Northern NY Agricultural Development Program
2013-2014 Project Report

One- and Two-Pass Weed Control Programs for Glyphosate Resistant Soybeans

Project Leader:

- Russell R. Hahn, Associate Professor, Section of Soil and Crop Sciences, School of Integrative Plant Sciences, Cornell University. Phone: 607-255-1759, email: rrh4@cornell.edu

Collaborators:

- Michael E. Hunter, CCE of Jefferson County
  Kitty O'Neil, CCE Northern NY

Cooperating Producer:

- Jay Canzonier, Jefferson County

Background:

Poor common lambsquarters control when glyphosate has been applied alone in glyphosate-resistant (GR) soybeans has been reported numerous times since 2006. This has led some to suggest that these surviving lambsquarters are a GR biotype. Although similar observations have been reported in other states as well, no one has confirmed GR lambsquarters according to the "International Survey of Herbicide Resistant Weeds" (www.weedscience.org) (1) as of March 15, 2015.

Greenhouse and field experiments in NY have suggested that these lambsquarters are not GR but that the size of lambsquarters at the time of application is important (2). There are relatively few postemergence (POST) soybean herbicides that can be pre-mixed or tank-mixed with glyphosate and the application of glyphosate alone has resulted in generally good weed control. As a result, the use of soybean herbicides other than glyphosate declined about 80% in the U.S. during the 10 years following the introduction of GR soybeans in 1996 (3).

Reliance on glyphosate alone for soybean weed control not only runs the risk of poor lambsquarters control, but also increases the chances of developing GR weed populations. The introduction of several "new" preemergence (PRE) residual herbicides with different sites of action than glyphosate (Group 9 herbicide) provides the potential to help manage lambsquarters and other weeds in soybeans. Among these PRE herbicides are Kixor (Group 14 herbicide) powered products OpTill, a premix of Kixor and Pursuit (Group 2 herbicide), and Verdict, a premix of Kixor and Outlook (Group 15 herbicide). In addition to providing residual annual broadleaf weed control, Kixor powered products can provide rapid burndown of broadleaf weeds in zone/no-tillage. The registration of Warrant (Group 15 herbicide) in NY State brought

another residual herbicide option that provides significantly better annual broadleaf activity than similar herbicides like Dual.

These and other residual herbicides could play an important role in two-pass soybean weed control programs. Two-pass programs would provide better weed control and more flexibility in the timing of POST glyphosate applications than one-pass glyphosate only programs. They would also play a role in preventing development of GR weed populations.

Knowing that soybean growers prefer one-pass herbicide programs, it was decided that it would be informative to compare some POST pre-mix and tank-mix options with glyphosate only applications. Examples included Flexstar GT, a premix of Reflex (Group 14 herbicide) plus glyphosate, and Extreme, a premix of Pursuit (Group 2 herbicide) plus glyphosate. Tank-mixes of glyphosate with Harmony SG (Group 2 herbicide) or Synchrony XP (Group 2 herbicide) are also possibilities. The cost effectiveness of these one- and two-pass programs should help NNY soybean growers make informed decisions about their weed control programs and help avoid the development of GR weed populations.

Methods:

A small plot experiment with four replications was conducted near Woodville, NY, in Jefferson County. Soybeans, 'NK S14-J7', were planted June 9, 2014 and PRE herbicides, shown in Table 1, were applied June 10 to individual plots that were 10 by 25 ft. These PRE treatments were rated for crop injury and for weed control 5 weeks after treatment (WAT). Each of these PRE treatments received a late POST (LPOST) glyphosate application July 18. The one-pass herbicide treatments, shown in Table 2, were applied that same day.

Lambsquarters and wild radish were the dominant weeds, however, common ragweed and large crabgrass were also present. At the time of the LPOST herbicide applications, lambsquarters and wild radish averaged 14 and 20 inches tall respectively in plots that had not received a PRE herbicide. While this LPOST timing was fine for the two-pass treatments where weeds had been suppressed or controlled, it was clearly later than ideal for the one-pass treatments. A second set of weed control ratings were made 3 weeks after the LPOST herbicide applications. Soybeans were harvested October 28.

Results:

There was no significant soybean injury from the PRE herbicides 5 WAT. Table 1 shows that the standard treatment of Dual II Magnum plus Python provided good (83%) common ragweed control 5 WAT. Other PRE treatments, except Sharpen, Warrant, and Prefix, provided ragweed control equal to or better than the standard treatment. The Sharpen, Warrant, and Reflex treatments only averaged about 20% ragweed control.

Near 100% lambsquarters control was achieved with the standard Dual II Magnum plus Python treatment as well as with OpTill, Valor SX, Valor XLT, and Enlite. While Verdict provided good (86%) lambsquarters control, Sharpen, Warrant, and Prefix did not provide adequate lambsquarters control.

Large crabgrass control was 85% or greater with all PRE treatments except for Sharpen. Sharpen has no activity against grasses.

Finally, wild radish control was excellent (97-100%) with the PRE standard, OpTill, Valor XLT, and Enlite. Good radish control was achieved with Verdict (87%) and Valor SX (93%). The other PRE treatments of Sharpen, Warrant, and Prefix, did not provide adequate radish control.

Ultimately, all of the PRE followed by LPOST treatments resulted in excellent control of all weeds when evaluated 3 WAT with LPOST glyphosate.

Table 1. PRE herbicide treatments, cost per acre, percent weed control ratings 5 weeks after treatment (at the time of the LPOST glyphosate applications), and soybean yields.

		Rate	Cost**	% Control 5 Weeks After PRE Treatment				Yield
Trt. #	Herbicides*	Amt./A	$/A	Ragweed	Lambs	Crabgrass	Radish	Bu/A
2	Dual II Mag Python WDG	1.33 pt 0.89 oz	$35.98	83	99	99	100	56
3	Sharpen	1 fl oz	$11.22	23	55	0	3	52
4	Verdict	5 fl oz	$13.88	87	86	95	97	55
5	OpTill	2 oz	$19.12	93	100	93	100	62
6	Warrant	1.5 qt	$18.01	20	47	85	50	48
7	Prefix	1 qt	$17.12	20	30	99	70	47
8	Valor SX	2 oz	$17.60	85	100	96	93	57
9	Valor XLT	3 oz	$19.25	97	99	95	99	56
10	Enlite	2.8 oz	$23.19	95	100	97	97	61
LSD				11	13	6	11	9

*Each of these treatments received a late postemergence application of 22 fl oz/A of Roundup PowerMax plus 2.5 lb/A of AMS (ammonium sulfate) at the time of these control ratings.
**Cost/A includes the cost of the late postemergence Roundup PowerMax plus ammonium sulfate.

While the LPOST timing was fine for the two-pass treatments where weeds had been suppressed or controlled, it was clearly later than ideal for the one-pass treatments. As a result, the canopy of lambsquarters and wild radish prevented the LPOST herbicides from reaching the small lambsquarters beneath the canopy. It was these small plants that resulted in the 70 to 80% lambsquarters control ratings shown in Table 2. From the standpoint of soybean yields, this was unfortunate. It was however a great learning experience because virtually all of the large lambsquarters and wild radish plants were killed by these LPOST treatments.

As mentioned previously, we had thought that poor lambsquarters control was mainly because of size. In this case, growing conditions, i.e. soil moisture and air temperatures, were ideal for active lambsquarters growth. This suggests that growing conditions may be more important than size in getting good lambsquarters control with glyphosate based treatments. Generally speaking, POST herbicides are less effective when weeds are under drought and/or temperature stress than when weeds are actively growing.

Table 2. LPOST, one-pass herbicide treatments, cost per acre, percent weed control ratings 3 weeks after treatment, and soybean yields.

		Rate	Cost*	% Control 3 Weeks After LPOST Treatments				Yield
Trt. #	Herbicides*	Amt./A	$/A	Ragweed	Lambs	Crabgrass	Radish	Bu/A
11	Roundup PM	22 fl oz	$5.39	100	70	100	96	39
12	Roundup PM	33 fl oz	$7.49	100	80	100	95	32
13	Roundup PM Harmony SG	22 fl oz 0.125 oz	$9.98	100	75	100	93	35
14	Roundup PM Synchrony XP	22 fl oz 0.375 oz	$10.09	100	75	100	91	34
15	FlexStar GT	3.75 pt	$17.85	100	75	100	94	32
16	Extreme	3 pt	$13.88**	100	76	100	91	38
LSD				0	8	0	4	9

*Includes the cost of 2.5 lb/A ammonium sulfate.
**Includes the cost of 0.2 pt/A of Induce NIS.

Soybean yields for the nine, two-pass PRE followed by LPOST treatments averaged 55 bu/A while the yields for the six, one-pass LPOST treatments averaged 35 bu/A. Generally good to excellent weed control ratings for the LPOST treatments suggest this huge difference was largely due to the late application.

Weeds, especially the lambsquarters and wild radish, were allowed to compete with the soybeans too long and the soybeans never fully recovered from this early season competition. Yields for the two-pass PRE followed by LPOST treatments ranged from 47 bu/A for the Prefix treatment to 62 bu/A for the OpTill treatment. The PRE treatments that did not provide good lambsquarters and radish control, Sharpen, Warrant, and Prefix, had an average yield of 49 bu/A while the PRE treatments that controlled these two dominant weeds had an average yield of 58 bu/A. There were no yield differences among the one-pass LPOST treatments.

The cost of herbicides and adjuvants (April 2014 dealer costs plus 5% margin with no dealer discounts or grower rebates included) for the two-pass programs ranged from $11.22/A for Sharpen to $35.98/A for the Dual II Magnum plus Python standard treatment, and averaged about $19.50/A. Herbicide and adjuvant costs for the one-pass LPOST programs averaged about $10.75/A. The roughly $9/A higher cost for herbicides in the two-pass programs and the $8 to $10/A added cost for making the second application are likely reasons why it's difficult to have growers be proactive about herbicide resistance management that incorporates the use of herbicides with different sites of action.

Although two-pass programs will routinely provide excellent weed control and provide greater opportunity to incorporate herbicides with different sites of action, they may only be practical for zone/no-tillage situations where growers need a burndown application in place of primary tillage and seedbed preparation.

Conclusions/Outcomes/Impacts:

The fact that the large lambsquarters were controlled with LPOST glyphosate alone and with the combination treatments changed our thinking. Prior to this research, we thought that poor lambsquarters control with glyphosate was mainly related to the size of lambsquarters at the time of application. These results suggest that growing conditions may be more important than size. When lambsquarters are under stress from hot, dry conditions, growers should make adjustments in their programs by increasing the rate of glyphosate and/or by using a premix or tank mix with other herbicides. The yield results clearly demonstrate the penalty for late application when using a one-pass program. The results also demonstrate that a two-pass program provides the most reliable weed control and provides the opportunity to utilize herbicides with different sites of action. This should delay or prevent the development of glyphosate resistant weed populations.

Outreach:

A "Soybean Weed Control Plot Walk" sponsored by CCE and NNYADP was held at the site on August 18, 2014. There were 20 participants including growers, custom applicators, crop consultants, and extension educators. Two hours were spent observing/discussing the weed control results with each treatment. Weed control and soybean yield results were discussed as part of "Weed Management Updates" for CCE's Agriculture and Food Systems In-Service in Ithaca November 20, 2014, for 12 extension educators, and for Northeast Region Certified Crop Advisor's Advanced Training in Syracuse December 3, 2014, for 96 participants. Finally, results of the field experiment were presented at the North Country Crop Congress meetings at Miner Institute in Chazy and at Lowville on February 17 and 18, 2015 respectively. A total of 110 attended these two sessions. A Power Point presentation of these results can be viewed at https://blogs.cornell.edu/ccefieldcropnews/files/2015/04/NNYADP2014-2bgcsq3.ppt

Next Steps: Results of this field trial have been, and will continue to be incorporated into presentations on lambsquarters control in GR soybeans across NY State.

Acknowledgments: This trial was funded solely by the NNYADP.

For More Information:

- Russell R. Hahn, 607-255-1759, rrh4@cornell.edu
- Michael E. Hunter, 315-788-8450, ext. 266, meh27@cornell.edu
- Jay Cazonier, North Branch Farms, 315-523-0760, northbranchfarms@frontiernet.net

Literature citations:

1) Heap, I. The International Survey of Herbicide Resistant Weeds. Online. Internet. Sunday, February 24, 2013. Available www.weedscience.org
2) Hahn, R.R. and P.J. Stachowski. 2007. Size of common lambsquarters is critical for control with glyphosate. *What's Cropping Up?* 17(3):10-11.
3) U.S. Department of Agriculture, National Agricultural Statistics Service Data and Statistics site http://www.nass.usda.gov/Data_and_Statistics/Quick_Stats/