FIELD EVALUATION OF IN-FURROW AND SURFACE-BAND APPLICATION OF EQUITY SOIL AMMENDMENT FOR COTTON PRODUCTION M. Wayne Ebelhar, Gabe L. Sciumbato and Davis R. Clark Mississippi State University Stoneville, MS

<u>Abstract</u>

Increasing nutrient uptake efficiency has been a goal of researchers for years and many continue to evaluate concepts and products that may increase fertilizer efficiency. EquityTM, a soil amendment from Naturize BioSciences was evaluated in a replicated field trial on a Forestdale silty clay loam soil over a 2-year period. Two Equity formulations were used in the initial trial, one with humate, one without humate, while only one was evaluated during the second year. The products were applied in-furrow (IF) at planting, as a surface band (SB) application at planting, and as a combination of in-furrow and surface band (IF+SB) applications. These treatments were then compared to untreated controls (UTC). Nitrogen rates were similar for all plots and other cultural practices maintained uniformly across all plots. Seedcotton and lint yields were determined for all treatment combinations with lint yields based on hand-grab samples taken at harvest and ginned through a 10-saw micro-gin. Plant stands were measured following harvest by counting the two harvest rows. The highest seedcotton and lint yield was obtained the first year with 2 qt/acre Equity+humate applied in-furrow. In-furrow application of 2 qt/acre increased the lint yield by 118 lb/acre (8.9%) compared to the average of the two untreated controls. In the second year, one product was eliminated and the rates increased for the remaining product. There were no significant effects measured or observed in the second year. With any in-furrow application of material, there is a risk of damage to seed and potential stand loss. There was no significant change in stand as a result of the in-furrow applications in either year even when the in-furrow rate was increased. Final stands in 2003 were 3.1 to 3.2 plants/ft of row and 2.9 to 3.0 plants/ft of row in 2004. This translated to a plant population of around 41,000 and 38,500 plants/acre for respective years. When averaged across the two sources of Equity, both the IF and SB application of 2 qt/acre significantly increased seedcotton yields compared to the UTC using a 10% level of significance in 2003. The IF+SB system was intermediate between the other systems. When seedcotton yields were adjusted for lint percent, the lint yields were not significantly different at the 10% level. The trends were similar to those observed for seedcotton with yields that were 4.1 to 4.5% higher than the UTC. In 2004, there were no significant treatment effects with respect to yield and final plant populations. Reniform nematode numbers were evaluated at the end of the growing season. While numbers were above threshold levels, there was no apparent relationship between treatments and nematode numbers.

Introduction

Increasing nutrient uptake efficiency has long been a goal of researchers across the country and many continue to evaluate concepts and products that may lead to more efficient nutrient use that ultimately could reduce environmental implications of excess fertilizer applications. Naturize BioSciences and the Auburn University Biological Control Institute have been developing and field testing Equity[™] which is complex blend of soil microorganisms formulated in a flowable form with a rich organic food base. Equity development and use are based on the principles of agroecology. Agroecology has been defined as the study of agriculture as an ecosystem rather than just a production system. The soil system is very complex ecosystem in which microorganisms are the essential living component. These soil microorganisms include fungi, bacteria, actinomycetes, plant parasitic nematodes, bacterial- and fungal-feeding nematodes, micro-arthropods, yeasts, and blue-green algae. There are three major principles of agroecology:

- 1. Crop growth and health can be negatively affected by an imbalance in the microbial community;
- 2. The microbial balance in soils can be altered to favor beneficial microorganism that results in improved plant growth and tolerance to diseases;
- 3. Greater microbial activity of a soil results in less damage from soil-borne pathogens.

The primary effect of Equity on plants is a larger root system. This increased roots system helps plants with nutrient uptake, yield, and tolerance to the soil-borne diseases. When plants have inadequate nutrition, changes can occur in the chemicals being exuded from roots. Microbial balance can be altered by increasing organic matter, using cover crops, improving fertility, or by possibly adding beneficial bacteria as inoculants to soil or plants. The Naturize program is based

on solid scientific principles that believe that crop health can be improved by increasing the microbial activity of soil. Equity is being reported as a microbial product that introduces a complex and balanced microbial community to the soil. Mixtures of strains should be more consistent in promoting growth or causing biological control than individual strains. Equity has been reported to contain bacteria that produce plant growth regulators, bacteria that produce antifungal compounds, bacteria that fix nitrogen, actinomycetes that inhibit pathogenic fungi, and bacteria that produce polysaccharides to help form soil aggregates.

Initial investigations and research trials were implemented on potatoes, tomatoes, peppers, cucumbers, tobacco, peanuts, citrus, sweet potatoes, turf, pine nurseries, and pecans. Initial trials on cotton were begun in North and South Carolina, Georgia, and Alabama. Many of the studies were set up in grower fields that tend to be quite variable. This makes it difficult to account for random variation that occurs in all fields. In an effort to move the research effort into the Mid-South cotton area, field evaluations were set up in the Mississippi Delta. The objective of this research was to determine cotton response to in-furrow (IF) application, surface-band (SB) application, and a combination of IF and SB applications in the Mississippi Delta at different rates of product.

Materials and Methods

The initial study was established in 2003 on a Forestdale silty clay loam (Typic ochraqualfs) at the Tribbett Satellite Farm near Tribbett, MS. The study had a 4x2 factorial arrangement of EquityTM sources (with and without humate) and methods of application. The application systems were 1) an untreated control (UTC), 2) 2 qt/acre sprayed in-furrow at planting, 3) 2 qt/acre applied as a 4-in broadcast band directly over the row at planting, and 4) a combination of 2 qt/acre IF plus 2 qt/acre SB. A total of 150 lb N/acre was applied with 60 lb N/acre applied prior to planting and the remainder, 90 lb N/acre in 2003, applied as a sidedress application. In 2004, the N rate was reduced to 120 lb/acre with only 60 lb N/acre applied as the sidedress application. The N was applied as urea-ammonium nitrate solution (32% N) and "knifed" ten inches from both sides of the drill. Equity was diluted to give a spray volume of 5 gal/acre and sprayed at the time of planting. The cone-planter was equipped for in-furrow and broadcast-band applications either individually or combined and calibrated to deliver 5 gal/acre through a compress air-charged delivery system. 'SurwGrow 105' in 2003 and 'Phytogen 355' cotton seed was pre-weighed into packets and treated prior to planting. The area was conventionally planted on May 2, 2003 and April 21, 2004. All cultural practices including weed control, insecticide applications, and defoliation were held constant across all treatments.

Defoliation occurred in early to mid-September with a second defoliation applied as needed. All plots were harvested September 30 in both 2003 and 2004, with a commercial spindle picker adapted for plot harvest. Hand-grab samples of seedcotton were taken at harvest and ginned through a 10-saw micro-gin, without seedcotton or lint cleaning, to determine lint percent. Seedcotton yields were calculated based on the harvest from the two center rows of each 4-row plot. Final plant stands were taken after harvest and after the stalks were shredded by counting all plants from the two harvest rows. Soil samples were taken for soil analyses and nematode testing after harvest. Nematode samples were discarded by mistake in 2003 prior to analysis. Samples in 2004 were taken about six weeks after harvest. Soil samples were taken at the same time to determine nutrient status. Lint yields were then calculated from lint percent determined from the micro-gin for each individual plot. All yield data and components including seedcotton and lint yields and the lint percents, were analyzed statistically using the Statistical Analysis Systems (SAS) and Fisher's protected LSD for mean separations at the 10% level of significance. Main effects means were evaluated and presented when interactions were not significant at the 10% level.

Results and Discussion

The 2003 growing season was the initial look at Equity[™] soil amendment for potential use in cotton production in the Mississippi Delta with a follow-up study completed in 2004. While some positive results have been obtained with other crops, little is known about the product's use in cotton. Seedcotton and lint yields have been summarized in Figures 1a, 1b, 2a, and 2b. Seedcotton yields ranged from a low of 3272 lb/acre to a high of 3591 lb/acre in 2003 and from 3258 to 3533 lb/acre in 2004. The highest yield in 2003 was obtained with 2 qt/acre of Equity+humate applied in-furrow at the time of planting (Figure 1a). In-furrow applications of Equity without humate resulted in a significantly lower seed cotton yield. Combining in-furrow plus surface-band applications did not increase the seedcotton yields. There were significant differences in seedcotton yield observed in 2004. Total lint yields followed the same pattern as seedcotton yields each

year. The lint yield ranged from a low of 1317 to a high of 1448 lb/acre in 2003 and 1364 to 1483 lb/acre in 2004. In-furrow application of 2 qt/acre increased the lint yield by 118 lb/acre (8.9%) compared to the average of the two untreated controls (Figure 2a) in 2003 but no significant treatment effects were observed in 2004 even when Equity rates were doubled (Figure2b).

With any in-furrow application of material, there is a risk of damage to seed and potential stand loss. Final stand counts taken after harvests are summarized in Figures 3a (2003) and 3b (2004). There was no significant change in plant stand as a result of the in-furrow applications either year. Final stands were 3.1 to 3.2 plants/ft of row in 2003 and 2.9 to 3.0 plants/ft in 2004. This translated to a plant population of 40,500 to 41,800 plants/acre in 2003 and around 38,500 plants/acre in 2004.

There were no significant interaction between the application systems and the Equity sources or Equity rates. Therefore, some of the main effects are summarized in Figures 4a and 4b. Lint yields were 1329, 1389, 1383, and 1362 lb/acre for the UTC, IF, SB, and IF+SB systems, respectively in 2003 (Figure 4a). Both the IF and SB application of 2 qt/acre significantly increased seedcotton yields compared to the UTC at the 10% level of significance but the difference was not significant for lint yield. The IF+SB system was intermediate between the other systems. The trends were similar to those observed for seedcotton with yields that were 4.1 to 4.5% higher than the UTC. It was important to repeat these series of treatments again in 2004 in an effort to determine whether the trends may be significant in subsequent years. In 2004, the Equity-treated plots, when averaged across the two rates, were 2.8 to 5.3% lower than the untreated control with the greatest reduction in yield evident with IF application.

Reniform nematode counts were made more than a month following harvest and revealed above-threshold levels in many of the plots. However, the levels did not appear to be related to Equity applications. Further observations will be made in 2005 to monitor nematode numbers before, during, and after the growing season.

Summary

General field observations during the growing seasons would not have suggested any difference in treatments in either 2003 or 2004. However, yield measurements did show some significance at the 10% level and trends toward a response in 2003. The study was modified in 2004 with base treatments repeated in the same location to examine potential additive effects as suggested by Naturize Corporation. After two years, consistent results have not been obtained but lint yields have been high even in the presence of reniform nematodes. Further study is needed to address this factor.



Figure 1b: Cotton Reponse to Equity Soil Amendment *Total Seedcotton Yield*











Figure 3b: Cotton Reponse to Equity Soil Amendment Final Plant Stand



Figure 4a: Cotton Reponse to Equity Soil Amendment Total Lint Yield - Main Effects



Figure 4b: Cotton Reponse to Equity Soil Amendment *Total Lint Yield - Main Effects*

