CORN, COTTON AND SOYBEAN RESPONSE TO REDUCED TILLAGE STALE SEEDBED SYSTEMS

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ABSTRACT

Studies were conducted to evaluate cotton yield response to tillage systems; and corn and soybean yield response to rotation and tillage. A three-year (2003-2005) tillage study on a Leeper silty clay loam soil in North Mississippi indicated differences between tillage systems but no tillage by year interaction for yield, plant height and number of nodes. No-till had less mid-season height and fewer nodes per plant than the early spring Prepmaster® bed system, fall bed-roller, fall Paratill® (10-12 inch depth under-row tillage) + bed-roller and alternating years of fall bed-roller and fall paratill + bed-roller. The fall applied bed-roller and spring applied Prepmaster stale seedbed system yields were 21 to 24% higher than no-till and equal to the Paratill treatments. A 5-year (2001-2005) study on a Blackland prairie clay soil (Catalpa silty clay loam) indicated no-till corn following no-till soybeans showed a rotation yield response 3 of 5 years with a 5-year average of 21%. There was no added corn yield response from tillage applied to the previous soybean crop. After the first two years (2001 and 2003), subsequent years (2003-2005) showed that no-till yield in both continuous soybeans and in a rotation with no-till corn were equivalent to the fall applied chisel-harrow (one-pass operation) reduced tillage stale seedbed system. However, the fall applied chisel-harrow system for the first 2 years averaged 13% and 20% more yield than no-till with continuous soybean and in rotation with no-till corn, respectively.

INTRODUCTION

Previous corn and cotton research on a silty clay loam soil in North Mississippi indicated deep under the row tillage in a reduced tillage stale seedbed system improved yield and profitability (Buehring et al., 1999a; Buehring et al., 1999b; Buehring et al., 2004). On a Blackland prairie clay soil, narrow soybeans in continuous monoculture and in rotation with corn showed a positive yield response to a fall applied reduced tillage stale seedbed system (Buehring et al., 1999c). No-till corn in the rotation with no-till soybean produced yield equal to conventional tillage corn. More recent cotton and corn research indicated no yield response to deep under the row tillage (Buehring et al., 2005; Dobbs et al., 2004). Our objectives in these studies were to evaluate: cotton growth and yield response to one-pass minimum tillage raised stale seedbed systems in comparison to raised stale seedbed systems with deep under the row tillage; and soybean and corn yield response to rotation and a fall applied reduced tillage stale seedbed system.

MATERIALS AND METHODS

Cotton Tillage Systems

The study was conducted on a Leeper silty clay loam soil as a randomized complete block design with 4 replications. Plot size was 4 rows (38-inch) by 500 ft long. All tillage treatments (fall bed-roller, fall paratill + bed-roller) except the Prepmaster® were applied in January 2003 (due to wet fall in 2002), October 2003 and November 2004. The Prepmaster treatment was applied in late March or early April of each year where stalks had been mowed the previous fall.

The Paratill implement, manufactured by Bigham Brothers, Lubbock, Texas, has an offset shank which lifts the soil under the row as it passes through the soil profile. Prepmaster is a pre-plant herbicide incorporator implement manufactured by Bigham Brothers, Lubbock, Texas. This implement was equipped with 16 inch wide sweeps positioned on the center of the row, a 9 inch wide buster sweep, rolling cutter bar, rolling basket and smooth metal roller. This implement was operated at 6 to 7 mph and formed a wide smooth surface bed height of 4 to 6 inches.

Recommended agronomic practices were used in the study for a 2 bale/acre cotton yield goal. Delta and Pineland Company Suregrow SG 215BR variety was planted no-till on all plots in late April or early May. Potassium and phosphorus fertilizers were applied based on soil test recommendation. Nitrogen fertilizer at 90 lb N/acre as a UAN (32%N) solution, was applied with a colter-knife system that placed the fertilizer approximately 6 inches from the row and 2 inches deep. The nitrogen fertilizer was applied to cotton in the pinhead square stage of growth. Pentia (mepiquat pentaborate) applications were made each year as needed to control rank growth.

The center 2 rows of the study were harvested in mid to late September with a 2-row spindle picker equipped for plot harvest. Grab samples were pulled from the seed cotton samples of each plot. The seed cotton samples were ginned with an 8-saw laboratory gin (no dryer, seed cotton cleaners, or lint cleaners) to determine percent lint turnout.

Data collected were: plant stands 5 weeks after planting (WAP); mid-season plant height and nodes/plant 11 WAP; seed cotton yield; percent lint turnout; and lint yield. The data were subjected to SAS mixed procedure analysis with year as main plot and tillage treatment as subplots (Littell et al. 1996). Means were separated using Fisher's Protected LSD calculated at the 5% significance level.

Corn-Soybean Rotation Tillage Systems

The study was conducted as a randomized complete block design with 4 replications in 20 ft wide by 60 ft long plots. The corn and soybean tillage and rotation systems are listed in Table 2 and 3, respectively. The reduced tillage (FCH) stale seedbed system was applied in the fall of each year with a high clearance chisel plow equipped with coulters in front of each chisel shank and a chain harrow attached to the rear of the chisel plow. All treatments were planted with a no-till planter equipped with residue movers and coulters.

Roundup WEATHERMAX (glyphosate) + Clarity (dicamba) at 1.0 + 0.25 lb ai/acre were applied in March of each year as a burndown to the entire study area. The Roundup Ready corn was planted no-till in late March or early April of each year at 28,000 seed/acre. Roundup Ready Maturity Group V soybean was also planted no-till in late April of each year. Both corn and soybeans were planted in 30 inch rows in 2000-2004 and 38 inch rows in 2005. Recommended agronomic practices were used for a yield goal of 150 bu/acre for corn and 50 bu/acre for soybeans.

The center 2 rows in each corn and soybean plot were harvested with a plot combine for grain yield. Corn and soybean grain yields were adjusted to 15 and 13% seed moisture, respectively. The data were subjected to Analysis of Variance procedure and means were separated using Fisher Protected LSD calculated at the 5% significance level.

RESULTS AND DISCUSSION

Cotton Tillage System

The environmental growing seasons were highly variable but the study mean lint yield was 1071 lb/acre. Since there was no year by tillage system interaction for mid-season plant height, nodes per plant, plant population and lint yield, the data was pooled over years and analyzed.

End of each growing season bed height measurements indicated 1 to 2 inches for continuous no-till and 4 to 6 inches for all other raised bed systems in 2003-2005 (data not shown). Tillage systems had no effect on population and percent lint turnout (data not shown).

Tillage systems showed differences for mid-season plant height, mid-season nodes per plant and lint yield (Table 1). Prepmaster, fall bed-roller, fall paratill + bed-roller and alternating years of fall bed-roller and fall paratill + bed-roller systems showed more mid-season growth (nodes/plant and plant height at 11 WAP) and 21 to 25% more lint yield than continuous no-till cotton. There were no yield differences among the raised bed systems which had some tillage. These results differed from reports (Stevens, et al., 1992; Triplett et al., 1996; Hutchinson et al., 1990) that after 2 years of no-till production on silt loam soils cotton yields were equal or greater than conventional tillage. The difference in no-till yield responses may be related to soil texture differences between the silt loam soil and the silty clay loam soil.

The spring one-pass (late March/early April) Prepmaster and the fall bed-roller tillage systems produced yield equal to the annual fall paratill + bed-roller or alternating years of fall bed-roller + fall paratill + bed-roller. This was in contrast to earlier research which showed a positive yield and profitable response to deep under the row tillage (Buehring et al., 1999a; Buehring, et al., 2004). However, the results are in agreement with more recent research that showed no yield response to deep under the row tillage for cotton (Buehring, et al., 2005). The contrasting results suggest that with less tillage in recent years, soil changes may have occurred which negated the positive benefit of deep under row tillage.

Corn-Soybean Rotation Tillage Systems

Corn study mean yield ranged from 124.4 in 2003 to 164.0 bu/acre for 2005 (Table 2). Three (2001, 2003, 2004) of 5 years, corn showed a positive yield response to rotation with a 5-year average increase of 21%. In the rotation, tillage with the previous soybean crop did not improve no-till corn yield. These results are in agreement with previous research that no-till corn showed yield equivalent to corn with conventional tillage on a Blackland prairie clay soil (Buehring et al., 1999c). However, the results are in contrast with Hairston et al. (1984) research reported that conventional tillage corn on a Blackland prairie clay soil produced higher yield than no-till.

The soybean study mean yields ranged from 40.5 in 2001 to 54.3 bu/acre in 2004 (Table 3). In the continuous monoculture, the FCH stale seedbed system only produced higher yield than no-till in 2002. However, in the rotation, FCH produced 8.3 and 9.6 bu/A higher yield than no-till soybeans in 2001 and 2002. Subsequent years 2003, 2004 and 2005, showed no yield differences between FCH and no-till in both continuous soybean and in rotation with corn. These results differ from research report by Hairston et. al., (1984) that on a Blackland prairie clay soil, conventional tillage soybean produced higher yield than no-till. However, these results agreed with previous research (Buehring et al., 1999c) on a Blackland prairie clay soil which indicated in continuous soybean and in a corn-soybean rotation FCH only produced higher yield than no-till soybeans in year one of a 3 year study. These results also are similar to reports (Stevens, et al., 1992, Hutchinson et al., 1990; Triplett et al., 1996) with cotton that after 2 years of no-till production on silt loam soils, cotton yields were equal or higher than conventional tillage.

When expressed as a percentage of yield averaged over years 2001 and 2002, and 2003-2005, FCH showed 9% and 13% higher yield for the rotation than continuous soybean, respectively, (Table 4). This is in contrast to no-till which showed a rotation advantage of 1% averaged for 2001 and 2002 and an 8% average advantage for 2003-2005.

Compared to no-till in continuous soybean, FCH showed 13% greater yield average for 2001-2002 but averaged 3% less yield than no-till for 2003-2005. In the corn-soybean rotation, FCH showed a 20% greater yield average than no-till for 2001-2002 with only a 2% greater yield average than no-till for 2003-2005.

CONCLUSIONS

Cotton Tillage Systems
A fall applied bed-roller or spring applied Prepmaster bed systems will produce yield equal to deep under the row tillage and 21 to 24% higher yield than no-till. Deep under row tillage may not be necessary on the silty clay loam soils of North Mississippi.

Corn-Soybean Rotation Tillage Systems
The rotation of no-till corn with no-till soybeans can improve corn yield as much as 21%. In a continuous soybean monoculture and rotation with corn, no-till may show as much as a 13% and 20% respectively, lower yield than FCH the first 2 years with no difference in subsequent years. Due to the potential 13 to 20% yield loss the first 2 years, the adoption of the no-till soybean production on the Blackland prairie clay soils of North and East Mississippi will be limited. However, FCH as a one-pass stale seedbed system offers an alternative to no-till or conventional tillage.

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Table 1. Three year (2003-2005) average tillage system effect on mid-season nodes per plant and plant height, and lint yield on a Leeper silty clay loam soil, Verona, MS.

Tillage System	Tillage Time	Plant height 11 WAP	Nodes per plant 11 WAP	Lint lb/acre
1. Prepmaster	Spring	34	12.0	1122
2. Fall bed-roller	Fall	35	12.4	1094
3. Fall paratill + bed-roller	Fall	35	12.2	1098
4. Fall bed-roller 2002 fb fall paratill + bed-roller 2003 fb fall bed-roller 2004	Fall	36	12.4	1134
5. No-till	---------	29	11.2	905
Mean		34	12.0	1071
LSD 0.05		2	0.6	54

Table 2. Corn yield response to tillage and rotation on a Blackland prairie clay soil in 2001-2005, Verona, MS.

	------------------Yield bu/acre-----------------					
Rotation/tillage systems	2001	2002	2003	2004	2005	5 yr Mean
I. Continuous corn						
1. No-till (NT)	105.3	151.8	94.2	107.4	156.3	123.0
II. Corn rotated after soybeans						
2. NT corn after NT soybean (Bn)	148.2	163.0	139.7	132.7	163.6	149.4
3. NT corn after fall colter-chisel-harrow (FCH) Bn	153.9	158.3	139.3	135.9	172.1	151.9
Mean	135.8	157.7	124.4	125.3	164.0	141.4
LSD (.05)	12.2	NS	33.9	11.0	12.6	
% CV	9.2	3.5	16.2	5.5	4.7	

Table 3. Soybean yield response to tillage and rotation on a Blackland prairie clay soil in 2001-2005, Verona, MS.

	------------------Yield bu/acre------------------					
Rotation/tillage systems	2001	2002	2003	2004	2005	5 yr Mean
I. Continuous soybean						
1. No-till (NT)	38.1	37.6	38.6	53.4	42.2	42.0
2. Fall colter-chisel-harrow (FCH)	41.0	45.8	36.0	52.2	42.7	43.5
II. Soybeans rotated after corn						
3. NT Bn after NT corn	37.2	39.0	41.9	55.2	48.4	44.3
4. FCH Bn after NT corn	45.5	49.4	44.5	56.5	48.3	48.8
Mean	40.5	43.0	40.3	54.3	45.4	44.7
LSD (.05)	5.2	4.8	5.2	NS	4.5	
% CV	8.4	3.5	8.7	7.7	6.4	

Table 4. Soybean percent yield response as influenced by tillage system and rotation, 2001-2005, Verona, MS.

	2001-2002	2003-2005	5 year Av
Tillage System	----------------% Rotation yld > continuous----------------		
FCH	9	13	11
No-till	1	8	5
Production System	--------------% FCH yield > no-tillage--------------		
Continuous Soybean	13	-3	4
Soybean – corn rotation	20	2	9