Cotton Response to Cover Crops and Tillage in the Brown Loam of Mississippi

H. Bloodworth[1] and J. Johnson[1]

INTRODUCTION

Cotton produces less residue than corn, sorghum, or soybean and has a greater amount of tillage associated with its production. Consequently, it is one of the most erosive row crops grown in the southeastern United States. Murphree and Mutchler (3) calculated a C-value for the Universal Soil Loss Equation of over 1 for the winter and spring tillage period with an over-all yearly average of 0.58.

With the passage of the Food Security Act of 1985, alternative systems such as no-tillage and/or cover crops may have to be implemented for cotton planted on highly erodible land. This study was conducted to study the effects of cover crops and tillage on cotton in the Brown Loam of Mississippi.

MATERIALS AND METHODS

Research was conducted at the Jamie L. Whitten Plant Materials Center near Coffeeville, MS on a Grenada silt loam in 1988-91. A split plot design with four replications was used with cover crops as main plots and tillage systems as split plots. Individual plots were six 101-cm rows 12.2 m in length.

Cover crops were drilled (20 cm rows) at seeding rates of 22, 34, and 134 kg/ha for crimson clover, hairy vetch, and wheat, respectively. Native cover consisted of carolina geranium, cutleaf evening primrose, wild garlic, and annual bluegrass. All plots received a uniform rate of P and K in the fall according to soil test recommendations. Wheat received an additional 28 kg N/ha as ammonium nitrate. Canopy cover of the cover crops was visually rated at three week intervals from February to mid-April. Cover crop DM yield was determined by hand harvesting .3 square meters in each plot prior to termination, air dried, and weighed.

On approximately April 15 each year, cover crops in the conventionally tilled (CT) plots were disked twice or in the no-till (NT) plots chemically killed with glyphosate. Conventionally tilled plots were also chiseled and harrowed before planting. Cotton 'DES 119' was planted at a seeding rate of 23 seeds per row-meter using a no-till planter with a ripple coulter and double disk openers. Planting dates were May 25, 1989, May 7, 1990, and June 3, 1991. Nitrogen (45 kg/ha as ammonium nitrate) was applied to all plots prior to planting. Fluometuron and metolachlor were applied preemergence at 1.7 kg ai/ha each. Four weeks after emergence in 1989 and 1991, cotton received an additional 11, 45, and 45 kg N/ha in crimson clover, native, and wheat plots (2). In 1990, all plots received 45 kg N/ha four weeks after emergence. Seedcotton yield was determined by hand harvesting one middle row in each plot. Ten plants in each plot were measured to calculate plant height at maturity. Plant population was calculated by counting the number of plants per 3 m of row two weeks after emergence in 1989 and after harvest in 1990 and 1991. Whole plants from 0.3 meter of row were harvested on the fifth row of each plot at 4, 8, 12, and 16 weeks after planting (WAP). Plants were separated by parts (stems, leaves, roots, squares, and bolls), dried in a forced draft oven for 72 hours at 35 "C, and weighed.

'Jamie L. Whitten Plant Materials Center, Coffeeville, MS, and [2]North Mississippi Branch Experiment Station, Holly Springs, MS.

Records were kept of all operations and inputs to calculate total production expenses for each cover crop-tillage system. Expenses were based upon the three year average of all operations and inputs used in this study.

RESULTS *AND* DISCUSSION

Weather conditions were more favorable for the cover crops in 1988-89 than in the other two years. Record low temperatures occurred in December 1989 and killed many plants. In 1990, temperatures were above normal from early November to mid-December. A sudden drop in temperature in late December killed most of the crimson clover due to lack of acclimation to cold weather. Therefore, data for crimson clover and cotton in 1991 were not analyzed.

Wheat produced more canopy cover than the legumes from emergence to late January (data not presented). Generally, this trend continued until April when hairy vetch produced more cover than crimson clover or wheat (Table 1). In 1991, native cover produced more cover than the planted cover crops on three of the four dates. Competition from these weeds in the planted cover crop plots was higher in NT plots than in the CT plots. Wheat produced significantly higher DM yields during two of the three years (Table 1). Low yields for 1990 reflect the damage resulting from the record cold weather in December 1989.

When cotton was planted in late May or early June, NT cotton produced a higher yield than CT cotton (Table 2). Although delayed by wet weather, NT plots were ready to be planted earlier than CT plots. In 1990 when cotton was planted on May 7, no yield differences occurred between tillage systems. When periods of dry weather occurred during boll development in all years, CT cotton tended to show earlier wilting signs than NT cotton. Cover crop did not affect seedcotton yields. Plant height was influenced by tillage system only in 1989 (Table 2) when plants were significantly shorter in CT plots. Cover crops affected plant height in 1990 when cotton with a legume cover crop was taller. Plant population responded differently to tillage systems (Table 2). Population was higher for CT cotton in 1989 but was lower in 1991. When plant population was reduced, stands were adequate to produce maximum yields.

No-till cotton in 1989 produced more vegetative growth (Table 3) and also produced higher seedcotton yield. Reproductive weights for NT cotton tended to be higher at all sampling dates. In 1990, no consistent trends were found for components' weights between dates. Total plant weights were significantly higher for NT cotton from 4 to 12 WAF in 1989. In 1990, however, heavier plants were produced by CT cotton only at 4 WAP. Cover crops did not affect weights in either year.

Averaged across cover crops, no-till cotton reduced total production expenses by $31.00 per

Table 1. Cover crop canopy and dry matter yield, by dates, 1989-91.

	Canopy cover												
	1989			1990			1991				DM yield		
Cover crop	2/9	3/13	3/28	4/11	3/30	4/13	2/7	2/27	3/21	4/15	1989	1990	1991
	----------%----------										----kg ha?'----		
Crimson clover	80	70	90	100	23	28	--	--	--	--	3013	167	---
Hairy vetch	60	60	90	100	47	85	6	13	41	95	2249	1027	1732
Wheat	93	78	83	94	52	77	25	25	48	52	3699	2195	1652
Native	17	25	58	74	48	59	87	88	90	96	1552	419	1595
LSD(0.05)	14	6	10	10	NS	20	9	10	10	4	1381	608	NS

Table 2. Seedcotton yield, plant height, and plant population as affected by cover crops and tillage, 1989-91.

	Seedcotton yield			Height			Population		
cover crop	1989	1990	1991	1989	1990	1991	1989	1990	1991
	kg ha^{-1}			cm			x 1000 ha^{-1}		
Crimson clover	1722	3099	---	117	102	--	148.7	70.9	----
Hairy vetch	1743	3384	2286	117	109	97	151.2	67.2	110.2
Wheat	1920	3076	2344	112	97	94	134.4	75.3	112.1
Native cover	1950	2790	2184	109	91	94	140.8	71.4	93.1
Tillage means									
Conventional	1534	3167	2096	104	99	97	155.1	72.6	83.5
No-till	2134	3007	2447	122	99	94	132.4	69.9	126.7
LSD(0.05) Cover crop	NS	NS	NS	NS	10	NS	NS	NS	NS
Tillage	326	NS	368	5	NS	NS	19.2	NS	27.2

Table 3. Dry weight of cotton plant components at 4, 8, 12, and 16 weeks after planting, by tillage systems, 1989-90.

	Dry weight							
Plant part	4 weeks		8 weeks		12 weeks		16 weeks	
	Conv.	No-till	Conv.	No-till	Conv.	No-till	Conv.	No-till
	g/plant							
	1989							
Stem	.26*	.36	6.63*	9.19	16.18*	22.20	23.40*	31.74
Roots	.16	.15	1.37*	1.75	3.08	3.66	4.60	5.39
Leaves	.54*	.76	7.86*	10.14	15.00*	20.30	13.30	16.89
Squares			.12*	.18	1.28	1.70		
Bolls					.03	.12	23.84	30.14
Total	.96*	1.27	15.98*	21.26	35.37*	47.98	65.14	84.16
	1990							
Stem	.06*	.04	1.78	2.02	15.60	13.56	36.21	38.51
Roots	.06	.04	.70	.74	3.78	3.26	5.46	4.64
Leaves	.30*	.19	4.51	5.20	28.61	27.94	38.50	35.93
Squares			.05	.04	2.63	2.10	2.29	2.32
Bolls							37.70	33.93
Total	.42*	.27	7.04	8.00	50.62	46.86	120.16	116.33

* Component means by date are significantly different at the 0.05 level of probability.

Table 4. Average total production expenses by cover crop-tillage system, 1989-91.

	Cover crop							
	Crimson		H. vetch		Wheat		Native	
	Tillage system							
Item	NT	CT	NT	CT	NT	CT	NT	CT
	$/ha							
Defoliant	56.46	56.46	56.46	56.46	56.46	56.46	56.46	56.46
Fertilizer	150.11	150.11	143.50	143.50	169.85	169.85	162.61	162.61
Fungicide	32.41	32.41	32.41	32.41	32.41	32.41	32.41	32.41
Herbicide	141.81	93.70	141.22	93.70	114.81	93.70	121.40	93.10
Insecticide	120.16	120.16	120.16	120.16	120.16	120.16	120.16	120.16
Seed	60.23	60.23	79.45	79.45	52.82	52.82	25.15	25.15
Op. labor	38.12	51.89	38.12	51.89	38.54	52.32	35.07	48.85
Diesel fuel	15.09	22.42	15.09	22.42	15.30	22.63	14.19	20.95
Rep. & Main.	67.38	78.46	67.38	78.46	67.76	74.73	63.69'	74.78
Unalloc. labor	30.50	41.52	30.50	41.52	30.84	41.86	28.06	39.08
Interest	31.82	30.98	30.67	31.64	29.55	32.16	30.29	31.94
Tot. Direct	750.08	738.34	754.95	751.61	728.49	749.09	689.48	706.07
Tot. fixed	138.67	164.14	138.67	164.13	139.45	164.91	130.33	155.78
Tot. Spec.	888.75	902.48	893.62	915.74	867.94	914.00	819.81	861.85

hectare (Table 4). Additional expense of the burndown herbicide in NT cotton was more than offset by the decrease of $13.78 and $7.19 per hectare for labor and diesel fuel, respectively.

Of the planted cover crops, wheat was slightly cheaper than crimson clover. Average cost of seed (dollars per kg) was .20, 1.56, and 1.61 for wheat, crimson clover, and hairy vetch, respectively. Hairy vetch and crimson clover reduced fertilizer cost by producing an expected 45 and 34 lb N/A, respectively, for the cotton (2). Fertilizer expense for wheat was higher due to the application of 28 kg N/ha in the fall. Results from Tennessee suggest that seeding rates of legume cover crops can be reduced by 25% without decreasing DM production or N fixation (1). Therefore, seeding costs of legume and possibly wheat would be reduced.

LITERATURE CITED

1. **Duck, B.N., and D.D. Tyler.** 1990. Seeding rate effects on legume biomass and N accumulation. p. 313. In Agronomy abstracts. ASA, Madison, WI.

2. **Funderburg, E.R.** 1987. Cover crops. Mississippi Coop. Ext. Serv. Information Sheet 1552.

3. **Murphree, C.E., and C.K. Mutchler.** 1980. Cover and management factors for cotton. Trans. ASAE 23:585-588, 595.