Table 3. Percent Surface Residue Cover in West Tennessee No-Till Cotton Fields From Cotton Residue and From Winter Weeds (No Cover Crops).

	Mean Residue Cover			Range	
Landscape Position and Years in No-till	Total	Cotton Residue	Winter Weeds	Cotton Residue	Winter Weeds
	%				
Upland, 1-4% Slopes					
1st Year No-till	33.5	27.4	6.2	15-42	0-39
2 + Years No-till	47.9	34.4	13.6	10-67	0-55
Uplands 5 to 9% Slopes					
1st Year No-till	23.0	16.7	6.2	7-29	0-37
2 + Years No-till	29.6	25.7	3.8	17-39	0-32
Bottoms (1993 Only)					
1st Year No-till	47.8	35.0	12.8	30-45	2-20
2 + Years No-till	66.1	49.4	16.7	30-66	0-29

Table 4. Effect of Winter Weeds and Cotton Residue on the Number of Observations Exceeding 30% and 45% Surface Residue Cover (No Cover Crops).

	Cotton Residue Only			Cotton & Weeds		
Landscape Position and Years in No-till	<30%	30-44%	≥45%	<30%	30-44%	≥45%
	N					
Upland, 1 to 4% Slopes						
1st Year No-till	17	10	0	12	13	2
2 + Years No-till	15	28	10	6	13	34
Uplands 5 to 9% Slopes						
1st Year No-till	9	0	0	6	2	1
2 + Years No-till	10	3	0	10	2	1

EFFECT OF TILLAGE, HERBICIDE PROGRAM AND ROW SPACING ON COTTON GROWTH AND YIELD IN TWO CONSERVATION TILLAGE SYSTEMS

C.H. Burmester, M.G. Patterson and D.W. Reeves
Extension Agronomist, Extension Weed Scientist and Research Agronomist, respectively
Department of Agronomy and Soils and USDA-ARS
National Soil Dynamics Laboratory
Auburn University
Auburn, AL

Abstract

A three year field study (1994-1996) in North Alabama compared cotton *(Gossypium hirsutum L.)* growth and yields in two no-tillage systems with conventional tillage. Many farmers in this region have observed lower cotton yields in fields that have been no-tilled two or more consecutive years. These lower cotton yields may be due to increased soil compaction or herbicide build-up on these heavier soils. The soil type was a Decatur silt loam (Rhodic Paleudult) which is the major soil type for this area. Row spacing, preemergence and postemergence herbicide programs and a no-till cultivator were evaluated for their usefulness in increasing cotton yields.

The two no-tillage systems evaluated were: 1) planting into old cotton residue, 2) planting into a wheat *(Triticum sativa L.)* cover crop. Conventional tillage included fall chisel plowing and a field cultivator and a roterra used for spring soil leveling. Cotton in each tillage system was planted in both 30 inch and 40 inch row spacings. The herbicide treatments consisted of a standard soil applied preemergence program versus total postemergence herbicide applications. A no-till cultivator was operated in half the plots in early June. The cultivator was evaluated for weed control and it's usefulness in reducing soil compaction.

A good rainfall pattern produced excellent yields in 1994 and 1996. However, in 1995 severe tobacco budworm pressure in July and August greatly reduced yields. Only early season bolls were harvested in 1995. Each season the trend for higher cotton yields in each tillage system when cotton was planted in 30 inch row spacing compared to a 40 inch spacing was found. During the three years, 30 inch row spacings outyielded 40 inch rows by 10.8 percent in no-tillage in old cotton residue, 13.2 percent in no-tillage with a wheat cover crop and 7.6 percent in conventional tillage. Early season height measurements indicated that cotton no-tilled into old cotton residue was often shorter than cotton in the other tillage treatments. However, these height differences were no longer evident by August. Cotton yields were not effected by tillage treatments except in 1996. In this year, cotton no-tilled into old cotton residue produced 93 and 89 percent, respectively, of the yields produced by no-tillage into a wheat cover crop or conventional tillage.

Results with the no-till cultivator varied by years. A trend toward lower yields with cultivation was found in all tillage treatments in 1994; however, a trend toward higher yields with cultivation was found in 1996. No yield differences due to cultivation were found in 1995. Although the yield increases found in 1996 with the cultivator are encouraging, root pruning may be a problem in some years.

During the three years, preemergence herbicides were found to have no adverse effect on cotton growth or yield. Postemergence weed control was excellent in 1994 and 1995, but poor in 1996. Weed pressure was much higher, especially in the no-tillage systems, after two seasons of only postemergence herbicide applications. Results of this study indicate that a total postemergence weed control system did not increase cotton yield over the standard preemergence herbicide treatments. Some preemergence weed control may be necessary to control early season weeds.

Introduction

Cotton is grown extensively on the red silty clay loam soils of Alabama's Tennessee Valley. Many of these soils are classified as highly erodible land (HEL) which requires soil conservation practices. No-till cotton production has been one practice used by farmers in the area to meet soil loss requirements. Recently, Tennessee Valley farmers have reduced no-till cotton acreage because of low cotton yields in fields that have been no-tilled two or more consecutive years. Auburn University research has indicated that part of this cotton yield reduction may be due to the development of a surface soil compaction layer. This layer can restrict root growth and usually develops at a depth of six inches or less on the heavier textured soils when no tillage is applied (Burmester et al., 1993).

In 1994 an experiment was initiated to further study cotton yields in the two no-till cotton systems commonly used by North Alabama farmers. The effects of row spacing, a no-till cultivator and two weed control systems were studied from 1994 to 1996.

Materials and Methods

This study was conducted at the AAES Tennessee Valley Substation in Northern Alabama. The soil type was a Decatur silt loam (clayey, kaolinitic, thermic Rhodic Paleudult) which is the major soil type in the area. The experimental design was a split-plot with tillage as the main variable, subplots were a factorial arrangement of two row spacings, two cultivation treatments, and two weed control programs. Tillage treatments included: 1) Conventional fall and spring tillage, 2) no-tillage with planting into old cotton stalk residue, 3) no-tillage with a wheat cover crop that was killed prior to cotton planting.

Plot widths were either 8-30 inch rows or 4-40 inch rows, 30 feet long. Half the plots were cultivated in early June with a Brown Chiselvator Cultivator®. Plots either received the preemergence herbicide treatments that are standard for the area or received only postemergence weed control. The 'Chiselvator' cultivator was equipped with a subsoil shank that operated 10 to 12 inches deep between rows. This no-till cultivator also has a wide sweep with fingers that runs flat under the soil to reduce soil coverage of residue. The cultivator was operated in June each year to reduce root pruning damage.

The preemergence weed control program consisted of pendimethalin and fluometuron applied broadcast at planting at rates of 1.25 and 1.8 pounds per acre a.i., respectively. The postemergence weed control program consisted of fluazifop-butyl applied broadcast at a rate of 0.2 lb. a.i./A, to control grasses and a later broadcast application of pxrithiobac (0.063 lb. a.i./A) for broadleaf weed control. In 1994 and 1995 only one grass and broadleaf postemergence application was needed, however, in 1996 two postemergence broadleaf treatments were needed and two postemergence grass treatments had to be applied. In 1996 the second postemergence grass treatment used a combination of fluazifop-butyl plus fenozaprop for control. All treatments received a lay-by herbicide treatment of cyanazine plus MSMA in July.

The wheat cover crop and winter weeds were terminated by glyphosate applications each year about three weeks prior to planting. Planting was performed with a 4 row John Deere Maxi-Emerge® planter equipped with Acra-Plant® retrofit seed opening discs/V slice inserts. In 1994 and 1995 'DPL 51' seed were planted, but due to extreme budworm damage in 1995, 'NuCotn 33B' was planted in 1996. The two middle rows were harvested in all 40 inch row plot while the 4 middle rows were harvested in all 30 inch row plots. Data presented in this report includes cotton height measurements made each season in June and August and three years of seed cotton yields.

Results and Discussion

In 1994 and 1996 cotton had excellent growing conditions in North Alabama. Above average rainfall each year in August and September produced outstanding yields. In 1995, heavy budworm pressure in July and August dramatically reduced cotton yields and only bolls set early in the season were harvested.

Each season June cotton heights were significantly shorter in cotton no-tilled into old cotton residue compared to cotton grown with conventional tillage or cotton no-tilled into a wheat cover crop (Table 1). In 1994 the conventional tillage cotton was also significantly taller than cotton no-tilled into a wheat cover crop. Each season these height differences, however, had disappeared by August (Table 2). Abundant rainfall during bloom in 1994 and 1996 may have allowed cotton to compensate for early season growth differences. Heavy budworm damage in 1995 severely affected boll set in all treatments and increased vegetative growth.

Seed cotton yields (Table 3) were not affected by tillage treatments except in 1996. In 1996 cotton no-tilled into old cotton residue produced 93 and 89 percent of the yields produced by no-tillage into a wheat cover or conventional tillage, respectively. These yield reductions in the third year of no-tillage are similar to what farmers have observed and what past research in Alabama has also found (Burmester, et al., 1995).

Each year a trend toward higher yields in 30 inch row spacings compared to a 40 inch row spacing was found (Table 4). This was statistically significant ($P \leq 0.10$) for all tillage treatments in 1994 and no-tillage with a wheat cover crop in 1996. When averaged over the three years, 30 inch row spacing outyielded 40 inch rows by 10.8 percent in no-tillage in old cotton residue, 13.2 percent in no-tillage with a wheat cover crop and 7.6 percent in conventional tillage. These data supports previous work that found a seven to nine percent increase in cotton yields with 30 inch row spacing compared to 40 inch rows on these soil types (Patterson et al., 1992). These data would indicate that the yield response to 30 inch rows compared to 40 inch rows may be even greater when cotton is no-tilled on these soils.

Cotton yields results with the 'Chiselvator' cultivator varied by year (Table 5). In 1994, cotton yields were reduced by the June cultivation in the conventional tillage and no-tillage in old cotton residue. Apparently this cultivation resulted in root pruning which reduced yields. In 1995 no differences were found, but in 1996 cultivation significantly increased cotton yields with no-tillage in old cotton residue. There was also a trend for higher yields with cultivation in no-tillage with a wheat cover crop. The yield response to between the row tillage in 1996 supports the theory that soil compaction may be reducing cotton yields after two or more years of no-tillage on these soils. However, root pruning was also a problem in 1994 so farmers must use caution with this type of equipment.

Preemergence or postemergence herbicide programs had no effect on cotton yields in 1994 or 1995 (Table 6). In 1996 weed pressure was much greater, especially in the no-tillage systems. In the postemergence herbicide program, crabgrass control was poor with fluazifop-butyl alone. Fluazifop-butyl plus fenozaprop was applied in a second application to control crabgrass. Broadleaf weeds were mainly prickly sida *(sida spinosa)* and morningglories *(ipomoea sp.)*. Late season rains made a second broadcast application of pyrithiobac necessary. The trend in 1996 was for lower cotton yields in all tillage systems with postemergence weed control compared to preemergence weed control. This yield reduction with postemergence weed control was significant ($P \leq 0.10$) in the no-tillage in old cotton residue. In this experiment, higher weed pressure after two years of postemergence only weed control, suggests that preemergence herbicides may be necessary to control early season weeds. The preemergence herbicides did not reduce cotton yields any year of the experiment.

Conclusions

Cotton growth differences among tillage systems were smaller than previously observed. This may have been due to above average rainfall during fruiting in 1994 and 1996. Yield data, however, support Tennessee Valley farmer's observations that cotton yields often decline in fields that have been no-till into old cotton residue two or more consecutive years. The response to the no-till cultivator in 1996 also suggest that part of this problem is due to soil compaction. Growing conservation tillage cotton on these heavier textured may require some soil tillage to reduce this soil compaction. Growing cotton in 30 inch rows instead of 40 inch rows also appears to consistently increase cotton yields on these soil types. This yield increase may be even greater for conservation tillage cotton grown in 30 inch rows. Preemergence herbicides are often blamed for stunting early season growth and reducing cotton's yield potential. This three year study found no adverse effects of the preemergence herbicides on cotton's growth or yield. In fact, when only a postemergence weed control program was used, weed pressure increased dramatically in the third year.

Literature Cited

Burmester, C.H., M.G. Patterson and D.W. Reeves. 1993. No-till Cotton Growth Characteristics and Yield in Alabama. Proceedings 1993 Southern Conservation Tillage Conference for Sustainable Agriculture. pp. 30-36.

Burmester, C.H., M.G. Patterson, and D.W. Reeves. 1995. Challenges of no-till cotton production on silty clay soils in Alabama. In Conservation-Tillage Systems for Cotton. Arkansas Agricultural Experiment Station Special Report 169. pp. 5-7.

Patterson, M.G., D.P. Moore, B.E. Norris and W.B. Webster. Evaluating Narrow Row Cotton in Alabama. Volume 39, No. 1, 1992. Alabama Agricultural Experiment Station Highlights. pp. 15.

Table 1. Effect of tillage systems on June cotton heights.

	Cotton Heights (cm)		
Tillage	1994	1995	1996
No-till - Cotton Residue	33.5	29.4	26.4
No-Till - Wheat Residue	35.3	34.7	29.1
Conventional	38.9	35.8	30.9
LSD (0.10)	2.1	4.4	1.8

Table 2. Effect of tillage systems on August cotton heights.

	Cotton Heights (cm)		
Tillage	1994	1995	1996
No-till - Cotton Residue	106	75.6	105.8
No-Till - Wheat Residue	102	82.6	108.0
Conventional	110	75.1	103.1
LSD (0.10)	5	9.7	8.4

Table 3. Effect of tillage systems on seed cotton yields.

	Seed Cotton (lb/A)		
Tillage	1994	1995	1996
No-till - Cotton Residue	3770	2000	3150
No-Till - Wheat Residue	3770	2340	3370
Conventional	3880	2298	3558
LSD (0.10)	242	590	383

Table 4. Effect of row spacing and tillage system on seed cotton yields.

		Seed Cotton (lb/A)		
Tillage	Row Spacing (in.)	1994	1995	1996
No-till - Cotton Residue	30	3920	2260	3260
No-till - Cotton Residue	40	3620	1750	3050
No-Till - Wheat	30	3910	2600	3650
No-Till - Wheat	40	3640	2090	3090
Conventional	30	4050	2520	3550
Conventional	40	3710	2080	3560
	LSD (0.10)	242	590	383

Table 5. Effect of tillage and use of a no-till cultivator on seed cotton yields.

		Seed Cotton (lb/A)		
Tillage	Cultivator	1994	1995	1996
No-till - Cotton Residue	+	3630	2050	3320
No-till - Cotton Residue	-	3900	1960	2980
No-Till - Wheat	+	3730	2320	3470
No-Till - Wheat	-	3810	2360	3280
Conv.	+	3730	2370	3630
Conv.	-	4040	2230	3480
	LSD(0.10)	150	126	302

Table 6. Effect of tillage and herbicide program on seed cotton yields.

		Seed Cotton (lb/A)		
Tillage	Herbicide	1994	1995	1996
No-till - Cotton Residue	Pre	3730	1950	3360
No-till - Cotton Residue	Post	3810	2060	2950
No-Till - Wheat	Pre	3770	2260	3460
No-Till - Wheat	Post	3770	2430	3290
Conventional	Pre	3880	2240	3690
Conventional	Post	3890	2360	3420
	LSD(0.10)	155	202	308

COVER CROPS FOR WEED CONTROL IN NO-TILL COTTON

D. Wayne Reeves, Mike G. Patterson, and Brian E. Gamble
USDA-ARS National Soil Dynamics Laboratory and
Department of Agronomy & Soils
Auburn University
Auburn, AL

Abstract

Black oat (*Avena strigosa* Schreb.) is the predominate cover crop on millions of acres of conservation - tilled soybean [*Glycine max* (L.) Merr.] in southern Brazil due in part to its weed suppressive capabilities. We initiated a field study in 1995 on a Dothan fsl (fine-loamy, siliceous, thermic Plinthic Paleudult) in southeastern AL to determine the suitability of black oat as a cover crop for conservation-tilled cotton (*Gossypium hirsutum* L.) using the Brazilian system of managing cover crops. The site had been in conservation tillage for the previous 8 yr and had a high population of Palmer Amaranth (*Amaranthus palmeri* S. Watts.). Cotton was grown in a strip-plot design of four replications. Horizontal plots were winter covers of black oat, rye (*Secale cereale* L.), wheat (*Triticum aestivum* L.) or fallow. The cover crops were terminated with an application of glyphosate (1.0 lb a.i./A) 3 wks prior to planting DPL 5690 cotton in early May each year. Within 3 days following glyphosate application, the covers were rolled with a modified stalk chopper to lay all residue flat on the soil surface. Vertical plots were herbicide input levels: none, low, or high. The low herbicide input level consisted of a preemergence application of pendimethalin (1.0 lb a.i./A) + fluometuron (1.5 lb a.i./A). For the high input level, additional applications of fluometuron (1.0 lb a.i./A) + DSMA (1.5 lb a.i./A) early post-direct and lactofen (0.2 lb a.i./A) + cyanazine (0.75 lb a.i./A) late post-direct were made. In 1995, because the site has a well developed hardpan, the cotton was in-row subsoiled with a narrow parabolic subsoiler equipped with pneumatic tires to close the subsoil channel with minimal disturbance of the residue. In 1996, the area was paratilled 2 wks prior to planting.

In 1995 residue production was similar for all winter cereal covers, averaging 4665 lb dry matter/A. Winter weeds produced 1260 lb dry matter/A in fallow plots. The severe winter of 1996 resulted in differences in residue production by the covers. Dry matter averaged 5580, 3900, 1175, and 780 lb/A for rye, wheat, black oat, and winter fallow, respectively, in 1996. Although there were significant cover X herbicide input level interactions, no cover crop was economically effective in controlling weeds without a herbicide program. Without herbicide, black oat gave more effective weed control (based on visual ratings and weed biomass) than rye (35% control vs. 25% control) in 1995 but in 1996 rye gave greater control than black oat (54% control vs. 18% control) due to severe winter kill of black oat. Weed control following wheat and winter fallow were similar both years, averaging 14% and 19% in 1995 and 1996, respectively. Averaged across winter covers, seed cotton yields were 3449