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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, egg-layer units in many parts of Iowa. Although most units 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-layer units in many parts of Iowa. Although most units 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 effective calcium carbonate equivalent (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 ECCE using traditional methods (Table 1). Equal ECCE rates of agricultural lime and ground eggshells, based on the lab analysis, were applied in April 2002 (Table 2). 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 (2002–2012). Soil samples, 0–6 in. depth, were collected prior to application and following harvest annually from 2002 to 2008. The plots were also sampled in 2010 and 2012 following corn. 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. 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. At 72 months (Figure 2), the pH was higher for all eggshell rates. This indicates that the ECCE of the eggshells was actually higher than the analysis reported. In 2012, (126 months after application), the soil pH of all eggshell plots was greater than the pH of all of agricultural lime plots (Table 3). The pH values of all samples taken in 2012 were lower likely due to the drought. The soil pH with the eggshells continued to increase through the 78-month period, and have remained high with the latest 2010 and 2012 sampling. The soil pH increased above 7.0 only for the highest material application rates, especially with the eggshell rate based on lab-determined ECCE. The standard procedure used to determine ECCE underestimated the liming ability of ground eggshells by two to three times. Using incorrect ECCE values for the eggshells resulted in over-liming.

Conclusions

Ground eggshells are a highly effective liming source; however, correct ECCE values need to be used to avoid over-liming soils. The eggshells seem to have a slower initial dissolution rate than traditional agricultural lime, but standard ECCE values underestimate the liming ability of ground eggshells by two to three times.

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Table 1. Complete analysis of liming materials.

	Moisture (%)	N (%)	P (ppm)	K (ppm)	CCE %[b]	ECCE (lb/T)0
Lime	5%	BDL[a]	< 2.5	186	97	1,871
Eggshells	16%	1.16 %	939	959	74	400

[a]Below detectable level.
[b]Calcium carbonate equivalent.

Table 2. Application rate of liming materials.

Rate (ECCE lb/acre)	0	500	1,000	2,000	4,000	8,000
Eggshells (lb/acre)	0	2,500	5,000	10,000	20,000	40,000
Ag. lime (lb/acre)	0	650	1,300	2,600	5,300	10,600

Table 3. Soil pH for several ECCE rates for eggshell lime and agricultural lime plots at three time intervals.

Eggshell treatments					Agricultural lime treatments				
Rate	Initial pH	2008 pH	2010	2012	Rate	Initial pH	2008 pH	2010	2012
0	5.64	5.85	5.83	5.18	0	5.66	5.79	----	5.08
500	5.72	6.12	6.08	5.36	500	5.79	5.95	5.87	5.25
1000	5.70	6.46	6.53	5.84	1000	5.57	5.99	5.96	5.28
2000	5.63	7.03	7.25	6.71	2000	5.67	6.21	6.18	5.55
4000	5.55	7.19	7.52	7.04	4000	5.62	6.35	6.48	5.66
8000	5.69	7.39	7.66	7.21	8000	5.62	7.08	7.19	6.51

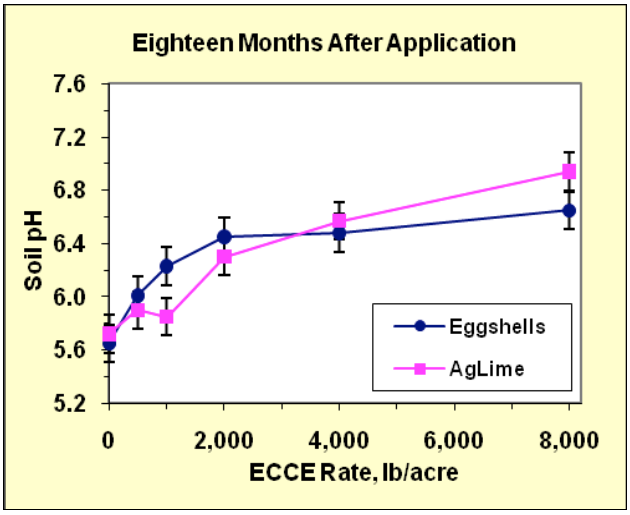

Figure 1. Soil pH, October 2003. Vertical bars are confidence intervals (90%) for each mean value.

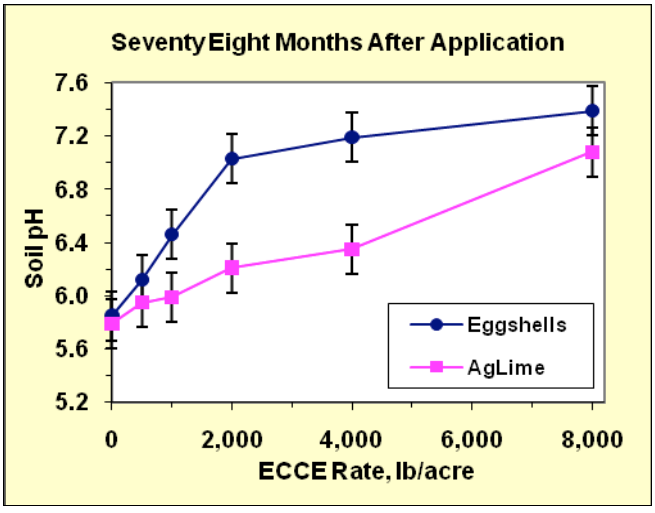

Figure 2. Soil pH, October 2008. Vertical bars are confidence intervals (90%) for each mean value.