Cotton Response to Tillage Rotation and Row Spacing

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Abstract: Mississippi grower interest in narrow row cotton and reduced tillage is supported by the need for a cotton row spacing that is complimentary with other agronomic row crops, and tillage systems which meet the conservation compliance mandates of the 1990 Food Security Act. Row spacing, tillage. and rotation studies indicated that 3-yr (1993-95) avg. row spacing (30 and 38-in.) had no effect on lint yield on the Marietta silt loam soil, and there was a tillage by row spacing interaction on the Leeper silty clay soil. The 30-in. rows produced more lint than 38-in. no-tillage with no difference between minimum tillage 30 and 38-in. row. Conversely. the 38-in. rows produced more lint than 30-in. rows in conventional tillage All continuous cotton tillage treatments on the Marietta silt loam and all 30-in. row cotton tillage treatments on the Leeper soil showed no lint yield differences. The 3-yr avg. lint yield for MT cotton following ridge-tillage corn in a 2-yr rotation was higher than continuous MT on both soils. Two-yr (1993-94) cotton fiber quality data indicated tillage, rotation and row spacing on both soils had no effect on fiber length. uniformity index, and strength. Row spacing had no effect on micronaire and lint yellowness and reflectance on the Leeper silty clay and Marietta silt loam soils. RT 30-in. in the Marietta had lower micronaire than all other treatments.

Introduction

Cotton producers are not only interested in meeting conservation compliance for the 1990 Food Security act but also narrow row cotton production systems which are complimentary to row spacings of other crops grown on their farms. Research (Mutchler et al., 1983) indicates that cotton in a continuous conventional tillage system on sloping soils (5% slope) in Mississippi had annual soil erosion losses of 30 ton/acre/yr. This is 25.5 ton/acre/yr in excess of the tolerable levels established by the USDA Natural Resource Conservation Service. The report also indicated that no-tillage and reduced tillage soil losses on the 5% slope silt loam soil were in excess of the 4.5 ton/acre/yr, established tolerable level. Research also indicated that cotton in rotation with high residue crops such as corn under reduced tillage satisfied the conservation compliance requirement for the cotton crop and produced higher yield than continuous cotton (Spurgeon et al., 1963; Keeling et al., 1988).

John Deere Company's narrow row cotton picker introduction in the 1980's enhanced narrow row cotton production system research. In California (Kerby, 1991) and the lower Rio Grande Valley of Texas (Heilman and Namken, 1987) reported that 30-in. row produced 6.6 and 14% more yield than 40-in. rows, respectively. However, in the mid-south rainbelt, results have been inconsistent and ranged from no yield difference (Hutchinson et al., 1985) between 30 and 40-in. row to 19% higher yield for 30-in. rows on a Dundee silty clay (Williford et al., 1986; Williford, 1990). The objective of this study was to evaluate the effect tillage, row spacing and rotation on clay and silt loam soils had on cotton lint yield and fiber quality.

Materials and Methods

Cotton tillage studies (1993-95) were established in the fall of 1992 on bottom-land Leeper silty clay loam and bottom-land Marietta silt loam soils at the Northeast Branch Station, Verona, MS. These studies were established on both soils as randomized complete blocks with 5 replications and 8 row wide plots x 60 ft long. Studies were established in the fall of 1991 where soybean and cotton had been grown in 1991 on clay and silt loam soils, respectively. The first year (1992) tillage and crop rotation treatments were allowed to go through one complete crop cycle before data collection was initiated in 1993.

The following continuous cotton tillage treatments were evaluated on both soils and in both 30- and 38-in. rows: 1) no-tillage [(NT) - mowed cotton stubble and applied burndownherbicide 10-28 days before planting (DBP) and no cultivation during the growing season]; 2) minimum tillage [(MT) - mowed cotton stubble + bedding followed by (Fb) a burndown herbicide 10-28 DBP and 2 cultivations during the growing season]; and 3) conventional tillage [(CT) - mowed stubble + chisel + disk + bed Fb a harrow before planting and 2 cultivations during the growing season]. Continuous ridge-tillage [(RT), mowed cotton stubble and applied burndown herbicide 10-28 DAP and 2 cultivations (formed a 4 to 6- in. raised bed) during the growing season with a high clearance cultivator] system was also evaluated

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in 30-in. rows on both soils.

Cotton tillage, following corn in a 2-yr rotation, evaluated on both soil types in 30-in. rows were: 1) RT corn (planted no-till and cultivated once during the growing season with a high-clearance cultivator) Fb MT cotton (fall disk corn stubble + bed with a burndown herbicide applied 10-28 DBP and 2 cultivations during the growing season); and 2) RT corn (planted no-till and cultivated once to form a 4 to 6-in. raised bed with a high clearance cultivator during the growing season) Fb RT cotton (planted no-till cotton Fb 2 cultivations during the growing season with a high clearance cultivator.

All NT, RT, and MT cotton plots in 30 and 38-in. rows on both soils received a preplant application of Gramoxone (paraquat) or Roundup@ (glyphosate) + surfactant applied 10-28DBP. Cotton was seeded at 70,000 seed/acre in both 30 and 38-in. rows on April 30, 1992, May 27, 1993, May 10, 1994, and May 16, 1995. All plots were planted with planters equipped with granular pesticide applicator boxes, bubble coulters, and an inverted disk-flat press wheel seed-slit closing system. Appropriate granular insecticides (thrip and aphid control) and fungicides (seedling disease control) were applied at planting. Weeds were controlled on all plots through the use of appropriate burndown, preemergence, post-directed, and postemergence herbicides and cultivation where appropriate. All NT treatments received broadcast applications of herbicides. All cultivated treatments (CT, MT, and RT) received band (15-in.) applications of herbicide.

Granular ammonium nitrate at 40 lb of N/acre was applied on both soils as a preplant sidedress application (6 in. from the row and 4 in. deep) with a granular fertilizer applicator equipped with coulters. The silt loam and clay soil studies received sidedress applications of an additional 50 and 80 lb of N/acre at pinhead square, respectively. All sidedress applications were made in the same manner as preplant applications.

Cotton plots were scouted twice weekly for insects (boll weevil, bollworm, and budworm) and appropriate insecticide applications were made when insects exceeded threshold levels. Cotton plots in both studies were defoliated in late September-early October when all harvestable bolls were within 4 nodes above the node with a cracked boll in the first fruiting branch position. Both studies were harvested as a once-over harvest in mid to late October. The center 2 rows of all plots were harvested with a single-row picker with picker wheels adjusted to travel between the 30 and 38-in. rows. Individual grab seedcotton samples were taken from each treatment plot for 3 replications on both soils. The seedcotton samples were ginned with a micro-gin and the lint samples (1993 and 1994) were sent to the USDA Cotton Classing Division, Dumas, AR for high volume instrumentation (HVI) fiber analysis. All data was subjected to analysis of variance (SAS. Cary, NC, 1988) and means were separated by Least Significant Difference at the *5%* probability level.

Results and Discussion

Leeper Silty Clay

Lint yield data (1993-95) indicated tillage by yr, rotation by yr, and row spacing by yr by tillage interactions (Table 4). Lint yield data indicated that NT 3 of 3 yr, MT 1 of 3 yr, and CT 2 of 3 yr showed no response to row spacing. Three yr (1993-1995) avg. data showed that CT (38-in. rows) and NT (30-in. rows) produced more yield than CT-30 and NT-38, respectively, while MT showed no yield difference between row spacing.

Continuous cotton tillage data also indicated a yr by tillage interaction. During all 3 yr of the study, MT-30 and CT-30 showed no lint yield difference. In 1993. RT-30, NT-38, NT-30, CT-38, and MT-38 were not different in yield but produced more lint than MT-30 and CT-30. All 30-in. row tillage treatments in 1994 were equal in yield. Yields for RT-30, NT-38, and RT-30 following RT-30 corn in 1995 were lower in yield than all other treatments except NT-30 and CT-30. The 3-yr avg. lint yield for all continuous cotton tillage treatments indicated no difference between all 30-in. rows.

The corn-cotton rotation results showed that in only 1 of 3-yr (1993), did both MT-30 and RT-30 following RT-30 corn in a 2-yr rotation produce more lint than continuous RT-30 and MT-30 cotton. Both RT-30 and MT-30 cotton in a rotation following RT-30 corn, 3-yr (1993-1995) avg. had more lint yield than continuous RT-30 and MT-30 cotton. These results concur with reports (Spurgeon et al., 1963 and Keeling et al., 1988) that cotton in rotation with corn produced higher yield than continuous cotton.

Cotton fiber properties data (Table 2) indicated that tillage, rotation, and row spacing had no effect on fiber length, uniformity, strength, and reflectance. The NT-38, however, showed lower micronaire than RT-30 cotton following RT-30 corn and RT-30 continuous cotton. All other treatments showed no difference in micronaire. RT-30 cotton following RT-30 corn and MT-30 cotton following RT-30 corn had lower yellowness color than all other treatments, except RT-30 continuous cotton. All continuous cotton tillage treatments except RT-30 cotton showed no difference in yellowness and had higher yellowness values than the rotation tillage treatments.

Marietta Silt Loam

With the exception of 1993, row spacing had no effect on lint yield (Table 3). In 1993, CT-38 and MT-38 produced more lint than NT-30 and CT-30, respectively. The 3-yr (1993-95) avg. indicated no lint yield response to row spacing. These results concur with other research (Hutchinson et al., 1985) in the mid-south that indicated row spacing had no effect on yield.

In continuous 30-in. row cotton, except for CT-38 in 1993 and 1994, tillage had no effect on yield during all 3 yr. However, CT-38 produced more lint than CT-30 in 1993 and 1994. NT-30, and RT-30 in 1993; and NT-30 and MT-38 in 1994.

Table 1. Lint yield response to row spacing **and** tillage system on a Leeper silty clay loam 1993-1995 at the MAFES Northeast Branch Station, Verona, MS.

Tillage/rotation	Row spacing (inches)	Clay soil 1993	1994	1995	3 yr mean
		Lint, lb/ac			
A. Continuous cotton					
1. No-till (NT)	38	550	352	255	386
2. NT	30	546	502	346	465
3. Minimum till (MT)	38	482	356	491	443
4. MT	30	355	550	522	476
5. Conventional till (CT)	38	481	423	562	489
6. CT	30	354	415	431	400
7. Ridge till (RT)	30	477	533	218	409
B.					
8. RT corn Fb RT cotton	30	634	572	314	507
9. RT corn Fb MT cotton	30	675	636	518	610
	Mean	506	482	406	465
	LSD	97	164	129	73
	CV%	15	24	18	19
	R^2	73	63	84	73

Table 2. Influence of tillage and row spacing (1993-1994) on fiber properties on a Leeper silty clay soil at the MAFES Northeast Branch Station, Verona, MS.

Tillage/rotation	Row spacing (inches)	Fiber: Length (in.)	Unf. index	Strength gm/tex	Mic.	Color: yellow +b	reflect rd
A. Continuous cotton							
1. No-till (NT)	38	1.13	85.3	30.74	4.26	81.3	66.4
2. NT	30	1.12	85.7	31.12	4.48	83.8	66.9
3. Minimum till (MT)	38	1.12	85.2	30.58	4.33	81.9	67.5
4. MT	30	1.12	84.7	30.51	4.45	81.3	67.2
5. Conventional till (CT)	38	1.13	85.5	30.89	4.34	82.3	67.3
6. CT	30	1.14	85.9	31.12	4.37	82.2	68.3
7. Ridge till (RT)	30	1.13	85.6	30.75	4.56	79.4	67.0
B. Corn-cotton rot.							
8. RT corn Fb RT cot.	30	1.13	85.1	30.68	4.67	76.3	79.3
9. RT corn Fb MT cot.	30	1.13	85.4	31.04	4.50	78.3	66.9
Mean		1.13	85.4	30.86	4.45	80.1	67.0
LSD.05		NS	NS	NS	0.26	2.7	NS
CV %		1.89	1.5	4.32	6.69	3.7	3.3

Table 3 Lmt yield response to row spacing and tillage system on a Marietta silt loam soil 1993-1995 at the MAFES Northeast Branch Station, Verona, MS.

Tillage/rotation	Row spacing (inches)	1993	1994	1995	3 yr mean
		Silt loam			
		Lint, lb/ac			
A Continuous cotton					
1 No-till (NT)	38	717	735	547	665
2 NT	30	624	630	615	623
3 Minimum till (MT)	38	687	591	525	601
4 MT	30	649	738	604	664
5 Conventional till(CT)	38	730	780	577	695
6 CT	30	600	751	571	641
7 Ridge till (RT)	30	611	700	505	625
B. Rotational cotton					
8. RT corn Fb RT cotton	30	776	777	366	639
9. RT corn Fb MT cotton	30	789	917	607	771
	Mean	687	735	559	658
	LSD	100	161	157	80
	CV %	13	18	14	16
	R^2	46	38	59	55

Table 4. Tillage and row spacing influence (1993-1994) on fiber properties on a Manetta silt loam sod at the MAFES Northeast Branch Station, Verona, MS.

Tillage/rotation	Row spacing (inches)	Length (in.)	Unf. index	Strength gm/tex	Mic.	yellow +b	reflect rd
		Fiber				Color	
A. Continuous cotton							
1. No-till (NT)	38	1.12	90.9	29.64	4.20	78.46	68.60
2. NT	30	1.12	90.5	29.71	4.10	81.62	68.46
3. Minimum till (MT)	38	1.11	90.1	29.47	4.08	79.85	69.00
4. MT	30	1.12	90.3	29.54	3.86	80.30	67.54
5 Conventional till (CT)	38	1.12	91.4	29.78	4.37	79.39	68.62
6. CT	30	1.13	91.3	29.68	3.88	79.08	67.15
7. Ridge till (RT)	30	1.11	89.8	29.14	3.39	81.31	68.62
B. Corn-cotton rot.							
8. RT corn Fb RT cot.	30	1.13	90.3	29.64	3.82	79.15	66.77
9. RT corn Fb MT cot.	30	1.13	90.7	29.47	3.89	77.46	67.00
Mean		1.12	90.5	29.54	4.00	79.88	67.71
LSD.05		NS	NS	NS	0.34	2.71	1.72
CV %		1.57	13.4	3.63	10.82	4.35	3.25

Three yr (1 993-95) avg., however, indicated no yield differences between all continuous cotton tillage treatments.

With the exception for 1995, MT-30 cotton following RT-30 corn rotation had higher lint yield than continuous MT-30 continuous cotton. The RT-30 cotton following RT-30 corn only produced more lint than RT-30 continuous cotton in 1993. The 3-yr avg. indicated that MT-30 rotation treatment was the highest yield treatment but was not different from continuous CT-38 cotton.

Cotton fiber quality data (1 993-1994) indicated crop rotation, tillage, and row spacing had no effect on fiber length, uniformity, and strength (Table 4). All treatments had higher micronaire than continuous RT-30. All treatments, except for NT-30, MT-30, and RT-30 cotton, showed no differences in yellowness color. RT-30 cotton following RT-30 corn had the lowest reflectance and was lower than MT-38, CT-38, NT-30 and NT-38. All other treatments showed no difference in reflectance.

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