GETTING THE MOST OUT OF ENLIST SOYBEANS FOR WEED CONTROL IN DELAWARE

A proposal submitted to the Delaware Soybean Board for funding in 2021. This was a new project

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Enlist soybeans are resistant to 2,4-D, glufosinate, and glyphosate herbicides. With resistance to three different herbicide modes of action, these soybeans provide more flexibility for weed control options than were previously available. While 2,4-D could be used as a pre-plant herbicide, applications were not permitted within 7 to 15 days prior to planting and at lower use rates.

Due to the concern of 2,4-D off-target movement and limited availability of Enlist research projects; UD Weed Science has not had as many opportunities to test Enlist soybeans as Xtend soybeans. Research in the mid-West over the past 2 to 3 years have shown that volatility of 2,4-D choline (the salt formulation in Enlist herbicide) is at a much lower risk than dicamba (in Xtendimax or Engenia). Physical movement (drift with small droplets and wind) is still a concern, but volatility may not be as much of a concern. Evaluating tankmixtures of glyphosate and glufosinate, or glufosinate plus 2,4-D is needed to understand the strength and weaknesses of these mixtures.

Liberty plus Enlist appears to be a better tankmixture than Liberty plus Xtendimax. Enlist allows for a smaller droplet size than Xtendimax/Engenia and the smaller droplet size will improve the spray coverage of Liberty and in turn improving its control. Note UD research has found very similar results between Engenia and Xtendimax so we do not make a distinction between the two.

A limited number of studies in the mid-West have shown the potential for reduced

grass control when glyphosate is tankmixed with Enlist One. In addition, glufosinate (the third trait in Enlist soybeans) is not very effective on grasses, so additional research is needed to ensure grass control is adequate with this trait.

Xtend soybeans (dicamba-tolerant) have been studied more extensively by UD Weed Science through funding by BASF, Monsanto/Bayer, DuPont, and Syngenta. However, most of the research projects have focused on postemergence weed control. Local research comparing 2,4-D with dicamba as a burndown herbicide has not been done. Identifying the strength and weaknesses of these herbicides for burndown of difficult to control weeds such as marestail/horseweed or primrose, is important when comparing these herbicide traits.

The **research objectives** are to evaluate:

- the utility of Enlist versus Xtend soybeans for burndown weed control; and
- the best use of Enlist soybean traits for postemergence weed control.

The **first objective** is evaluating the utility of Enlist versus Xtend soybeans for burndown weed control.

Methods:
2,4-D choline (Enlist One) and dicamba (Xtendimax) were tankmixed with glyphosate for burndown treatments under four different applications scenarios. Applications were made 14 days before soybean planting with no rye; applied 4 weeks before soybean planting without rye; sequential applications with first applied 4 weeks before planting followed by an application 14 days before planting; and with cereal rye, an application 14 days before planting. An additional treatment included Enlist One plus glyphosate applied 4 weeks before planting followed by Trivence plus glyphosate applied 14 days before planting. An untreated check was also included. See table 1 for treatment list.

Cereal rye as drilled October 25, 2020 and plots without cereal rye were sprayed with clethodim (Select Max) on March 9, 2021. Applications made 28 days before planting were applied May 3, and 14 days before planting were applied May 18. However, due to drought, soybean planting occurred June 16. Rating schedule was based on a presumed June 1 planting date.

All herbicides were applied at 20 g/A with appropriate TeeJet TurboTee Induction nozzles. Enlist One was applied at 1 lb ae/A, Xtendimax was applied at 0.5 lb ae/A, and glyphosate was applied at 1.1 lb ae/A. Labeled adjuvants were used for each treatment.

Results:
Horseweed density was low and all treatments provided excellent control (99% control). Cutleaf eveningprimrose and field pansy (Johnny jumpup) were also rated (Table 1). At intended soybean planting, primrose control was at least 90% control for all plots treated 4 weeks before planting. Control was less when treatments were delayed until 10 days before planting. The exception was in plots with cereal rye cover crop sprayed with Enlist One. Previous research has also shown that 2,4-D provided better control

of this species than dicamba.

Field pansy control was best with sequential applications of Enlist One plus glyphosate or cereal rye terminated with Enlist One plus glyphosate. In addition, cereal rye germinated with Xtendimax plus glyphosate or Trivence at planting provide 87% control.

Summer annual weed control was rated two weeks after intended planting (Table 2). No additional weed control had been used other than the burndown treatments. Palmer amaranth control was variable with the best treatments ranging from 85 to 96% control. These included Xtendimax treatments except sequential treatments (not sure why this was low), preemergence application of Trivence, and presence of cereal rye. Palmer amaranth required a postemergence application to provide full-season control, regardless of burndown treatments.

Morningglory and large crabgrass control was best with cereal rye and Trivence, but a postemergence treatment was needed for full-season control.

Trivence is a pre-packaged mixture of metribuzin, chlorimuron, and flumioxazin. It represents one of the most comprehensive herbicide premixes and many other programs may not have been as successful.

The site experienced short-term drought when soybeans were scheduled for planting. Planting was delayed 10 days and late season weed control was very poor. As a result, yield data was not collected.

The **second objective** evaluated various tankmixes with Enlist One for postemergence weed control.

Methods:
The initial trial was planted no-till, but field was planted with Xtend soybeans and replanting was necessary.

Second planting was made July 15, with Enlist soybean into a conventionally tilled field. Entire experimental area was sprayed with Outlook (dimethenamid) at 0.5X rate. Enlist One was tankmixed with postemergence grass herbicides (Select or Assure II), glyphosate, Liberty, or Reflex to evaluate benefits with tankmix partners, see Table 3 for full treatment list. Standard treatments were included for comparisons. Postemergence applications were made August 10 and sequential treatments were applied August 18. On August 10, Palmer amaranth plants were up to 8 inches tall. All treatments included appropriate adjuvants.

Soybeans were rated for crop injury and weed control was rated.

Results:
The initial application was made on August 10, under conditions favorable for leaf burn (heat index 100 at time of application). All treatments with Reflex exhibited leaf burn, with 16, 22, 37 when tankmixed with Enlist One, glyphosate, and Liberty, respectively

(Table 3). By 10 days after treatment, only the Reflex plus Liberty treatment was showing stunting.

Ratings less than 99% were due to larger Palmer amaranth plants still alive with green tissue. No additional emergence of Palmer amaranth occurred at this site. Enlist One with either Assure II or Select provided 87 to 94% Palmer amaranth control. Since neither Assure II nor Select provide any broadleaf weed control, this indicates the activity provided by Enlist One. Enlist One tankmixtures with glyphosate and Liberty provided over 95% control, as well as Reflex plus Liberty; and these was better than Reflex plus glyphosate (70%) or Liberty plus glyphosate (80%).

Enlist One plus Assure II reduced fall panicum control. There have been numerous reports of antagonism between Enlist One and postemergence grass herbicides.

Yields were similar for all treatments.

Table 1. Burndown treatments for winter annual weed control. Ratings taken at soybean planting.

				Primrose			Field pansy	
TrtNo	Treatment	Timing		control			control	
1	Enlist+glyphosate	4wks		99	a		53	e
2	Xtendimax+glyphosate	4wks		90	ab		57	e
3	Enlist+glyphosate	10days		78	c		68	d
4	Xtendimax+glyphosate	10days		86	bc		80	c
5	Enlist+glyphosate	4wks fb 10d		99	a		99	a
6	Xtendimax+glyphosate	4wks fb 10d		99	a		80	c
7	Rye/Enlist+glyphosate	10days		93	ab		93	ab
8	Rye/Xtendimax+glypho	10days		78	c		87	bc
9	Enlist+glyphosate	4wks		99	a		87	bc
	Trivence+glyphosate	10days		99	a		53	e

glypho= glyphosate

Table 2. Effect of burndown treatments on early-season summer annual weed control. Ratings taken two weeks after soybean planting.

				Palmer amaranth			Morning-glory			Large crabgrass	
TrtNo	Treatment	Timing		control			control			control	
1	Enlist+glyphosate	4wks		0	c		0	d		0	d
2	Xtendimax+glypho	4wks		85	a		10	d		23	c
3	Enlist+glyphosate	10d		55	b		43	c		67	b
4	Xtendimax+glypho	10d		87	a		57	bc		67	b
5	Enlist+glyphosate	4wks fb 10d		50	b		47	c		67	b
6	Xtendimax+glypho	4wks fb 10d		50	b		47	c		77	ab

7	Rye/Enlist+glypho	10d		90	a		67	ab		78	ab
8	Rye/Xtendimax+glyho	10d		87	a		72	ab		82	ab
9	Enlist+glyphosate	4wks		96	a		77	a		92	a
	Trivence+glyphosate	10d									
10	Untreated										

glypho= glyphosate

Table 3. Soybean response to postemergence herbicide treatments

				Leaf burn			Stunting			Stunting	
TrtNo	Treatment	Timing		4 DAT			10 DAT			17 DAT	
1	Enlist One + glyphosate	POST		0	d		0	b		0	b
2	Enlist One + Liberty	POST		0	d		0	b		0	b
3	Enlist One + Reflex	POST		16	c		0	b		0	b
4	Enlist One + Assure II	POST		0	d		0	b		0	b
5	Enlist One + Select	POST		0	d		0	b		0	b
6	Liberty fb Enlist One + glyphos	POST +7day		0	d		0	b		0	b
7	Enlist One + glyphosate fb Enlist One	POST +7day		0	d		0	b		0	b
8	Reflex + glyphosate	POST		22	b		0	b		0	b
9	Liberty + glyphosate	POST		0	d		0	b		0	b
10	Reflex + Liberty	POST		37	a		16	a		8	a

Table 4. Weed control from postemergence herbicide treatments

				Palmer amaranth			Fall panicum			Yield	
TrtNo	Treatment	Timing		control			control			bu/A	
1	Enlist One + glyphosate	POST		99	a		99	a		41.4	a
2	Enlist One + Liberty	POST		97	ab		99	a		41.2	a
3	Enlist One + Reflex	POST		93	ab		73	c		40.9	a
4	Enlist One + Assure II	POST		87	bc		83	b		41.4	a
5	Enlist One + Select	POST		94	ab		95	a		41.9	a
6	Liberty fb Enlist One + glyphos	POST +7day		99	a		99	a		40.8	a
7	Enlist One + glyphosate fb Enlist One	POST +7day		99	a		99	a		43.3	a
8	Reflex + glyphosate	POST		70	d		99	a		40.2	a
9	Liberty + glyphosate	POST		80	cd		96	a		40.6	a
10	Reflex + Liberty	POST		99	a		99	a		40.7	a

Summary:

There was no clear differences between Xtendimax and Enlist herbicide programs for no-till burndown in this study. Xtendimax slowed the growth of Palmer amaranth and morningglory, but the control not as consistent or as effective as a preemergence herbicide.

Enlist One applied by itself to Palmer amaranth plants was not adequate to provide complete control. Enlist One programs need to be applied to Palmer amaranth plants at four inches tall or less. Enlist One can reduce grass control from postemergence grass herbicides and should not be tankmixed if grasses are big. Enlist One tankmixed with glyphosate or Liberty provided excellent weed control.

This information has been presented at UD Carvel Research Farm Field Day in August 2021, Delaware Ag Week, and incorporated into the MidAtlantic Weed Management Guide.