

LIMING ACID SOILS

*John M. Zak
Department of Plant & Soil Sciences
University of Massachusetts*

In order to keep down the production cost of farm crops, the farmer has to produce maximum yields. This brings into play the use of lime, fertilizer, equipment, hybrids or varieties, pest control and other factors.

Soils in New England are acidic. They are mostly formed from granite which is classified as an acidic rock. Leaching of basic elements (calcium, magnesium, potassium, and sodium) from the soil by percolating water also occurs in this area where we have about 40 inches of rainfall per year. The clay and organic colloids instead of being saturated with Ca^{++} and Mg^{++} ions now have a high percentage of H^+ and Al^{+++} ions. These soils become very acid. The Al^{+++} ions can also be toxic to plants in very acid soils. The constant use of commercial fertilizer also contributes to soil acidity. Thus a good liming program is a must for high productivity of crops in New England.

Dr. John Baker (UMass) found from an analysis of fourteen soils in Massachusetts that had a pH of less than 5.0 the following:

1. Seven of the fourteen soils had less than 200 lbs of calcium per acre.
2. Ten of the fourteen soils had less than 300 lbs of calcium per acre.
(soil test for Ca - low).

Lack of calcium in the soil can contribute to poor plant growth. The use of fertilizer in soils low in calcium can further contribute to a deficiency of calcium within the plant. Scientists have found that the accumulation of Ca by plants depends upon the ratio of Ca^{++} ions to other cations if K^+ , Mg^{++} and NH_4^+ in the soils. Since many soils in Massachusetts are acidic and coarse textured it is essential to apply the amounts of limestone per acre as recommended by the 'Lime Required Test'. Coarse soils generally contain low amounts of calcium. Listed below are the benefits derived from liming acid soils:

- (1) Corrects soil acidity and makes plant food elements more available.
- (2) Supplies calcium and magnesium to plants.
- (3) Hastens decay of organic matter and release of minerals tied up in the O.M. This is very important for nitrification and nitrogen available for plants.
- (4) Increases the availability of residual and applied phosphates.
- (5) Increases fixation of nitrogen by legume plants and soil organisms.
- (6) Increases crop yields.
- (7) Improves the physical condition of the soil.
- (8) Reduces the activity of injurious substances in the soil. Aluminum and manganese toxicity reduced.

Deficiency of lime in a soil is seldom seen in plants. However, under controlled experiments it shows up as short roots that turn black and die. Also, the growing points of new growth die and the leaves become wrinkled.

Two forms of limestone are available in Massachusetts. The calcic form (CaCO_3) is more soluble and brings about a faster pH change than does dolomitic ($\text{CaMg}(\text{CO}_3)_2$) limestone which contains a high percentage of magnesium. Where dolomitic limestone has been used continuously over a period of years and the magnesium content of the soil is very high, calcic limestone should be used. Where soil tests show a low test of magnesium then dolomitic limestone is preferable. Calcic limestone with 7-10% magnesium will also supply a good amount of magnesium when applied in ton lots to a soil.

Limestone can be applied any time of the year on soils to change the soil pH. It is best to thoroughly mix it into the soil to accomplish a uniform pH change of the soil solution. Where large amounts of limestone are applied (2 tons or more), a split application (before and after plowing) brings about a more uniform pH change in the topsoil. Thorough mixing of limestone in a very acid soil to bring about a pH change is a problem. Grassland areas should be limed in the fall or early spring of the year to get the lime leached into the soil. Lime-loving plants like alfalfa should be limed and the pH raised to 6.5 or 7.0 before seeding for best results in the establishment of this legume.

It should be noted that the 'Lime Requirement' of a soil is based on an acre furrow slice which means an acre of soil $6\frac{2}{3}$ inches deep. If you are plowing your soil 9 inches deep you are going to need more limestone to bring about a desirable pH of the soil.

EVALUATION OF LIMING MATERIALS

Stephen J. Herbert & William A. Rosenau
Department of Plant & Soil Sciences
University of Massachusetts

Tests are currently being conducted on behalf of the Pfizer Chemical Company to determine the agricultural merit of a kiln dust product that was previously a waste material. Similar to conventional agricultural limestone, the product is primarily calcium carbonate and calcium oxide. It is currently under test by the Department of Plant & Soil Sciences at the University of Massachusetts.

Experiments are underway using corn, alfalfa, winter rye, and turf, and are intended to determine its effects on soil acidity and plant growth. Initial results have been positive for the use of the kiln dust in agriculture.