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Use of Ground Eggshells as a Liming Source

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Abstract
It has become common to see large-scale egglaying units in many parts of Iowa. Although most plants ship the eggs intact, some facilities also ship liquid eggs. At these locations, the eggshells are ground, stockpiled, and applied to farm fields. Farmers want to know if the eggshells have value as a liming source, and if so, at what rate they should be applied.

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Use of Ground Eggshells as a Liming Source

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Introduction

It has become common to see large-scale egg-laying units in many parts of Iowa. Although most plants ship the eggs intact, some facilities also ship liquid eggs. At these locations, the eggshells are ground, stockpiled, and applied to farm fields. Farmers want to know if the eggshells have value as a liming source, and if so, at what rate they should be applied.

Objectives

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

Materials and Methods

The experiment site was Clarion loam soil. Eggshell samples were collected from stockpiles prior to application and analyzed for effective calcium carbonate equivalent (ECCE) using traditional methods (Table 2). Equal ECCE rates of agricultural lime and ground eggshells were applied in April 2002. Treatment rates were CHECK, 500, 1000, 2000, 4000, and 8000 lb ECCE /acre. Plot size was 20 ft × 50 ft. Treatments were replicated five times. Liming materials were incorporated prior to planting. Plots were planted to corn or soybean annually (2002–2008). Soil samples, 0–6 inch-depth, were collected prior to application and following harvest annually from 2002 to 2008. 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 nutrients in the eggshells or due to soil test differences.

Results and Discussion

There was no statistical difference in corn and soybean yields between the eggshell and the agricultural lime treatments (data not shown). Six months following application of the traditional agricultural lime, plots had soil pH equal to or greater than the soil pH of the eggshell plots (Table 1). The agricultural lime treatments were consistent with the recommendations provided in "A General Guide for Crop Nutrient and Limestone Recommendations in Iowa (PM 1688)." Figure 1 depicts the soil pH of the treatments 18 months following application. At the lower application rates the eggshell treatments had soil pH greater than the agricultural lime treatments. This would suggest that the ECCE of the eggshells was actually higher than the analysis reported. Seventy-eight months following application (2008), the soil pH of all the eggshell plots was greater than the pH of all of the agricultural lime plots. Statistically, the responses to the material (ag lime vs. eggshells) and to the ECCE rate were highly significant ($P < 0.0001$) (Table 3).

The soil pH of the eggshell plots seemed to plateau for rates above 2000 lb ECCE after 18 months. This trend continued for rates above 2000 lb ECCE/acre; however, the soil pH was much higher in recent years (Figure 1 and 2). As the soil pH approached 7.0, the pH change was less. It becomes increasingly more difficult to raise soil pH as the soil pH approaches 7.0.

Conclusions

Ground eggshells are a highly effective liming source. The eggshells seem to have a much slower dissolving rate than traditional agricultural lime. The standard procedure used to determine ECCE seems to underestimate the liming ability of ground eggshells.

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Table 1. Soil pH for several ECCE rates for eggshell lime and agricultural lime plots at three time intervals.

Eggshell lime treatments				Agricultural lime treatments			
Rate	Initial pH	6 mo pH	2008 pH	Rate	Initial pH	6 mo pH	2008 pH
0	5.64	5.66	5.85	0	5.66	5.77	5.79
500	5.72	5.90	6.12	500	5.79	5.94	5.95
1000	5.70	5.93	6.46	1000	5.57	5.85	5.99
2000	5.63	5.91	7.03	2000	5.67	6.12	6.21
4000	5.55	5.92	7.19	4000	5.62	6.18	6.35
8000	5.69	6.16	7.39	8000	5.62	6.51	7.08

Table 2. Complete analysis of liming materials.

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

[a]Below detectable level.

Table 3. Statistical analysis of eggshell lime study, October 2008.

Source of variation	Numerator degrees of freedom	Denominator degrees of freedom	F-level	P-significance
Material	1	8	66.35	< .0001
Rate	5	40	149.15	< .0001
Material * rate	5	40	15.36	< .0001

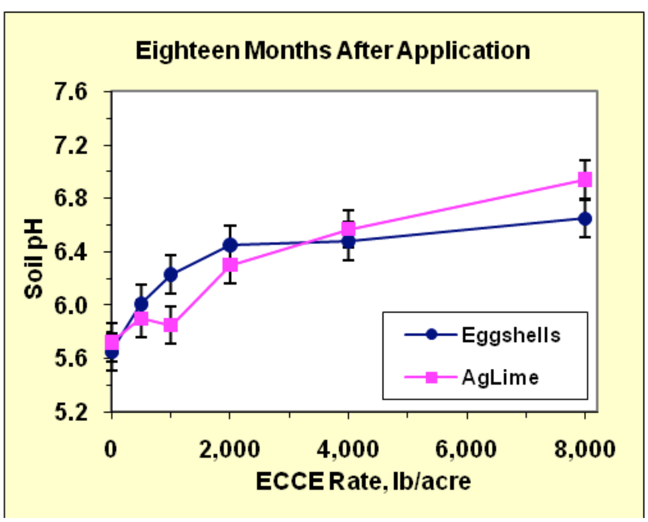

Figure 1. Soil pH, October 2003. Vertical bars are confidence intervals (90%) for each mean value.

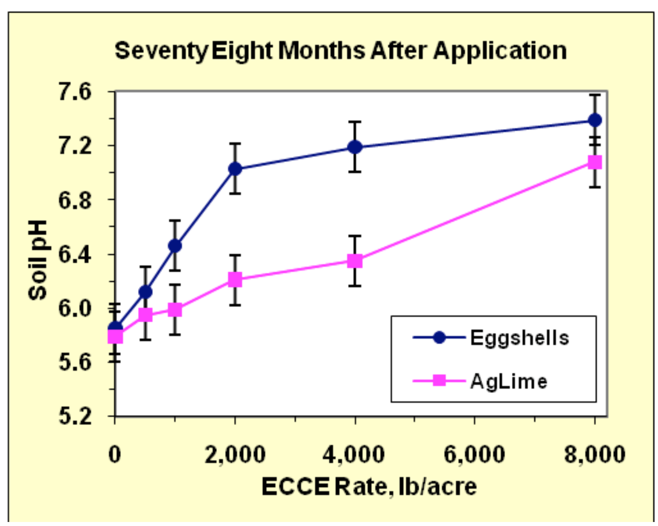

Figure 2. Soil pH, October 2008. Vertical bars are confidence intervals (90%) for each mean value.