phosphate and urea to turf also contributes to soil acidity.

Soil pH. A notation often used to describe the acidity or alkalinity of a soil is pH. For example, soil with a pH below 7.0 is acidic and above 7.0 is alkaline. The p in pH represents 'potential' and the H, 'hydrogen.' When subjected to a soil pH test, acidic soils 'yield' high levels of hydrogen (H^+) or aluminum (Al^+) ions. A soil with a pH of 5.0 is 10 times more acidic than soil with a pH of 6.0 and 100 times more acidic than soil with a neutral pH (pH = 7). Alkaline soils, unlike acidic soils, contain a predominance of hydroxyl (OH^-) ions. They have high amounts of 'basic' cations such as Ca^{++} Mg^{++} and $K.^+$ Excessively high concentrations of sodium ions (Na^+) in soils make turfgrass maintenance and sod production extremely difficult if not impossible.

Effect of Soil pH on Availability of Essential Mineral Nutrients. The availability of essential mineral elements in soil is greatest when the pH is slightly acid. Strongly acidic (pH $\leq$ 5.5) soils may be very low or deficient in Ca, Mg and phosphorus (P). Yet these same soils may contain toxic amounts of Al or manganese (Mn). The formation



of insoluble tricalcium phosphate in strongly alkaline (pH $\geq$ 8.5) soils reduces the availability of P for uptake by turfgrasses. The aerial shoots of plants growing in alkaline soils often lose color as Fe becomes less and less available.

Soil pH, Thatch, Diseases and Weeds. Beneficial soil microorganisms involved in the decay of grass clippings and thatch may not thrive in excessively acidic soils. Research indicates that soil pH can also affect the severity of several turfgrass diseases. Fusarium patch, spring dead spot, summer patch and take-all patch can be much more severe when turfs are growing in alkaline soils. Acid soil conditions favor the growth of certain turfgrass weeds.

Moss growing in a compacted, acidic soil.

Shepherds purse, a common broadleaf weed, is often an indicator of strongly acidic soils. Similarly, mosses may be more prevalent in moderately to strongly acidic soils than in soils with a neutral pH. Some herbicides and insecticides do not perform well when applied to acidic soils.

Considering Soil Test Recommendations. Lime is used to neutralize soil acids and raise the pH. Soil testing is a key to determining when it is necessary to apply lime and the amount of lime to apply. Personnel at the University of Tennessee Soil Testing Laboratory use a glass electrode to measure the pH of the soil sample. Ten milliliters of de-ionized water is added to 10 grams of dry, pulverized soil before measuring the level of acid in the soil solution. The pH of this solution is reported on the soil test result form as 'water pH.' Water pH is used to indicate a need for lime. The amount of acid held (adsorbed) by clay and organic matter in the soil that must be neutralized is reported as 'buffer pH.' Soils containing large amounts of clay most often require much more lime than sandy soils to produce an equal amount of pH increase. Clayey soils are more 'resistant' to a change in pH compared to sandy soils.

Liming Materials. Ground agricultural limestone is commonly applied to turfs throughout Tennessee to neutralize soil acids. It is manufactured by grinding rock containing either a large amount of calcium carbonate (calcitic limestone) or a combination of calcium and magnesium carbonate (dolomitic limestone). In Tennessee, dolomitic limestone usually contains about 9 percent Mg by weight. Dolomitic limestone is recommended when both the soil pH and the available Mg level are low. The fine particles of calcitic and dolomitic ground agricultural limestone may be aggregated into larger particles (granules) to reduce dust and to make application easier. Other liming materials include hydrated or slaked lime (calcium hydroxide), burnt or quick lime (calcium oxide) and blast-furnace slag. These materials must be handled and applied very carefully. For example, hydrated lime can irritate the skin and, if applied to moist turf while temperatures are high, may severely injure or burn turfgrass leaves.

Granular Dolomitic Limestone

The calcium carbonate equivalent (CCE), relative neutralizing value (RNV) and fineness of all agricultural liming materials sold in Tennessee are indicated on the label or invoice. Liming materials must have a minimum CCE of 75 and a RNV $\geq$ 65. At least 85 percent of the liming material must pass through a 10-mesh (10 openings per linear inch or 100 openings per sq. in.) sieve and a minimum of 50 percent, through a 40-mesh sieve.

CCE. The lime recommendation on a soil test result form usually indicates the total amount of lime required to raise the soil pH to the optimum level and assumes that the liming material used will have the same neutralizing potential as pure calcium carbonate. For example, a liming material with a CCE of 100 percent has the same neutralizing potential as pure calcium carbonate. Calcitic limestone may have a CCE from 85 to 100 percent; dolomitic limestone, a CCE from 95 to 109 percent. The CCE of slaked lime is 135 percent.

RNV. The relative neutralizing value of a liming material is calculated by multiplying the CCE by the total particle-size efficiency (see next page).

The liming material in the example had a total particle size efficiency of 90.3.

Size Range	Percent Material		Efficiency Factor		Particle Efficiency
> 10 mesh	3	x	0.33	=	1.0
10 to 40 mesh	17	x	0.73	=	12.4
40 to 60 mesh	45	x	0.93	=	41.9
< 60 mesh	35	x	1.00	=	35.0
	Total Particle Size Efficiency =				90.3

If the CCE of this liming material is 90 percent, the RNV = CCE x Total Particle Size Efficiency
= 0.90 x 90.3 = 81.3

Calculating the Actual Amount of Liming Material to Apply. The CCE is used to calculate the actual amount of liming material required. For example, if the soil test recommendation is 25 lbs. of limestone per 1,000 sq. ft. and the CCE of the liming material purchased is 85 percent, the actual amount of liming material to apply per 1,000 sq. ft. = (soil test recommendation / CCE of liming material) x 100 = (25 / 85) x 100 = 29.4 lbs. of liming material per 1,000 sq. ft.

No more than 50 pounds of limestone per 1,000 sq. ft. should be applied to established golf course fairways, sports turfs and lawns in a single application. Greens and closely mowed tees should receive no more than 25 pounds of limestone per 1,000 sq. ft. per application. If necessary, limestone may be applied semi-annually for one or more years until the total requirement is met.

How and When to Apply. For best results, limestone should be uniformly broadcast over a dry turf surface. Ground agricultural limestone can be very difficult to apply with some fertilizer spreaders. Finely ground particles may 'bridge' rather than flow out the spreader openings. Ground limestone can be applied by hand to small turf areas. Drop-, pendulum- and spinner-type spreaders are used to apply pelletized limestone. Commercial spreader trucks with flotation tires may be available for custom spreading. Immediately after liming, turf may be irrigated with ½ inch of water to rinse lime particles from the aerial shoots of turfgrasses. Although limestone may be broadcast almost any time of year, fall is preferred. Rainfall, snow and soil heaving in winter help move limestone through thatch and into the soil.


Pendulum spreader

If large quantities of limestone are recommended or liming materials must be applied sequentially for one or more years, an annual soil test is recommended to monitor changes in soil pH and the impact of the liming program on the availability of the essential mineral nutrients.

Visit the UT Extension Web site at
http://www.utextension.utk.edu/

W161G-3/08