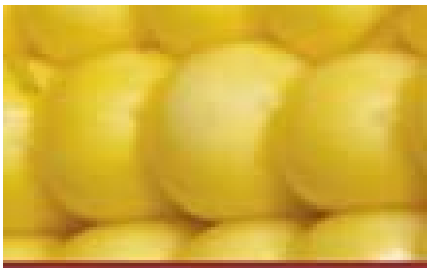
Mississippi Corn Promotion Board
2012 Progress Report



Project Title: Addressing acid soil conditions in Mississippi corn production

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Department: Plant and Soil Sciences:

Project Summary (Issue/Response)

Lime is expensive in Mississippi because calcitic and dolomitic materials must be imported. This leads to reluctance to lime soils, yet soil acidity issues plague producers every year through reduced yields due to inefficient nutrient availability in the soil and reduced root growth. The soil testing recommendation for lime is termed a "Lime Requirement" which is not a simple function of pH; instead it reflects the reactivity of the soil which depends on site-specific, unique mineralogy and organic matter characteristics. It is not uncommon for two soils with the same pH to need very different quantities of lime to change the pH upward. However, low pH is the first indicator that productivity and profits may be diminished. Although it varies among the soil regions of the state, about half the soil samples tested by the MSU Extension Service with feed grains as the intended crop had pH values less than 6 over the past five fiscal years. This indicates that productivity may be limited on those soils. Input side thought experiment: if these samples reflect only 25% the corn acreage in the state, or about 200,000 acres for this example, and each acre was recommended to receive two tons of $40/ton lime per acre. The lime investment would be $4,000,000 per year prorated over four years (the recommended interval between lime applications). On the output side, if yields are diminished 20% from 180 bushel per acre due to soil acidity, at $4 per bushel (conservatively as the cash bid is $7.16 as of this writing), the diminished gross return is $144 per acre. If only 100,000 acres are affected, or about one-eighth the total acreage, the loss to acidity is about $14,000,000 each year, or $56,000,000 over four years. Buffer-pH lime determinations use chemical solutions to estimate the quantity of lime that should produce the desired change in soil pH. These solutions used in soil testing must meet criteria such as cost effectiveness, shelf life, ease of use, repeatability, agronomic effectiveness, and environmentally conscientious disposal. Significant research has been conducted over the past decade to verify the soundness of various options to older, less environmentally safe solutions

Objectives

1. Continue the validation of the revised Sikora buffer pH method as a viable alternative for determining lime requirements for corn production in Mississippi by incorporating a field trial component.
2. Continue disseminatation of the importance of managing soil acidity through MSU Extension Programming r to improve corn production profitability and soil fertility management.

Project Results

Phase 1:
Ten soils with initial pH values of 4.33 to 5.26 were collected and preliminary Lime Requirements (LR) were determined to a target pH of 6.8 using an average of current methods used by the University of Georgia, the University of Kentucky, and Auburn University. Incubations of six weeks with alternating wetting and drying cycles were conducted with regent grade $CaCO_3$ added at the rates of 0, 0.25xLR, 0.5xLR, 0.75xLR, and LR to each soil. Subsamples of the incubated soil were then sent to Mississippi State University, Auburn University, University of Kentucky, University of Georgia, North Carolina State University, University of Florida, and Clemson University public soil testing laboratories for analysis of pH and LR using the routine methods of the respective laboratories. The regression analysis (Table 1) shows that the Sikora (2) method LR was more highly correlated with buffer than the other methods, including the Modified Woodruff currently used by the MSU ES Soil Testing Laboratory.

Phase 2:
Twelve soils from different sources were collected from various sources. Samples were analyzed for texture and initial pH in water. Initial pHs ranged from 4.1 to 4.9, indicating these soils would all require lime addition to reach the target pH. The amount of $CaCO_3$ needed to reach a target pH of 6.8 was determined using the Sikora and Woodruff methods. Reagent grade $CaCO_3$ was added to each soil in the appropriate amounts and deionized water was added to 80% of field capacity. Lime rates ranged from 4020 to 8534 lb/A for the Sikora buffer method to 4080 to 8400 lb/A for the Woodruff buffer method. The soils were then incubated with alternating wetting/drying cycles for approximately 30 days. At the end of the incubation period, the soils were again analyzed for pH in water. After incubation, pH values for the soils where the Woodruff buffer method was used to determine the lime requirement ranged from 7 to 7.6 with an average of 7.3 (0.5 pH units over the target pH). Values for the soils where the Sikora method was used to determine the lime requirement ranged from 6.1 to 8.3 with an average of 7.1. It appears the Sikora method will give a better estimate of lime requirement for soil testing purposes.

Phase 3
Beginning in 2012, a field component was added as a third research objective. An on-farm site for lime requirement research was found near Sidon, MS. Grid soil samples were collected and lime requirement determined using the existing (Woodruff) and the proposed (Sikora II) buffer methods. Plots consisted of zero rate controls and the recommended rate of lime determined by the two methods. Both methods recommended 1.7 t/A. Each plot was replicated at least three times. Lime applications were coordinated with private sector agricultural retailers and custom applicators. After liming treatments were applied each plot will be soil sampled on 6 month intervals to evaluate each lime requirement determination's ability to predict a target pH. We are requesting a no-cost extension to continue monitoring the change in pH over the next year.

Table 1.Correlation of buffer pH and Lime Requirement as determined by methods used by public soil testing laboratories in the southeastern United States.

Buffer Method	r^2
Adams and Evans	0.32
Mehlich	0.22
Modified Adams/Evans	0.27
Moore-Sikora	0.26
Sikora (2)	0.89
Modified Woodruff	0.37

Project Impacts/Benefits

Soil pH is considered a master soil variable that affects a wide range of soil chemical and biological functions including nutrient and toxin availability. Once we establish the soil pH is low, we must determine the reactivity of the soil. This project will provide farmers in Mississippi an accurate method of determining that reactivity. This study will also find an alternative lime requirement method that discontinues the use of chemicals determined to be hazardous to the environment. These findings should help to maintain the cost of soil test analysis. They will also provide an indication of lime reactivity across the wide range of soil properties found in the state and thus, have a large impact on corn production in the state.

Project Deliverables

Oldham, L and M.S. Cox . The Mississippi Lime Project. SERA-IEG-6 2011 Annual Meeting. 19-21. Raleigh, NC (invited)

Cox. M.S. and J.L. Oldham. Lime Requirement Method comparison for Use in Mississippi. ASA, CSSA, SSSA Annual Meetings. San Antonio TX.

Cox, M.S. Lime Requirement of Soils. Cox, M.S. Mississippi Crop College.

Cox. M.S.,The Mississippi Lime Requirement Contest. SERA-IEG-6 Annual Meeting