Nova Scotia Agricultural College

Soil & Crop Improvement Association of Nova Scotia

fact sheet

Liming Pastures

Soil pH is a measure of the acidity or alkalinity of soil. Soil acidity is caused by the presence of hydrogen (H^+) ions in the soil. As the presence of H^+ ions increases, the soil becomes more acidic.

A pH of 7.0 is neutral. A pH of 6.0 is slightly acidic. A 1-unit change in pH results from a 10-fold change in acidity. Compared to a soil with a pH of 6.0, a soil with a pH of 5.0 is 10 times more acidic and a soil with a pH of 4.0 is 100 times more acidic.

The parent material of soil in Atlantic Canada has very little neutralizing capability; therefore, the soil is naturally acidic, and often has a pH less than 6.0.

How do soils become acidic?

Clay particles and organic matter in the soil have a negative charge; therefore, the soil can attract and hold positively charged ions (cations). Both acidic and alkaline cations may be held by the soil, but some are more strongly held than others.

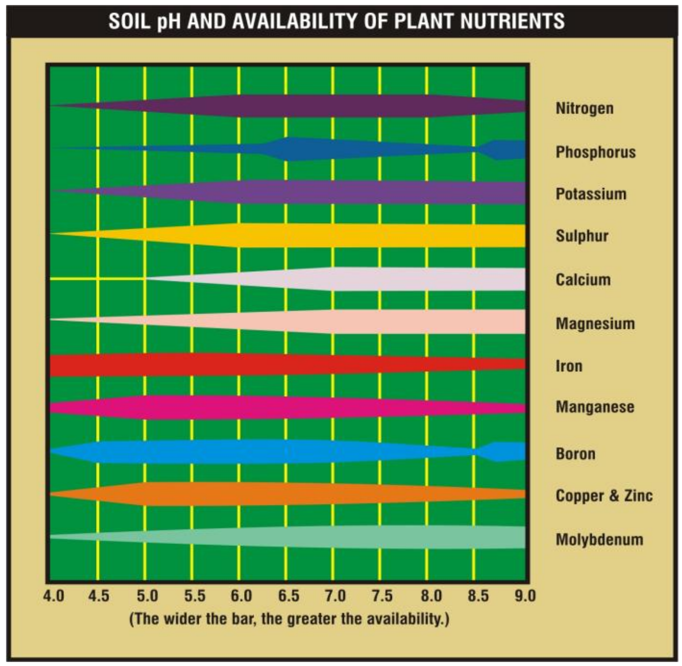
Calcium (Ca^{2+}), magnesium (Mg^{2+}), sodium (Na^+), and potassium (K^+) are alkaline cations that neutralize acidity. H^+ is an acidic cation that contributes to acidity and is also more strongly held by the soil than the alkaline cations. With rainfall, the alkaline cations may be leached from the soil, leaving behind the more strongly held H^+. The loss of alkaline cations and the accumulation of H^+ increases the acidity of the soil and decreases the soil's fertility.

Other sources of soil acidity are the acids that are produced by decomposing organic matter, the use of ammonium based nitrogen fertilizers, and acid rain.

Why is the pH of pasture soil important?

Soil acidity influences the productivity of pastures. The control of soil acidity should be incorporated into pasture management for the following reasons:

1) Nutrient availability. Below a pH of 5.5, the macronutrients nitrogen, phosphorous, potassium, sulphur, calcium, and magnesium are less available to plants. At the same time, the micronutrients iron, manganese, copper, and zinc become more plant available, and can increase to toxic concentrations.



2) Phosphorous fixation. Soil phosphorous can form compounds with iron and aluminium at pH levels below 6.0, and with calcium at pH levels above 7.0. These compounds make the phosphorous unavailable for plant uptake. Phosphorous is most available between a pH of 6.0 and 7.0.

3) Aluminium and Manganese toxicity. Below pH 6.0, aluminium and manganese are more available for plant uptake and can increase to concentrations toxic to plants.

4) Fertilizer use efficiency. Fertilizer use is less efficient in acidic soil. At pH 6.0, fertilizer use efficiency is 80%, but at pH 5.0, it is less than 50%.

5) Plant sensitivity. Many species are sensitive to acidic conditions and are most productive at a pH between 6.0 and 7.0.

6) Weed tolerance. Some weed species can tolerate acidity. Acidic soil conditions could result in an increased presence of weeds in the pasture.

7) Activity of micro-organisms. Many of the micro-organisms involved in nutrient cycling in the soil cannot tolerate acidic conditions. The natural supply of nutrients may be inhibited in acidic soil.

Reducing soil acidity

Applying lime reduces the acidity of the soil. There are two forms of acidity that must be neutralized to raise soil pH: active and reserve acidity. Active acidity is the measure of H^+ cations in the soil solution. Reserve acidity is the measure of H^+ cations held by clay particles and organic matter. Due to higher reserve acidity, a soil with high clay and/or organic matter will need more lime to neutralize soil acidity than a sandy soil.

Liming materials differ in their ability to neutralize acidity depending on the chemical composition, neutralizing value (a measure of impurities), and fineness of grind of the material. A finer ground material has more surface area in contact with the soil and will be faster acting.

The limestone used in agriculture is typically calcitic (calcium carbonate) or dolomitic (calcium magnesium carbonate). As well as increasing soil pH, calcitic lime adds calcium to the soil, and dolomitic lime adds magnesium and calcium. When the magnesium content of the soil is low relative to the calcium content, dolomitic limestone should be used.

Demonstration Results

On farm demonstration of the surface application of lime to pastures to reduce soil acidity showed, in all cases, the final soil pH was higher than the initial soil pH. In some cases the changes were dramatic, with increases from pH 5.0 up to 6.0 and from pH 5.3 up to 6.0 in the year of lime application.

Often it takes several years for forage yields to respond to lime application. Even so, at one demonstration site, a 20% higher yield was observed in the first year after lime application, relative to areas of the pasture where lime was not applied. At another site, a 30% higher yield was observed in the same year of lime application. Further monitoring of the other demonstration sites is expected to produce similar results.

Applying lime to your pasture

- Always apply lime based on a soil test.
- Lime is slow acting. Ideally, lime is applied in the fall prior to the growing season, but lime applied in the spring will still have some benefit.
- Pastures have unbroken sod cover; do not apply more than 5 tonnes/ha (2 tonnes/acre) of lime a year to unbroken sod.
- More frequent light applications of lime are better than one heavy application.
- Applications should be spread over several years if there is a high lime requirement.
- Lime applications equivalent to 0.5 tonnes/ha per year will be required to maintain a desired pH.
- Use dolomitic limestone if soil magnesium is deficient.

Additional Resources

Atlantic Soils Need Lime (Advisory Committee on Soil Fertility) and the *Atlantic Forage Guide* (Forage and Corn Variety Evaluation Task Group).

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