Mississippi Corn Promotion Board
2019 Progress Report

Project Title: Stepwise Evaluation of High Tech Production Systems Contrasted to Existing Standard Production Systems

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Project Summary (Issue/Response)

As corn acreage and production has increased over the last few years in the South, the need for continued evaluation and incorporation of technology adapted to the region is needed. The grain yields produced exceed the calibration range of many soil tests and biotechnological advances are continuing at great costs to the producer. They face many decisions about inputs to incorporate and what inputs result in economic gains. Yield gains do not always lead to financial gains when the whole-farm enterprise is considered. Research has shown yield gains but have not included the economic implications. Inputs for the project included: Whole plots (SR vs TR and seeding rates of 32K or 40K); and Subplots (N rates, P and K rates, S, Zn, and fungicides). Researchers have utilized a stepwise technique that creates a "high tech" system and then systematically removes an input such as additional N, P, K, or fungicide then evaluates yield gain or loss. The other system to be evaluated starts with a "standard practice" system, then adds the individual "high tech" input again in a stepwise fashion. The protocol established a "standard system" with of six inputs: seeding rates (32,000 seed/A), N (210 lb N/A) P and K (soil test recommended level), sulfur (none), zinc (none) and fungicide application (none). The "high tech" system had: increased seeding rate (40,000 seed/A), N (280 lb N/A), P (40 lb P/A), K (100 lb K/A), S (20 lb S/acre), Zinc (10 lb Zn/acre), and fungicide application (follow proposed recommendation). The 24-treatment studies were located at the Delta Research and Extension Center following soybean. Planting pattern (single-row [SR] vs twin-row [TR]) was evaluated at 32,000 and 40,000 seed/acre (whole plots). Heavy rainfall during the early growing season delayed planting until 1 April (50 inches of rainfall occurring in the first half of 2019). Some areas of poor beds led to poor stands and yields had to be adjusted based on stands in a few instances. Grain yields on the west end of the field (adjusted to 15.5%) ranged from a low of 184.6 bu/acre to a high of 238.6 bu/acre and an overall average yield of 218.4 bu/acre. Bushel test weights averaged 59.1 lb/bu while Seed Index was 34.1384 g/100 seed. Grain yields on the east side of the filed were very similar with a grain yield range from 185.6 to 238.3 bu/acre and a field average of 212.5 bu/acre.

Project Results/Outcomes

The project, as originally designed, was planted on 1 April 2019 after 12.57 inches of rainfall in February and 3.57 inches in March. After heavy rainfall through the fall of 2018 and winter of 2018-2019, the fields were extremely wet and prepared beds had deteriorated. Single-row [SR] planting was achieved with a John Deere MaxEmerge planter and the twin-row planting [TR] was accomplished with a Monosem twin-row planter. Both were set on 40-in row centers. Some of the poor beds resulted in reduced stands in both studies. The initial fertilizer N application was made 19 March with 120 lb N/acre applied as urea-ammonium nitrate (UAN, 32% N). The solution was applied with a rolling coulter applicator to both sides of the row for both SR and TR systems. The remaining N was applied with the same applicator on 22 May. The dry fertilizer additions were broadcast-applied on 15 May by simulated aerial application followed by incorporation with a cultivar. Zinc was dissolved in water and also applied with the rolling coulter applicator at a rate of 10 lb Zn/acre as zinc sulfate. The fertilizer phosphorus (P) and potassium (K) was applied at a rate of 90 lb P_2O_5/acre and 120 lb K_2O/acre with pre-weigh bags. Sulfur (S) was applied at 20 lb S/acre.

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 determine harvest moisture, bushel test weight, and Seed Index (100-seed weight). Grain yields were significant increased with respect to SR vs TR planting pattern and seeding rate. The grain yields were 209.1, 215.4, 222.4 and 226.8 bu/acre for the SR-32K, SR-40K, TR-32K and TR-40K combinations, respectively in the "Addition" Study (19-CR71). With respect to the subplot treatments (systems), grain yields were also significantly affected with applications of zinc and fungicide leading to higher yields. For the "Deletions" study (19-CR72), grain yields were also significantly affected by planting pattern and seeding rate in the same order as the other study. Yields were 204.2, 208.9, 217.0, and 220.0 bu/acre for treatments as listed. The subplots treatment were more variable but the greater yields were achieved with the higher N rate (280 lb N/A). System yields ranged from 204.0 to 217.3 bu/acre when adjusted to 15.5% moisture.

Bushel test weight and Seed Index (100 seed weight) were both significantly impacted by the planting pattern X seeding rate whole plot (RSxSR). Bushel test weight followed the same pattern as exhibited in the grain yield analysis while Seed Index was opposite. The greatest Seed Index was found with the SR-32K treatment and the lowest with the TR-40K system.

The impact of treatments was significant, especially with respect to planting pattern (row spacing, [RS]) and seeding rates [SR]. This has been demonstrated in other studies over the years indicating potential yield increases with using twin-row production systems and higher seeding rates in corn. Stand counts taken at harvest did show uneven stands in some strips but the non-uniformity of stand was more related to non-uniform beds rather than actual treatments. Production fields tend to be more uniform and this has been pointed out to the farm operations. Continuation of the project will be important to verify the results obtained in 2019. Some modification of the design will be made in 2020 in an effort to make more meaningful subplot comparisons.

Project Impacts/Benefits

Station research and on-farm research have both shown benefits from increased seeding rates and N rates in corn. Often the small increases in grain yields from increasing N rates has not been profitable even though the differences are significant. On-farm big plot research has shown grain yields increases up to 40,000 (40K) seeds/acre. Current research is being completed to take seeding rates in the Mid-South to even higher levels. After several years of research, going above 45K is not giving higher yields but is decreasing profits. IN the same study, increasing N rates above recommended levels has also not resulted in higher grain yields but does reduce profitability. The current project is planned for continuation. The combination of input factors is vital to profitable corn production in the Mid-South. The study puts together in one study many of the fertility and production related inputs that pose questions for producers each year. The overall impact is to increase profitability and this may actually be obtained with current yields. Producer often seek higher yields but greater profitability should be more important. While higher yields are important, unit cost of production is more important. The proposed research also shows the impact of just adding extra fertilizer when it may not be needed. Applying fertilizer for the sake of application may not be profitable. Soil sampling and belief in the product delivered is equally important to profitability. Producers should know the philosophy of the person/company handling their fertilizer needs and remember that they are in business to sell a product. Applying unneeded fertilizer can be a detriment to the environment and pocket book

Project Results

CORN PRODUCTION WITH MULTI-FACTOR INPUTS
Whole Plot Analysis – Planting Pattern X Seeding Rate
(Averaged across Subplot Factors) – 2019 ADDITION

Whole Plot Treatments	Grain Yield @ 15.5%		Bushel Test Weight		Seed Index	
	(bu/acre)		(lb/bu)		(grams/100 seed)	
SR – 32K	209.1	a	58.7		35.1594	a
SR – 40K	215.4	b	59.1		34.4901	ab
TR – 32K	222.4	c	59.2		34.1423	b
TR – 40K	226.8	d	59.3		32.7620	C
Prob. > F	< 0.0001	***	0.0766	ns	0.0008	***
LSD (0.05)	3.7		0.4		0.8364	
PP X SR Interaction	0.4098	ns	0.3312	ns	0.2070	ns

SR = Single-row TR = Twin-row 32K = 32,000 seed/acre 40K = 40,000 seed/acre

CORN PRODUCTION WITH MULTI-FACTOR INPUTS
SubPlot Analysis – Fertility/Fungicide Inputs
(Averaged across Whole Plot Factors) – 2019 ADDITION

Sub Plot Treatments	Grain Yield @ 15.5%		Bushel Test Weight		Seed Index	
	(bu/acre)		(lb/bu)		(grams/100 seed)	
N-210	214.9	b	59.1	ab	34.1202	
N-280	212.1	b	59.1	ab	33.8300	
N-280+P&K	222.5	a	59.0	b	33.7062	
N-280+P&K+S	215.8	b	59.0	b	34.7154	
N-280+P&K+S+Zn	222.0	a	59.6	a	34.1736	
N-280+P&K+S+Zn+F	223.1	a	58.7	b	34.2853	
Prob. > F	0.0010	**	0.0575	ns	0.7137	ns
LSD (0.05)	6.1	ns	0.6	ns	1.3247	ns

Project Deliverables

Results from this project will be the topic of discussion for the upcoming National Conservation Systems Cotton and Rice Conference and Southern Corn and Soybean Conference. One must be cautious in presenting limited data. However, when delivered in the proper manner, it can be quite useful to producers because it allows them to compare the practices with on-going research. As the studies are repeated and additional support for the practices become available, more confidence will be gained in the results and a stronger push for adoption. Theory is good but not always practical or economic. Popular press pushes information, supported by seed companies for high yields in yield contests. Unfortunately, when the grower is asked about his/her whole farm yields and the profitability of their "garden" plot, he/she is reluctant to respond.