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Ag lime impact on yield in several tillage systems

Paul C. Kassel
Iowa State University, kassel@iastate.edu

Michael J. Tidman
Iowa State University

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Abstract
Crop farmers in northwestern Iowa know there are benefits of applying ag lime to acidic soils. But, until recently, little data existed that told them how effective ag lime is in correcting surface soil acidity in the dominant upland soils in northwestern Iowa. Now, research in northwestern Iowa suggests that ag lime application when surface pH is low can benefit soybean yields in different tillage systems, including in no-till.

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Soil pH measures the level of acidity of the soil--the lower the pH, the more acidic the soil. For the dominant upland soils in northwestern Iowa, pH levels for corn and soybean production should be above 6.0 for optimal crop growth. Research has shown that soil pH less than 6.0 can decrease crop yields.

Corn and soybean growers have been advised that they must incorporate ag lime into the soil to make it effective. Therefore, those who use a no-till management system question the effectiveness of ag lime applications if the ag lime is not incorporated into the soil.

Researchers wanted to find answers to the questions about the cost and potential benefits of various application rates, duration of the benefits, and implications related to tillage systems. Also, many producers question the economic benefits of applying ag lime--costs are high in northwestern Iowa. Producers must not only pay for the lime but also for trucking and application charges, resulting in an average cost for ag lime of $22-24 per ton delivered and applied on the field.

A study was established at Iowa State University's Northwest Iowa Research Farm to explore the costs versus benefits of ag lime applications. The study investigated corn and soybean yield response to ag lime under conditions and management systems typical of northwestern Iowa. The ag lime was incorporated by tillage in the chisel-plow system, but surface applied with no-till, and incorporated only by cultivation with ridge-till. In the no-till management system in this study, a post-planting shallow cultivation was the only incorporation.

The initial pH level for the research plots was 5.6. For the majority of soils in the region, Iowa State University recommendations suggest that producers need 5,000-6,000 pounds of ag lime (conditions specific to this study site) to correct pH in their soil for several years. Factors that can affect recommendations include soil type, cropping practices, and the original pH levels.

The yield results are in for the first 5 years of the research. Soybean yields are significantly increased with lime application in all tillage systems, with higher application rates resulting in higher yields. All tillage systems showed similar results (Table 1). Corn yield was not increased by lime application in any year.

When considering application rates, the research showed a yield increase up to the highest lime rate, with a 3- to 4-bushel per acre increase from just 2,000-4,000 pounds/acre ag lime. Although the study shows yield response from soybeans, corn yields did not respond to ag lime, even though the surface soil pH was fairly acidic.

Many factors ultimately control how much economic benefit can be gained from ag lime and how long it can be sustained. For budget analysis, see Table 2. Generally, results from ag lime application depend on application rates and how much soil acidity is neutralized. In this study, ag lime in a no-till system increased soybean yields. However, profitability can only be determined by the soybean crop (because lime only increased soybean yield in this corn-soybean rotation), with the number of effective soybean crop-years being dependent upon application rate, lime cost, and soybean prices. The best recommendation is that producers gather their individual costs and soil analysis information, and figure out their own costs and benefits.

Table 1. **Effect of ag lime rate on soybean yield (mean for all tillage systems)**.

Ag lime (lb/acre)	1994	1995	1996	1997	1998	Mean
0	35.2	42.1	45.7	49.6	44.7	43.4
500	35.2	44.6	44.7	50.2	44.9	44.0
1,000	38.1	45.8	47.1	54.5	46.5	46.4
2,000	38.2	46.3	47.2	54.1	47.0	46.6
4,000	37.7	46.8	47.6	57.9	46.7	47.3
6,000	38.7	46.6	49.8	57.2	48.4	48.2

Table 2. **Partial budget analysis--soybean response to ag lime.**

Ag lime (lb/acre)	Total lime cost (@ $25/acre) $/acre	Yield response (bu/acre)	Gross return (@ $6.00/bu) $/acre	No. of soybean crops to pay for total lime costs (crop-years)
0	--	--	--	--
500	$6.25	0.6	$3.60	1.74
1,000	$12.50	3.0	$18.00	0.69
2,000	$25.00	3.2	$19.20	1.30
4,000	$50.00	3.9	$23.40	2.14
6,000	$75.00	4.8	$28.80	2.60

Measurements: Yield measurements for the ag lime research were taken at the ISU Northwest Research Farm, Sutherland, IA. The crop rotation was established in 1992, with the ag lime applied in December 1993. Yield measurements have been taken since the 1994 crop year, with no new lime applied since December 1993. **Soils**: Galva, Primghar, Marcus all with silty clay loam surface texture. **Tillage**: Entire site moldboard plowed Fall 1991 with tillage and corn-soybean crop rotation started in 1992. **Soil pH**: Initial 5.6 soil pH (surface 0-6 inches, May 1993). **Tillage treatments**: chisel plow, ridge-till, no-till. **Other management**: 120-130 lb N per acre as ammonium nitrate surface broadcast applied to corn. P and K broadcast across all plots as needed.

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