

# Residual control of multiple-resistant Palmer amaranth with soil-applied herbicides in corn

Jonathon R. Kohrt and Christy L. Sprague Department of Plant, Soil and Microbial Sciences, Michigan State University, East Lansing, MI

## Introduction

- Extended emergence patterns, rapid growth rates, prolific seed production and resistance to multiple herbicide sites of action make Palmer amaranth one of the biggest weed threats that field crop growers in Michigan and the Midwest have encountered.
- In Michigan, Palmer amaranth populations range from being resistant to only glyphosate (Group 9) or ALS inhibitors (Group 2), to many populations being resistant to both the Group 2 and Group 9 herbicides.
- In 2012, a Palmer amaranth population identified in Barry Co., MI exhibited resistance to both the Group 2 and 9 herbicides and demonstrated variable levels of resistance to atrazine (Group 5).
- The resistance issues expressed by this population ultimately make it a management challenge in corn.

## Objectives

- Evaluate control of multiple-resistant Palmer amaranth with several soil-applied herbicide active ingredients alone and in combination with atrazine.
- Evaluate several commercial soil-applied premixtures for the control of multiple-resistant Palmer amaranth.

## Materials and Methods

- Field study conducted in a commercial corn field near Middleville, Michigan (2013, 2014, and 2015)
- Randomized complete block design; 4 replications
- Preemergence (PRE) herbicide applications (Table 1) were made at or near the time of corn planting
- Weed control evaluations were made from 21 days after treatment (DAT) to 72 DAT
- Palmer amaranth biomass was harvested and dried from 2-0.25 m<sup>2</sup> quadrats, 45 DAT
- Data were analyzed in PROC MIXED in SAS; means separated using Fisher's protected LSD ( $p \leq 0.05$ )

## Soil-applied herbicide treatments

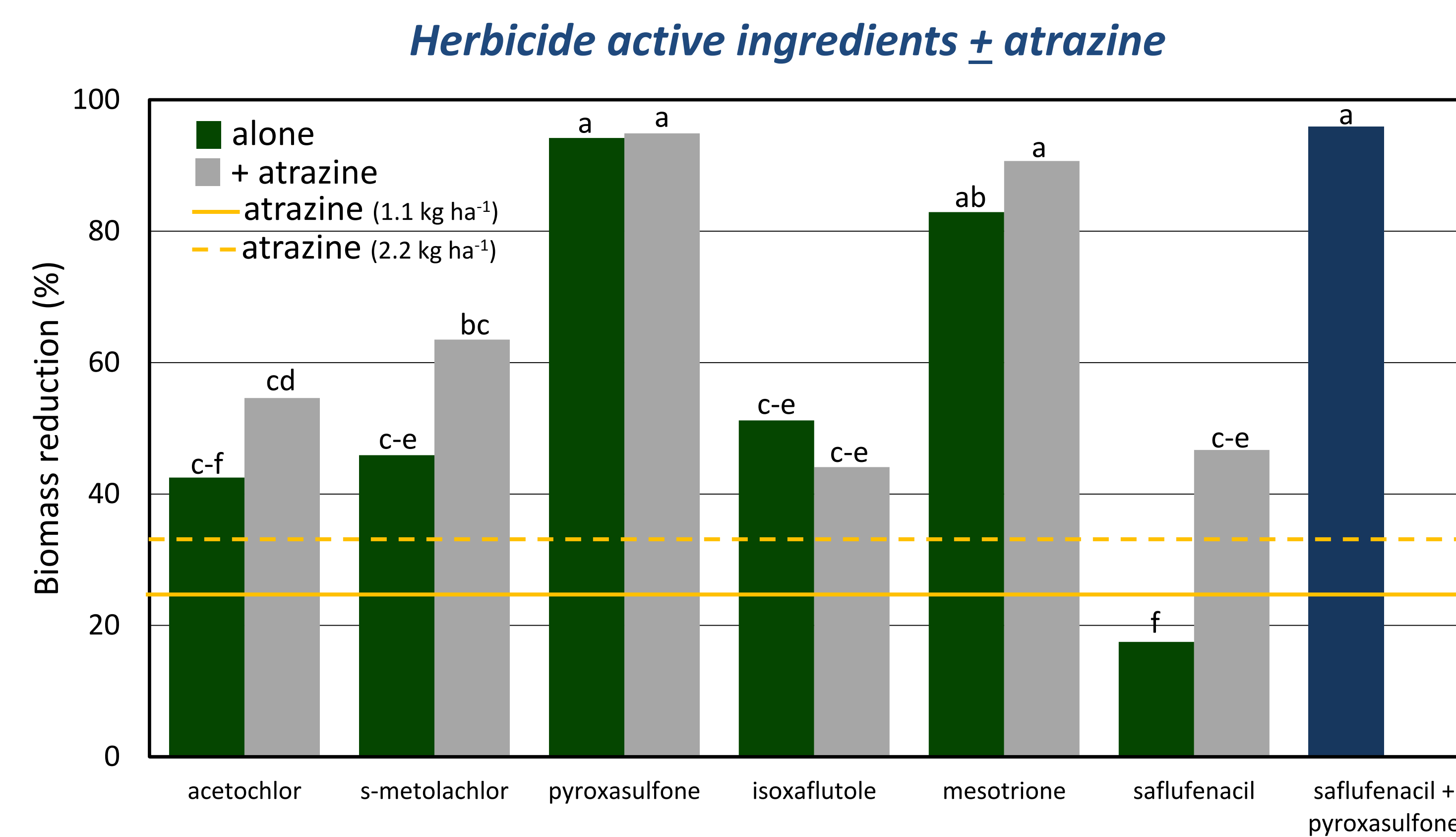
**Table 1.** Soil-applied herbicide active ingredients and commercial premixes evaluated in 2013, 2014, and 2015.

Herbicides alone + atrazine <sup>#</sup>	Rate (kg a.i. ha <sup>-1</sup> )	Commercial premixes	Active ingredients	Rate (kg a.i. ha <sup>-1</sup> )
atrazine	1.12 / 2.24	Harness Xtra <sup>®</sup>	acetachlor + atrazine	1.73 + 1.4
acetochlor	1.79	Bicep II Magnum <sup>®</sup>	s-metolachlor + atrazine	1.41 + 1.83
s-metolachlor	1.42	Zemax <sup>™</sup>	s-metolachlor + mesotrione	1.87 + 0.19
pyroxasulfone	0.18	Verdict <sup>®</sup>	dimethenamid-p + saflufenacil	0.66 + 0.075
isoxaflutole	0.11	Lumax <sup>®</sup>	s-metolachlor + mesotrione + atrazine	2.03 + 0.08 + 0.76
mesotrione	0.21	Lexar <sup>®</sup>	s-metolachlor + mesotrione + atrazine	1.46 + 0.19 + 1.46
saflufenacil	0.08	Acuron <sup>™</sup> *	s-metolachlor + mesotrione + bicyclopyrone + atrazine	1.8 + 0.20 + 0.05 + 0.84
pyroxasulfone + saflufenacil	0.08 + 0.18	TripleFLEX <sup>™</sup> *	acetachlor + clopyralid + flumetsulam	1.31 + 0.13 + 0.04

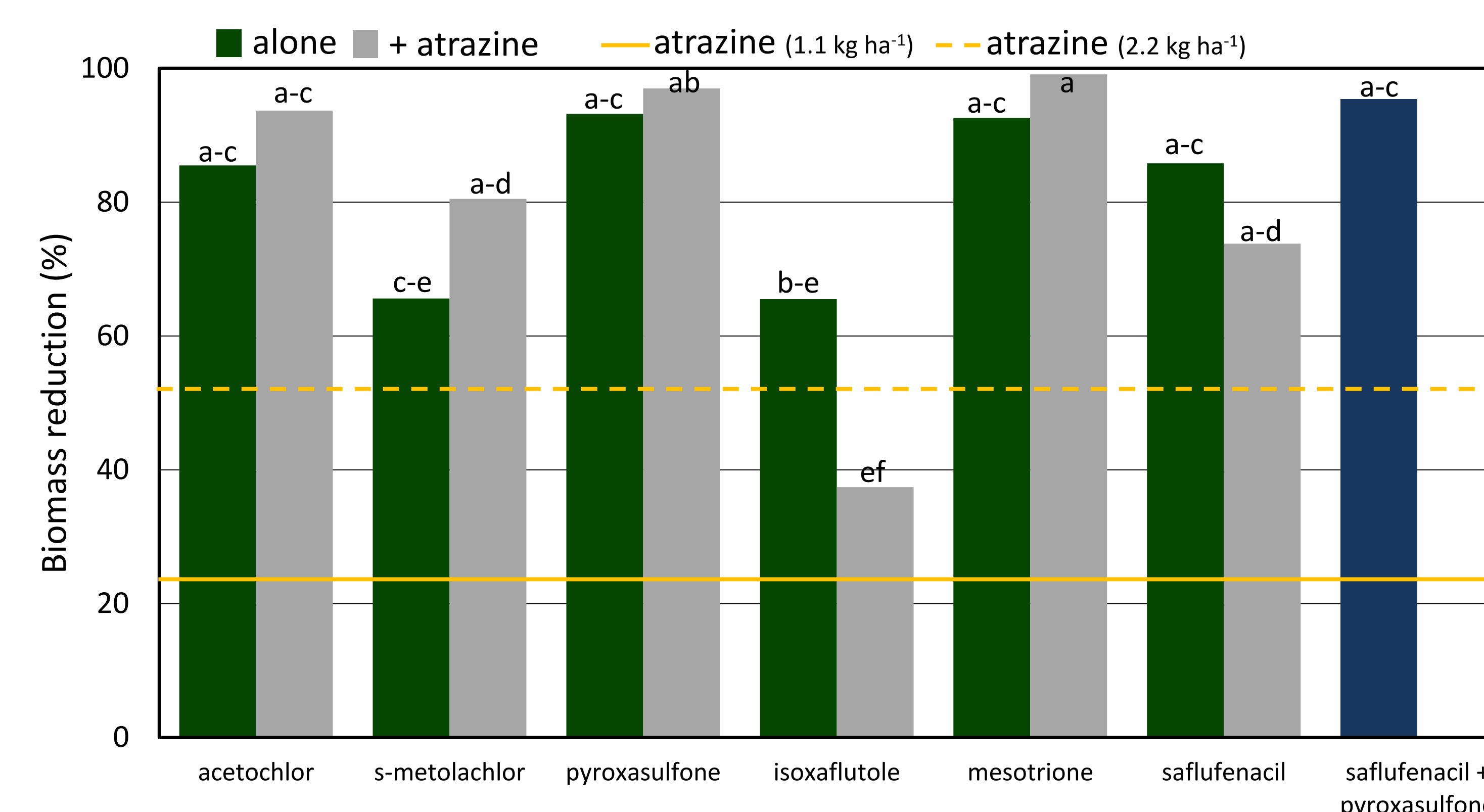
<sup>#</sup> All single active ingredients, except atrazine, were applied alone + atrazine at 1.12 kg a.i. ha<sup>-1</sup>

\* Only applied in 2014 and 2015

## Results and Discussion



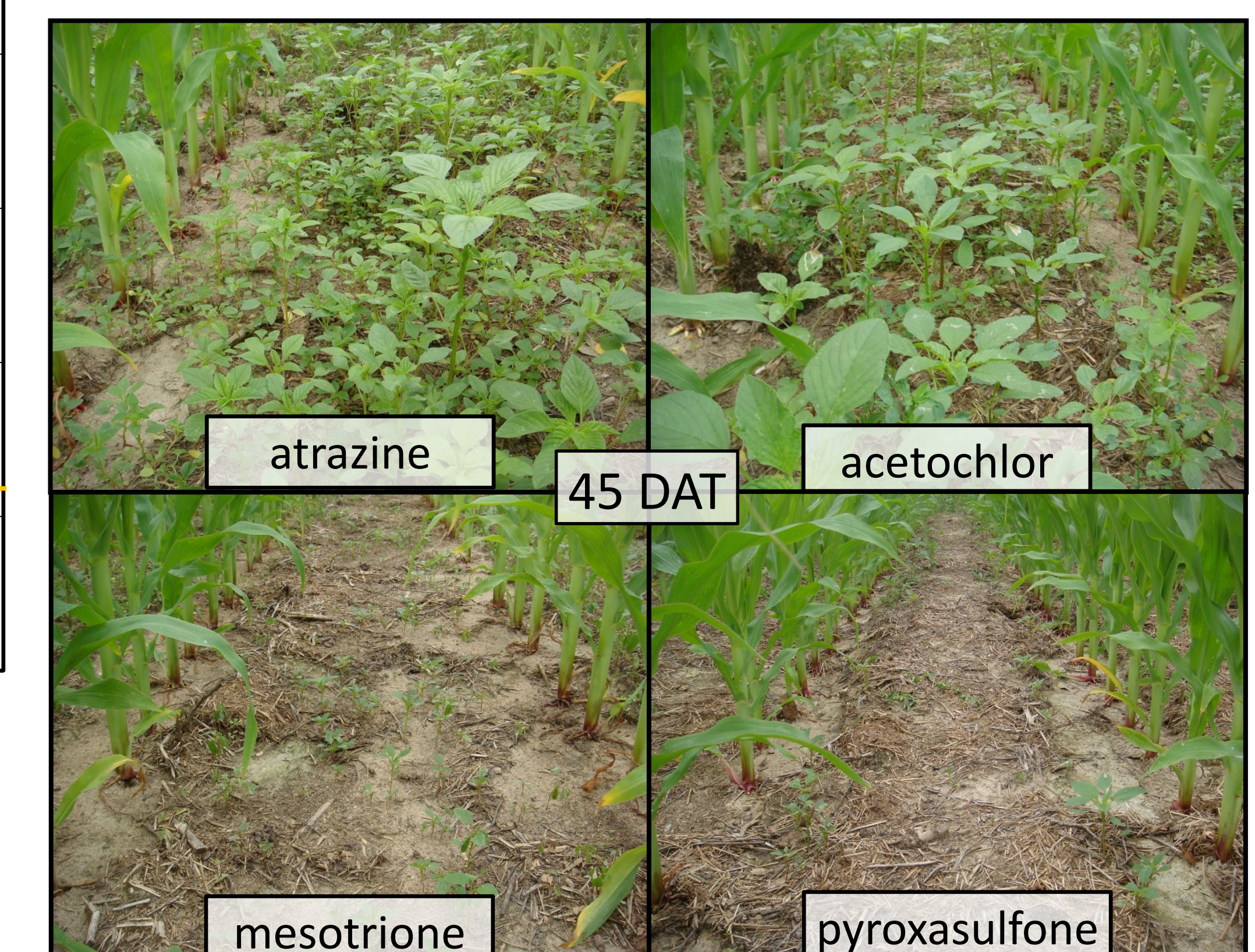
**Figure 1.** Palmer amaranth biomass reduction of single herbicide active ingredients alone and with atrazine 45 DAT, 2013.



**Figure 2.** Palmer amaranth biomass reduction of single herbicide active ingredients alone and with atrazine 45 DAT, 2014.

- Data from the 2015 field season is not presented. All soil-applied treatments with the exception of both rates of atrazine and saflufenacil significantly reduced Palmer amaranth biomass 45 DAT.

- Palmer amaranth control was extremely variable within and among the years.
- Atrazine failed to provide adequate control of this population, helping to confirm the variable resistance to Group 5 herbicides that has been observed in the greenhouse (Figures 1-3).
- Among the three years pyroxasulfone and mesotrione were the only single herbicide active ingredients that consistently provided greater than 80% control.
- The addition of atrazine did not increase Palmer amaranth control, except when added to saflufenacil in 2013 (Figure 1).
- Palmer amaranth control with the commercial premixes was greater than 80% in 2014 and 2015, 45 DAT. However, in 2013 only Lemax, Lexar, and Zemax provided adequate Palmer amaranth control (data not shown).
- In most cases, evaluations for Palmer amaranth control 72 DAT indicated that most products would have needed a POST herbicide application for season-long control.



**Figure 3.** Palmer amaranth control with four single herbicide active ingredients alone 45 DAT, 2013.

## Conclusions

- Over the three years there was substantial variability in the level of Palmer amaranth control in this population. The increased levels of control in 2015 could possibly indicate that there may be a fitness penalty associated with the level of triazine resistance in this population.
- While some of the herbicide programs evaluated provided adequate levels of Palmer amaranth control well into the growing season, a follow up postemergence application with an effective herbicide will be necessary for complete control of this multiple-resistant Palmer amaranth population.

## Acknowledgments

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