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Liming Acidic Soils to Improve Soil and Crop Productivity

By Dr. Tarlok Singh Sahota CCA-ON

Soil pH and nutrient availability: Soils below pH 7.0 (neutral) are acidic and above 7.0 are alkaline. For practical purposes soils, with a pH range of 6.5-7.5 are considered neutral. When the soil pH goes below 6.2, growth and productivity of crops such as alfalfa is restricted. If it goes down further to 5.5 or below, the growth and productivity of most field crops is severely curtailed. Why? Because, availability of major essential plant nutrients and also zinc is maximum in the pH range of 6.5-7.5. In this range there is no toxicity of nutrients such as aluminium and manganese that (coupled with phosphorus deficiency) could severely restrict root growth. Microbial activity also is minimized at soil pH of 5.5. However, availability of iron, manganese and boron is higher in acidic soils and that of molybdenum (required by legumes more than by cereals) is lower in alkaline soils than in neutral soils.

Why apply lime and which source?

Unless pH of acidic soils is raised by applying lime, applied nutrients, especially phosphorus (important for root growth), will be rendered unavailable in the soil (known as fixation of nutrients). As well, oxides of aluminium, iron and manganese will react with phosphate to make compounds that aren't water soluble (e.g. aluminium phosphate). Therefore, application of liming materials that contain calcium (Ca) and/or magnesium (Mg) capable of neutralizing soil acidity are required to correct soil acidity.

Suitable materials include calcitic and dolomitic limestone, burned lime, slaked lime, marl, shells, and by-products such as sugar beet lime, and sludge from water treatment plants. However, calcitic (calcium carbonate) and dolomitic limestone (magnesium carbonate) are the most effective and more commonly used materials.

Based on the buffer pH, soil labs will recommend rates of lime application. The effectiveness of a liming material, also known as the Agricultural Index, will depend upon its neutralizing value and particle size; which is the neutralizing value X fineness rating divided by 100. The finer the liming material, the more reactive it is in soils and the higher Agricultural Index it has! An Agricultural Index of 75 is usually considered a standard in Ontario.

The rate of application of liming material will be modified by its Agricultural Index. Supposing the lab recommends lime application @ 4 MT/ha and

the Agricultural Index of the liming material you get is only 37.5 % (instead of 75 %), you will be required to apply it @ 8 MT/ha (instead of 4 MT/ha) to compensate for the lower Agricultural Index of the liming material. And, if the Agricultural Index of the liming material is 90 %, you will lower the rate of lime application from 4 MT/ha to 3.33 MT/ha. To know how to calculate Agricultural Index, visit <https://www.extension.umn.edu/agriculture/nutrient-management/nutrient-lime-guidelines/liming-materials-for-minnesota-soils/>.

Where to source lime? Check with your ag retailer or CCA in your area.

When and how to apply lime? Lime should be applied at least one cropping season ahead. Fall or late summer, as soon as you are free from combining/harvesting spring crops, could be ideal for lime application. A lime spreader can be used to uniformly apply lime over the soil surface. It needs to be worked in well by disking and cultivating. If you are a no tiller, this tillage to incorporate lime in the soil is critical. The more volume of soil that comes in contact with the lime, the better it is for the reaction of lime to raise the soil pH. Divide your farm into four sections and every year at least one section should get lime. After four years, start all over again if the soil pH demands lime application.

A long-term experiment on soil liming was conducted at TBARS Thunder Bay on soil with a starting pH of 5.9, which wasn't too acidic.

- Lime was applied every two to four years to raise the soil pH from 5.9 to 6.7-7.0.
- Liming didn't improve the soil organic matter.
- Available P, Ca, and Mn appeared to improve and all other nutrients (except copper) declined, though the decline was higher in aluminium and iron contents.
- Average per year increase in crop yields with liming, over a three-year crop cycle, was 540 kg/ha in alfalfa, 335 kg/ha barley grain, 235 kg/ha barley straw and only ~120 kg soybean grains/ha. All crops were grown with recommended rates of NPK application.

The lower the soil pH, the higher will be the benefit from lime application! I have seen fields with such low pH that the crop roots wouldn't grow more than two inches leading to very poor crop growth. It is therefore advisable to apply lime to acidic soils!

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This industry driven program helps ensure that Ontario crop producers are well served by those providing their crop production advice. This article was written by one of those CCA's.