Cover Crops for Weed Control in Conservation-Tilled Cotton

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INTRODUCTION

The use of cover crops in conservation tillage offers many advantages, one of which is to control weeds. In southern Brazil, black oat *(Avena strigosa* Schreb.) is the predominant cover crop on millions of acres of conservation - tilled soybean *[Glycine max* (L.) Merr.] due in part to its weed suppressive capabilities. We initiated a field study in 1995 to determine the suitability of black oat as a cover crop for conservation-tilled cotton *(Gossypium hirsutum* L.) using the Brazilian system of managing cover crops. The Brazilian system is based on terminating the cover crops during early reproductive growth by treating with a herbicide and mechanically rolling the covers to form a dense mat of residue on the soil surface. We wantedto compare the Brazilian system using black *oat* and two common cover crops used in the southeasternUSA, i.e., rye *(Secale cereale* L.) and wheat *(Triticum aestivum* L.). Results reported here are for the first 2-yrs of the study (1995 and 1996).

MATERIALS *AND* METHODS

The *study* site was a Dothan fine sandy loam (fine-loamy, siliceous, thermic Plinthic Paleudult) in southeastern Alabama It had been in conservation tillage (strip-tilled) for the previous 8 yr and had a high population of Palmer Amaranth *(Amaranthus palmer;* S. Watts.). Cotton was grown in a strip-plot design of four replications. Horizontal plots were winter covers of black oat, rye, wheat, or fallow. Dominant winter weeds in the fallow system were cutleaf evening primrose *[Oenothera laciniota* Hill] and chickweed *[Stellaria media* (L.) Vill.]. The cover crops were sown in November of 1994, 1995, and 1996. Cover crops were terminated with an application of glyphosate (1.0 lb a.i./a) 3 wk prior to planting DPL 5690 cotton in early May each year. Within 3 d following glyphosate application, the covers were rolled with a modified stalk chopper to lay all residue flat on the soil surface. Cotton wasplanted in 36-in row widths with a John Deere MaxiMerge® planter equipped with Martin@ row cleaners and Accra-Plant@retrofit seeding disk openers.

Vertical plots were herbicide input levels: none, low, or high. The low herbicide input level consisted of a preemergence application of pendimethalin (1.0 lb a.i./a) + fluometuron (1.5 lb a.i./a). For the high input level, additional applications of fluometuron (1.0 lb a.i./a) + DSMA (1.5 lb a.il/a) early post-direct and lactofen (0.2 lb a.i./a) + cyanazine (0.75 lb a.i./a) late post-direct were made. In 1995, because the site has a well developed hardpan, the cotton was in-row subsoiled with a narrow parabolic subsoiler equipped with pneumatic tires to close the subsoil channel with minimal disturbance of the residue. In 1996, the area was paratilled 2 wk prior to planting. In both years, residue disturbance was minimal and residue formed a dense mat over the soil surface.

Weed control was determined by visual ratings (0 to 100 % control scale) early in the season (approximately 30 days after planting) and late in the season at 51 and 80 days after planting, respectively, in 1995 and 1996. In 1995, we also determined weed biomass and control ratings for grasses (primarily large crabgrass *[Digitaria sanguinalis* (L.) Scop.] and Texas panicum *[Panicum texanum* Buckl.]) and sedges *[Cyperus esculentus* L. and *C. rotundus* L.], sicklepod *(Cassia obtusifolia* L.), and Palmer amaranth. We then determined Pearson correlation coefficients between visual ratings and weed biomass to measure the validity of visual ratings. Correlation coefficients ranged from 0.77 to 0.94 and in 1996 we only used visual ratings to measure weed control. Late season weed control ratings in Table 2 are averaged over all dominant weed species.

Recommended practices were used for insect control. Seed cotton yield was determined by machine harvesting the middle two rows of each 30-A long plot.

RESULTS AND DISCUSSION

In 1995, residue production was similar for all winter cereal covers, averaging 4665 lb dry mater/a. Winter weeds produced 1260 lb *dry* matter/a in fallow plots. The severe winter of 1996 resulted in differences in residue production by the covers. Dry matter averaged 5580, 3900, 1175, and 780 lb/a for rye, wheat, black oat, and winter fallow, respectively, in 1996.

Although there were significant cover x herbicide input level interactions, no cover crop was economically

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effective in controlling weeds without a herbicide program (Table 1). Without herbicide, black oat gave more effective weed control (based on visual ratings and weed biomass than rye (35% control vs. 25% control) in 1995 but in 1996, rye gave greater control than black oat (54% control vs. 18% control) due to severe winter kill of black oat. Weed control following wheat and winter fallow were similar both years, averaging 14% and 19% in 1995 and 1996, respectively.

Averaged across winter covers, seed cotton yields were 3449 and 2925 lb/a with the high herbicide input system vs. the low input *system* in 1995. Without herbicide, there were no harvestable yields. Seed cotton yields with the low input system following black oat (3242 lb/a) were comparable to those following winter fallow (3267 lb/a) and the high input system (Table 2).

In 1996, yields averaged 428, 1475, and 2892 lb seed cotton/a with no, low, and high herbicide input programs, respectively. Winter covers also affected seed cotton yields in 1996, averaging 820, 1292, 1520, and 2759 lb/a for fallow, black oat, wheat, and rye, respectively. Maximum yield occurred with the high herbicide input system and a rye cover crop (3691 lb/a). Within the low herbicide input program, yields averaged 393, 1029, 1380, and 3098 lb seed cotton/a following covers of winter fallow, black oat, wheat, and rye, respectively.

Preliminary results indicate: 1) rye and black oat are more effective cover crops than wheat for weed control in conservation cotton, but inferior cold tolerance of black oat compared to rye may limit its zone of adaptation, 2) a strong yield benefit for planting conservation tilled cotton using the Brazilian management system, i.e., cover crops grown to produce large amounts (>4,000 lb/a) of residue rolled to form a dense mat on the soil surface.

Table. 1. Seed cotton yields as affected by cover crop and herbicide system.

	1995				1996			
	Herbicide Input System				Herbicide Input System			
Cover Crop	High	Low	None	*Mean*	High	LOW	None	*Mean*
	seed cotton (lb/a)							
Black oat	3424	3242	---†	***3334***	2826	1029	24	***1293***
Fallow	3267	2686	---	***2977***	2069	393	0	***821***
Rye	3557	2989	---	***3273***	3691	3098	1489	***2759***
Wheat	3545	2783	---	***3164***	2983	1380	200	***1521***
Mean	***3449***	***2925***	---		***2892***	***1475***	***428***	

1995 $LSD_{(0.10)}$ for cover crop = ns *(P50.20)*; for herbicide level = 421 ; for cover crop withm herbicide level interaction = ns *(P≤0.24)*; for herbicide level within cover crop interaction = ns *(P≤0.24)*.
1996 $LSD_{(0.10)}$ for cover crop = 362; for herbicide level = 434; for cover crop withm herbicide level interaction = ns *(P≤0.23)*; for herbicide level withm cover crop interaction = ns *(P≤0.23)*.

†No harvestable yield.
‡Calculated for High and Low level of herbicide only.

Table 2. Cotton weed control as affected by cover crop and herbicide system.

	1995				1996			
	Herbicide Input System				Herbicide Input System			
Cover Crop	High	Low	None	*Mean*	High	LOW	None	*Mean*
	weed control (%)							
Black oat	95	91	35	*74*	78	55	18	*50*
Fallow	94	86	13	*64*	72	43	22	*45*
Rye	94	89	26	*70*	91	82	54	*76*
Wheat	94	87	14	***65***	82	43	20	***51***
Mean	***94***	***88***	***22***		***81***	***58***	***28***	

1995 $LSD_{(0.10)}$ for cover crop = 6; for herbicide level = 4; for cover crop withm herbicide level interaction = 8; for herbicide level withm cover crop interaction = 7.
19% $LSD_{(0.10)}$ for cover crop = 8; for herbicide level = 10; for cover crop withm herbicide level interaction = ns *(P≤0.18)*; for herbicide level within cover crop interaction = ns *(P≤0.18)*.