

Liming acidic soils to improve soil and crop productivity

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Soil pH and nutrient availability: Soils below pH 7.0 (neutral) are considered acidic and above 7.0 are considered alkaline. However, 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 at which there is no toxicity of nutrients such as aluminium and manganese that (coupled with phosphorus deficiency) could severely restrict root growth. Microbial activity too is minimized at soil pH of 5.5. However, availability of iron, manganese and boron is more in the acidic soils and that of molybdenum (required by legumes more than by cereals) is more in the alkaline soils than in the neutral soils.

Why to apply lime and from which source? Unless pH of acidic soils is raised by application of liming materials, applied nutrients, especially phosphorus (important for root growth), will be rendered unavailable in the soil (known as fixation of nutrients); oxides of aluminium, iron and manganese will react with phosphate to make compounds that aren't water soluble (e.g. aluminium phosphate). Thunder Bay farmers were fortunate to have wood ash delivered free of charge on farms nearly a decade ago by Resolute Forest (then BoWater), but not anymore. Therefore application of liming materials that contain calcium (Ca) and/or magnesium (Mg) compounds capable of neutralizing soil acidity; such as calcitic and dolomitic limestone, burned lime, slaked lime, marl, shells, and by-products such as sugar beet lime, and sludge from water treatment plants is the only option to correct soil acidity. However, calcitic (calcium carbonate) and dolomitic limestone (magnesium carbonate) are most effective and more commonly used materials. In case of magnesium deficiency in soils, dolomitic limestone should be preferred to calcitic lime stone. Based on the buffer pH, Soil labs will recommend rates of lime application. The effectiveness of a liming material, also known as Agricultural Index, will depend upon its neutralizing value and particle size; which is = neutralizing value X fineness rating divided by 100. The finer the liming material more reactive it is in soils and higher Agricultural Index it has! An Agricultural Index of 75 is 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.

From where to source lime? The following contacts may be helpful:

Graymont Inc., Superior Wisconsin, Terry Spooner: 715 394-1714

Dave Evans Transport, Superior Wisconsin, Bob or Julio: 715 718-2711

Cole International, Thunder Bay customs broker, Helen Rossi: 807 624-2124

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. Lime spreader could be used to uniformly apply lime over the soil surface and it needs to be worked in the soil well by disking and cultivation; more the volume of soil comes in contact with lime, better it is for 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.

Findings from a long term experiment on soil liming at TBARS (with a starting pH of 5.9, which wasn't too acidic!) were:

- Application of lime every 2-4 years was required 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, and
- Average per year increase in crop yields with liming 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.

Lower the soil pH, higher will be the benefit from lime application! I have seen fields with low pH in our area to the extent 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!

Published in Northwest Link, September 2017, Pages 3-5, Ontario Farmer, October 3, 2017, Page B18 and also at [http://tbfarminfo.org/liming-acidic-soils-to-improve-soil-and-crop-productivity/!](http://tbfarminfo.org/liming-acidic-soils-to-improve-soil-and-crop-productivity/)