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Relative Sensitivity of Common Preemergence Herbicides for Soybeans

Selecting the appropriate herbicide requires careful consideration of several factors, with soybean tolerance. Although most herbicide studies examine both weed control efficacy and crop safety, there is often a limited amount of data that focuses exclusively on the impact to the crop itself. This gap in information can make it challenging for growers to make fully informed decisions. In recent years, several new herbicide premixes have been introduced to the market, many promising enhanced weed control and broader spectrum of control. However, the effectiveness and safety of these new products under the diverse environmental and management conditions of the Mid-Atlantic region remain largely untested. As a result, there is a pressing need to thoroughly evaluate the crop safety and overall performance of these herbicides within the context of current soybean production practices. To address this, a trial was established at the University of Delaware's Research and Education Center in Georgetown, DE, to assess soybean crop safety following preemergence herbicide applications and to determine the influence of environmental conditions at planting on soybean safety.

Factors included soil applied-herbicides, soybean variety and planting dates. Five herbicides were included (*table 1*); these were applied alone or in combination (*table 2*). The herbicides rates were 25% higher than recommended rates. Two soybean varieties were used based on previous research that exhibited different tolerances to metribuzin and chlorimuron, AG37XF1 and AG38XF3. Planting dates were April 15 and May 13, 2024, representing early-planted soybeans and a more conventional planting date. Plots were arranged as randomized complete block with four replications.

Plots were planted into no-till field at 160K seeds per acre in 30-inch rows with 2 rows per plot and 25 ft long. Soil was a Rosedale loamy sand (75% sand, 14% silt 11% clay) with 1.6 O.M. and 6.2 pH. Plots were sprayed with a 6-nozzle boom with 11002 AirMix tips at 20 GPA one day after planting. Treatments received irrigation within 48hrs of application. A postemergence herbicide was applied to the entire study to eliminate weed competition. Overhead irrigation was supplied as needed.

Plots were rated on 7 to 10 day intervals starting at unifoliate stage on a scale of 0 (no injury) to 100 (plant dead). Soybean injury over time was calculated with analysis of area under the curve (AUC). AUC is a value that represents the average daily stunting over a period of 20 days (from 30 to 50 days after planting). Analysis of variance was conducted and means separated using Fisher's Protected LSD test, p=0.05.

Table 1. Herbicide rates.

	Herbicide	**Rate**	
1	Dual Magnum (s-metolachlor)	1.88	pt/A
2	Metribuzin	6	oz wt/A
3	Valor EZ (flumioxazin)	3.75	fl oz/A
4	Spartan (sulfentrazone)	9	fl oz/A
5	Classic (chlorimuron)	2.5	oz wt/A

Table 2. Herbicide single and combination treatments.

TrtNo.	**Herbicide 1**		**Herbicide 2**		**Herbicide 3**
1	Dual Magnum				
2	Dual Magnum	+	Metribuzin		
3	Spartan				
4	Spartan	+	Metribuzin		
5	Valor EZ				
6	Valor EZ	+	Metribuzin		
7	Classic	+	Metribuzin		
8	Spartan	+	Classic		
9	Spartan	+	Classic	+	Metribuzin
10	Valor EZ	+	Classic		
11	Valor EZ	+	Classic	+	Metribuzin
12	Untreated Check				

Results

April-planted soybeans emerged 14 days after planting (DAP) while May planted emerged 10 DAP. There were slight differences between the two varieties used in the trial, with AG38XF3 exhibiting slightly more injury than AG37XF1. Averaged across all other factors, AG37XF1 exhibited 17% injury while AG38XF3 exhibited 21%. Variety was not significant with interactions, so data is presented averaged over variety.

Trends observed at 30 days after planting (DAP) were consistent for all rating dates. For April-planted soybeans, Valor plus metribuzin and Dual alone were the two treatments with the least

injury (less than 12%) (*table 3*). Injury for May-planted soybeans at 30 DAP was higher overall, yet Dual alone, Dual plus metribuzin, and Valor alone had less than 12% injury. Injury was higher for May-planted soybeans treated with Spartan+metribuzin, Spartan+Classic, Spartan+Classic+metribuzin, and Valor+Classic compared to the April-planted soybeans. At 30 DAP, April-planted soybeans were at 1 trifoliate stage whereas May-planted soybeans were at the 3-4 trifoliate stage. The more advanced soybean plants account for the difference in the amount of stunting observed. Since soybeans were planted at different times, ratings at 30 DAP were also collected on different dates. Injury was less with Valor alone in May planting compared to April-planted soybeans.

Treatments with chlorimuron, regardless of planting date, exhibited the most injury. There was little differences among chlorimuron-containing treatments. The study did not include a chlorimuron only treatment to parse out differences.

AUC was higher for the April-planted soybeans than the May-planted plots. The difference in soybean stage at 30 DAP accounted for these differences. Dual had the lowest AUC (least amount of injury over time). For comparison, Dual only for April-planted soybeans was 11.5, 1, and 0%, when rated at 30, 40, and 50 DAP. Spartan and Spartan+metribuzin was higher than Valor treatments, and all treatments with chlorimuron had the highest AUC values (highest injury levels).

The effect of metribuzin on soybean injury was not consistent. When metribuzin was combined with Dual, Spartan, and Valor increases in injury ratings were inconsistent and were seldom significant. One situation was the addition with Valor for May-planted soybeans increased injury, but the addition of metribuzin to Valor plus chlorimuron did not increase injury for the same planting date.

Table 3. Soybean stunting at 30 days after planting (DAP) and area under the curve (AUC). AUC is a value that represents the average daily stunting over time. AUC time-period in our trials was 20 days (from 30 to 50 days after planting).

TrtNo.	Herbicide(s)	April planted soybean injury		May planted soybean injury		April planted AUC[a]		May planted AUC	
1	Dual	11.5	ijk[x]	7.4	kl	56	i	59	i
2	Dual+Metribuzin	15.1	hij	11.9	ijk	183	h	188	h
3	Spartan	16.9	ghi	21.5	e-h	377	ef	298	fg
4	Spartan+Metribuzin	15.1	hij	30	bcd	422	e	389	ef
5	Valor EZ	15.1	hij	8.4	jk	250	gh	48	i
6	Valor EZ+Metribuzin	9.8	ijk	15.3	g-j	214	gh	248	gh

7	Classic+Metribuzin	19.9	fgh	22.8	d-g	792	b	468	e
8	Spartan+Classic	22.8	d-g	34.4	ab	786	b	662	cd
9	Spartan+Classic+Metribuzin	19.9	fgh	40	a	824	ab	728	bcd
10	Valor EZ+Classic	25	c-f	35.6	ab	900	a	761	bc
11	Valor EZ+Classic+Metribuzin	28.8	b-e	32.5	abc	790	b	647	d
12	Untreated Check	0	I	0	I	0	i	0	i
	P[y]>F 0.0001								

[a] AUC = area under the curve

[x] Means within a column followed by the same letter are not significantly different (p=0.05) according to Fisher's protected LSD test.

[y] P values ≤0.05 indicate significant differences exist among treatments

Soybean injury did not translate directly to yield loss. April-planted soybeans yield higher than May-planted soybeans, the untreated check for April planting yielded 75 lb/A and May planting yielded 68 bu/A. This supports the current trend of Delaware farmers to plant soybeans in April rather than planting in May or June. Yields of April-planted soybeans were reduced with Dual alone, Dual+metribuzin, and Valor+metribuzin as compared to the untreated check (*table 4*). May-planted soybean yields were similar for all treatments except Classic+metribuzin and Valor+Classic+metribuzin. Treatments containing chlorimuron (Classic) had the most amount of stunting and injury, but most these treatments had similar yields to the untreated check.

Table 4. Soybean yield as percentage of untreated check for variety and planting date.

TrtNo.	**Herbicide(s)**	April planted soybean yield (%UTC)			May planted soybean yield (%UTC)	
1	Dual	89.7	**		96.7	
2	Dual+Metribuzin	87.7	**		91.1	
3	Spartan	98.0			96.9	
4	Spartan+Metribuzin	91.0			96.0	
5	Valor EZ	94.1			98.5	
6	Valor EZ+Metribuzin	88.9	**		97.3	
7	Classic+Metribuzin	91.3			89.6	**

8	Spartan+Classic	99.1			90.1	
9	Spartan+Classic+Metribuzin	95.6			91.3	
10	Valor EZ+Classic	99.7			91.5	
11	Valor EZ+Classic+Metribuzin	95.0			87.1	**
P[y]>*F*		0.053				

[x] Means within a column followed by the same letter are not significantly different (p=0.05) according to Fisher's protected LSD test.

**Indicate mean is significantly different from untreated check for respective variety and planting date

[y] P values ≤0.05 indicate significant differences exist among treatments

Summary

- Classic consistently showed greater injury than other herbicides regardless, of planting date however no yield reductions were observed with Classic treatments applied to the April-planted soybeans. With the May-planted soybeans, Classic plus metribuzin and the three-way combination of Valor+Classic+metribuzin had lower yield than untreated check.
    - Note that the chlorimuron (Classic) rate used in this study was based on amount of chlorimuron in Canopy premix. Chlorimuron rates in many other premixes is lower. Furthermore, we seldom observe injury in our research over 10% from chlorimuron-containing products when used at their recommend rates.
- Yields of soybeans planted in April planting were reduced with three treatments (Dual alone, Dual+metribuzin, and Valor+metribuzin) even though these treatments exhibited less injury.
- Valor consistently exhibited less injury than Spartan.
- Based on AUC, overall injury was reduced with treatments sprayed in the May planting date compared to April planting.
- Based on soybean injury (mostly stunting) metribuzin was quite safe which was unexpected given the concern voiced by farmers and ag-chemical dealers over the years about injury.
- Additional research is needed to understand the consistency of these results and underlining factors involved

Recommendations

- Caution when using metribuzin and Dual for April-planted soybeans
    - While we observed less injury, yields were lower
- Less concern about injury with May-planted soybeans

    - Make folks are aware of chlorimuron injury, even though it may not translate to yield loss
- Chlorimuron was the herbicide in this trial with the highest concern for injury and care to avoid over-applying and over-lapping applications
- Follow up research to focus on April-planted soybeans for both injury and yield