

Extension Folder 656—1982

MANAGEMENT OF CROPS AND SOILS  
IN NORTH CENTRAL  
AND NORTHEASTERN MINNESOTA  
CORRESPONDENCE COURSE

# Unit 2—Soil Acidity and the Importance of Liming

## Purposes

- Understand the importance of liming in your crop rotation and under your soil conditions.
- Understand the long- and short-term benefits of properly liming your soils.
- Understand the potential cost effectiveness of using lime on your fields with special reference to the crop, the soil, and ACP cost sharing.



## UNDERSTANDING SOIL pH

ST. PAUL CAMPUS

Soil pH is a numerical means of describing the degree of acidity in soils. The lower the number, the more acidity there is in a soil. If the pH of your soil is 7.0, you have a neutral soil (no acidity). If it is 6.0, your soils are slightly acid; if it is 5.0, your soils are quite acid. Most of the mineral soils in north central and northeastern Minnesota have a slightly acid to acid soil pH. Most of the soils in the western part of Minnesota have pH values greater than 7.0. These soils are described as alkaline.

## UNDERSTANDING WHY SOILS ARE ACID OR BECOME ACID WITH TIME

In general, soils are acid or become acid for the following reasons:

- The parent material on which the soils were originally formed was acid.
- Over the centuries, rainfall has leached the limy materials down into the subsoils, leaving fields more acid.
- Crops remove basic materials from the soil, leaving them more acid.
- Some fertilizers (especially nitrogen fertilizers) form acid in soils.
- Decomposition of organic materials such as crop residues and manure releases organic acids and other acid-forming substances that can make soils more acid.

You should have a soil test run to determine what the pH of your soil is. The pH numbering system used as part of the soil test will also tell you how acid your fields are.

## WHAT CAN BE DONE TO OVERCOME SOIL ACIDITY?

The only way to overcome soil acidity is to add lime. Agricultural lime is a calcium or calcium and magnesium containing material that neutralizes soil acidity. It is important to remember, however, that most calcium and magnesium materials are not liming materials. Gypsum, for example, is a calcium sulfate material that does not correct for soil acidity and is therefore not a liming material. A liming material must neutralize soil acidity.

The amount of liming material you need to add to your fields to overcome soil acidity will depend on:

- How acid your soils are. The more acid the soil, the more lime you must apply.
- What the texture of your soil is. Coarse textured (sandy) soils generally require less lime to correct soil acidity than do fine textured (clayey) soils. There have been instances in north central and northeastern Minnesota in which increased alfalfa production has not been realized when acid, fine textured soils have been limed. This is usually because only the plow layer is acid. Because of the relatively poor drainage of these fine textured soils, the soil right under the plow layer is limy, so no additional benefits come from adding lime. If you think you have this situation and do not know whether to lime, have your

subsoil tested. Samples should be taken from at least one foot below the surface and not farther than two feet. Soil pH in these samples will be 6.5 or higher if this condition exists.

- Which crops you are growing. If you have alfalfa in your crop rotation, you must add enough lime to reach a pH of 6.5 for best alfalfa yields. Alfalfa simply will not yield well at lower pH values. If your crop rotation does not include alfalfa, you do not have to add lime if the pH of your soil is 5.7 or above. There are some cases in which an acid soil pH is desirable. If you are growing potatoes, for example, high soil acidity helps control the potato scab organisms.

In any liming program, you need to know whether you need to lime and, if you do, how much you should apply. To ensure the best possible lime recommendation, be sure to fill in your soil sample information sheet completely. A good lime recommendation is possible only if the laboratory knows your cropping system. Soil category (see Unit 1 of this course) and soil pH are determined in the laboratory from the soil sample you submit.

## BENEFITS OF LIMING

If your soils are acid, liming will:

- Promote the growth of favorable microorganisms that aid in the decay or breakdown of crop residues and other organic materials such as manure and decomposable soil organic matter. This decomposition of organic materials releases plant nutrients (food) in forms that are available to plants.
- Make soil phosphorus and added fertilizer phosphorus more available to your crop. Generally, phosphorus is most available to plants in a soil pH range of 5.7 to 7.0.
- Promote the growth of the bacteria that produce nodules on alfalfa and supply the plant with nitrogen from the atmosphere. These bacteria are pH sensitive and grow best when soil pH is 6.5 or higher.
- Furnish calcium and magnesium (plant nutrients) to the crop you are growing. In north central and northeastern Minnesota, magnesium levels may be low, especially if you are growing corn or alfalfa, which have relatively high requirements for this nutrient.
- Promote best growth of your crop, which makes it less susceptible to damage by disease and insects.
- Overcome or neutralize the acidifying effects of commercial fertilizers (especially nitrogen fertilizers) and manure you are adding to your soil.

## COST EFFECTIVENESS OF LIMING

If you wish to establish a longer lasting, higher yielding legume such as alfalfa or sweet clover, liming is a necessity on most north central and northeastern Minnesota soils. Liming is the difference between being able to establish and maintain these crops and changing to more acid-tolerant crops such as red clover or grasses. The cost of lime must be estimated over the length of the entire

rotation rather than for only the first year of establishment.

In comparing alfalfa and red clover yields, University research has shown that alfalfa generally will outyield red clover by about 1.2 tons per acre the first two years after planting and by more than 2.3 tons per acre in the third and fourth years. The increased yield for four years will be about 7 tons per acre more for alfalfa. In estimating the increased returns over and above the cost of liming, you should consider not only this higher yield but also the potential of having the alfalfa stand last for at least six years.

## TYPES OF LIME TO APPLY

There are several types of liming materials available in north central and northeastern Minnesota. These include:

- **Marl**, which is composed mainly of calcium carbonate (the liming material) and varying amounts of silt, clay, and organic matter. Most marl deposits are in northern Minnesota. Some problems with drying and getting an even spread on the field are associated with the use of marl. In north central and northeastern Minnesota, the cost per ton is competitive with other liming materials because transportation costs are lower.
- **Liquid lime**, a liming material that has had water added to it so it can be applied as a liquid. One of the problems associated with liquid lime is getting enough applied to effectively neutralize soil acidity for best crop growth. Although the material is fast acting, long-term benefits cannot be realized because only small amounts can be applied.
- **Calcitic limestone**, which is composed mainly of calcium carbonate. Very little calcitic limestone is quarried in Minnesota for use as agricultural lime. Most of the calcitic lime sold in north central and northeastern Minnesota comes from out of state, mainly from Michigan. The University generally does not recommend calcitic lime for use in north central and northeastern Minnesota because it does not contain any magnesium. Because many of the soils in this area of the state do not contain large amounts of magnesium, deficiencies can be induced as a result of adding calcitic lime.
- **Dolomitic limestone**, which is composed of both calcium and magnesium carbonates. It is the most commonly mined liming material in Minnesota. Because it contains both calcium and magnesium, it is the liming material recommended for north central and northeastern Minnesota.

## HOW AND WHEN TO APPLY LIME

Lime should be broadcast and then thoroughly mixed into the plow layer. Because lime is only effective where it is placed in the soil, thorough mixing throughout the plow layer is extremely important. You should disk, field cultivate or harrow, and then plow. Following this procedure is especially important on strongly acid soils being limed for the first time. Plowing without disking turns the lime under but does *not* thoroughly mix it with the soil. The University

has documented many cases in which poor mixing of lime resulted in poor stands and poor yields of alfalfa.

The best time to apply lime is 6 to 12 months prior to seeding of alfalfa, which gives the lime time to neutralize soil acidity. If lime cannot be applied during this period, it can be applied even just before seeding to establish adequate stands. If lime is needed and not applied, crop production will not be optimal.

## **DOES ACP COST SHARING STILL APPLY?**

ACP cost sharing for lime still applies in Minnesota. The general policy is that if you are to qualify for cost sharing you must apply lime within 12 months of the time you seed forage legumes. This cost sharing could be up to 75 percent of the cost of the lime.

**Be sure to contact your local ASCS office** for information concerning ACP cost sharing in your county. To qualify for ACP cost sharing, you must follow closely the ASCS regulations regarding conservation practices for seeding a legume cover crop.

## **Glossary of Soil Terms**

**Agricultural lime:** Any material applied to fields that neutralizes soil acidity.

**Alkaline soil:** A soil with a pH above 7.0.

**Calcitic limestone:** An agricultural liming material that contains only calcium carbonate.

**Calcium:** An essential element needed for plant growth. There are no known calcium deficiencies in Minnesota.

**Dolomitic limestone:** An agricultural liming material that contains both calcium and magnesium carbonates.

**Gypsum:** A calcium sulfate material used to correct sulfur deficiencies. It is used on sulfur deficient, coarse textured soils in north central and northeastern Minnesota. Another term for gypsum is land plaster. Gypsum is not a liming material.

**Liquid lime:** A finely ground liming material that has water added to it.

**Marl:** A liming material that is primarily made up of calcium carbonate and impurities of silt, clay, and organic matter. It is usually mined from old lake beds.

**Neutralize:** Meaning to counteract or overcome, it is used here to mean correcting acidity.

**Nodules:** The small growths on alfalfa root hairs that house the bacteria that fix atmospheric nitrogen for the plant.

**Nutrient deficiency:** When the absence of one or more essential elements limits normal plant growth and reduces yields.

**Parent material:** The unweathered material beneath the subsoil from which the soil above was formed.

**Soil pH:** A term used to describe soil acidity numerically. The lower the number, the more acid the soil is. Soil pH 5.5 is acid; soil pH 6.5 to 7.0 is neutral.

**Subsoil:** That part of the soil below the plowlayer depth that is partially weathered.

Authors: W. E. Fenster and C. J. Overdahl, extension soils specialists; G. R. Chambers, county extension director, Aitkin County; and J. D. Radford, area extension agent, Small Farm Programs.

Issued in furtherance of cooperative extension work in agriculture and home economics, acts of May 8 and June 30, 1914, in cooperation with the U.S. Department of Agriculture. Norman A. Brown, Director of Agricultural Extension Service, University of Minnesota, St. Paul, Minnesota 55108. The University of Minnesota, including the Agricultural Extension Service, is committed to the policy that all persons shall have equal access to its programs, facilities, and employment without regard to race, creed, color, sex, national origin, or handicap.

# Soil Acidity and the Importance of Liming

*Please fill out and return*

Name \_\_\_\_\_

Address \_\_\_\_\_ County \_\_\_\_\_

1. Do you now think you have a good understanding of soil acidity and why soils become acid?
2. Do you understand the concept of soil pH and how you can use it as a management tool?
3. Have you used lime on your farm. If you haven't, why not?
4. Do you know if your soils are acid and if you should be spreading some lime to aid in crop production?
5. If you have applied lime on your farm, what type did you apply? Do you now have a better understanding of which lime is probably best for your farm? Explain.
6. Please list any questions you have on soil acidity and liming.

The following materials are available on request. Please check those you would like to receive.

- Lime Needs in Minnesota*, Soils Fact Sheet 10
- Liming Minnesota Soils*, Extension Folder 210

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