Can ground eggshells be used as a liming source?

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Introduction

Iowa has become the leading egg producing state in the U.S. It's common to see large-scale egg-laying units in many parts of Iowa. Although most plants ship the eggs intact, some facilities have begun to ship liquid eggs. One egg-breaking operation in northern Iowa produces approximately 15 tons of ground eggshells daily. Several other egg-breaking facilities are also operating in Iowa. The eggshells at most locations are ground, stockpiled, and applied to farm fields. Farmers want to know if the eggshells have any value as a liming source, and if so, at what rate they should be applied.

Objectives

This experiment evaluated the usefulness of ground eggshells as a liming source. The study also compared soil pH change and crop yield attained at multiple ECCE rates for traditional agricultural lime and ground eggshells.

Methods

The study was conducted at the Northern Iowa Research Farm (NIRF) near Kanawha and the Northwest Iowa Research Farm (NWRF) near Sutherland. The soil at the NIRF is a Clarion loam and the soil at the NWRF is a Galva silty clay loam. Both soils have a natural soil pH of 5.6-7.3. Eggshell samples were collected from stockpiles prior to application and analyzed for effective calcium carbonate equivalent (ECCE). Equal ECCE rates of agricultural lime and ground eggshells were applied. Treatment rates were CHECK, 500, 1000, 2000, 4000, and 8000 lb. /acre ECCE for eggshell and agricultural lime treatments. Treatments were replicated five times in Kanawha and four times in Sutherland. Plot size was 20 ft. x 50 ft. The treatments at the Northern Iowa Farm were applied during the spring of 2002; the treatments at the Northwest Iowa Farm were applied in the spring of 2003. Liming materials were incorporated prior to planting. Plots were planted to corn or soybean annually. Soil samples, 0-6 inch depth, were collected prior to application and following harvest annually. Plots were machine harvested and grain yield calculated using 15% moisture for corn and 13% moisture for soybean. Adequate rates of N, P, and K were applied across the entire study area to alleviate any potential yield responses from eggshells or soil test differences.

Results

Traditional agricultural lime appeared to change soil pH more quickly and to a greater degree at both locations six months following application (Figures 1 & 2). Statistically the material was significantly different at the NIRF, but not at the NWRF. The rate response was highly significantly different at both locations.

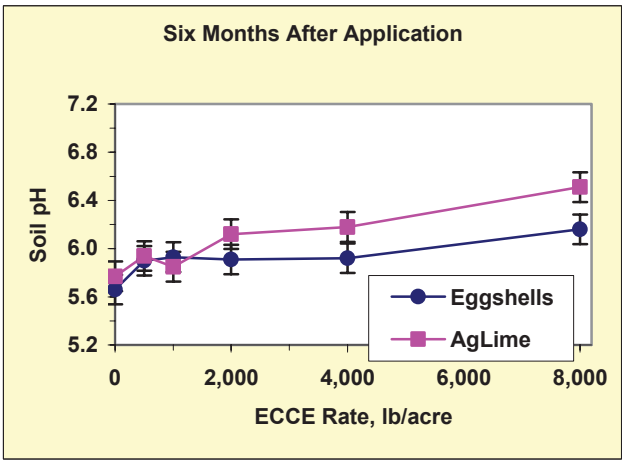

Figure 1. Soil pH change six month after application at Kanawha.

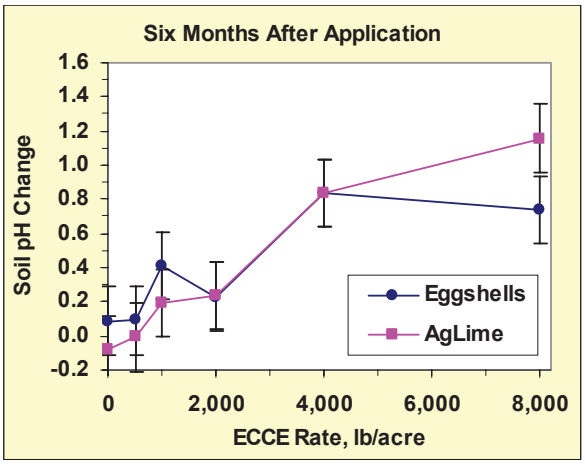

Figure 2. Soil pH change six months after application at Sutherland.

Soil pH changes in the eggshell treatments stop increasing as early as eighteen months following application for rates greater than 1000 lb. ECCE / acre (Figures 3 and 4). As soil pH increases the rate of change slows. The soil pH change for the low ECCE rates of eggshells surpassed the agricultural lime treatments as early as eighteen months following application. This would suggest that the ECCE of the eggshells was actually higher than the analysis reported. Thirty months after application the soil pH change appeared to plateau at the 4000 lb. ECCE rate at both Sutherland and Kanawha. The soil pH change has slowed because the soil pHs at both sites have risen to 6.5 or greater in these treatments. As soil pH approaches 7.0 it becomes more difficult to change the pH; therefore, the pH change has slowed or even stopped in these plots as the pH approaches 7.0 (Figure 6). The soil pH change continued to remain constant 54 months after application (2006) at Kanawha. This would indicate that the eggshells continue to react with the soil keeping the soil pH high (figures 7 & 8)

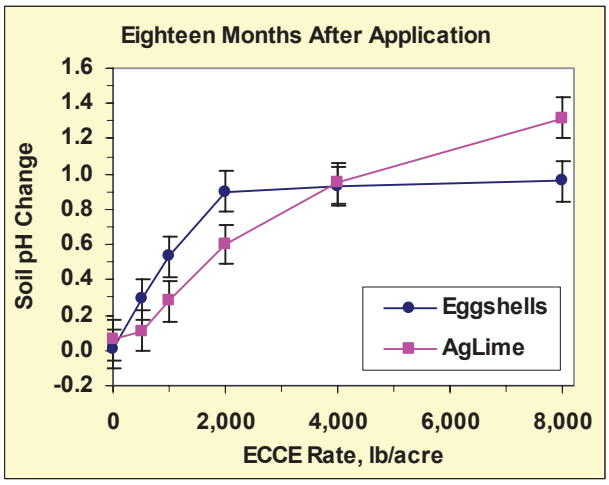

Figure 3. Soil pH change 18 months (2003) after application at Kanawha.

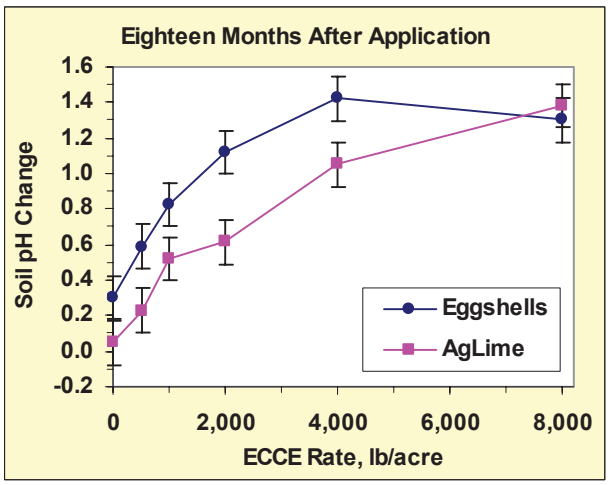

Figure 4. Soil pH change 18 months (2004) after application at Sutherland

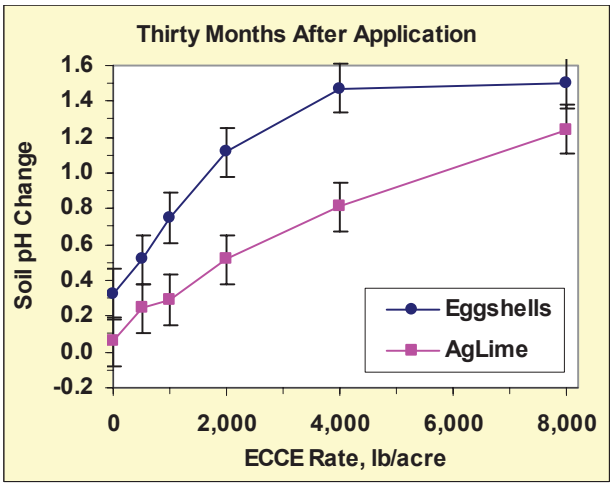

Figure 5. Soil pH change 30 months (2005) after application at Sutherland.

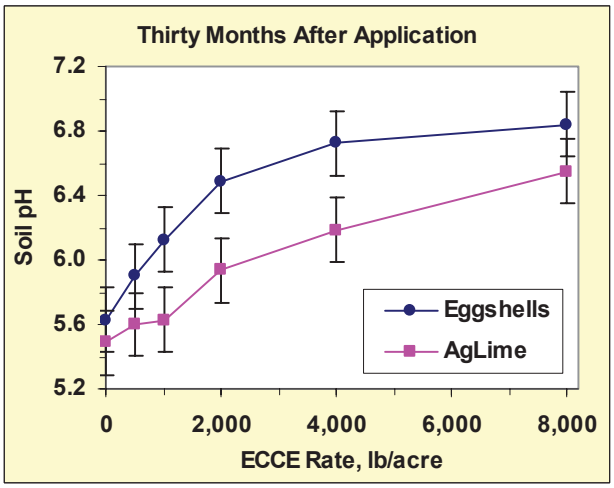

Figure 6. Soil pH 30 months (2005) after application at Sutherland.

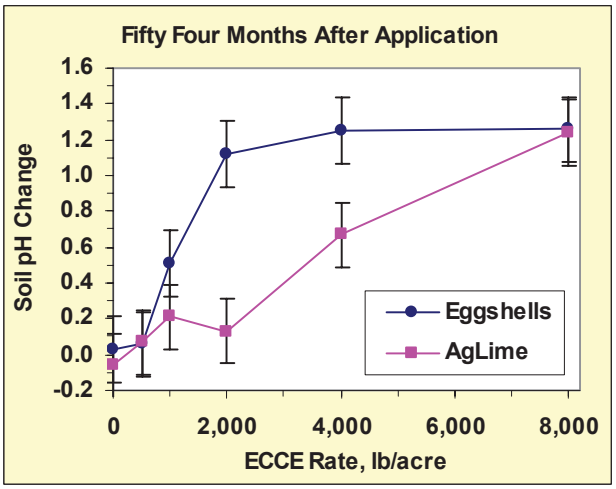

Figure 7. Soil pH change 54 months (2006) after application at Kanawha.

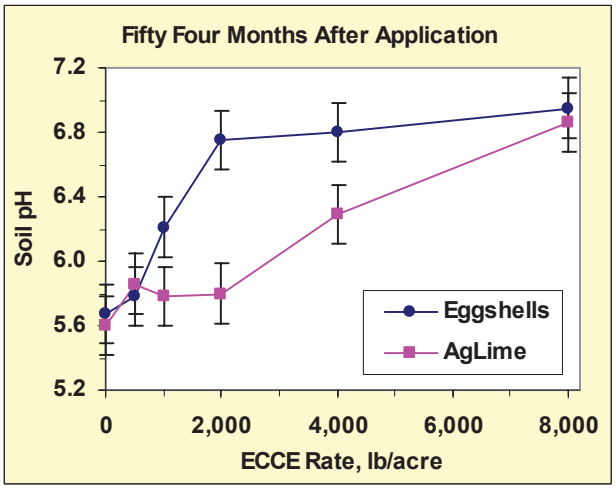

Figure 8. Soil pH 54 months (2006) following application at Kanawha.

No corn yield response was attained at either location from liming, regardless of the material (Figures 9). In 2006 the Sutherland site had a significant soybean yield response (Figure 10). The eggshells appeared to increase the soil pH more efficiently at the lower ECCE rates. Soybean yields at Kanawha were unaffected by liming rate or material in 2003 and 2005.

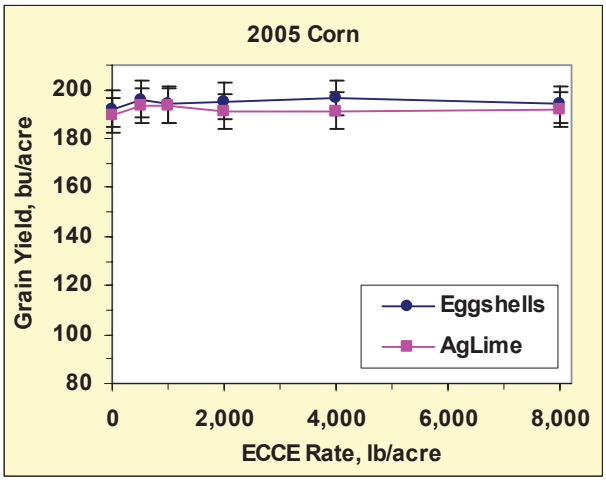

Figure 9. 2005 Corn yield response, Sutherland

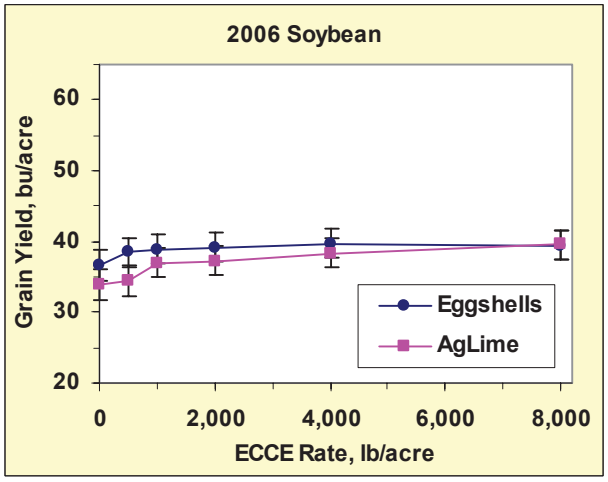

Figure 10. 2006 Soybean yield response, Sutherland

Conclusions.

Ground eggshells are an effective liming source. The standard procedure used to determine ECCE under-estimated the liming ability of eggshells. It appears that the ECCE should be 2-2½ times greater than the current method predicts.

Acknowledgements

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Complete analysis of liming materials

Kanawha

	Moisture	N	P (ppm)	K (ppm)	ECCE lb./T.
Lime	5%	BDL	<2.5	186	1871
Eggshells	16%	1.16 %	939	959	400

Sutherland

	Moisture	N	P (ppm)	K (ppm)	ECCE lb./T.
Lime	5%	BDL	<2.5	----	1560
Eggshells	17%	.53 %	683	775	300