

## In the "Lime" Light

FEBRUARY 9, 2013

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Always base your lime applications on soil test results from reputable labs.

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Unlike nutrients such as nitrogen and phosphorus, you don't apply lime for plants—you apply it to feed soil microorganisms. The microscopic creatures that are so important to healthy soil cannot thrive in acid conditions, explains Farm Journal Field Agronomist Ken Ferrie.

"Soil microbes decompose crop residue and make those nutrients, and other nutrients stored in the soil, available to plants," he says. "They degrade herbicides and prevent carryover. Proper soil pH—6.4 in a continuous corn or corn/soybean rotation—is the foundation of high yield."

As vital as soil pH is, Ferrie still sees farmers and applicators making mistakes with lime. For example, a fertilizer plant discovered fields were not responding to lime applications—they were underapplying because they had switched soil testing laboratories. Their old lab made recommendations in tons of lime, based on its state standard for limestone. But the new lab, in another state, expressed its recommendations as pounds of calcium carbonate equivalent, which is not the same thing as standard tons of lime.

Mistakes are understandable because calculating the proper rate of lime is tricky. They also are avoidable, if you have a basic understanding of lime.

Start with a soil test. "It's easier to keep pH in the optimum range if you test soil every two years and apply lime more frequently, in smaller amounts," Ferrie says. "If you only test soil every five years, your lime applications will be reactive, rather than proactive, and soil pH will fluctuate more."

Ferrie prefers a buffer pH test along with a water pH test, which is the standard test at many labs. "A water pH test tells you when to lime, but it doesn't tell you how much to apply," Ferrie says. "A buffer pH test takes soil texture into account, which lets you determine the correct rate."

Some land-grant universities publish charts of the correct liming rate for various soil water pH test results, based on soil type. Other approaches include keeping soil textures separate when taking samples or sampling by management zones.

"If you're in a grid testing system, realign the grids so each one represents one soil texture," Ferrie says.

"This kind of sampling sets you up for variable-rate lime application, which is a good idea if you have more than one soil type in a field."

Understand the standard upon which your lab's recommendation is based. Some labs make recommendations of calcium carbonate equivalent (CCE, sometimes called "effective neutralizing value,"), while others make recommendations in tons of lime—meaning tons of lime product with a typical CCE for the state.

Compare lime sources. CCE lets you compare the acid neutralizing power of lime and calculate the correct rate to apply. It is expressed as a percentage of the neutralizing power of pure calcium carbonate. "Because there is no universal standard across all states for what constitutes a ton of agricultural lime, you must evaluate lime sources in terms of calcium carbonate equivalent," Ferrie says.

The most popular source of agricultural lime is ground limestone, including calcitic limestone and dolomitic limestone. Calcitic lime is mainly calcium carbonate. Dolomitic lime contains both calcium carbonate and magnesium carbonate, which also neutralizes soil acid.

With any source of lime, the seller should tell you its CCE value. As a rule of thumb, you can expect calcitic limestone to range from 85% to 100% CCE, and dolomitic lime from 95% to 108%. (The CCE can be more than 100% if the product exceeds the neutralizing power of pure calcium carbonate.) Hydrated lime typically ranges from 120% to 135%, and basic slag from 60% to 90%.

Because lime varies in CCE, you might have to apply a correction factor to your lab's recommendation to determine the correct rate. If a lab says you need 1,000 lb. of calcium carbonate per acre to neutralize a soil and lime from a certain quarry has a CCE of 50%, you'll need to apply 2,000 lb. of that lime product per acre.

Another factor affecting lime quality is its fineness of grind. The smaller the particles, the faster lime will neutralize acidity. Fineness is quantified by the percentage of particles passing through various sizes of mesh screens. "Particles that fall through a 60-mesh screen are effective the first year," Ferrie says. "But larger particles need more time."

The acid-neutralizing effect of a particle of lime extends outward only 1/8"—whether the particle is the size of a grain of sand, or (theoretically) a golf ball. Depending on the price per ton, a finely ground limestone with a lower CCE might be a better buy than a coarse product with a higher CCE.

Some states take CCE and fineness into account and publish a standard called "total neutralizing value." You can use that to compare value.

Application errors. The finest grade of lime can be challenging to spread uniformly. "It's almost impossible to spread fine lime on a windy day," Ferrie says. "The wind may blow the product onto your neighbor's field. If fine lime gets wet, it cakes up and doesn't flow uniformly. A blend of fine and coarse limestone provides a better spread pattern."

A common mistake is failing to calibrate for each spreader truck and each lime source. Set several large flat pans on the ground, and make a pass over them to check width and uniformity. A coarse lime will give you a wider pattern than a fine lime.

The worst cases of uneven application can result from applying municipal lime products with a manure spreader. "That may be tempting if a municipality offers you sludge-cake lime for free," Ferrie says. "But blobs of lime create a high pH in a micro-environment next to an acid situation. That can make 'free' lime expensive."

Municipal liquid lime, while a good product, can be tricky. The percentage of liquid and solid content can vary from 30% to 50%, which changes the CCE. You need to demand that information from your supplier. "You

must adjust the application rate for each load," Ferrie says. A similar issue of varying CCE could arise if you spread limestone from two different quarries.

Tillage plans. Always consider how deep you plan to incorporate your lime. If you're in strip-till or no-till, or planning to till deeply, you'll need to adjust the rate.

"Typically, lime recommendations are based on the depth of the soil sample," Ferrie says. "If recommendations call for 2 tons per acre, based on a 6" sample, and you plan to incorporate it 8" or 9" deep, you may need 3½ to 4 tons per acre. But if you leave 2 tons per acre on the surface, that's like applying 3 or 4 tons per acre in the top 3" of soil. It will tie up nutrients, and cause herbicide carryover and nitrogen volatility."

If a no-till field has become acidic, you probably will need to till in a lime application, Ferrie notes. "Once you have built pH back to the optimum range, you can maintain it by making surface applications," he says.

Consistent pH levels make for happy microorganisms. Healthy soil encourages higher, more consistent yields, which makes happy farmers.

### Sources of Lime

The most commonly used source of lime is ground limestone, but there are many others, including:

- Fly ash, a byproduct of coal combustion.
- Basic slag, or calcium silicate, from the steel industry.
- Lime slurry or fluid lime, which is limestone pulverized and suspended in water, often a byproduct from municipal water treatment facilities.
- Hydrated lime or quicklime, from water treatment facilities, has a high calcium carbonate equivalent, but is caustic to handle.
- Bone meal.
- Burned lime, which is used for plaster and sheetrock.
- Pelleted lime, made from finely ground limestone, to control dust.

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**STEP 1** Obtain the efficiency factor for your lime. This is based on what percentage of the particles fall through various sizes of screens.

#### EFFICIENCY FACTOR AFTER APPLICATION

PARTICLE SIZES	1 year	4 years
Greater than 8-mesh	5	15
8- to 30-mesh	20	45
30- to 60-mesh	50	100
Passing 60-mesh	100	100

**STEP 2** Calculate the efficiency factor for one year, for your lime source. It has 13.1% of particles greater than 8-mesh, 40.4% between 8- and 30-mesh, 14.9% between 30- and 60-mesh and 31.6% passing 60-mesh. It has a CCE of 86.88%. First, use the fineness efficiency factors to calculate total fineness efficiency:

$$13.1/100 \times 5 = 0.65$$

$$40.4/100 \times 20 = 8.08$$

$$14.9/100 \times 50 = 7.45$$

$$31.6/100 \times 100 = 31.60$$

**47.78 total fineness efficiency**

**STEP 3** Calculate the effective neutralizing value (ENV):

$$\frac{\text{Total fineness efficiency} \times \% \text{ calcium carbonate equivalent}}{100} = \text{ENV}$$

$$\frac{47.78 \times 86.88}{100} = 41.51$$

**STEP 4** To get the correction factor, divide the ENV of typical lime for your state (46.35 in Illinois; elsewhere, check with your state Extension service) by the ENV of your lime product:

$$\frac{46.35}{41.51} = 1.12 \text{ correction factor}$$

If your recommendation called for 3 tons of lime per acre, you would need to apply 3.36 tons (3 x 1.12) of this product.

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FEATURED IN: Farm Journal - Mid February 2013

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