

Preemergence weed control in an Enlist soybean cropping system at Rosemount, MN - 2020. Sarangi, Debalin, Douglas Miller, and Ryan Mentz. The objective of this experiment was to compare weed control efficacy and soybean injury with Authority Edge to Authority Supreme, Authority First, Zidua Pro, and Boundary in an Enlist (2,4-D choline) tolerant soybean herbicide program. The experiment was conducted at Rosemount, MN on a Waukegon silt loam (5% sand, 61% silt, 34% clay) with pH 6.8 and 3.8% organic matter. Soil test P and K were 102 and 242 lbs/A, respectively. The area was weedy fallow in 2019 and was chisel plowed in the fall. In the spring of 2020, the area was tilled with a soil finisher on April 6 and fertilized with 60 lbs/A P and 120 lbs/A K on April 9. The area was field cultivated on May 11 and Enlist E3 Stine 20EB23 Brand soybeans were seeded in 30 inch rows at a rate of 150,000 seeds/A. The experimental design was a randomized complete block with four replications. Plot size was 15 by 30 feet. On May 12, preemergence treatments were applied to the center 10 foot wide strip (4 rows) with a tractor mounted, compressed air sprayer with an eight nozzle boom and 15 inch nozzle spacing at 35 psi pressure using 110015VS XR Teejet flat-fan spray tips, producing a spray volume of 15 gpa. On June 9, a postemergence sequential application of Anthem Maxx + Roundup was applied to one of the preemergence treatments (Authority Edge 8oz/A) using the same application methods as described for the preemergence treatments. On June 12, a postemergence application of Enlist One (0.95 lbs ae/A) + Roundup PowerMax (0.77 lbs ae/A) + AMS (3 pts/A) was applied to all preemergence treatments (excluding the Authority Edge / Anthem Maxx/Roundup sequential) and to a check treatment that did not receive a preemergence application. This application was made with a tractor mounted, roller pump sprayer with an eight nozzle boom and 20 inch nozzle spacing at 40 psi pressure using Teejet 110020 AIXR spray tips producing a spray volume of 17 gpa. A broadcast application of Select Max (0.12 lb ai/A) plus COC (1qt/A) was applied to the entire experimental area on July 7. Weed control and soybean injury were visually rated on June 8, July 1, and October 5. Weed densities were measured on June 8 and July 2 in four 0.25 m² grids in each plot. Yields were determined by harvesting the two center rows on November 4. All data were evaluated with an analysis of variance. Data transformations were used as referenced in the Tables. All data presented are the original un-transformed means. Application environmental conditions and weed data are presented below.

Treatment Date	May 12	June 9	June 12
Application	Preemergence	Postemergence Sequential	Postemergence Broadcast Sequential
Target Weed Stage	--	2" weeds	2" weeds
Soybean Stage	--	2 trifoliolate / 6-7"	2 trifoliolate / 6-7"
Air Temperature (°F)	55	78	75
Relative humidity (%)	22	53	47
Dewpoint (°F)	14	60	54
Soil Moisture	moist at 1.5"	moist at 0.5"	moist at 1.0"
Soil Temperature (°F)	62	75	77
Sky	clear	50% clouds	10% clouds
Wind (mph)	WW 3-5	SE 5-8	NNW 3-5
Rainfall before Application			
Week 1 (inch)	0.00	2.19	1.65
Rainfall after Application			
Week 1 (inch)	3.78	0.42	0.99
Week 2 (inch)	0.25	1.56	0.67
Week 3 (inch)	2.17	3.66	3.56

Weed height on June 9 (inches)

untreated check / treated with preemergence*

Common Lambsquarters	--	0.25-2 / 0.25-0.75
Eastern Black Nightshade	--	0.25-1.5 / 0.25
Tall Waterhemp	--	0.25-2 / 0.25
Velvetleaf	--	1-6 / 1-4
Woolly Cupgrass	--	0.5-6 / 0.25-4

* weeds present in preemergence herbicide treated plots were generally smaller compared to the untreated check

Preemergence broadleaf weed control was the primary objective followed by grass species control. Common lambsquarters, eastern black nightshade, tall waterhemp, and velvetleaf were the dominant broadleaf species present. Lambsquarters, tall waterhemp, and velvetleaf distribution were the most uniform of these species. Pennsylvania smartweed was also present but densities were low and highly variable and data are not presented. Woolly Cupgrass and giant / yellow foxtail were the grass species present. A separate application of Select Max was applied on July 7 to remove uncontrolled grasses after the initial ratings. Following the preemergence application on May 12, 0.48 inch of rainfall occurred on May 16 and 3.26 inches on May 17. Total rainfall from May 12 to the June 8 rating date was 8.4 inches. Total rainfall from June 8 to the July 1 rating date was 5.6 inches. A check treatment was included that did not receive a preemergence herbicide but received the postemergence Roundup + Enlist application.

Common lambsquarters was the prominent broadleaf species present with total average density of 308/m² on June 8. Authority Edge, Authority Supreme, and Authority First provided excellent common lambsquarters control throughout the growing season. Zidua Pro also provided good to excellent lambsquarters control with some small seed producing plants noted at the October rating date. Residual control with Boundary was the lowest of the preemergence treatments and did not differ significantly from the postemergence only check on July 1 and October 5. Both the Boundary and the check treatments had seed producing lambsquarters present on October 5. Lambsquarter densities in the Zidua Pro and Boundary treatments were significantly higher than the other preemergence treatments at the June 8 rating date. After the postemergence applications, some late emergence occurred just prior to the July rating date. Lambsquarter densities on July 2 were highly variable however and differences between treatments were not significant.

Eastern black nightshade populations averaged 33/m² on June 8. All preemergence treatments provided excellent control throughout the season and showed significantly greater control than the postemergence only check on July 1 and October 5. Some seed producing plants were present in the check treatment on October 5. Nightshade densities did not significantly differ between treatments on July 2.

Tall waterhemp populations averaged 99/m² on June 8. All preemergence treatments provided excellent control of waterhemp on June 8. At the July 1 rating, the Boundary treatment showed slightly less control than the other preemergence treatments. All preemergence treatments had significantly greater weed control than the postemergence only check at the July 1 and October 5 rating dates. Waterhemp densities did not differ significantly between the preemergence treatments at the June 8 rating date. The Authority Edge/Anthem Maxx preemergence/postemergence sequential had significantly lower waterhemp densities than the other treatments on July 2 with the exception of the Authority Supreme treatment. The Boundary treatment had greater waterhemp densities than any of the other preemergence treatments on July 2. The postemergence only check had the highest waterhemp densities on July 2, significantly greater than all of the preemergence treatments on that date.

Velvetleaf populations averaged 27/m² on June 8. The 10 oz/A rate of Authority Edge, Authority First, and Zidua Pro provided significantly greater velvetleaf control compared to the other preemergence treatments at the June 8 rating date. Boundary provided significantly less velvetleaf control than the other treatments on June 8. Velvetleaf growth suppression was a factor that contributed to the overall better control with these treatments. Density counts on June 8 followed the trends of the control ratings. The postemergence applications (June 9 and 12) controlled the majority of emerged velvetleaf on those dates with the exception of the postemergence only check treatment. Velvetleaf in that treatment ranged up to 6 inches in size compared to a maximum of 3-4 inches in any of the preemergence treatments, resulting in poorer postemergence control. There were no significant differences in visual velvetleaf control or densities between any of the preemergence treatments at the July rating/count dates. The few velvetleaf present in those preemergence treatments were newly emerged after the postemergence application. The lower control and higher velvetleaf densities in the postemergence only check were attributed to the poor postemergence control of the larger velvetleaf present at the postemergence application date. Newer emerging velvetleaf densities in that check treatment (data not shown) did not differ significantly from densities of any of the preemergence treatments on July 2.

Woolly cupgrass populations averaged 419/m² and foxtail populations averaged 37/m² on June 8. Grass species were rated together for control; however those ratings skewed toward woolly cupgrass control because of the higher densities and larger size compared to the foxtail species. Foxtail species (giant and yellow) were combined in the density counts. Foxtail densities were highly variable however and there were no significant differences between treatments.

The 10 oz/A rate of Authority Edge, Authority Supreme, and Zidua Pro resulted in the greatest grass control on June 8 compared to the 8 oz/A rate of Authority Edge and Boundary. All of those treatments caused injury and growth suppression of woolly cupgrass in addition to somewhat lower densities compared to the check (although density differences were not statically significant). Authority First showed little control of woolly cupgrass on June 8. The 21% control rating in the Authority First treatment was attributed to significant woolly cupgrass chlorosis and a slight growth

reduction compared to the check. Density counts in the Authority First treatment were similar to the untreated check on June 8. The woolly cupgrass injury/suppression observed in some of the preemergence treatments on June 8 lead to incomplete kill of those plants by the postemergence applications. This was most apparent with the Authority Edge and Authority Supreme treatments. The best overall kill of woolly cupgrass by the postemergence applications occurred in the Authority First and postemergence only check treatments where the cupgrass was actively growing. The Select Max application on July 7 controlled all remaining grass species and no grasses were observed at the October rating.

No visible soybean injury symptoms were observed. Soybean yields averaged 58.9 bu/acre (data not shown). There were no significant yield differences between treatments, including the check treatment.

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Table 1. (Weed Control)

Treatment	Rate (product/A)	Common Lambsquarters			Eastern Black Nightshade			Tall Waterhemp			Velvetleaf			grass species ¹		
		6/8	7/1	10/5	6/8	7/1	10/5	6/8	7/1	10/5	6/8	7/1	10/5	6/8	7/1	10/5
		----- (% Control) -----														
<u>Preemergence (5-12) / Postemergence (6/9)</u>																
Authority Edge ² / Anthem Maxx ³ + Roundup ⁴	8 oz / 2.5 oz + 22 oz	99 a	99 a	100 a	99 a	98 a	100 a	99 a	99 a	100 a	86 b	97 a	99 a	76 cd	93 d	100 a
<u>Preemergence (5-12) / Postemergence (6/12)</u>																
Authority Edge / Enlist One ⁵ + Roundup + AMS ⁶	8 oz / 2 pts + 22 oz + 3 pts	99 a	99 a	100 a	99 a	99 a	99 a	99 a	99 a	100 a	84 b	98 a	100 a	79 bcd	96 c	100 a
Authority Edge / Enlist One + Roundup + AMS	10 oz / 2 pts + 22 oz + 3 pts	99 a	99 a	100 a	99 a	98 a	100 a	99 a	98 a	100 a	96 a	98 a	100 a	92 a	96 bc	100 a
Authority Supreme ⁷ / Enlist One + Roundup + AMS	8 oz / 2 pts + 22 oz + 3 pts	99 a	99 a	99 a	99 a	99 a	100 a	99 a	99 a	100 a	85 b	98 a	100 a	88 abc	96 c	100 a
Authority First ⁸ / Enlist One + Roundup + AMS	6.4 oz / 2 pts + 22 oz + 3 pts	99 a	99 a	100 a	99 a	98 a	100 a	99 a	98 a	100 a	98 a	97 a	100 a	21 e	98 a	100 a
Zidua Pro ⁹ / Enlist One + Roundup + AMS	6 oz / 2 pts + 22 oz + 3 pts	96 a	98 a	96 ab	99 a	98 a	100 a	99 a	98 a	99 a	95 a	98 a	100 a	91 ab	97 ab	100 a
Boundary ¹⁰ / Enlist One + Roundup + AMS	29 oz / 2 pts + 22 oz + 3 pts	95 a	96 b	94 b	97 a	97 a	100 a	99 a	97 b	99 a	30 c	96 a	99 a	75 d	98 a	100 a
<u>Check - No Preemergence / Postemergence (6/12)</u>																
Enlist One + Roundup + AMS	2 pts + 22 oz + 3 pts	--	97 b	95 b	--	90 b	95 b	--	91 c	93 b	--	77 b	99 a	--	98 a	100 a

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

¹ woolly cupgrass (92%) and giant & yellow foxtail (8%).

² Authority Edge 4.25SC = sulfentrazone (2.73 lb ai/gal) & pyroxasulfone (1.52 lb ai/gal).

³ Anthem Maxx 4.3SC = fluthiacet-methyl (0.126 lb ai/gal) & pyroxasulfone (4.174 lb ai/gal).

⁴ Roundup PowerMax 4.5SL (glyphosate).

⁵ Enlist One 3.8L =2,4-D choline salt.

⁶ AMS = Amsol ammonium sulfate solution (3.4 lbs/gal).

⁷ Authority Supreme 4.16SC = sulfentrazone (2.08 lb ai/gal) & pyroxasulfone (2.08 lb ai/gal).

⁸ Authority First 70DF = 63.1% sulfentrazone & 7.9% chloransulam-methyl..

⁹ Zidua Pro 4.09L = 2.28 lbs ai/gal pyroxasulfone & 0.48 lbs ai/gal saflufenacil & 1.33 lbs ai/gal imazethapyr .

¹⁰ Boundary 6.5L = S-metolachlor (5.25 lb ai/gal) & metribuzin (1.25 lb ai/gal).

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Table 2. (Weed Density)

Treatment	Rate (product/A)	Common Lambsquarters		Eastern Black Nightshade		Tall Waterhemp		Velvetleaf		Woolly Cupgrass		foxtail species ¹	
		6/8	7/2	6/8	7/2	6/8	7/2	6/8	7/2	6/8	7/2	6/8	7/2
----- (# / m ²) -----													
<u>Preemergence (5-12) / Postemergence (6/9)</u>													
Authority Edge ² / Anthem Maxx ³ + Roundup ⁴	8 oz / 2.5 oz + 22 oz	1.3 a	30.8 a	0.8 a	0.8 a	0.8 a	1.8 a	4.8 ab	1.5 a	291 a	83.0 d	5.5 a	6.0 a
<u>Preemergence (5-12) / Postemergence (6/12)</u>													
Authority Edge / Enlist One ⁵ + Roundup + AMS ⁶	8 oz / 2 pts + 22 oz + 3 pts	0.5 a	39.0 a	0.0 a	1.5 a	0.0 a	5.8 bc	6.0 ab	3.5 ab	276 a	60.8 cd	2.3 a	15.5 a
Authority Edge / Enlist One + Roundup + AMS	10 oz / 2 pts + 22 oz + 3 pts	0.5 a	50.5 a	0.8 a	0.3 a	0.8 a	5.5 bc	2.8 a	1.8 a	257 a	49.8 c	17.0 a	24.3 a
Authority Supreme ⁷ / Enlist One + Roundup + AMS	8 oz / 2 pts + 22 oz + 3 pts	0.3 a	41.5 a	0.0 a	1.0 a	0.5 a	3.8 ab	6.0 ab	2.5 a	374 a	60.5 cd	3.8 a	2.5 a
Authority First ⁸ / Enlist One + Roundup + AMS	6.4 oz / 2 pts + 22 oz + 3 pts	1.8 a	27.3 a	2.0 a	1.0 a	2.5 a	8.0 bcd	7.0 ab	1.5 a	421 a	15.0 ab	13.3 a	7.0 a
Zidua Pro ⁹ / Enlist One + Roundup + AMS	6 oz / 2 pts + 22 oz + 3 pts	22.0 b	100.8 a	0.5 a	0.3 a	2.8 a	10.8 cd	10.5 abc	1.8 a	197 a	33.0 abc	22.0 a	13.0 a
Boundary ¹⁰ / Enlist One + Roundup + AMS	29 oz / 2 pts + 22 oz + 3 pts	29.0 b	79.8 a	0.5 a	1.3 a	6.5 a	19.3 d	16.8 bc	2.3 a	261 a	41.0 bc	3.8 a	11.0 a
<u>Check - No Preemergence / Postemergence (6/12)</u>													
Enlist One + Roundup + AMS	2 pts + 22 oz + 3 pts	308 c	48.8 a	33.0 b	2.5 a	99.0 b	41.8 e	27.3 c	8.5 b	419 a	11.0 a	37.0 a	17.0 a
Data transformation applied ¹¹		AL	AL	AL	AS	--	AL	AL	AL	--	--	AS	AL

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

¹ giant & yellow foxtail.

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¹¹ Data transformation - AA = Automatic arcsine square root %, AL = Automatic log of X+1, AS = Automatic square root transformation of X+0.5, NT = Not transformed.