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

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Introduction
With the rise of herbicide-resistant weeds, producers have begun 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 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 (Abutilon 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 TT110015 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 Equation¹ to calculate tank mixture interactions:

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

\[ E = \frac{X + Z - \frac{(XY + XZ + YZ)}{100}}{100} \]

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

Results
Herbicide efficacy by treatment, species, and rate

- Russian Thistle 0.25X
- Kochia 0.25X
- Rye 0.5X
- Velvetleaf 0.5X
- Horseweed 0.25X

Fig 1: Herbicide injury taken 28 DAT compared to the expected herbicide injury values based 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.

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