AGRONOMY

SOYBEAN/CORN ROTATION WITH TWIN-ROW PRODUCTION SYSTEMS AND INCREASED NUTRIENT MANAGEMENT ON DIFFERENT SOILS

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"THIS RESEARCH, SPONSORED IN PART BY THE MISSISSIPPI SOYBEAN PROMOTION BOARD, IS EVALUATING THE NEED FOR SOIL TESTING AND FOLLOWING SOIL TEST RECOMMENDATIONS PLUS EXAMINES THE BENEFITS OF CROP ROTATION IN TWIN-ROW PLANTING SYSTEMS."

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Rotations involving corn and soybean have been occurring around the country especially in the Midwest and much of the Corn Belt. The most common rotation has been one year of soybean followed by one year of corn (1/1). The literature has been filled with documentation of the "rotation effect" with many potential explanations as to why the effect occurs. In the Mid-South and Southeast, less crop rotation was practiced because of cotton's presence on the farm landscape. Many fields have been continuously cropped to cotton for decades. In recent times, corn has replaced cotton, irrigation has replaced dryland or rain-fed production, and soybean has moved from the last crop planted to the Early Soybean Production System (ESPS) with planting in March and April rather than May and June. Raised beds remain the choice for most producers in the Delta on the lighter textured soils. Getting water off (drainage) and getting water on (irrigation) is of primary concern especially with early planting in corn and soybean. Large-tired equipment and the presence of cotton stimulate producers toward wide-row planting systems while many variations in planting patterns continue to be developed and evaluated. Twin-row planting helps to combine the wide-row and narrower-row technology into a viable alternative for Mid-South production systems. John Deere's introduction of a twin-row planter demonstrated industry's vision for the future as well and their recent purchase of Monosem planters. Twin-row production (two rows on a single bed) allows for more rapid ground cover and yet maintains adequate waterways for surface drainage and irrigation without bed compaction.

As grain yields increase, nutrient uptake and subsequently nutrient removal is increased. Many producers perceive fertility as not an issue in the Mississippi Delta, especially for soybean. Unfortunately, that perception has resulted in more and more nutrient deficiencies showing up across the area. With higher yields and little supplemental fertilizer nutrients, soil levels continue to decline. Nutrient nitrogen (N), phosphorus (P), potassium (K), sulfur(S) removal is generally higher for corn and soybean compared to cotton (as much as two to three times). Uptake in grain crops is much higher with some nutrients remaining in the stover material. These nutrients are recycled and reused. Should residues be removed for energy generation, as some have proposed, the decline in soil-available nutrients would be even greater. The purpose of this research has been to combine the future technologies into a management system that can optimize yields and increase profitability. The overall objectives of the study were 1) determine the agronomic implications of soybean/corn rotations in twin-row planting systems under standard and high fertility management and irrigation, and 2) evaluate the economic impact of the above systems on whole-farm enterprise profitability.

Multi-year field studies were established at two locations in 2012, one on traditional cotton/corn soil and the other on a clay soil that favors rice/soybean production. Two rotation system were included: 1/1 soybean/corn (SB/CR) rotation (one year SB followed by one year CR) and a 2/1 system (SB/SB/CR, two years of SB followed by one year CR). Each crop will be grown each year to minimize environmental confounding and to accurately portray the value of each crop each year. In six years, the 1/1 rotation will have gone through three cycles and the 2/1 system will have completed two cycles. The experimental units consisted of four rows on a 40-in row configuration and planted with a Monosem twin-row (TR) planter. Four replications were used for each location with four subunits within each treatment for examining variation within a treatment. Irrigation has been supplied through roll-out pipe with initiation determined by appropriate means. Planting seed selection has been based on the latest technology with seed price as a component of the economic analysis. The same cultivars are being used at each location but vary across years. Standard fertility (SF) practices have been defined as those based on soil test recommendation for the crop being grown. The high fertility (HF) has then been defined as 20-25% above recommended levels for each fertilizer nutrient. Plots have been maintained uniformly across treatment when possible. Harvest has been completed with commercial plot

TRT	Crop Sequence	2016 Crop	Fertility (lb/ac)			Soybean Yield (lb/ac) @13%	Corn Yield (lbu/ac) @15%
			N	P	K		
1	CR-SB	CR	220	0	0	–	187.6 b
2	SB-CR	SB	0	0	0	56.2	–
3	CR-SB-SB	SB	0	0	0	58.7	–
4	SB-CR-SB	CR	220	0	0	–	189.4 b
5	SB-SB-CR	SB	0	0	0	56.1	–
6	CR-SB	CR	260	26.2	50	–	206.2 a
7	SB-CR	SB	0	26.2	50	60.6	–
8	CR-SB-SB	SB	0	26.2	50	60.4	–
9	SB-CR-SB	CR	260	26.2	50	–	210.5 a
10	SB-SB-CR	SB	0	26.2	50	59.7	–
	LSD (0.05)					4.1	14.4
	Prob >F					0.1207 ns	0.0116

***Table 1.** Summary of 2016 grain yields in crop rotation systems for twin-row planting patterns averaged across replications (4) and subplots (4), sandy loam soil site.*

harvester modified for plot harvest with samples taken to determine harvest moisture, bushel test weight, and seed index (100-seed weight). The 2016 corn and soybean production on the sandy loam site has been summarized in Table 1 with grain yield corrected for moisture. There was no significant difference between the soybean yields as affected by the previous crop or fertility regime. Corn yields following soybean at the high fertility level were significantly higher (Table 1) with greater fertility but were not affected by the rotation system. In 2015, at the standard fertility level, corn following two years of soybean were 40 bushels per acre higher (28.8%). In 2016, when averaged across rotation systems, corn yields were increased by 20 bushels per acre (10.6%) with higher fertility.

The results from the clay site had much lower corn yields but similar soybean yields compared to the sandy site. The corn crop on the clay soil site was adversely affected by wet soil conditions early and later in the growing season. The results have been summarized in Table 2. Soybean yields were a little lower compared to the sand site with no response to increased fertility. Soil tests show the area to be above levels expected to respond to additional fertilizer. Fall and spring tillage can be delayed due to wet soils. Corn yields were 6.4 bushels per acre higher (4.1%) for the higher fertility treatments but the difference was not significant.

This was the fifth year of a planned six-year study and will be continued in 2017. This project has been supported in part by the Mississippi Soybean Promotion Board and their support is greatly appreciated. Soil samples were again collected after harvest from each plot. These samples were dried, ground, and then analyzed by the Soil Testing and Plant Analysis Laboratory at MSU. These results are used to determine fertility recommendations for the study.

Table 2. *Summary of 2016 grain yields in crop rotation systems for twin-row planting patterns averaged across replications (4) and subplots (4), clay soil site.*

TRT	Crop Sequence	2016 Crop	Fertility (lb/ac)			Soybean Yield (bu/ac) @13.0%	Corn Yield (bu/ac) @15.5%
			N	P	K		
1	CR-SB	CR	220	0	0	–	155.1
2	SB-CR	SB	0	0	0	55.7	–
3	CR-SB-SB	SB	0	0	0	56.4	–
4	SB-CR-SB	CR	220	0	0	–	156.3
5	SB-SB-CR	SB	0	0	0	56.1	–
6	CR-SB	CR	260	26.2	50	–	163.1
7	SB-CR	SB	0	26.2	50	56.0	–
8	CR-SB-SB	SB	0	26.2	50	53.2	–
9	SB-CR-SB	CR	260	26.2	50	–	161.2
10	SB-SB-CR	SB	0	26.2	50	57.2	–
	LSD (0.05)					5.1	11.9
	Prob >F					0.6701 ns	0.4107 ns