Influence of pH on Carryover of Triketone Herbicides in Missouri No-till Corn and Soybean Rotations

Missouri Fertilizer and Lime Council Final Report, 2010

Investigators: Dr. Kevin Bradley and Dr. Peter Scharf

Objectives: To determine if variations in soil pH have an influence on the carryover of the triketone herbicides Callisto (mesotrione), Impact (topramezone), and Laudis (tembotrione) to soybeans the season following treatment.

Procedures: The experiment was arranged in a split block design with 4 replications of 4 herbicide treatments and 5 pH levels. Whole plots were herbicide treatments while subplots were individual pH levels. Five soil pH levels were maintained on existing variable pH plots located at the Bradford Research and Extension Center near Columbia, Missouri. Each year, soil samples were taken in each plot to determine amounts of lime and iron sulfate needed to adjust pH levels prior to the initiation of the experiments. This resulted in the following five average pH levels: 4.5, 5.4, 6.7, 7.0, and 7.2. The soil type was a Mexico silt loam with 2.5% organic matter. The year prior to soybean, herbicide treatments applied to corn consisted of Callisto at 3 fl ozs/A, Impact at 0.75 fl ozs/A, Laudis at 3 fl ozs/A, and an untreated, weed-free check. In both years, these treatments were applied to corn that was 75 cm in height. Herbicide applications were made on June 21 in 2008 and June 17 in 2009. All herbicide treatments were applied across each of the five average soil pH levels resulting in a total of 20 treatment comparisons. In both corn and soybeans, all plots were kept weed-free throughout the experiments through applications of glyphosate and hand weeding. MorSoy 3738 and Asgrow 4005 soybeans were planted at 160,000 seed/A on June 2, 2009 and May 28, 2010, respectively. Visual soybean injury and height (2 measurements per plot) were recorded each year at 14 and 28 days after emergence. Soybeans were harvested from the two center rows in each plot with a small plot combine and yields were adjusted to 13% moisture content. All data were analyzed using the PROC MIXED procedure in SAS and means were separated using Fisher's protected LSD (0.05). Soybean heights at both the 14 and 28 day after emergence assessment intervals were significantly different between years and therefore the data were analyzed separately. There were no differences in soybean yields between years, therefore 2009 and 2010 data were pooled for analysis.

Results: Rainfall totals received in all 3 years of the experiment were significantly greater than the 30-year average, especially in April, June and July (Figure 1). This likely had a dramatic impact on the degree of triketone herbicide carryover observed in these experiments. Under drier conditions and years with a more "normal" rainfall pattern, carryover of these herbicides is more likely and the results of these experiments may have differed.

There were no differences in soybean height at either assessment timing in 2009 (data not shown). However, there were slight differences observed in 2010 and these are recorded in Tables 1 and 2. When compared to the untreated control, soybean heights 14 days after emergence in 2010 were significantly lower in response to Callisto applications made the previous season in plots with the most acidic soil pH values (Table 1). However, there were no

reductions in soybean height at 14 days after emergence in response to Impact or Laudis applications made to corn the previous season, regardless of soil pH. By 28 days after emergence, however, the soybeans had recovered and there were no reductions in soybean height in response to applications of Callisto made the previous season (Table 2). Also at 28 days after emergence, soybean heights were reduced in response to Impact applications made the previous season in plots with the most acidic soil pH values (Table 2). Within all plots that had an average soil pH of 4.5, Impact applications made the previous season also reduced soybean height more than either Callisto or the untreated control.

Across all soil pH values, soybean yields in plots that received a triketone herbicide the year prior to soybean planting were not reduced compared to plots not receiving a triketone herbicide application (Table 3). However, soybean yields in the most acidic plots that received Impact were significantly lower than all other plots that received Impact.

Summary and Conclusions: In this research, none of the triketone herbicides reduced soybean yields the season following treatment compared to the untreated control, regardless of soil pH. However, results from this research also indicated that Impact applied on acidic soils (~pH 4.5) in corn has the potential to cause height and yield reductions to soybeans the season following treatment. Although some initial stunting occurred on acidic soils in response to Callisto applications made the previous season, soybeans recovered by 28 days after emergence and no yield reductions were observed. Another interesting finding from this research is that no visual symptoms of triketone herbicide carryover injury were observed in response to any treatment during either growing season (data not shown), yet some height and yield responses were observed. Above-average rainfall amounts received throughout these experiments are likely to have played a major role in the persistence of triketone herbicides in the soil and the results of these experiments.

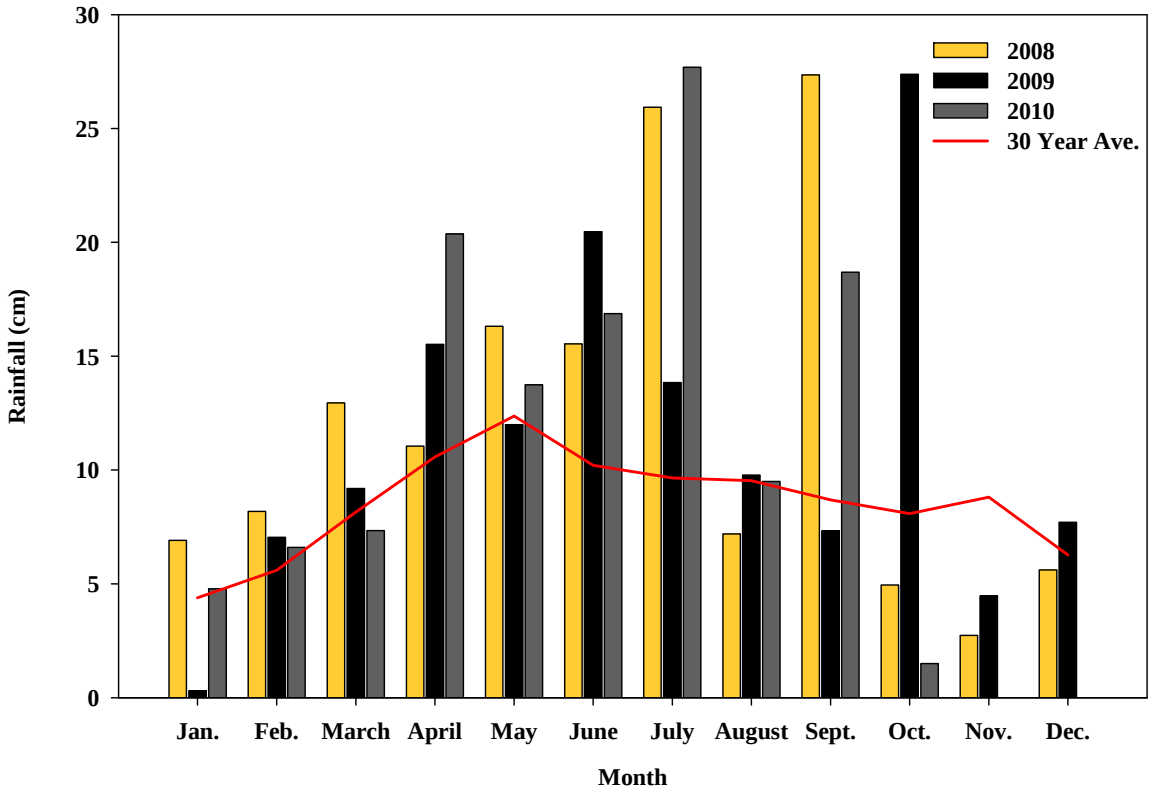

Figure 1. Monthly rainfall totals in Columbia, Missouri throughout the experiment as compared to the 30-year average.

Table 1. Soybean heights 14 days after emergence in response to soil pH and triketone herbicide applications made to the 2009 corn crop.

	Average Soil pH				
Treatment[a]	4.5	5.4	6.7	7.0	7.2
	---------2010 Soybean Heights 14 Days after Emergence (cm)[bc]----------				
Callisto	12.9 B b	14.3 A ab	15.1 AB a	13.3 B ab	13.0 A b
Impact	14.3 AB b	14.1 A b	16.0 A a	15.2 A ab	14.0 A b
Laudis	13.2 AB a	14.6 A a	13.2 B a	13.5 B a	13.1 A a
Untreated	14.5 A a	14.1 A a	13.8 B a	13.7 AB a	14.3 A a

[a] Treatments applied to 75-cm corn the growing season prior to soybean planting.
[b] Means within a column followed by same uppercase letters are not different (P≤0.05).
[c] Means within a row followed by same lowercase letters are not different (P≤0.05).

Table 2. Soybean heights 28 days after emergence in response to soil pH and triketone herbicide applications made to the 2009 corn crop.

	Average Soil pH				
Treatment[a]	4.5	5.4	6.7	7.0	7.2
	---------2010 Soybean Heights 28 Days after Emergence (cm)[bc]----------				
Callisto	39.7 A a	39.7 A a	40.5 A a	39.5 A a	40.0 A a
Impact	34.3 B c	38.1 A b	40.8 A a	38.4 A ab	40.6 A ab
Laudis	36.4 AB b	40.0 A ab	41.0 A a	40.3 A a	38.9 A ab
Untreated	38.4 A b	38.7 A ab	41.1 A a	40.0 A ab	41.0 A a

[a] Treatments applied to 75-cm corn the growing season prior to soybean planting.
[b] Means within a column followed by same uppercase letters are not different (P≤0.05).
[c] Means within a row followed by same lowercase letters are not different (P≤0.05).

Table 3. Soybean yield response to soil pH and triketone herbicide applications made the previous growing season (2009 and 2010 combined data).

	Average Soil pH				
Treatment[a]	4.5	5.4	6.7	7.0	7.2
	---------- Soybean Yield (Bu/A)[bc] ----------				
Callisto	53 A a	52 B a	54 AB a	52 A a	53 AB a
Impact	51 A b	57 A a	56 A a	54 A a	56 A a
Laudis	50 A b	55 AB a	54 AB ab	53 A ab	54 AB ab
Untreated	49 A a	49 C a	52 B a	51 A a	51 B a

[a] Treatments applied to 75-cm corn the growing season prior to soybean planting.
[b] Means within a column followed by same uppercase letters are not different (P≤0.05).
[c] Means within a row followed by same lowercase letters are not different (P≤0.05).