

Cotton Conservation Tillage and Cover Crop Systems For Cotton on the Macon Ridge

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This long-term experiment – now in its 14th year – was continued in 2000 to evaluate dryland cotton responses to tillage, winter cover crops and N rates. This study was partially funded by the the Cotton Incorporated State Support Program from 1985 through 1999. The objectives of the study are to: 1) determine the short-term and long-term effects of three tillage systems -- no-till, ridge-till and surface-till -- on cotton performance, and 2) evaluate the short- and long-term effects of winter cover crops (wheat, hairy vetch, wheat + vetch combination and native volunteer vegetation) under each of the three tillage regimes.

Methods -- This study consists of three tillage systems, four cover crops treatments and two N rates. Tillage treatments are surface-till (ST), no-till (NT), and no-till with in-season cultivation (NTC). Cover crops are native volunteer vegetation, wheat, hairy vetch, and wheat + vetch combination. The N rates are 45 and 90 lb per acre. The experimental design is a factorial arrangement of tillage and cover crops with a split-plot arrangement of the N rates in a randomized complete block with four replications. The hairy vetch (25 lb/acre), wheat (90 lb/acre) and wheat and vetch mix (90 + 25 lb/acre) seed were planted with a grain drill into the standing cotton stalks on 28 September. The cotton stalks were shredded with a rotary mower immediately after the cover crops were seeded.

The ST treatments were disked twice on 25 April. Following disking, the ST plots were bedded with disk hippers. A reel-and-harrow bed conditioner was used to prepare a seedbed immediately ahead of the planter. The no-till and ridge-till treatments received an application of Roundup (1.0 lb ai/acre) on 11 April followed by Gramoxone Extra (0.6 lb ai/acre) three hours later. No seedbed preparation was used in the NT plots; however, ripple coulters were mounted ahead of each planter unit for planting these treatments. Stoneville 4892BR cotton (5.3 seed/ft) was planted in all plots on 8 May. Temik (0.5 lb ai/acre) and Terraclor Super X (1.88 lb ai/ acre) were applied in furrow.

Pre-emerge weed control in all three treatments consisted of a broadcast application of Prowl (1.0 lb ai/ acre) + Cotoran (1.2 lb ai/acre). All treatments received a banded post emergence application of Caporal + MSMA (0.6 + 1.0 lb ai/acre). Layby was Bladex at (1.0 lb ai/acre) and MSMA at (1.0 lb ai/acre).

On 29 May all treatments received 45 lb N/acre or 90 lb N/acre (as per treatment requirement) as 32% UAN solution knifed into the beds approximately 3 inches deep and 10 inches to the side of the drill.

The entire test was defoliated with Def (.5 lb ai/acre) plus Dropp (.04 lb ai/acre) on 23 August. A spindle picker was used to harvest the center two rows of each plot on 7 September. Thirty randomly selected bolls were hand-harvested from the border rows of each plot to provide information on boll size and lint percentages. Boll samples were ginned on a 20-saw laboratory gin to provide samples for HVI fiber analysis. Lint yields were calculated by multiplying machine-picked seedcotton yields by laboratory-derived lint percentages. Plant development in each treatment was monitored by recording plant stands 30 days after planting, and plant height, node number per plant, node above white flower, and internode length at 7 day intervals throughout the growing season.

Results – Cotton yields were low in 2000 due to abnormally low rainfall and high temperatures. Despite the water deficits, some of the cover crop and tillage treatments resulted in higher cotton yields than others. There were also significant yield interactions among tillage and cover crop treatments. The use of a winter wheat cover crop or no tillage practices each increased the yield of the following cotton crop (Table 1). The highest cotton yields, however, were produced where cotton was planted no-till into wheat cover crop residue so that the combined benefits of no till and wheat cover crop were realized. The superior performance of cotton in no till wheat residue was consistent with results from previous years of the study (Table 1). Treatments that received in-season cultivation following no-till planting were lower yielding than no-till treatments without cultivation (Tables 1 and 4). Surface tillage of the no-winter-cover-crop treatments increased cotton yield compared with no-till, no-winter-cover-crop. However, these yields were still much lower than the yields obtained from no-till planting into a wheat cover crop residue.

Table 1. Effects of tillage systems and cover crops on yield of dryland cotton grown on a Gigger silt loam soil; Macon Ridge Research Station, Winnsboro, LA, 1987-2000.

Tillage System	Cover Crop	Lint Yield					
		1987-89	1990-92	1993-95	1996-98	1999	2000
		-----lbs/acre-----					
Surface-tillage	No Cover Crop	654	780	866	771	418	494
	Wheat + vetch ¹	677	740	776	723	435	471
	Hairy Vetch	672	804	832	739	373	496
	Wheat	664	810	863	800	429	520
No-tillage with cultivation ²	No Cover Crop	509	730	769	706	355	461
	Wheat + vetch ¹	540	643	655	683	420	502
	Hairy Vetch	630	771	743	708	379	519
	Wheat	714	761	826	794	479	562
No-tillage w/o cultivation	No Cover Crop	570	779	900	764	376	490
	Wheat + vetch ¹	542	779	812	700	514	523
	Hairy Vetch	611	864	907	776	478	513
	Wheat	695	813	983	848	518	579
<u>Tillage means across cover crops</u>							
Surface-tillage		667	784	834	759	414	495
No-till with cultivation ²		598	726	748	723	408	511
No-till w/o cultivation		604	809	901	772	472	526
<u>Cover crop means across tillage systems</u>							
	No Cover Crop	577	763	845	747	383	481
	Wheat + vetch ¹	587	720	747	702	456	499
	Hairy Vetch	637	813	827	741	410	509
	Wheat	691	795	891	814	475	553
LSD (0.05) Tillage System x Cover Crops		n.s.	70	73	96	46	44
LSD (0.05) Tillage Systems		n.s.	36	38	50ns	23	22ns
LSD (0.05) Cover Crops		n.s.	42	44	57	27	26
C. V. (%)		16	6	5	8	11	9

¹ Crimson clover was planted as the cover crop in these plots from 1987 through the 1996 growing season. In the fall of 1996 a mixture of hairy vetch and wheat was planted due to long-term low yields associated with the use of crimson clover as a cover crop for cotton.

² From 1987 through the 1999 growing seasons these plots were ridge-tillage. Due to consistent lower yields associated with the use of ridge-tillage, a no-tillage with in-season cultivation treatment was initiated on these plots in 2000..

Table 2. Effects of tillage systems and cover crops on plant population density of dryland cotton grown on a Gigger silt loam soil; Macon Ridge Research Station, Winnsboro, LA, 1987-2000.

Tillage System	Cover Crop	Plant Population					
		1987-89	1990-92	1993-95	1996-98	1999	2000
		-----plant/acre x 1000-----					
Surface-tillage	No Cover Crop	41.6	36.7	39.3	41.1	35.7	41.9
	Wheat + vetch ¹	35.2	38.6	40.5	40.5	31.0	34.2
	Hairy Vetch	40.7	38.6	39.8	44.5	29.4	39.0
	Wheat	38.1	36.5	39.0	42.0	29.9	39.6
No-tillage with cultivation ²	No Cover Crop	36.3	35.6	40.7	39.3	37.0	39.9
	Wheat + vetch ¹	39.8	38.6	32.2	38.5	32.1	27.6
	Hairy Vetch	36.7	35.4	36.0	37.6	35.4	34.0
	Wheat	44.8	38.7	43.0	42.0	33.9	33.3
No-tillage w/o cultivation	No Cover Crop	32.2	30.3	38.2	36.4	25.9	37.6
	Wheat + vetch ¹	32.8	28.4	29.5	32.2	32.2	30.8
	Hairy Vetch	30.1	30.1	31.6	33.5	27.7	39.5
	Wheat	39.2	33.4	40.2	35.6	25.5	36.2
<u>Tillage means across cover crops</u>							
Conventional		38.9	37.6	39.7	42.8	31.5	38.7
No-till with cultivation ²		39.4	37.1	38.0	39.6	34.6	33.7
No-till w/o cultivation		33.6	30.6	34.9	34.4	27.8	36.0
<u>Cover crop means across tillage systems</u>							
	No Cover Crop	36.7	34.2	39.4	39.9	32.9	39.8
	Wheat + vetch ¹	36.0	35.2	34.1	37.1	31.8	30.9
	Hairy Vetch	35.8	34.7	35.8	38.5	30.9	37.5
	Wheat	40.7	36.2	40.7	39.9	29.8	36.4
LSD (0.05) Tillage System x Cover Crops		n.s.	5.6	6.8	4.4	5.6	5.7
LSD (0.05) Tillage Systems		n.s.	2.9	3.5	2.3	2.8	2.9
LSD (0.05) Cover Crops		n.s.	n.s.	4.1	2.7.	3.3	3.4
C. V. (%)		35.9	9.9	11.2	7.0	17.9	15.9

¹Crimson clover was planted as the cover crop in these plots from 1987 through the 1996 growing season. In the fall of 1996 a mixture of hairy vetch and wheat was planted due to long-term low yields associated with the use of crimson clover as a cover crop for cotton.

²From 1987 through the 1999 growing seasons these plots were ridge-tillage. Due to consistent lower yields associated with the use of ridge-tillage, a no-tillage with cultivation treatment was initiated on these plots in 2000..

Table 3. Effects of tillage systems and cover crops on plant growth and development of dryland cotton grown on a Gigger silt loam soil; Macon Ridge Research Station, Winnsboro, LA, 2000.

Tillage System	Cover Crop	Plant Height		Mainstem Nodes		NAWF ⁴			TIL ⁵			Boll Weight -grams-
		44 DAP ³	87 DAP	44 DAP	87 DAP	58 DAP	64 DAP	70 DAP	58 DAP	64 DAP	70 DAP	
		----inches----		---number---		-----number-----		-----inches-----				
Surface-tillage	No Cover Crop	20.2	32.0	8.9	12.9	7.7	4.0	1.5	2.18	1.91	1.27	3.54
	Wheat + vetch ¹	19.9	29.8	9.9	12.9	6.8	3.3	1.3	2.01	1.88	1.24	3.38
	Hairy Vetch	20.0	30.9	9.5	12.7	7.4	3.4	1.4	2.10	1.92	1.30	3.73
	Wheat	21.0	31.3	9.4	12.6	7.5	3.4	1.4	2.16	1.88	1.22	3.49
No-tillage with cultivation ²	No Cover Crop	18.4	30.8	8.6	13.2	7.8	4.5	2.1	2.11	1.92	1.43	3.47
	Wheat + vetch ¹	20.8	33.1	9.8	14.1	8.3	4.4	2.1	2.04	1.93	1.61	3.54
	Hairy Vetch	23.2	33.3	9.6	13.6	7.7	4.0	1.7	2.13	1.93	1.47	3.52
	Wheat	22.5	35.7	9.6	14.2	7.9	4.2	2.0	2.13	1.98	1.57	3.68
No-tillage w/o cultivation	No Cover Crop	20.8	32.8	9.4	12.8	8.1	3.9	1.6	2.19	1.95	1.27	3.34
	Wheat + vetch ¹	23.2	36.4	9.8	14.5	8.7	4.6	1.9	2.22	1.97	1.49	3.25
	Hairy Vetch	23.7	35.6	10.5	13.9	7.8	3.9	1.6	2.19	1.94	1.30	3.16
	Wheat	23.3	36.7	9.6	14.0	8.6	4.1	1.8	2.21	2.04	1.47	3.41
<u>Tillage means across cover crops</u>												
Surface-tillage		20.3	31.0	9.4	12.8	7.4	3.5	1.4	2.11	1.90	1.26	3.53
No-till with cultivation ²		21.2	33.2	9.4	13.8	7.9	4.3	2.0	2.10	1.94	1.52	3.55
No-till w/o cultivation		20.3	35.4	9.8	13.8	8.3	4.1	1.7	2.20	1.98	1.38	3.29
<u>Cover crop means across tillage systems</u>												
No Cover Crop		19.8	31.9	9.0	12.9	7.9	4.2	1.7	2.16	1.92	1.32	3.45
Wheat + vetch ¹		21.3	33.1	9.8	13.8	7.9	4.1	1.8	2.09	1.93	1.45	3.39
Hairy Vetch		22.3	33.3	9.9	13.4	7.6	3.7	1.6	2.14	1.93	1.35	3.47
Wheat		22.2	34.6	9.5	13.6	8.0	3.9	1.7	2.16	1.97	1.42	3.53
LSD (0.05) Tillage System x Cover Crops		1.6	1.5	0.5	0.6	0.7	0.5	0.4	0.13	0.13ns	0.20	0.30
LSD (0.05) Tillage Systems		0.8	0.8	0.2	0.3	0.3	0.2	0.2	0.07	0.07ns	1.10	0.15
LSD (0.05) Cover Crops		0.9	0.9	0.3	0.3	0.4ns	0.3ns	0.2ns	0.08ns	0.08ns	0.12ns	0.18ns
C. V. (%)		7.6	4.6	5.1	4.2	8.7	11.9	21.3	6.2	6.7	14.2	8.7

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³DAP = Days after planting.

⁴NAWF = Nodes above white flower.

⁵TIL = Terminal internode length (above white flower).

Table 4. Effects of tillage systems and cover crops on plant population density and yield of non-irrigated cotton grown on a Gigger silt loam soil; Macon Ridge Research Station, Winnsboro, LA, 1987-2000 (Averages).

Tillage System	Cover Crop	Plant Population	Lint Yield
		--plants/acre x 1000--	--lbs/acre--
Surface-tillage	No Cover Crop	40.2	723
	Wheat + vetch ²	37.8	690
	Hairy Vetch	39.9	715
	Wheat	38.3	740
No-tillage with cultivation ²	No Cover Crop	38.0	640
	Wheat + vetch ²	36.2	606
	Hairy Vetch	36.2	675
	Wheat	40.9	738
No-tillage w/o cultivation	No Cover Crop	33.9	708
	Wheat + vetch ²	30.9	681
	Hairy Vetch	31.7	748
	Wheat	36.2	794
<u>Tillage means across cover crops</u>			
	Surface-tillage	39.1	717
	No-till with cultivation ²	37.8	665
	No-till w/o cultivation	33.2	733
<u>Cover crop means across tillage systems</u>			
	No Cover Crop	37.4	690
	Wheat + vetch ²	35.0	659
	Hairy Vetch	35.9	713
	Wheat	38.4	757
LSD (0.05) Tillage System x Cover Crops		4.8	49
LSD (0.05) Tillage Systems		2.4	24
LSD (0.05) Cover Crops		2.7ns	28
C. V. (%)		17.2	9

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²From 1987 through the 1999 growing seasons these plots were ridge-tillage. Due to consistent lower yields associated with the use of ridge-tillage, a no-tillage with cultivation treatment was initiated on these plots in 2000.