Residual herbicides in Liberty Link soybeans at Rosemount, MN - 2013. 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 applied in preemergence/postemergence and postemergence only systems. The experiment was conducted at Rosemount, MN on a Waukegon silt loam soil with pH 6.6 and 4.7% organic matter. Soil test P and K were 19 and 131 lbs/A respectively. Following oats, the experimental area was fall chisel plowed. In the spring, 60 lbs/A P and 60 lbs/A K were applied on May 8. The area was disked twice and field cultivated twice on June 3 and planted with Crop Plan Genetics LC2080 (LL) 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. All herbicide treatments were applied with a CO_2 powered backpack sprayer utilizing a six nozzle boom with 20 inch nozzle spacing, 110015VS XR Teejet flat-fan nozzles, 35 psi pressure, and a spray volume of 15 gpa. Application dates, environmental conditions, and weed data are presented below. Broadleaf weed control data are presented in Table 1. Grass weed control, soybean injury and yield data are presented in Table 2.

Treatment Date	June 3	June 28	July 8	July 19	July 29
Air Temperature (°F)	68	72	85	80	75
Relative humidity (%)	38	61	51	55	46
Dewpoint (°F)	42	58	65	63	53
Soil Moisture	moist at 0.25”	dry to 0.25”	dry to 1.5”	dry	dry
Soil Temperature (°F)	65	72	85	93	82
Sky	cloudy	10% clouds	20% clouds	10% clouds	25% clouds
Wind (mph)	SE 7-10	WNW 8-15	NE 2-5	NW 8-12	S 3-5
Rainfall before Application					
Week 1 (inch)	1.14	1.87	0.00	1.86	0.16
Rainfall after Application					
Week 1 (inch)	0.90	0.41	2.61	0.48	1.36
Week 2 (inch)	1.37	0.78	0.42	0.22	0.62
Soybean					
Stage	--	V2	V4-V5	V9-R1	R10-R11
Height (inch)	--	5-6	9-11	16-18	18-20
Weed Height (inches)					
Common Lambsquarters - Colq	--	0.25-2 (mostly 1)	2-6	2-8*	2-12*
Common Ragweed - Corw	--	1-3 (mostly 2)	3-8	2-12*	2-6*
Nightshade - Ebns	--	1-3 (mostly 2)	--	1-5*	2-3*
Pennsylvania Smartweed - Pesw	--	1-4 (mostly 2)	2-6	4-6*	2-8*
Pigweed species - Rrpw	--	1-3 (mostly 1)	--	2-10*	1-5*
Grasses	--	2-4 (mostly 3)	--	1-8*	--

* - Range for all treatments applied. Refer to the results section for detailed weed height data with specific treatments.

Weed Density (plants/ft^2) on June 28	
Common Lambsquarters - Colq	14
Common Ragweed - Corw	6
Nightshade - Ebns	2.4
Pennsylvania Smartweed - Pesw	12
Pigweed species - Rrpw	1.3
Grasses	2

Treatment Scheme

Seven preemergence treatments were applied at planting. Two of these treatments (Valor SX and Enlite) received a sequential postemergence application of Liberty/AMS tank mixed with a residual component (Zidua or Outlook, respectively). Target application time was 1 to 3 trifoliate leaf soybeans which is the Zidua labeled restriction. The other five preemergence treatments received sequential postemergence applications of Liberty/AMS and target application timing was 2 to 4 inch weeds with a second Liberty/AMS application optional if needed. Of these five preemergence treatments, the Prowl and Dual required two postemergence Liberty/AMS applications, the first on July 8. The other three preemergence treatments (Authority First, Valor XLT, and Optill + Outlook) required only one postemergence application of Liberty/AMS (applied on July 19). Three other treatments (Liberty/AMS with or without a residual component) were postemergence only with two application timings. The early application targeted V2 soybeans and the later application targeted 2 to 4 inch weeds. Two of the late sequential applications also had residual components of Zidua or Outlook, and were applied at an advanced soybean stage beyond their respective label restriction.

Results

Over 4 inches of rain occurred within three weeks after the preemergence application. With the exception of Prowl and Dual, preemergence treatments had excellent weed control at the June 28 rating date. Only a few broadleaf weeds (mainly common ragweed) were present in these plots. Sequential postemergence Liberty with Zidua or Outlook was applied to the Valor SX and Enlite treatments on June 28. Weed control in these two treatments remained excellent throughout the season.

Broadleaf weeds were emerged in the Prowl and Dual treatments on June 28 with overall weed control significantly less than the other preemergence treatments on both June 28 and July 9 rating dates. Both treatments had little to no control of common ragweed and only poor to fair control of Pennsylvania smartweed. Prowl had poor nightshade control but control of lambsquarters, pigweed and grasses (data not shown) was excellent. Dual had only fair common lambsquarters control but excellent nightshade, pigweed and grass (data not shown) control. The postemergence Liberty application on July 9 controlled most lambsquarters, nightshade, and pigweed with the exception of some of the larger lambsquarters present in the Dual treatment. Also, some larger ragweed and smartweed present in both treatments were not completely killed as observed on the July 18 rating date. By July 29, these surviving weeds plus newly emerged broadleaf weeds resulted in the need for a follow-up Liberty application. Weed sizes at this application timing varied for each treatment as follows:

Weed height (inches) on July 29	Prowl	Dual
Common lambsquarters	*	2-8
Common ragweed	2-10	2-6
Nightshade	2-3	*
Pennsylvania smartweed	2-4	4-8
Pigweed	3-5	1-2
Grasses	*	*

* = not present

The follow-up application adequately controlled the existing weeds. Scattered weeds were present at the October rating date but were small and had not posed any competition to the soybean crop. Grass control remained at 100% throughout the season for both the Prowl and Dual treatments.

The other three preemergence treatments maintained good overall weed control. In addition to the few common ragweeds noted in all treatments at the June 28 rating, a few later emerging weeds were present by the July 18 rating date. These included nightshade and pigweed in the Valor XLT treatment and common lambsquarters and pigweed in the Optill + Outlook treatment. The July 19 Liberty application controlled these weeds and these treatments remained nearly weed free up to soybean harvest. Weed sizes on July 19 following preemergence treatments were as follows:

Weed height (inches) on July 19	Authority First	Valor XLT	Optill + Outlook
Common lambsquarters	*	*	1-2
Common ragweed	2-12	2-5	3-8
Nightshade	*	2-5	*
Pennsylvania smartweed	*	*	*
Pigweed	*	1-2	1-2
Grasses	3-10	3-14	*

* = not present

Of the three postemergence-only treatments, Liberty + Prefix resulted in the most complete overall weed control, providing some extra burn down of existing weeds and also soil residual. Liberty + Warrant provided excellent control of ragweed, nightshade, pigweed and grasses, however Pennsylvania smartweed and common lambsquarters control was lower than the Liberty + Prefix treatment. Control with Liberty alone was similar to the Liberty + Warrant treatment but with somewhat higher control of lambsquarters and less control of nightshade and smartweed. The sequential postemergence applications resulted in nearly 100% control of existing weeds. Weed sizes on July 19 following the initial postemergence treatments were as follows:

Weed height (inches) on July 19	Liberty + Prefix	Liberty +Warrant	Liberty
Common lambsquarters	2-4	2-8	2-8
Common ragweed	2-8	2-4	2-4
Nightshade	*	*	1-2
Pennsylvania smartweed	*	5	4-6
Pigweed	*	2-8	2-10
Grasses	1-4	*	8

* = not present

June 28 postemergence applications of Liberty tank mixed with Zidua, Outlook and Prefix caused injury on soybeans. Injury observed July 8 was greatest with the Prefix tank mix followed by the Zidua tank mix. Prefix injury was leaf crinkling and necrosis. Zidua injury was leaf cupping and crinkling with necrotic edges. Outlook injury was minimal with some minor leaf crinkling. Injury from Liberty + Zidua was also observed on July 29 from the postemergence sequential applied July 19. Injury was leaf crinkling, necrotic tips, and chlorosis. No injury was observed with the Liberty + Outlook treatment applied on July 19 or the Liberty + Warrant treatment applied June 28. Injury observed July 18 and 29 on the Prowl and Dual treatments was a height reduction and may have been a result of increased weed pressure in these treatments.

Little or no rainfall from late July through mid September resulted in highly variable yields. Soybean yields were not significantly different between herbicide treatments. Untreated check plots were not harvested due to high weed populations. Soybean yields in the untreated plots were estimated to be less than 5 bu/A.

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Table 1. Broadleaf weed control ratings.

		Broadleaf Weed Control																								
		Colq					Corw					Ebns					Pesw					Rrpw				
Treatment[1]	Rate[1]	6/28	7/8	7/18	7/29	10/9	6/28	7/8	7/18	7/29	10/9	6/28	7/18	7/29	10/9		6/28	7/8	7/18	7/29	10/9	6/28	7/8	7/18	7/29	10/9
	(product/A)	(%)																								
(Preemergence June 3) / (Postemergence June 28)																										
(Valor SX[2]) / (Liberty[3] + Zidua[4] + AMS[5])	(2 oz) / (29 oz + 2 oz + 1.75 qt)	99	100	100	100	96	98	100	99	99	98	100	100	100	100		99	100	100	100	99	100	100	99	100	100
(Enlite[6]) / (Liberty + Outlook[7] + AMS)	(2.8 oz) / (29 oz + 14 oz + 1.75 qt)	100	100	100	100	99	99	100	100	100	99	100	100	100	100		100	100	100	100	99	100	100	100	100	100
(Preemergence June 3) / (Postemergence July 8) / Postemergence July 29																										
(Prowl H_2O[8]) / (Liberty + AMS) / (Liberty + AMS)	(2.4 pt) / (29 oz + 1.75 qt) / (29 oz + 1.75 qt)	99	99	100	99	99	5	0	97	88	100	46	100	98	100		65	38	94	91	99	100	98	100	98	99
(Dual II Magnum[9]) / (Liberty + AMS) / (Liberty + AMS)	(1.33 pt) / (29 oz + 1.75 qt) / (29 oz + 1.75 qt)	85	78	99	91	98	6	6	97	94	100	100	100	100	99		49	36	97	98	100	100	100	99	98	100
(Preemergence June 3) / (Postemergence July 19)																										
(Authority First[10]) / (Liberty + AMS)	(6.5 oz) / (29 oz + 1.75 qt)	100	100	100	100	100	99	99	99	99	100	100	100	100	100		100	100	100	100	100	100	100	100	100	100
(Valor XLT[11]) / (Liberty + AMS)	(3.5 oz) / (29 oz + 1.75 qt)	100	100	100	100	100	99	99	99	100	100	100	95	100	100		100	100	100	100	100	100	100	99	100	100
(Optill[12] + Outlook) / (Liberty + AMS)	(2 oz + 10 oz) / (29 oz + 1.75 qt)	100	100	99	100	100	99	98	97	100	99	100	100	100	100		100	100	100	100	100	100	100	96	100	100
Postemergence June 28 / Postemergence July 19																										
(Liberty + Prefix[13] + AMS) / (Liberty + Zidua + AMS)	(29 oz + 2 pt + 1.75 qt) / (29 oz + 2 oz + 1.75 qt)	--	99	96	100	100	--	100	99	100	100	--	100	100	100		--	100	100	100	99	--	100	100	100	100
(Liberty + Warrant[14] + AMS) / (Liberty + Outlook + AMS)	(29 oz + 3 pt + 1.75 qt) / (29 oz + 14 oz + 1.75 qt)	--	91	70	99	96	--	99	99	100	100	--	100	100	100		--	96	99	100	99	--	98	97	100	100
(Liberty + AMS) / (Liberty + AMS)	(29 oz + 1.75 qt) / (29 oz + 1.75 qt)	--	97	78	100	99	--	99	98	100	100	--	98	100	100		--	96	93	99	96	--	99	98	100	100
LSD (0.05)		4	7	8	1	1	5	3	1	3	ns	20	ns	1	ns		22	17	3	4	2	ns	ns	ns	1	ns

[1] Treatments and rates in parenthesis represent a separate application timing.
[2] Valor SX 51WDG = flumioxazin.
[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] Enlite 47.86DG = chlorimuron ethyl (2.85%) & flumioxazin (36.21 %) & thifensulfuron methyl (8.80 %).
[7] Outlook 6EC = 6.0 lbs ai/gal dimethenamid-P.
[8] Prowl H2O 3.3EC = pendamethalin.
[9] Dual II Magnum 7.64E = s-metolachlor.
[10] Authority First 70DF = 62% sulfentrazone & 8% chloransulam-methyl .
[11] Valor XLT 40.3WDG = flumioxazin (30.0%) & chlorimuron ethyl (10.3%).
[12] Optill 68WG = 17.8% saflufenacil & 50.2% imazethapyr.
[13] Prefix 5.29EC = 4.34 lbs ai/gal s-metolachlor & 0.95 lbs ai/gal fomesafen.
[14] Warrant 3CS = acetochlor.

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Table 2. Grass weed control, soybean injury, and soybean yields.

Treatment[1]	Rate[1]	Grass Control			Soybean Injury				Soybean
		7/18	7/29	10/9	6/28	7/8	7/18	7/29	Yield
	(product/A)	---------- (%) ----------							(bu/A)
(Preemergence June 3) / (Postemergence June 28)									
(Valor SX[2]) / (Liberty[3] + Zidua[4] + AMS[5])	(2 oz) / (29 oz + 2 oz + 1.75 qt)	100	100	99	0	15	0	0	34
(Enlite[6]) / (Liberty + Outlook[7] + AMS)	(2.8 oz) / (29 oz + 14 oz + 1.75 qt)	100	100	100	0	4	0	0	39
(Preemergence June 3) / (Postemergence July 8) / Postemergence July 29									
(Prowl H_2O[8]) / (Liberty + AMS) / (Liberty + AMS)	(2.4 pt) / (29 oz + 1.75 qt) / (29 oz + 1.75 qt)	100	100	100	0	0	8	3	37
(Dual II Magnum[9]) / (Liberty + AMS) / (Liberty + AMS)	(1.33 pt) / (29 oz + 1.75 qt) / (29 oz + 1.75 qt)	100	100	100	0	0	9	9	43
(Preemergence June 3) / (Postemergence July 19)									
(Authority First[10]) / (Liberty + AMS)	(6.5 oz) / (29 oz + 1.75 qt)	93	99	100	0	0	0	0	37
(Valor XLT[11]) / (Liberty + AMS)	(3.5 oz) / (29 oz + 1.75 qt)	95	100	100	1	0	0	0	37
(Optill[12] + Outlook) / (Liberty + AMS)	(2 oz + 10 oz) / (29 oz + 1.75 qt)	100	100	100	0	0	0	0	36
Postemergence June 28 / Postemergence July 19									
(Liberty + Prefix[13] + AMS) / (Liberty + Zidua + AMS)	(29 oz + 2 pt + 1.75 qt) / (29 oz + 2 oz + 1.75 qt)	99	100	100		23	0	21	37
(Liberty + Warrant[14] + AMS) / (Liberty + Outlook + AMS)	(29 oz + 3 pt + 1.75 qt) / (29 oz + 14 oz + 1.75 qt)	100	100	100		0	0	0	37
(Liberty + AMS) / (Liberty + AMS)	(29 oz + 1.75 qt) / (29 oz + 1.75 qt)	99	100	100		0	0	0	42
LSD (0.05)		2	ns	ns	ns	3	5	6	ns

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

[2] Valor SX 51WDG = flumioxazin.

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[4] Zidua 85WG = pyroxasulfone.

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