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Estimating Ag Lime Quality

This NebGuide discusses how to calculate lime quality based on material purity and fineness and how this relates to application rates and recommendations.

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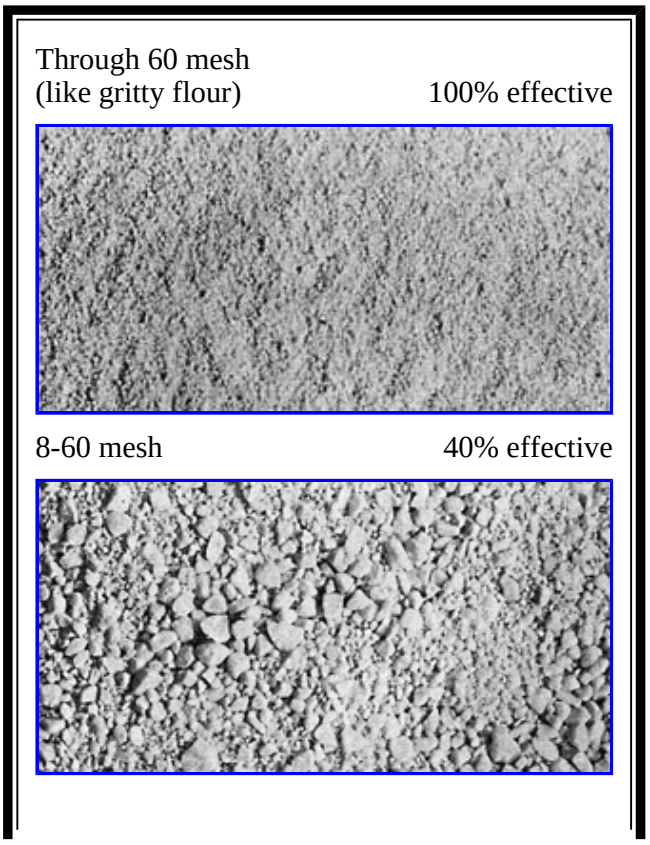
The effectiveness of a liming material for correcting soil acidity depends on two factors — *purity* and *fineness*. These two factors, along with water content, must be considered in determining how much lime to apply per acre.



Purity

Purity refers to the acid-neutralizing capacity of the liming material. It is measured and reported as "percent calcium carbonate equivalence" (CCE). Pure calcium carbonate would test 100%. Limestones are primarily calcium carbonate or a mixture of calcium and magnesium carbonates. They may contain some impurities, such as shale or chert, which have no neutralizing value. A number of other substances also have an acid-neutralizing capacity. Pure magnesium carbonate has a CCE of 119, dolomite has a CCE of 108, and calcium hydroxide (hydrated lime), 120 to 136.

Fineness

Fineness refers to the particle size of the liming material. Many ground limestones contain a range of particle sizes

from dust to the size of coarse gravel. When crushed limestone is applied t soil, the fine particles dissolve and chemically react with the so l acid neutralizing them. The coarse particles react very slowly a d have little value.

The fineness of ground limestone is determined by passing a sample through a set of screens or sieves. Usually three sieves are used; the coarsest of these has four openings per inch, while the finest has 60. These sieve sizes are commonly referred to as four mesh and 60 mesh. Materials finer than 100 mesh appear to have the same agronomic effectiveness as 60 to 100 mesh. *Figure 1* shows how ag lime looks when separated by sieving into the three size ranges.

Held on 8 mesh
(like gravel) Less than 10% effective

Figure 1. Ag lime separated by sieving into the three size ranges.

Size Range of Lime

1. 8 to 16 mesh
2. 16 to 30 mesh
3. 30 to 50 mesh
4. 50 to 100 mesh
5. 100 to 200 mesh

Figure 2 shows how the soil pH changed during a five-year period after applying ag lime of five different particle size ranges, all at the rate of eight tons per acre mixed to ten inches of soil depth. The initial pH was 5.9.

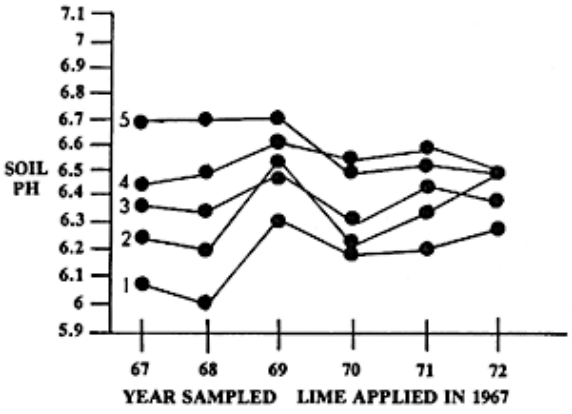


Figure 2. Effect of lime particle size on pH.

Moisture

The moisture content of stored liming material varies with the weather. Excessive moisture in the lime does not lower its effectiveness, but the weight of water it contains has no value for neutralizing acid soil. As the lime is ground, it is usually put in cone shaped piles for storage. In this way the bulk of the lime is not affected by seasonal rains.

Rate of Application Depends on Quality of Liming Material

Effective Calcium Carbonate (ECC)

Effective calcium carbonate (ECC) is calculated from the purity (CCE) and fineness.

Sum: Percent passing 4 mesh screen × .1 = a
Percent passing 8 mesh screen × .3 = b
Percent passing 60 mesh screen × .6 = c

Formula: (a + b + c) × CCE ÷ 100 = ECC
(these factors are equivalent to using .1 for 4 to 8 mesh, .4 for 8 to 60 mesh and 1.0 for fraction finer than 60 mesh.) The moisture content is considered by the laboratory when reporting CCE.

Example for calculating ECC:

The following example shows how to calculate effective calcium carbonate by two methods:

1. using percent of material in each mesh range, and
2. using total material passing through the 4, 8 and 60 mesh.

Consider a sample that sieves out as follows.

Calculation I			**Calculation II**	
Sieve range	*Percent of material*		*Sieve size*	*Percent of material passing*
4 to 8 mesh	10	*or*	4	100
8 to 60 mesh	60		8	90
passes 60	30		60	30

To calculate ECC due to fineness.

I. (10 × 0.1) + (60 × 0.4) + (30 × 1.0) = 55% ECC at 100% purity

or

II. (100 × 0.1) + (90 × 0.3) + (30 × 0.6) = 55% ECC at 100% purity

To adjust for a purity of 95% CCE (CCE is to be reported on a moist basis so that adjusting for water is not necessary except for lime slurry).

55% (ECC for fineness) × 95% CCE ÷ 100 = 52.25 = [52% ECC]

Table I. Rate adjustment for ECC.	
Effective Calcium Carb. (ECC)	*Adjustment Factor*
15	4.0
20	3.0
25	2.4
30	2.0
35	1.7
40	1.5
45	1.3
50	1.2
55	1.1
60	1.00
65	.95
70	.90
75	.80
80	.75
85	.70
90	.66
95	.63
100	.60

Rate Adjustment for ECC

If the material available varies from 60% ECC, adjust the rates according to *Table I*.

Lime Recommendations

The lime recommendations given on UNL soil test reports are based on liming material that is 60% ECC. If you buy materials of lower effectiveness, you need more lime; if you buy lime of higher quality, less lime is needed. Adjust your rate of application according to the quality of lime to be applied. For example, if your soil tests show a lime requirement of 6,000 lbs. (3 tons) per acre and you are buying 50 percent effective lime, then from *Table I*, 6000 × 1.2 = 7200 lbs. (3.6 tons) per acre needed.

Apply the lime several months before seeding legumes if possible. Liming just before seeding the legume is usually less effective than applying it several months before seeding. Time and mixing with the soil is necessary for the lime to react with the soil. However, applying lime close to seeding time is better than not applying any lime at all if it is needed.

Lime can be spread at any time of the year and is harmless to all crops, even though some of it sticks to the leaves.

Adjusting for Depth of Tillage

Lime recommendations usually consider that tillage practices will incorporate the lime with 6 to 7 inches of

soil. If tillage practice results in mixing with a different depth, the rate can be adjusted according to *Table II*.

Table II. Factors for depth adjustment of lime recommendation.	
Depth of Incorporation (inches)	*Factor to Multiply by*
2	.30
3	.45
4	.60
5	.75
6	.90
7	1.00
8	1.20
9	1.35
10	1.50
11	1.65

Example:

If a tillage system such as disking is used that works the soil no deeper than four inches, note the factor in *Table II* of 0.60 for incorporating to four inches. The factor is multiplied by the recommended rate for seven inches [i.e., 7,200 lbs. (3.6 tons) per acre × 0.6 = 4400 lbs. or 2.2 tons]. A particle of lime reacts with a soil volume no greater than 1/4 inch across, so reaction with the soil is dependent on mixing of the lime with the soil.

Kinds of Liming Materials

Ground limestone

Limestone is valuable for its content of calcium carbonate or calcium plus magnesium carbonate. These materials, depending on the fineness, neutralize soil acidity and supply the necessary calcium for all crops. Dolomitic limestone supplies both calcium and magnesium.

Industrial by-product

Lime is often used in industrial processing and becomes a by-product. Sugar factory lime is a fine, floury material high in calcium carbonate, and therefore an excellent liming material when dewatered. Some fly ash contain materials capable of neutralizing soil acidity.

Hydrated and burned lime

Hydrated and burned (quick) lime are very effective and quick acting. These materials are caustic and therefore hard to handle. Respectively, 74 and 56 lbs. are equal to 100 lbs. pure limestone.

Table II. Factors for depth adjustment of lime recommendation.	
Application	*Soil pH after 6 months*
Lime slurry	
5000 lbs. ECC	6.3
1000 lbs. ECC	6.0
Ag lime	

	5000 lbs. ECC	6.4
Check		
	No lime	5.4

Lime slurries

Lime slurries are also called fluid lime and liquid lime. They are pulverized limestone suspended in 30 to 50% water. Effectiveness is based on the fineness and purity of the dry material. This material will react quickly in the soil if incorporated. Reaction rate is the same for either the slurry or the dry pulverized material. After one season little difference in soil pH is experienced when compared to ag lime on an ECC basis. The following results were obtained in Kansas State University field experiments comparing ag lime with lime slurry.

Agricultural Liming Materials Act

This law, which went into effect July 1, 1983, requires all persons who manufacture, distribute or retail agricultural liming materials to register annually with the Nebraska Department of Agriculture. All liming material offered for sale must also be registered and be accompanied by a label which specifies:

a. the name and address of the manufacturer or distributor;
b. the brand or trade name;
c. the type of liming material;
d. the net weight;
e. the minimum effective calcium carbonate equivalent (ECC), and
f. the pounds of ECC per ton.

Ag lime slurry is not required to be registered, however the labeling requirements for the pulverized lime used in the slurry must be met.

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