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The Time to Lime

A dry fall like this one is a great time to get some of the farm tasks done that often get put off from year to year, such as having lime spread on pastures and fields. Pretty much all farmers have the understanding that fields need a balance of pH and that they need limed from time to time. What's less understood is the true causes of soil acidity, how lime works, and just how long it takes for lime to neutralize that acid.

Liming ag fields isn't really an 'extra' application, so much as it's just as vital as the N, P, and K. Lots of research has shown the dramatic crop yield declines when fields get into the mid-5s. However, in Southeast Kansas, lime applications can be considered at any pH below 6.1, with some research saying that anything 6.4 should be considered for a lime application. Lime applications in our heavy clay can be anywhere from one ton in a pasture or no-till field to three tons of ag lime in an acidic conventional till field. Of course, a soil test is the only way to tell. I recommend grid-sampling or detailed management zone testing if it's been a long time since any lime was applied. No field, especially in this area, will have a consistent pH throughout the field.

The sources of soil acidity are both man-made and natural. Farmers know that nitrogen fertilizer, most of which contains hydrogen in the form of ammonia, will acidify the soil over time. However, there are natural sources of acidity that work over a much longer time frame. Decomposition of organic and plant residues can leave behind acids, plants up taking the basic cations like calcium, magnesium, and potassium, and the rain, too, can have acidifying compounds. Even the soil itself has levels of aluminum (Al^{3+}) that leaves hydrogen behind when it reacts with water. Of course, our soil also has high levels of basic cations slowly being weathered out of the clays and rocks over very long periods of time to counterbalance the acidification. It's always a balance of acidic hydrogen versus basic cations but our soils are naturally more acidic because they are older and our higher rainfall (…on average). Our soil is also highly buffered because of all the clay. Clay is like a microscopic puff pastry with lots of flaky layers for stuff to get trapped, especially cations, giving us a high cation exchange capacity (CEC) on average. That means it takes longer for nitrogen fertilizers to acidify the soil and that it takes more lime to increase the pH of the soil.

When ag lime is added to soil, it's not instant, but only takes a little time for the magic to happen. Ag lime application, which is calcium carbonate, will have an initial quick pH increase as the microscopically sized particles of carbonate find the hydrogen to create water and CO_2. Then there is the longer phase where the slightly bigger particles dissolve and the calcium does its work of binding aluminum and displacing cations and acids from the clay and organic

surfaces. The majority, probably something like 80-90% of the liming effect happens in the first week, but then takes about five months for the last 10-20%. Note that nearly all hydrogen is bound onto clay surfaces, which is why lime application rates are based on **buffer** pH and not soil pH directly.

Something incredibility frustrating for researchers and farmers alike is the soil pH is not constant throughout the year. Notice in this figure from Cornell that pH was lower in warmer and dry soils by about 0.3 pH than in the cooler and wetter months (figure 1). It's ideal to take soil samples at the same time of the year, like in the fall, but also being a little conservative at what point soil should be limed. A 6.1 pH in a wet winter might be 5.8 in a dry summer when the soybeans are in the field. Also, the pH test itself can vary a little bit and, as stated before, pH changes considerably throughout a field.

In conclusion, if the soil allows you, soil test anytime this fall. If it's been 8 to 10 years or more since you've limed, and the field has a history of fertilizer applications, then take a grid-sample or detailed management zones (not more than 20 acres per sample). Be conservative at what pH needs lime. My recommendation is to consider liming when parts of the field are below 6.1 pH, but lime any other part that is 6.4 or below as well. Any amount of incorporation of the lime is better than none, even in drill overseeding pastures or no-till. Also remember it takes about a week for the majority of the ag lime to be effective.

For more information about liming your crop fields, contact James Coover, Crop Production Agent, at jcoover@ksu.edu or (620) 724-8233. For information about liming a pasture, contact Wendie Powell at wendiepowell@ksu.edu or 620-784-5337.

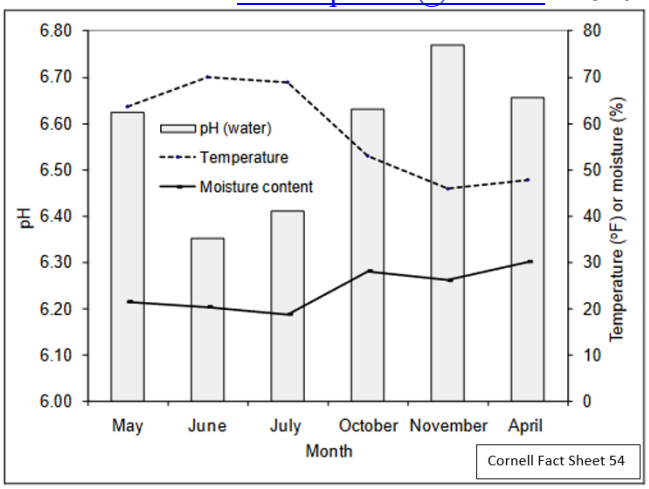

Figure 1: Soil pH tends to be lower in the warmer and drier summer months than in the rest of the year.

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