Grain Crops Update

A service of the University of Kentucky, College of Agriculture, Food and Environment. Updates are provided by Extension faculty with responsibilities for management of corn, soybean and small grains.

Wednesday, April 8, 2015

Buyer beware when it comes to "alternatives" to ag lime

Josh McGrath and Edwin Ritchey, Extension Soil Specialists, University of Kentucky

Over the past few months we've had farmers at each county agronomy meeting ask about liquid lime. After a little investigation we found out that what was being marketed as a liquid lime with neutralizing value was in fact calcium chloride ($CaCl_2$). This was bad news because $CaCl_2$ provides ***NO liming value*** and is in fact not "liquid lime." Calcium chloride is used for many purposes including road salt or tractor tire ballast, it however cannot be used to neutralize soil acidity. This post is intended to provide some information on liming materials, the lime reaction, and explain why $CaCl_2$ is not a lime source.

Maintaining soil pH in the proper range is one of the most important parts of soil fertility management. Soil pH is considered the "master variable" because it influences so many of the chemical and biological functions of the soil. Maintaining our Kentucky soils in the optimum pH range often requires liming. Kentucky soils are naturally acidic even though much of the soils sit on top of limestone. Nitrogen fertilizers also contribute acidity when ammonium (NH_4^+) is nitrified to form nitrate (NO_3^-). Notice that ammonium has four hydrogens and nitrate has none. When ammonium transforms to nitrate it releases hydrogen ions to the soil solution and pH is a measure of the activity or concentration of hydrogen ions (H+), which is represented mathematically as pH = $-\log[H^+]$. The more hydrogen ions present the lower the pH value, since it is a negative logarithm. Values below seven are considered acidic and values above seven are considered alkaline. For most crops grown in Kentucky, we target a soil pH from 6.4 to 6.8. In this range the essential mineral nutrients are most available to growing plants. At pH below 5.0 soluble aluminum, iron, and manganese may be toxic to the growth of some plants and phosphorus availability is decreased.

What is Lime?

So what is "lime" and how does it work? Liming materials are typically oxides (O^{2-}), hydroxides (OH^-), carbonates (CO_3^{2-}) or silicates (SiO_4^{4-}) of calcium (Ca) or magnesium (Mg). Some examples (with their chemical formulae) are calcitic lime ($CaCO_3$), dolomitic lime ($CaMg(CO_3)_2$, quick lime (CaO), and hydrated lime ($Ca(OH)_2$). Many people mistakenly believe it is the Ca or Mg that works to "lime" a soil (i.e. neutralize acidity), but this is not true. It's the oxide, hydroxide, carbonate, or silicate that removes the H+ ions from solutions and raises the soil pH. The lime reaction is a two-step process where first the lime dissolves in solution (Eq. 1) producing an anion.

$$CaCO_3 + H_2O \rightarrow Ca^{2+} + HCO_3^- + OH^-$$

Equation 1.

In the second step the anion reduces the concentration of hydrogen ions (H^+) in solution forming a water molecule (Eq. 2).

$$OH^- + H^+ \rightarrow H_2O$$

Equation 2.

Equations 1 and 2 provide an example of how calcium carbonate or calcitic lime reduces soil acidity. The anion produced by dissolving calcitic lime is a hydroxyl (OH^-) anion, which then removes an H^+ ion from solution forming a water molecule. In this example we can see that the Ca or Mg actually does not reduce soil acidity, but instead it is the anion associated with the metal that is doing all the work.

Liquid Lime

What is liquid lime? It is simply a liming product that is dissolved in water. It is typically a high

KyGRAINS.info

Follow by Email

Email address... Submit

Search This Blog

Search

UK CES

College of Agriculture, Food and Environment
Cooperative Extension Service

Blog Archive

quality lime with small particle size that dissolves easily in water. Liquid lime usually has a high relative neutralizing value (RNV) so it can quickly modify soil pH (for more information on RNV check out University of Kentucky Cooperative Extension ID-163). However, since lime is dissolved in water, it typically consists of approximately 50% lime and 50% water by weight. Therefore, per ton of liquid lime applied you would only be getting ½ ton of lime. If you needed 2 tons per acre of 100% effective lime you would probably need to apply over 4 tons per acre of the liquid lime - well in excess of 700 gallons per acre. That's a lot of liquid to apply in one application, so you would probably have to make multiple applications throughout the year to get the amount of effective lime on the field recommended by your soil test. Liquid lime is an actual product with some distinct advantages (fast acting) and distinct disadvantages (takes a lot of material to get the amount of carbonates required). However, $CaCl_2$ is not liquid lime and has no liming ability. When we researched the product being marketed in Kentucky that the farmers were referring to as liquid lime we found this on the product website, "liquid calcium presents growers with an alternative solution to lime applications." The website also stated that "Calcium neutralizes soil acidity." This is simply not true, because as we saw in Equations 1 and 2 it's not the metal (Ca or Mg) in lime that reduces the H^+ activity, but the associated anion.

The other sales pitch made was the need for available calcium, an essential plant nutrient. The marketing materials implied that $CaCl_2$ provides calcium you are not getting from your lime, saying "ag lime tends to be insoluble and can take years to break down and show its effectiveness." It is true that limestone can be moderately soluble, but the finer particles in limestone are soluble and provide available calcium fairly quickly. According to the MSDS provided on the website (available at: http://www.agrigro.com/products/crops/agrical/) the product is 10% Ca (as $CaCl_2$). At the recommended application rate of 2 to 5 gallons (11.07 lbs/gal) per acre, that's 2.2 to 5.5 lbs of Ca. There are 800 lbs of Ca in a ton of calcitic lime (assuming 100% effective calcium carbonate). Even low-grade agricultural lime will typically provide a couple hundred pounds of soluble lime in the first year after application. Typically Ca deficiencies are not common for row crop production in Kentucky when proper pH management practices are followed.

In summary, as is often the case the buyer must beware when salesman start making claims that are too good to be true. There is no substitute for lime. The calcium or magnesium in agricultural lime are not what is responsible for its liming action. Furthermore, it is very unusual to need calcium or magnesium fertilizer on Kentucky soils, which typically have plenty of both available for plant growth with proper pH management. However, if you do need calcium or magnesium using a calcitic or dolomitic limestone source is a great way to meet those needs.

Posted by Josh McGrath at 11:12 AM

Labels: lime, liquid lime, soil pH

Newer Post Home Older Post

Related Sites

- Grain Crops Extension
- Grain Marketing and Management
- Wheat Science Newsletter
- KY Crop & Weather Report (USDA)
- Chat 'n Chew Cafe
- UT Crops

Grain Crops Experts

- Carrie Knott
- Chad Lee
- Colette Laurent
- Don Hershman
- Doug Johnson
- Jordan Shockley
- Josh McGrath
- Paul Vincelli
- Todd Davis
- Unknown

Translate

Select Language Select Language

Powered by Google Translate
Powered by Google Translate