

Report to the Delaware Soybean Board for Research funding in 2010.

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### **WEED MANAGEMENT PROGRAMS IN SOYBEANS WITH NEW TECHNOLOGIES**

**Objective:** Comparison of Herbicide-Resistant Soybeans for No-Till Weed, specifically, evaluate the weed control effectiveness of genetically-altered soybeans, utilizing Roundup Ready, sulfonylurea tolerant (STS), and glufosinate-resistant (Liberty Link) soybeans.

#### **JUSTIFICATION AND PROGRESS TO DATE:**

Soybean producers are faced with the difficulty of maximizing weed control. 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. The weed science program at the University of Delaware has developed a proposal to examine new technology and evaluate cost effective strategies to address current and developing weed problems.

Since Liberty-Link soybeans are new, many questions still remain on where they have the best fit in Delaware production systems. How they compare to glyphosate for management of herbicide-resistant biotypes and species that are becoming more problematic in current management schemes. There have been no reports of a comparison amongst the various herbicide resistant soybeans, to determine where each one will have the greatest impact in Delaware.

The objective of this research was to compare four approaches to weed management with four herbicide-resistant crops program. Treatments were also designed to include PPO-inhibiting herbicides (Group 14) into the program to help resistance management.

Two locations were used for this project, UD Research and Education Center near Georgetown, DE and UD Demonstration Site near Middletown, DE. Georgetown location was planted on May 13, 2010 and Middletown was planted on May 26, 2010. All the treatments were identical at the two locations. 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 early-POST [ 28 days after planting], preemergence followed by late-POST [42 DAP], reduced rate of preemergence followed by early-POST). In addition, preemergence treatment followed by a higher rate of Ignited 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 6 to 10 feet wide and 25 feet long. The entire area at UD-REC was irrigated within 3 days of herbicide application to ensure soil activation.

The treatments examined were:

	Conventional		Liberty Link		STS		Roundup Ready	
	Herbicides	Rate	Herbcd	Rate	Herbicides	Rate	Herbicide	Rates
No PRE, only POST	Reflex Basagran NIS	1 pt 1.5 pt 0.25%	Ignite AMS	29 oz 2 lbs	Synchrony STS COC	0.75 oz 1qt	Glyphosate	32 oz
PRE fb EPOST	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 EPOST	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 <sup>a</sup>	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

<sup>a</sup>For 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 at UD-REC. Weed pressure was very light and inconsistent at the Middletown site. As a result, variability of data was greater. Yield was not recorded at Middletown.

#### UD-REC site:

Valor XLT treated soybeans showed about 10% stunting when rated at 21 days after planting (DAP) (Table 1). But no stunting was observed at 28 DAP. Weed control at 21 DAP, which reflects only preemergence herbicides showed no effect of herbicide rate for

the PRE treatments. All treatments provided excellent control (>96%) of pigweed, common lambsquarters, and large crabgrass (data not presented). Common ragweed was excellent for all treatments except Dual+Prowl+Sencor. Control of morningglory was variable.

At 42 DAP, residual control was best for common ragweed and pigweed with Valor XLT (100%) and Prefix (>92%) (Table 2). Control of common lambsquarters, morningglory, and large crabgrass was variable at this point

Postemergence treatments. At 42 DAP, the treatment of Reflex plus Basagran had leaf burn from the EPOST treatments, but the soybeans grew out of this injury quickly (Table 3).

Common lambsquarters control was excellent for all treatments except the total POST approach with conventional soybeans, which relied on Reflex plus Basagran. Reflex plus Basagran only provided 75% control.

In general, weed control of common ragweed was excellent (mean of 96%) for all programs with a residual control, while the total POST approach averaged only 70%. Total POST with Roundup Ready was excellent (98%).

Morningglory control, in general, was better with a PRE application followed by a POST application, than total POST. Control dropped significantly at LPOST timing for the conventional programs compared to the other programs. Weeds were larger at time of the LPSOT application and resulted in poorer control with the conventional program.

Yields were higher with the SS LL499N (Liberty Link and conventional programs) than SS RT4996N-STS (Roundup Ready and STS programs). This was due to the inherent yield potential of the hybrids rather than treatment effects.

Middletown site: Weed pressure was very light at this site which resulted in variable results. At 29 DAP, soybean stunting with Valor XLT was observed (Table 2). Morningglory was best with the full-rate of Valor XLT (85%) compared to the reduced rate (73%). Other treatments were poor (<67%). Fall panicum control was best with full rates of Dual+Prowl+Sencor (82%) and Valor XLT (100%).

Postemergence control of morningglory was excellent (>95%) for all approaches with soil-applied herbicides and only 60% control of total POST approach. Conventional herbicide program averaged 68% control of morningglory, while the other programs averaged 85 to 88% control. Fall panicum control was excellent for all programs (>95%) except conventional which averaged 82%.

Preliminary data from this trial demonstrate the benefits of residual herbicides for weed control, regardless of the use of herbicide-resistant soybeans or conventional soybeans. This is particularly noticeable with a species like morningglory that consistently are difficult for postemergence control. Further research is needed to document the

consistency of these results.

Table 1. Effect of soil-applied herbicides at 28 and 42 DAP, prior to postemergence applications. Data from UD-REC, Georgetown

Treatment Name	Rate	Unit	Soybean	Common Ragweed	Mornglry Species	Pigweed Species	Common Ragweed	Common Lambqtrs	Mornglry Species	Large Crabgrass
			Injury %	Control %						
			6/3/2010 21 DAP	6/10/2010 28 DAP	6/10/2010 28 DAP	6/25/2010 42 DAP				
Conventional Soys										
Dual Magnum	1.3	pt/A	0 b	73 bc	58 a	82 c	60 b	87 a	58 a	77 a
Prowl	1.75	pt/A								
Sencor	3	oz wt/A								
Roundup Ready Soys										
Valor XLT Premix	3	oz wt/A	14 a	99 a	86 a	100 a	100 a	100 a	80 a	92 a
Liberty-Link Soys										
Prefix Premix	2	pt/A	0 b	99 a	57 a	94 ab	92 a	97 a	63 a	91 a
Conventional Soys Reduced Rates PRE										
Dual Magnum	0.87	pt/A	0 b	65 c	40 a					
Prowl	1.2	pt/A								
Sencor	2	oz wt/A								
Roundup Ready Soys Reduced Rates PRE										
Valor XLT Premix	2	oz wt/A	11.3 a	99 a	90 a					
Liberty-Link Soys Reduced Rates PRE										
Prefix Premix	1.3	pt/A	0 b	90 ab	53 a					
LSD (P=.05)			0.78	21.46	34.99	9.57	22.02	17.14	34.77	33.78
Standard Deviation			0.44	11.8	19.23	4.56	10.49	8.16	16.56	16.09
CV			26.96	13.49	30.02	4.94	12.22	8.59	25.12	18.33
Treatment Prob(F)			0.0001	0.0167	0.0583	0.0169	0.0156	0.3043	0.3786	0.5736

Table 2. Effect of soil-applied herbicides at 28 and 42 DAP, prior to postemergence applications.  
Data from Middletown.

Treatment Name	Rate	Unit	Soybean	Mornglry	Fall	Mornglry	Fall
			Injury %	Species Control %	Panicum Control %	Species Control %	Panicum Control %
			6/24/2010 29 DAP	6/24/2010 29 DAP	6/24/2010 29 DAP	7/8/2010 43 DAP	7/8/2010 43 DAP
Conventional Soys							
Dual Magnum	1.3	pt/A	0 c	67 bc	82 ab	67	73
Prowl	1.75	pt/A					
Sencor	3	oz wt/A					
Roundup Ready Soys							
Valor XLT Premix	3	oz wt/A	19 a	85 a	100 a	63	73
Liberty-Link Soys							
Prefix Premix	2	pt/A	0 c	57 c	68 b	63	80
Conventional Soys Reduced Rates PRE							
Dual Magnum	0.87	pt/A	0 c	57 c	65 b		
Prowl	1.2	pt/A					
Sencor	2	oz wt/A					
Roundup Ready Soys Reduced Rates PRE							
Valor XLT Premix	2	oz wt/A	12 b	73 ab	68 b		
Liberty-Link Soys Reduced Rates PRE							
Prefix Premix	1.3	pt/A	0 c	57 c	63 b		
LSD (P=.05)			2.4	11.86	18.47	17.86	20.63
Standard Deviation			1.3	6.52	10.15	9.49	10.95
CV			24.9	9.9	13.64	14.67	14.17
Treatment Prob(F)			0.0001	0.0014	0.0092	0.9751	0.8482

Table 3. Effect weed control approaches and HR-crops on weed control.

Data from UD-REC.

Treatment Name	Soybean Injury % 6/17/2010	Common Ragweed Control % 7/15/2010	Common Lambqtrs Control % 7/15/2010	Mornglry Species Control % 7/15/2010	Large Crabgras Control % 7/15/2010	Soybean Yield Bu/A 11/3/2010
Total POST (28 DAP) Conventional Soys	15.7 a	63 b	75 b	63 d	43 b	54.2
Total POST (28 DAP) Roundup Ready Soys	0 c	98 a	98 a	70 bcd	98 a	51.4
Total POST (28 DAP) Liberty-Link Soys	1.7 c	63 b	91 a	65 cd	94 a	54
Total POST (28 DAP) STS Soys	3.3 bc	57 b	93 a	75 bcd	50 b	38
PRE fb POST (28 DAP) Conventional Soys	16.3 a	98 a	98 a	63 d	98 a	54.4
PRE fb POST (28 DAP) Roundup Ready Soys	0 c	98 a	98 a	82 abc	98 a	54.8
PRE fb POST (28 DAP) Liberty-Link Soys	1.7 c	92 ab	98 a	63 d	98 a	56.2
PRE fb POST (28 DAP) STS Soys	1.7 c	97 ab	97 a	77 bcd	97 a	44.1
PRE fb LPOST (42 DAP) Conventional Soys		90 b	90 a	45 e	95 a	52.2
PRE fb LPOST (42 DAP) Roundup Ready Soys		98 a	98 a	95.3 a	98 a	30.3
PRE fb LPOST (42 DAP) Liberty-Link Soys		98 a	98 a	79 a-d	98 a	59.5
PRE fb LPOST (42 DAP) STS Soys		98 a	98 a	84 ab	92 a	44.5
Reduced PRE fb POST (28 DAP) Conventional Soys	14.7 a	98 a	98 a	63 d	95 a	53.6

Treatment Name	Soybean Injury % 6/17/2010	Common Ragweed Control % 7/15/2010	Common Lambqtrs Control % 7/15/2010	Mornglry Species Control % 7/15/2010	Large Crabgras Control % 7/15/2010	Soybean Yield Bu/A 11/3/2010
Reduced PRE fb POST (28 DAP) Roundup Ready Soys	0 c	90 b	97 a	85 ab	97 a	45.7
Reduced PRE fb POST (28 DAP) Liberty-Link Soys	5.7 b	98 a	98 a	65 cd	98 a	52.6
Reduced PRE fb POST (28 DAP) STS Soys	1 c	98 a	98 a	96 a	98 a	45.5
Late Application of Ignite Liberty Link Soys		95 ab	98 a	63 d	98 a	56.1
Untreated Check (Liberty Link Soys)						46.3
LSD (P=.05)	3.37	8.21	8.7	17.35	10.52	16.07
Standard Deviation	1.99	4.93	5.22	10.41	6.31	9.64
CV	38.68	5.48	5.47	14.33	6.94	19.34
Treatment Prob(F)	0.0001	0.0001	0.0006	0.0001	0.0001	0.0743

Table 4. Effect weed control approaches and HR-crops on weed control.  
Data from Middletown.

	Morning Species Control % 8/5/2010	Fall Panicum Control % 8/5/2010
Total POST (28 DAP) Conventional Soys	50 f	53 a
Total POST (28 DAP) Roundup Ready Soys	62 def	100 a
Total POST (28 DAP) Liberty-Link Soys	63 c-f	90 a
Total POST (28 DAP) STS Soys	67 b-f	100 a
PRE fb POST (28 DAP) Conventional Soys	88 a-d	83 a
PRE fb POST (28 DAP) Roundup Ready Soys	100 a	100 a
PRE fb POST (28 DAP) Liberty-Link Soys	95 ab	95 a
PRE fb POST (28 DAP) STS Soys	88 a-d	100 a
PRE fb LPOST (42 DAP) Conventional Soys	57 ef	100 a
PRE fb LPOST (42 DAP) Roundup Ready Soys	100 a	100 a
PRE fb LPOST (42 DAP) Liberty-Link Soys	92 abc	100 a
PRE fb LPOST (42 DAP) STS Soys	100 a	100 a
Reduced PRE fb POST (28 DAP) Conventional Soys	77 a-f	92 a

	Morning Species Control % 8/5/2010	Fall Panicum Control % 8/5/2010
Reduced PRE fb POST (28 DAP) Roundup Ready Soys	92 abc	100 a
Reduced PRE fb POST (28 DAP) Liberty-Link Soys	92 abc	93 a
Reduced PRE fb POST (28 DAP) STS Soys	85 a-e	100 a
Late Application of Ignite Liberty Link Soys	93 abc	100 a
LSD (P=.05)	29.28	24.46
Standard Deviation	17.56	14.67
CV	21.32	15.53
Treatment Prob(F)	0.01	0.06