

Introduction

Herbicide resistance has increased considerably in the last decade (Heap 2019). Herbicide-tolerant crops were introduced in the market providing growers new herbicide options to include in weed management programs. This allowed growers to spray additional selective and non-selective herbicides in postemergence applications in transformed crops, such as soybean and cotton. The Enlist™ system crops are 2,4-D, glufosinate, and glyphosate tolerant (Meyer and Norsworthy 2019). Three way tank-mixtures of 2,4-D, glyphosate and glufosinate add a lot of versatility to the weed control system, but could be problematic from an antagonism standpoint.

Objective

Evaluate efficacy of 2,4-D, glyphosate and glufosinate applied alone or in combination on Palmer amaranth (*Amaranthus palmeri*) and kochia (*Bassia scoparia*) using two different nozzles.

Hypothesis

The combination of 2,4-D, glyphosate and glufosinate will provide an improved weed control system compared to any of the herbicides applied alone or combined in pairs.

Materials & Methods

The study was conducted as a randomized complete block design with a factorial arrangement of treatments: two nozzles and seven herbicide treatments, plus one untreated check. Each treatment had four replications. The study was repeated twice on the same area in one season.

Table 1. List of products, rates and nozzles used in the study

Product	Active Ingredient	Rate
*Enlist One	2,4-D	798 g ae ha ⁻¹
*Enlist Duo	2,4-D + Glyphosate	784 g ae ha ⁻¹ + 833 g ae ha ⁻¹
*Durango DMA	Glyphosate	1,120 g ae ha ⁻¹
*Liberty	Glufosinate	654.18 g ai ha ⁻¹
*Enlist One Liberty	2,4-D Glufosinate	798 g ae ha ⁻¹ 654.18 g ai ha ⁻¹
*Enlist Duo Liberty	2,4-D + Glyphosate Glufosinate	784 g ae ha ⁻¹ + 833 g ae ha ⁻¹ 654.18 g ai ha ⁻¹
*Durango DMA Liberty	Glyphosate Glufosinate	1,120 g ae ha ⁻¹ 654.18 g ai ha ⁻¹
Nozzles		
TTI11002	Turbo TeeJet Induction Flat	
AIXR11002	TeeJet Yellow Acetal Polymer Air Induction XR Flat Spray Tip Nozzle	

- All treatments include 5% v v⁻¹ liquid ammonium sulfate.
- Pressure: 276 kPa
- Boom height: 50 cm; Volume: 140 L ha⁻¹.
- Plots were sprayed in two different timings:
 1. Application 20- to 30 cm tall;
 2. Application 30-to 40 cm tall.
- Visual estimations of injury were recorded at 7, 14, 21, and 28 (DAT).

Results

Palmer Amaranthus and Kochia



Figure 1. Glufosinate applied at 654 g ai ha⁻¹ using a TTI11002.



Figure 2. 2,4-D applied at 798 g ae ha⁻¹ using a TTI11002.



Figure 3. Glyphosate + glufosinate applied at 1,120 g ae ha⁻¹ + 654 g ai ha⁻¹ using a TTI11002

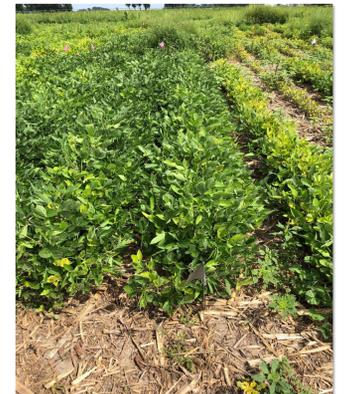


Figure 4. 2,4-D + glufosinate applied at 798 g ae ha⁻¹ + 654.18 g ai ha⁻¹ using a TTI11002

Results: Visual injury

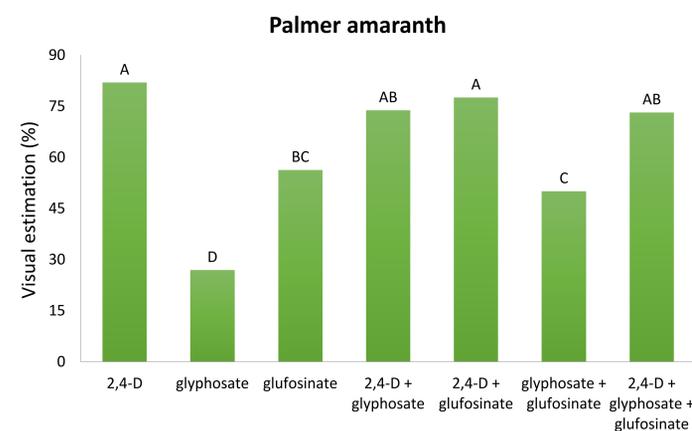


Figure 5. Visual injury at 21 days after application caused by different herbicides solutions. Means followed by the same letter are not different ($p < 0.01$).

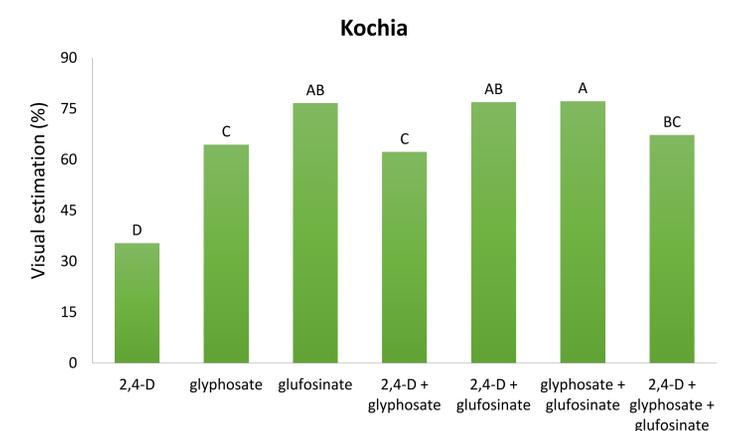


Figure 6. Visual injury at 21 days after application caused by different herbicides solutions. Means followed by the same letter are not different ($p < 0.01$).

Discussion & Conclusion

- Solutions containing 2,4-D had better control on Palmer amaranth as the population had glyphosate-resistant biotypes.
- For kochia, glufosinate alone, glufosinate + 2,4-D, and glufosinate + glyphosate provided satisfactory control (>75%).
- Overall, the glyphosate, 2,4-D, and glufosinate tank-mixture solution did not perform as expected, suggesting possible antagonistic interactions, especially on kochia.

Future research

Additional studies are necessary to understand herbicide tank-mixture interactions for controlling herbicide-resistant weeds.

References

1. Heap I (2019) International survey of herbicide resistant weeds. weedscience.org. Accessed October 25, 2019
2. Meyer CJ and Norsworthy JK (2019) Influence of weed size on herbicide interactions for Enlist™ and Roundup Ready® Xtend® technologies. Weed Technol 33: 569–577. doi: 10.1017/wet.2019.27

Acknowledgements

This project was conducted in the Pesticide Application Technology Laboratory at the West Central Research and Extension Center, North Platte, Nebraska.

Special thanks to Estefania Polli, Karina Beneton, Raquel Berna, Kasey Schroeder, Guilherme Sousa Alves and Pedro Henrique Alves Correa for all support.