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Establishment Methods of Cover Crops in No-till Cotton

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Abstract

Most plantings of fall-seeded crops in Mississippi include conventional tillage. Quick establishment of these crops before the arrival of cool, wet weather is critical for survival. A field experiment was conducted on a Grenada silt loam (fine silty, mixed thermic Ochreptic Fragiudalf) in 1988-1991 to compare various establishment methods of cover crops [crimson clover (*Trifolium incarnatum* L. var. 'Tibbee'), hairy vetch (*Vicia villosa* L.), wheat (*Triticum aestivum* L.), and rye (*Secale cereale* L. var. 'Elbon')] in no-till cotton (*Gossypium hirsutum* L.). In addition to planting no-till, other establishment methods were disking once, chiseling once, and paratill plowing. Grass cover crops produced more canopy cover by mid-March. However, hairy vetch provided the highest canopy cover by mid-April. Disking tended to decrease percent ground cover of cover crops. Rye and wheat produced the highest dry matter (DM) yields during 2 of the 3 years. Establishment methods did not affect DM yields. Seed cotton yield was significantly decreased by disking only in 1989. Highest seed cotton yield was produced by cotton following hairy vetch while cotton following rye produced the lowest yield. Results from this study indicate that no tillage is required to establish a cover crop for no-till cotton to obtain high seed cotton yields.

Introduction

Acreage of crops grown with conservation tillage has steadily increased during the last several years. A crop with one of the largest acreage increases in conservation tillage is cotton. In some areas of the southeastern United States, yields of no-till (NT) cotton have been equal to or higher than conventionally-tilled (CT) cotton. Stevens et al. (1992) reported no differences in seed cotton yields between NT, minimum tilled (disked once or hipped once), or CT cotton. Keeling et al. (1988) reported that with irrigation, lint yields were similar for CT and NT cotton, but under dryland conditions, NT cotton yields were higher. In Mississippi, NT cotton has reduced soil loss by 86 percent as compared to CT cotton (Spurlock and Misra, 1989).

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Previous studies on establishing crops for cover or doublecropping have been conducted for corn (*Zea mays* L.) and soybean (*Glycine max* (L.) Merr.). Bathke et al. (1991) reported that disking, compared to chiseling or paratilling prior to planting wheat, decreased wheat and soybean seed yields. Frye et al. (1988) found that overseeding hairy vetch or bigflower vetch (*V. grandiflora* Scopoli) 3 weeks before corn harvest instead of drilling after harvest increased dry matter (DM) yield and nitrogen (N) production. With the interest increasing in cover crops and no-till cotton, a study was designed to evaluate establishment methods of four cover crops compatible with no-till cotton. Effects of these methods were rated with respect to canopy development and DM yield for each cover crop and to seed cotton yield.

Materials and Methods

This experiment was conducted at the USDA-SCS Plant Materials Center near Coffeeville, MS. Soil type

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was Grenada silt loam with a pH of 6.8 and organic matter content of 1.48 percent. Experimental design was a split plot in a randomized complete block with four replications. Establishment methods were whole plots with cover crops as split plots. Individual plot size was 13.3 feet by 25 feet.

Following stalk shredding in the fall, four tillage systems were evaluated for establishing cover crops. These systems were no-till, disking one time (1X), chiseling 1X, and paratill plowing. Cover crops were drill-planted (8-inch rows) Oct. 27, 1988, Nov. 20, 1989, and Oct. 26, 1990. Seeding rates were 20, 35, 120, and 120 pounds per acre for crimson clover, hairy vetch, rye. and wheat, respectively. Fertilizer, broadcast applied, consisted of 0-35-66 (N-P-K) pounds per acre to all plots and 25 pounds N, as ammonium nitrate, per acre to rye and wheat. 'Abruzzi' rye was planted in 1988 but failed to germinate. Elbon was substituted and planted Dec. 5, 1988.

Glyphosate was applied on approximately April 17 of each year at 2.0 lb ai/A for burndown of the cover crops. A no-till planter with a ripple coulter was used to plant cotton 'DES 119' on May 25, 1989, June 3, 1990, and May 7, 1991. Seeding rate was 7 seeds per row foot (40-inch row spacing). Fluometuron and metolachlor, 1.5 lb ai/A each, were applied preemergence. N rates were 40, 60, 90, and 90 lb/A for cotton following hairy vetch, crimson clover, rye, and wheat, respectively. Half of each rate was applied at planting with the remainder applied 4 weeks after cotton emergence. N source was ammonium nitrate. Cyanazine at 1.0 lb ai/A and MSMA at 2.0 lb ai/A were applied as a layby application. Insecticide applications were made according to scouting reports, and cotton was defoliated when 65 percent of the bolls were open.

Canopy cover by the cover crops was visually estimated from February to mid-April. Cover crop DM yield was determined by hand harvesting 4 square feet in each plot at termination. Seed cotton yield was determined by hand harvesting the middle two rows in each plot.

Plots were assigned to the same cover crop establishment method system for the duration of the experiment. Data were subjected to analysis of variance, and Duncan's Mutilple Range Test (DMRT) was used to separate means that were significantly different at the $P < 0.05$ level (Steel and Torrie, 1960). No significant interactions were found for any parameter studied. Therefore, only main effects will be discussed.

Results and Discussion

All cover crops emerged to good stands providing some fall cover. Some plants were freeze killed during record low temperatures in December 1989. In December 1990, crimson clover was killed by a sudden drop in temperature because of a lack of preconditioning to cold weather. Therefore, data from the crimson clover plots were not included in the analyses in 1991.

Generally, the grasses provided more fall growth and cover than the legumes. This trend continued until mid-March (Table 1). Hairy vetch, being a viney plant, produced more lateral growth than the upright crimson clover. As the season progressed, cover by the legumes was equal to or higher than the cover by the grasses. Plant growth of the legumes during this time was mostly by leaves while the grasses produced more stem growth.

Disking to establish cover crops tended to decrease canopy cover as decreases ($P < 0.05$) were found in 1989 and 1991 (Table 2). Studies have shown that disking loosens the soil surface but compacts the soil below the plow layer, thus reducing deep root growth (Khalilian et al., 1988; Radcliffe et al., 1988). Establishing cover crops without tillage maintains residue cover, thus reducing soil erosion. Earlier SCS studies found that paratill plowing reduced residue cover by only 5 percent. This establishment method could play a dual role when restrictive layers occur on highly erosive soils.

Wheat and rye produced significantly more DM yields than the legumes in 1989 and 1990 (Table 3). Grass yields in 1989 were surprisingly high for the amount of N fertilizer applied in the fall of 1988. Some residual N may have remained from the preceding cotton crop. In years when residual N levels are excessive,

Table 1. Percent canopy cover, by dates, of cover crops, 1989-1991.

	1989				1990		1991			
Cover crop	2/9	3/13	3/28	4/11	3/30	4/13	2/7	2/27	3/21	4/11
	%									
Crimson clover	30d*	36d	67b	97b	15b	22c	–	–	–	–
Hairy vetch	41c	45c	86a	100a	46a	86a	9c	14c	48	97a
Rye	81b	71b	73b	88c	40a	63b	41a	32a	49	53b
Wheat	96a	85a	87a	92b	39a	60b	36b	27b	51	53b

*Means within a column not followed by a common letter are significantly different as determined by DMRT ($P < 0.05$).

Table 2. Percent canopy cover, by dates, as affected by establishment methods, 1989-1991.

Establishment method	1989				1990		1991			
	2/9	3/13	3/28	4/11	3/28	4/11	2/7	2/27	3/21	4/15
	%									
No-till	69*	65a	85a	97	31	56	25	23b	44	71
Paratill	66	63ab	81a	97	44	67	29	25ab	45	73
Disk	60	55b	70b	94	25	52	24	21b	45	72
Chisel	68	59ab	79a	95	39	60	29	28a	62	72

*Means within a column not followed by a common letter are significantly different as determined by DMRT ($P<0.05$).

wheat or rye could be planted to reduce N leaching through the soil during the time the row crop is absent.

Cover crop yields were not significantly affected by establishment method in this experiment (Table 4). Elsewhere, Flocker et al. (1958) have reported that DM yields of 12 cover crops were decreased by severe soil compaction as compared to light and moderate compaction. In their study, vetch, oats (*Avena sativa* L.), and rye produced higher DM yields with moderate compaction.

Cotton was planted later than the last recommended date of May 15 because of wet weather in 1989 and 1990. Plants emerged to a good stand in all cover crop and establishment method plots in all years.

Significant differences were found between cover crops and for establishment methods on seed cotton yield (Tables 5 and 6). Cotton in hairy vetch plots produced the highest seed cotton yields in 1989 and 1990, but these yields did not significantly differ from that of cotton with a wheat cover crop. Cotton in rye plots started to mature earlier and showed more moisture stress in August, possibly contributing to its low yield. Brown et al. (1985) reported similar results for rye and vetch. In their study, more N (30 lb/A) was required for cotton following rye for yields to equal a fall plowing system. They also reported that NT cotton planted into clover or native cover decreased yield as compared to the fall plow system.

Disking significantly decreased seed cotton yield as compared to no-till and paratill plowing methods only in 1989. Plants in the disked plots could have had restricted root growth due to compaction caused by the heavy disk.

Table 4. Cover crop dry matter yield, by establishment methods, 1989-1991.

Establishment method	DM yield		
	1989	1990	1991
	lb/A		
No-till	2,764	1,244	1,659
Paratill	2,831	1,043	1,615
Disk	2,650	804	1,179
Chisel	3,032	919	1,523

Table 5. Seed cotton yield as affected by cover crop, 1989-1991.

Cover crop	Seed cotton yield		
	1989	1990	1991
	lb/A		
Crimson clover	1,640bc*	2,052ab	–
Hairy vetch	1,790a	2,260a	1,704
Rye	1,512c	1,872b	1,645
Wheat	1,695ab	2,076ab	1,631

*Means not followed by a common letter are significantly different as determined by DMRT ($P<0.05$).

Table 3. Cover crop dry matter yield, 1989-1991.

Cover crop	DM yield		
	1989	1990	1991
	lb/A		
Crimson clover	2,167b*	108c	–
Hairy vetch	1,852b	626b	1,859a
Rye	3,684a	1,718a	1,456ab
Wheat	3,572a	1,558a	1,168b

*Means within a column not followed by a common letter are significantly different as determined by DMRT ($P<0.05$).

Table 6. Seed cotton yield as affected by cover crop establishment method, 1989-1991.

Establishment method	Seed cotton yield		
	1989	1990	1991
	lb/A		
No-till	1,822a*	1,878	1,628
Paratill	1,770a	2,032	1,690
Disk	1,436b	2,029	1,696
Chisel	1,608ab	2,322	1,625

*Means not followed by a common letter are significantly different as determined by DMRT ($P<0.05$).

Conclusions

Results of an experiment to evaluate establishment methods of cover crops suggest that little or no tillage is necessary. Canopy cover of plants established NT was equal to or higher than that following paratill plowing, disking, or chiseling. Wheat and rye provided more early fall and early spring cover. Hairy vetch and crimson clover produced more cover during late March and mid-April. Crimson clover as a cover crop may be limited by its last recommended planting date of October 15 for this area (Kimbrough and Watson, 1988). Labor and equipment necessary to drill crimson clover before this date may be unavailable. However, overseeding crimson clover before cotton defoliation has been shown to produce adequate stands (Brown et al. 1985).

No-till cotton following hairy vetch or wheat produced higher yields. Using rye, however, decreased seed cotton yield.

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