Livestock Newsletter

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Soil Acidity and Liming: Basic Information for Farmers and Gardeners

Situation in North Carolina

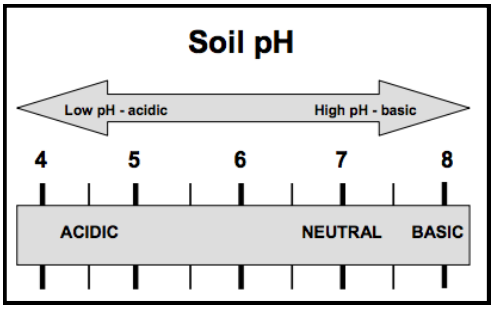
Nearly all North Carolina soils are naturally acidic and need lime, which neutralizes the acidity, for optimum growth of crops, forages, turf, trees, and many ornamentals. Even though most of these soils have been limed in the past, periodic additions of lime based on soil tests are still needed. Soil test summaries and field records compiled by the North Carolina Department of Agriculture & Consumer Services (NCDA&CS) emphasize that poor management of soil pH accounts for a high percentage of the crop problems in North Carolina.

Nature and Cause of Soil Acidity

Soil acidity is the term used to express the quantity of hydrogen and aluminum cations (positively charged ions) in soils. When the levels of hydrogen or aluminum become too high and the soil becomes too acidic, the soil's negatively charged cation exchange capacity (CEC) becomes "clogged" with the positively charged hydrogen and aluminum pushing the nutrients needed for plant growth out. This is why root growth and plant development suffer when soils become too acidic.

Over time, soils also become acidic because calcium and magnesium leach out, because hydrogen is added to soils by decomposition of plant residues and organic matter, or because nitrification of ammonium occurs when fertilizer, manure, or plant residues are added to the soil. Lime will neutralize this acidity by dissolving and releasing a base into the soil solution that reacts with the acidic components.

Soil pH is an indicator of soil acidity. A pH of 7.0 is defined as neutral. Values below 7.0 are acidic and values above 7.0 are basic or alkaline. Small changes in numbers indicate large changes in soil acidity. A soil with a pH of 5 is 10 times more acidic than a soil with a pH of 6 and 100 times more acidic than a soil with a pH of 7. Most plants can grow in slightly acidic soils, so the goal of liming is not to raise the pH to neutral (7.0), but to avoid crop problems related to excessive acidity.



Proper liming provides a number of benefits:

- Plants develop healthier roots because they are exposed to less potentially toxic aluminum. Better root growth may enhance drought tolerance.
- Lime is a source of calcium (as well as magnesium, if dolomitic limestone is applied).
- Nutrient solubility is improved by a higher pH, so plants have a better nutrient supply. (The optimum pH for most crops is 5.8 to 6.2 when grown on mineral soils in North Carolina).
- Increased soil CEC occurs, as well as reduced leaching of basic cations, particularly potassium.
- Nodulation of legumes is enhanced, which improves nitrogen fixation.
- Triazine herbicides, such as atrazine and simazine, work better.
- Optimal pH allows the breakdown of some herbicides, preventing damage to rotational crops.
- Some nematicides work better.

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Table 1. Target pH for a variety of North Carolina plants when produced on mineral soils*.

Plant group	Target pH	Species
Field crops	6.0	Corn, millet, small grains, sorghum, soybeans, tobacco
	6.2	Cotton
Forage grasses	6.0	Fescue, orchardgrass, timothy (maintenance), bahiagrass, bluegrass, sudangrass
	6.5	Fescue, orchardgrass, timothy (establishment), bermuda
Forage legumes	6.0	Crimson and white clover, lespedeza
	6.5	Alfalfa, ladino, red clover

Lime Form

The most commonly used liming material in North Carolina is finely ground dolomitic rock, but calcitic lime is also widely used. Additional liming materials include burnt lime or hydrated lime, pelleted lime, liquid lime, wood ash, and industrial slags. North Carolina has few good natural lime sources. Calcitic marl liming materials (soft marine shell deposits) are available in the coastal plain, but there are no dolomitic lime deposits in the east. Dolomitic lime is commonly obtained from the mountains of Virginia or Tennessee.

Most agricultural lime is sold in bulk as a damp powder because dry lime is very dusty and difficult to handle and spread. However, lime is occasionally excessively wet. Because lime is sold by the ton, you should be aware you may be purchasing a substantial amount of water. You should adjust lime rates accordingly. Lime pellets are not large grains of solid limestone; they are formed from lime that has been finely ground. Pellets are less dusty and easier to spread, but they are more expensive than powdered lime. Pelleted lime comes into contact with fewer soil particles than finely ground lime. As a result, soil pH changes are slower with the pellets. Soil reaction will be enhanced if the soil can be tilled several days after the pellets have been mixed into the soil and become soft. Pelleted lime is convenient for landscape use, but is not an economical source for most field crops.

Lime is sometimes sold as a suspension, often called liquid lime. It consists of fine lime particles mixed with water and a suspending clay. All the lime particles must be 100-mesh or finer. Up to 1,000 pounds of lime can be suspended in a ton of liquid product. The main advantages are ease of handling and precise application. Although it is a fluid, this material does not react any faster than dry lime of the same particle size. All of the lime in a suspension is fast acting, and a ton of product (1,000 pounds of fine lime particles plus clay and water) will raise the pH as fast as a ton of dry lime. However, due to particle size and enhanced initial reactivity, the effectiveness is short lived, compared to regular agricultural limestone, and liming will probably have to be repeated every year. Suspensions may also raise soil pH slightly above the target pH, and they are a considerably more expensive way to correct soil acidity.

Occasionally, industrial byproduct liming materials become available. If the neutralizing value is known and the material is ground finely enough to react in the soil, these can be economical substitutes. Often such materials contain other plant nutrients. Wood ash and steel mill slag are two examples of such products. These products must meet the legal standards above to be sold as liming materials in North Carolina. Even if they do not meet all of the standards, they can be sold as fertilizer and may still be capable of reducing soil acidity and supplying a variety of nutrients. If a product does not meet all the specifications of the lime law, the supplier is barred from making claims about liming effectiveness, and the purchaser must have the material tested. Each lot of such materials should be analyzed, as considerable variation in CCE and fineness may occur. As with conventional lime, the ENV needs to be known in order to determine the appropriate application rate.

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Sincerely,

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