# Lime AND Turf

## What You Need to Know about Soil pH, Nutrient Availability and Liming

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Why do the soils in this region persistently need lime? Answer: to neutralize the naturally acidic soil in our region. Soil that is more than slightly acidic makes many key nutrients — including phosphorus, calcium and magnesium — much less unavailable to plants, and it increases the soil levels of aluminum, manganese and iron metals, creating possible toxicity. Both situations create an inhospitable growing environment for most plants, including turfgrass.

Unfortunately, acidification is a natural process that occurs continuously in soils throughout the Mid-Atlantic. Nitrogen fertilization is one of the several factors that speeds up its development, as does the breakdown of organic matter (i.e., thatch). Since most turf managers routinely apply nitrogen fertilizers and battle the resulting buildup (and consequent breakdown) of organic matter, they also must periodically apply lime to reduce soil acidity and its potentially damaging results. Liming is a critical management practice for maintaining soil pH at optimal levels for plant growth.

### pH basics

A measurement of the acidity in the soil's water, soil pH is responsible for the solubility of many nutritional elements. Figure 1 (opposite page) illustrates the relationship between soil pH and the relative plant availability of nutrients.

The majority of nutrients become most available to plants in a slightly acidic soil — between 5.8 and 6.5 pH. When a soil is strongly acidic (lower than 5.0 to 5.5 pH), plant growth is limited by aluminum toxicity. Also, when a soil is strongly acidic, many herbicides lose effectiveness. When soils are alkaline (higher than 7.0 pH), micronutrients such as manganese and zinc become much less available to plants.

### The benefits of liming

By reducing soil acidity, liming increases the availability of several

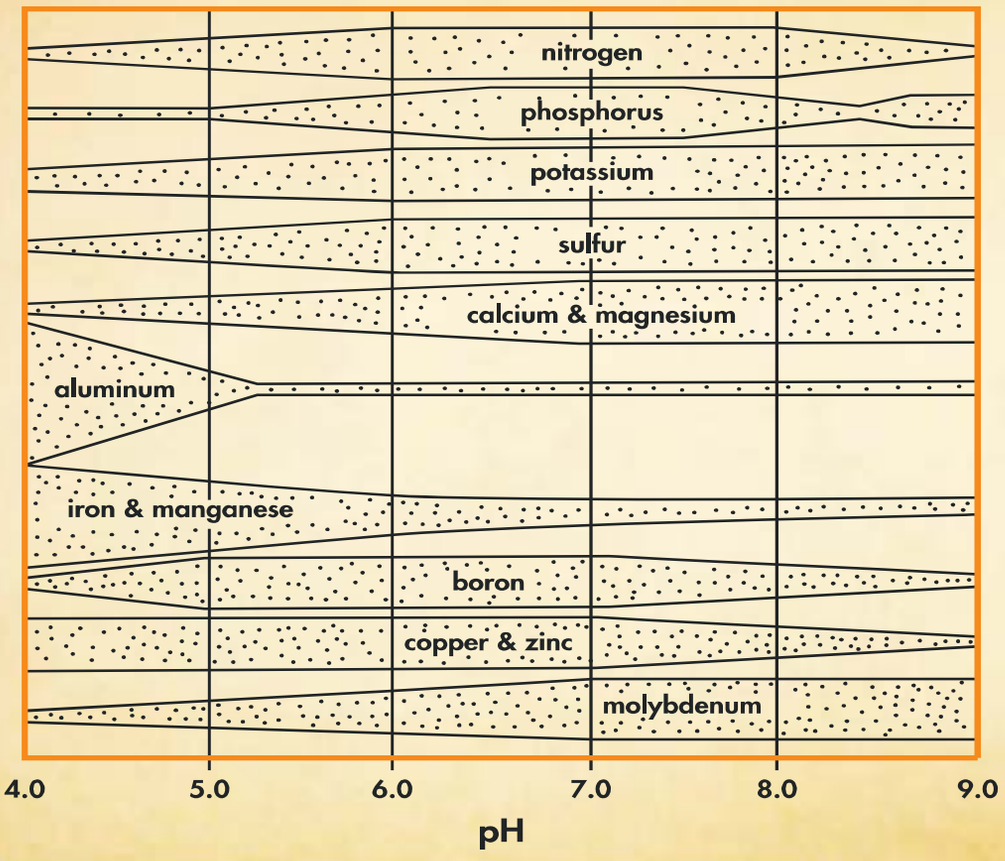


**Figure 1.** Relationship between soil pH and nutrient availability.

essential nutrients. Phosphorus (P) solubility and plant availability, for instance, are controlled by complex soil chemical reactions, which are often pH-dependent. Plant availability of P is generally greatest in the pH range of 5.5 to 6.8. When soil pH falls below 5.8, P reacts with iron and aluminum to produce insoluble iron and aluminum phosphates that are not readily available for plant uptake. At high pH values, phosphorus reacts with calcium to form calcium phosphates that are also relatively insoluble and have low availability to plants.

Liming reduces the solubility and potential toxicity of aluminum and manganese. It also supplies the essential elements of calcium and/or magnesium.

Finally, soil organisms also grow best in near-neutral soil. In general, acidic soil inhibits the growth of most organisms, including many bacteria and earthworms. Thus, acidic soil slows many important activities carried on by soil microbes, including nitrogen fixation, nitrification and organic matter decay.

## Determining lime requirements

The need for — and rate of — limestone applied to any area should be based on a soil-test recommendation. If the soil pH is above the plant's target pH, then no lime is recommended. If needed, a lime application should last two to three years.

Sandy soils generally require less lime at any one application than silt loam or clay soils to decrease soil acidity by a given amount. Sandy soils, however, usually need to be limed more frequently because their buffering capacity is low.

If the pH is well above the ideal range, then sometimes an application of sulfur is recommended to help lower the pH faster; however, most of the time, you can just let the soil pH drop on its own.

## Liming materials and chemical composition

A number of materials are available for liming acid soils. The selection of a liming material should be based on its ability to neutralize soil acidity, chemical composition, fineness of grind, ease of handling and cost.

Limestone is a naturally occurring sedimentary rock that is rich in the minerals calcite or dolomite. Relatively pure deposits of calcite are called "calcitic" limestone, while materials containing more magnesium are called "dolomitic" limestone. In the Mid-Atlantic, dolomitic limestone is widely used as a lime (and magnesium) source.

You can use this information when you select and apply a lime source. For example, if the soil test recommendation indicates that 50 pounds of lime are recommended per 1,000 $ft^2$ (the recommendation is on the basis of pure calcite) and if the lime source available has a CCE of 90 percent, you will need to apply 55.5 pounds of the source (50 pounds per 0.9 = 55.5 pounds) per 1,000 $ft^2$ to achieve the recommended liming rate. Conversely, if dolomitic limestone (with a CCE on the label of 109 percent) is selected, only 46 pounds (50 pounds per 1.09 = 46 pounds) per 1,000 $ft^2$ are required.

## Fineness of grind

Because liming materials have a limited solubility, the rate of reaction is largely determined by the amount of the material's surface area exposed to acid soil. As fineness of the liming material increases, the rate of its reaction increases.

Agricultural lime, which has a wide variety of particle sizes, is particularly cost effective for new establishment sites where it can be incorporated into the seedbed prior to planting. Ag-lime, though, is more difficult to apply because of its non-uniform particle size. Powdered lime provides a rapid response, but it is extremely difficult to handle and apply.

Instead, in turf settings, pelletized lime — finely ground limestone made into pellets by using a binding agent — is commonly used. It is more expensive than powdered lime, but the ease in handling and application makes it a very popular choice. The large pellets retain the quick reaction time of fine particles, without the dust of the powdered form.

Pellets break down when wetted to release the finely ground particles. When applied to bare ground, pelletized lime should be wetted and allowed time for particles to break down prior to tillage or incorporation into the soil. Otherwise, the particles will be in contact with much less of the soil surface and will not be as effective in neutralizing soil acidity.

## Managing lime applications

The general recommendation is to apply no more than 50 pounds of lime per 1,000 $ft^2$ at any one time to established turf (25 pounds per application to golf putting greens). If the soil test suggests more, then the amount should be applied monthly in incremental amounts.

All the beneficial effects of liming occur only where lime and soil are in contact. Liming materials are sparingly soluble and react strongly with the soils with which they come in contact. As a result, lime is relatively immobile in the soil, and surface applications generally affect no more than the top 2" or 3" during a growing season.

For this reason, it is imperative to adjust the pH of soils prior to turf establishment and to incorporate the lime early enough so that neutralization of the acidity has time (two to four weeks for finely ground lime) to take place. Thorough incorporation throughout the rooting zone increases the rate of reaction and treats a larger volume of the soil, maximizing the benefits of lime.

Attempting to change the pH in the deep rooting zone of an established turf is difficult, at best. When applied only to the soil surface (i.e., not tilled into the soil), lime is slow to react, and it affects only a fraction of an inch of soil per year. One method of getting lime somewhat deeper in established turf areas is to apply lime in conjunction with core aeration events. Applying lime in the fall and winter months is also possible because the potential for leaf burn is very low, and the freezing and thawing of the soil aid in mixing lime throughout the rootzone.

## Over-liming

Again, lime application should be based on soil tests to ensure that excessive lime is not added. When no information on the soil sample information sheet is provided regarding the last lime application, the lab assumes that you have not applied lime in the past 18 months. Do not overlime! Too much lime can be as harmful as too little. Over-liming dramatically reduces the availability of micronutrients and can result in deficiencies that are very difficult to correct.

While a good liming program usually provides adequate levels of calcium and magnesium, there are times when lime is not recommended but additional calcium and/or magnesium are required. Sources such as gypsum (calcium sulfate), magnesium sulfate and potassium-magnesium sulfate should be used in this instance to supply needed nutrients without the addition of pH-increasing lime.