

IS GIANT RAGWEED BECOMING RESISTANT TO GLYPHOSATE?

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One of the characteristics of Roundup Ready soybeans in the first few years following their introduction was the notable absence of weeds following postemergence glyphosate applications. This applied to relatively easy to control weeds as well as those that are not well controlled by other herbicides. Some growers continue to have excellent success at weed control in Roundup Ready soybeans. However, 10 years later, several weeds have become problematic in soybeans again, and we no longer assume that all Roundup Ready soybean fields will be free of weeds at the end of the season. Weeds that currently seem to be most problematic in Roundup Ready soybeans in the eastern Corn Belt include giant ragweed, lambsquarters, horseweed (marestail or Canada fleabane), and pokeweed. There can be any number of reasons why these weeds have become more prevalent, and more difficult to control. Within the United States, populations of horseweed, common ragweed, and Palmer amaranth have developed resistance to glyphosate over the past 5 years, and we believe populations of giant ragweed are developing resistance also.

Some problems are certainly due to the assumption by many growers that, even when grossly mismanaged, glyphosate will eventually control any population of weeds if applied often enough. This may have been true for several years after the adoption of Roundup Ready soybeans, but no longer seems to be the case in many fields. The ability of glyphosate to control a broad spectrum of weeds, even large weeds when necessary, does not change the need for the following components in weed management programs: (1) either a fall or spring treatment to control winter weeds, and early-emerging summer annuals; (2) an early postemergence glyphosate application when weeds are 4 to 8 inches tall; and (3) a second postemergence application as necessary to control late-emerging weeds or those not completely controlled with the first application. Producers who integrate glyphosate with other herbicides, as in the inclusion of 2,4-D ester and residual herbicides in fall or preplant treatments, may improve control of certain weeds, reduce the need for a second postemergence application, and reduce selection for glyphosate resistance. Deviation from this two to three application program can result in less effective weed control in general, and problems may be most acute with weeds such as giant ragweed, lambsquarters, and marestail.

Glyphosate Resistance Issues

Glyphosate-resistant marestail is widespread throughout Ohio and Indiana, especially in the southern areas. This problem has developed in continuous Roundup Ready soybean fields as well as fields where Roundup Ready soybeans have been rotated with corn. A primary cause of the problem appears to be use of exclusively glyphosate in

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the soybeans. The more frequent mid to late-season infestations of giant ragweed in the last several years could be an indication of the adaptation of weed populations to intensive use of glyphosate. The number of Roundup Ready soybean fields with giant ragweed control problems increased from 2005 to 2006, and we expect this to increase again into 2007. The most severe control problems appear to be occurring in continuous Roundup Ready soybean fields, with a history of reliance on exclusively glyphosate for weed control. Some of these fields were treated three to four times with glyphosate in 2006, and giant ragweed was still not well controlled.

Greenhouse research conducted over the past several years by OSU and Purdue University has resulted in the identification of populations of lambsquarters and giant ragweed that appear to have a low level of resistance to glyphosate. A number of these populations are from fields where control with glyphosate has been inadequate. We have the greatest concern about giant ragweed, which is generally more difficult to control in soybeans compared to lambsquarters, because glyphosate has been one of our most effective tools. In greenhouse and field dose response studies with these populations, we have observed giant ragweed surviving 3 lb ae/A of glyphosate, and also multiple applications of lower rates.

We conducted field studies at four sites in Ohio and Indiana in 2006 with giant ragweed populations that exhibited this type of response, with the goals of validating our greenhouse research findings and determining whether these populations could be controlled with glyphosate-based programs (Table 1). Plants survived multiple applications of glyphosate at all of these sites. We were not able to adequately control the giant ragweed where we used glyphosate exclusively, except at one site. We were able to obtain effective control at all sites where the weed management program consisted of all of the following: (1) a preplant burndown treatment that included glyphosate and 2,4-D ester; (2) an initial postemergence application of either glyphosate (1.5 lb ae/A) or Flexstar (1.3 pt/A) when plants were not more than about 6 to 12 inches tall; and (3) a second postemergence glyphosate application of 0.75 lb ae/A 3 weeks later. Where we included a residual herbicide in the preplant treatment (cloransulam plus flumioxazin, in this case), we obtained adequate control using the same sequence of treatments, but we were able to use 0.75 lb ae/A of glyphosate in the first postemergence application.

We were not able to adequately control giant ragweed with single postemergence glyphosate application, even where we used a preplant burndown and residual herbicide. In addition, although we observed adequate control with these programs, we almost always observed plants surviving and producing seed. This was our second year of research at one of these sites, and we made similar observations on control the previous year. Based on the results of these studies, we have concluded that giant ragweed populations with a low level of resistance to glyphosate have developed. These populations are not consistently controlled where glyphosate is the only herbicide used, which may explain some of the giant ragweed control failures evident in Ohio and Indiana in 2006.

Table 1. Results of 2006 field research conducted by OSU and Purdue University on control of giant ragweed in fields with a history of glyphosate performance problems (glyphosate-resistant giant ragweed). Data for resistant populations represent the average of four sites, as compared to control at one glyphosate-sensitive site. Glyphosate rates in () are lb acid equivalent per acre. POST glyphosate was applied when most of the giant ragweed plants were 6 to 12 inches tall, except in plots where no burndown was applied, where plants were 15 to 25 inches tall. Burndown herbicides = glyphosate + 2,4-D ester. Residual herbicide = cloransulam plus flumioxazin.

	% control – at harvest	
	Resistant	Sensitive
No preplant burndown – POST only		
POST glyphosate (0.75)	37	73
POST glyphosate (0.75) + Late POST glyphosate (0.75)	74	85
Preplant burndown followed by POST		
POST glyphosate (0.75)	55	83
POST glyphosate (0.75) + Late POST glyphosate (0.75)	88	100
POST glyphosate (1.5)	61	75
POST glyphosate (1.5) + Late POST glyphosate (0.75)	96	100
POST Flexstar (1.3 pts/A) + Late POST glyphosate (0.75)	99	100
Preplant burndown + residual followed by POST		
POST glyphosate (0.75)	70	95
POST glyphosate (0.75) + Late POST glyphosate (0.75)	97	100
POST glyphosate (1.5)	71	90
POST glyphosate (1.5) + Late POST glyphosate (0.75)	97	100

Management Strategies – Soybeans

Giant ragweed has a number of characteristics that make it a “great” weed, and inherently difficult to control. Giant ragweed emerges from late March through early July in Ohio, and management programs need to address this long period of emergence. It is usually present at the time of planting, and should be controlled with an effective preplant burndown treatment. A combination of preemergence and postemergence herbicides should be used to control this weed from planting through late June. Several preemergence herbicides have activity on giant ragweed, and these should be used to reduce the populations that emerge after planting, and slow the growth of surviving plants. It is possible to obtain adequate control with single postemergence glyphosate application in fields without a history of control problems, but only where an effective preplant burndown and residual herbicides have been used. The populations and emergence pattern in many fields justify two postemergence applications. Giant ragweed grows rapidly and is extremely competitive with soybeans, and should be controlled

when relatively small, which usually results in the need for a second postemergence application to control later-emerging plants.

While many growers rely on multiple applications of glyphosate to control giant ragweed, this has led to control failures in some fields, and the development of populations with a low level of glyphosate resistance. Based on recent research from Purdue University and The Ohio State University, it is still possible to control giant ragweed with glyphosate-based herbicide programs in fields where previous reliance on glyphosate alone has resulted in resistance and poor control. Growers experiencing problems with control should follow the guidelines shown below as closely as possible. Where control of giant ragweed has not been a problem, and the soybeans have been rotated with non-Roundup Ready corn, growers may choose not to use residual herbicides. We strongly suggest that no-till soybeans be treated with a preplant application of 2,4-D ester even where problems with control have not been experienced. Specific guidelines are as follows:

1. Start weedfree at planting using tillage or a preplant burndown herbicide treatment consisting of 2,4-D ester plus either glyphosate or paraquat.
2. In no-till, include an herbicide that provides residual control of giant ragweed in preplant burndown treatments. Where the field is tilled prior to planting, apply residual herbicide before soybeans emerge. The following preemergence herbicides provide some control of giant ragweed, so they can reduce the population and slow the growth of remaining plants: Authority First, Canopy, Synchrony, FirstRate, Scepter, Sonic, or Gangster. Note - these herbicides will not control ALS-resistant giant ragweed.
3. Growers with a history of giant ragweed control problems should apply one of the following POST treatments when giant ragweed plants are no more than 6 to 10 inches tall: glyphosate (1.5 lb ae/A); Flexstar (1.3 pints/A); Cobra/Phoenix (12.5 oz/A); or FirstRate (0.3 oz/A – only where population is not ALS resistant). Where Flexstar, Cobra, Phoenix, or FirstRate is applied, include a POST grass herbicide such as clethodim or Fusion. In fields where control has not been a problem, use a glyphosate rate of 0.75 lb ae/A on plants up to 6 inches tall, and 1.5 lb ae/A on larger plants.
4. In fields with a history of control problems, make a second POST application of glyphosate (0.75 lb ae/A) approximately 3 weeks after the first POST treatment. Proper timing of this application is essential to obtain control. Do not delay application until giant ragweed plants are evident above the soybean canopy, or control will be reduced. Where control has not been a problem in the past, scout fields 3 weeks after the first POST treatment. Make a second POST glyphosate application (0.75 lb ae/A) as necessary to control late-emerging plants or to complete control of plants that survive the first application.

Management Strategies – Corn

Giant ragweed should be effectively controlled throughout the crop rotation, and strategies in corn are overall similar to those in soybeans. In Ohio, too many growers attempt to control giant ragweed in corn with total preemergence herbicide programs. OSU research has shown that even the most effective preemergence corn herbicide programs, such as Lexar, Lumax, and mixtures of atrazine with Balance or Hornet, are unlikely to adequately control giant ragweed except in fields with very low populations. Where the risk of water contamination precludes use of atrazine, or allows only low rates, preemergence herbicide programs will be even less effective. Many postemergence broadleaf herbicides have activity on giant ragweed, although resistance to ALS inhibitors in some fields can limit the number of options. Effective management of giant ragweed in corn, which minimizes early-season interference and ensures control of late-emerging plants, results from a combination of preemergence and postemergence herbicides. Preemergence herbicide treatments used in this approach should provide enough control during the several weeks following planting, so that postemergence herbicides can be applied when corn is approximately 15 inches tall. This ensures control of late-emerging giant ragweed, which may not interfere with corn, but can still produce seed and interfere with harvest.

Resources for More Information

The recommendations presented here can also be found in the “Weed Control Guide for Ohio and Indiana”, which is available on the OSU weed science website or from the OSU publications office (614-292-1607). Weed scientists at OSU and Purdue University have also collaborated on several fact sheets on the value of preemergence herbicides in Roundup Ready soybeans and control of lambsquarters and giant ragweed. Weed scientists across the Midwest have collaborated on a series of bulletins on glyphosate stewardship and resistance, and control of specific weeds that can be problematic in Roundup Ready systems. Free copies of these fact sheets and bulletins are available from extension weed scientists at OSU (Mark Loux, 614-292-9081, loux.1@osu.edu). They can also be downloaded from the following websites:

OSU weed science – <http://agcrops.osu.edu/weeds>

Purdue weed science – <http://www.btny.purdue.edu/weedscience/>

Glyphosate, Weeds and Crops group – <http://www.glyphosateweedsandcrops.org>