# Interaction of Tank-mixtures of Glyphosate and Dicamba on Glyphosate-resistant Horseweed Control

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## INTRODUCTION

- A statewide survey conducted in Nebraska reported horseweed as the second most troublesome weed for farmers (Sarangi and Jhala 2018).
- Dicamba plus glyphosate is a common tank mixture combination for broad-spectrum weed control. Previous research has shown antagonistic interactions between dicamba and glyphosate (Ou et al. 2018); however, these interactions are not clearly understood.

## OBJECTIVES AND HYPOTHESIS

- **Objectives:** Evaluate the interaction of dicamba plus glyphosate tank-mixtures on glyphosate-resistant (GR) horseweed.
- **Hypothesis:** Dicamba and glyphosate combinations applied on GR horseweed may have antagonistic effect.

## MATERIALS AND METHODS

### Experimental and Treatment Design:

- Randomized Complete Block Design (RCBD)
- 6 x 6 factorial arrangement
- 4 replications

**Table 1.** Treatment table

| Trt# | Solution | Rate (g ai or ae ha$^{-1}$) | Trt# | Solution | Rate (g ai or ae ha$^{-1}$) |
|---|---|---|---|---|---|
| 1 | Dicamba (Dic)[a] | 0 | 19 | Gly | 1260 |
| 2 | Dic | 140 | 20 | Gly + Dic | 1260 + 140 |
| 3 | Dic | 280 | 21 | Gly + Dic | 1260 + 280 |
| 4 | Dic | 560 | 22 | Gly + Dic | 1260 + 560 |
| 5 | Dic | 840 | 23 | Gly + Dic | 1260 + 840 |
| 6 | Dic | 1120 | 24 | Gly + Dic | 1260 + 1120 |
| 7 | Glyphosate (Gly)[b] | 315 | 25 | Gly | 1892 |
| 8 | Gly + Dic | 315 + 140 | 26 | Gly + Dic | 1892 + 140 |
| 9 | Gly + Dic | 315 + 280 | 27 | Gly + Dic | 1892 + 280 |
| 10 | Gly + Dic | 315 + 560 | 28 | Gly + Dic | 1892 + 560 |
| 11 | Gly + Dic | 315 + 840 | 29 | Gly + Dic | 1892 + 840 |
| 12 | Gly + Dic | 315 + 1120 | 30 | Gly + Dic | 1892 + 1120 |
| 13 | Gly | 630 | 31 | Gly | 2522 |
| 14 | Gly + Dic | 630 + 140 | 32 | Gly + Dic | 2522 + 140 |
| 15 | Gly + Dic | 630 + 280 | 33 | Gly + Dic | 2522 + 280 |
| 16 | Gly + Dic | 630 + 560 | 34 | Gly + Dic | 2522 + 560 |
| 17 | Gly + Dic | 630 + 840 | 35 | Gly + Dic | 2522 + 840 |
| 18 | Gly + Dic | 630 + 1120 | 36 | Gly + Dic | 2522 + 1120 |

[a] Xtendimax ® with Vapor Grip® technology, Monsanto Company, St. Louis, MI, USA
[b] Roundup PowerMax®, Monsanto Company, St. Louis, MI, USA

### Spray application parameters:

- TTI11002
- 140 L ha$^{-1}$
- 276 kPa
- 2 m s$^{-1}$
- Three-nozzle spray chamber
- Glyphosate-resistant Horseweed [*Erigerion canadensis L.*] (Plant diameter: 9 cm)

### Data collection:

- Plants were harvested at 28 days after treatment (DAT) and oven-dried at 65 C until constant weight.

### Statistical analysis:

- Performed in R Software© utilizing the drc package
- Colby analysis was conducted to evaluate the nature of the interaction between the herbicides.

## RESULTS AND DISCUSSION

**Table 2.** Statistical analysis of Dose-Response Curve for Dicamba and Glyphosate

| | | Dicamba (g ae ha$^{-1}$)[a] | | | | | |
|---|---|---|---|---|---|---|---|
| | | 0 | 140 | 280 | 560 | 840 | 1120 |
| Glyphosate (g ai ha$^{-1}$)[b] | 0 | 0 | 56 | 74 | 73 | 80 | 83 |
| | 315 | 38 | 69 (72) | 74 (84)* | 85 (83) | 84 (88)** | 84 (89)** |
| | 630 | 64 | 75 (84)** | 77 (91)** | 83 (90)** | 79 (93)** | 84 (94)** |
| | 1260 | 76 | 71 (89)** | 75 (94)** | 77 (93)** | 82 (95)** | 85 (96)** |
| | 1892 | 74 | 74 (88)** | 88 (93)* | 85 (93)** | 87 (95)** | 86 (95)** |
| | 2522 | 72 | 82 (87)** | 79 (93)** | 85 (92)** | 86 (94)** | 91 (95)** |

[a] Expected value, presented in parenthesis, was determined by the Colby equation: E= (X + Y) – (XY/100), where E is expected percent control with herbicide A + B, X and Y is observed percent control with herbicide A and B, respectively.
[b] Significantly different from the observed value (P < 0.05) as determined by t test, indicating antagonism of tank mixing herbicides A and B.
Significance levels: *P ≤ 0.01; **P ≤ 0.001.
Red and yellow cells indicate antagonistic and additive interaction between herbicides, respectively.

**Figure 1.** Treatment 1, without glyphosate and dicamba (check), at 21 DAA.

**Figure 2.** Treatment 15, glyphosate at 630 g ai ha$^{-1}$ and dicamba at 280 g ai ha$^{-1}$, at 21 DAA.

**Figure 3.** Treatment 22, glyphosate at 1260 g ai ha$^{-1}$ and dicamba at 560 g ai ha$^{-1}$, at 21 DAA.

**Figure 4.** Treatment 36, glyphosate at 2530 g ai ha$^{-1}$ and dicamba at 1120 g ai ha$^{-1}$, at 21 DAA.

- GR horseweed control increased with the increasing herbicide doses (Figure 2 and 4) based on check (Figure 1), and the efficacy of dicamba was more pronounced when glyphosate dose was 0 (Table 2).
- For glyphosate at 1260 g ai ha$^{-1}$ and dicamba at 560 g ai ha$^{-1}$ (Figure 3), estimated GR horseweed biomass reduction was 93%, respectively, compared to 77% biomass reduction observed (Table 2).
- Results obtained are in accordance with Ou et al. (2018) in which a dicamba/glyphosate–resistant and –susceptible *Kochia scoparia* population was subjected to different dicamba plus glyphosate combinations. As a result, the investigation suggested an antagonistic interaction between those herbicides and the translocation of both herbicides was significantly reduced.
- Huff (2010) reported antagonistic dicamba and glyphosate interactions across multiple weed species.

## CONCLUSIONS

- Dicamba and glyphosate caused an antagonistic effect on GR horseweed.
- The highest dose of dicamba and glyphosate did not overcome the antagonistic interaction; therefore, the tank-mixture between those herbicides might reduce efficacy on GR horseweed control.

## FUTURE RESEARCH

- Analyze the interaction of dicamba and glyphosate tank-mixtures on glyphosate-susceptible horseweed and barnyardgrass (*Echinochloa crus-galli (L.) P. Beauv.*).
- Identify the influence of adjuvants on this potential antagonistic interaction to increase herbicide efficiency.

## REFERENCES

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