

## Introduction

- Glyphosate-resistance has been confirmed in 29 weed species worldwide, including 15 species in the United States (Heap 2014).
- Several approaches proposed for managing herbicide-resistant weeds, include diversifying weed management practices and using multiple herbicide modes of action (MOA) (Norsworthy et al. 2012).
- No herbicide with new mode of action has been commercialized in last 22 yrs, therefore synergistic mixtures of existing herbicide chemistries offer suitable option for controlling weeds, including glyphosate-resistant weeds.
- A new prepackaged mixture of fluthiacet-methyl and mesotrione (1:17.5 ratio) has been registered for POST broadleaf weed control in field corn, seed corn, yellow popcorn and sweet corn.
- This mixture of protoporphyrinogen oxidase (PPO) and 4-hydroxyphenylpyruvate dioxygenase (HPPD) inhibitors has both contact and systemic activity.

## Objective

- To determine the response of glyphosate-resistant common waterhemp, giant ragweed, and kochia to prepackaged mixture of fluthiacet-methyl plus mesotrione when applied to 10- and 20-cm tall plants under greenhouse conditions.

## Materials and Methods

- **Green house experiment**
- Year and Location: 2014, University of Nebraska-Lincoln, Lincoln
- Three glyphosate-resistant weed species: common waterhemp, giant ragweed, and kochia
- Two growth stages: 10- and 20-cm tall
- Herbicide treatments : 8 rates (0, 0.25x, 0.50x, 0.75x, 1.0x, 1.5x, 2.0x, and 2.5x), prepackaged mixture of fluthiacet-methyl and mesotrione
  - ❖ where, 1x = recommended field rate of fluthiacet-methyl plus mesotrione (87.4 g ai ha<sup>-1</sup>).
- **Experimental design**
  - ❖ A factorial of eight rates of fluthiacet-methyl plus mesotrione, three weed species, and two growth stages
  - ❖ Pots were arranged in a completely randomized design with four replications.
  - ❖ A single plant per pot was considered as an experimental unit.
- Visual weed control assessment: At 7, 14, and 21 d after treatment (DAT) using a scale ranging from 0% (no control) to 100% (complete control).
- Aboveground biomass of each weed species was harvested at 21 DAT, oven-dried for 7 d at 65 C, and dry weight was determined.
- **Statistical analysis**
  - ❖ Visual control ratings and dry weight reduction (as a percentage compared to nontreated control) data were regressed over herbicide treatments using the four-parameter log-logistic model (Seefeldt et al. 1995).  $Y = C + \{D - C / 1 + \exp [B (\log X - \log E)]\}$
  - ❖ Where, Y is the response variables (percent weed control or percent reduction in dry weight), C is the lower limit, D is the upper limit, B is the slope of the line, E is the dose resulting in a 50% control (known as ED<sub>50</sub>), and X is the herbicide dose.
- Analyses of dose-response curves were performed separately for each weed species and ED<sub>50</sub> and ED<sub>90</sub> values (effective dose that provided 50 and 90% weed control) were determined using the *drc* package in R software (Ritz and Streibig 2005).

## Results and Discussion

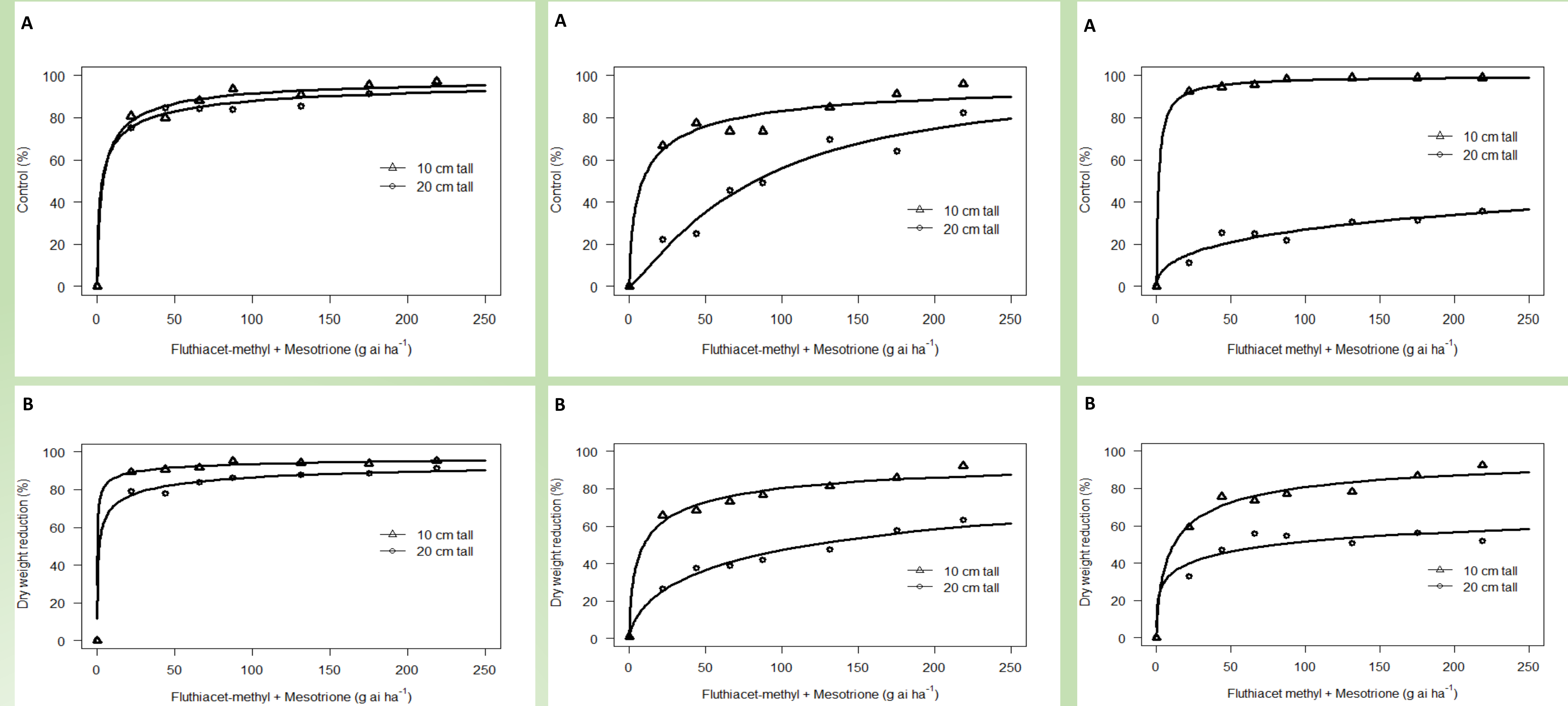


Figure 1. Glyphosate-resistant common waterhemp (A) control, and (B) percent dry weight reduction at 21 d after treatment in a dose response study with a prepackaged mixture of fluthiacet-methyl and mesotrione.

Figure 2. Glyphosate-resistant giant ragweed (A) control, and (B) percent dry weight reduction at 21 d after treatment in a dose response study with a prepackaged mixture of fluthiacet-methyl and mesotrione.

Figure 3. Glyphosate-resistant kochia (A) control, and (B) percent dry weight reduction at 21 d after treatment in a dose response study with a prepackaged mixture of fluthiacet-methyl and mesotrione.

Glyphosate-resistant weed species	g ai ha <sup>-1</sup>		Glyphosate-resistant weed species	g ai ha <sup>-1</sup>	
	ED <sub>50</sub> (± SE) <sup>a</sup>	ED <sub>90</sub> (± SE) <sup>a</sup>		ED <sub>50</sub> (± SE) <sup>a</sup>	ED <sub>90</sub> (± SE) <sup>a</sup>
<i>Common waterhemp</i>					
10-cm tall	4.0 (2.0)	78.3 (13.0)	10-cm tall	0.2 (0.1)	29.0 (6.3)
20-cm tall	3.1 (2.0)	144.0 (37.3)	20-cm tall	1.2 (0.4)	227.0 (32.1)
<i>Giant ragweed</i>					
10-cm tall	9.0 (3.0)	251.0 (72.5)	10-cm tall	9.4 (1.5)	384.0 (63.1)
20-cm tall	82.0 (8.0)	489.0 (136.2) <sup>b</sup>	20-cm tall	119.0 (7.0)	3,764.5 (1,106.0) <sup>b</sup>
<i>Kochia</i>					
10-cm tall	1.4 (1.0)	17.0 (4.0)	10-cm tall	12.0 (2.0)	315.0 (47.0)
20-cm tall	799.0 (365.0) <sup>b</sup>	79,349.0 (113,173.0) <sup>b</sup>	20-cm tall	83.1 (8.3)	105,946.0 (102,357.0) <sup>b</sup>

<sup>a</sup>Abbreviations: ED<sub>50</sub>, effective dose required for 50% control/dry weight reduction of glyphosate-resistant weeds; ED<sub>90</sub>, effective dose required for 90% control/dry weight reduction of glyphosate-resistant weeds; SE, standard error. The values present in parenthesis are standard errors. <sup>b</sup> These values have a limited biological meaning because 90% control/dry weight reduction in 20-cm tall giant ragweed and kochia was never achieved even with the highest rate of fluthiacet-methyl plus mesotrione.

- The response and the effective rate required to achieve acceptable control varied depending on the weed species and their growth stage.
- The rates of fluthiacet-methyl plus mesotrione required for 90% control (ED<sub>90</sub>) of 10-cm tall common waterhemp, giant ragweed, and kochia were 78, 251, and 17 g ai ha<sup>-1</sup>, respectively, compared to 144, 489, and 79,349 g ai ha<sup>-1</sup>, respectively, for 20-cm tall plants at 21 d after treatment (DAT).
- Kochia at 10 cm height, was the most sensitive to this prepackaged herbicide mixture followed by common waterhemp, while giant ragweed was the least sensitive.



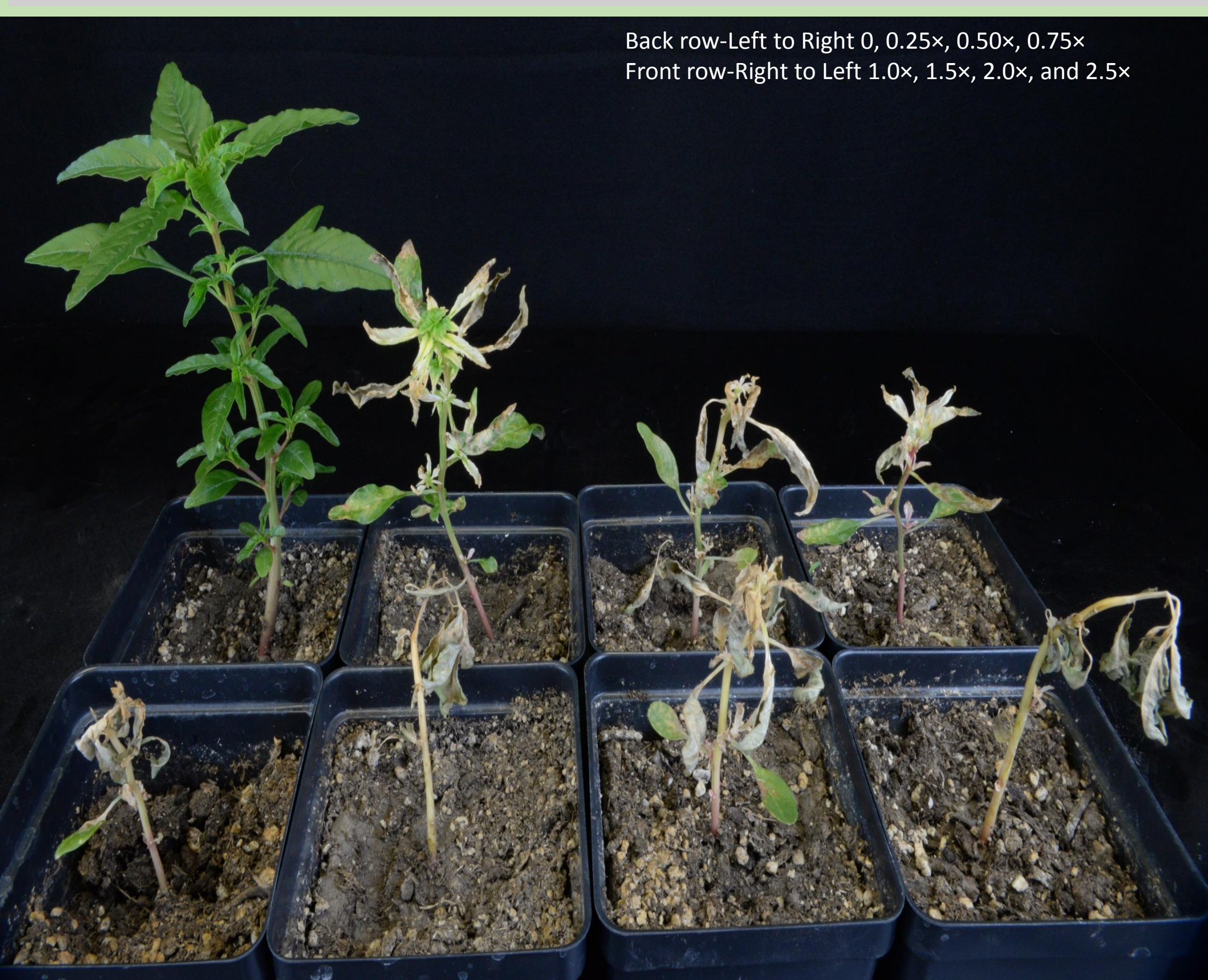
d). Response of giant ragweed to fluthiacet-methyl and mesotrione applied at 10-cm height 14DAT (Left to right: 0, 0.25x, 0.50x, 0.75x, 1.0x, 1.5x, 2.0x, and 2.5x) e). Injury symptoms on giant ragweed, common waterhemp and kochia in response to fluthiacet-methyl and mesotrione

## Conclusion

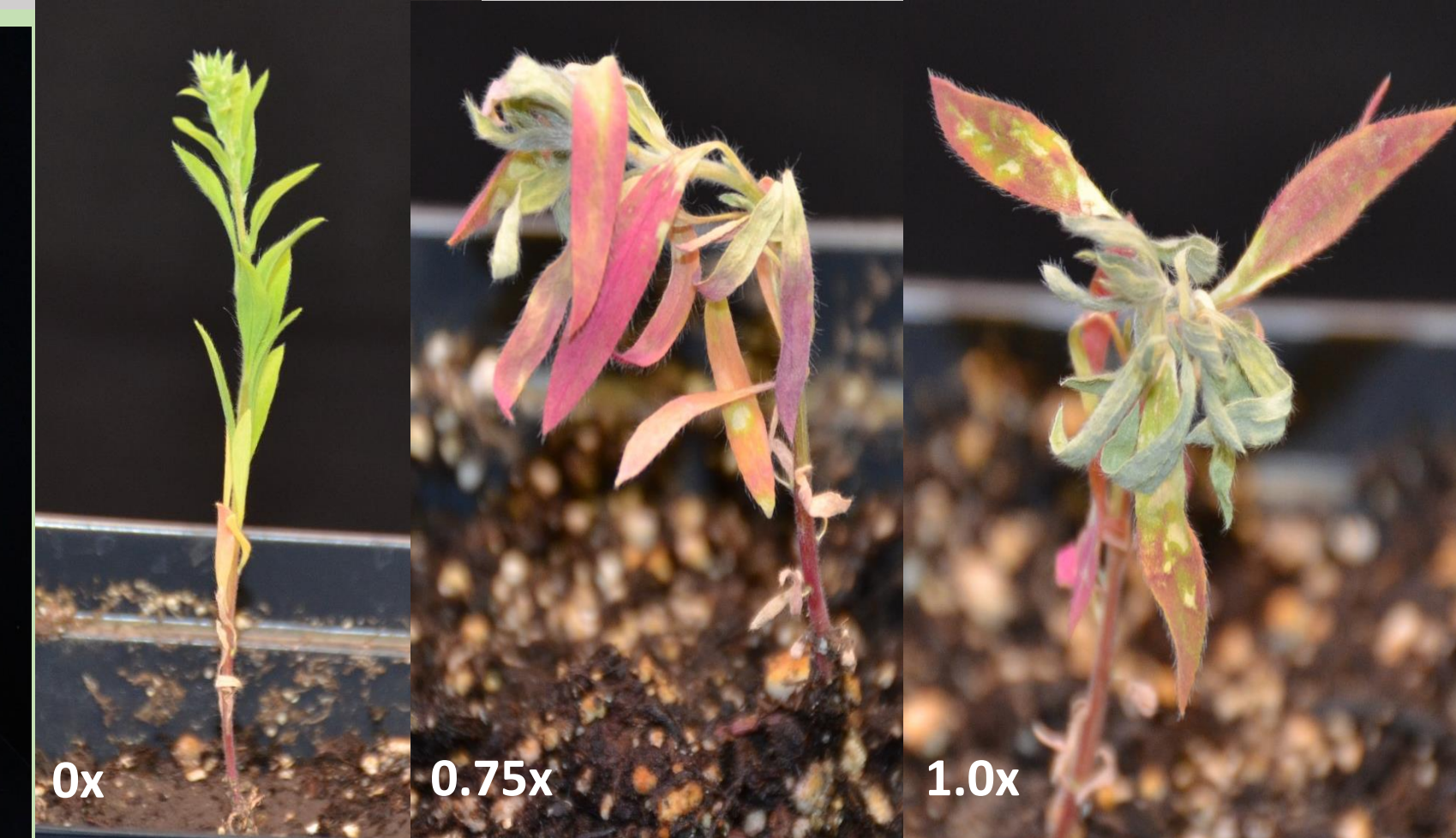
- **Prepackaged mixture of fluthiacet-methyl plus mesotrione applied POST at the labeled rate (87 g ai ha<sup>-1</sup>) has the potential to control glyphosate-resistant common waterhemp and kochia in corn, but a higher rate would be required to achieve 90% control of glyphosate-resistant giant ragweed.**
- However, appropriate recommendations can be made on the basis of dose response studies conducted with corn under the field conditions.

## References

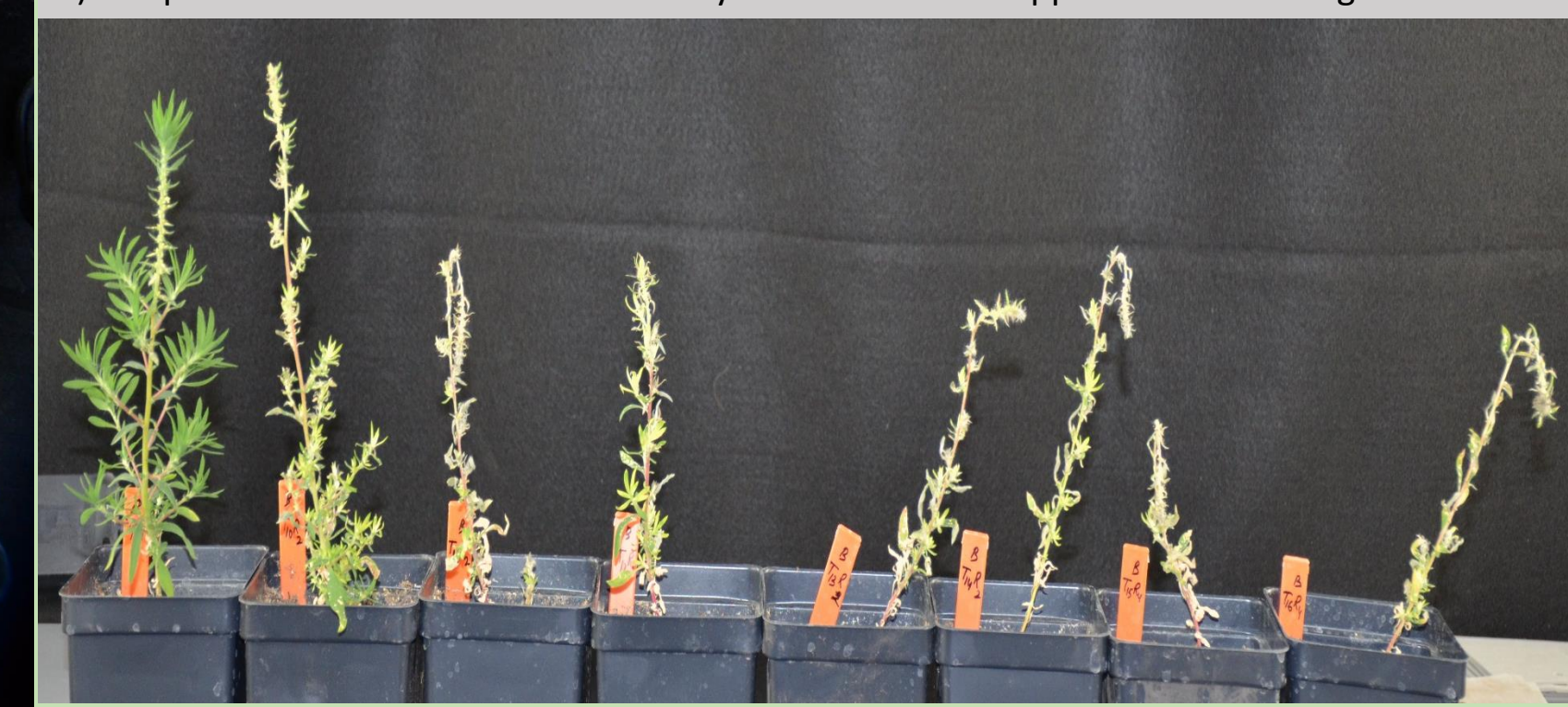
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a). Response of common waterhemp to fluthiacet-methyl and mesotrione applied at 20-cm height 14 DAT



b). Response of kochia to fluthiacet-methyl and mesotrione applied at 10-cm height 14DAT



c). Response of kochia to fluthiacet-methyl and mesotrione applied at 20-cm height 14DAT