EVALUATION OF CROP SAFETY AND WEED CONTROL PROGRAMS IN DICAMBA TOLERANT COTTON

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Abstract

The development and spread of glyphosate-resistant Palmer amaranth and other weed species has forced growers and private industry alike to seek out alternative weed control methods. One alternative that holds promise in the future is dicamba tolerant crops. The gene that provides tolerance to dicamba in broadleaf agronomic crops was discovered by researchers at the University of Nebraska. These researchers isolated a soil bacteria located at a dicamba manufacturing plant that detoxifies dicamba. This gene is known as the dicamba monooxygenase (DMO) gene and has imparted tolerance to dicamba of up to 5 lb ai/ac in soybeans and up to 25 lbs ai/acre in tobacco (Behrens et. al.2007). Dicamba/glufosinate/glyphosate tolerant cotton is scheduled to be released in approximately 2016. Previous research evaluating efficacy of dicamba on Palmer amaranth is lacking. Data regarding dicamba/glufosinate/glyphosate tolerant cotton tolerance to POST applications of dicamba, glufosinate, glyphosate, and tank-mix combinations thereof is also lacking. Therefore, this research was conducted to evaluate cotton tolerance and glyphosate-resistant Palmer amaranth control following application of dicamba, glufosinate, and glyphosate alone and tank-mixed.

Experiments were conducted in Robinsonville, MS; Marianna, AR; Macon County, GA; Mount Olive, NC; and Lake County, TN in 2011. Glyphosate-resistant Palmer amaranth was present at all locations. All plots were planted between May 20 and June 16, 2011. Plots were two or four rows wide and 20 – 30 feet in length with treatments replicated three or four times. All herbicide applications were made with a tractor-mounted compressed-air sprayer or a CO_2-powered backpack sprayer. Treatments are as follows: (1) glyphosate EPOST followed by (fb) glyphosate Mid-POST; (2) glufosinate EPOST fb glufosinate Mid-POST; (3) glufosinate + dicamba EPOST fb glufosinate Mid-POST; (4) glyphosate + dicamba EPOST fb glufosinate Mid-Post; (5) dicamba PRE fb glufosinate EPOST fb glufosinate Mid-POST; (6) dicamba PRE fb glyphosate + dicamba EPOST fb glufosinate Mid-POST; (7) dicamba PRE fb dicamba EPOST fb glufosinate Mid-Post; (8) dicamba PRE fb glufosinate + dicamba EPOST fb glufosinate + dicamba Mid-POST; (9) dicamba PRE fb glufosinate EPOST fb glyphosate + dicamba Mid-POST; (10) dicamba PRE fb glufosinate + dicamba EPOST fb glyphosate + dicamba Mid-POST; (11) dicamba PRE fb glyphosate + dicamba EPOST fb glyphosate + dicamba Mid-POST; (12) dicamba PRE fb glufosinate Delayed-EPOST; (13) dicamba PRE fb glufosinate + dicamba Delayed- EPOST; (14) dicamba PRE fb glyphosate + dicamba Delayed- EPOST. All treatments received diuron (1 lb ai/ac) + MSMA (2 lb ai/ac) at LAYBY. The following rates were used in all treatments: dicamba – 0.5 lb ai/ac; glufosinate - 0.53 lb ai/ac; and glyphosate – 0.75 lb ae/ac. Target Palmer amaranth heights at each application are as follows: EPOST: 2 – 4 inches in height; delayed EPOST:

6 – 9 inches in height; Mid-Post: 10 – 18 inches; LAYBY: 30 – 60 inches. Visual estimates of crop injury and weed control were collected three times during the growing season. The first visual estimates were collected when the delayed EPOST applications were made. Elapsed time between the EPOST and delayed EPOST applications varied with location ranged and from 2 – 17 days. Visual estimates of crop injury and weed control efficacy were also made when the Mid-POST applications were made. Elapsed time between Mid-Post applications and EPOST and delayed EPOST applications varied depending on location and ranged from 17 – 30 days and 9 – 17 days, respectively. Final estimates of crop injury and weed control efficacy were collected 10 days after LAYBY application. Data were subjected to analysis of variance using the PROC Mixed procedure in SAS 9.2. Means were separated using Fisher's Protected LSD at $p = 0.05$.

Cotton injury following the EPOST treatment (data collected when delayed EPOST application made) was less than 5% for all treatments. Application of glufosinate EPOST with or without dicamba PRE resulted in less than 1.5% visual injury on cotton. Cotton injury following application of glufosinate + dicamba applied EPOST with or without dicamba PRE ranged from 3.5 – 4%. Control of glyphosate-resistant Palmer amaranth from EPOST applications was less than 55% with glyphosate alone. Dicamba alone EPOST provided 86% control of glyphosate-resistant Palmer amaranth. Application of glufosinate, glufosinate + dicamba, and glyphosate + dicamba EPOST following application of dicamba PRE provided 89 – 93% control of glyphosate-resistant Palmer amaranth. Cotton injury at the time Mid-POST applications were made was less than 2.5% for all treatments. Control of glyphosate-resistant Palmer amaranth with glufosinate + dicamba or glyphosate + dicamba applied EPOST or delayed EPOST ranged from 86 – 91% at the Mid-POST application timing. Application of dicamba or glufosinate EPOST provided 77 – 79% control of glyphosate-resistant Palmer amaranth at the time Mid-POST applications were made. Two weeks after LAYBY application cotton injury was greatest (~11%) with the following treatments: dicamba PRE fb dicamba EPOST fb glufosinate Mid-Post or dicamba PRE fb glufosinate EPOST fb glyphosate + dicamba Mid-POST. Less than 1% cotton injury was observed two weeks after LAYBY with the following treatments:) dicamba PRE fb glufosinate Delayed- EPOST; dicamba PRE fb glufosinate + dicamba Delayed- EPOST; dicamba PRE fb glyphosate + dicamba Delayed- EPOST; and glyphosate EPOST fb glyphosate Mid-POST. Glyphosate-resistant Palmer amaranth control greater than 97% was observed two weeks after LAYBY application with the following treatments: glufosinate + dicamba EPOST fb glufosinate Mid-POST; glyphosate + dicamba EPOST fb glufosinate Mid-Post; dicamba PRE fb glufosinate EPOST fb glufosinate Mid-POST; dicamba PRE fb glyphosate + dicamba EPOST fb glufosinate Mid-POST; dicamba PRE fb glufosinate + dicamba EPOST fb glufosinate + dicamba Mid-POST; dicamba PRE fb glufosinate EPOST fb glyphosate + dicamba Mid-POST; dicamba PRE fb glufosinate + dicamba EPOST fb glyphosate + dicamba Mid-POST; dicamba PRE fb glyphosate + dicamba EPOST fb glyphosate + dicamba Mid-POST. Seed cotton yields were maximized at 1169 – 1735 lbs/ac following application of: dicamba PRE fb glufosinate EPOST fb glufosinate Mid-POST; dicamba PRE fb glufosinate EPOST fb glyphosate + dicamba Mid-POST; dicamba PRE fb glufosinate + dicamba EPOST fb glufosinate + dicamba Mid-POST.

In conclusion, dicamba/glufosinate/glyphosate tolerant cotton demonstrated excellent tolerance to dicamba, glufosinate, and glyphosate alone and tank-mixed. Season-long control (>90%) of glyphosate-resistant Palmer amaranth required application of glufosinate, dicamba, or tank-mixes thereof in a timely manner (less than 6 – 8" in height). Although excellent control of glyphosate-resistant Palmer amaranth has been demonstrated with dicamba and glufosinate tank-mixes, residual herbicides will continue to be an integral part of a total weed management program.

Reference

Behrens, M.R., N. Mutlu, S. Chakraborty, R. Dumitru, W.Z. Jiang, B.J. LaCallee, P.L. Herman, T.E. Clemente, and D.P. Weeks. 2007. Dicamba Resistance: Enlarging and Preserving Biotechnology-Based Weed Management Strategies. Science. 316:1185-188.