

Soil pH and liming research update and management strategies with low crop prices

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Key points

- Soil pH should be used to determine if a soil requires liming but the Buffer-pH test is needed to determine the amount of lime to apply to increase pH to a certain value.
- Corn and soybean have similar optimum pH and lime requirements, and yield increases are not likely with pH 6.0 or higher in Iowa regions with soils having calcareous subsoil and with pH 6.5 or higher in other areas.
- A 6-inch soil sampling depth should be used in fields managed with tillage. In fields managed with no-tillage or established forages used for grazing or hay, a sampling depth of 2 to 3 inches is recommended because in these fields lime seldom changes pH in deeper depths.
- Liming materials should be applied based on the effective calcium carbonate equivalent (ECCE) analysis, which considers both the material chemical properties and particle fineness. Research has shown no consistent or large yield differences between sources when the application is based on ECCE, and both the material and delivery costs determine the convenience of using a specific material.

Soil pH should be used to determine whether a soil is too acidic and requires liming and the buffer-pH soil test is used to determine the amount of lime needed to increase soil pH to a desirable level. Liming products should be

applied based on the effective calcium carbonate equivalent (ECCE) analysis, which considers the materials chemical properties and fineness since both affect acid neutralization capacity.

Results of an on-farm study with corn-soybean rotations conducted from 2007 to 2012 in 14 Iowa fields encompassing ten counties confirmed the adequacy of guidelines in Iowa State University Extension (ISUE) publications for soil sampling (CROP 3108) and interpretations of results (PM 1688). Treatments for each 4-year strip trial were an unlimed control and aglime at 3 ton ECCE/acre. Dense grid sampling, yield monitors, GPS, and GIS were used to assess crop responses for different parts of each field. There was no statistical difference between corn or soybean responses to lime. The optimum pH for both crops was higher (pH 6.5) in soils with acidic subsoil than in soils with calcareous (high pH) subsoil (pH 6.0). Figure 1 shows averages across both crops for soils with or without high-pH subsoil. Iowa State University Extension publication PM 1688 includes a map indicating regions with soils having calcareous subsoil (mainly in central, northern, and western Iowa).

The pH results of the on-farm study confirmed that lime application to no-till fields does not significantly increase pH below a depth of about 3 inches. Figure 2 shows

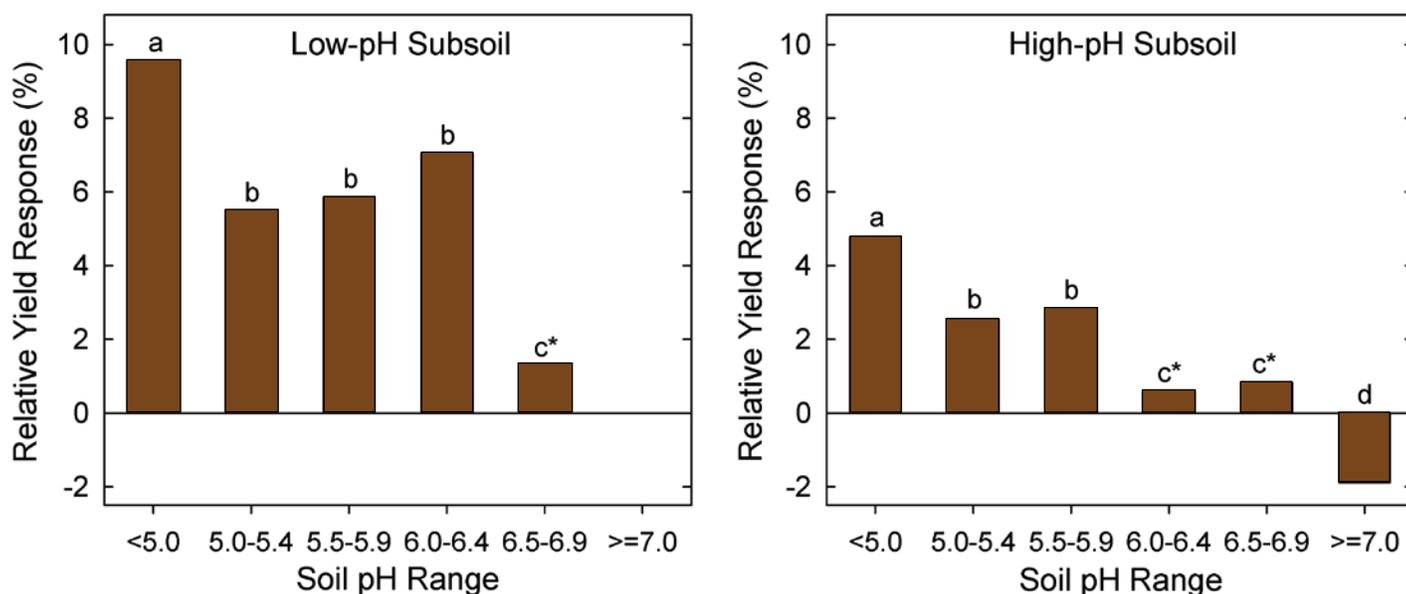


Figure 1. Relative grain yield response to lime across corn and soybean crops as affected by soil pH and subsoil pH (different letters indicate statistical differences between pH ranges and asterisks indicate no difference from zero).

average results across the four fields that were managed with no-till. For this reason, ISUE publications PM 1688 and CROP 3108 suggest a 6-inch sampling depth for tilled fields but 2 to 3 inches for no-till and established forages. Sampling to a 6-inch depth in these cases is tempting because this is the best sampling depth for nutrients. Unless the lime recommendation for a 6-inch depth is reduced to about one half, however, excess lime will be applied that will not increase yield compared with a lower rate and may even decrease yield.

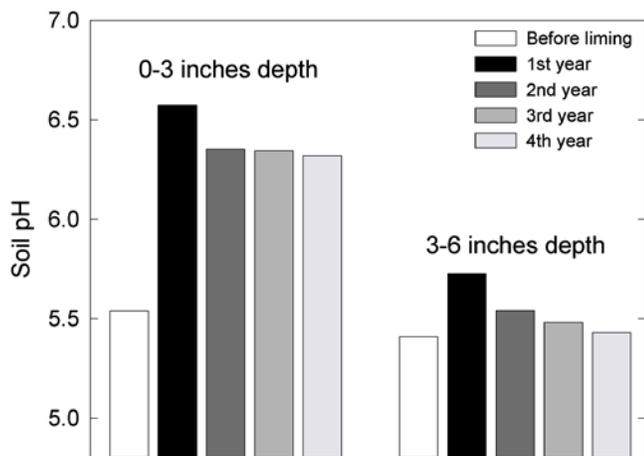


Figure 2. Average effect of 3 ton/acre of effective calcium carbonate equivalent (ECCE) on soil pH across four fields managed with no-tillage and corn-soybean rotations.

Another project studied the efficiency of pelleted lime because the supply of pelleted lime in Iowa has increased, but many farmers are doubtful of its value and ISU had not evaluated it until recently. Six 2-year trials were established

in 2015 to compare pure calcium carbonate, aglime, and pelleted lime for corn and soybean in soils with pH 4.9 to 5.6. All materials were spread and incorporated into the soil by disking in the fall prior to planting corn and no-till soybean was grown the second year.

The pure calcium carbonate and the pelleted lime had similar effects on pH and maximized soil pH 4.5 months after the application, but with aglime maximum pH was reached 12 months after liming. However, there were no yield differences between the sources. Liming increased corn grain yield in three fields and soybean yield in four fields. Figure 3 shows the average crop responses across responsive sites. Rates of 2.9 and 1.2 ton ECCE/acre maximized corn and soybean yield, respectively. Therefore, for application methods and rates used in this study, the costs of the materials and delivery will determine the most cost-effective lime source.

Resources

General guide for crop nutrient recommendations in Iowa

store.extension.iastate.edu/Product/5232

Take a good soil sample to help make good fertilization decisions

store.extension.iastate.edu/Product/3915

Lime and soil pH topic. Soil fertility website, Iowa State University Extension

www.agronext.iastate.edu/soilfertility/limesoilph.html

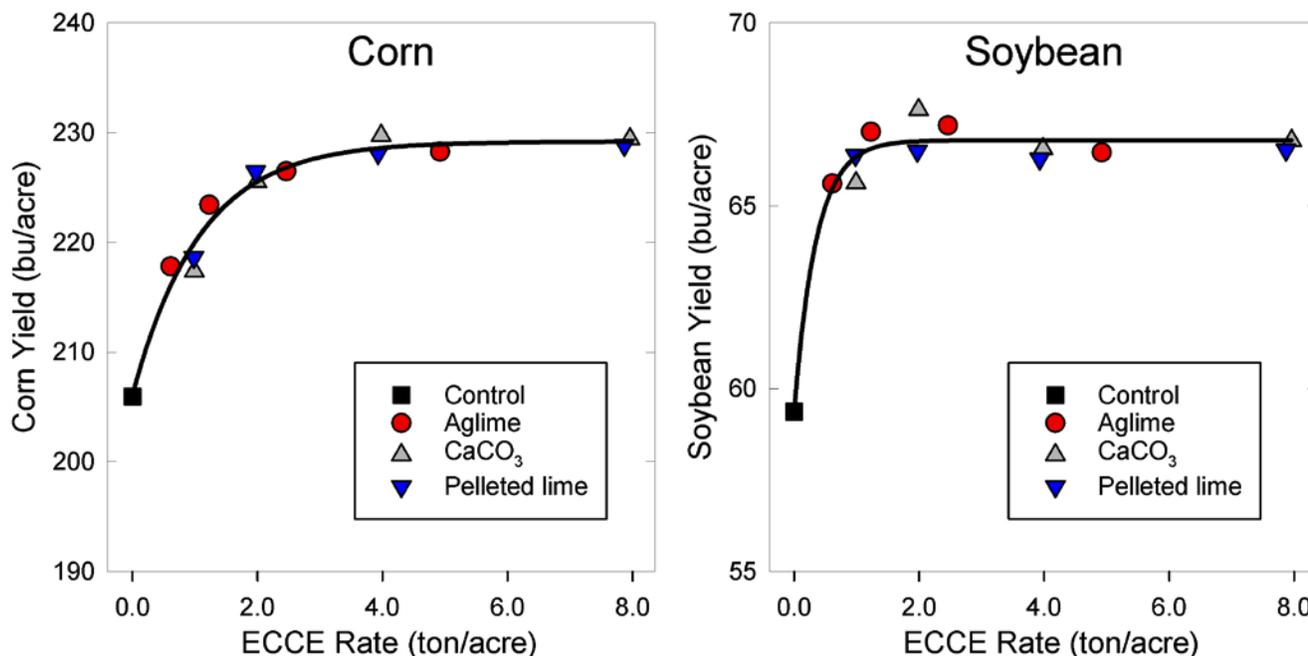


Figure 3. Effect of calcium carbonate, calcitic aglime, and pelleted lime on grain yield of corn and soybean (averages across responsive sites).