MULTIPLE RESISTANCE TO GLYPHOSATE AND AN ALS INHIBITOR IN PALMER AMARANTH IN GA

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Abstract

There are currently 187 weed species in the world that have biotypes that are resistant to one or more herbicides. Fifteen species have biotypes with confirmed resistance to glyphosate; 97 species have biotypes with confirmed resistance to the ALS-inhibiting herbicides. One species with known resistance to both chemical classes is Palmer amaranth, one of the most troublesome weeds of cotton and other Southern row crops. In 2006, a Macon County, GA farmer was unable to control a population of glyphosate resistant Palmer amaranth using field rates of Staple LX. The objective of this study was to determine if a population in central GA was resistant to glyphosate and an ALS inhibitor**.**

Field experiments designed to describe the response of a suspected glyphosate/ALS resistant Palmer amaranth biotype to glyphosate and pyrithiobac, singly and in combination, were conducted in a conventional, non-irrigated, cotton field in Macon County, GA in 2007 and 2008. Individual plots were 6' X 25' long. Three sets of herbicide treatments were applied to 2-4" Palmer amaranth: Glyphosate (Roundup WeatherMax) at 22, 44, 88 and 176 oz/A; pyrithiobac (Staple LX) (+ 0.25% v/v of non-ionic surfactant) at 2.5, 5, 10, and 15 oz/A; and WeatherMax + Staple LX at 22 + 2.5, 44 + 5, 88 + 10, 176 + 15 oz/A. Field rates in GA for Roundup WeatherMax and Staple LX when applied alone are 22 oz/A and 2.5 oz/A, respectively. The experimental design was a randomized complete block with four replicates. Visual control ratings were taken at 1, 5, and 8 weeks after treatment (WAT). Data were analyzed using the mixed models procedure in SAS.

Greenhouse experiments were conducted in Tifton, GA in 2008 to evaluate the response of four Palmer amaranth biotypes (glyphosate/ALS susceptible, glyphosate resistant, ALS resistant, and glyphosate/ALS resistant) to glyphosate and pyrithiobac applied singly. Roundup WeatherMax was applied to the glyphosate/ALS susceptible and ALS resistant biotypes at 0, 1, 2, 3, 4, 5, 6, 8, and 80 oz/A when the plants were 4" in height. The glyphosate resistant and glyphosate/ALS resistant biotypes were treated with Roundup WeatherMax at 0, 1, 8, 16, 24, 32, 40, 60, and 80 oz/A. Staple LX was applied to the glyphosate/ALS susceptible and glyphosate resistant biotypes at 0, 0.08, 0.16, 0.3, 0.6, 1.3, 2.5, 5, and 60 oz/A. The ALS resistant and glyphosate/ALS resistant biotypes were treated with Staple LX at 0, 0.08, 2.5, 5, 10, 15, 20, 40, and 60 oz/A. The different rate series were used because of extreme differences in herbicide sensitivity between the biotypes. The experimental design was a randomized complete block with four replicates; the experiment was run twice in time. Injury ratings were taken 21-28 days after treatment (DAT). Traditional dose-response curves were generated using the Seefeldt model. Preliminary differences in biotype response to glyphosate and pyrithiobac were described by comparing I_{50} values.

Palmer amaranth control in-field increased as herbicide rate increased, although even the highest rates of Roundup WeatherMax and Staple LX applied singly and in combination were unable to effect more than 92% control. RoundUp WeatherMax at 22, 44, 88, and 176 oz/A controlled 2" Palmer amaranth 5, 34, 68, and 89%, respectively, 1 WAT. Control at 8 WAT, for the same rates, was 3, 19, 49, 76%, respectively. Staple LX at 2.5, 5, 10, and 15 oz/A controlled 2" Palmer amaranth 28, 39, 39, and 47%, respectively, 1 WAT. Control at 8 WAT, for the same rates, was 13, 17, 29, 48%, respectively. At 8 WAT, WeatherMax in combination with Staple LX controlled 2" Palmer amaranth 16, 48, 72, and 90% when applied at 22 + 2.5, 44 + 5, 88 + 10, 176 + 15 oz/A, respectively.
The preliminary I_{50} values for the glyphosate resistant and glyphosate/ALS resistant biotypes were at least 10 fold greater than the I_{50} value for the glyphosate/ALS susceptible biotype when treated with Roundup WeatherMax. The

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Both field and greenhouse analyses suggest that the Palmer amaranth biotype evaluated in these studies is resistant to both glyphosate and an ALS inhibiting herbicide. The development of multiple resistance to two important classes of herbicides for cotton production will force growers to use alternate methods, such as tillage and residual at-plant herbicides, to control Palmer amaranth. Growers should ensure that Palmer amaranth plants in a production field do not reach reproductive maturity to prevent the local and long-distance spread of the resistance traits by seed and pollen.