A Dual Tank/Boom Sprayer Reduced the Antagonism of Clethodim From Dicamba on Volunteer Corn Control in Soybean

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PURDUE WEED SCIENCE

INTRODUCTION

- **Volunteer Corn (*Zea mays* L.):** Weed that grows from corn grain left in the field after corn harvest (Fig. 1 and 2)

Figure 1. Volunteer corn sprouting from corn ears.
Photo credit: Dr. Amit Jhala

Figure 2. Volunteer corn clumps.
Photo credit: Jenny Rees

- **Impacts:** Soybean [*Glycine max* (L.) Merr.] yield loss (Fig. 3); corn rootworm (*Diabrotica* spp.) host (Fig. 4); soybean grain contamination; reduced harvest efficiency [1, 2]

Figure 3. Volunteer corn competition in a soybean field.
Photo credit: Dr. Travis Legleiter

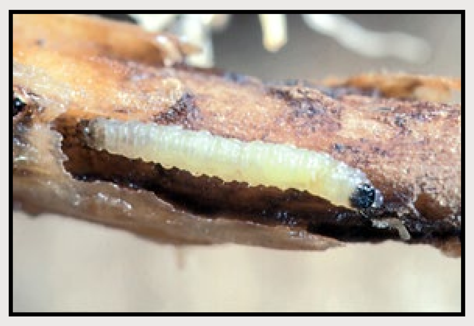

Figure 4. Western Corn Rootworm larva.
Photo credit: John Obermeyer

- **Herbicide Options for Control:** Limited depending on corn herbicide-resistance traits
  - Acetyl CoA Carboxylase (ACCase) inhibiting herbicides are effective options for postemergence control of glyphosate-resistant volunteer corn in soybean (Fig. 5 and 6) [1, 3, 4, 5]

Figure 5. Necrosis of corn growing point at the whorl following application of ACCase-inhibiting herbicides.

Figure 6. Plants stop growing within hours of application and newer leaves die first.

- **The Problem:** Synthetic auxin herbicides and glyphosate antagonize volunteer corn control with ACCase-inhibiting herbicides [6, 7, 8, 9, 10, 11]
  - Increased reports of failed volunteer corn control due to the widespread adoption of dicamba- and 2,4-D-resistant soybeans
- **A Solution?** Reduced herbicide antagonism was observed in a 2021 field trial when using a dual tank delivery system to separate clethodim from dicamba + glyphosate in comparison to a single tank mixture [12]

HYPOTHESIS

The physical separation of clethodim from dicamba + glyphosate using a dual tank delivery system may alleviate the antagonism of clethodim by reducing chemical interactions in the spray solution.

OBJECTIVE

Evaluate the effect of splitting clethodim from dicamba + glyphosate by using a dual tank delivery system in comparison to single tank mixtures on the control of glyphosate-resistant volunteer corn.

Figure 7. Agronomy Test Machine (ATM) equipped with the John Deere See & Spray™ Ultimate dual tank system.

MATERIALS & METHODS

Site Description:

- **Location:** A field experiment was conducted at four locations in 2022: Keiser, AR; West Lafayette, IN; Greenville, MS; and Kinston, NC.
- **Crop:** Dicamba-resistant soybean varieties were planted in 76 or 97-cm rows at 310,000 to 360,000 seeds ha^{-1}.
- **Weeds:** F1 glyphosate- and glufosinate-resistant corn was planted randomly between the two middle soybean rows of all plots at 25 to 30 seeds per plot. The presence and density of endemic weeds varied by location (data not presented).

Herbicide Treatments and Application Parameters:

- **Herbicides:** Three clethodim rates (Select Max® at 25.5, 51, and 102 g ai ha^{-1}) + *S*-metolachlor (Dual Magnum® at 1390 g ai ha^{-1}) were applied alone as broadcast treatments, or in combination with dicamba (Engenia® at 560 g ae ha^{-1}) + glyphosate (Roundup PowerMAX® 3 at 1260 g ae ha^{-1}) in either a single tank/boom or as split applications using a dual tank delivery system.
- **Adjuvants:** A drift reduction agent (UltraLock™ at 0.208% v/v) and a volatility reduction agent (Volt-Edge™ at 1.04% v/v) were added to all treatments containing dicamba. A nonionic surfactant (Preference® at 0.25% v/v) plus a water conditioner (Class Act® NG® at 5% v/v) were added to all treatments containing clethodim, except in tank mixtures with dicamba.
- **Application:** Herbicide treatments were applied to corn ranging from 36 to 58 cm in height (V4 to V6). All treatments were applied using the John Deere See & Spray™ Ultimate dual tank sprayer system (Fig. 7) at 140 L ha^{-1} carrier volume.

Data Collection and Analysis:

- **Data Collection:** Visual estimates of weed control by species (0 to 100% scale) were taken at 7, 14, and 21 days after treatment (DAT); Volunteer corn height and density measurements were collected at 28 or 35 DAT.
- **Statistical Analysis:** Data were analyzed using SAS 9.4 PROC GLIMMIX with mean separation using Tukey's Honest Significant Difference test (α = 0.05).

RESULTS & DISCUSSION

Volunteer Corn Control (Fig. 8 and 9)

- Clethodim + *S*-metolachlor applied alone resulted in 52, 83, or 85% control of volunteer corn at 21 DAT for clethodim rates of 25.5, 51, or 102 g ha^{-1}, respectively.
- The addition of dicamba + glyphosate to clethodim + *S*-metolachlor in a single tank reduced volunteer corn control at 21 DAT to 23, 38, or 62% for clethodim rates of 25.5, 51, or 102 g ha^{-1}, respectively.
- Splitting the application of clethodim + *S*-metolachlor from dicamba + glyphosate by using the dual tank/boom system completely resolved the antagonism.

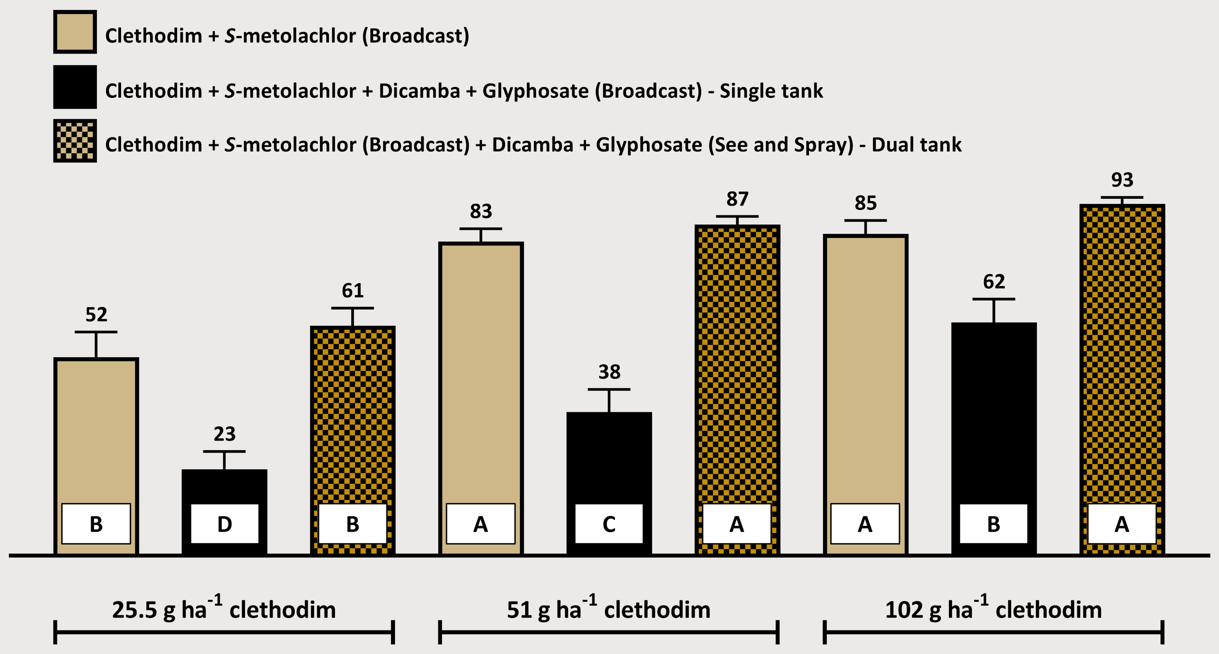

Figure 8. Volunteer corn control (%) with clethodim at 21 days after treatment. Data pooled across all locations (n = 16). Mean values and the standard error of the mean (error bars) are presented at the top of each bar. Letters of separation for Tukey's Honest Significant Difference test (α = 0.05) are found at the bottom of each bar. Herbicide rates: Clethodim = 25.5 to 102 g ai ha^{-1}; Dicamba = 560 g ae ha^{-1}; Glyphosate = 1260 g ae ha^{-1}; *S*-metolachlor = 1390 g ai ha^{-1}.

RESULTS & DISCUSSION

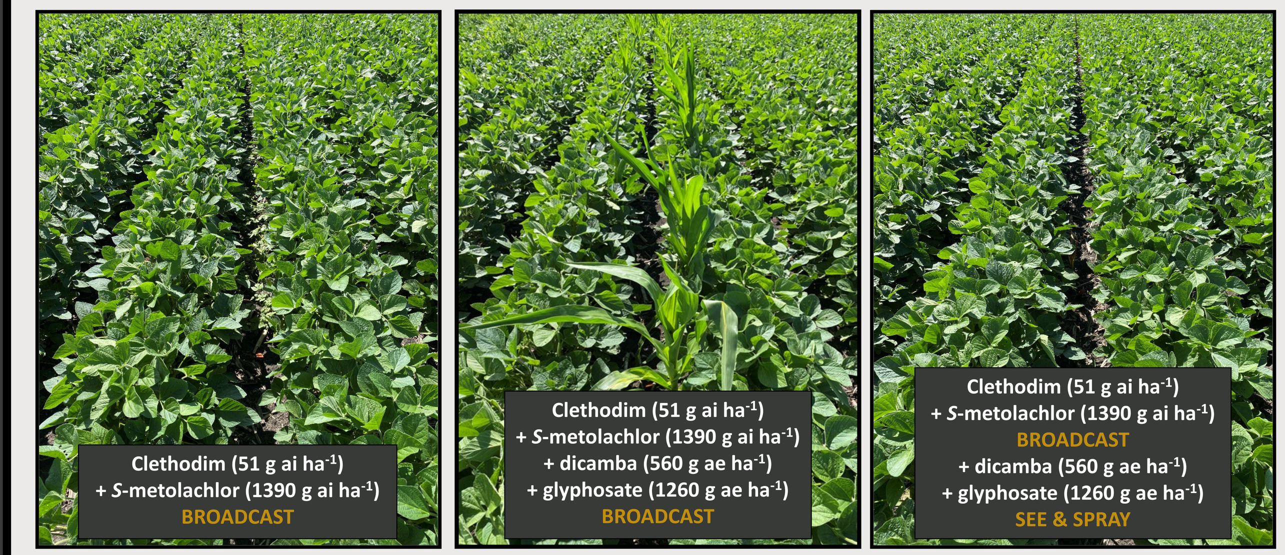

Figure 9. Volunteer corn control with clethodim at 21 days after treatment at West Lafayette, IN in 2022.

- Data for volunteer corn height and density reduction at 28 to 35 DAT showed similar trends to the visual estimates of control (data not shown).

CONCLUSIONS & IMPLICATIONS

- The alleviation of clethodim antagonism by physical separation from dicamba + glyphosate applied simultaneously using the dual tank delivery system would suggest this interaction does not originate from a physiological incompatibility in corn. These results are contrary to previous literature on the interactions of group 1 and 4 herbicides.[6, 7, 13]
- Thus, the antagonistic response caused by the addition of dicamba + glyphosate on the control of volunteer corn with clethodim may involve more important chemical interactions in the spray solution than previously thought.
- The dual tank/boom sprayer system may alleviate herbicide compatibility problems associated with herbicide mixtures in addition to providing site-specific herbicide application.

FUTURE RESEARCH

- Further elucidate the basis for the antagonism of clethodim from dicamba + glyphosate.
- Investigate the effect of using the dual tank delivery system on other mixtures of broadleaf + grass herbicides.
- Evaluate the effect of other dicamba formulations and adjuvants on the antagonistic response of grass herbicides.
- Conduct greenhouse experiments to validate field results.

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