

2011

Soil pH Change over Time as Affected by the Limestone Sources and Application Rate

Agustin Pagani
Iowa State University

Antonio P. Mallarino
Iowa State University, apmallar@iastate.edu

Follow this and additional works at: http://lib.dr.iastate.edu/farms_reports



Part of the [Agricultural Science Commons](#), [Agriculture Commons](#), and the [Agronomy and Crop Sciences Commons](#)

Recommended Citation

Pagani, Agustin and Mallarino, Antonio P., "Soil pH Change over Time as Affected by the Limestone Sources and Application Rate" (2011). *Iowa State Research Farm Progress Reports*. 171.
http://lib.dr.iastate.edu/farms_reports/171

This report is brought to you for free and open access by Iowa State University Digital Repository. It has been accepted for inclusion in Iowa State Research Farm Progress Reports by an authorized administrator of Iowa State University Digital Repository. For more information, please contact digirep@iastate.edu.

Soil pH Change over Time as Affected by the Limestone Sources and Application Rate

Abstract

Limestone is commonly used in Iowa to maintain optimum soil pH for crop production. There is insufficient information, however, concerning the reaction time in the soil and short-term effects on crop yield for different sources and application rates. This information is needed to improve soil pH management and lime recommendations. The objective of this study was to study the soil pH and crop response to the application of pure calcium carbonate (CaCO₃), and calcitic or dolomitic limestone in a typical acid soil of central Iowa.

Keywords

RFR A10113, Agronomy

Disciplines

Agricultural Science | Agriculture | Agronomy and Crop Sciences

Soil pH Change over Time as Affected by the Limestone Sources and Application Rate

RFR-A10113

Agustin Pagani, graduate research assistant
Antonio Mallarino, professor
Department of Agronomy

Introduction

Limestone is commonly used in Iowa to maintain optimum soil pH for crop production. There is insufficient information, however, concerning the reaction time in the soil and short-term effects on crop yield for different sources and application rates. This information is needed to improve soil pH management and lime recommendations. The objective of this study was to study the soil pH and crop response to the application of pure calcium carbonate (CaCO_3), and calcitic or dolomitic limestone in a typical acid soil of central Iowa.

Materials and Methods

The experiment was established in spring 2009 at the Ag Engineering/Agronomy Research Farm on an area with Clarion loam soil. The initial soil pH was 5.7, SMP buffer pH was 6.6, and organic matter was 4.2 percent. Fifteen treatments replicated three times were the combinations of three lime sources and five application rates. The sources were pure, finely ground calcium carbonate (CaCO_3), calcitic limestone (41% calcium and 0.2% magnesium), and dolomitic limestone (20% calcium and 8% magnesium). The calcium carbonate equivalent (CCE) concentrations were 99, 89, and 69 percent, respectively. The application rates were based on the CCE of each source, and were 0, 2, 4, 6, and 10 ton CCE/acre. The Effective CCE (ECCE, which also considers fineness) was 98, 54, and 39 percent, respectively. The highest ECCE rates applied were 9.8, 5.4, and

3.9 ton/acre for the calcium carbonate and the calcitic and dolomitic limestone. The amendments were applied on April 17, and were incorporated into the soil by disking. Soybean was planted in 2009. Soil samples were collected from a 6-in. depth before applying lime, seven times until September 20, 2010. No-till corn was planted after the last soil sampling date to evaluate grain yield for a second year.

Results and Discussion

The soil pH increase over time due to lime application was curvilinear with decreasing increments to a maximum plateau for all lime sources and application rates. The maximum plateau pH level varied across lime sources and rates, but was reached about 150 days after liming or sooner (Figure 1). Data for the control plots were useful to demonstrate a significant seasonal variation of soil pH. We were very careful to avoid lime contamination of the control plots. The acid initial pH of 5.7 (average of several samples) seemed to be a temporal natural variation that was not observed again until the end of the study. The early pH increase and the maximum pH reached were greater for the pure calcium carbonate than for either limestone. We did not expect such a fast reaction of limestone with soil, but plateau maxima observed for the three sources suggest that no further pH increase would occur.

The CCE application rate needed to maximize soil pH was lowest for the calcium carbonate, intermediate for calcitic limestone, and highest for dolomitic limestone (Figure 2). Because the rates were based on similar amounts of CCE for all sources, we believe that a finer particle size likely explains a higher maximum acid-neutralizing effect for

the finely ground, pure calcium carbonate. The lowest maximum soil pH reached with the dolomitic limestone compared with the calcitic limestone was explained by its coarser particle size.

There were no corn or soybean grain yield increases from application of any lime source. This result gives support for a temporal variation for the very acid initial pH, because pH for the control plots was higher for most other sampling dates.

Conclusions

The different lime sources determined different rates of soil pH increase until about 150 days after application. The maximum plateau pH reached was lower for limestone than for pure CaCO₃, presumably due to a coarser particle size (lower ECCE).

Acknowledgements

We thank Michael Fiscus, Agronomy Farm, for his help with the crop and soil management and Louis Thompson, ag specialist, for his help with soil sampling and crops harvest. This study was supported in part by the Iowa Soybean Association.

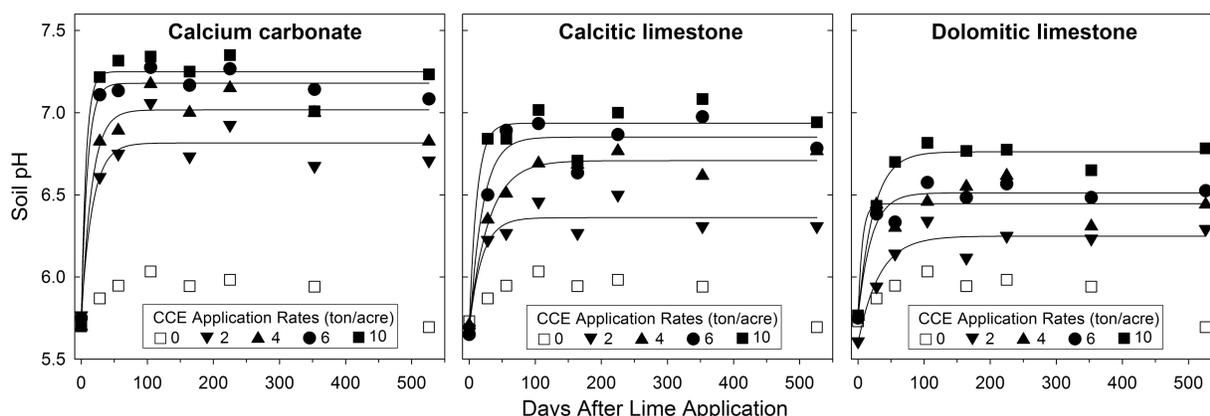


Figure 1. Soil pH trends over time as affected by three lime sources and the calcium carbonate equivalent (CCE) application rate.

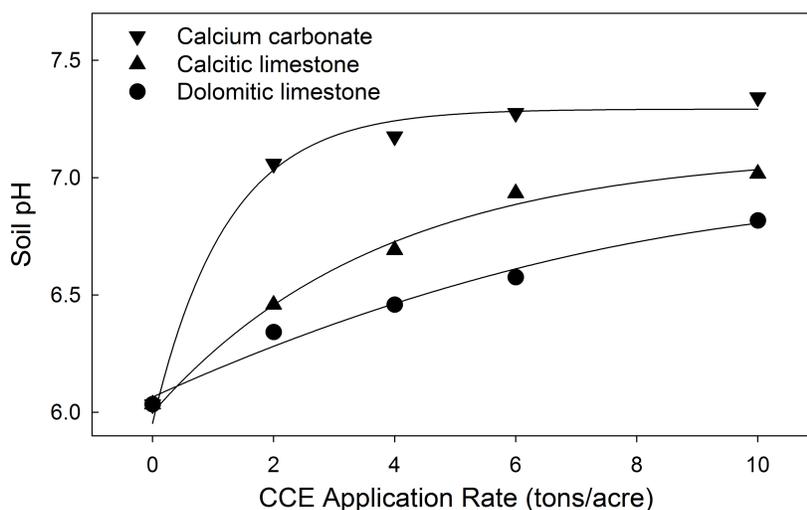


Figure 2. Soil pH as affected by three lime sources and the calcium carbonate equivalent (CCE) application rate for the sampling date about 100 days after liming (when the maximum pH was reached for most treatments).