WiscWeeds Research Update Series: Article 2
October 2020
Madison, WI

Soybean Injury as Influenced by Synthetic Auxin Formulation and Spray Additives[1]

Take Home Message

- Mitigating off-target movement (OTM) is a challenge for producers considering the use of synthetic auxin herbicides
- Glyphosate did not impact soybean symptomology; however, application time of year (weather conditions) was one of the most influential factors
- Early POST applications (late May to mid June) of dicamba may be more likely to face weather conditions at the time of and following dicamba applications less conducive for secondary OTM

Introduction

Synthetic auxin herbicides have been commonly used for selective control of broadleaf weeds in labeled cropping systems since the registration of 2,4-D in the late-1940s. Approximately 41% of Wisconsin corn acres were treated with a synthetic auxin herbicide in 2018 (USDA-NASS 2019). Recent commercialization of soybean varieties with stacked resistance to synthetic auxin herbicides, Roundup Ready 2 Xtend® (RR2X) and Enlist E3™, permit use of dicamba (RR2X) and 2,4-D choline (Enlist E3™) postemergence (POST), respectively. A 2020 Wisconsin Cropping Systems Survey indicated roughly 1/3 of growers planting RR2X soybeans were planning to utilize dicamba POST while 80% of those planting Enlist E3™ were planning to apply 2,4-D choline POST (Arneson and Werle 2020).

Field Experiment Overview

In 2019 the UW-Madison Cropping Systems Weed Science Lab conducted several field low tunnel volatility experiments evaluating the impact of synthetic auxin formulation and spray additives on soybean injury (description below).

Off-target Movement of Synthetic Auxins

A challenge to the use of synthetic auxin herbicides is managing the risk for OTM. Current label restrictions on products approved for use in RR2X and Enlist E3™ soybeans largely address primary particle drift. Secondary OTM, movement of vapor and small particles, is known to be influenced by environmental conditions (Behrens and Lueschen 1979; Bish et al. 2019a; Egan et al. 2014; Egan and Mortensen 2012; Mueller et al. 2013; Sciumbato et al. 2004a; Soltani et al. 2020). OTM can result in injury in nearby sensitive crops, such as non-tolerant soybeans (Fig. 1).

Figure 1. Typical injury symptoms resulting from synthetic auxin OTM; dicamba (left) and 2,4-D (right).

Materials and Methods (Technical Description)

A low tunnel volatility experiment was conducted in Arlington, 2019 and repeated in space (separate, adjacent fields), comparing early and late application timing for six treatments and one nontreated control (NTC). The six treatments at 4× labeled POST rates consisted of XtendiMax® with VaporGrip® technology (88 fl oz ac^{-1}), Status® (64 fl oz ac^{-1}), and Enlist One™ with Colex D technology (6 pts ac^{-1}), with and without glyphosate (Roundup Powermax®, 128 fl oz ac^{-1}). The 4× rates are commonly used in low tunnel volatility experiments to increase likelihood of volatility and treatment separation. Planting dates for RR2Y soybeans were staggered to permit the experiments to be conducted on V3 to V5 soybeans, regardless of application timing.

Briefly, low tunnels were constructed of PVC arches and pipes and covered with clear plastic sheeting so that the tunnel ran parallel with the soybean rows (Fig. 2). Herbicide treatments were applied to flats filled with soil at an offsite location, transported to the field, and carefully placed in the center of the tunnel between two soybean rows. Flats and tunnels were removed 48 h after placement. Soybean visual injury (0-100%) was collected 28 days after treatment (DAT) at the center of the plot and in 1' increments for an additional 10'.

Statistical analysis – R 4.0.0 Field injury data was used to calculate Area Under Injury over Distance Stairs (AUIDS), generating one value reflecting severity and consistency of injury in the plot. A linear mixed model was fit to the AUIDS data and analyzed as a four-way factorial (synthetic auxin herbicide, glyphosate, experiment and application timing), subjected to ANOVA and means were adjusted using Tukey's HSD.

Objective

Determine the impact of tank-mixing glyphosate and application time of year on soybean symptomology from volatility of dicamba and 2,4-D choline.

[1]Access the journal publication: https://doi.org/10.1017/wet.2020.89

Results and Discussion

Glyphosate was not significant in any interactions or as a main effect; however, there was a synthetic auxin herbicide by application timing by experiment interaction and results are presented averaged over levels of glyphosate for this three way interaction. For the early application timing in experiment 1, no differences were detected for synthetic auxin herbicides (Fig. 3a). We were able to detect differences for the remaining application timing for the two experiments (Fig. 3b-d). Xtendimax® with VaporGrip® technology (DGA+VG) and Status® (NA+DIF) showed similar levels of symptomology for the late applications in both experiments (Fig. 3c-d). It is important to note that the rate of Status® used in this study provided a lower amount of dicamba active ingredient than what was provided with the rate of Xtendimax® with VaporGrip® technology. Overall, Enlist One™ with Colex D technology (2,4-D choline) treatments had minimal to no symptomology (Fig. 3a-d). Environmental conditions influenced the results observed across application timing and experiments (Fig. 4a-d). In particular, higher temperatures (>85°F) and lower wind speeds (<3 mph) associated with the early and late applications for experiment 2 (Fig. 4b and d) help to explain why greater symptomology was observed for those applications. In contrast, the early application in experiment 1 (where little injury was observed) had low air temperatures (<75°F) and adequate wind speeds (∼ 10 mph) following application (Fig. 4a).

Figure 2. A low-tunnel prior to treatment application and flat placement in 2019 at University of Wisconsin-Madison Arlington Agricultural Research Station, Arlington, WI.

Conclusion

Field low tunnel volatility experiments did not detect an impact of glyphosate on soybean symptomology from dicamba or 2,4-D; however, application time of year (weather conditions) influenced our findings. This suggests early applications of dicamba may be more likely to have favorable weather conditions at the time of and following dicamba applications and minimize potential for secondary OTM.

Recommendation for Applicators

Apply products containing dicamba and 2,4-D choline under ideal weather conditions to minimize primary and secondary drift. Be sure to avoid applications during temperature inversions. Glyphosate may be recommended to be sequentially applied instead of tank-mixed with dicamba, but more research is needed to fully understand its effect on volatility and soybean injury.

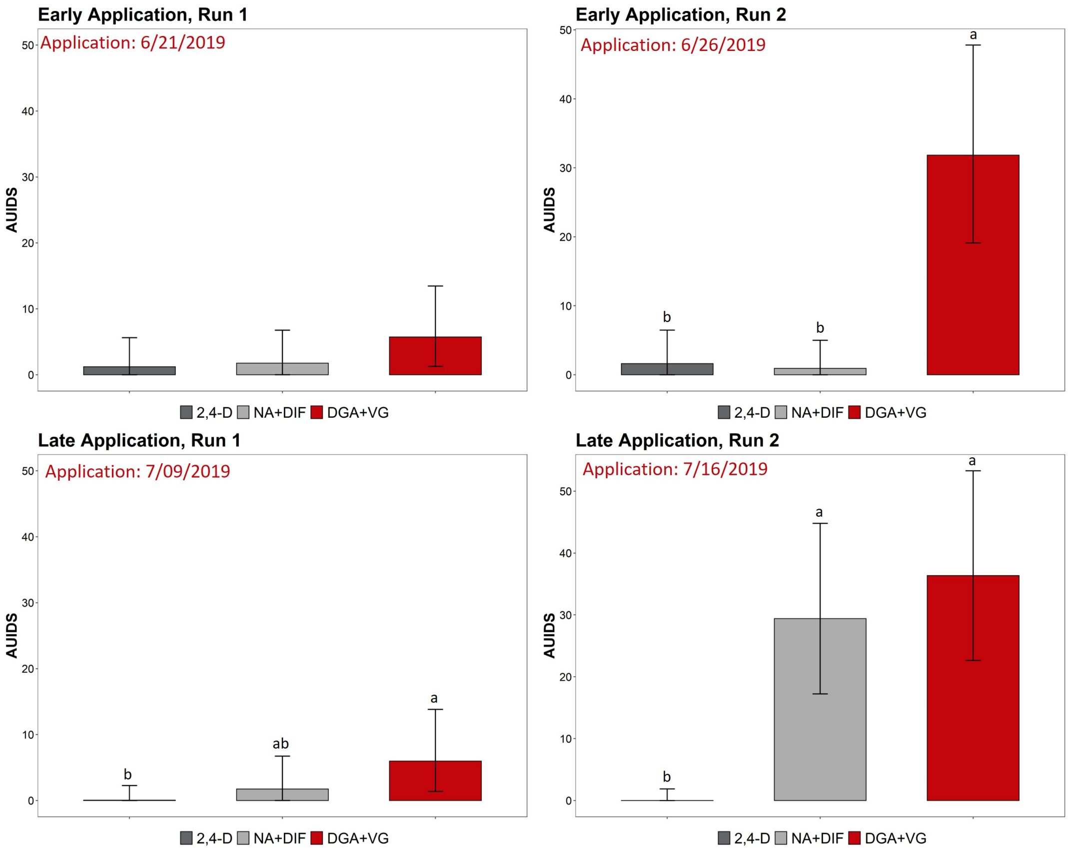

Figure 3. Area Under Injury Over Distance Stairs (AUIDS) for synthetic auxin herbicides for each application time of year in repeated low tunnel volatility experiments (averaged across levels of glyphosate) conducted in Arlington 2019. Abbreviations: 2,4-D (Enlist One™ with Colex D technology), NA + DIF (Status®), DGA + VG (XtendiMax® with VaporGrip® technology). Bars that share a letter are not significantly different at P>0.05. Bars indicate the upper and lower levels of a 95% confidence interval built around the mean.

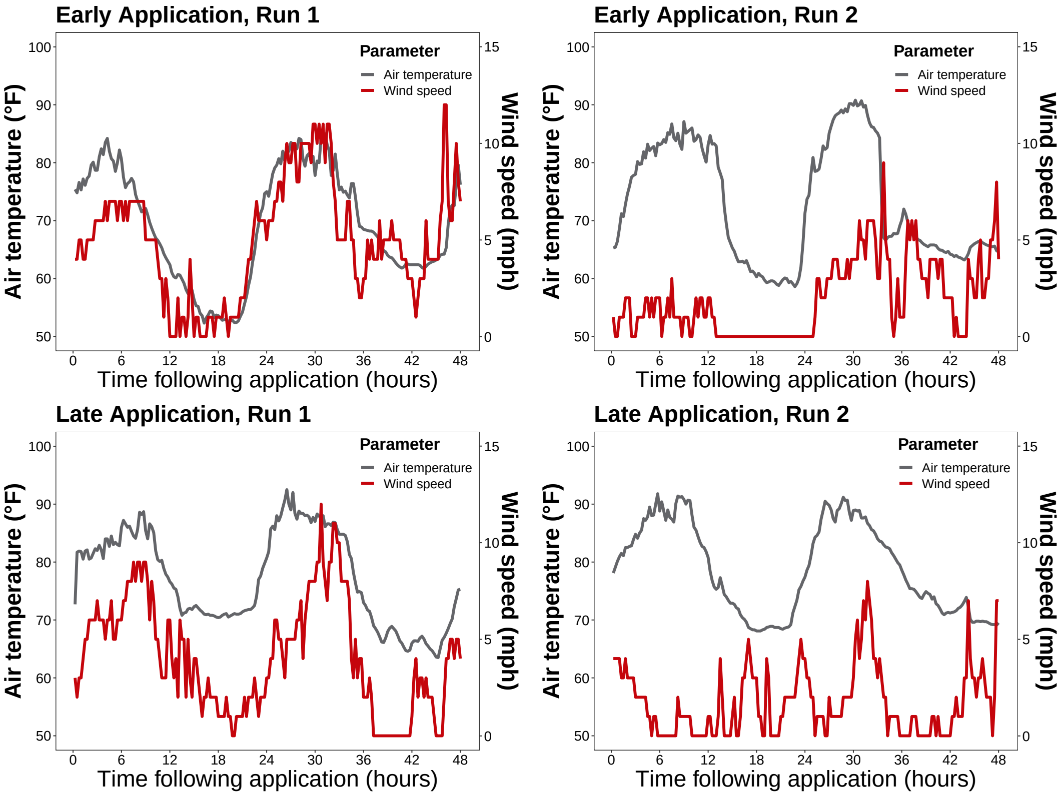

Figure 4. Weather conditions for each application time of year in repeated volatility experiments conducted in Arlington, WI 2019. Air temperature (°F) inside tunnel and wind speed (mph) outside tunnel are on primary and secondary y-axes, respectively, over the duration of 0-48 h following application.

Authors:
Sarah Striegel, Maxwel C. Oliveira, Nicholas J. Arneson, Shawn P. Conley, David E. Stoltenberg, and Rodrigo Werle

Address:
Department of Agronomy, College of Agricultural and Life Sciences, University of Wisconsin-Madison

Correspondence:
Rodrigo Werle - rwerle@wisc.edu

Visit the UW-Madison Cropping Systems Weed Science Blog:

wiscweeds.info

References

Anonymous (2019a) Engenia herbicide product label. BASF Corporation Publication No. NVA 2018-04-385-0080. Research Park, NC: BASF. 29 p

Anonymous (2019b) XtendiMax with VaporGrip technology herbicide product label. EPA Registration No. 524-617. St. Louis, MO: Monsanto Company. 10 p

Anonymous (2020) XtendiMax with VaporGrip additional labeling. Accessed February 17, 2020

Arneson N, Werle R (2020) Enlist E3 soybean system in 2020: what we think applicators should know.

Behrens MR, Lueschen WE (1979) Dicamba volatility. Weed Sci 27:466–493

Bish MD et al. (2019) Dicamba losses to air after applications to soybean under stable and nonstable atmospheric conditions. J Environ Qual 48:1675–1682

Egan JF et al. (2014) A meta-analysis on the effects of 2,4-D and dicamba drift on soybean and cotton. Weed Sci 62:193–206

Egan JF, Mortensen DA (2012) Quantifying vapor drift of dicamba herbicides applied to soybean. Environ Toxicol Chem 31:1023–1031

Mueller TC, Steckel LE (2019a) Spray mixture pH as affected by dicamba, glyphosate, and spray additives. Weed Technol 33:547–554

Mueller TC, Steckel LE (2019b) Dicamba volatility in humidomes as affected by temperature and herbicide treatment. Weed Technol 33:541–546

Mueller TC et al. (2013) Effect of formulation and application time of day on detecting dicamba in the air under field conditions. Weed Sci 61:586–593

Sciumbato AS et al. (2004) Determining exposure to auxin-like herbicides. I. Quantifying injury to cotton and soybean. Weed Technol 18:1125–1134

Soltani N et al. (2020) Off-target movement assessment of dicamba in North America. Weed Technol 34:318-330.

USDA-NASS (2019) Quick Stats. Accessed January 23, 2020

Acknowledgments: Funding for this project was provided by Bayer Crop Science and the R. Gordon Harvey Distinguished Graduate Fellowship.

UNIVERSITY OF WISCONSIN–MADISON

Additional Resources

- Enlist E3 Soybean System in 2020: What We Think Applicators Should Know.
- 2019 Wisconsin Weed Science Research Report.
- Post-emergence Corn and Soybean Herbicide Product Restrictions for Broadcast Applications.