Evaluation of Tank-Mixture Interactions Between Glyphosate, Glufosinate, and Dicamba

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Introduction

With the rise of herbicide-resistant weeds, producers have began to utilize more herbicide tank-mixture options to reduce the potential selection pressure. To utilize more tank-mixture options, new GE crops have been made to be tolerant to multiple herbicides such as glyphosate, glufosinate, and dicamba. When applied as a tank-mixture, herbicides tend to interact with each other in one of three ways: antagonistically, synergistically, or additively. These interactions can vary between from plant species to plant species and from one herbicide to another. While studies have been done on common weeds in temperate climates using two-way herbicide tank-mixtures, there is less information regarding interactions in semi-arid climates and with three-way tank-mixtures.

Research Question

The purpose of this study was to evaluate how tank-mixtures of glyphosate, glufosinate, and dicamba in two-way and three-way tank-mixtures would affect the control of eight different weed species in Western Nebraska.

Approach

- The experiment was conducted in two runs using a Randomized Complete Block Design with four replications.
- Oat (*Avena sativa L.*), velvetleaf (*Abuliton theophrasti medik.)* kochia (*Bassia scoparia* (L), horseweed (*Erigeron canadensis* L.), Russian thistle (*Salsola tragus* L.), Palmer *amaranth(Amaranthus palmeri* S.), and rye *(Avena sativa* L.) were evaluated.
- Herbicides were applied with a 3 m, six nozzle sprayer using TJet TTI110015 nozzles at 147 L ha^{-1}.
- Visual estimations of weed control were taken at 28 DAT.
- Herbicide injury data were analyzed using SAS Statistical Software and herbicide interaction was determined using the Colby method at α=0.05 significance.
- Colby Equation[2] to calculate tank mixture interactions:

$$E = X + Y - \frac{XY}{100}$$

$$E = X + Y + Z - \frac{(XY + XZ + YZ)}{100} + \frac{XYZ}{10,000}$$

Tank-mixture treatments applied to oat, grain sorghum, and velvetleaf.

Solution	Rate g ae or ai ha^{-1}
Gly.[1]	1266
Dic.[2]	560
Glu.[3]	520
Gly. + Dic.	1266 + 560
Gly. + Glu.	1266 + 520
Dic. + Glu.	560 + 520
Gly. + Dic. + Glu.	1266 + 560 + 520
Gly.	628
Dic.	280
Glu.	260
Gly. + Dic.	628 + 280
Gly. + Glu.	628 + 260
Dic. + Glu.	280 + 260
Gly. + Dic. + Glu.	628 + 280 + 260
Gly.	314
Dic.	140
Glu.	130
Gly. + Dic.	314 + 140
Gly. + Glu.	314 + 130
Dic. + Glu.	140 + 130
Gly. + Dic. + Glu.	314 + 140 + 130

Table 1: [1] Gly. = Glyphosate; [2] Dic. = Dicamba; [3] Glu. = Glufosinate

Results

Herbicide efficacy by treatment, species, and rate

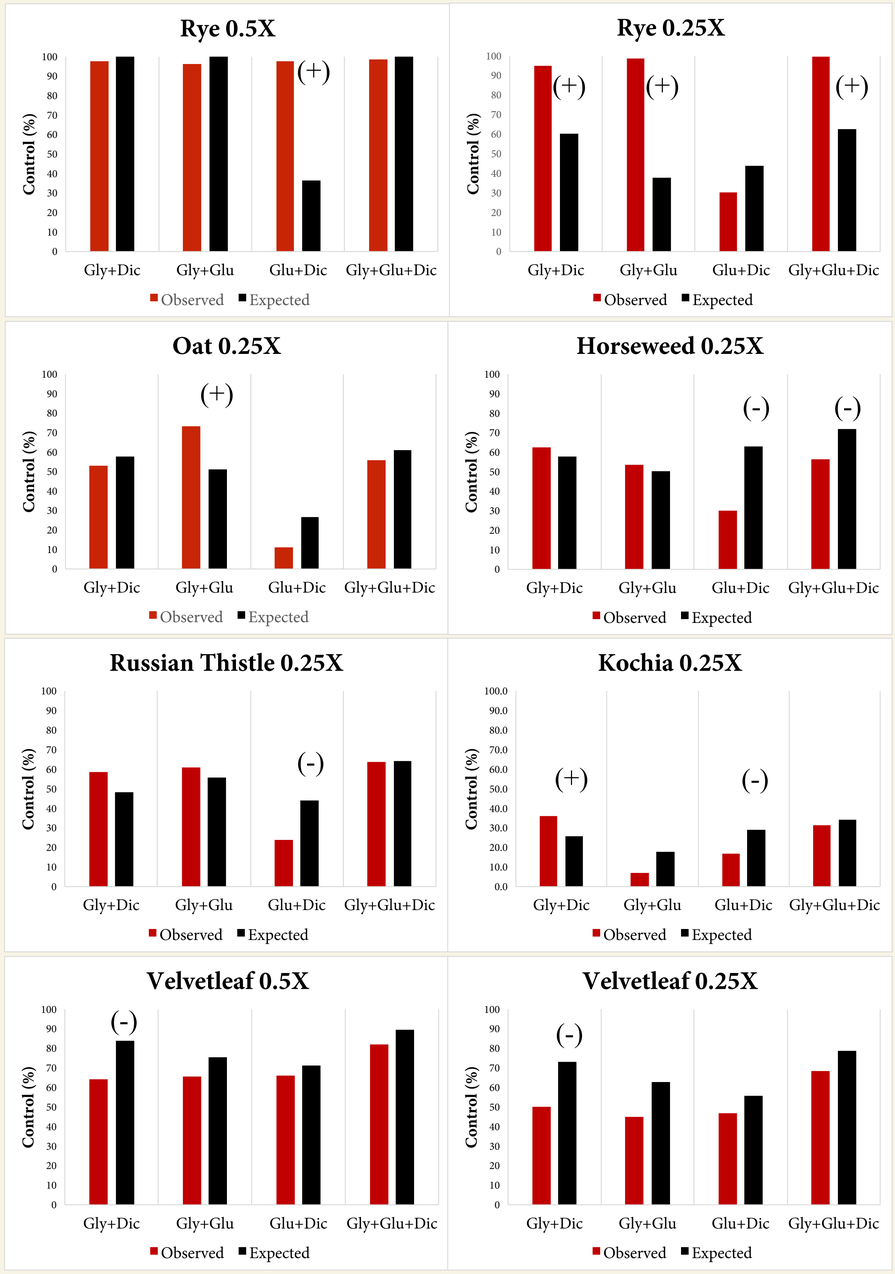

Fig 1: Herbicide injury taken 28 DAT compared to the expected herbicide injury values ba sed upon applications of individual herbicides and calculated using the Colby Method. Observed values statistically lower than expected values are labeled (-) and are considered antagonistic. Observed values statistically greater than the expected values are labeled (+) and are considered synergistic. All other treatments are considered additive.

Results

Palmer amaranth herbicide efficacy by treatment

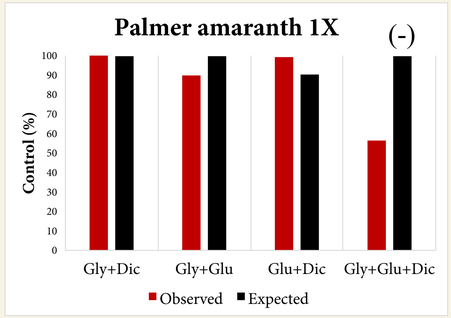

Fig. 2: Observed herbicide injury at 28 DAT compared to expected values based on the Colby method. Antagonism labeled by (-), indicating observed values statistically lower than expected.

- Treatments were generally additive for weed control
- Interactions varied from species-to-species
- Glyphosate + dicamba tank-mixtures produced synergistic interactions in grass species and kochia
- Glyphosate + dicamba tank-mixtures produced antagonistic interactions for velvetleaf species at two rates
- Glufosinate + dicamba tank-mixtures produced antatgonistic interactions in horseweed, kochia, and Russian thistle
- Three-way tank mixtures produced generally additive interactions with exceptions occurring in Palmer amaranth, rye, and horseweed

Conclusions

- Tank-mixtures of these three herbicides are generally additive in nature.
- Interactions do occur, but vary based on species
- Weather and climate may be a factor, especially for contact herbicides such as glufosinate
- Further testing should be done at different rates and with more species to further understanding of these interactions
- Findings from this study will allow producers to more effectively utilize tank-mixtures that involve these herbicides in their cropping systems