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COTTON YIELD RESPONSE TO REDUCED TILLAGE SYSTEMS AND ROTATION

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Abstract

Seven tillage systems for corn residue incorporation in continuous cotton and cotton following ridge-tillage corn were evaluated (1999-2002) in a non-irrigated system on a Marietta silt loam soil to determine their influence on cotton lint yield and turnout. The corn production system across all cotton tillage systems was planted no-till and had one ridge-till cultivation during the growing season. The 3-yr (2000-2002) cotton lint yield average was 984 lb/acre. Rotation increased yield from 57 to 160 lb/acre with a 3-yr (2000-2002) average of 100 lb/acre. Analysis indicated a tillage and a year by rotation effect on lint yield. There was no rotation, rotation by tillage, year by tillage, or year by tillage by rotation effect on yield. The year 2000 was the only year rotation had yields higher than conventional cotton. Conventional tillage, fall terratill-bed-roller (one-pass operation) and ridge-till followed by (Fb) do-all (row conditioner) at planting had yield of 933 to 945 lb/acre. This was 55 to 82 lb/acre lower than fall disk + bed-roller Fb do-all; fall disk + terratill-bed-roller Fb do-all; fall coulter-chisel-harrow (one-pass operation) + terratill-bed-roller Fb do-all; fall terratill-bed-roller Fb do-all which showed no differences in yield. Year and tillage only affected gin turnout. The year 2000 had a turnout of 38.7% and was higher than the 2001and 2002 turnout of 37.8% and 34.4%, respectively. Conventional tillage, fall terratill-bed-roller Fb do-all and coulter-chisel-harrow + terratill-bed-roller Fb do-all had lower turnout than disk + bed-roller Fb do-all.

Introduction

In a competitive global farm market, cotton production cost must be reduced either with increasing yield, decreasing input costs, or a combination of both. Cotton following high residue crops such as wheat, sorghum, and corn have shown increased cotton yield (Buehring et al. 1998; Spurgeon and Grissom 1963; Keeling et al. 1988; Wesley et al. 1993; Matocha et al. 2003). Under conventional tillage, cotton in a rotation with corn has also shown higher yield than in a rotation with soybean (Matocha et al. 2003). However, with today's emphasis on reducing tillage trips, little information is available on how reduced tillage affects cotton yield in a corn-cotton rotation. Therefore, a study was conducted to determine the influence of reduced tillage systems in a cotton following corn rotation and continuous cotton on cotton lint yield and gin turnout.

Materials and Methods

The study was conducted on a Marietta silt loam soil at the North Mississippi Research and Extension Center from 1999-2002. The study was established in the fall of 1998 and plots were on the same site for the duration of the study. Since this was a rotation study, the yield data were collected in 2000-2002. The experimental design was a split plot in a randomized complete block with 4 replications. The main plot was rotation and subplots were tillage systems. Plot size was 8 30 inch rows by 85 ft long. Duplicate treatments for corn-cotton rotation were maintained in the study so rotation data were acquired each year.

Fertilizer was applied based on soil test recommendations for a 2 bale/acre cotton yield and corn yield of 150 bu/acre. Potash (K) and phosphorous (P) was applied broadcast to the soil surface in the fall of each year. Nitrogen as UAN solution (32% N) was applied as a sidedress application (6 inches from row and 2 inches deep) at 80 lb N/acre to cotton in the pinhead square stage of growth. Rates of all inputs used and operations performed on each treatment were recorded.

All tillage treatments were applied in the fall of each year, except ridge-till treatment which only received a do-all application at planting and 2 ridge-till cultivations with 10-inch band herbicide applications during the growing season (Table 1). In addition to the fall tillage, treatment 1 also received a field cultivation in late March or early April followed by bedding and 2 cultivations with 10-inch band herbicide applications during the growing season.

A burndown herbicide application was applied to all cotton treatments in early March, except the conventional treatment (Table 1). All cotton plots except the fall terratill-bed-roller (treatment 6) were do-alled (to smooth the bed and remove dry soil from the bed) prior to planting cotton. The fall teratill-bed-roller treatment was planted no-till with no do-all application. Cotton cultivar Delta and Pineland DP 20B was seeded at 3 seed/ft. Temik 11G (aldicarb) and Ridomil (mefenoxam) at 0.45 and 0.88 lb ai/acre, respectively, were applied in-furrow at planting. Weeds were effectively controlled with appropriate preemergence, postemergence and post-directed herbicide applications. Broadcast post-directed herbicide applications were made to all treatments, except the conventional tillage (treatment 1) and ridge-till (treatment 7) treatments which received 2 cultivations with post-directed herbicides in a 10-inch band. A layby application was also made to all cotton treatments if

needed. Insecticides were applied to the entire study when insect pests reached or exceeded threshold levels with a twice-weekly scouting program.

All cotton plots were defoliated when the last harvestable boll was at the fourth node above the first position cracked boll. The center 2 rows of each 8-row plot were harvested with a spindle picker modified for plot harvest. The plot seed cotton weights were recorded. All the seed cotton from each plot was ginned with a mini-gin (a state of the art small scale cotton gin equivalent to a commercial gin) to determine the percent gin turnout and calculate lint yield. In the analysis, years were treated as an independent variable. The lint yield and gin turnout data were subjected to SAS Mixed procedure. When no interactions were detected, the data was pooled over rotation, tillage and years as appropriate. Treatment means were separated using Fisher's Protected LSD calculated at the 5% significance level.

Results and Discussion

The analysis indicated there was no tillage by rotation or year by tillage by rotation interaction for yield (Table 3). However, there was a tillage and year by rotation interaction. Rotation across years increased yield by 57 to 160 lb/acre. The year 2000 was the only year rotation had yields higher than conventional cotton. The 3-year averaged yield was 100 lb/acre more for the rotation. These results support research which has shown cotton yield increased with high residue crops in the rotation (Buehring et al. 1998; Spurgeon and Grissom 1963; Keeling et al. 1988; Wesley et al. 1993; Matocha et al. 2003).

Tillage influenced yield with no year by tillage or year by tillage by rotation interaction. Ridge-till Fb do-all, fall terratill-bed-roller with no do-all at planting, and conventional tillage produced similar yield (933 to 945 lb/acre) but were lower than the fall terratill-bed-roller Fb do-all fall disk + bed-roller, fall disk + terratill-bed-roller Fb do-all, and the fall coulter-chisel-harrow (one-pass operation) + terratill-bed-roller Fb do-all. The results support reports that reduced or minimum tillage produced equivalent or higher yield than conventional tillage (Buehring et al. 1998; Keeling et al. 1988; Matocha et al. 2003).

The percent gin turnout analysis indicated year and tillage effected turnout with no rotation, year by rotation, year by tillage, rotation by tillage, or year by rotation by tillage interactions (Table 3). The gin turnout averaged over tillage and rotation ranged from 37.8 to 34.3% with a 3-year mean of 37.0%. The year 2000 had 38.7% turnout and was higher than the 2001 and 2002 turnout of 37.8% and 34.4, respectively. The disk + bed-roller Fb do-all had the highest turnout of 37.7% and was higher than all other treatments except disk + terratill-bed-roller Fb do-all, terratill-bed-roller Fb do-all and ridge-till Fb do-all. Conventional tillage, coulter-chisel-harrow + terratill-bed-roller Fb do-all, and fall terratill-bed-roller gin turnout ranged from 36 to 36.6% and was lower than fall disk + bed-roller Fb do-all.

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Table 1. Annual tillage operations performed in cotton in a corn-cotton rotation study on a Marietta silt loam soil in 1999-2002, Verona, MS.

	Tillage Treatment #						
Season/Tillage	**1**	**2**	**3**	**4**	**5**	**6**	**7**
Fall							
Disk	X[1]	X	X				
Chisel Harrow	X						
Coulter/Chisel Harrow				X			
Bed	X						
Bed with Rollers		X					
TerraTill/Bed with Rollers			X	X	X	X	
Spring							
Field Cultivate	X						
Bed	X						
Row Conditioner (do-all)	X	X	X	X	X		X
Conv.Cult.+Band Herb.	2X						
Ridge-Till Cult.+ Band Herb.							2X

[1] Denotes tillage operations performed.

Table 2 Lint yield response to tillage and corn-cotton rotation in 2000-2002, Verona, MS.

Trt #	Fall tillage system	Lint lb/acre 3 yr mean
1	Conventional tillage; fall disk + chisel –harrow + bed + spring rebed Fb do-all[1]	945
2	Disk + bed-roller Fb do-all	1027
3	Disk + terratill–bed-roller Fb do-all	1020
4	Coulter-chisel-harrow + terratill-bed-roller Fb do-all	1012
5	Terratill-bed-roller Fb do-all	1000
6	Terratill-bed-roller	933
7	Ridge-till Fb do-all	945
	Tillage $LSD_{.05}$: 44	

	Lint yield lb/acre			
Rotation	**2000**	**2001**	**2002**	**3 yr avg.**
Continuous cotton	1106	806	888	933
Cotton after corn	1266	863	970	1033
$LSD_{.05}$ WI Year: 99				
$LSD_{.05}$ WI Rotation: 47				

1 Do-all applied prior to planting.

Table 3 Gin turnout as influenced by tillage system and rotation system in 2000-2002, Verona, MS.

Rotation system	% Gin lint turnout			
	2000	2001	2002	Mean
Continuous cotton	38.7	37.4	34.5	36.9
Cotton after corn	38.7	38.1	34.3	37.0
Mean	38.7	37.8	34.4	37.0
Year $LSD_{.05}$: 0.5				

Trt #	Fall tillage system	% Gin lint turnout
1	Conventional tillage; fall disk + chisel –harrow + bed + spring rebed Fb do-all[1]	36.6
2	Disk + bed-roller Fb do-all	37.7
3	Disk + teratill – bed-roller Fb do-all	37.1
4	Coulter-chisel-harrow + terratill-bed-roller Fb do-all	36.6
5	Terratill-bed-roller Fb do-all	37.2
6	Terratill-bed-roller	36.0
7	Ridge-till Fb do-all	37.3
	Tillage $LSD_{.05}$: 0.7	

[1] Do-all applied prior to planting.