

Residual herbicides in Liberty Link soybeans at Rosemount, MN - 2014. Gunsolus, Jeffrey L., Douglas W. Miller, and Bradley Kinkaid. The objective of this experiment was to evaluate weed control and crop response with residual herbicides and Liberty applied in preemergence/postemergence and postemergence only Liberty Link soybean systems. The experiment was conducted at Rosemount, MN on a Waukegon silt loam soil with pH 6.5 and 4.1% organic matter. Soil test P and K were 16 and 198 lbs/A respectively. Following weedy fallow, the experimental area was fall chisel plowed. In the spring, 60 lbs/A P and 60 lbs/A K were applied and the area was field cultivated on May 5. The area was field cultivated again on May 22 and planted with LG Seeds C2259LL soybeans at a rate of 150,000 seeds/A with 30 inch row spacing. The experimental design was a randomized complete block with four replications and plot size was 10 by 30 ft. Herbicide treatments were applied with either a tractor mounted, compressed air sprayer with an eight nozzle boom and 15 inch nozzle spacing or a CO₂ powered backpack sprayer with a six nozzle boom and 20 inch nozzle spacing. Both sprayers utilized 110015VS XR Teejet flat-fan nozzles at 35 psi pressure producing a spray volume of 15 gpa. Seven preemergence treatments were applied at planting. Each of these treatments received either a sequential postemergence application of Liberty/AMS alone or Liberty/AMS tank mixed with a residual component. Target application timing was the V2 soybean stage or 2 to 4 inch weeds. All of these treatments could have received a second Liberty/AMS application if needed. In addition, three other treatments (Liberty/AMS with or without a residual component) were applied early postemergence targeting V2 soybeans with a sequential application targeting 2 to 4 inch weeds. Plots were visually rated throughout the growing season. On October 10, giant ragweed plants with seed were counted in each plot (center 7.5 feet x 30 feet length). Soybean yields were determined by harvesting the two center rows of each plot. Application dates, environmental conditions, and weed data are presented below. Broadleaf weed control data are presented in Tables 1 and 2. Grass weed control, soybean injury and yield data are presented in Table 2.

Treatment Date	May 23	June 17	June 23	July 10
Application Target	Preemergence	EPost V2 Soybean	2-4" weeds following Preemergence	2-4" weeds following EPost and LPost (if needed)
Sprayer type	Tractor	Backpack	Tractor	Tractor
Air Temperature (°F)	70	71	80	79
Relative humidity (%)	40	70	55	53
Dewpoint (°F)	45	61	63	61
Soil Moisture	dry to 1.0"	moist	dry to 0.25"	not recorded
Soil Temperature (°F)	69	73	82	not recorded
Sky	5% clouds	10% clouds	80% clouds	10% clouds
Wind (mph)	W 0-3	SSW 0-3	NNW 0-3	SE 10
Rainfall before Application				
Week 1 (inch)	1.61	2.90	3.68	0.65
Rainfall after Application				
Week 1 (inch)	0.54	3.23	0.78	1.58
Week 2 (inch)	2.44	0.85	0.20	0.02
Soybean				
Stage	--	V2 (10%) -V3 (90%)	V4 (35%)-V5 (65%)	V9-R1 (most V9)
Height (inch)	--	5-7	9-11	18-20

Average weed density (plants/ft²) in untreated check

Common Lambsquarters - Colq	--	2.6	--	--
Common Ragweed - Corw	--	2.0	--	--
Giant Ragweed - Girw	--	0.76	--	--
Nightshade - Ebns	--	1.4	--	--
Pennsylvania Smartweed - Pesw	--	0.4	--	--
Amaranth species	--	2.1	--	--
Grass species	--	150-700	--	--

Weed height (inches) / leaf number

Common Lambsquarters - Colq	--	0.25-1.25" (most 0.5-0.75") / 2-4 leaf	--	0.5-1.5 "
Common Ragweed - Corw	--	1.5-3" / 2-6 leaf	1-4 "	1-5 "
Giant Ragweed - Girw	--	1-5" / cot-8 leaf	2-10 "	2-5 "
Nightshade - Ebns	--	0.25-1" / 1-3 leaf	--	0.25-0.5 "
Pennsylvania Smartweed - Pesw	--	1.5" / 3 leaf	--	--
Amaranth species	--	0.25-1.5" / 1-5 leaf	--	0.5-7 "
Grass species	--	0.25-6" (most 0.75-1.25) / 1-6 leaf	1-8 "	0.5-5 "

Results

General observations

Broadleaf weed densities were low. Pennsylvania smartweed density was the lowest and most variable. Smartweed germinated early with no later season flushes. Common lambsquarters and eastern black nightshade populations were more evenly distributed. Amaranth species included mainly redroot pigweed and Powell amaranth with variable populations of tall waterhemp. Amaranth species were also more evenly distributed. Lambsquarters and amaranths (in particular waterhemp) all had some mid-season germination flushes (nightshade had some mid-season germination but densities were extremely low). Common ragweed was the most evenly distributed broadleaf species. Giant ragweed was present throughout the experimental area but densities were somewhat variable. Ragweed species generally germinated early, however a few late germinating ragweeds were noted at the July 9 rating date. Grass species densities were very high and heavy growth flushes occurred into July. Early populations consisted of giant and yellow foxtail and woolly cupgrass. Late germinating flushes consisted mainly of wild proso millet. Foxtails and proso millet were the most evenly distributed while woolly cupgrass populations were patchier.

Rainfall (0.54 inches) occurred 5 days after planting to activate the preemergence treatments. Over 3 inches of rainfall occurred 2 days following the June 17 application. 0.78 inches of rainfall occurred 6-7 days following the June 23 application. Over 1.5 inches of rainfall occurred 1 to 3 days following the July 10 application. Total rainfall for the month of June was 10.57 inches. Spray drift of Status herbicide from an adjacent corn production field occurred on June 26. This resulted in soybean injury to the entire experiment. Leaf cupping occurred on the upper 3 to 4 leaves with greatest injury on the youngest leaves. Subsequent leaf growth was normal and the crop appeared to have recovered well.

Broadleaf Weed Control

Preemergence control of lambsquarters, nightshade, smartweed, and amaranth species was excellent for all treatments with the exception of the two Verdict treatments (Table 1). Observations on June 17 noted small (< 0.5") lambsquarters, smartweed and amaranths present in one or two replications of the Verdict treatments. Low control was noted in one plot in particular which skewed the average control ratings for that treatment (ANOVA resulted in no significant differences). Ratings six days later (June 23) noted none of these weeds present. Four inches of rain occurred between June 17 and June 23 and ragweed and grass control was poor in these plots. One possible explanation is that the small lambsquarters, smartweed and amaranths may have died off due to a combination of the rain and weed competition. The early application in the two-pass postemergence treatments controlled all lambsquarters, nightshade, smartweed, and amaranth species. The Liberty + Prefix provided excellent residual control of these species. Liberty + Outlook provided good residual control compared to Liberty alone (especially for amaranth species). The late postemergence treatments combined with soybean canopy closure resulted in season long control of these broadleaf species.

Control of common ragweed was good to excellent for all preemergence treatments with the exception of the Verdict treatments where control was poor (Table 2). The sequential postemergence applications of Liberty with or without a residual component controlled all common ragweed present. At the July 9 rating date, the Optill + Outlook, Verdict / Liberty + Outlook, and Verdict / Liberty / Liberty treatments had some new common ragweed emerged. The second application of Liberty in the Verdict / Liberty / Liberty treatment and canopy closure in all treatments resulted in 100% control for the remainder of the season. The early application in the two-pass postemergence treatments controlled all common ragweed. The Liberty + Prefix treatment provided excellent residual control. Liberty + Outlook provided good residual control compared to Liberty alone. The late postemergence treatments combined with soybean canopy closure resulted in season long control of common ragweed in these treatments.

Overall preemergence control of giant ragweed was fair to poor. Envive, Optill + Outlook, and Fierce provided the greatest control and Authority First and Verdict provided the poorest control (Table 2). The sequential postemergence applications of Liberty with or without a residual component controlled all giant ragweed present. Giant ragweed present at the July 9 rating date were newly emerged plants. No significant differences were noted on July 9 between the treatments in the preemergence / postemergence groupings. The early application in the three two-pass postemergence treatments controlled the giant ragweed present on the June 17 application date (June 23 ratings reflect that the plants were not yet completely dead). Giant ragweed present on July 9 were plants that had emerged after the June 17 postemergence application. The Liberty + Prefix treatment provided significant residual control versus the Liberty + Outlook treatment or the Liberty-alone treatment. The late postemergence Liberty applications controlled the remaining giant ragweed for the remainder of the season.

Giant ragweed plants with seed remained in all of the treatments that received only one postemergence application of Liberty (with or without a residual component). In contrast, treatments receiving two applications of Liberty had no seed

bearing giant ragweed at harvest. Although the differences were not statistically significant and seed viability was not determined, the potential for no new seed being added to the seed bank should not be discounted.

Grass Weed Control

Initial preemergence grass control on June 16 was good to excellent with the Verdict treatments having the lowest control (Table 2).

The two June 17 sequential applications of Liberty with residual components of Zidua (sequential to Valor XLT) or Outlook (sequential to Envive) resulted in excellent grass control for the remainder of the season.

On June 23, Authority First had fair grass control, Fierce had excellent control, and Optill + Outlook had good control. Control in the two Verdict treatments had declined to poor by June 23. The postemergence sequential applications of Liberty or Liberty + Outlook on June 23 controlled the grass species present in these treatments.

Following the postemergence sequential applications on June 23, more grass emergence occurred. The Authority First and Fierce treatments maintained excellent control into the July 9 rating date and good control into the July 24 rating date. Soybean canopy coverage prevented grasses in these treatments from providing much competition for the remainder of the season.

The preemergence Optill + Outlook treatment provided less residual control after the June 23 sequential Liberty application and grass control for this treatment was significantly less at the later rating dates. In hindsight, this treatment should have been a candidate for a second Liberty application on July 10. On July 9, when the decision was made to treat a second time or not, the overall weed population was judged not serious enough to warrant a second Liberty application. By the time the weed population and size (in particular grasses) appeared to warrant another application, the soybean stage was beyond that allowed by the Liberty label.

Liberty + Outlook applied sequentially on June 23 to one of the Verdict preemergence treatments provided significant residual grass control for the remainder of the season. The Liberty applied to the other preemergence Verdict treatment controlled the grass species present on June 23 but another grass species flush occurred following that application. A second Liberty application on July 10 controlled those grasses and with canopy closure, excellent control was maintained for the rest of the season.

In the two-pass postemergence-only treatments, grass species were not yet totally controlled by the early application when the plots were rated on June 23, however they eventually died. Both Prefix and Outlook provided good residual control of grasses at the July 9 rating date compared to the Liberty-alone treatment. After the July 10 postemergence sequential treatment, few grasses emerged in any of the treatments and with soybean canopy competition, no grasses were present at the October rating date.

Soybean Injury and Yields

Fierce and Envive resulted in some observable injury at the early rating date. Both caused a "draw string" effect on the first trifoliolate leaf. In addition, Envive caused some leaf chlorosis. All postemergence treatments resulted in some degree of injury, in most cases it was leaf chlorosis. The Liberty + Prefix treatment had the greatest injury and consisted of necrosis (leaf speckling), chlorosis, and shredding of the second trifoliolate. Injury was observed on the Liberty + Prefix treatment through the July rating date.

Yields did not differ significantly between the herbicide treatments. All herbicide treated plots yielded significantly greater than the untreated check.

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Table 1. Weed control (part 1).

Treatment ¹	Rate ¹ (product/A)	Broadleaf Weed Control																			
		Colq					Ebns					Pesw					Amaranth species				
		6/17	6/23	7/09	7/24	10/10	6/17	6/23	7/09	7/24	10/10	6/17	6/23	7/09	7/24	10/10	6/17	6/23	7/09	7/24	10/10
		(%)																			
<u>(Preemergence May 23) / (Postemergence June 17)</u>																					
(Valor XLT ²) / (Liberty ³ + Zidua ⁴ + AMS ⁵)	(3.5 oz) / (29 oz + 2 oz + 1.75 qt)	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
(Envive ⁶) / (Liberty + Outlook ⁷ + AMS)	(4 oz) / (29 oz + 14 oz + 1.75 qt)	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
<u>(Preemergence May 23) / (Postemergence June 23)</u>																					
(Authority First ⁸) / (Liberty + AMS)	(6.5 oz) / (29 oz + 1.75 qt)	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	99	100	100
(Fierce ⁹) / (Liberty + AMS)	(4 oz) / (29 oz + 1.75 qt)	100	100	99	99	99	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
(Optill ¹⁰ + Outlook) / (Liberty + AMS)	(2 oz + 10 oz) / (29 oz + 1.75 qt)	100	100	100	100	99	100	100	100	99	100	100	100	100	100	100	100	99	96	93	99
(Verdict ¹¹) / (Liberty + Outlook + AMS)	(5 oz) / (29 oz + 10 oz + 1.75 qt)	98	100	99	97	98	100	100	100	100	100	99	100	100	100	100	96	100	100	100	100
<u>(Preemergence May 23) / (Postemergence June 23) / (Postemergence July 10)</u>																					
(Verdict) / (Liberty + AMS) / (Liberty + AMS)	(5 oz) / (29 oz + 1.75 qt) / (29 oz + 1.75 qt)	88	100	97	99	97	100	100	99	100	100	94	100	100	100	100	90	100	95	100	100
<u>(Postemergence June 17) / (Postemergence July 10)</u>																					
(Liberty + Prefix ¹² + AMS) / (Liberty + Warrant ¹³ + AMS)	(29 oz + 2 pt + 1.75 qt) / (29 oz + 3 pt + 1.75 qt)	--	100	97	99	100	--	100	100	100	100	--	100	100	100	100	--	100	99	100	100
(Liberty + Outlook + AMS) / (Liberty + Warrant + AMS)	(29 oz + 14 oz + 1.75 qt) / (29 oz + 3 pt + 1.75 qt)	--	100	90	99	99	--	100	99	100	100	--	100	100	100	100	--	100	89	99	100
(Liberty + AMS) / (Liberty + AMS)	(29 oz + 1.75 qt) / (29 oz + 1.75 qt)	--	100	86	99	99	--	100	99	100	100	--	100	100	100	100	--	100	68	100	100
LSD (0.05)		ns	ns	5	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	10	ns	ns

¹ Treatments and rates in parenthesis represent a separate application timing.

² Valor XLT 40.3WDG = flumioxazin (30.0%) & chlorimuron ethyl (10.3%).

³ Liberty 280 SL = glufosinate-ammonium (2.34 lb ai/gal).

⁴ Zidua 85WG = pyroxasulfone.

⁵ AMS = N-Pak ammonium sulfate solution (3.4 lbs/gal).

⁶ Envive 41.3DG = chlorimuron ethyl (9.2%) & flumioxazin (29.2%) & thifensulfuron methyl (2.9%).

⁷ Outlook 6EC = 6.0 lbs ai/gal dimethenamid-P.

⁸ Authority First 70DF = 62% sulfentrazone & 8% chloransulam-methyl.

⁹ Fierce 76WDG = 33.5% flumioxazin & 42.5% pyroxasulfone.

¹⁰ Optill 68WG = 17.8% saflufenacil & 50.2% imazethapyr.

¹¹ Verdict 5.57EC = saflufenacil (0.57 lbs ai/gal) & dimethenamid-P (5.0 lbs ai/gal).

¹² Prefix 5.29EC = 4.34 lbs ai/gal s-metolachlor & 0.95 lbs ai/gal fomesafen.

¹³ Warrant 3CS = acetochlor.

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Table 2. Weed control (part 2), soybean injury, and soybean yields.

Treatment ²	Rate ² (product/A)	Broadleaf Weed Control										Girw Counts ¹ 10/10 (plants/A)	Grass Weed Control					Soybean Injury				Soybean Yield (bu/A)
		Corw					Girw						Grass Weed Control					Soybean Injury				
		6/17	6/23	7/09	7/24	10/10	6/17	6/23	7/09	7/24	10/10	10/10	6/17	6/23	7/09	7/24	10/10	6/17	6/23	6/26	7/9	
----- (%) -----																						
(Preemergence May 23) / (Postemergence June 17)																						
(Valor XLT ³) / (Liberty ⁴ + Zidua ⁵ + AMS ⁶)	(3.5 oz) / (29 oz + 2 oz + 1.75 qt)	99	100	100	100	100	58	99	96	97	98	194	96	98	99	98	100	3	13	6	0	61
(Envive ⁷) / (Liberty + Outlook ⁸ + AMS)	(4 oz) / (29 oz + 14 oz + 1.75 qt)	99	100	100	100	100	84	99	98	98	98	387	94	99	99	99	100	9	10	8	0	57
(Preemergence May 23) / (Postemergence June 23)																						
(Authority First ⁹) / (Liberty + AMS)	(6.5 oz) / (29 oz + 1.75 qt)	98	96	100	100	100	24	58	98	98	99	194	95	81	98	93	97	0	1	4	0	60
(Fierce ¹⁰) / (Liberty + AMS)	(4 oz) / (29 oz + 1.75 qt)	100	99	100	100	100	83	83	99	99	99	97	99	99	97	92	93	10	3	4	0	57
(Optill ¹¹ + Outlook) / (Liberty + AMS)	(2 oz + 10 oz) / (29 oz + 1.75 qt)	98	94	97	99	100	81	59	96	98	97	334	97	93	92	83	83	1	4	4		58
(Verdict ¹²) / (Liberty + Outlook + AMS)	(5 oz) / (29 oz + 10 oz + 1.75 qt)	34	18	99	100	100	14	35	99	99	99	48	89	69	99	100	99	1	0	6	0	61
(Preemergence May 23) / (Postemergence June 23) / (Postemergence July 10)																						
(Verdict) / (Liberty + AMS) / (Liberty + AMS)	(5 oz) / (29 oz + 1.75 qt) / (29 oz + 1.75 qt)	39	39	97	100	100	21	33	97	99	99	0	91	66	93	98	99	0	4	5	0	56
(Postemergence June 17) / (Postemergence July 10)																						
(Liberty + Prefix ¹³ + AMS) / (Liberty + Warrant ¹⁴ + AMS)	(29 oz + 2 pt + 1.75 qt) / (29 oz + 3 pt + 1.75 qt)	--	100	99	100	100	--	99	99	100	100	0	--	90	93	99	100	0	25	21	11	56
(Liberty + Outlook + AMS) / (Liberty + Warrant + AMS)	(29 oz + 14 oz + 1.75 qt) / (29 oz + 3 pt + 1.75 qt)	--	100	95	100	100	--	98	88	99	99	0	--	87	92	99	100	0	14	9	0	57
(Liberty + AMS) / (Liberty + AMS)	(29 oz + 1.75 qt) / (29 oz + 1.75 qt)	--	100	90	100	100	--	99	89	99	100	0	--	86	58	98	100	0	6	2	0	59
Untreated Check		--	--	--	--	--	--	--	--	--	--	26426	--	--	--	--	--	0	0	0	0	15
LSD (0.05)		23	18	3	ns	ns	21	23	5	1.7	1.4	195	4	7	8	2	3	3	4	5	1	6

¹ Giant ragweed plants with seed.

² Treatments and rates in parenthesis represent a separate application timing.

³ Valor XLT 40.3WDG = flumioxazin (30.0%) & chlorimuron ethyl (10.3%).

⁴ Liberty 280 SL = glufosinate-ammonium (2.34 lb ai/gal).

⁵ Zidua 85WG = pyroxasulfone.

⁶ AMS = N-Pak ammonium sulfate solution (3.4 lbs/gal).

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⁹ Authority First 70DF = 62% sulfentrazone & 8% chloransulam-methyl .

¹⁰ Fierce 76WDG = 33.5% flumioxazin & 42.5% pyroxasulfone.

¹¹ Optill 68WG = 17.8% saflufenacil & 50.2% imazethapyr.

¹² Verdict 5.57EC = saflufenacil (0.57 lbs ai/gal) & dimethenamid-P (5.0 lbs ai/gal).

¹³ Prefix 5.29EC = 4.34 lbs ai/gal s-metolachlor & 0.95 lbs ai/gal fomesafen.

¹⁴ Warrant 3CS = acetochlor.