Liming Acid Soils

Why is liming an acid soil important?

Nutrient availability and biologic activity in the soil can both be affected by pH, especially at levels too far removed from neutral. Nutrient availability is affected by the pH of the soil in two ways. Clay and organic matter carry negative charges. Positively charged particles, called cations (kat-I-ons) are attracted to and held by, the negatively charged sites on the clay and organic matter particles. These nutrients are taken up by plants when the plant roots encounter the nutrient and exchange one or more hydrogen ions (H^+) for it.

There are a finite number of cation exchange sites in a given soil. This can be measured in the laboratory and is reported on some laboratory reports as the cation exchange capacity (CEC) of the soil. As the cation exchange sites get filled up with hydrogen ions, fewer sites can be occupied by the cations needed for the metabolic processes in the plant. The essential plant nutrients held as cations in the soil include: Nitrogen in the ammonium form (NH_4^+), Potassium (K^+), Magnesium (Mg^{2+}), Calcium (Ca^{2+}), Copper (Cu^+ and Cu^{2+}), Zinc (Zn^{2+}), Manganese (Mn^{2+}) and Iron (Fe^{2+} and Fe^{3+}).

Soil chemistry is a dynamic process. Various compounds constantly form and dissociate and only a fraction of the total quantity of a nutrient present in the soil will exist in a plant available form at any one time. One of the factors affecting the availability of many nutrients, is pH. A pH of 6.0 to 7.0 is ideal because in that range the major plant nutrients are most available for use by plants. Phosphorus, Potassium, Calcium, Sulfur, Molybdenum and Boron are all more available to plants in this range than at lower pH values. When pH drops below 6.0, the availability of many of these nutrients is reduced and the lower the pH value below 6.0, the less available they become.

Conversely, at very low pH values (below 5.2), aluminum enters the exchangeable ion complex. Aluminum is toxic to plants and further depresses yields if pH is allowed to get this low.

Besides the effect that pH has on the purely chemical processes in the soil, pH also affects the microbiological processes. Bacteria in the soil are more active between pH 6.0 and 7.0, thus mineralization of organic matter is better (increasing the availability of nitrogen and other nutrients such as phosphorus, sulfur and other nutrients). Also, the bacteria associated with nodule formation and nitrogen fixation by legumes function better in the 6.0-7.0 pH range.

As a rule, it is best to maintain the soil pH at values above 6.0. A pH of 6.5 is considered ideal for agricultural crops. It usually takes several years for lime to fully react in the soil and for that reason, liming should be considered an eight-year investment. Remember also, the same things that made the soil acidic in the first place, are going to continue to occur, requiring periodic applications of lime in the future.

Do you have to apply the recommended amount of lime?

University of Nebraska lime recommendations are for the amount of lime required to bring the top seven inches of soil up to a pH of 6.5. Less lime will not bring the level up as much nor maintain it at the higher level as long. An analogy would be the decision to fill the gas tank on the pickup which might take $35 or only to put $10 worth of gas in the tank. Both will help you get down the road, but you won't go as far on $10. Basically, there is no way around the laws of chemistry. It takes a given amount of calcium carbonate equivalent to neutralize the active and reserve acidity in the soil and bring the measured pH up to an acceptable level.

Are there differences in lime quality or effectiveness?

There can be differences in lime quality due to the chemistry of the product used and the particle size. The ag lime mined in eastern Nebraska is a mixture of mostly calcium carbonate with some magnesium carbonate plus impurities. Both calcium carbonate and magnesium carbonate are effective in neutralizing pH and both Calcium and Magnesium are essential plant nutrients.

Limestone is not very water soluble and needs to have a small particle size to dissolve into the soil solution quickly enough to be considered effective. Limestone held on an eight-mesh screen (the size of gravel) is less than 10 percent effective, whereas that passing an eight-mesh screen and held on a 60-mesh screen (like course to fine sand) is about 40 percent effective, and that passing through a 60-mesh screen (like gritty flour) is 100 percent effective.

Lime is tested in the laboratory and the acid neutralizing effectiveness is expressed as Calcium Carbonate Equivalent (CCE). Lime suppliers in Nebraska must register with the State Department of Ag and the minimum CCE value must be specified. Most ag lime in Nebraska runs between 60-65 percent CCE. The University of Nebraska lime recommendations assume ag lime with a CCE of 60 percent will be used to correct low soil pH. When interpreting lime recommendations from other soil laboratories, check to see whether the recommendation is stated as pounds of ag lime or pounds of CCE equivalent. A recommendation of 4,800 pounds per acre of CCE lime is equal to a UNL recommendation of 8,000 pounds per acre of 60 percent CCE ag lime.

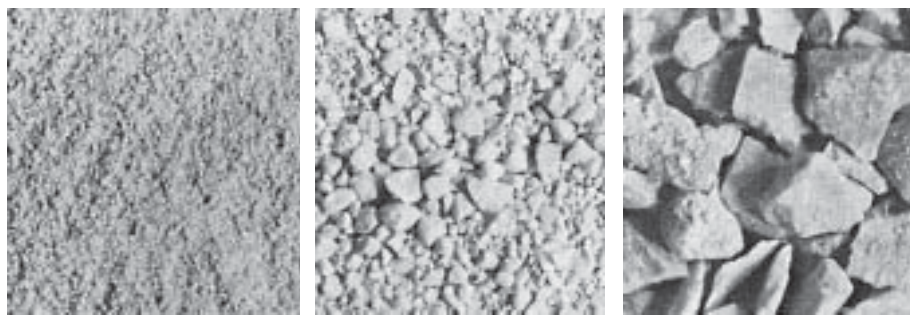
As discussed above, up to a certain limit, smaller particle sizes are more effective in neutralizing acidity in the soil. There is a practical lower limit to particle size when spreading lime using traditional broadcast methods because lime that is ground too fine, would blow away (like smoke) before hitting the ground. Manufacturers overcome this problem by pressing the finely ground limestone into pellets. "Pell" lime, as it is called, is easy to apply because it has a uniform particle size, is easily handled and the large particle size does not drift in the wind like a powdered product. Once the pellet is in or on the soil and is wetted, it sloughs (melts) and the fine particles disburse and react in the soil. Another method for applying very finely ground lime is to mix it with water and apply it as "liquid" lime.

Many tenants, especially those with short-term leases, prefer to use "pell" or "liquid" lime products because the extremely fine particles react quickly in the soil, providing first year results. Due to higher manufacturing costs, the cost per pound of CCE is considerably higher than ag lime. These products do provide flexibility in application methods which may partially overcome the cost disadvantage. Annual applications of relatively small quantities of these products are often recommended as an alternative to periodically spreading ag lime which costs more up-front but lasts several years.

For more information:
- *"Estimating Ag Lime Quality" (NebGuide, G84-714)*
- *"Soils Home Study Course" (University of Nebraska, EC98-152)*
- *"Liming Acid Soils" (Kansas State University, MF-1065)*

Smaller Ag Lime Particle Sizes Are More Effective

The fineness of ground limestone is determined by passing a sample through a set of screens or sieves. Usually, the following three screens are used:



Lime that passes through a 60-mesh screen is 100% effective.

Lime held a 60-mesh screen is 40% effective

Lime held on an 8-mesh screen is less than 10% effective.

Animal Science Youth Field Day April 2

An Animal Science Youth Field Day sponsored by UNL Cooperative Extension will be held Saturday, April 2, 9 a.m.–4:30 p.m. on UNL East Campus at the Animal Science Complex. All high school youth ages are invited to participate — no cost to attend. Fun activities will increase your science-based knowledge of animals. Pre-registration not required, but requested — call Deanna at 441-7180.

University of Nebraska Lincoln
Pioneering new frontiers.

Nebraska Agricultural Youth Institute Applications Due April 15

High school juniors and seniors are invited to take part in the Nebraska Agricultural Youth Institute (NAYI) which will be held July 10–14. The NAYI is to help build leadership skills, explore new aspects of agriculture and encourage young people to become more involved with and remain in agriculture. The Institute takes place at the University of Nebraska-Lincoln. All meals, lodging and activities are sponsored by the Nebraska Department of Agriculture. The only expense for students is transportation to and from the Institute. Applications are due April 15. If interested, contact extension at 441-7180 for an application.