

## Report to the Delaware Soybean Board for 2015 Funding

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### **PALMER AMARANTH WEED MANAGEMENT FOR NO-TILL AND DOUBLE-CROPPED SOYBEANS**

The **research objectives** are to evaluate the effectiveness of various approaches for Palmer amaranth control.

Specific objectives are:

- Evaluate various herbicide options for control of Palmer amaranth in double-cropped soybeans;
- Examine timing of burndown application for full-season soybeans; and
- Evaluate the management of cereal rye cover crop for Palmer amaranth control; and
- Evaluate the usefulness of residual herbicides when applied as a tankmixed partner for POST application (completed in 2015)

These projects are designed to address weed control in terms of effectiveness, adaptability to Delaware's specific needs, as well as resistance management. Most of these projects will be repeated in 2016 to determine the consistency and reliability of the results.

### **ONGOING PROJECTS:**

The first objective is examining control of Palmer amaranth in double cropped soybeans. In many situations, Palmer amaranth will have emerged prior to planting soybeans and it will need to be controlled; as well as control plants that emerge after planting. Two studies examining control with burndown treatments, with treatments made one week after wheat harvest planting (July 7). The studies did not have the same treatments; one study focused on control of Palmer amaranth and the second had a much broader range of weed species (Tables 1 and 2). Data in Table 1 shows all treatments that contained Gramoxone as well as Tricor+Valor provided the highest level of control, at both 7 and 14 days after treatment (DAT). However, large crabgrass control was best with treatments including Liberty or glyphosate. In addition, it appears Gramoxone plus metribuzin also provided a high level of crabgrass control and these were the treatments that worked well for both species. Treatments in Table 2 were very similar to the 2014 trial, but all the treatments were not repeated. Multiple weed species were rated at 10 and 16 DAT, although only 10 DAT are presented in Table 2.

Horseweed control was excellent for all treatments including Liberty or Sharpen. Palmer amaranth control was >97% with Tricor+Valor, as well as most of the treatments containing glyphosate since most of the plants at the experimental site were glyphosate-resistant. Large crabgrass control was the highest with all treatments containing glyphosate as well as Gramoxone plus Tricor+Valor. Common lambsquarters control was good to excellent with most treatments, except for Liberty alone or Liberty plus glyphosate or Canopy plus glyphosate.

Table 1. Control of Palmer amaranth and large crabgrass with burndown treatments prior to planting soybeans (applied after wheat harvest).

				AMAPA Palmer amaranth 7/14/2015 7 DAT	DIGSA Large crabgrass 7/14/2015 7 DAT	AMAPA Palmer amaranth 7/21/2015 14 DAT	DIGSA Large crabgrass 7/21/2015 14 DAT
Trt No.	Herbicides	Rate Unit	Timing	% control	% control	% control	% control
1	Untreated Check			0	0	0	0
2	Canopy Premix	4 oz wt/A	Pre-Plant	99.7 a	86 b	100 a	90 ab
	----metribuzin						
	----chlorimuron						
	Gramoxone SL....paraquat	3 pt/A	Pre-Plant				
	Crop Oil Concentrate	1 qt/A	Pre-Plant				
	30% Urea Ammonium Nitrate	8 qt/100 gal	Pre-Plant				
3	Valor XLT Premix	3.6 oz wt/A	Pre-Plant	99 a	68.3 d	100 a	63.3 c
	---flumioxazin						
	----chlorimuron						
	Gramoxone SL....paraquat	3 pt/A	Pre-Plant				
	Crop Oil Concentrate	1 qt/A	Pre-Plant				
	30% Urea Ammonium Nitrate	8 qt/100 gal	Pre-Plant				
4	Authority XL Premix	4.8 oz wt/A	Pre-Plant	100 a	71.7 cd	100 a	56.7 c
	---sulfentrazone						
	----chlorimuron						
	Gramoxone SL....paraquat	3 pt/A	Pre-Plant				
	Crop Oil Concentrate	1 qt/A	Pre-Plant				
	30% Urea Ammonium Nitrate	8 qt/100 gal	Pre-Plant				
5	Liberty 280....glufosinate	36 fl oz/A	Pre-Plant	82.5 d	95.9 a	79.9 b	99.6 a
	Roundup PowerMax..glyphosate	32 fl oz/A	Pre-Plant				
	Dry Ammonium Sulfate	10 lb/100 gal	Pre-Plant				
6	Callisto.....mesotrione	5.3 fl oz/A	Pre-Plant	98 ab	78.3 bc	100 a	84.3 b
	Gramoxone SL....paraquat	3 pt/A	Pre-Plant				
	Crop Oil Concentrate	1 qt/100 gal	Pre-Plant				
	30% Urea Ammonium Nitrate	8 qt/100 gal	Pre-Plant				
7	Canopy Premix	4 oz wt/A	Pre-Plant	91 bc	96.3 a	96 a	97 a
	----metribuzin						
	----chlorimuron						
	Liberty 280....glufosinate	36 fl oz/A	Pre-Plant				
	Crop Oil Concentrate	1 qt/A	Pre-Plant				
	Dry Ammonium Sulfate	10 lb/100 gal	Pre-Plant				
8	Canopy Premix	4 oz wt/A	Pre-Plant	90 cd	97 a	91.7 a	99 a
	----metribuzin						
	----chlorimuron						
	Roundup PowerMax..glyphosate	32 fl oz/A	Pre-Plant				
	Dry Ammonium Sulfate	10 lb/100 gal	Pre-Plant				
9	Liberty 280....glufosinate	36 fl oz/A	Pre-Plant	96 abc	80 b	81.7 b	93.3 ab
	Dry Ammonium Sulfate	10 lb/100 gal	Pre-Plant				
10	Tricor DF.....metribuzin	4 oz wt/A	Pre-Plant	99 a	98.7 a	100 a	99 a
	Valor SX.....flumioxazin	2.95 oz wt/A	Pre-Plant				
	Gramoxone SL....paraquat	3 pt/A	Pre-Plant				
	Crop Oil Concentrate	1 qt/A	Pre-Plant				
	30% Urea Ammonium Nitrate	8 qt/100 gal	Pre-Plant				
11	Tricor DF.....metribuzin	4 oz wt/A	Pre-Plant	100 a	36.7 e	100 a	43.3 d
	Valor SX.....flumioxazin	2.95 oz wt/A	Pre-Plant				
	Crop Oil Concentrate	1 qt/A	Pre-Plant				
	30% Urea Ammonium Nitrate	8 qt/100 gal	Pre-Plant				
LSD P=.05				7.85	7.7	9.89	10.71
Standard Deviation				4.56	4.47	5.74	6.22
CV				4.77	5.53	6.05	7.53
Treatment Prob(F)				0.0001	0.0001	0.0001	0.0001

Data in same column, followed by the same letter are not significantly different from one another

Table 2. Broad spectrum weed control with burndown treatments prior to planting soybeans (applied after wheat harvest).

Trt No.	Herbicides	Rate	Unit	Timing	ERICA	AMAPA	CHEAL	GGAN
					Horseweed	Palmer amaranth	Common lambsquarter	Annual grasses
					7/16/2015	7/16/2015	7/16/2015	7/16/2015
					10 DAT	10 DAT	10 DAT	10 DAT
					% control	% control	% control	% control
1	Untreated Check				0	0	0	0
2	Liberty 280.....glufosinate	36 fl oz/A		Pre-Plant	100 a	91.7 a	72.7 d	56 b
	Dry Ammonium Sulfate	10 lb/100 gal		Pre-Plant				
3	Tricor DF.....metribuzin	4 oz wt/A		Pre-Plant	100 a	100 a	94 ab	53.3 b
	Valor SX.....flumioxazin	2 oz wt/A		Pre-Plant				
	Crop Oil Concentrate	1 qt/A		Pre-Plant				
	Dry Ammonium Sulfate	10 lb/100 gal		Pre-Plant				
4	Roundup PowerMax..glyphosate	32 fl oz/A		Pre-Plant	50 c	88.3 a	95.3 a	95.7 a
	Dry Ammonium Sulfate	10 lb/100 gal		Pre-Plant				
5	Roundup PowerMax..glyphosate	42.7 fl oz/A		Pre-Plant	60 bc	96 a	93 abc	96.3 a
	Dry Ammonium Sulfate	10 lb/100 gal		Pre-Plant				
6	Canopy Premix	4 oz wt/A		Pre-Plant	65 bc	96.7 a	79.3 d	93 a
	----metribuzin							
	----chlorimuron							
	Roundup PowerMax..glyphosate	32 fl oz/A		Pre-Plant				
	Dry Ammonium Sulfate	10 lb/100 gal		Pre-Plant				
7	Liberty 280.....glufosinate	36 fl oz/A		Pre-Plant	100 a	97.3 a	83 bcd	93 a
	Roundup PowerMax..glyphosate	32 fl oz/A		Pre-Plant				
	Dry Ammonium Sulfate	10 lb/100 gal		Pre-Plant				
8	Liberty 280.....glufosinate	36 fl oz/A		Pre-Plant	100 a	99 a	82.3 cd	88.7 a
	Roundup PowerMax..glyphosate	32 fl oz/A		Pre-Plant				
	Dry Ammonium Sulfate	10 lb/100 gal		Pre-Plant				
	Methylated Seed Oil	1.5 pt/A		Pre-Plant				
9	Anthem Premix	6 fl oz/A		Pre-Plant	55 bc	95.7 a	93.3 abc	98.3 a
	----pyroxasulfone							
	----fluthiacet							
	Roundup PowerMax..glyphosate	32 fl oz/A		Pre-Plant				
	Dry Ammonium Sulfate	10 lb/100 gal		Pre-Plant				
	Crop Oil Concentrate	1 qt/A		Pre-Plant				
10	Anthem Premix	6 fl oz/A		Pre-Plant	66.5 b	99.7 a	96 a	97.7 a
	----pyroxasulfone							
	----fluthiacet							
	Aim.....carfentrazone	1.5 fl oz/A		Pre-Plant				
	Roundup PowerMax..glyphosate	32 fl oz/A		Pre-Plant				
	Dry Ammonium Sulfate	10 lb/100 gal		Pre-Plant				
	Crop Oil Concentrate	1 qt/A		Pre-Plant				
11	Roundup PowerMax..glyphosate	32 fl oz/A		Pre-Plant	100 a	99.7 a	92.3 abc	97.7 a
	Sharpen.....saflufenacil	1 fl oz/A		Pre-Plant				
	Dry Ammonium Sulfate	10 lb/100 gal		Pre-Plant				
	Methylated Seed Oil	1.5 pt/A		Pre-Plant				
12	Tricor DF.....metribuzin	4 oz wt/A		Pre-Plant	100 a	100 a	95.7 a	98 a
	Valor SX.....flumioxazin	2 oz wt/A		Pre-Plant				
	Gramoxone SL....paraquat	3 pt/A		Pre-Plant				
	Crop Oil Concentrate	1 qt/A		Pre-Plant				
	Dry Ammonium Sulfate	10 lb/100 gal		Pre-Plant				
LSD P=.05					16.01	11.56	11.19	14.01
Standard Deviation					6.54	6.79	6.57	8.23
CV					8.03	7.02	7.4	9.35
Treatment Prob(F)					0.0006	0.5314	0.0021	0.0001

Data in same column, followed by the same letter are not significantly different from one another

In a companion trial looking at postemergence control in double-cropped soybeans (objective 2), soybeans were planted July 14, about one week after a burndown

application of glyphosate plus Liberty (Table 3). Treatments were identical to those used in 2014. The Palmer amaranth at this site were susceptible to glyphosate as a result only Blazer or Storm did not provide as good of control as the treatments containing glyphosate. As in 2014, treatments with Synchrony were not as effective as Raptor for controlling Palmer amaranth.

Table 3. Postemergence weed control in double-cropped soybeans. All treatments were applied 3 weeks after planting.

Trt No.	Herbicides	Rate Unit	Timing*	AMAPA	IPOSS	AMAPA	IPOSS	GLXMA Soybean 11/23/2015 Yield Bu/A
				Palmer amaranth 8/6/2015 7 DAT	Mornigglory species 8/6/2015 7 DAT	Palmer amaranth 8/17/2015 18 DAT	Mornigglory species 8/17/2015 18 DAT	
1	Untreated Check			0	0	0	0	28.8 a
2	Roundup PowerMax...glyphosate Dry Ammonium Sulfate	32 fl oz/A 10 lb/100 gal	POST POST	100 a	89 b	99.3 a	98 a	40.7 a
3	Liberty 280.....glufosinate Dry Ammonium Sulfate	29 fl oz/A 10 lb/100 gal	POST POST	96.3 a	99 a	93.3 a	92.3 c	--
4	Liberty 280.....glufosinate Dry Ammonium Sulfate	36 fl oz/A 10 lb/100 gal	POST POST	98.7 a	99 a	93.7 a	96.3 ab	--
5	Ultra Blazer....acifluorfen Nonionic Surfactant	1.5 pt/A 1 qt/100 gal	POST POST	62 c	88.3 b	81.3 a	95.3 ab	36.6 a
6	Storm Premix ----bentazon ----acifluorfen Nonionic Surfactant	1.5 pt/A  1 qt/100 gal	POST  POST	68.3 bc	83.3 c	86.7 a	97.7 a	32.3 a
7	Raptor.....imazamox Crop Oil Concentrate 30% Urea Ammonium Nitrate	5 fl oz/A 1 qt/A 2.5 gal/100 gal	POST POST POST	76.7 b	53.3 e	100 a	94.7 bc	32.3 a
8	Synchrony XP Premix ----chlorimuron ----thifensulfuron Crop Oil Concentrate 30% Urea Ammonium Nitrate	0.75 oz wt/A  1 qt/A 2.5 gal/100 gal	POST  POST POST	65 c	71.7 d	89 a	96 ab	31.8 a
LSD P=.05				10.69	4.93	12.21	2.76	7.53
Standard Deviation				5.95	2.77	6.79	1.55	4.14
CV				7.35	3.32	7.39	1.62	12.26
Treatment Prob(F)				0.0001	0.0001	0.0566	0.012	0.0619

\*Timing was 28 days after planting (DAP) in 2014; 21 DAP in 2015

Data in same column, followed by the same letter are not significantly different from one another

The second objective is comparing various approaches for burndown weed control for no-tillage soybeans (Table 4). One single spring application timing is being compared to multiple application timings for overall weed control. These include applications in the fall (December 15, 2014), early spring (4 weeks before planting [April 13]), late spring (10 days before planting [April 24]), or at planting (May 7). 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 (June 25).

Most treatments provided excellent control of the winter annuals weeds present before soybean planting (Table 4). The herbicides applied in the fall, with no spring

application, were not as effective due to weeds emerging either late fall in the spring prior to soybean planting. The addition of Canopy EX provided a higher level of overall control than Valor. At four weeks after planting, Palmer amaranth control was best with the burndown and residual herbicide applied no earlier than 10 days before planting; with the exception of Valor used in the fall, and Canopy used 20 days before planting. Morningglory control was inconsistent with all treatments providing less than 75% control prior to the POST application. Large crabgrass control was poor prior to the POST treatment, with all treatments less than 77% control, but all treatments were 91% control or higher with the POST application of glyphosate.

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, except if the application was made 10 days before planting. Timing of herbicide application is critical to providing effective weed control.

Table 4. Comparison of various approaches for burndown and early-season weed control for full-season no-till soybeans.

		Winter annuals 6/7/2015 Control %	AMAPA Palmer amaranth 6/7/2015 Control %	IPOSS Morningglory species 6/7/2015 Control %	DIGSA Large crabgrass 6/7/2015 Control %
Fall applications	Spring applications		4 WAP	4 WAP	4 WAP
None	None	0 d			
None	Early: glyphosate + 2,4-D** + Canopy	100 a	43 bc	47 abc	37 cde
None	Late: glyphosate + 2,4-D* + Canopy	97 a	100 a	72 a	60 abc
None	Double knock <sup>#</sup>	100 a	97 a	77 a	67 abc
glyphosate + 2,4-D	None	27 c	30 c	0 d	0 e
glyphosate + 2,4-D	Early: glyphosate + 2,4-D** + Canopy	100 a	63 abc	62 ab	47 bcd
glyphosate + 2,4-D	Late: glyphosate + 2,4-D* + Canopy	100 a	90 ab	72 a	89 a
glyphosate + 2,4-D	Double knock <sup>#</sup>	100 a	100 a	68 a	68 abc
glyphosate + 2,4-D + Canopy EX	None	93 al	43 bc	27 bcd	43 cd
glyphosate + 2,4-D + Canopy EX	Early: glyphosate + 2,4-D** + Canopy	100 a	60 abc	73 a	57 abc
glyphosate + 2,4-D + Canopy EX	Late: glyphosate + 2,4-D* + Canopy	100 a	98 a	78 a	63 abc
glyphosate + 2,4-D + Canopy EX	Double knock <sup>#</sup>	100 a	97 a	81 a	78 abc
glyphosate + 2,4-D + Valor	None	85 b	67 abc	17 cd	10 de
glyphosate + 2,4-D + Valor	Early: glyphosate + 2,4-D** + Canopy	100 a	100 a	63 ab	87 ab
glyphosate + 2,4-D + Valor	Late: glyphosate + 2,4-D* + Canopy	100 a	92 ab	80 a	87 ab
glyphosate + 2,4-D + Valor	Double knock <sup>#</sup>	100 a	100 a	65 ab	87 ab
LSD P=.05		10.93	48.49	39.34	42.25
Standard Deviation		6.54	28.94	23.48	25.22
CV		7.47	36.82	40.06	43.05
Treatment Prob(F)		0.0001	0.0358	0.0032	0.0023

Early= glyphosate + 1 qt 2,4-D plus Canopy 4 weeks before planting

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

Double knock is glyphosate plus 2,4-D applied 4 weeks before planting followed by Gramoxone plus Canopy at planting

Data in same column, followed by the same letter are not significantly different from one another

The third objective is examining various methods of cereal rye management for weed control in soybeans (Table 5). This study is looking at the combination of three factors:

level of rye biomass, timing of spring burndown application, and the need for residual herbicides. Rye biomass levels were achieved by spring nitrogen applications and timing of glyphosate application. Two bushels of rye were seeded in the fall. Timing of burndown (glyphosate applications) were March 19, April 29, or May 7. Residual herbicide with this trial was Envive, which will also help with overall burndown weed control. All combinations of these treatments were examined to determine their compatibility, and which factor(s) will have the greatest impact on weed control. Similar to the previous study, not all residual herbicides can be evaluated, but Envive was selected because it provides control of many broadleaf weeds and contains two commonly used active ingredients (chlorimuron= Classic; flumioxazin= Valor). The entire trial was sprayed with a postemergence application of Roundup plus Reflex on June 25.

Rye biomass at time of soybean planting averaged about 9,000 lbs/A for the high rye treatment, regardless of timing of termination, and the treatments with no nitrogen but terminated late (10 days before planting). Previous research has demonstrated that this amount of rye will provide early-season weed control in many situations.

At 35 days after planting (at time of the POST applications), Palmer amaranth control was best when Envive was used as part of the burndown treatment, regardless of the amount of rye present, greater than 99% control. If only glyphosate was used for burndown, the high biomass rye alone provided 88% Palmer amaranth control, and the low rye biomass provided 73% control. Control was the similar regardless if the burndown was applied 10 or 20 days before planting. The Palmer amaranth at this site are still sensitive to ALS-inhibiting (Group 2) herbicides. A number of locations in Delaware are resistant to Group 2 herbicides and the Envive is likely to be less effective on these populations of Palmer amaranth.

Large crabgrass control was better with rye, regardless of the amount of biomass produced; when Envive was used as part of the burndown; and if the burndown was applied 10 before planting compared to 20 days before planting.

Although cereal rye was not as effective for controlling summer annual weeds as the herbicide Envive, the presence of the rye reduced the number and vigor of the weeds present and helped to improve the effectiveness of the POST herbicides.

Table 5. Evaluating cereal rye cover crop for influence on weed control with full-season no-till soybeans. Burndown treatments were made wither 20 days before planting (20 EPP) or 10 days before planting (10 EPP).

			AMAPA	IPOSS	GGGAN	
			Palmer	Morningglory	Annual	
			amaranth	species	grasses	Soybean
			6/25/2015	6/25/2015	6/25/2015	10/22/2015
			Control	Control	Control	Yield
			% control	% control	% control	Bu/A
No. Rye	Burndown	Timing				
1 High Rye Biomass	Glyphosate + Envide	20 EPP	97 a	67 a	89 ab	31.2
2 High Rye Biomass	Glyphosate + Envide	10 EPP	100 a	78 a	92 ab	34.6
3 High Rye Biomass	Glyphosate only	20 EPP	92 ab	63 a	74 abc	30.5
4 High Rye Biomass	Glyphosate only	10 EPP	84 bc	66 a	84 ab	32.2
5 Low Rye Biomass	Glyphosate + Envide	20 EPP	100 a	46 a	87 ab	26.2
6 Low Rye Biomass	Glyphosate + Envide	10 EPP	100 a	75 a	92 ab	35.1
7 Low Rye Biomass	Glyphosate only	20 EPP	68 de	47 a	58 cd	33.6
8 Low Rye Biomass	Glyphosate only	10 EPP	78 cd	55 a	75 abc	35.5
9 No Rye - NT	Glyphosate + Envide	20 EPP	100 a	47 a	72 bc	34.7
10 No Rye - NT	Glyphosate + Envide	10 EPP	100 a	64 a	91 ab	30.6
11 No Rye - NT	Glyphosate only	20 EPP	63 e	34 a	40 d	30.5
12 No Rye - NT	Glyphosate only	10 EPP	70 de	52 a	60 cd	29.6
13 High Rye Biomass	None		97 a	68 a	93 ab	28.2
14 No Rye - NT	Glyphosate + Envide	20 EPP	100 a	83 a	94 a	30.2
LSD P=.05			11.77	35.04	22.06	6.09
Standard Deviation			6.97	20.75	13.09	3.63
CV			7.81	34.4	16.62	11.47
Treatment Prob(F)			0.0001	0.2462	0.0005	0.1075

Data in same column, followed by the same letter are not significantly different from one another

## COMPLETED PROJECT:

### Evaluation of tankmixtures with Liberty 280 for residual weed control, 2014 and 2015.

Liberty Link soybean use has been increasing due to the presence of glyphosate-resistant Palmer amaranth and horseweed. Liberty 280 (glufosinate) is a broad-spectrum herbicide that provides effective control of these species, but does not provide residual control. Liberty 280 effectiveness is best when applied to weeds less than 3 inches, and this application timing maybe as much as two weeks before soybean canopy closure. So there is an opportunity for weeds to emerge after application and before canopy closure and a residual herbicide will reduce the likelihood of needing a second herbicide application. This study was conducted to evaluate the effectiveness and crop safety of potential herbicides for tankmixing with Liberty 280.

The experiment was conducted at the University of Delaware's Research and Education Center in both years. In 2014 the plots were conventional tilled in a field of loamy sand soil (79:14:7 sand:silt:clay), 1.4% o.m. and 6.1 pH; and 2015 the field was no-tillage planted into a desiccated rye cover crop with sandy loam soil (78:13:9 sand:silt:clay), 2.5% o.m. and 4.8 pH. The experiment was conducted as a randomized complete block design with 14 treatments and with three replications. Treatments were arranged as a factorial of residual herbicides tankmixed with Liberty 280 and the addition of ammonium sulfate. All herbicides were applied with 32 fl oz/A of Liberty 280, herbicide and rates are listed in Table 1. Treatments were applied with or without

ammonium sulfate; AMS rate was 10 lb/100 gal of spray solution. Irrigation was used to reduce moisture stress in 2014. Plots consisted of seven 15-in. rows, 25 ft. long. Soybeans ('Southern States LL-473N' and 'Dyna-Gro S45LL33' in 2014 and 2015, respectively) were planted May 19, 2014 and May 20, 2015 at 220,000 seeds/A in 2014 and 150,000 seeds/A in 2015. Treatments were applied 4 weeks after planting (WAP), each year. Applications were made with a tractor mounted, compressed air sprayer in 2014 and backpack CO<sub>2</sub> sprayer in 2015. Applications were made with 20 g/A, at 3 mph, and 11002 spray nozzles (Greenleaf AirMix), with 30 psi in 2014 and 40 psi in 2015. Plots were combined at crop maturity and final yield was determined as bu/A.

Leaf burn was highest with the Reflex treatments at over 23% leaf burn when rated 7 days after treatment (DAT) in both years (Table 6). All other treatments resulted in less than 13% leaf burn in 2014. In 2015, Outlook, Prowl H<sub>2</sub>O, and Zidua caused 14 to 18% leaf burn. No treatment was less than 7% for both growing seasons. Palmer amaranth control at 3 WAT was highest for Palmer amaranth at 93% in 2014. No other treatment resulted in more than 84% control. All treatments in 2015 were above 93% and there were no significant differences in the treatment. The higher ratings in 2015 were due to ~0.5 inches of rain the day after treatment to incorporate the herbicide and lower weed pressure than 2014. In 2014, 0.26 inches of rain fell 8 DAT and only 0.4 inches for 14 day after treatment.

When averaged across all herbicide combinations, the addition of AMS increased soybean leaf burn from 12 to 16% and increased Palmer amaranth control from 87 to 90%. No interaction was detected between AMS and herbicides.

In a separate field trial conducted with the same treatments but no soybean crop planted, Reflex provided the highest level of control at 97% (Table 7). No other treatment provided more than 85% control.

In a greenhouse trial with the similar treatments focusing on soybean injury, Reflex plus Liberty caused the most leaf burn at 6 DAT, with 11% and all other treatments were less than 3% (Table 2). By 14 DAT, Dual or Zidua (both with Liberty) had the most stunting of soybean plants ranging 11 to 13%, while all others, including Reflex had less than 6% stunting.

While Reflex caused more leaf burn than other herbicides included in this trial, the injury was temporary and did not cause a yield reduction. In addition, it was the most consistent herbicide tankmixed with Liberty for residual Palmer amaranth control. If one of the other herbicides are used, it is critical to irrigate shortly after planting to ensure maximum efficacy.

Table 6. Postemergence applications of Liberty 280 in combination with residual herbicides. Soybean leaf burn and Palmer amaranth control are reported.

Trt No.	Herbicide	Rate unit	Leaf burn (%) 7 DAT		Palmer amaranth control (%) 3 WAT		Yield Bu/A
			2014	2015	2014	2015	
			1	Dual Magnum +Liberty 280	1 pt/A 32 fl oz/A	11 b	
2	Zidua +Liberty 280	1 oz wt/A 32 fl oz/A	11 b	14 bc	81 b	98 a	86.4 a
3	Outlook +Liberty 280	12 fl oz/A 32 fl oz/A	12 b	15 bc	84 b	93 a	88.0 a
4	Prowl H2O +Liberty 280	1.5 pt/A 32 fl oz/A	9 bc	18 b	76 c	94 a	84.5 a
5	Warrant +Liberty 280	1.5 pt/A 32 fl oz/A	7 c	13 c	76 c	97 a	84.1 a
6	Reflex +Liberty 280	1 pt/A 32 fl oz/A	23 a	28 a	93 a	100 a	84.5 a
	LSD P=.05		3.17	4.58	3.41	9.32	12.92
	Standard Deviation		2.65	3.82	2.85	7.78	11.12
	CV		21.78	23.3	3.53	8.1	13.6
	Treatment Prob(F)		0.0001	0.0001	0.0001	0.6272	0.4825

Table 7. Greenhouse and field trial with Liberty 280 and various residual herbicides for soybean safety (greenhouse trial) and residual control (field trial).

Trt No.	Herbicide	Rate unit	Greenhouse			Field trial Palmer amaranth control (%) 5 WAT
			Leaf burn (%)		Stunting (%)	
			6 DAT	14 DAT	14 DAT	
1	Dual Magnum +Liberty 280	1 pt/A 32 fl oz/A	2 b	7 a	11 a	75 abc
2	Zidua +Liberty 280	1 oz wt/A 32 fl oz/A	2 b	10 a	13 a	87 ab
3	Outlook +Liberty 280	12 fl oz/A 32 fl oz/A	0 c	1 b	2 b	50 c
4	Prowl H2O +Liberty 280	1.5 pt/A 32 fl oz/A	--	--	--	62 bc
5	Warrant +Liberty 280	1.5 pt/A 32 fl oz/A	0 c	0 b	1 b	63 bc
6	Reflex +Liberty 280	1 pt/A 32 fl oz/A	11 a	11 a	6 ab	97 a
	LSD P=.05		6.5	5.2	9.9	26.6
	Standard Deviation		5.3	0.67	7	14.4
	CV		75.2	30.6	52.9	19.9
	Treatment Prob(F)		0.0002	0.0001	0.0169	0.0273