Mississippi Corn Promotion Board
2019 Progress Report

Project Title: Interaction of Nitrogen and Zinc Rates for Corn and Cotton Grown in Rotation

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Project Summary (Issue/Response)

Zinc deficiency symptoms have continued to surface over the last several years and have been evident in both corn and cotton. The problem has been most evident on the sandier soils where organic matter levels are generally less than 1%. Efforts have been underway in the Mississippi Delta to increase organic matter levels by utilizing crop rotations. Crop rotations date back hundreds of years but the practice was abandoned in favor of mono-crop cotton when cotton was king in the Mid-South. In the last ten years, cotton acreage has decreased, and corn acreage has increased, especially when corn prices were high. In the last few years, corn acreage has declined and fluctuates from year to year but still exceeds cotton acreage in most years. Soil test zinc has been observed in the deficient range and could be increased with zinc fertilizer applications. Both soil-applied and foliar products are available but range in application cost and can be quite expensive. Research at the Delta Research and Extension Center has shown significant yield increases when cotton follows corn compared to cotton following cotton. The advantage has averaged from 10-17% in on series of studies to over 20% in the Centennial Rotation.

A corn/cotton rotation system is currently in place that has been used to evaluate the interaction of zinc rates and nitrogen rates for both the corn crop and the cotton crop. This will be a continuation of the on-going research. The studies are located at the Delta Research and Extension Center with four nitrogen (N) rates (Corn: 160, 200, 240, and 280 lb N/acre; Cotton: 30, 60, 90, and 120 lb N/acre) and four zinc (Zn) rates (0, 5, 10, and 15 lb Zn/acre). Zinc sulfate was utilized (dissolved the dry material in water) and applied with a rolling coulter rig, similar to urea-ammonium nitrate solution. The zinc application was applied as early as possible and applied as a sidedressed band. The area being utilized, consisted of five replications with plots 90-100 feet in length and has been established as a corn/cotton rotation (1:1). Results from the studies could then be used by producers in their decision-making process.

Project Results/Outcomes

The corn study was planted 2 April with a John Deere SR planter into a prepared seedbed. Heavy rainfall during the early growing season made March plantings difficult with over 50 inches of rainfall occurring in the first half of 2019. Cotton was planted 16 May into a prepared seedbed. The corn study never looked good during the year and had a relatively weak stand. The adjoining corn test was replanted but yields were even worse. Harvest of the center two rows of a 4-row plots was completed with a commercial combine (Gleaner K2) modified for plot harvest. Grab samples were collected during the harvest process and then used to determine harvest moisture, bushel test weight, and Seed Index (100-seed weight). Laboratory processing was completed for all grain samples and the data analyzed. Cotton was harvested on 19 November with exceptional yields, even after sitting in the field for 8-10 weeks after defoliation. Corn yields ranged from a low of 149.0 bu/acre to a high of 180 bu/acre and a field average of 164.9 bu/acre. With respect to corn, treatments were found to be significantly for both N rate and Zn rate with no significant interaction.

Bushel test weight and Seed Index were not influenced by the Zn rate while N rate was affected was significant for Seed Index. There was significant interaction between N rate and Zn rate so main effects could be calculated. When averaged across Zn rates (n=20) there was a significant N rate response in 2019 but no increase above 160 lb N/acre. For Zn rate main effects (averaged across N rates, n=20), there was a significant response to Zn but no advantage above 5 lb Zn/acre.

The cotton study was planted on 16 May with the initial N applied by the end of May. Sidedress N and Zn were applied at the same time but not in the same operation. Cotton was harvested on 19 November after sitting in the field for at least eight weeks waiting for harvest (not under control of the project). Unlike corn, there was no response to N rates or Zn rates in the cotton study. Lint yields ranged from a low of 1162 lb/acre to a high of 1459 lb/A but even with five replications the was a high level of variability across the field. The overall field average was 1300 lb/A (n=80 observations).

Results from the study would indicate that corn is more responsive to Zn applications than cotton in 2019 but that does not mean that this would be true in other years. The corn and cotton studies are being rotated with N rates adjusted for the crop being grown. The lack of response to N in the cotton is an indication that soil available N is present. With the level of rainfall in the last 18-24 months, one should expect above normal denitrification and loss of N from the soil profile. This research will continue should funds be available .

Project Impacts/Benefits

Zinc deficiencies are being observed in some area and some fields around the state in multiple crops including corn and rice and occasionally in cotton. Soil tests around indicate a low soil available Zn in a growing number of soils. As grain crops are grown in place of cotton and with the higher nutrient removal, nutrient deficiencies are going to continue. This is particularly true with sulfur (S) as the supply of S to soil is dwindling. The current research, especially for corn, has demonstrated a need and response to zinc. Further studies are needed for soil applied S but also research with other S sources. The S and Zn issues are not going away as long as nutrient removal continues to occur. Several Zn sources are available in the marketplace and that indicates the need must be present. The interaction of N rates along with Zn rates helps examine the interaction of the two nutrients. Producers need the results from unbiased research to aid in their decision making process.

Project Results

Delta Research and Extension Center
Interaction of Nitrogen Rates and Zinc Rates
Corn Grain Yield

N Rate	Zinc Rate (lb Zn/acre)									
(lb N/A)	0 lb/A		5 lb /A		10 lb/A		15 lb/A		MAIN	
	Grain Yield at 15.5% (bu/acre)									
120	149.0	f	162.2	b-f	158.2	c-f	165.8	a-e	158.8	B
160	151.0	ef	162.7	b-f	168.1	a-d	173.7	ab	163.9	AB
200	164.7	b-e	165.7	a-e	172.7	abc	168.3	a-d	167.8	A
240	155.9	def	172.4	abc	180.8	a	166.5	a-d	168.9	A
LSD (0.05)	(Prob. > F = 0.0074) 15.2								7.6	
MAIN	155.1	B	165.7	A	169.9	A	168.6	A	7.6	
N Rate X Zn Rate Interaction (Prob. > F = 0.4313 ns)										

Delta Research and Extension Center
Interaction of Nitrogen Rates and Zinc Rates
Cotton Lint Yield

N Rate	Zinc Rate (lb Zn/acre)									
(lb N/A)	0 lb/A		5 lb /A		10 lb/A		15 lb/A		MAIN	
	Cotton Lint Yield (lb/acre)									
30	1362		1360		1283		1162		1292	
60	1345		1303		1459		1213		1330	
90	1168		1186		1404		1374		1283	
120	1303		1344		1162		1360		1292	
LSD (0.05)	(Prob. > F = 0.4058) 258 ns								129 ns	
MAIN	1295		1298		1327		1277		129 ns	
N Rate X Zn Rate Interaction (Prob. > F = 0.1253 ns)										

Project Deliverables

Results from these studies are being presented at the Beltwide Cotton Conference and at the Southern Branch – American Society of Agronomy (Southern Association of Agricultural Scientists). This information in the form of deliverables is being made to producers and consultants as needed and will be better as more information (through repeated studies) becomes available. Have studies across multiple environmental seasons adds dependability to the outcomes of the research. With time and replications, the information gathered can be used to make sound decisions on Zn applications in both corn and cotton. The key to success is knowing what soil test Zn levels are present and also factors, such as pH, that influences Zn availability.