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Cover Crop Response to Soil-Applied Herbicides Used in Cotton

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Introduction

To control weeds and maintain high cotton yields, producers may apply herbicides before planting, at planting, early postemergence, and/or at lay-by. Crutchfield (1990) reported that 99 percent of the cotton acreage in the Delta States was treated with herbicides. Trifluralin (Treflan®), fluometuron (Cotoran®), and norflurazon (Zorial®) were applied to 64, 31, and 19 percent, respectively, to the total cotton acreage nationwide.

Trifluralin is primarily a grass herbicide with some activity on small-seeded broadleaf annuals (WSSA, 1989). Residues from spring applications are usually low enough not to injure fall-seeded crops. However, Burnside (1974) reported that trifluralin at 2.0 pounds of active ingredient per acre (lb ai/A) reduced oat (*Avena sativa* L.) yield. Early oat growth was decreased at 1.0 lb ai/A, but the plants recovered and produced an average yield.

Fluometuron controls most annual grasses and broadleaf weeds (WSSA, 1989). It can be preplant incorporated, applied preemegence, and/or applied postemergence. Half-life of fluometuron is about 30 days, with nondetectable levels (0.10 ppm) occurring up to 4 months after application (WSSA, 1989). Snipes et al. (1984) found that fluometuron decreased green weed weight, increased seed cotton yield, and produced a higher net return than diuron (Karmex®) or trifluralin. Green (1978) stated that fluometuron applied preemergence plus two post-directed applications could injure fall seeded crops. In his study, fluometuron caused more damage to fall-seeded crops than trifluralin, metribuzin (Sencor®), or linuron (Lorox®).

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Norflurazon can suppress or control perennial weeds such as fescue (*Festuca* spp.), nutsedge (*Cyperus* spp.), and bermudagrass (*Cynodon dactylon* L.) as well as annual grasses and broadleaves (WSSA, 1989). It can be applied preplant incorporated, preemergence, or in split applications. Persistence of norflurazon has been found to be related to soil organic matter and clay component (Lo and Merkle, 1984). Keeling et al. (1989) reported that norflurazon at 1.0 lb ai/A caused only slight injury to wheat (*Triticum aestivum* L.), corn (*Zea mays* L.), and sorghum (*Sorghum bicolor* (L.) Moench) 14 months after application, but a rate of 2.0 lb ai/A caused significant injury. Repeated annual applications, even at 1.0 lb ai/A, resulted in crop injury 3 years after the last application.

Cotton is one of the most erosive row crops grown in Mississippi. Murphree and Mutchler (1980) calculated an annual C-factor of 0.58 from a watershed with a 0.2 percent slope in the Mississippi Delta. Bloodworth et al. (1993) reported that using crimson clover (*Trifolium incarnatum* L.), hairy vetch (*Vicia villosa* L.), or wheat as a cover crop reduced soil loss by 22, 20, and 31 percent, respectively, as compared to native cool season weeds.

Herbicide persistence in the soil is necessary to provide adequate weed control. Buchanan and Burns (1970) stated that cotton required approximately 8 weeks of weed-free competition to produce maximum yields. Residual levels of soil-applied herbicides must be high enough to prevent weed seed germination for this length of time. Some studies (Barnes and Lavy, 1991; Schroeder and Banks, 1986) have shown increased concentrations of herbicides that are satisfactory for labeled crops would be detrimental in a crop rotation. This study was conducted to determine the effects on cover crops of three soil-applied herbicides used in cotton.

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Materials and Methods

The cotton seedbed was prepared by disking twice, chiseling once, and harrowing. Application methods and rates of application were: fluometuron preemergence at 1.5 lb ai/A; norflurazon preemergence at 1.5 lb ai/A, and trifluralin preplant incorporated at 0.75 lb ai/A. In 1988, norflurazon was applied in split applications (preplant and preemegence) at 0.75 lb ai/A each. Herbicides were applied using a CO_2-powered backpack sprayer calibrated to deliver 10 gallons of water per acre.

Cotton (cv. 'DES 119') was planted in 40-inch rows on May 5, 1988, May 10, 1989, and May 10, 1990. Phosphorus (P) and potassium (K) were applied according to soil tests results. Nitrogen (N), as ammonium nitrate, was applied at 40 lb/A at planting and 40 lb/A 4 weeks after cotton emergence. Cotton was defoliated using Def 6® and Prep® at 1.1 and 2.0 lb ai/A, respectively.

Cover crops were no-till drilled in 8-inch rows on October 27, 1988, November 25, 1989, and October 25, 1991. Excessive soil moisture reduced plant stands in 1990-1991. Seeding rates were 20, 30, 120, and 120 pounds per acre for 'Tibbee' crimson clover, hairy vetch, rye (*Secale cereale* L., var. 'Elbon'), and wheat, respectively. Rye and wheat received 25 lb/A of N at planting. Canopy cover was determined by visually rating each plot from February to April. Dry matter yield was determined by hand harvesting 4 square feet in each plot. Samples were air-dried and weighed.

This study was conducted at the Jamie L. Whitten Plant Materials Center near Coffeeville, MS, from 1988-1992. Soil type was a Grenada silt loam. Experimental design was a split block with three replications. Plot size was 13.3 feet by 13.3 feet. Analysis of variance was used to determine if significant differences occurred among herbicides and cover crops. Duncan's Multiple Range Test (DMRT) (Steel and Torrie, 1960) was to separate means.

Results and Discussion

Canopy cover by herbicides is presented in Tables 1, 2, and 3 for 1989, 1991, and 1992, respectively. Herbicides did not influence canopy cover in any year. Wheat did show some signs of crop injury (leaf chlorosis) from norflurazon in mid-February of each year. This lasted 10-14 days and the wheat fully recovered. Kendig and Talbert (1991) stated that wheat recovery from norflurazon injury appeared to be from tolerable stand losses and increased tillering. Rogers et al. (1986) found that reduction in ground cover by wheat and hairy vetch was dependent upon soil type, herbicide program, and year. In a comparison of herbicides applied at lay-by, stand counts of wheat and hairy vetch were not influenced by prometryn (Caparol®), cyanazine (Bladex®), diuron, or linuron (Hurst, 1992). In this study, dry matter yields were not affected by herbicides (Tables 1, 2, and 3).

By late February of each year, rye and wheat produced significantly more canopy cover than the legumes (Tables 1, 2, and 3). By April, however, canopy covers of the legumes were equal to or significantly higher than the grasses. In 1990, crimson clover emerged to excellent stands in all plots. Growing conditions following planting were warm with adequate soil moisture. During late December, temperatures suddenly decreased, freeze killing most of the plants due to lack of preconditioning.

Hairy vetch, which has a higher tolerance to low temperatures than crimson clover, was not affected by the sudden change in temperature. In Mississippi, the last recommended planting date for crimson clover and hairy vetch is October 15 (Kimbrough and Watson, 1988) while wheat and rye may be planted by

Table 1. Canopy cover and dry matter yield as influenced by herbicide and cover crop, 1989.

	Canopy cover				DM yield
	2/21	3/13	3/28	4/11	4/13
	%				lb/A
Herbicide					
Fluometuron	53	46	65	86	1,428
Norflurazon	51	43	66	88	1,540
Trifluralin	51	41	62	76	1,295
Check	44	34	62	76	1,469
Cover crop					
Crimson clover	41c	39b	70ab	90a	1,840a
Hairy vetch	23d	9c	63bc	88a	1,154b
Rye	60b	43b	47d	49b	1,213b
Wheat	80a	75a	78a	86a	1,471ab

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

Table 2. Canopy cover and dry matter yield as influenced by herbicide and cover crop, 1991.

	Canopy cover				DM yield
	2/07	2/27	3/21	4/15	4/23
	%				lb/A
Herbicide					
Fluometuron	25	28	50	72	1,435
Norflurazon	19	25	48	72	1,177
Trifluralin	20	18	42	72	1,239
Check	20	19	43	72	1,359
Cover crop					
Crimson clover	–	–	–	–	–
Hairy vetch	13b*	21	59a	100a	1,661a
Rye	27a	26	38b	48b	1,246b
Wheat	25a	20	40b	50b	1,001b

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

Table 3. Canopy cover and dry matter yield as influenced by herbicide and cover crop, 1992.

	Canopy cover			DM yield
	1/31	3/04	4/06	4/22
	%			lb/A
Herbicide				
Fluometuron	25	30	48	2,866
Norflurazon	23	31	46	3,170
Trifluralin	23	31	50	2,674
Check	23	30	45	2,622
Cover crop				
Crimson clover	12b*	25	55	4,105a
Hairy vetch	7b	15	40	2,464b
Rye	41a	35	45	2,268b
Wheat	46a	50	50	2,494b

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

November 15 (Houston, 1989). Cotton harvest is usually not completed until mid-November, which leaves little time and labor to plant a cover crop by the last recommended date.

When used as a green manure crop, vetch and rye+vetch increased lint yield by 100 pounds per acre (Talbert et al., 1983). Scott et al. (1990) reported lint yield increases of 235, 129, and 72 pounds per acre from rye+vetch, vetch, and rye+crimson clover, respectively. They noted that yields of cotton were higher following a cover crop when summers where hot and dry. In another study, native cool-season weeds, vetch, and wheat did not alter the composition nor hinder control of summer weeds (Hurst, 1989).

Crimson clover produced significantly higher dry matter (DM) yield in 1989 and 1992 (Tables 1 and 3). In 1991, DM yield of hairy vetch was significantly higher than wheat or rye (Table 2). Cotton seedlings did not show any injury from any cover crop or herbicide during this experiment (data not shown).

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