Winter Cover Crops' Influence on Cotton Yield

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Introduction

Winter cover crops, usually legumes, may have had a useful role in cotton *(Gossypium hirsutum* L.) production in the Midsouth until about 1950 (Keisling et al., 1994). Cover crops were primarily used to provide nitrogen to the subsequent cotton crop. They also provided the benefit of increased humus (organic matter) in the soil. Humus is the key component for maintaining high quality soil. It builds soil structure and tilth (Reicosky and Lindstrom, 1993). Excessive tillage greatly accelerates the breakdown of organic matter (Keisling et al., 1994).

Winter cover crops, while beneficial, also have associated costs. Costs of seed, planting, elimination by shredding or herbicides, and the shortened spring season for seedbed preparation must be weighed against measurable or potential benefits. From the mid-1900's through the present, Midsouth cotton producers have opted for commercial nitrogen fertilization rather than the green manure crops.

The size of farm machinery has increased dramatically since the 1960's. With these larger machines comes a change in seedbed preparation, from flat breaking to running a disk harrow as a primary tillage tool (Reicosky and Lindstrom, 1993). Humus depletion has been shown to increase as the number of tillage trips increase. Cotton producers may make as many as 10 or `trips per acre in preparing the seedbed (Keisling et al., 1995).

The organic matter of many of the more productive Midsouth soils is approximately one percent. As organic matter decreases, soil tilth is lessened and compaction problems rob producers of profits. The traffic pan reduces root penetration and water infiltration. To combat this, many producers are using subsoilers to break this traffic pan. These trips require high horsepower, have a high cost per acre, take valuable time during fall or spring seedbed preparation, and results are unpredictable (Keisling et al., 1995).

Planting a green manure cover crop has been shown in studies to have a positive impact on yields (Keisling et al., 1994). Cover crops offer advantages other than yield increases. In the winter and early spring, when heavy rainfall is more likely, an established cover can slow water runoff, thereby, keeping soil in place and possibly avoiding fertilizer or herbicide contamination in streams or underground aquifers.

The practical significance of humus loss or 'burn-out' can be summarized as (1) mineralization of soil organic nitrogen for subsequent uptake and use for plant growth, (2) deterioration of soil tilth and soil structure with increased surface crusting, an d (3) less amelioration and degradation of some herbicides (Keisling et al., 1994). A concern about the adverse impact of continuing organic matter loss led to the establishment of this experiment.

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Materials and Methods

In 1994, research was done at the Delta Branch Station, Clarkedale, AR on a Dubbs (fine silty, mixed, nonacid, t mic Typic HapludalQ-Dundee (fine silty, mixed, thermic Aeric Ochraqualf) soil association. 'Deltapine 51' cotton was planted on May 17. Seeds were double-treated and planted at a seeding rate of eight seeds per row/foot. The cover crop treatments were originally established in a randomized complete block design. The test has been modified to some degree as to cover crops, herbicides, and seedbed preparation used (Keisling et al., 1994). Currently, the experimental design consists of cover crop main plots arranged in a randomized complete block. Main plots are split for tillage comparisons of ridge-till versus conventional tillage. The cover crops are listed in Table 1. Cotton management practices are summarized in Table 2.

In-season management practices for 1994 are as follows. Herbicides were varied according to the type of treatment imposed. The conventionally tilled cotton received a broadcast rate of 1 lb ai/A of trifluralin on April 27, incorporated to a depth of 1.5 inches. Fluometuron at 0.8 lb ai/A was banded behind the planter on May 17. The minimum-tilled cotton received 0.63 lb ailA of paraquat on April 18 and received an application of metolachlor at 1.5 lb ai/A on April 27. The ridge-tilled treatments received two post-directed applications (June 13 and June 16) of fluometuron 0.6 lb ai/A and MSMA at 1.1 lb ai/A. On June 16, the minimum-tilled plots received a post-directed application of fluometuron 0.6 lb ailA and MSMA at 1.1 lb ai/A.

Also, conventional plots were mechanically cultivated with a Buffalo@ cultivator on June 1, June 6, June 15, and June 28. The Buffalo cultivator was used in the minimum-tilled plot on June 15 and June 28. All plots in 1994 were flame-cultivated on July 6, July 14, and July 21. Propane was set at 30 PSI and travel speed was 3 MPH.

Insecticide applications were the same for all plots. Azinphosmethyl was applied at the broadcast rate of 0.25 lb aiIA on June 15 and June 20 for the control of boll weevil. Cyfluthrin and profenofos were applied at the rate of 0.04 lb ai/A and 0.25 lb ai/A, respectively, on August 9, August 16, and August 30 €or worm and egg control.

Four 40-inch-wide rows were planted in each plot and trimmed back to harvest length of 50 feet. Mean harvest plant population for all plots was 44,981 plants per acre. The field was limed according to soil tests at the rate of 2.5 tons/A on March 20, 1994. Nitrogen was applied at the rate of 90 lb/A as ammonium nitrate on June 1, followed by a sidedress application of 30 lb N/A of 32% solution on June 17. Foliar applications were made on August 8 and August 12 of 4.6 !h/A as urea and 0.1 1bIA boron each trip. These plots received no supplemental irrigation, but 18.2 inches of rainfall were recorded from May through October.

Harvest aids, consisting of tributul phosphorotrithioate at 0.75 lb ai/A, glyphosate at 0.8 Ib ai/A, and ethepon at 1.5 lb ai/A, were applied on September 13. Cotton was machine-harvested first on Oct. 4, 1994 and picked the second time on Oct. 11, 1994 . Gin turnout was based on returns of station-picked cotton processed at a local gin.

Results and Discussion

The statistical analysis for yield indicated no interactions. The wheat and clover cover crops in 1994 yielded significantly higher than wheat and vetch alone as shown in Table 1. Table 1 also points out the combination of wheat with a legume resulted in higher yields than the legume alone. The reason for this is possibly because while the legume fixes N, the wheat acts like a scavenger and in its uptake produces more plant mass that better facilitates the following cotton crop. The yield difference between conventional tillage and ridge-tillage was not significant, Table 1. This could be due in part to the good 1994 crop year, but more particularly to the cultivation performed on the test after emergence.

The results of soil mineral analysis are given in Table 3. The organic matter of conventional and ridge-till were essentially equal. Stratification of soil pH, organic matter, K, Ca, Na, Mg, Fe, P, NO;, and EC is apparent. It is interesting to note that Na, an element taken up only in small amounts by plants, is being lessened in the surface soil layer (0 to **2** inches). All other soil characters are being increased. The cover crop influenced soil pH, Cu, NO;, and EC. Essentially, the pure legume had higher NO; and lower pH, while the legume-grass mixture was intermediate in NO;. The EC basically reflected the soil NO; content. Tillage systems only influenced soil P levels, with ridge-till having measurably more P than conventional.

Table 1. Yield of lint cotton at the Delta Branch Experiment Station, 1994.

Cover	Yield (1b/A)
Wheat and Clover	1,130.94 a*
Wheat and Vetch	1,060.59 b
Winter Weeds	973.69 c
Vetch	968.02 c
Tillage	
Conventional	1,046.92 a
Ridge-till	1.007.63 a

*Numbers in the same column and category followed with the same letter are not significantly different at the ***5%*** level.

Table 2. Summary of the cotton management practices by year.

	Date of Planting		Fertilizer			Harvest	Cotton
Year	Cover	Cotton	Amount	Type	Time	Dates	Cultivar
			(Kg/ha)				
1994	10-10-93	5-17-94	100	NH4NO,	sd*	10-4-94	DPL 51
			34	NH4N03	sd	10-11-94	
			10	urea	sd		

* sidedressed

Literature Cited

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Table 3. Soil Test1 Results for Various Tillage, Cover Crops, and Depths in the Fall of 1994.

	Soil Test Results													
	PH	**O.M.~**	**K**	**Ca**	**Na**	**Mg**	**Fe**	**Mn**	**Cu**	**Zn**	**S**	**P**	**NO3**	**EC**
Depth		(%)					lb/A							(moh)
0 to 2 in.	6.0a*	1.4a	392a	2185a	134b	461a	336b	60a	2.6a	7.4a	51a	158a	89a	137a
2 to 6 in.	5.4b	1.2b	287b	1980b	142a	358b	351a	60a	2.6a	7.2a	48a	125b	79b	122b
Level of Sig.	1%	1%	1%	1%	5%	1%	1%	10%	10%	10%	10%	1%	1%	1%
Cover2														
Vetch	5.5b	1.2a	317a	2038a	136a	393a	348a	60a	2.7ab	7.1a	48a	139a	96a	139a
Wheat & Clover	5.5b	1.3a	330a	2035a	144a	395a	357a	64a	2.4b	7.2a	4 6a	138a	Slab	124b
Wheat & Vetch	5.5b	1.3a	327a	1904a	130a	374a	347a	57a	2.4b	7.4a	51a	133a	Slab	127ab
Winter Weeds	5.8a	1.2a	316a	2190a	147a	404a	336a	60a	2.8a	7.3a	50a	134a	74b	120b
Level of Sig.	5%	10%	10%	10%	10%	10%	10%	10%	5%	10%	10%	10%	10%	5%
Tillage*														
Ridge-till	5.6a	1.2a	328a	2107a	140a	400a	344a	61a	2.7a	7.4a	49a	140a	84a	130a
Conventional	5.6a	1.2a	316b	1992b	139a	384b	348a	59a	2.5b	7.1a	49a	132b	81a	125a
Level of Sig.	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%	5%	10%	10%

[1] Soil test results were obtained using 1994 University of Arkansas soil testing procedures.
* Means are weighted according to depth of the sample to give 0 to 6 inches or an acre furrow slice.
[3] O.M. = Organic Matter.
* Numbers in the same column and category followed with the same letter are not significantly different.