Utilizing Geospatial Technology to Assess Off-target Dicamba Injury and Yield Loss in Missouri Soybean Fields

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INTRODUCTION

In 2016 and 2017, applications of dicamba were made to dicamba-tolerant (DT) soybean and cotton in order to control problematic weeds, such as herbicide resistant waterhemp and palmer amaranth. Unfortunately, a portion of these applications moved off-target and caused an estimated 40,000 and 130,000 hectares of non-DT soybean damage in Missouri in 2016 and 2017, respectively. Similar situations occurred throughout the eastern half of the United States. Previous research has shown soybean yield loss is dependent on growth stage and exposure dosage[1]. However, in field settings, practitioners are usually unaware of the specific dose of dicamba that moved off target to non-DT soybeans, making yield difficult to predict.

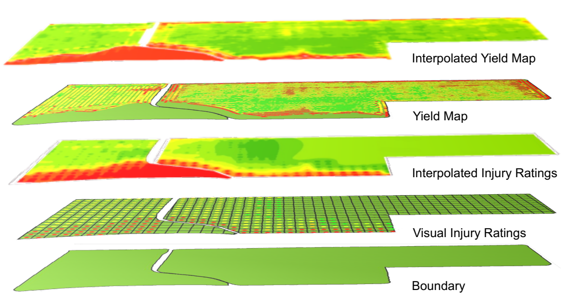
OBJECTIVES

To determine if late-season visual evaluations of dicamba injury can predict yield loss on a field-scale level.

MATERIALS AND METHODS

- Between 2016 and 2017 seven separate non-DT soybean fields that were injured by off target movement of dicamba were visually assessed according to the Behrens and Lueschen scale (1979).[2]
- Field boundaries and sample grids of 25 meter spacing were mapped in AgLeader SMS Mobile software.
- Visual soybean injury ratings were recorded once soybean reached the R6/R7 stage of growth. Handheld GPS units (Fig. 4) were used to navigate to the predetermined grid locations so ratings could be georeferenced (Fig. 1).
- Injury evaluations were grouped by severity and interpolated in GIS so area associated with each range could be calculated (Fig. 1, Table 1).
- Site-specific yield information for each sampled location was obtained through combine yield monitors (Fig. 1).
- Yields were grouped into ranges representing how site-specific yield values compared to the field average, then interpolated to calculate area (Fig. 1, Table 1).
- Soybean yield and visual injury ratings at each predetermined sample location were compared in SAS using the MEANS and GLM procedure at the 0.05 level of significance.
- Injury ratings were grouped to predict yield loss ranges based on the MEANS procedure and compared to the actual yields.

Figure 1

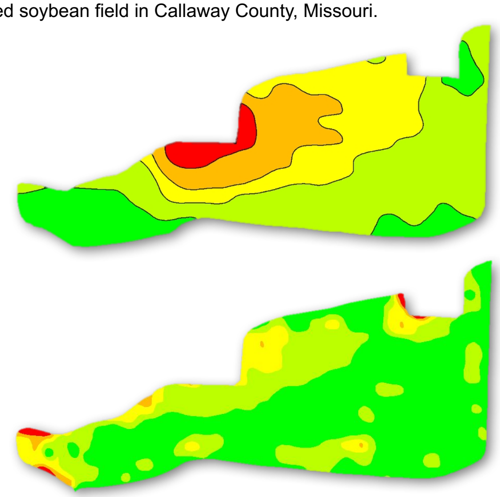


RESULTS

Figure 2. Late season visual injury (A) and yield (B) from a dicamba-injured soybean field in Callaway County, Missouri.

A

B



Legend for Figure 2A and 2B		
Color Scheme	% Visual Injury Ranges (A)	% Yield of Field Average (B)
	0	≤ 100
	1-20	99-90
	21-40	89-80
	41-60	79-70
	61-80	≤ 70

- For the Callaway County field, estimated total yield was within 2300 kg (3.6%) of actual yield (Table 1). However substantial differences existed between the estimated number of hectares and the actual number of hectares assigned to each range (Table 1).
- Across 7 fields sampled in 2 years, yield estimations ranged from -1.6 to 4.9% of the actual harvested yields (Table 2).
- Based on historic yield averages, mean yields were much higher in 2017 than 2016 (Table 3).*

Table 1. **Estimated** vs. Harvested Yield for the Callaway County Field Example

Injury Range (%)	%Yield of Field Avg.	Mean (Kg/Ha)		Hectares		Yield (Total Kg)	
		Estimated	Actual	**Estimated**	Actual	**Estimated**	Actual
0	>100	**4,427**	4,206	**2.36**	8.70	**10,625**	36,592
1-20	100-90	**4,430**	3,996	**5.76**	2.22	**25,694**	8,871
21-40	90-80	**3,946**	3,575	**3.30**	2.12	**13,022**	7,579
41-60	80-70	**3,780**	3,154	**2.00**	0.64	**7,560**	2,419
61-80	<70	**3,339**	2,944	**0.52**	0.26	**1,670**	756
Totals				**13.94**	13.94	**58,571**	56,217

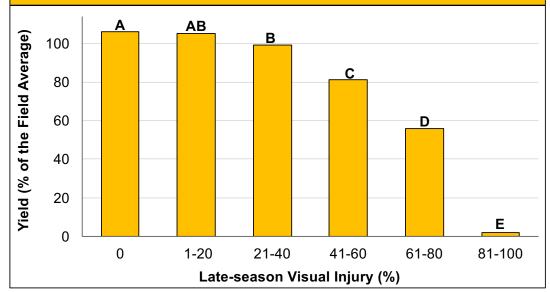
Table 2. **Estimated** Total Yield vs Harvested Yield (Kg) for All Fields

Field #	**Estimated (Kg)**	Harvested (Kg)	Percent of Harvested
1	**58,871**	59,825	-1.6%
2	**51,063**	50,426	1.2%
3	**60,831**	57,832	4.9%
4	**72,768**	71,499	1.7%
5	**58,571**	56,217	3.6%
6	**191,063**	181,655	4.9%
7	**5,956**	5,755	3.4 %
Mean Percent of Harvested			**2.6 %**

Table 3. % Yield of Historic Average by Field

Year	Field #	% Yield of Historic Average	Mean
2016	1	92%	98%
	2	98%	
	3	100%	
	4	103%	
2017	5	140 %	119%
	6	117 %	
	7	100%	

Figure 3. Effect of late-season visual soybean injury on soybean yield loss across 7 fields assessed in 2016 and 2017.



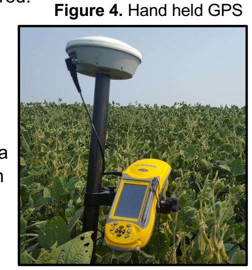
*means followed by the same letter are not different, P=0.05

- When less than 20% injury was observed on soybean at R6/R7, no significant yield loss occurred (as a percent of the field average) (Figure 3).
- When greater than 20% late-season visual injury was observed, soybean yield was significantly reduced compared to areas where no injury was observed (Figure 3).
- Yield losses of 7, 25, and 50% occurred with R6/R7 visual injury ratings of 21-40, 41-60 and 61-80%, respectively.

CONCLUSIONS

Results from these 7, real-world field examples show that soybean yield loss is likely if practitioners assess fields at the late growth stages (using the Behrens and Lueschen scale) and observe visual injury greater than 20%. These results should not be misinterpreted to mean that visual injury ratings taken at earlier growth stages will result in the same response. Preliminary results from this research also indicates that it is possible to predict late-season injury and yield loss if enough current and historical data is gathered. When averaged across all 7 fields, yield estimate predictions within 2.6% of the actual yield harvested. Additionally, this research may provide insight into why many growers may have assumed there was no yield loss following dicamba injury in 2017, as yields were much greater than the historic average.

Figure 4. Hand held GPS



References

1. Solomon and Bradley, 2014. Weed Technol. 28(3).
2. Behrens and Lueschen, 1979. Weed Sci. 27.

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