

Report to the Delaware Soybean Board for Research funding in 2012.

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EVALUATING VARIOUS APPROACHES FOR WEED CONTROL WITH GENETICALLY-ALTERED SOYBEANS

Objectives: to evaluate the effectiveness of various approaches for weed control with genetically-altered soybeans, utilizing Roundup Ready, sulfonylurea tolerant (STS), and glufosinate-resistant (Liberty Link) soybeans for summer annual weed control. Also, evaluate the contribution of soil-applied herbicides for burndown weed control.

JUSTIFICATION AND PROGRESS TO DATE:

Soybean producers are faced with the difficulty of maximizing weed control in light of herbicide-resistance issues. Due to the diversity of weed species and changing technology available for weed management, producers are faced with an ever-increasing array of complex issues. Including herbicides with different sites/modes of action is critical to managing herbicide resistant weeds as well as improve control of species that are not as susceptible to glyphosate. This project will address the dual role of residual herbicides providing both burndown weed control as well as residual control. Many commonly used herbicides do not provide activity on emerged weeds (such as Dual, Command, Prowl) or they do not provide effective residual control (such as Kixor, glyphosate or Liberty 280).

This objective was developed based on the priorities outlined by the DSB in their request for proposals.

Methods:

Both trials were conducted at UD Research and Education Center near Georgetown, DE.

Comparison of various approaches with genetically-altered soybeans.

Georgetown location was planted on May 23, 2012. Treatments consisted of a

factorial arrangement of soybean genetics for herbicide resistance (Roundup Ready, Liberty Link, STS, and conventional soybeans) and four approaches to weed management (total postemergence [POST], preemergence followed by POST [28 days after planting], preemergence followed by late-POST [42 DAP], reduced rate of preemergence followed by POST). In addition, preemergence treatment followed by a higher rate of Liberty 280 was included as well as an untreated check for comparison. All treatments were replicated three times.

Southern States LL499N was used for the Liberty Link and conventional programs. Southern States RT4996N-STS was used for both the STS and Roundup Ready programs. Plots were planted with a no-till drill modified for planting research plots. The entire research area was treated with glyphosate prior to planting to remove all winter annual weeds. This study was designed to look only at summer annual weed control. Individual plots were 10 feet wide and 25 feet long. The experimental site was irrigated within 2 days of herbicide application to ensure soil activation.

The treatments examined were:

	Conventional		Liberty Link		STS		Roundup Ready	
	Herbicides	Rate	Herbicide	Rate	Herbicides	Rate	Herbicide	Rates
No PRE, only POST	Reflex Basagran NIS	1 pt 1.5 pt 0.25%	Liberty AMS	29 oz 2 lbs	Synchrony STS COC	0.75 oz 1qt	Glyphosate	32 oz
PRE fb POST	Dual Prowl Sencor	1.3 pt 1.75 pt 3 oz	Prefix	2 pt	Prefix	2 pt	Valor XLT	3 oz
Reduced rate PRE fb POST	Dual Mag Prowl Sencor	0.8 pt 1.2 pt 2 oz	Prefix	1.3 pt	Prefix	1.3 pt	Valor XLT	2 oz
PRE fb LPOST ^a	Dual Mag Prowl Sencor	1.3 pt 1.75 pt 3 oz	Prefix	2 pt	Prefix	2 pt	Valor XLT	3 oz

Abbreviations: COC= crop oil concentrate; EPOST= early postemergence (28 days after planting); fb= followed by; LPOST= last postemergence (42 days after planting); NIS= non-ionic surfactant; PRE=preemergence

^aFor late POST treatments Select Max was included at 1 pt/A for control of large crabgrass.

Visual ratings were made at regular intervals and final yield was recorded.

Benefits of residual herbicides for burndown weed control.

This study examined the differences of various herbicides, all containing either chlorimuron (Classic) or cloransulam (FirstRate) which should help with burn down control of horseweed (marestail). Also, most of these products contain a group 14 herbicide to complement the first objective (Valor or Authority). These products were tested with low rates of glyphosate and glufosinate (Liberty 280).

Residual herbicides combined with glyphosate plus 2,4-D (Touchdown Total 20 fl oz plus 2,4-D ester at 1 pt) or Liberty 280 plus 2,4-D (Liberty 280 22 fl oz plus 2,4-D ester at 1pt). Additionally, all treatments included AMS.

Residual Herbicides	Rate	Equivalent products
Valor XLT	3.6 oz wt/A	Classic (1.5 oz) + Valor (2.1 oz)
Canopy	3.5 oz wt/A	Classic (1.5 oz) + metribuzin (3 oz)
Canopy EX	1.65 oz wt/A	Classic (1.5 oz) + Express (0.15 oz)
Authority XL	4.83 oz wt/A	Classic (1.5 oz) + Authority (4 oz)
Gangster	3 oz wt/A	FirstRate (1.5 oz) + Valor (2.5 oz)
Authority First	5.3 oz wt/A	FirstRate (0.5 oz) + Authority (4.4 oz)
No residual herbicide		

Treatments were applied on April 30, 2012 and soybeans were planted on May 16, 2012. Visual ratings were taken. However, this site was not irrigated and due to heavy weed density and lack of rainfall, moisture stress severely impacted this trial.

RESULTS:

Genetically-altered soybean comparisons:

June 21 (4 WAP) all preemergence treatments provided good control of Palmer amaranth and large crabgrass (>88%) regardless of herbicide program or rate, and there were no significant differences between treatments. Similarly, common ragweed, common lambsquarters, and large crabgrass control with all the preemergence herbicides were similar (>90% for common ragweed, >94% for common lambsquarters, and >95% for large crabgrass control).

Morningglory control at 4 WAP was highest with Valor XLT (72 to 81% control). Prefix and the combination of Dual, Prowl, and Sencor provide 43 to 53% control.

At mid-season, none of the only POST applications provided excellent control of Palmer amaranth. Palmer amaranth control with only POST applications was rated 84% for glyphosate, but was poor for all other systems (Table 1). A program of PRE followed by POST was >93% for all four systems, and >95% for a reduced rate PRE fb POST. A late POST treatment was >87% for Liberty-Link, Roundup Ready, and the conventional system, but only 83% for the STS system, a statistically lower value than the other treatments. The outstanding control with glyphosate was due to the Palmer amaranth population being sensitive to glyphosate (no glyphosate-resistant biotypes in this field).

Control of morningglory was best if Valor XLT was used at planting and glyphosate used postemergence. Only glyphosate applied POST, resulted in 77% control, however, with the addition of Valor XLT at planting, morningglory control ranged from 82 to 92% control. None of the other systems were as effective or as consistent as the Roundup Ready system.

Large crabgrass control was >90% for all treatments, and no differences between treatments were detected.

Prickly side populations were quite variable in the trial site and resulted in high variability in the data. But in general terms, Liberty 280 and glyphosate were more effective than Synchrony or Basagran plus Reflex. Prefix and Valor XLT were more effective than Dual plus Prowl plus Sencor.

A treatment with higher rates of Liberty was included at the late POST timing. For all four species evaluated, there were no differences in weed control with the 34 fl oz rate compared to the 29 fl oz rate.

Yields were significantly different among the treatments.

There was a clear advantage to using a PRE herbicide for control of Palmer amaranth, morningglory and prickly sida.

Benefits of residual herbicides for burndown weed control.

Horseweed control shortly after application was better with treatments containing Liberty 280 than glyphosate because of the faster activity of Liberty, and the presence of glyphosate-resistant horseweed. However, by 4 weeks after treatment, there was little difference between Liberty 280 and glyphosate. Treatments with Canopy, Gangster, and Authority First (or Sonic) had the highest level of horseweed control at 4 weeks after treatment (83 to 91% control). By 7 weeks after treatment, the same three treatments and Canopy EX had similar level of horseweed control, ranging from 71 to 78% control.

Primrose control was over 90% control with all treatments containing Liberty 280; 93% if Liberty 280 was used alone. Glyphosate alone provided only 50% control. Glyphosate with Valor XLT, Canopy, Gangster, and Authority First/Sonic provided 83 to 86% control. By 4 weeks after treatment, primrose plants were beginning to senesce due to the heat.

Field pansy control was quite variable and was not significantly different between the residual herbicides evaluated. However, overall Valor XLT, Canopy, and Authority XL had the highest ratings.

Lack of rainfall to activate these residual herbicides, limited their control of summer annual weeds. Plots were harvested, but due to the lack of rain yields were less than 25 bu/A.

Table 1. Weed control ratings at mid-season when comparing approaches within four herbicide/soybean systems (conventional soybeans, Liberty Link soybeans, Roundup Ready soybeans, and STS soybeans).

Trt No.	Genetics Traits	Treatment Approach	Treatment Name	Product Rate	Product Rate Unit	Timing	AMAPA	IPOSS	DIGSA	SIDSP
							Palmer amaranth control %	Morninglry species control %	Large crabgras control %	Prickly sida control %
1	Conv.	Total POST	Reflex	1	pt/A	4 WAP	67 e	63 fg	100 a	65 ab
			Basagran	1.5	pt/A	4 WAP				
			Select Max	16	fl oz/A	4 WAP				
2	RR	Total POST	Glyphosate	32	fl oz/A	4 WAP	84 bc	77 bcd	100 a	100 a
3	LL	Total POST	Ignite 280	29	fl oz/A	4 WAP	70 de	70 def	93 a	95 a
4	STS	Total POST	Synchrony STS	0.75	oz wt/A	4 WAP	67 e	75 b-e	100 a	33 b
			Select Max	16	fl oz/A	4 WAP				
5	Conv.	PRE fb POST	Dual Magnum	1.3	pt/A	PRE	100 a	53 g	93 a	87 a
			Prowl	1.75	pt/A	PRE				
			Sencor	3	oz wt/A	PRE				
			Reflex	1	pt/A	4 WAP				
			Basagran	1.5	pt/A	4 WAP				
6	RR	PRE fb POST	Valor XLT	3	oz wt/A	PRE	97 abc	85 ab	98 a	93 a
			Glyphosate	32	fl oz/A	4 WAP				
7	LL	PRE fb POST	Prefix	2	pt/A	PRE	93 abc	68 def	100 a	99 a
			Liberty 280	29	fl oz/A	4 WAP				
8	STS	PRE fb POST	Prefix	2	pt/A	PRE	97 abc	77 bcd	90 a	82 a
			Synchrony STS	0.75	oz wt/A	4 WAP				
9	Conv.	PRE fb	Dual	1.3	pt/A	PRE	93 abc	40 h	100 a	100 a

			Synchrony STS	0.75 oz wt/A	4 WAP				
17	LL	RPRE fb LPOST	Prefix	2 pt/A	PRE	95 abc	72 c-f	100 a	72 a
			Liberty 280	34 fl oz/A	6 WAP				
			Select Max	16 fl oz/A	6 WAP				
18	LL	Untreated	Untreated Check			0	0	0	0
LSD (P=.05)						13.82	10.78	8.75	36.58
Standard Deviation						8.29	6.47	5.25	21.79
CV						9.24	9.26	5.35	26.22
Treatment Prob(F)						0.0001	0.0001	0.3891	0.0393

Table 2. Evaluating burndown and residual weed control from common soybean herbicides. Rates of Touchdown Total (TD Total), Liberty, and 2,4-D are lower than recommended in order to evaluate effectiveness of the residual herbicides.

Trt No.	Treatment Name	Product Rate Unit	Grow Stg	ERICA	OEOLA	ERICA	OEOLA	ERICA
				Horse-weed Control %				
				5/16/2012	5/16/2012	5/28/2012	5/28/2012	6/18/2012
				16 D-	16 D-	28 D-	28 D-	49 D-
1	No Residual			60	50	63.3	80	0
	TD Total + 2,4-D + AMS	20 oz + 1 pt	14 EPP					
2	Valor XLT	3.6 oz wt/A	14 EPP	56.7 fg	85 bc	60 e	98.7 a	53.3 e
	TD Total + 2,4-D + AMS	20 oz + 1 pt	14 EPP					
3	Canopy	3.5 oz wt/A	14 EPP	71.7 de	83.3 c	90.3 a	99 a	78.3 ab
	TD Total + 2,4-D + AMS	20 oz + 1 pt	14 EPP					
4	Canopy EX	1.65 oz wt/A	14 EPP	53.3 g	53.3 e	81.7 abc	94 a	76.7 abc
	TD Total + 2,4-D + AMS	20 oz + 1 pt	14 EPP					
5	Authority XL	4.8 oz wt/A	14 EPP	60 f	70 d	75.3 cd	100 a	70 bcd
	TD Total + 2,4-D + AMS	20 oz + 1 pt	14 EPP					
6	Gangster	3 oz wt/A	14 EPP	74.3 cde	86 abc	84.3 abc	99.7 a	76.7 abc
	TD Total + 2,4-D + AMS	20 oz + 1 pt	14 EPP					
7	Authority First	5.3 oz wt/A	14 EPP	70 e	83.3 c	87.7 ab	97.3 a	86.7 a
	TD Total + 2,4-D + AMS	20 oz + 1 pt	14 EPP					
8	No Residual			73.3	93.3	56.7	99	0
	Liberty + 2,4-D + AMS	22 oz + 1 pt	14 EPP					
9	Valor XLT	3.6 oz wt/A	14 EPP	77.7 bc	91.7 ab	75 cd	98.7 a	56.7 de
	Liberty + 2,4-D + AMS	22 oz + 1 pt	14 EPP					
10	Canopy	3.5 oz wt/A	14 EPP	91.7 a	92.3 ab	92 a	99 a	76.7 abc
	Liberty + 2,4-D + AMS	22 oz + 1 pt	14 EPP					
11	Canopy EX	1.65 oz wt/A	14 EPP	79.3 bc	90 abc	75.7 cd	99.7 a	66.7 b-e

	Liberty + 2,4-D + AMS	22 oz + 1 pt	14 EPP										
12	Authority XL	4.8 oz wt/A	14 EPP	76	bcd	89.3	abc	69.3	de	99	a	63.3	cde
	Liberty + 2,4-D + AMS	22 oz + 1 pt	14 EPP										
13	Gangster	3 oz wt/A	14 EPP	80.3	b	92.7	a	84.3	abc	99	a	65	b-e
	Liberty + 2,4-D + AMS	22 oz + 1 pt	14 EPP										
14	Authority First	5.3 oz wt/A	14 EPP	76	bcd	92.3	ab	78.3	bcd	100	a	66.7	b-e
	Liberty + 2,4-D + AMS	22 oz + 1 pt	14 EPP										

LSD (P=.05)	5.46	7.42	11.93	3.48	13.38
Standard Deviation	3.22	4.38	7.04	2.06	7.9
CV	4.46	5.21	8.86	2.09	11.33
Treatment Prob(F)	0.0001	0.0001	0.0006	0.0958	0.0013