

Potential of Glyphosate-Manganese Interaction, 2008-2010

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Introduction

There have been a few reports in the Upper Midwest about Mn related problems with Roundup Ready (RR) soybean. Dodds et al. (2001) found growth of a RR variety on Mn limiting soil was inhibited more by Mn deficiency than for growth of a conventional variety, although Dodds et al. (2002) also found that not all RR varieties exhibited the same response. Gordon (2007) found a RR variety to be more responsive to Mn fertilization than for a conventional variety under a high yield environment.

The board members of the Howard County Experimental Farm were curious of this subject and voted to study this issue on some of the common soils farmed in Howard County. Thus, a three year trial was initiated in 2008 at the Howard County Experimental Farm.

Materials and Methods

Cropping history at this site was a long-term corn-soybean rotation. Tillage was a tandem disk tillage pass in spring before planting. These were large plots with the experimental units averaging 0.37 acres. The 2008 and 2010 trials were conducted on Lourdes loam and Protivin loam soils. The 2009 trial was conducted on Clyde silty clay loam, Riceville loam and Cresco loam soils.

The trial in 2008 only compared POST glyphosate and Mn applications. In 2009, a spring applied sulfur fertilization treatment was added. In 2010, a conventional herbicide treatment was added to compare against the POST glyphosate herbicide program.

The trial was a randomized complete block design with three replications. The soybean planting rate was 163,000 seeds per acre in 30-inch rows. A 6% Mn chelate product was applied foliar at 0.3 lb. Mn/ac. The sulfur treatment in 2009 was applied preemergence at 30 lbs. S/ac. as calcium sulfate. Soybean variety, planting date, treatments and yields are provided in Tables 3-5.

Soil fertility was maintained under a grid sampling system to meet Conservation Security Program (CSP) requirements. The soil test results from spring sample collections for each site/year is provided in Table 1.

Table 1. Soil test results.

Year	pH	OM	Bray P ₁	K	Mn	S
		%	ppm	ppm	ppm	ppm
2008	7.1	2.9	35	87	3.3	--
2009	6.8	3.5	31	111	3.6	4
2010	7.0	3.0	34	105	3.0	--

Plant analysis from samples collected at the R1 stage, prior to the application of POST-applied treatments, is provided in Table 2. Samples collected at early flower consisted of the newest fully developed leaf from two dozen plants.

Table 2. Plant analysis results at R1 stage.

Year	Mn	S
	ppm	%
2008	68	--
2009	49	0.15
2010	72	--

Results and Discussion

In 2008, there was a significant yield response to the foliar Mn application applied 14 days following the POST glyphosate application (Table 3). This occurred even though the plant analysis for Mn was 68 ppm, which should have been adequate. Mn levels in

soybeans are considered to be sufficient with 21-100 ppm Mn (Schulte E.E. and K.A. Kelling, 2004). However, this same reference suggests Mn soil test levels at this research site are low, being less than 10 ppm.

In 2009, there was no yield response to a foliar applied Mn application, or to spring applied sulfur fertilizer (Table 4). The plant analysis for S was 0.15%, which is considered to be at a Low to Deficient level (Schulte E.E. and K.A. Kelling, 2004). In 2007, this research site responded with a 5.3 bu/ac. yield increase in corn to S fertilizer.

In 2010, there was no difference in yield between Pre and Post herbicide programs (Table 5). Weed pressure was considered typical for the season (Figure 1). Weed control was very good for all programs. There were some escapes of Common Ragweed with the Prefix program, and some escapes of Lambsquarters with the Flexstar Fusion program. But the weed escapes were light, and all herbicide treatments provided adequate weed control for the season.

There was a small but significant difference in yield between the RR and Flexstar Fusion program (Table 5). Possibly this was from a necrosis or “burn” effect of Flexstar Fusion on the soybean foliage (Figure 2). This slowed canopy closure by about one week compared to the RR program.

There was no yield response to a foliar applied Mn application, whether following a RR program or not (Table 5). This is identical to results of in 2009, but in 2008 on the identical site as the 2010 trial a significant yield response to foliar Mn occurred. The positive yield response to the foliar Mn application in 2008 remains unexplained. However, it may be due to variety. The 2010 trial used Pioneer

92Y30RR while the 2008 trial used Pioneer 92M40RR. Dodds et al. (2002) found that not all RR varieties were responsive to Mn suggesting the Mn response may not be directly linked to the RR trait. Along these same lines, Zobiolo et al (2010) in Brazil found about 66% of RR soybean varieties tested did not show lower Mn concentrations in new leaves.

References

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Table 1. Yield and grain moisture, 2008. Pioneer 92M40 RR. Planted May 19, 2008.

Herbicide treatment	Grain yield	Grain moisture
	bu/ac	%
POST glyphosate on July 10	41.0 a	11.7 a
POST glyphosate tank mixed with Foliar Mn on July 10	39.0 a	11.8 a
POST glyphosate on July 10 + Foliar Mn on July 24	45.1 b	11.6 a
LSD _{0.05} Means sharing a common letter do not differ significantly.	2.2	0.4

Table 2. Yield and grain moisture, 2009. Pioneer 92Y30 RR. Planted May 12, 2009.

Herbicide treatment	Grain yield	Grain moisture
	bu/ac	%
POST glyphosate on July 11	45.0 a	11.7 a
POST glyphosate on July 11 + Foliar Mn on July 25	46.1 a	11.7 a
POST glyphosate on July 11 + Sulfur applied pre-plant	45.9 a	11.8 a
POST glyphosate on July 11 + Sulfur + Foliar Mn on July 25	45.4 a	11.8 a
LSD _{0.05} Means sharing a common letter do not differ significantly.	2.3	0.2

Table 3. Yield and grain moisture, 2010. Pioneer 92Y30 RR. Planted May 22, 2010.

Herbicide treatment	Grain yield	Grain moisture
	bu/ac	%
PRE, Prefix on May 26	57.4 ab	11.1 a
POST Flexstar Fusion on July 10	56.6 b	11.1 a
POST Roundup on July 10	58.7 a	11.1 a
POST Flexstar Fusion on July 10 + Foliar Mn on July 23	56.9 ab	11.1 a
POST Roundup on July 10 + Foliar Mn on July 23	57.4 ab	11.1 a
LSD _{0.05} Means sharing a common letter do not differ significantly.	2.0	0.1



Figure 1. Typical weed pressure and weed size one week prior to postemergence applications.



Figure 2. Left of the flag is soybeans after the Flexstar Fusion postemergence application. Right of the flag is soybeans after the Roundup postemergence application. There is a mild necrosis of the leaves following the Flexstar Fusion application.