

CHANGES IN COTTON WEED MANAGEMENT PRACTICES FOLLOWING THE DEVELOPMENT OF GLYPHOSATE-RESISTANT PALMER AMARANTH

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Abstract

The widespread adoption of glyphosate-resistant crops has resulted in significant changes in crop production practices; in cotton, these changes include: increased use of glyphosate and a concomitant decrease in the application of other herbicides (photosystem II inhibitors, dinitroanilines, arsenates, and biosynthesis inhibitors). Following the development of glyphosate-resistant (GR) Palmer amaranth (which may infest up to 50% of the US upland cotton acres), it is reasonable to assume that another shift in weed management practices is already occurring. Understanding grower methods and habits will help us fill gaps in research and extension programs, as well as identify potential areas of abuse and prevent the development of other herbicide resistances.

In 2010, two surveys (one for growers and one for county extension agents) were developed by the authors to determine changes in cotton weed management practices (herbicide use patterns, frequency of handweeding, prevalence if in-field cultivation) both before (from 2000-2005) and following (from 2006-2010) the development of GR Palmer amaranth. Growers provided information solely about their individual farming practices, whereas agents compiled 3rd party information about average countywide activities. Sixty-five growers in 16 counties (representing 13% of GA cotton acres), as well as ten county agents (representing 24% of GA cotton acres), completed the survey, which was administered in person. Both sets of respondents identified GR Palmer amaranth as being the most significant weed problem, currently (2006-2010), in GA cotton; according to growers and agents, >78% of cotton acres are infested with this pest.

Preplant/at plant/preemergence herbicide use: Growers and agents both reported that preplant glyphosate use declined, significantly, following the development of GR palmer amaranth, although the product was still being applied to more than 70% of all cotton acres. Conversely, the use of glufosinate and paraquat significantly increased between 2000-2005 and 2006-2010. Glufosinate, which was applied to less than 1% of GA cotton acres in 2000-2005, was applied on 12% (agents) to 25% (growers) of the cotton acreage in 2006-2010. The proportion of acres treated with paraquat increased from 15% (growers) and 23% (agents) to 29% (growers) and 38% (agents). According to both growers and agents, the use of diuron, flumioxazin, fomesafen, and pendimethalin also increased following the development of GR Palmer amaranth. Growers and agents reported that flumioxazin, which was used on only 3% of cotton acres in 2000-2005, was applied on at least 27% of all acres in 2006-2010. Fomesafen, which was used on less than 12% of cotton acres before the development of GR Palmer amaranth, was applied to 58% (agents) and 81% (growers) of acres in 2006-2010.

Postemergence herbicide use: With respect to postemergence herbicides, glyphosate use declined, significantly, between 2000-2005 and 2006-2010, although > 70% of GA cotton acres were still treated with the herbicide. At the same time, glufosinate and *S*-metolachlor use significantly increased. Growers and agents both reported that glufosinate was applied on 30%, or more, of acres from 2006-2010 (up from <1% in 2000-2005); *S*-metolachlor use increased from 12% (agents) and 16% (growers) of acres in 2000-2005 to 42% (agents) and 54% (growers) of acres in 2006-2010.

Post-directed/layby herbicide use: While glyphosate use at layby decreased significantly between 2000-2005 and 2006-2010 (<50% of acres treated), both agents and growers reported that the use of other herbicides (including diuron, MSMA, flumioxazin, *S*-metolachlor) had increased, substantially, over the same period of time. Agents reported that >70% of all cotton acres were treated with diuron and MSMA from 2006-2010; before the development of GR palmer amaranth, approximately 30% to 40% of cotton acres were treated with these herbicides. According to growers, flumioxazin and *S*-metolachlor, which were applied to 0% and 10% of cotton acres, respectively, from 2000-2005, were used on 23% and 2% of acres from 2006-2010. Agents reported observing similar trends; 3.5% and 5.4% of acres were treated with flumioxazin and *S*-metolachlor, respectively in 2000-2005 whereas 9% and 30% of acres received each product in 2006-2010.

The observed changes in herbicide use patterns has proved to be costly to GA growers; following the development of GR Palmer amaranth, herbicide costs have increased by approximately 50%, or more. Currently, GA growers spend between \$60 and \$70/A on herbicides. GR Palmer amaranth has also forced GA growers to rely on handweeding and in-field cultivation, in addition to costly herbicide programs, to manage aboveground weed populations and reduce the size of the soil seedbank. According to growers and agents, 5% or less of GA cotton was handweeded in 2000-2005, and for less than \$4/A; from 2006-2010, 50% to 60% of cotton acres were handweeded at a cost of \$21/A to \$24/A. Currently, 32% (agents) to 44% (growers) of all cotton acres in the state are subjected to mechanical cultivation for weed removal.

In summary, 1) GR Palmer amaranth is the most significant weed problem facing GA cotton growers and 2) growers and agents reported similar trends in changes in herbicide use patterns following the development of GR Palmer amaranth. Although glyphosate is still used on a substantial number of acres in GA, its use has decreased in recent years. At the same time, there has been a concomitant increase in the use of other herbicides, including: paraquat, glufosinate, *S*-metolachlor, flumioxazin, diuron, MSMA, and fomesafen. Although the adoption of diversified herbicide programs, handweeding and cultivation has substantially increased the cost of farm weed management programs, the use of varied and integrated methodologies is recommended to reduce the impact of GR palmer amaranth in current and future cotton production.