

## Report to the Delaware Soybean Board

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### **RE-THINKING NO-TILL WEED CONTROL FOR SOYBEANS**

#### **JUSTIFICATION AND PROCEDURES:**

Soybean producers are faced with the difficulty of maximizing weed control in light of herbicide-resistance issues. In addition, weed control in soybeans is very challenging due to the diversity of weed species, the size of the plants at time of application and the environment under which they are often treated. Growers are trying to use one herbicide application to control all the existing vegetation prior to planting and maintain the fields weed-free during the early stage of soybean growth. On the other hand, most of our no-till corn fields are receiving two herbicides application prior to planting and then often need a postemergence application. Furthermore, corn is often receiving a wider range of herbicide modes of action than the soybean crop which improves resistance management. This proposal is designed to adapt some of the approaches used successfully for no-till corn and implement them for soybeans. For instance, using two applications prior to soybean emergence; one uses glyphosate as the base herbicide and the second relying on paraquat. The timing of these two applications are being evaluated.

In addition, as soybean growers incorporate more cover crops into their cropping systems, it often adds an additional challenge to manage the vegetation. With cereal rye as a cover crop, we will examine different approaches for controlling winter annual as well as early-season weeds in soybeans.

The **research objectives** were to evaluate various approaches for burndown in no-till soybeans. Also, to evaluate approaches for management of rye cover crops and winter annual weeds.

### **Comparison of various approaches for no-till burndown.**

This study is comparing various approaches for burndown weed control for no-tillage soybeans. One single spring application timing is being compared to multiple application timings for overall weed control. These include applications in the fall (December 2, 2013), early spring (4 weeks prior to planting [May 2, 2014]), late spring (10 days prior to planting [May 20]), or at planting (May 29). Fall timings included residual herbicides. Canopy EX and Valor were used representing 1) herbicides that provide the broadest spectrum of control but limits rotations to only soybeans (Canopy EX) and 2) a herbicide that allows for rotation to both corn and soybeans (Valor).

Herbicides selected for treatments represent products that have performed consistently well in our screening program, but other residual products could be substituted based on grower preference. This trial was not designed to test all potential herbicides, rather to evaluate different approaches for control. The entire site received an application of glyphosate plus Reflex at 5 weeks after planting (July 9).

The amount of winter annual weeds present early in spring (May 14) was determined by percentage of soil surface covered by weeds, without separating by individual weed species (Table 1). Ground cover was highest for no fall herbicide application, covering 73% of the soil surface. If plots were treated in the fall with glyphosate plus 2,4-D, ground cover averaged 29%. Using residual herbicide in the fall, either Canopy EX or Valor, ground cover averaged 3%. Mouseear chickweed control at soybean planting was inadequate if no spring glyphosate was applied or Canopy EX was used in the fall. Valor did provide excellent control of mouseear chickweed. Knawel control was better if Canopy EX was used in the fall compared to Valor. Field pansy control was best if either Canopy EX or Valor was used in the fall, or glyphosate plus 2,4-D used in the fall followed by glyphosate plus 2,4-D applied four weeks prior to planting. Horseweed control was good for all treatments except, glyphosate plus 2,4-D in the fall with no spring treatment. Even with two spring burndown applications, glyphosate plus 2,4-D followed by paraquat plus Canopy provided only 53% control of field pansy. There was no situation where one herbicide application provided good to excellent control of all species present.

At four weeks after planting, Palmer amaranth control was consistently better if Gramoxone plus Canopy was applied at planting compared to 10 days or 4 weeks prior to planting (Table 2). Glyphosate plus Canopy at 10 days pre-plant generally provided better Palmer amaranth control than 4 weeks prior to planting, but it was not very consistent. Large crabgrass control was better if herbicides were applied either 10 days pre-plant or preemergence.

Plots with poor control of winter annuals resulted in poor early-season soybean growth. Also the presence of winter annual weeds resulted in poor growth of summer annual weeds such as Palmer amaranth and large crabgrass. While fall herbicide applications

with either Canopy EX or Valor provided good control of some winter annual species, they did not provide control of summer annual weeds. If fall herbicide applications were not followed by a spring burndown, soybean yields were reduced.

One herbicide application before soybean planting was not adequate to control both the winter annuals as well as the summer annual weeds in this trial. Timing of herbicide application is critical to provide effective weed control.

**Cereal rye cover crop for weed control.** This trial examined the benefit of fall herbicide applications when a cereal rye cover crop is used. Rye was drilled at 2 bu/A in the fall of 2013. Treatments included various herbicides applied either in the fall on December 2 or in the spring (May 20) and soybeans were planted on May 29. The fall herbicides were selected to control winter annual weeds, but not cause injury to the rye. In addition, half the plots received 40 lbs of N on March 11 in order to achieve two levels of rye biomass. On May 9, plots treated with herbicides in the fall were sprayed with only glyphosate to kill the rye. Other plots received a tankmixture of glyphosate plus Envive (3 oz wt/A). Soybeans were planted in 15 inch rows on May 29, 2014. The entire trial was sprayed with Roundup plus Reflex on July 9.

Weed density was quite low in the study area and resulted in some variable results as observed in the CV values. But at five weeks after spring herbicide applications Palmer amaranth control was generally higher in plots receiving spring nitrogen applications (Table 3). Plots treated with Envive average over 92% control. Similar trends were observed with morningglory control and large crabgrass. There were no differences in soybean yield, which is another indication that weed pressure was low in this trial.

A rye cover crop can help suppress annual weeds. But a rye cover crop may not eliminate the need for a preemergence herbicide if species such as Palmer amaranth or morningglory species are present.

Table 1. Evaluation of winter annual weeds with various approaches for burndown and preemergence weed control in soybeans.

Trt no.	Fall applications	Spring applications	Winter	Mouseear	Knawel	Field	Horse-
			weeds	Chickwd		Pansy	weed
			GrndCovr	Control	Control	Control	Control
			%	%	%	%	%
			5/14/2014	5/29/2014	5/29/2014	5/29/2014	6/30/2014
1	None	None	73 a	0 d	0 c	0 f	23 c
2	None	Early: glyphosate + 2,4-D** + Canopy		100 a	99 a	75 bcd	100 a
3	None	Late: glyphosate + 2,4-D* + Canopy	73 a	97 a	93 a	70 cde	100 a
4	None	Double knock#		97 a	91 a	53 e	100 a
5	glyphosate + 2,4-D	None	27 b	50 c	13 c	57 de	73 b
6	glyphosate + 2,4-D	Early: glyphosate + 2,4-D** + Canopy		100 a	100 a	100 a	96 a
7	glyphosate + 2,4-D	Late: glyphosate + 2,4-D* + Canopy	30 b	92 a	92 a	81 abc	100 a
8	glyphosate + 2,4-D	Double knock#		100 a	100 a	100 a	100 a
9	glyphosate + 2,4-D + Canopy EX	None	3 c	77 b	92 a	83 abc	87 ab
10	glyphosate + 2,4-D + Canopy EX	Early: glyphosate + 2,4-D** + Canopy		100 a	100 a	100 a	100 a
11	glyphosate + 2,4-D + Canopy EX	Late: glyphosate + 2,4-D* + Canopy	1 c	98 a	98 a	99 a	100 a
12	glyphosate + 2,4-D + Canopy EX	Double knock#		100 a	100 a	97 a	100 a
13	glyphosate + 2,4-D + Valor	None	4 c	100 a	68 b	93 ab	100 a
14	glyphosate + 2,4-D + Valor	Early: glyphosate + 2,4-D** + Canopy		100 a	100 a	100 a	100 a
15	glyphosate + 2,4-D + Valor	Late: glyphosate + 2,4-D* + Canopy	4 c	100 a	97 a	97 a	100 a
16	glyphosate + 2,4-D + Valor	Double knock#		100 a	100 a	100 a	100 a
LSD (P=.05)			14.87	12.37	14.15	20.35	13.8
Standard Deviation			8.49	7.42	8.48	12.21	8.28
CV			31.45	8.42	10.11	14.97	8.95
Treatment Prob(F)			0.0001	0.0001	0.0001	0.0001	0.0001

Means followed by same letter do not significantly differ (P=.05, LSD)

Early= glyphosate + 1 qt 2,4-D plus Canopy 4 wks prior to planting

Late= glyphosate + 1 pt 2,4-D plus Canopy 10 days prior to planting

Double knock is glyphosate plus 2,4-D applied 4 wks prior to planting followed by Gramoxone plus Canopy at planting

Table 2. Evaluation of summer annual weeds and soybean yield with various approaches for burndown and preemergence weed control in soybeans.

Trt no.	Fall applications	Spring applications	Palmer	Large	Yield
			Amaranth Control %	Crabgrass Control %	Bu/A
			30-Jun	30-Jun	21-Oct
1	None	None	--	--	44 cd
2	None	Early: glyphosate + 2,4-D** + Canopy	67 cd	67 bc	53 abc
3	None	Late: glyphosate + 2,4-D* + Canopy	100 a	76 abc	58 ab
4	None	Double knock#	100 a	96 a	51 bcd
5	glyphosate + 2,4-D	None	--	--	29 e
6	glyphosate + 2,4-D	Early: glyphosate + 2,4-D** + Canopy	70 cd	78 abc	53 abc
7	glyphosate + 2,4-D	Late: glyphosate + 2,4-D* + Canopy	95 a	96 a	59 ab
8	glyphosate + 2,4-D	Double knock#	99 a	99 a	60 ab
9	glyphosate + 2,4-D + Canopy EX	None	0 e	0 d	39 de
10	glyphosate + 2,4-D + Canopy EX	Early: glyphosate + 2,4-D** + Canopy	55 d	57 c	52 abc
11	glyphosate + 2,4-D + Canopy EX	Late: glyphosate + 2,4-D* + Canopy	70 cd	86 ab	58 ab
12	glyphosate + 2,4-D + Canopy EX	Double knock#	92 ab	92 ab	53 abc
13	glyphosate + 2,4-D + Valor	None	0 e	0 d	49 bcd
14	glyphosate + 2,4-D + Valor	Early: glyphosate + 2,4-D** + Canopy	73 bcd	59 c	61 ab
15	glyphosate + 2,4-D + Valor	Late: glyphosate + 2,4-D* + Canopy	75 bc	98 a	63 a
16	glyphosate + 2,4-D + Valor	Double knock#	98 a	80 abc	55 abc
LSD (P=.05)			18.88	25.91	12.37
Standard Deviation			11.15	15.37	7.42
CV			15.72	20.3	14.17
Treatment Prob(F)			0.0001	0.0001	0.0004

Means followed by same letter do not significantly differ (P=.05, LSD)

Early= glyphosate + 1 qt 2,4-D plus Canopy 4 wks prior to planting

Late= glyphosate + 1 pt 2,4-D plus Canopy 10 days prior to planting

Double knock is glyphosate plus 2,4-D applied 4 wks prior to planting followed by Gramoxone plus Canopy at planting

Table 3. Management of rye cover crop for weed management in full-season no-till soybean.

Trt. No.	Fall treatment	Spring treatment	Spring Nitrogen	Palmer	Mornglry	Annual	Soybean	Soybean
				Control % June 30	Species Control % June 30	grasses Control % June 30	AvgHght Inches July 18	Yield Bu/A Nov 21
1	No Fall	glyphosate	None	27 c	27 c	47 d	15	65
2	glyphosate	glyphosate	50 lb/A	57 b	43 c	75 c	17	66
4	Harmony Extra	glyphosate	50 lb/A	40 bc	97 a	80 bc	16	67
7	Harm. Extra + 2,4-D (8 fl oz)	glyphosate	None	33 c	40 c	53 d	17	64
8	Harm. Extra + 2,4-D (8 fl oz)	glyphosate	50 lb/A	53 b	76 b	83 abc	17	66
9	No Fall	glyphosate + Envive (3 oz)	None	92 a	84 ab	95 ab	15	63
10	No Fall	glyphosate + Envive (3 oz)	50 lb/A	98 a	97 a	97 a	18	63
11	Harm. Extra + 2,4-D (8 fl oz)	glyphosate + Envive (3 oz)	None	86 a	97 a	88 abc	15	62
12	Harm. Extra + 2,4-D (8 fl oz)	glyphosate + Envive (3 oz)	50 lb/A	94 a	95 ab	93 ab	20	65
LSD (P=.05)				19.53	19.55	14.84	3.204	7.27
Standard Deviation				11.15	11.17	8.48	1.851	4.2
CV				17.33	15.33	10.73	11.19	6.5
Treatment Prob(F)				0.0001	0.0001	0.0001	0.0847	0.8175

All glyphosate= Roundup WeatherMax at 32 fl oz/A

All Harm. Extra= Harmony Extra at 0.6 oz wt/A