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Research Article

Weed Response to Co-Application of Herbicides and Acephate in Cotton

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Abstract

Determining compatibility of pesticides is important in developing effective management practices and adjusting to outbreaks of pests in cotton (*Gossypium hirsutism* L.). Field experiments were conducted in 2013 and 2014 to determine the effect of chloroacetamide herbicides with residual activity only and acephate with foliar activity against thrips (*Frankliniella spp.*) on control of emerged weeds by glyphosate, glufosinate, and a mixture of these herbicides. The residual herbicides acetochlor and S-metolachlor as well as the insecticide acephate did not affect control of emerged common ragweed (*Ambrosia artemisiifolia* L.) and Palmer amaranth (*Amaranthus palmeri* Watts.). Results from these trials indicate that weed control will not be compromised with co-application of glufosinate, glyphosate, and glufosinate plus glyphosate with acetochlor or *S*-metolachlor applied alone or with acephate.

Introduction

Adequate weed control is important to minimize weed interference in cotton *(Gossypium hirsutum L.)* and to enable efficient mechanical harvest [1]. Tobacco thrips *(Frankliniella fusca)* can adversely affect early season growth of cotton [2]. Insecticides are often applied to cotton foliage to suppress tobacco thrips and avoid yield loss [2,3]. Timing of application of herbicides to control emerged weeds and insecticides to control tobacco thrips often coincides, and co-application of these pesticides can be an efficient method of controlling pests if pesticide performance is not compromised due to adverse interactions.

Xiao-yan et al. [4] reported that control of broadleaf weeds by glyphosate was not affected by insecticides commonly used in cotton. In the same research, insect control was not affected by glyphosate. Likewise, Scroggs et al. [5] reported that weed control by glyphosate was not affected by insecticides including acephate. Residual herbicides also did not affect weed control by glyphosate [6]. Cahoon et al. [7] reported that co-application of glyphosate and glufosinate was more effective than glyphosate alone in controlling Palmer amaranth. However, co-application of these herbicides was less effective in controlling annual grasses than glyphosate alone. Meyer et al. [8] reported antagonism of glyphosate by glufosinate on selected annual grasses. However, in this research the impact of residual herbicides and insecticides were not evaluated with tank mixtures of glyphosate and glufosinate.

Herbicides with residual activity are often applied with herbicides that control emerged weeds to extend weed control and protect yield. Information in the peer-reviewed literature in North Carolina is limited with respect to the impact of acephate and the residual herbicides acetochlor and *S*-metolachlor on efficacy of glufosinate and glyphosate. Therefore, the objective of this experiment was to determine effects of co-applying chloroacetamide herbicides and acephate with glufosinate and glyphosate on emerged weeds.

Materials and Methods

Field experiments were conducted in North Carolina at the Peanut Belt Research Station near Lewiston-Woodville (36°08'03.93" N 77°10'38.38" W) and on a private farm near Mount Olive (35°11'18.37" N 77° 57'10.07" W) during 2013 and 2014. Soil at Lewiston-Woodville was a Norfolk loamy sand (fine-loamy, siliceous, thermic Typic Paleudult). Soil at Mount Olive was a Wagram loamy sand (loamy, kaolinitic, thermic Arenic Kandiudults). Fields were tilled with a disk and field cultivator and a natural infestation of weeds evaluated. A crop was not planted. A natural infestation of Palmer amaranth was present at Mount Olive while a natural infestation of common ragweed was present at Lewiston-Woodville. Plot size was 3 by 4 m at both locations.

Treatments consisted of a factorial arrangement of three levels of postemergence herbicide with no residual activity (glufosinate, glyphosate, and glufosinate plus glyphosate), three levels of chloroacetamide herbicide with no foliar activity (none, acetochlor, and *S*-metolachlor), and two levels of systemic insecticide (none and acephate). Acephate, acetochlor, glufosinate, glyphosate, and *S*-metolachlor were applied at 1,14 kg ai ha^{-1}, 1.28 kg ai ha^{-1}, 0.47 kg ai ha^{-1}, 0.84 kg ae ha^{-1}, and 1.13 kg ai ha^{-1}, respectively. Treatments were applied with a CO_2 pressurized backpack sprayer at a rate of 117 L ha^{-1} aqueous solution at 172 kPa when weeds were approximately 8 cm in height with 4 to 8 leaves.

Visual estimates of percent weed control were recorded 21 days after treatment using a scale of 0 to 100 where 0 = no control and 100 = complete control. Foliar chlorosis, necrosis, stunting, and stand reduction were considered when making the visual estimates. Data were subjected to analysis of variance using the general linear model procedure for SAS (Ver. 9.3; SAS Institute, Cary, NC) considering the factorial treatment arrangement. Interactions were tested using appropriate mean square values (McIntosh, 1983). Means of significant effects and interactions were separated using Fisher's Protected LSD Test at $P \leq 0.05$.

Results and Discussion

Control of common ragweed and Palmer amaranth by glyphosate, glufosinate, and glyphosate plus glufosinate was not affected by the residual herbicides acetochlor or *S*-metolachlor, the insecticide acephate, or combinations of residual herbicides and insecticide ($P > 0.05$). When pooled over years and levels of residual herbicide and insecticide treatments, Palmer amaranth was controlled 49% by glyphosate alone (Table 1). In contrast, control by glufosinate and glyphosate plus glufosinate was 87% and 86%, respectively (Table 1). The low level of control by glyphosate alone was likely due to presence of glyphosate-resistant individuals within the population of Palmer amaranth at this location [9,10]. Glufosinate has proven to be an effective herbicide in controlling glyphosate-resistant biotypes of Palmer amaranth [11]. Common ragweed was controlled 89 to 93% with these herbicide treatments when pooled over years, residual herbicides, and insecticide treatment (Table 1). Other research [12,13] reported no major negative impacts of residual herbicides or insecticides on efficacy of glyphosate or glufosinate.

Table 1: Palmer amaranth and common ragweed control by glyphosate, glufosinate, and glyphosate plus glufosinate.

		Control	
Herbicide treatments	Rate	Palmer amaranth	Common ragweed
	kg ha^{-1}	%	
Glyphosate	840	49 b	90 a
Glufosinate	770	87 a	91 a
Glyphosate plus glufosinate	840 + 770	86 a	94 a

[a]Means within a weed species followed by the same letter are not significantly different according to Fisher's Protected LSD Test at $P = 0.05$. Data are pooled over years and levels of residual herbicide and acephate treatments.

Conclusion

Collectively, these results indicate that the residual herbicides acetochlor and *S*-metolachlor and the insecticide acephate will not adversely affect control of emerged common ragweed and Palmar amaranth by glyphosate, glufosinate, and the mixture of these herbicides. Therefore, glyphosate and glufosinate alone or in mixture can be applied with these residual herbicides to control weeds and with the systemic insecticide acephate to suppress thrips in cotton.

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