

## Preliminary Report to the Delaware Soybean Board

Personnel: Mark VanGessel, Extension Specialist and Professor  
University of Delaware  
Research and Education Center  
16487 County Seat Highway  
Georgetown, DE 19947  
302/856-7303 (phone)      302/856-1845 (fax)

Quintin Johnson, Extension Associate  
Barbara Scott, Research Associate

### **MANAGEMENT OF PALMER AMARANTH IN SOYBEAN**

As production practices change, new weed species emerge and become problematic for management. For instance, with the wide-spread use of Roundup Ready Soybeans, glyphosate-resistant horseweed became a significant problem for farmers. Palmer amaranth is moving into the region from the south. Fields have been found throughout Delaware, as well as in Virginia, Maryland, southeastern Pennsylvania, and New Jersey. This species is related to our common smooth pigweed, but it is much more aggressive. It is not uncommon for this plant to grow as tall as 6 feet. It produces a tremendous number of seeds. The most alarming issue is the frequency of resistance developing in this species. Glyphosate-resistance and Group 2 resistance (ALS-inhibiting herbicides) have been confirmed in Delaware. Successful management programs need to be developed to effectively control this species as well as avoid the development of other herbicide-resistant biotypes.

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

Specific objectives were:

- Determine effective herbicide programs for herbicide-resistant Palmer amaranth biotypes with Roundup Ready, Liberty Link, and conventional soybeans
- Evaluate various herbicide options for control of Palmer amaranth in double-cropped soybeans
- Evaluate the usefulness of residual herbicides when applied as a tankmixed partner for POST application

These projects are designed to address weed control in terms of effectiveness, adaptability to Delaware's specific needs, as well as resistance management.

**Palmer amaranth control with herbicide-resistant soybeans.** This study compared Roundup Ready and Liberty Link soybean systems for Palmer amaranth control in a

naturally infested field at the UD's Research and Education Center. The approaches examined the need for residual herbicides in combination with various POST herbicides. Soybeans were planted on June 13, 2014 and preemergence herbicides were sprayed immediately after planting. Postemergence applications were made July 10 and July 30. Soil-applied herbicides such as Valor XLT and Prefix were used at planting and Roundup and Ignite 280 were applied postemergence as well as conventional postemergence herbicides. This study is focused on herbicides other than Group 2 (Classic, FirstRate, and Pursuit) due to the potential for resistance to develop.

At four weeks after planting, Palmer amaranth control was 100, 93, and 100% for Valor at 2 oz/A, Valor at 3 oz/A, and Prefix at 2 pts/A, respectively. Prefix at 1.3 pt/A provided only 64% control of Palmer amaranth. One week after the late POST applications, glyphosate alone provided only 77% control of Palmer, while all other treatments provide at least 98% control. There were no significant differences when plots were rated in September.

Table 1. Palmer amaranth control with Liberty Link and Roundup Ready soybean programs

Trt no.	Treatments	Product	Rate	Stage	Palmer Amaranth Control % 8/6/2014	Palmer Amaranth Control % 9/10/2014	Soybean Yield bu/A 10/27/14
1	Untreated Check				0	0	44
2	Glyphosate	32 fl oz/A	4 WAP		77 b	100 a	47
3	Liberty 280 + AMS	29 fl oz/A	4 WAP		98 a	90 a	42
4	Valor SX	3 oz wt/A	PRE		100 a	90 a	44
	Glyphosate	32 fl oz/A	4 WAP				
5	Prefix	2 pt/A	PRE		100 a	100 a	40
	Liberty 280 + AMS	29 fl oz/A	4 WAP				
6	Valor SX	3 oz wt/A	PRE		100 a	100 a	45
	Glyphosate	32 fl oz/A	6 WAP				
7	Prefix	2 pt/A	PRE		100 a	100 a	41
	Liberty 280 + AMS	29 fl oz/A	6 WAP				
8	Valor SX	2 oz wt/A	PRE		100 a	100 a	44
	Glyphosate	32 fl oz/A	4 WAP				
9	Prefix	1.3 pt/A	PRE		100 a	100 a	36
	Liberty 280 + AMS	29 fl oz/A	4 WAP				
10	Valor SX	3 oz wt/A	PRE		100 a	100 a	35
	Liberty 280 + AMS	29 fl oz/A	4 WAP				
11	Dual Magnum	0.5 pt/A	PRE		100 a	100 a	36
	Reflex + Select Max	1.5 + 8 pt/A	4 WAP				
12	Dual Magnum	0.5 pt/A	PRE		93 a	100 a	34
	Cobra + Select Max	12.5 + 8 fl oz/A	4 WAP				
LSD (P=.05)					12.96	14.56	10
Standard Deviation					7.61	8.55	5.96

CV	7.84	8.76	14.75
Treatment F	2.588	0.739	1.807
Treatment Prob(F)	0.0337	0.6817	0.1248

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

Note, this trial was also done in 2012 and 2013 as well. No differences were observed in 2012. In 2013, Prefix followed by Liberty provided the highest level of control (better than Valor followed by Liberty).

The second objective examined control of Palmer amaranth in double cropped soybeans. In many situations, Palmer amaranth will have emerged prior to planting soybeans and will need to be controlled with a burndown treatment; as well as needing to control plants that emerge after planting. Soybeans were planted after small grain harvest, on July 10. Burndown treatments were made immediately after planting. In a companion trial looking at postemergence control, soybeans were planted on the same day with a burndown application of Gramoxone plus Boundary. Postemergence treatments were made August 6.

No Palmer amaranth plants were present in the study area and so only horseweed was rated. All treatments with Liberty 280 and Sharpen provided excellent horseweed control (Table 2). Canopy, Aim, or Anthem used in combination with glyphosate did not improve control over glyphosate alone.

Postemergence control of Palmer amaranth in double cropped soybeans was >94% with Liberty 280, Ultra Blazer, and Raptor when rated two weeks after application (data not shown). When rated in mid-October, the best treatment was Raptor (100% control). The Palmer amaranth population was resistant to Synchrony (78% control, and confirmed in the greenhouse). Liberty and Blazer do not provide residual control so Palmer amaranth plants emerged late in the growing season (after the postemergence treatments were applied) and resulted in poor full-season control.

Table 2. Control of horseweed with burndown for double-cropped soybeans

Trt No.	Treatment Name	Rate	Unit	Horseweed Control %	
				7/22/2014	8/5/2014
1	Untreated Check			0	0
2	Liberty 280	36	fl oz/A	100 a	100 a
	Dry Ammonium Sulfate	10	lb/100 gal		
3	Liberty 280	36	fl oz/A	100 a	97.7 a
	Crop Oil Concentrate	1	qt/A		
	Dry Ammonium Sulfate	10	lb/100 gal		
4	Roundup PowerMax	32	fl oz/A	43.3 c	56.7 d

	Dry Ammonium Sulfate	10	lb/100 gal				
5	Roundup PowerMax	42	fl oz/A	46.7	bc	73.3	c
	Dry Ammonium Sulfate	10	lb/100 gal				
6	Canopy Premix	4	oz wt/A	58.3	b	66.7	cd
	Roundup PowerMax	32	fl oz/A				
	Dry Ammonium Sulfate	10	lb/100 gal				
7	Liberty 280	36	fl oz/A	100	a	97.7	a
	Roundup PowerMax	32	fl oz/A				
	Dry Ammonium Sulfate	10	lb/100 gal				
8	Liberty 280	36	fl oz/A	100	a	91	ab
	Roundup PowerMax	32	fl oz/A				
	Dry Ammonium Sulfate	10	lb/100 gal				
	Methylated Seed Oil	1.5	pt/A				
9	Anthem Premix	6	fl oz/A	43.3	c	60	d
	Roundup PowerMax	32	fl oz/A				
	Dry Ammonium Sulfate	10	lb/100 gal				
	Crop Oil Concentrate	1	qt/A				
10	Anthem Premix	6	fl oz/A	50	bc	63.3	cd
	Aim	1.5	fl oz/A				
	Roundup PowerMax	32	fl oz/A				
	Dry Ammonium Sulfate	10	lb/100 gal				
	Crop Oil Concentrate	1	qt/A				
11	Roundup PowerMax	32	fl oz/A	93.3	a	86.7	b
	Sharpen	2	fl oz/A				
	Dry Ammonium Sulfate	10	lb/100 gal				
	Methylated Seed Oil	1.5	pt/A				
12	Roundup PowerMax	32	fl oz/A	96	a	86.7	b
	Sharpen	1	fl oz/A				
	Dry Ammonium Sulfate	10	lb/100 gal				
	Methylated Seed Oil	1.5	pt/A				
LSD P=.05				12.9		10.16	
Standard Deviation				7.55		5.97	
CV				9.99		7.46	
Treatment F				36.758		22.578	
Treatment Prob(F)				0.0001		0.0001	

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

The third objective evaluated the effectiveness of including residual herbicides as tankmix partners with POST herbicides. Liberty Link soybeans were planted on May 19 and Liberty 280 with various residual herbicides were applied on June 18. Residual

herbicides included Dual Magnum, Zidua, Outlook, Warrant, Reflex, and Prowl. Reflex provided the best residual control (>92% control) when rated 5 weeks after treatment (data not presented). Outlook averaged 84% control and Zidua averaged 80%. Dual, Prowl, and Warrant did not provide as consistent control averaging 75% control.

The addition of AMS improved postemergence Palmer amaranth control by 5% when averaged over all the herbicide combinations. Liberty plus Reflex caused 23% leaf burn, but this did not affect final yields. All other herbicides resulted in 7 to 12% leaf burn.

None of the tankmix partners with Liberty 280 improved control of morningglory species compared to Liberty alone.

The combination of these trials indicate Palmer amaranth can be effectively controlled with proper herbicide selection and timely applications. Trying to reduce the number of herbicide applications can result in application timings that allow Palmer amaranth plants to reach heights where they are not effectively controlled. Palmer amaranth requires an effective herbicide application at planting followed by a postemergence treatment prior to Palmer amaranth achieving a height of 4 inches.