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The Effects of Lay-by Herbicides on Wheat, Vetch, and Winter Weeds as Cover Crops for Cotton

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Abstract

Caparol®, Bladex®, Karmex®, and Linex® were applied lay-by to evaluate the affect on the establishment of wheat, vetch, or winter weeds as cover crops. Plant counts taken in October or December indicated the cover crops were not adversely affected. Lay-by herbicides did not affect total surface residue determined mid-March to mid-April.

Introduction

It is estimated that about 50 percent of the cotton (*Gossypium hirsutum L.*) acreage in the Mississippi Delta receives an herbicide application at the final cultivation (2). Use of cover crops in cotton production has received added emphasis, primarily because vegetative cover on the soil in late winter and early spring prevents or reduces runoff and soil erosion.

Recent government restrictions place tillage limits for cotton production on highly-erodible land using preplant operations. Regulations and farmer opinion of economic benefits have increased interest in cotton production with as little preplant tillage as possible. In the future, post-plant tillage on sloped, highly erodible soils will probably be severely restricted or prohibited. These concerns necessitate the development of information about the effects of midseason cotton herbicides on naturally-occurring and planted vegetative covers during the winter and spring months of the following year.

This report includes information from 1987 through 1990. The objective was to study the effects of July applications of four lay-by herbicides on the population and growth of wheat (*Triticum aesitivum* L.), vetch (*Vicia sativa* L.), and winter weeds the winter and spring after application.

Materials and Methods

Wheat, vetch, and winter weed cover crops were initially established in the area of this study in 1978. In earlier studies, herbicides were not applied at midseason. During the duration of this experiment, uniform seedbed preparation and herbicide programs for control of summer weeds were used.

Prior to cotton planting, areas of wheat and winter weeds were sprayed with Roundup® (glyphosate) and vetch was sprayed with Ignite® (glufosinate). Griffin and Dabney (1) reported the effectiveness of Ignite on vetch and other winter legumes. Preplant "burn-down" with Roundup and Ignite was used to reduce the amount of green vegetation present at the time of seedbed formation.

After preplant herbicide "burn-down" application, beds were formed with a four-row hipper. Just before planting, beds were reduced to one-half height with a bed conditioner, Treflan® (trifluralin) was applied, and the bed conditioner was used again for herbicide incorporation and to reduce beds to the final planting height.

'DES 119' cotton was planted with a John Deere 7100® planter. Cotoranz® (fluometuron) was applied preemergence after planting. Postemergence-directed herbicides and row cultivation were used as needed. Cotton was harvested mechanically in late September to early November with a picker adapted to harvest small plots.

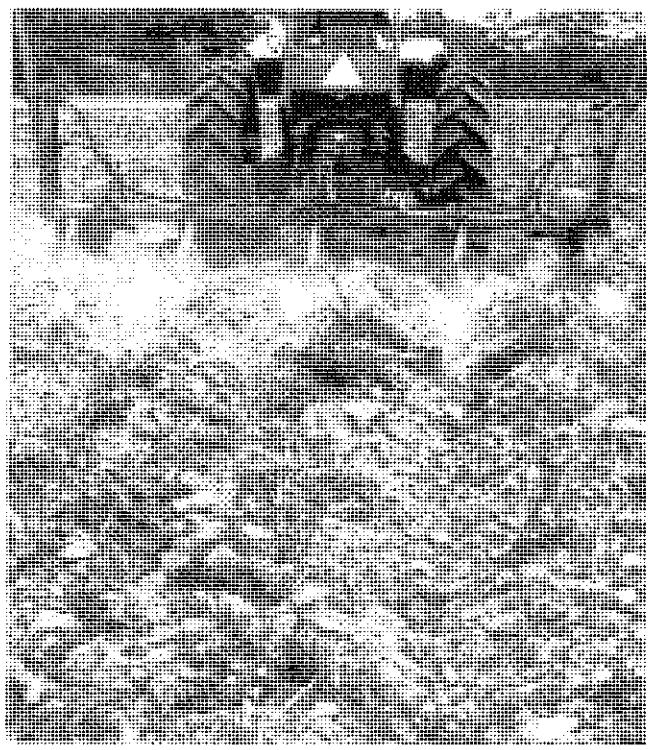

Figure 1. Hipping the plot area in October 1987.

Immediately after harvest, cotton stalks were rotary mowed to a height of 3 to 4 inches, the area was subsoiled 16 inches deep at 45° to the row direction (5), and hipped on the old row profile. Wheat ('Florida 302,' 'Traveler,' Florida 302 followed by 'Pioneer 2555,' and 'Coker 9733' in 1987-1990, respectively) and common vetch were broadcast seeded in mid-October (seeding was repeated December 1, 1989, because of inadequate seedling emergence) at 73 to 93 lb/A for wheat and 65 to 111 lb/A for vetch on the freshly-hipped beds with a hand-carried rotary seeder. Seed was covered by subsequent rainfall. Winter weeds emerged naturally.

Predominant winter weeds were henbit (*Lamium amplexicaule* L.), common chickweed [*Stellaria media* (L.) Vill.], bittercress (*Cardamine spp.*), annual bluegrass (*Poa annua* L.), and Carolina foxtail (*Alopecurus carolinianus* Walt.). The area was not tilled until 26, 34, 25, and 7 days before planting cotton in 1987-1990, respectively.

Winter cover crop population was evaluated December 8, 1987, November 17, 1988, February 13, 1990, and November 16, 1990. Plants were counted in an area 12 x 40 inches with the long axis between the center two rows at five random locations in each plot. Above-ground vegetation of the winter cover crops was harvested at five random locations between the two center rows of each plot in March or April of each year. Samples were dried to a constant weight in a forced air dryer at 120°F. The per acre yield of surface residue (crop residue plus new growth) was calculated from these samples. A visual estimate of ground cover (0 = none, 100% = total cover) was made for wheat, vetch and winter weeds in mid-April 1989 and 1990, and in late March, 1991.

Lay-by herbicides were applied with a tractor-mounted applicator with one slide unit in each row middle calibrated to deliver 20 gallons total volume per acre. The lay-by herbicides and broadcast rate active ingredient per acre used were (**1**) no herbicide, (**2**) Caparol 4L® (prometryn) at 2.0 lb, (**3**) Bladex 4L® (cyanazine) at 1.2 lb, (**4**) Karmex 80DF® (diuron) at 1.0 lb, and (**5**) Linex 4L® (linuron) at 1.0 lb. Activate® surfactant was used in 1987 and 1988, and X-77 Spreader® surfactant was used in 1989 and 1990, at 0.5% v/v with all herbicide treatments.

Each of the lay-by treatments was made to wheat, vetch, and winter weed cover crop areas. The treatments were applied in early July each year (1987-1990). All subplots remained in place for the duration of the experiment.

This experiment was arranged as a split-plot design with four replications. Main-plot treatments were cover crops and subplot treatments were herbicides. Individual subplots were four, 40-inch wide rows by 40 feet long. Data were subjected to analysis of variance. Means were separated at P=0.05 using Duncan's Multiple Range Test (DMRT).

Figure 2. This field is hipped and ready for seeding cover crops on loose soil, October 1990.

Figure 3. This device is being used to apply lay-by herbicides in July 1989.

Figure 4. Area from which residue was sampled in wheat in March 1988.

Results

Based on plant population counts, neither wheat nor vetch was affected by lay-by herbicides in any year when compared with no herbicide treatment (Table 1). However, in 1987, the Linex lay-by treatment reduced the vetch population compared to Karmex.

When averaged across main-plot treatments, there were no differences in the amount of surface residue obtained from any subplot treatment (Table 2). No main-plot by subplot interaction occurred for surface residue any year. Analysis of surface residue from main-plot treatments showed vetch yielded more than wheat or winter weeds in 1988, and wheat and vetch yielded more than winter weeds in 1989. Although differences were not significant in 1990 or 1991, winter weeds treatment resulted in the lowest numerical yield, particularly in 1990.

When percent ground cover was evaluated visually in March or April, there was no main-plot by subplot treatment interaction in any year (Table 3). Vetch produced more ground cover than winter weeds in 1989 and 1991 (winter weed main-plot treatments were not evaluated in 1990). Vetch produced more ground cover than wheat in 1989 and 1990, but was not different from wheat in 1991. Percent ground cover of wheat and winter weeds was not different in 1989 and 1991. Vetch contributed an average of 85% to the total ground cover while wheat contributed an average of 70% to the total when averaged over the 3 years (data not shown).

A main-plot by subplot interaction did occur with the common chickweed count on February 13, 1990 (Table 4). Where no lay-by herbicide was applied, there were fewer common chickweed plants in the vetch areas. In plots treated with Caparol, more common chickweed plants occurred in wheat areas. After Bladex, Karmex, or Linex application, there were no differences in the populations of common chickweed among cover crop treatments. In wheat, there were no differences in common chickweed among lay-by treatments. In vetch, the no lay-by treatment contained fewer common chickweed plants than the Linex treatment. Fewer common chickweed plants occurred in winter weeds with all lay-by treatments compared to no lay-by herbicide (Table 4).

Table 1. The effect of cotton lay-by herbicides on wheat and vetch stand, 1987-1990, MAFES Delta Branch Experiment Station, Stoneville, MS.

Cover crop	Lay-by herbicide and broadcast rate (lb ai/Acre)	Avg. number plants/sq. ft. 12/8/87	11/17/88	2/13/90	11/16/90
		(no.)			
Wheat[1]	None	5.1	9.0	1.9	5.1
	Caparol 4L 2.0	4.7	8.8	2.1	4.5
	Bladex 4L 1.2	5.5	8.2	1.7	4.6
	Karmex 80DF 1.0	6.2	8.8	1.7	5.0
	Linex 4L 1.0	6.1	8.6	1.9	4.7
Vetch[1]	None	7.5 ab	8.5	2.1	3.8
	Caparol 4L 2.0	6.6 ab	8.7	1.7	3.6
	Bladex 4L 1.2	7.1 ab	8.3	2.2	4.3
	Karmex 80DF 1.0	8.4 a	8.4	2.4	3.9
	Linex 4L 1.0	5.5 b	8.6	1.9	4.4

[1] Means within a column within a cover crop followed by the same letter do not differ significantly (P=0.05) according to DMRT.

Table 2. Dry weight of cover crops following annual applications of cotton lay-by herbicides, 1987-1990, MAFES Delta Branch Experiment Station, Stoneville, MS.

	Dry weight of cover crops and surface residue[1]			
	3/28/88	3/28/89	4/18/90	3/19/91
	(tons/acre)			
Cover Crop[2]				
Wheat	1.65 b	1.78 a	2.17	1.28
Vetch	2.59 a	1.83 a	2.11	1.35
Winter weeds	1.82 b	1.27 b	1.13	1.21
Lay-by Herbicide and Broadcast Rate (lb ai/Acre)[2]				
None	1.86	1.71	1.57	1.41
Caparol 4L 2.0	1.98	1.64	1.75	1.26
Bladex 4L 1.2	2.13	1.47	2.09	1.27
Karmex 80DF 1.0	2.00	1.63	1.51	1.21
Linex 4L 1.0	2.13	1.67	2.11	1.27

[1] Includes residue from previous cotton crop.

[2] Means within a column within a cover crop followed by the same letter do not differ significantly (P=0.05) according to DMRT.

Table 3. Winter ground cover following cover crop establishment and annual applications of cotton lay-by herbicides, 1987-1990.

	Visual estimate of total ground cover[1]		
	4/10/89	4/18/90	3/29/91
	(%)		
Cover Crop[2]			
Wheat	65.8 b	66.5 b	62.5 ab
Vetch	79.8 a	83.3 a	77.8 a
Winter weeds	56.0 b	–	53.8 b
Lay-by Herbicide and Broadcast Rate (lb ai/Acre)[2]			
None	76.3 a	72.5	70.8 a
Caparol 4L 2.0	71.7 ab	75.0	63.8 b
Bladex 4L 1.2	61.3 b	75.0	64.6 b
Karmex 80DF 1.0	59.2 b	72.5	61.7 b
Linex 4L 1.0	67.5 ab	79.4	62.5 b

[1] Not determined in 1988.

[2] Means within a column within a cover crop followed by the same letter do not differ significantly (P=0.05) according to DMRT.

Table 4. The interaction of cover crop by lay-by herbicide on the population of common chickweed, February 13, 1990, MAFES Delta Branch Experiment Station, Stoneville, MS.

Cover crop	Lay-by herbicide[1]				
	None	Caparol	Bladex	Karmex	Linex
	(Plants/sq. ft.)				
Wheat	2.39 A a	2.58 A a	2.33 A a	1.75 A a	2.25 A a
Vetch	0.47 B b	0.94 B ab	1.17 A ab	0.64 A ab	1.92 A a
Winter weeds	2.83 A a	1.17 B b	1.22 A b	0.86 A b	1.22 A b

[1] Means within a herbicide treatment followed by the same capital letter or means within a cover crop followed by the same lower case letter do not differ significantly (P=0.05) according to DMRT.

The common chickweed population was not affected by cover crop treatment any year or by lay-by treatments based on counts made in 1987 and 1990 (Table 5). Karmex, in 1988, reduced the common chickweed population compared to no lay-by treatment.

The henbit population was very large each year (Table 6) compared to other weeds. Henbit was not affected by cover crop based on counts made in 1988 and November 1990. The greatest number of henbit occurred in vetch in 1987 and in wheat in February 1990. Each year, henbit occurred in greatest numbers in plots that received no lay-by treatment (Table 6). No significant differences occurred between lay-by treatments in 1987. Henbit was reduced by Bladex in 1988, February 1990, and November 1990, and by Karmex in 1988, when compared with no lay-by treatment.

Bittercress was absent from the experimental area on November 16, 1990. This species was not affected by cover crop treatment in 1987 and 1988; however, more bittercress occurred in wheat in 1990 than in vetch or winter weeds (Table 7). Lay-by herbicide treatments did not affect bittercress in 1987. In 1988, the bittercress population was higher with no lay-by herbicide than with Karmex; however, in 1990, this was the only herbicide treatment not different from the no lay-by check.

Annual bluegrass was absent in 1989 and 1990 and was not affected by cover crop or by lay-by treatments in 1988 (Table 8). In 1987, lay-by treatments of Caparol and Bladex reduced the population below that of the no lay-by check.

On February 13, 1990, Carolina foxtail was not affected by cover crop treatment (Table 9). Compared with no lay-by treatment, Caparol reduced the foxtail population. This species was absent in 1987, 1988, and November 1990.

Conclusions

Lay-by applications of Caparol, Bladex, Karmex, or Linex in July did not adversely affect the establish-

Table 5. Effect of cover crop and cotton lay-by herbicides on common chickweed population, 1987-1990, MAFES Delta Branch Experiment Station, Stoneville, MS.

	Common Chickweed plants/sq.ft.			
	12/8/87	11/17/88	2/13/90[1]	11/16/90
	(no.)			
Cover Crop[2]				
Wheat	1.0	4.9	2.3	0.5
Vetch	2.7	7.9	1.0	0.4
Winter weeds	1.6	6.4	1.5	0.3
Lay-by Herbicide and Broadcast Rate (lb ai/Acre)[2]				
None	1.2	8.4 a	1.9	0.7
Caparol 4L 2.0	2.6	6.9 ab	1.6	0.3
Bladex 4L 1.2	2.1	5.8 ab	1.6	0.4
Karmex 80DF 1.0	1.6	4.0 b	1.1	0.2
Linex 4L 1.0	1.3	6.7 ab	1.8	0.3

[1] See Table 4 for interaction response on 2/13/90.

[2] Means within a column within a cover crop followed by the same letter do not differ significantly (P=0.05) according to DMRT.

Table 6. Effect of cover crop and cotton lay-by herbicides on henbit population, 1987-1990, MAFES Delta Branch Experiment Station, Stoneville, MS.

	Henbit plants/sq. ft.			
	12/8/87	11/17/88	2/13/90	11/16/90
	(no.)			
Cover Crop[1]				
Wheat	26.1 b	22.6	9.7 a	29.9
Vetch	35.2 a	25.9	4.6 b	35.7
Winter weeds	27.7 b	25.7	5.1 b	26.9
Lay-by Herbicide and Broadcast Rate (lb ai/Acre)[1]				
None	32.1	29.2 a	7.3 a	34.1 a
Caparol 4L 2.0	29.3	24.7 ab	6.6 ab	30.9 ab
Bladex 4L 1.2	29.1	22.3 b	5.3 b	27.6 b
Karmex 80DF 1.0	28.4	21.3 b	6.0 ab	30.4 ab
Linex 4L 1.0	29.4	26.2 ab	7.1 a	31.3 ab

[1] Means within a column within a cover crop followed by the same letter do not differ significantly (P=0.05) according to DMRT.

Table 7. Effect of cover crop and cotton lay-by herbicides on bittercress population, 1987-1990, MAFES Delta Branch Experiment Station, Stoneville, MS.

	Bittercress plants/sq. ft.		
	12/8/87	11/17/88	2/13/90
	----------	(no.)	----------
Cover Crop[1]			
Wheat	2.1	6.3	2.5 a
Vetch	1.8	8.6	0.3 b
Winter weeds	1.4	9.0	0.8 b
Lay-by Herbicide and Broadcast Rate (lb ai/Acre)[1]			
None	1.9	9.1 a	1.7 a
Caparol 4L 2.0	1.6	8.4 ab	1.1 b
Bladex 4L 1.2	2.0	8.1 ab	1.1 b
Karmex 80DF 1.0	1.5	6.2 b	1.2 ab
Linex 4L 1.0	1.8	8.2 ab	1.0 b

[1] Means within a column within a cover crop followed by the same letter do not differ significantly (P=0.05) according to DMRT.

Table 8. Effect of cover crop and cotton lay-by herbicides on annual bluegrass population, 1987-1990, MAFES Delta Branch Experiment Station , Stoneville, MS.

	Annual Bluegrass/sq. ft.	
	12/8/87	11/17/88
	----------	(no.) ----------
Cover Crop[1]		
Wheat	2.4	1.3
Vetch	2.4	4.2
Winter weeds	5.6	3.7
Lay-by Herbicide and Broadcast Rate (lb ai/Acre)[1]		
None	4.7 a	3.0
Caparol 4L 2.0	2.7 b	3.6
Bladex 4L 1.2	2.9 b	3.1
Karmex 80DF 1.0	4.0 ab	2.3
Linex 4L 1.0	3.0 ab	3.2

[1] Means within a column within a cover crop followed by the same letter do not differ significantly (P=0.05) according to DMRT.

ment of wheat or vetch in mid-October (early December 1989).

Surface residue ranged from 1.13 to 2.59 tons/acre when determined mid-March to mid-April. Winter weeds weighed less, but were significantly less than wheat in only 1 of 4 years and less than vetch in 2 of 4 years. Lay-by herbicides did not affect surface residues.

Vetch produced the greater ground cover biomass.

Table 9. Effect of cover crop and cotton lay-by herbicides on Carolina foxtail population, 1987-1990, MAFES Delta Branch Experiment Station, Stoneville, MS.

	Carolina foxtail/sq. ft. 2/13/90
	---------- (no.) ----------
Cover Crop[1]	
Wheat	0.1
Vetch	0.2
Winter weeds	0.7
Lay-by Herbicide and Broadcast Rate (lb ai/Acre)[1]	
None	0.6 a
Caparol 4L 2.0	0.1 b
Bladex 4L 1.2	0.2 ab
Karmex 80DF 1.0	0.4 ab
Linex 4L 1.0	0.3 ab

[1] Means within a column within a cover crop followed by the same letter to not differ significantly (P=0.05) according to DMRT.

Lay-by herbicides reduced ground cover only 10 to 15%, but results were inconsistent.

The populations of winter weeds were not consistently affected by cover crop or by the application of lay-by herbicides. Henbit was present in the greatest numbers; however, lay-by herbicides reduced the henbit population 12 to 27 percent.

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