

Introduction

- ❖ Waterhemp (*Amaranthus tuberculatus*) is one of the most common and problematic weeds in soybean production due to the ability to develop herbicide resistance quickly.
- ❖ Commercialization of the Xtendflex and Enlist E3 trait technology in soybean was driven by the need to control ALS, PPO, and glyphosate-resistant broadleaf weed populations, like waterhemp, with synthetic auxin herbicides.
- ❖ In recent years, Group 4 (dicamba and 2,4-D) and Group 10 (glufosinate) herbicides have been used post-emergence in the Xtendflex and Enlist E3 soybean systems to control herbicide resistant waterhemp.
- ❖ Tank mixing other modes of action with Group 4 herbicides might improve waterhemp control.

Hypothesis and Objective

Hypothesis: Herbicide programs that include a soil residual herbicide followed by a post-emergence mixture that contains the synthetic auxin and glufosinate will result in the highest level of control of ALS, PPO, atrazine, glyphosate, and dicamba resistant waterhemp.

Objective: Evaluate different herbicide programs that contain the synthetic auxin, glyphosate, and/or glufosinate for control of ALS, PPO, atrazine, glyphosate, and dicamba resistant waterhemp.

Materials and Methods

Methods:

- ❖ A burndown application of paraquat was made to control existing plants before soybean planting.
- ❖ Xtendflex and Enlist E3 soybean varieties were planted and PRE-emergence herbicides were applied immediately after planting.
- ❖ Initial POST-emergence applications were made when waterhemp height was 7-15 cm in plots without a PRE-emergence herbicide.
- ❖ Second POST-emergence applications were made two weeks after initial POST.
- ❖ Visual estimates of control were taken 21 days after the second POST-emergence application.
- ❖ Herbicides were applied at full labeled rates (Table 1).

Table 1: Herbicide rate of each herbicide used in each program

	Enlist E3	Xtendflex		Xtendflex
flumioxazin (flu)+ pyroxasulfone (pyr)	12 g ai/ha + 20 g ai/ha	flumioxazin (flu)+ pyroxasulfone (pyr)	12 g ai/ha + 20 g ai/ha	
glyphosate (gly)	1,539 g ai/ha	glyphosate (gly)	1,539 g ai/ha	
glufosinate (glu)	655 g ai/ha	glufosinate (glu)	655 g ai/ha	
2,4-D	1,063 g ae/ha	dicamba (dic)	558 g ae/ha	
pyroxasulfone (pyr)	91 g ai/ha	pyroxasulfone (pyr)	91 g ai/ha	

Data Analysis:

- ❖ Data were analyzed with an Analysis of Variance and means separated using Tukey's Honest Significant Difference ($\alpha = 0.05$).

Results – Enlist E3

Figure 1: Waterhemp control in Enlist E3 soybean in 2021 at 21 DAT

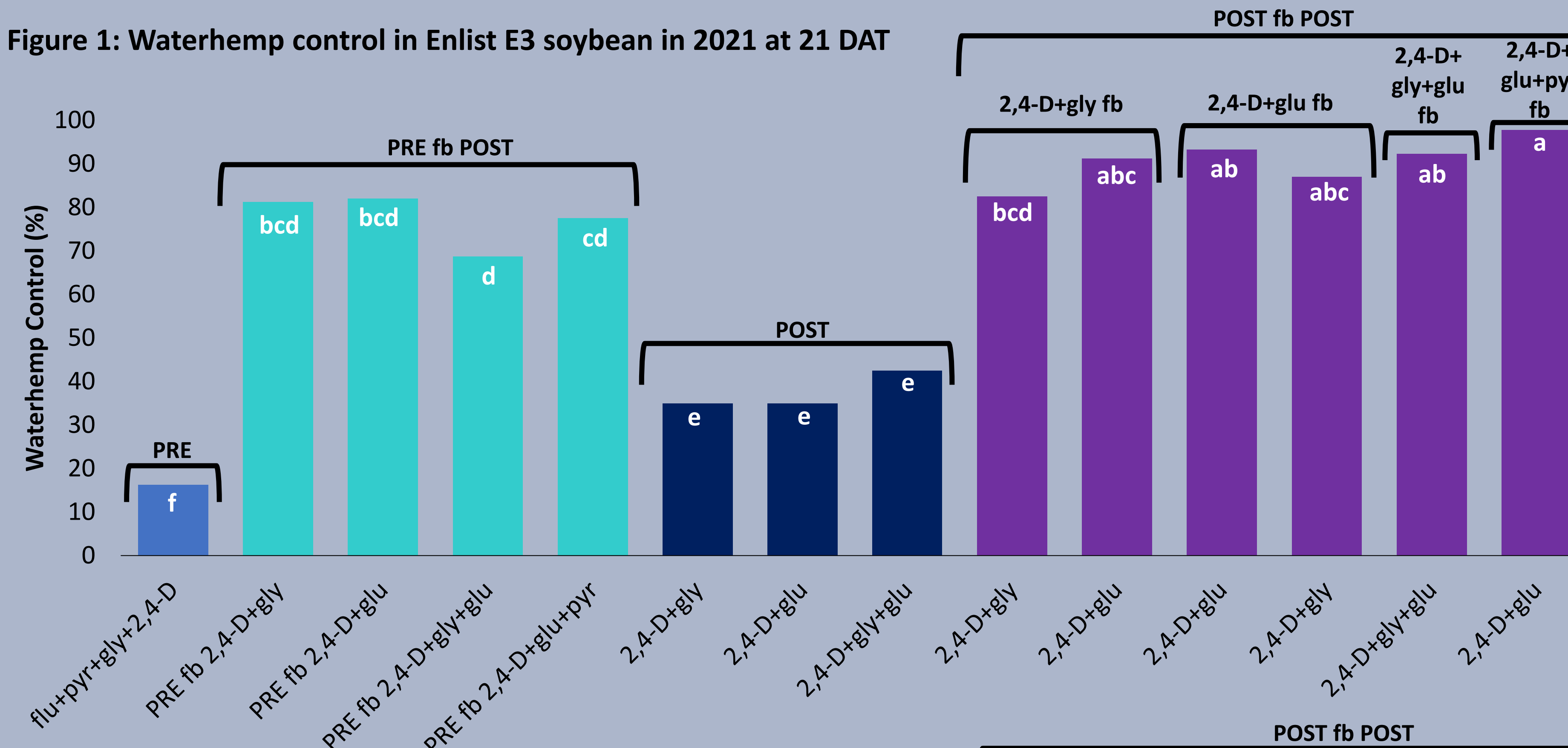
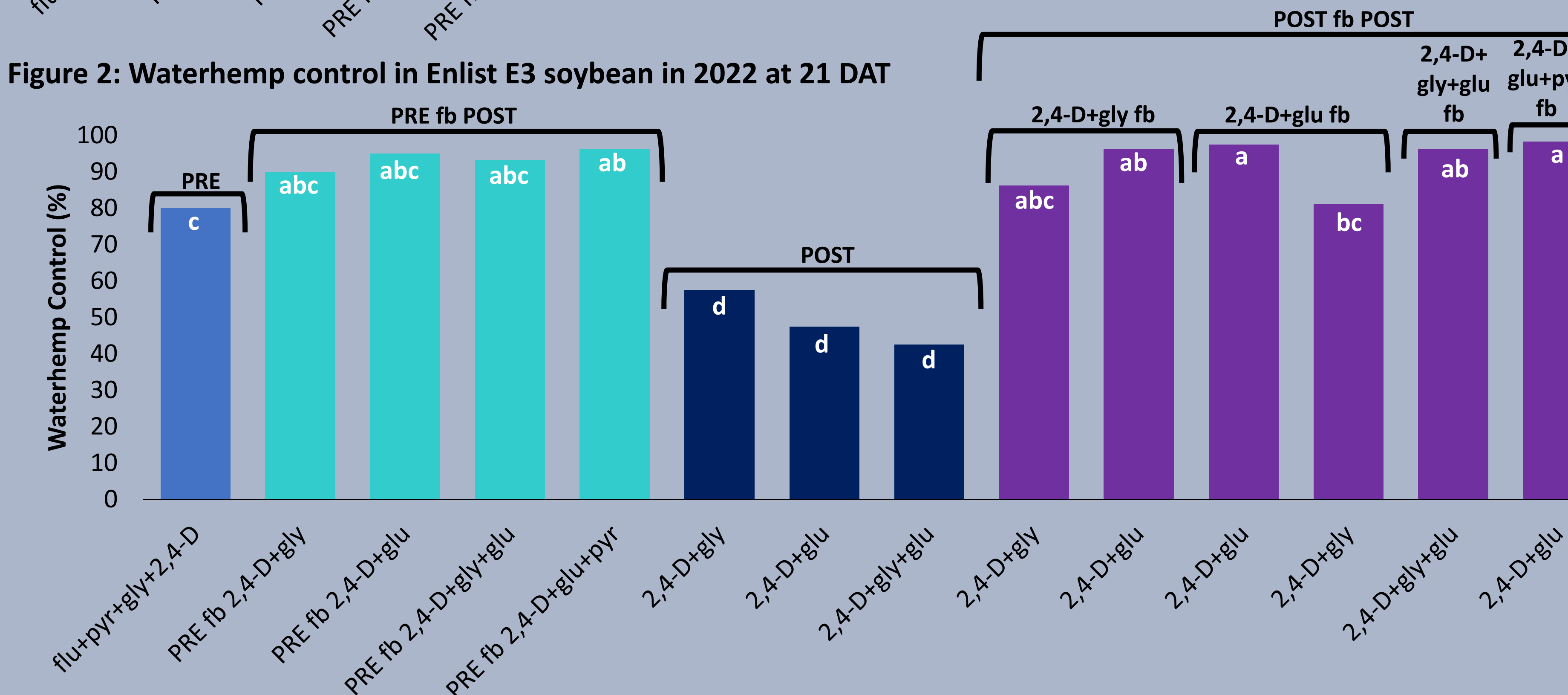


Figure 2: Waterhemp control in Enlist E3 soybean in 2022 at 21 DAT



Results - Xtendflex

Figure 3: Waterhemp control in Xtendflex soybean in 2021 at 21 DAT

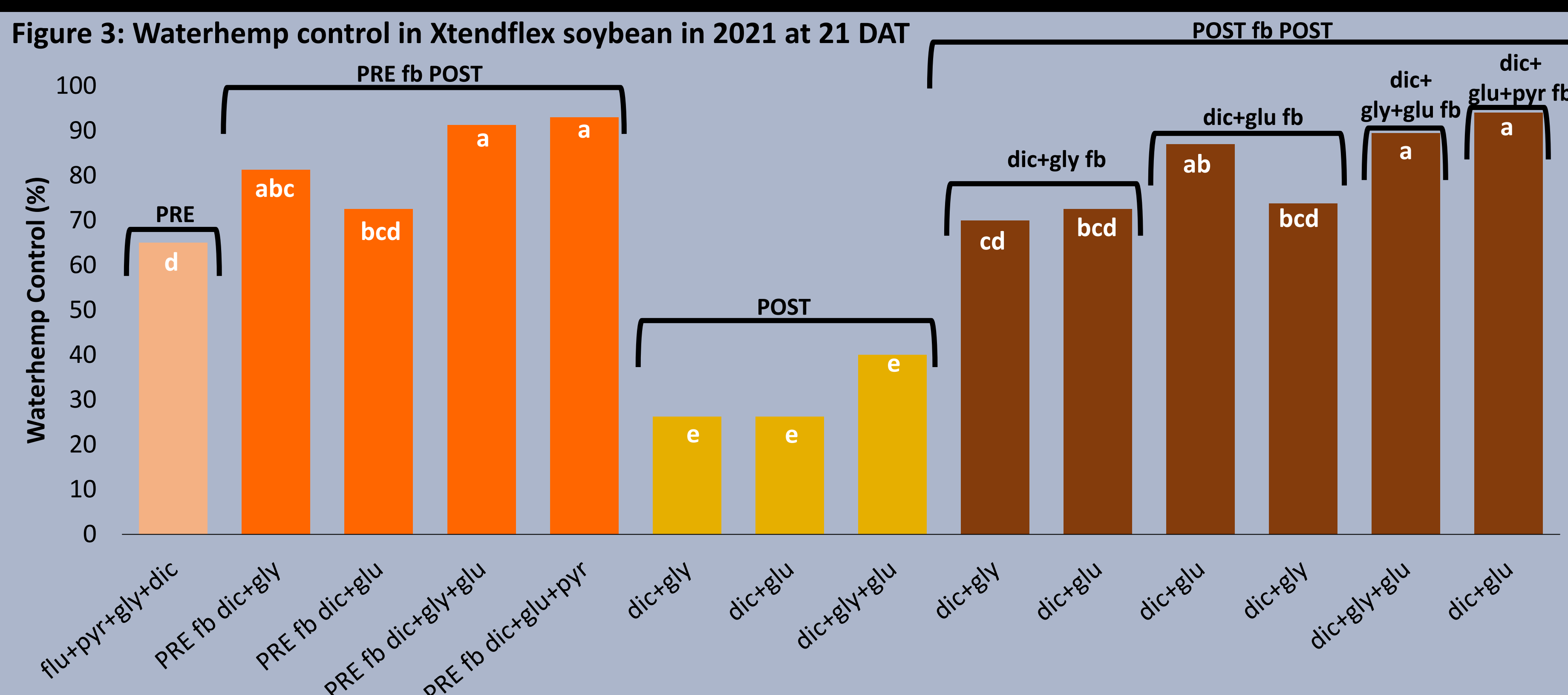
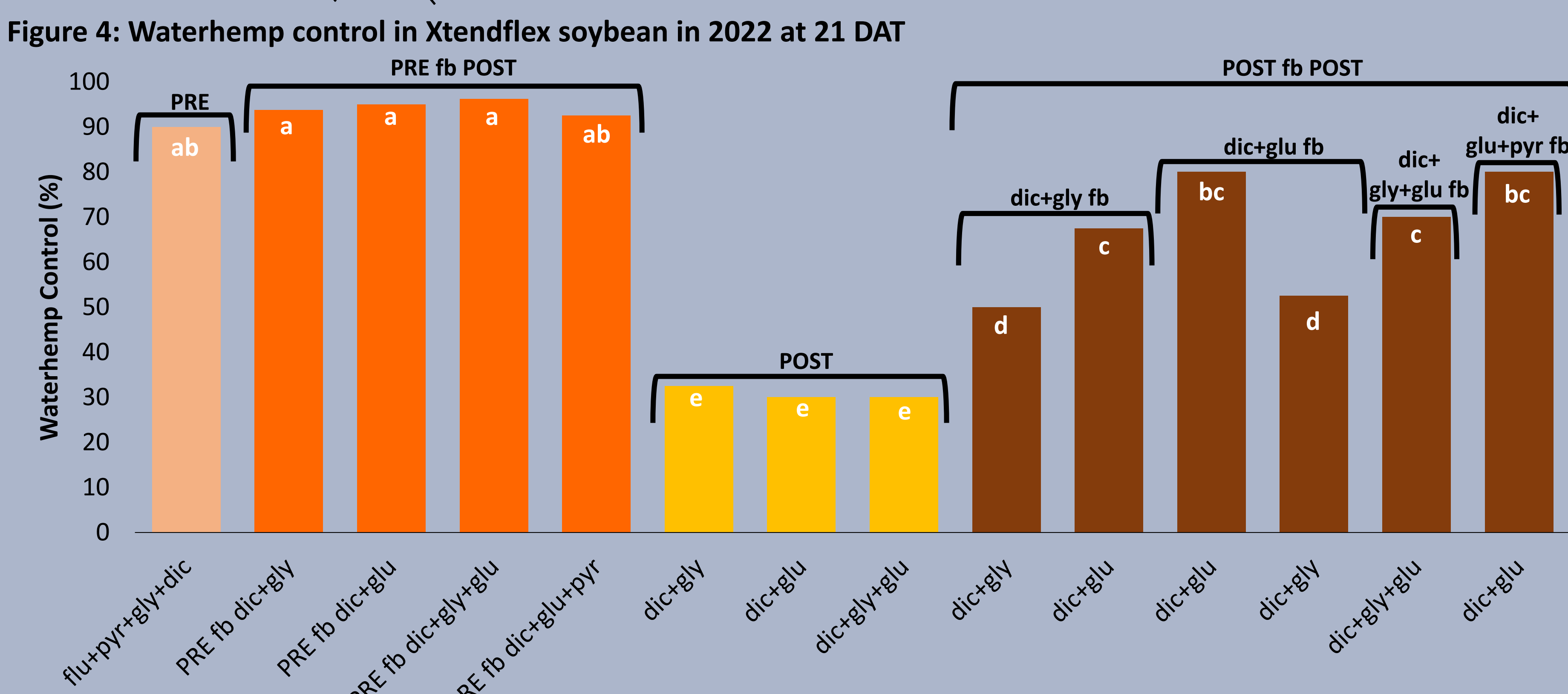


Figure 4: Waterhemp control in Xtendflex soybean in 2022 at 21 DAT



Discussion

Enlist E3 System

- ❖ In 2021...
 - ❖ Single pass programs resulted in inadequate waterhemp control (Figure 1).
 - ❖ All PRE fb POST programs resulted in similar levels of control, between 65% to 85% (Figure 1).
 - ❖ POST fb POST programs generally resulted in higher levels of control if the second POST treatment included glufosinate and 2,4-D (Figure 1).
 - ❖ The only program that resulted in 95% control or higher was the two pass POST program with 2,4-D + glufosinate + pyroxasulfone fb 2,4-D + glufosinate (Figure 1).
- ❖ In 2022...
 - ❖ Single pass programs resulted in inadequate waterhemp control (Figure 2).
 - ❖ Two pass POST programs that contained glufosinate in the POST resulted in at least 95% control (Figure 2).
- ❖ Summed over both site years, 5 out of 15 programs resulted in 95% control or higher and all contained 2,4-D + glufosinate POST.

Xtendflex System

- ❖ In 2021...
 - ❖ Single pass programs resulted in inadequate control (Figure 3).
 - ❖ Generally, treatments that included glufosinate in the POST application resulted in higher levels of waterhemp control than those without (Figure 3).
- ❖ In 2022...
 - ❖ The single pass PRE program resulted in similar control provided by the PRE fb POST programs (Figure 4), indicating that POST treatments provided limited additional control of this waterhemp population.
 - ❖ The addition of dicamba POST did not improve waterhemp control due to dry weather conditions.
- ❖ Across both site years, 1 out of 15 programs resulted in 95% control or higher.

Implications

- ❖ In fields with waterhemp resistant to glyphosate, dicamba, and other sites of action, there are more herbicide options that provide 95% control or higher in Enlist E3 soybeans.
- ❖ The use of glufosinate and 2,4-D post-emergence is crucial in order to control this population that is not completely controlled by soil residual herbicides and other post-emergence herbicides, such as glyphosate, dicamba, and fomesafen.
- ❖ Use of non-chemical control tactics may be necessary in the coming years for control of multiple resistant waterhemp populations.

Future Research

- ❖ Develop a full resistance profile to determine other resistance mechanisms in this population.
- ❖ Utilize molecular assays to confirm the mechanism of action for known resistance.