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Spray Solution pH 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
- Spray solution pH was highly influenced by the presence of glyphosate (regardless of salt type)
- Other spray additives tested had minimal impact of spray solution pH

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).

Lab Experiment Overview

In 2019 the UW-Madison Cropping Systems Weed Science Lab conducted several lab experiments evaluating the impact of synthetic auxin formulation and spray additives on spray solution pH (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).

Why Does Spray Solution pH Matter?

Current RR2X soybean dicamba product labels advise avoiding low spray solution pH (pH < 5.0) and adding a buffering agent to raise solution pH if needed (Anonymous 2019a, 2019b). Recent work suggests tank-mixing glyphosate with these products and Clarity® reduces spray solution pH close to or below that level (Mueller and Steckel 2019a), and increases detectable dicamba air concentrations (Bish et al. 2019; Mueller and Steckel 2019b). We currently have a limited understanding on whether this relationship indicated for RR2X soybean dicamba products is similar for 2,4-D choline or dicamba products commonly used in corn.

Materials and Methods (Technical Description)

Herbicide solutions were prepared by mixing tap water (pH 7.45 to 7.70) in a plastic container with additional components (according to the label) to a total volume of 100 mL solution (simulating a 15 GPA carrier volume) and thoroughly agitated. Solution pH was measured using an Oakton pHTestr® 50 Waterproof Pocket pH Tester, Premium 50 Series probe. Within each experiment, treatments were replicated three times. Four experiments were conducted, each were repeated twice:

Experiment 1: XtendiMax® with VaporGrip® technology (22 fl oz ac^{-1}) or Engenia® (12.8 fl oz ac^{-1}) + tank mix components; Grass control component: Roundup PowerMax® (28.4 fl oz ac^{-1}), Durango® DMA® (32 fl oz ac^{-1}), Select Max® (12 fl oz ac^{-1}), DRA addition: Intact™ (0.5 % v/v); Group 15 residual herbicide: Warrant ® (1.5 qt ac^{-1}), Zidua® SC (3.3 fl oz ac^{-1}).
Experiment 2: XtendiMax® with VaporGrip® technology + Intact ™; Glyphosate addition: Roundup PowerMax®; pH buffer: Vapor Grip Xtra (1 % v/v).

Experiment 3: Clarity® (16 fl oz ac^{-1}), Status® (5 oz ac^{-1}), DiFlexx ™ (16 fl oz ac^{-1}), DiFlexx® DUO (32 fl oz ac^{-1}) + tank mix components; Glyphosate addition: Roundup PowerMax®, Durango® DMA®; Water conditioner addition: AMS (8.5 lbs per 100 gal).
Experiment 4: Enlist One™ with Colex D technology (1.5 pts ac^{-1}) + tank mix components; Grass control component: Roundup PowerMax®, Durango® DMA®, Select Max®, or Enlist DUO® with Colex D technology (3.5 pts ac^{-1}); Water conditioner addition: AMS.

Statistical analysis – R 4.0.0 A linear mixed model was fit to the pH data and analyzed as a two-way factorial (treatment and concentration as fixed effects), subjected to ANOVA and means were adjusted using Tukey's Honest Significant Difference (HSD).

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

Objective

Determine solution pH response when various spray mix components are included with dicamba products or 2,4-D choline

Results and Discussion

Glyphosate influenced solution pH for all dicamba formulations and 2,4-D (Fig. 2), while other components tested (DRA, Group 15 herbicides, AMS, clethodim) had minimal impact on solution pH (data not shown). Additionally, inclusion of a pH buffer (VaporGrip® Xtra) was found to increase solution pH following a glyphosate addition (data not shown). We tested two salts of glyphosate, potassium (Roundup PowerMax®) and dimethylamine (Durango® DMA®), and found they similarly impacted solution pH (Fig. 2).

For most synthetic auxin formulations, solution pH was < 5.0 following addition of glyphosate (exceptions include Xtendimax® with VaporGrip® technology and Enlist One™ with Colex D technology). Neither dimethylamine or isopropylamine salts of glyphosate are approved tank mix partners with RR2X dicamba products (Anonymous 2020), as ammonia-based products increase volatility of dicamba. No such restrictions exist for dicamba products commonly used in corn or 2,4-D choline.

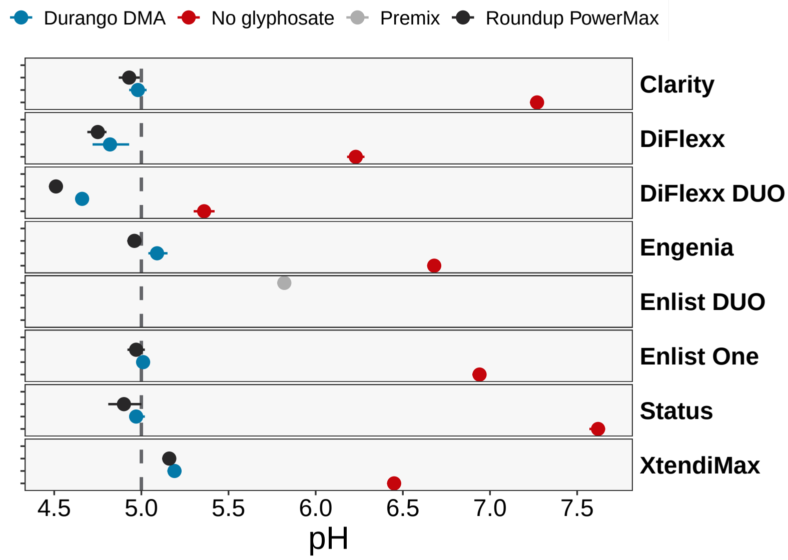

Figure 2. Mean solution pH for all dicamba and 2,4-D formulations tested alone in solution, tank-mixed with dimethylamine salt of glyphosate (Durango® DMA®) and potassium salt of glyphosate (Roundup PowerMax®) at 1× labeled POST rate for laboratory experiments conducted in Madison, WI 2019. Dashed line indicates cutoff pH of 5.0.

Conclusion

Laboratory experiments indicate solution pH was highly influenced by the presence of glyphosate, regardless of salt type. Our findings for other dicamba formulations commonly used in corn agree with findings of Mueller and Steckel (2019a) for novel formulations and Clarity®. Solution pH for many of these products when tank-mixed with glyphosate was < 5.0.

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. If concerned with the drop of pH of your spray solution, consider removing glyphosate from the tank.

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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.