INTEGRATED RESISTANT PIGWEED CONTROL IN THE SOUTHEAST

C. D. Monks
J. A. Kelton
M. G. Patterson
Auburn University, Auburn, AL
A. J. Price
USDA-ARS, Auburn, AL
A. S. Culpepper
University of Georgia, Tifton, GA
M. W. Marshall
Clemson University, Clemson, SC
R. L. Nichols,
Cotton Inc., Cary, NC
L. E. Steckle
The University of Tennessee, Jackson, TN.

Abstract

Conservation agriculture has been highly effective in reducing soil erosion, increasing water holding capacity, and minimizing surface water contamination. The adoption of herbicide resistant crops facilitated successful implementation of conservation agriculture practices throughout the Southeast due to the effective weed control achieved with these cropping systems; however, the continuation of conservation tillage practices is jeopardized with recent development of herbicide resistant weed species including Palmer amaranth (*Amaranthus palmeri*). Along with maximizing environmental benefits achieved through conservation practices, including the possibility of long-term increases in soil organic matter and consequent carbon fixation, the utilization of high residue cover crops can also provide substantial weed suppression and aid weed control for problematic weeds where limited herbicide options are available. This collaborative project, funded through an NRCS Conservation Innovation Grant and Cotton, Inc., is designed to help educate farmers throughout the southern United States about the benefits of high residue cover crops as well as effective strategies for incorporation into current production practices. In general, inversion tillage + herbicide systems resulted in similar or less pigweed emergence compared to winter fallow systems at most locations. Integrated weed management programs incorporating heavy rye residues, currently recommended herbicides, and in some instances inversion tillage were most effective at controlling GR Palmer amaranth.

Introduction

Conservation agriculture practices have seen an increase across the southern region of the US. However, the limited number of POST over-the-top herbicide options and the loss of weed control using tillage, paired with the effectiveness of glyphosate, have resulted in a heavy dependence of a single herbicide mode of action in these systems (Green et al. 2008; Givens et al. 2009; Kruger et al. 2009). At present, cases of glyphosate-resistant Palmer amaranth have been documented throughout the Southeast and Mid-South including: Alabama, Arkansas, Georgia, Louisiana, Mississippi, North Carolina, South Carolina, and Tennessee (Nichols et al. 2009). With this development, the retention and adoption of conservation tillage remains uncertain (Price et al. 2011).

This collaborative project, funded through an NRCS Conservation Innovation Grant and Cotton, Inc., is designed to help educate farmers throughout the southern United States about the benefits of high residue cover crops (Figure 1) as well as effective strategies for incorporation into current production practices. This is achieved through on-farm cotton demonstration sites in Alabama, Georgia, South Carolina, and Tennessee offering a comparison between conservation tillage systems with high-residue cereal cover crops and an inversion tillage system followed by a high residue winter cover crop. The objective is to demonstrate tenable production systems adaptable to local resistant pigweed conditions that have reduced profitability and threaten sustainability in the Southeast.

Figure 1. Cotton growing in rolled black oat (*Avena strigosa* Schreb.) residue.

Methods

Each demonstration site covers approximately 10 acres. Three systems compared in this project include: a high–residue system which utilizes a rye cover crop in conjunction with in–row subsoiling that is managed to maximize surface residue, an inversion tillage followed by high–residue system which consists of inversion tillage followed by the system described previously, and a farmer standard which may consists of a low residue cover crop system or a winter fallow system. In addition, some systems evaluated RoundupReady systems while others evaluated LibertyLink systems. Throughout the duration of the project, data is collected from each demonstration site and includes: cover crop/ground cover biomass at spring preplant termination, weed emergence, crop yield, and economic analysis. Production inputs and costs are recorded to account for changes in capital and labor intensity and will provide further insight into the economic benefits attributed to adopting conservation technologies.

Results

In 2009, five locations were established; severe drought conditions limited cover crop establishment success at some locations (Table 1). Additionally, adequate inversion tillage moisture delayed cover planting in some instances at some locations in both years. Overall, cover crop biomass ranged from <1,000 kg/ha to >5,000 kg/ha. In general, inversion tillage + herbicide systems resulted in similar or less pigweed emergence compared to winter fallow systems at most locations. In 2010, seven locations were established and cover crop biomass ranged from 1,400 kg/ha to > 13,000 kg/ha (Table 2). Palmer control responded similarly in 2011 except in instances with ineffective PRE activation/applications. Integrated weed management programs incorporating heavy rye residues, currently recommended herbicides, and in some instances inversion tillage were most effective at controlling GR Palmer amaranth.

Table 1. Average Rye Biomass, Palmer amaranth, and Seed Cotton Yield Response to Different Weed Management Systems in 2010.

	Agronomics		
	Rye Biomass (kg/ha)	Palmer Density (plants/ha)	Seed Cotton Yield (kg/ha)
Tipton Co. TN (WS[a])			
Bottom Plowed w/ Rye	990	43999	1342
No-Till w/ Rye	847	44999	1397
No-Till w/ Fallow	0	106998	1116
Macon Co. GA (LL, RR, WS)			
Bottom Plowed w/ Rye	5644	12,090	2863
No-Till w/ Rye	4958	1605	1907
No-Till w/ Fallow	0	38,272	1363
Macon Co. GA (LL, RR, WS)			
Bottom Plowed w/ Rye	5587	70	2806
No-Till w/ Rye	4723	251	2660
No-Till w/ Fallow	0	222	1626
Calhoun Co, SC (RR)			
Bottom Plowed w/ Rye	1946	20000	883
No-Till w/ Rye	1602	53000	943
No-Till w/ Fallow	0	133333	742
Lee Co, SC (LL)			
Bottom Plowed w/ Rye	712	46667	653
No-Till w/ Rye	997	86667	326
No-Till w/ Fallow	0	176667	1007

[a]Seed Trait/Herbicide System; LL, LiberyLink; RR, RoundupReady; and WS, Widestrike

Table 2. Average Rye Biomass, Palmer amaranth, and Seed Cotton Yield Response to Different Weed Management Systems in 2011.

	Agronomics		
	Rye Biomass (kg/ha)	Palmer Density (plants/ha)	Seed Cotton Yield (kg/ha)
<u>Barbour Co. AL (WS)</u>			
Bottom Plowed w/ Rye	3100	2266	1775
No-Till w/ Rye	6065	14049	1792
No-Till w/ Fallow	0	8837	1790
<u>Tipton Co. TN (WS)</u>			
Bottom Plowed w/ Rye	1643	17600	NA
No-Till w/ Rye	1406	18000	NA
No-Till w/ Fallow	0	42799	NA
<u>Worth Co. GA (RR)</u>			
Bottom Plowed w/ Rye	6790	0	NA
No-Till w/ Rye	5400	120	NA
No-Till w/ Fallow	0	23	NA
<u>Seminole Co. GA (LL)</u>			
Bottom Plowed w/ Rye	2300[b]	18	NA
No-Till w/ Rye	13,500	26	NA
No-Till w/ Fallow	0	125	NA
<u>Screven Co. GA (RR)</u>			
Bottom Plowed w/ Rye	5670	75	NA
No-Till w/ Rye	2610	1303	NA
No-Till w/ Fallow	0	1137	NA
<u>Calhoun Co. SC (RR)</u>			
Bottom Plowed w/ Rye	5340	13333	1203
No-Till w/ Rye	4628	26667	1098
No-Till w/ Fallow	0	136667	1083
<u>Lee Co. SC (LL)</u>			
Bottom Plowed w/ Rye	3338	10000	571
No-Till w/ Rye	1531	53333	459
No-Till w/ Fallow	0	173333	619

[a]Seed Trait/Herbicide System; LL, LiberyLink; RR, RoundupReady; and WS, Widestrike
[b]Rye planting delayed due to drought/tillage delay

References

Givens, W.A., D.R. Shaw, W.G. Johnson, S.C. Weller, B.G. Young, R.G. Wilson, M.D.K. Owen, and D. Jordan. 2009. A grower survey of herbicide use patterns in glyphosate-resistant cropping systems. Weed Tech. 23: 156-161.

Green, J.M., C.B. Hazel, D.R. Forney, L.M. Pugh. 2008. New multiple-herbicide crop Resistance and formulation technology to augment the utility of glyphosate. Plant Manag. Sci. 64: 332-339.

Kruger, G.R., W.G. Johnson, S.C. Weller, M.D.K. Owen, D.R. Shaw, J.W. Wilcut, D.L. Jordan,R.G. Wilson, M.L.

Bernards, and B.G. Young. 2009.U.S. grower views on problematic Weeds and changes in weed pressure in glyphosate-resistant corn, cotton, and soybean cropping systems. Weed Tech. 23: 162-166.

Nichols, R.L., J. Bond, A.S. Culpepper, D. Dodds, V. Nandula, C.L. Main, M.W. Marshall, T.C. Mueller, J.K.

Norsworthy, A. Price, M. Patterson, R.C. Scott, K.L. Smith, L.E. Steckel,D. Stephenson, D. Wright and A.C. York. 2009. Glyphosate-resistant Palmer amaranth (*Amaranthus palmeri)* spreads in the southern United States (U.S.). Resistant Pest Management Newsletter 18: 8-10.

Price, A. J., K. S. Balkcom, S. A. Culpepper, J. A. Kelton, R. L. Nichols, H. Schomberg. 2011. Glyphosate-resistant *Palmer amaranth*: A threat to conservation agriculture. J. Soil Water Conserv. 66:265-275.