CONTRIBUTIONS OF TILLAGE, RYE COVER CROP AND HERBICIDE PROGRAMS TO WEED CONTROL IN GLYPHOSATE-TOLERANT COTTON

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ABSTRACT

The effects of a rye (*Secale cereale* L.) cover crop, tillage, and glyphosate, applied alone or in combination with preemergence herbicides, were investigated on weed populations in glyphosate-tolerant cotton. The rye cover crop and tillage reduced the populations and occurrence of winter annual weeds with the exception of horseweed (*Conyza canadensis*) and cutleaf evening primrose (*Oenothera laciniata*). Weed control provided by the rye cover crop was sufficient to eliminate the use of preemergence herbicides. Glyphosate treatments reduced weed populations to near zero between applications. However, in the time from the last glyphosate application to cotton defoliation, weeds, especially browntop millet (*Brachiaria ramose* (L.) Stapf), re-grew beneath the cotton canopy and became the most prevalent weed. Browntop millet populations were highest in treatments having the rye cover crop. This added weed pressure could allow more competitive weeds to become established and also complicate mechanical harvest and effect the lint color grade and trash content.

INTRODUCTION

Cotton production practices in the Mississippi Delta usually include fall tillage either as shallow tillage to re-establish beds and irrigation furrows, or deep tillage followed by bedding to reduce soil compaction and restore beds. These operations bury cotton residues and can cause considerable soil erosion. Addition of a winter cover crop to cotton production systems may improve soil stabilization as well as contribute to improved weed control and soil properties. Winter cover crops are known to reduce populations of many winter annual weeds, and some summer annual weeds (Peachy et al. 1999). Although termination of most cover crops is required, reducing the number of species may result in a more uniform burndown, and reduce the amount of preemergence treatment required at planting. However, little is known about whether a cover crop can alter weed distributions or cause species shifts during subsequent crop development. Before the addition of a cover crop into a production system may be accepted or adopted, it is important to understand the contributions that each component makes to the entire weed control system. The objective of this study is to determine seasonal and long term changes in weed populations with respect to tillage, herbicides applications and a rye (*Secale cereale* L.) cover crop.

MATERIALS AND METHODS

Research was conducted at the USDA-ARS Southern Weed Science Research Farm, Stoneville, MS on a Dundee silt loam (fine-silty, mixed thermic Aeric Ochraqualf) soil with pH 6.7 and 1% organic matter. Field preparation consisted of fall disking and bedding. One month prior to planting, the experimental area was treated with glyphosate at 1 lb/A to kill existing vegetation and the rye cover crop, which was approximately one ft high. Experimental plots were eight rows spaced 40 inches apart and 96 ft long. A randomized complete block design with a split plot treatment arrangement and four replications was utilized. Main plots consisted of tillage and cover crop, and subplots were the herbicide programs. Conservation tillage consisted of a single-pass with a shallow furrow-opening sweep in the fall. Herbicide programs were: 1-PRE: metolachlor (1 lb/A), fluometuron (1.1 lb/A), glyphosate (1 lb/A), followed by glyphosate (1 lb/A) POST at 1-leaf and 4-leaf cotton; 2-No PRE: glyphosate (1 lb/A) at planting followed by glyphosate (1 lb/A) POST at 1-leaf and 4-leaf cotton. Herbicide treatments were applied with a tractor-mounted sprayer with TeeJet 8004 standard flat spray tips delivering 20 gal/A water at 30 psi..

Glyphosate-resistant cotton cultivar 'DP 436RR' was planted on May 1, 2004; and May 2, 2005 at 50,000 seeds/A using a John Deere7300 planter in 40-inch rows. Crops were furrow irrigated as needed. Cotton plant height was kept below 40 inches by applying mepiquat chloride (*N,N*-dimethylpiperidinium chloride) POST at first matchhead square stage followed by a second application 2 wk later. Harvest preparation consisted of defoliation by tribufos (*S,S,S*-tributyl phosphorotrithioate) at 1.4 lb/A, and boll opening by ethephon [(2-chloroethyl) phosphonic acid] at 1 lb/A.

Weed (shoot) dry weight was determined in three randomly selected quadrats of 11.2 ft^2 within each plot. Weed counts and species diversity were determined after preplant burndown and after defoliation. Cotton was mechanically harvested from the center two rows.

The data were subjected to an analysis of variance using Proc Mixed to determine significance of main effects and any interactions among main effects (SAS 2002). Treatments were separated at the 5% level of significance using an LSD test.

RESULTS AND DISCUSSION

Seed cotton yields were highest with no tillage and a rye cover crop in 2004 (Table 1). However, in 2005, the opposite result of greater seed cotton yields with tillage and no rye cover crop were found (Table 1). The reasons for the different responses are not clear. Inclusion of a preemergence herbicide program had no effect on seed cotton yield or weed biomass at harvest in either year. Browntop millet biomass at harvest was greater in no tillage in 2005. A similar trend was observed in 2004 although results were not significant in that year.

The percentage of the ground covered by browntop millet was greater with no tillage or a rye cover crop (Table 2). These data are consistent with the biomass data presented in Table 1. Tillage without a rye cover had the lowest percentage of weed cover and addition of a rye cover crop resulted in increased weed cover at harvest (Table 2). No tillage had high weed cover regardless of the presence a cover crop. Browntop millet was the most prevalent weed at canopy closure, and after defoliation, was almost entirely responsible for the ground cover. The presence of weeds at harvest may reduce harvest efficiency and quality in cotton. Browntop millet presents added concerns because its leaves and stalks are difficult to separate from cotton during the ginning process. In this study, weed control with glyphosate applications was sufficient to maintain weed control until layby; the weed biomass at harvest represents the population that was re-established when glyphosate treatments ceased at layby. Reddy et al. (2003) found that a rye cover crop without additional herbicide treatments reduced browntop millet biomass by 14 % at 7 weeks after planting. The low suppression of browntop millet by rye indicates that alternative control methods need to included if browntop millet populations are present.

Glyphosate resistant horseweed and cutleaf evening primrose, also a more difficult weed to control with glyphosate, survived the pre- and postemergence herbicide treatments in 2004 and 2005, although data on their populations were not determined. In 2006, these weeds were noticeably abundant and their populations were determined (Table 3). Glyphosate-tolerant horseweed was more abundant in no till plots at P= 0.08. These results demonstrate that, like herbicides, cover crops and tillage treatments may cause weed shifts.

REFERENCES

Peachy, E., J. Lina, R. Dick and R. Santell. 1999. Cover crop weed suppression in annual rotations. Oregon State University Extension Service publication EM8725.

Reddy K. N., R. M. Zablotowicz, M. A. Locke and C. H. Koger. 2003. Cover crop, tillage, and herbicide effects on weeds, soil properties, microbial populations, and soybean yield. Weed Science 51:987-994.

[SAS] Statistical Analysis Systems Institute. Inc. 2002. Software version 8.2. Cary, NC.

Table 1. Effects of tillage and rye cover crop on cotton yield and the brown top millet biomass present at harvest.

		Seed Cotton (lbs /A)		Browntop millet Biomass (g / 11.2 ft^2)	
		Year			
Tillage	Rye Cover	2004	2005	2004	2005
Till	Yes	2305	2454	5.9	70.9
Till	No	2128	2692	9.5	26.1
Notill	Yes	2564	2325	30.7	160.7
Notill	No	2393	2516	87.7	123.5
	$lsd_{(.05)}$	197	149	103.0	60.0

Table 2. Effect of tillage and rye cover crop on the percentage of ground covered by browntop millet at harvest in 2005.

Tillage	Rye	Browntop Millet (% coverage)
Till	Yes	52
Till	No	12
Notill	Yes	87
Notill	No	92
	$lsd_{(.05)}$	19

Table 3. Effects of tillage and rye cover on horseweed and cutleaf evening primrose densities in 2006.

		Number per plot	
Tillage	Rye Cover	Horseweed	Cutleaf Evening Primrose
Till	Yes	2.2	5.6
Till	No	0	7.9
Notill	Yes	7.8	4.2
Notill	No	17.3	13.5
	$lsd_{(0.05)}$	18.9	44.9