

Lime Needs in Minnesota

George Rehm, Robert Munter, Carl Rosen, and Michael Schmitt

The Importance of Lime

When needed, liming materials are major inputs for crop production enterprises in Minnesota. When soils are acid, there are many benefits from liming. Liming to a pH of 6.0 to 6.5 or higher provides an ideal environment for bacteria in soils. Some of these bacteria actively participate in the breakdown of soil organic matter. Others form nodules on the roots of legumes. With this bacterial partnership, legumes are able to utilize the nitrogen in the air and no fertilizer nitrogen is needed.

The availability of phosphorus is also affected by soil pH. So, liming to a pH of 6.0 to 6.5 also increases the supply of soil phosphorus available to plants. Soils contain ample calcium (Ca) for crop growth. Liming materials are not used to supply Ca.

Determining the Need for Lime

The need for lime is not uniform across Minnesota and recommendations will vary. Analyzing a soil sample for pH and buffer pH is the only way to arrive at an accurate lime recommendation. Soils should be sampled to a depth of 6 to 8 inches for this test. The recommendations will not be accurate if other sampling depths are used.

After the soil sample reaches the laboratory and is dried, a pH reading is taken for a mixture of equal parts of soil and water. This value is referred to as the soil pH. If the soil pH reading is less than 6.0, a buffer solution is added to the soil/water mixture and another pH reading is taken. This second reading is referred to as the buffer pH and is used to determine the amount of lime to apply. The pH of the buffer itself is 7.5. When it is added to an acid soil, the pH of the buffer will drop. The change in the pH of the buffer is directly related to the amount of lime needed.

The buffer pH is not determined on soils with a soil pH of 6.0 or higher. The relative error of using the buffer is too high in this soil pH range. For these soils, standard recommendations are used to raise the soil pH to 6.5.

Lime recommendations for Minnesota are summarized in tables 1-4. The area of the state must also be considered when these recommendations are used (see map on page 2).

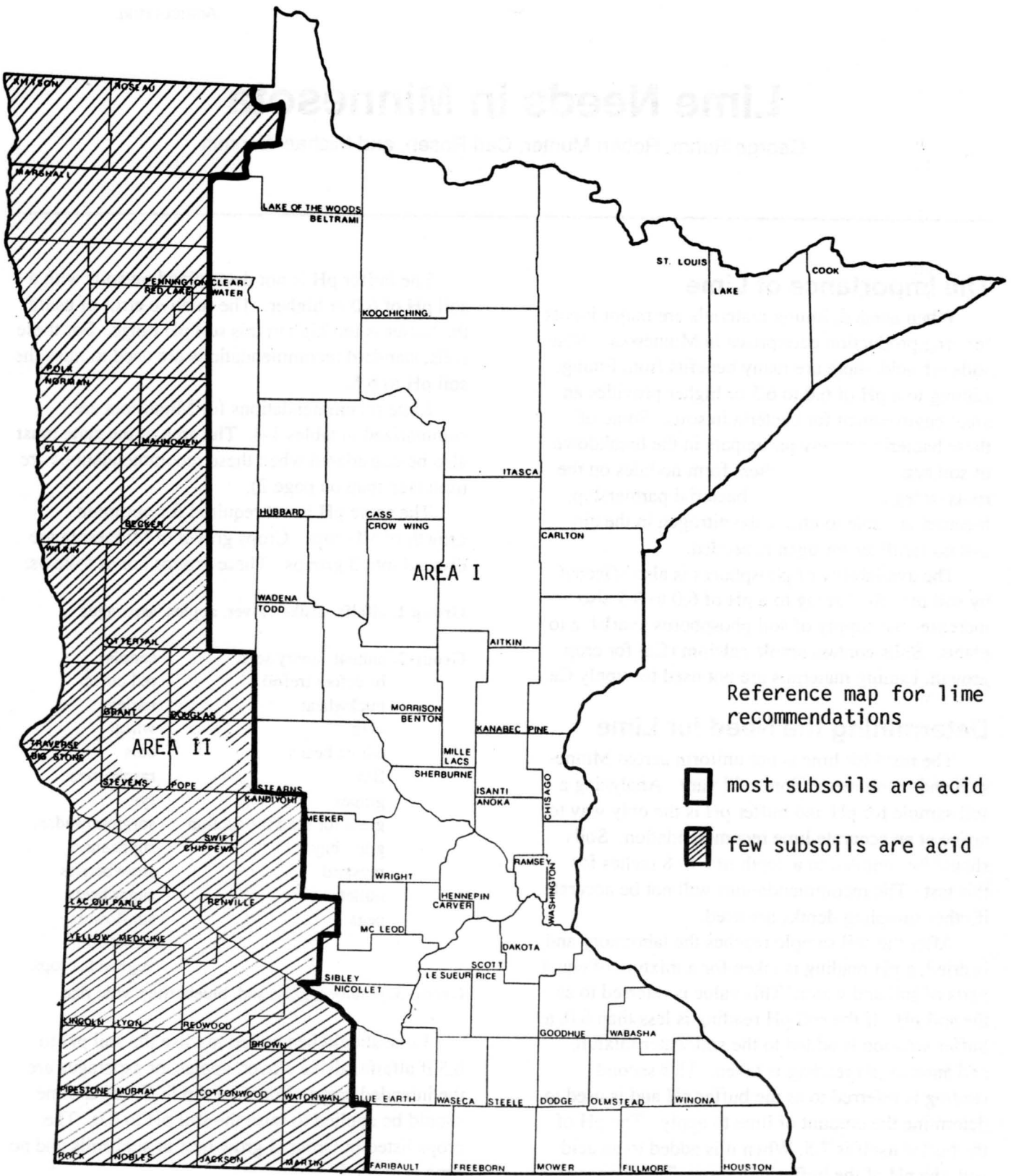
The same pH is not required for optimum growth of all crops. Crops grown in Minnesota are divided into 3 groups. These groups are as follows:

Group 1. alfalfa, alsike clover, apples, asparagus

Group 2. annual canary seed	canola
birdsfoot trefoil	red clover
buckwheat	barley
corn	wheat
edible beans	oats
flax	raspberries
grapes	rye
grass for seed production	sorghum sudan
grass hay	soybeans
mustard	strawberries
millet	sugar beets
peas	sunflowers
	sweet corn
	vegetable crops

Group 3. potatoes, grass sod, blueberries, wild rice

Lime should be applied to raise the soil pH to 6.5 if alfalfa, alsike clover, apples, or asparagus are the intended crops. For any crop in Group 2, lime should be applied to raise the soil pH to 6.0. The crops listed in Group 3 grow best in acid soils and no lime is needed.



Reference map for lime recommendations

- most subsoils are acid
- few subsoils are acid

Lime Recommendations

In Minnesota, lime recommendations are made on the basis of Effective Neutralizing Power (ENP). The ENP is computed from a laboratory determination of Total Neutralizing Power (TNP) and a particle size analysis. The particle size analysis provides an indication of the length of time that it takes for lime to dissolve and react with the soil. The analysis for TNP and particle sizes applies to the normal limestone materials as well as by-product materials that have some liming value. A more detailed discussion of ENP and liming materials is provided in another Fact Sheet, AG-FS-5957.

Liming recommendations from the University of Minnesota Soil Testing Laboratory are now made in terms of pounds of ENP per acre instead of tons per acre. The number of pounds of ENP per ton of liming material purchased will be given to the buyer for each load of liming material that is delivered. Therefore, lime recommendations in Tables 1-4 are listed as both tons per acre and pounds of ENP per acre. The conversion is based on the average ENP value for a ton of ag lime. For best accuracy, the actual ENP value of the liming material should be used.

When alfalfa is part of the crop rotation, lime is recommended to bring the soil pH to 6.5. For best results, the agricultural limestone should be broadcast and incorporated 6 to 18 months before seeding. For last minute changes in cropping plans, lime can be broadcast and incorporated just before seeding. There is very little benefit to topdressing lime to established stands of alfalfa in Minnesota.

Muck and peat soils are not treated like mineral soils. For these organic soils, if the water pH is 5.4 or less, lime is recommended to raise the soil pH to 5.5.

In western Minnesota (area II on the map), lime is not recommended if the soil pH is 6.1 or higher. When lime is recommended for this part of the state, the rate is one-half of that recommended for area I. The soils in western Minnesota frequently have subsoils with a pH of 7.0 or higher. Therefore, when alfalfa is grown, lime is recommended to raise the pH to 6.0.

Lime is not generally recommended for grass pastures because grass is fairly tolerant of low pH values and topdressing lime is not effective. However, lime is beneficial where legumes are to be introduced to renovate a pasture where soil pH values are less than 6.0.

Table 1. Lime recommendations for mineral soils when the soil pH is less than 6.0. The rates suggested should raise the pH to 6.0.

SMP Buffer Index	Area I		Area II	
	ENP	Ag Lime*	ENP	Ag Lime*
	lb./acre	ton/acre	lb./acre	ton/acre
6.8	2000	2.0	0	0
6.7	2000	2.0	0	0
6.6	2000	2.0	0	0
6.5	2500	2.5	0	0
6.4	3000	3.0	2000	2.0
6.3	3500	3.5	2000	2.0
6.2	4000	4.0	2000	2.0
6.1	4500	4.5	2000	2.0
6.0	5000	5.0	2500	2.5
5.9	5500	5.5	2500	2.5
5.8	6000	6.0	3000	3.0
5.7	6500	6.5	3000	3.0
5.6	7000	7.0	3500	3.5

* These are approximate recommendations based on the average ENP value of ag lime. An ENP of 1,000 lb. per ton is an average value for ag lime (crushed limestone) in Minnesota.

Table 2. Lime recommendations for mineral soils when the soil pH is less than 6.0. The rates suggested should raise the pH to 6.5.

SMP Buffer Index	Area I		Area II	
	ENP	Ag Lime*	ENP	Ag Lime*
	lb./acre	ton/acre	lb./acre	ton/acre
6.8	3000	3.0	2000	2.0
6.7	3500	3.5	2000	2.0
6.6	4000	4.0	2000	2.0
6.5	4500	4.5	2000	2.0
6.4	5000	5.0	2500	2.5
6.3	5500	5.5	2500	2.5
6.2	6000	6.0	3000	3.0
6.1	6500	6.5	3000	3.0
6.0	7000	7.0	3500	3.5
5.9	7500	7.5	3500	3.5
5.8	8000	8.0	4000	4.0
5.7	8500	8.5	4000	4.0
5.6	9000	9.0	4500	4.5

* These are approximate recommendations based on the average ENP value of ag lime. An ENP of 1,000 lb. per ton is an average value for ag lime (crushed limestone) in Minnesota.

Table 3. Lime recommendations for mineral soils when the SMP BUFFER TEST IS NOT USED (soil pH is 6.0 or higher). The rates suggested should raise the pH to 6.5.

Soil-Water pH	Area I		Area II	
	ENP	Ag Lime	ENP	Ag Lime
	lb./acre	ton/acre	lb./acre	ton/acre
6.5	0	0	0	0
6.4	2000	2.0	0	0
6.3	2000	2.0	0	0
6.2	3000	3.0	0	0
6.1	3000	3.0	0	0
6.0	3000	3.0	2000	2.0

* These are approximate recommendations based on the average ENP value of ag lime. An ENP of 1,000 lb. per ton is an average value for ag lime (crushed limestone) in Minnesota.

Table 4. Lime recommendations for organic soils. The rates suggested should raise the pH to 5.5.

Soil-Water pH	Area I		Area II	
	ENP	Ag Lime	ENP	Ag Lime
	lb./acre	ton/acre	lb./acre	ton/acre
5.4	2000	2.0	2000	2.0
5.3	2000	2.0	2000	2.0
5.2	2000	2.0	2000	2.0
5.1	2000	2.0	2000	2.0
5.0	2000	2.0	2000	2.0
4.9	3000	3.0	3000	3.0
4.8	3500	3.5	3500	3.5
4.7	4000	4.0	4000	4.0
4.6	4500	4.5	4500	4.5
4.5 or less	5000	5.0	5000	5.0

* These are approximate recommendations based on the average ENP value of ag lime. An ENP of 1,000 lb. per ton is an average value for ag lime (crushed limestone) in Minnesota.



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