

Economics of Herbicide Programs in Conventional, LibertyLink, and Roundup Ready 2 Xtend Soybeans Across Nebraska

2021 Crop Production Clinics



Adam Striegel*, Kent Eskridge, Stevan Knezevic, Nevin Lawrence, Gary Hein, Greg Kruger, Chris Proctor, Amit Jhala

ELEPHANT IN THE ROOM: HERBICIDE-RESISTANT WEEDS

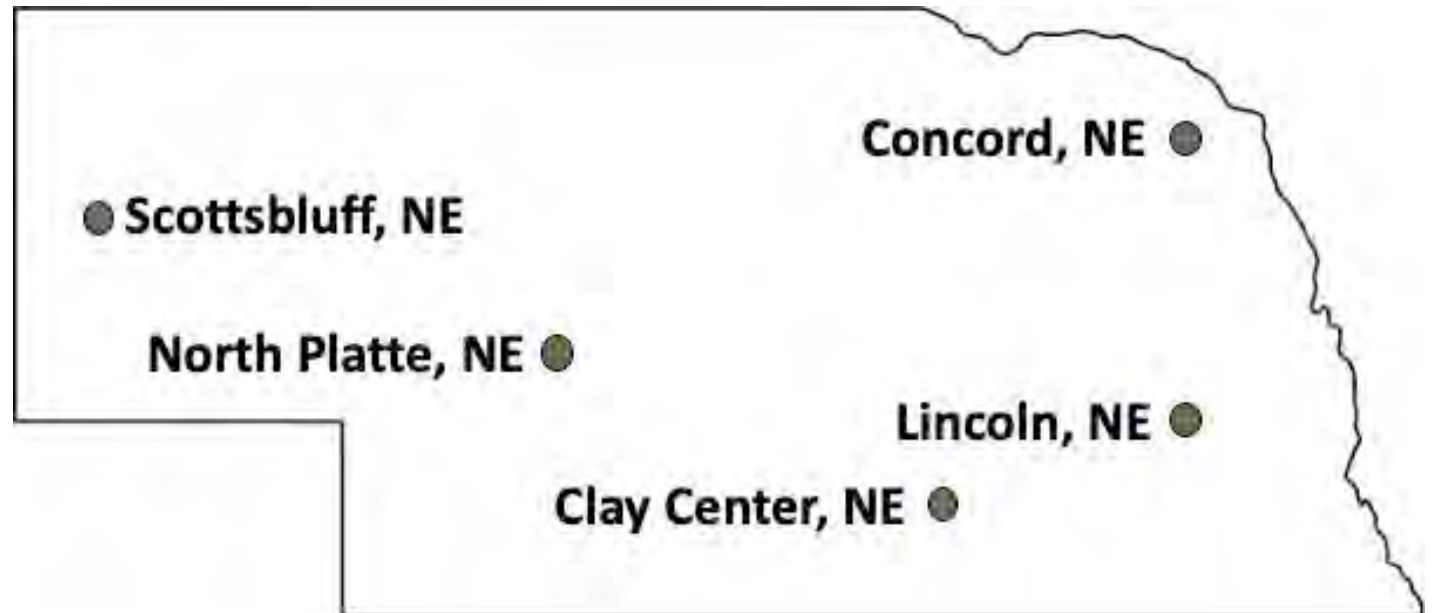


- A 2017 survey in Nebraska found **60%** of producers believe they have glyphosate-resistant weeds on their farms.
- National adoption of PRE herbicides in soybeans has increased from **25%** in 2000 to **70%** in 2015.
- Similar results in Nebraska:
 - 74% Nebraska corn acres
 - 59% Nebraska soybean acres

EXPERIMENT OBJECTIVE:

- Compare 5 commercially available “pre-mixed” PRE programs followed by 4 POST programs in soybeans:

1. Weed Control
2. Crop Safety
3. Yield
4. Economics



PRE Herbicide Programs

#	Trade Name	Rate (Ac)	Cost (\$/Ac)
1	Nontreated control	--	--
2	Zidua Pro + Warrant	6 fl. oz + 2 qt	\$45.75
3	Authority Elite + TriCor 4F	32 fl. oz + 20 fl. oz	\$54.25
4	Enlite	2.8 oz	\$23.50
5	Fierce + TriCor 4F	3 oz + 6 fl. oz	\$33.75
6	Trivence	8.7 oz	\$29.75
7	Zidua Pro	6 fl. oz	\$31.50

POST PROGRAMS IN SOYBEAN IS BASED ON HR-TRAIT

2018:



Present:



POST Herbicide Programs

#	Trade Name	Rate (Ac)	Cost (\$/Ac)
1	Xtendimax + Roundup Powermax	22 fl. oz + 32 fl. oz	\$37.00
2	Roundup Powermax	32 fl. oz	\$13.54
3	Liberty	32 fl. oz	\$20.25
4	Warrant + SelectMax + Cobra	2 qt + 14 fl. oz + 12.5 fl. oz	\$60.25

Soybean Varieties & Important Dates

Study Location	HR-trait	Soybean Variety	Company	Planting Date (140k ppa)	PRE Herbicide Application Date	POST Herbicide Application Date
Clay Center	RR2X	S29-k3x NK	Syngenta	May 07, 2018 May 15, 2019	May 07, 2018 May 15, 2019	June 04, 2018 June 13, 2019
	LibertyLink	P31T02L	Corteva			
	Conventional	A3253	Bayer			
Concord	RR2X	27MX8 NK	Syngenta	June 05, 2018 June 06, 2019	June 06, 2018 June 08, 2019	July 20, 2018 July 11, 2019
	LibertyLink	CZ260ILL	BASF			
	Conventional	P29T50	Corteva			
Lincoln	RR2X	S29-k3x NK	Syngenta	May 13, 2018 May 17, 2019	May 11, 2018 May 17, 2019	June 11, 2018 June 21, 2019
	LibertyLink	P31T02L	Corteva			
	Conventional	A3253	Bayer			
North Platte	RR2X	28XT58	Loveland	May 20, 2018 May 31, 2019	May 18, 2018 June 04, 2019	June 26, 2018 July 11, 2019
	LibertyLink	CZ260ILL	BASF			
	Conventional	A3253	Bayer			
Scottsbluff	RR2X	AG20X7	Bayer	May 21, 2018 June 05, 2019	May 21, 2018 June 05, 2019	July 18, 2018 July 26, 2019
	LibertyLink	H20L3	Hefty			
	Conventional	U11-917032 A2035	Husker Genetics Bayer			

RESULTS TO DISCUSS TODAY

1. Weed Control and Biomass Reduction
2. Crop Injury
3. Crop Yield and Economics

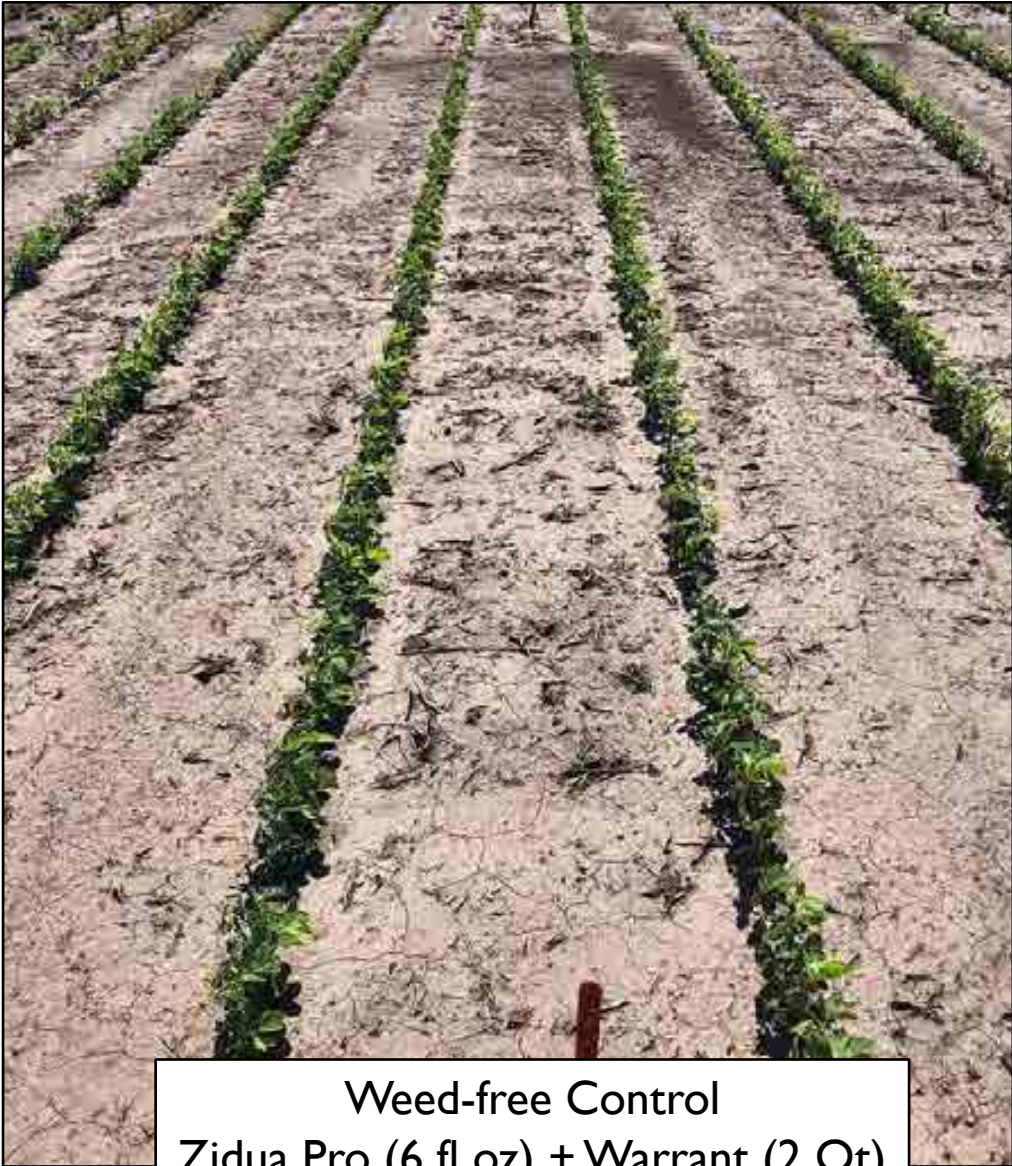
PRE HERBICIDE PROGRAM WEED CONTROL & BIOMASS REDUCTION

- At 28 d after PRE, all PRE programs provided \geq **80%** control of:
 - Palmer amaranth
 - Common lambsquarters
 - Velvetleaf
 - Large crabgrass, foxtails and sandbur
 - Kochia (65-95%)
- PRE programs provided **74-94%** weed biomass reduction at 28-45 d after PRE.

28 days after PRE (2019 Clay Center, NE)



Nontreated Control



Weed-free Control
Zidua Pro (6 fl oz) + Warrant (2 Qt)

28 days after PRE (2019 Clay Center, NE)



Authority Elite (32 fl. oz) + Tricor (20 fl. oz)



Enlite (2.8 oz)

28 days after PRE (2019 Clay Center, NE)



Fierce MTZ (3 oz plus 6 fl. oz co-pack)



Trivence (8.7 oz)

28 days after PRE (2019 Clay Center, NE)



Zidua Pro (6 fl. oz)

POST HERBICIDE PROGRAM WEED CONTROL & BIOMASS REDUCTION

- At 28 d after POST, all POST programs provided \geq **85-95%** control of:
 - Palmer amaranth
 - Common lambsquarters
 - Velvetleaf
 - Large crabgrass, foxtails and sandbur
 - Kochia (29-91%)
- POST programs provided **86-99%** weed biomass reduction 28 days after PRE.



28 days after POST (2019 Clay Center, NE)
Nontreated Control



28 days after POST (2019 Clay Center, NE)
Xtendimax (22 fl. oz/Ac) + Roundup (32 fl. oz/Ac)



28 days after POST (2019 Clay Center, NE)
Roundup (32 fl. oz/Ac)



28 days after POST (2019 Clay Center, NE)
Liberty (32 fl. oz/Ac)



28 days after POST (2019 Clay Center, NE)
Warrant (2 qt/Ac) + SelectMax (14 fl. oz/Ac) + Cobra (12.5 fl. oz/Ac)

PRE FB POST HERBICIDE PROGRAM CROP SAFETY

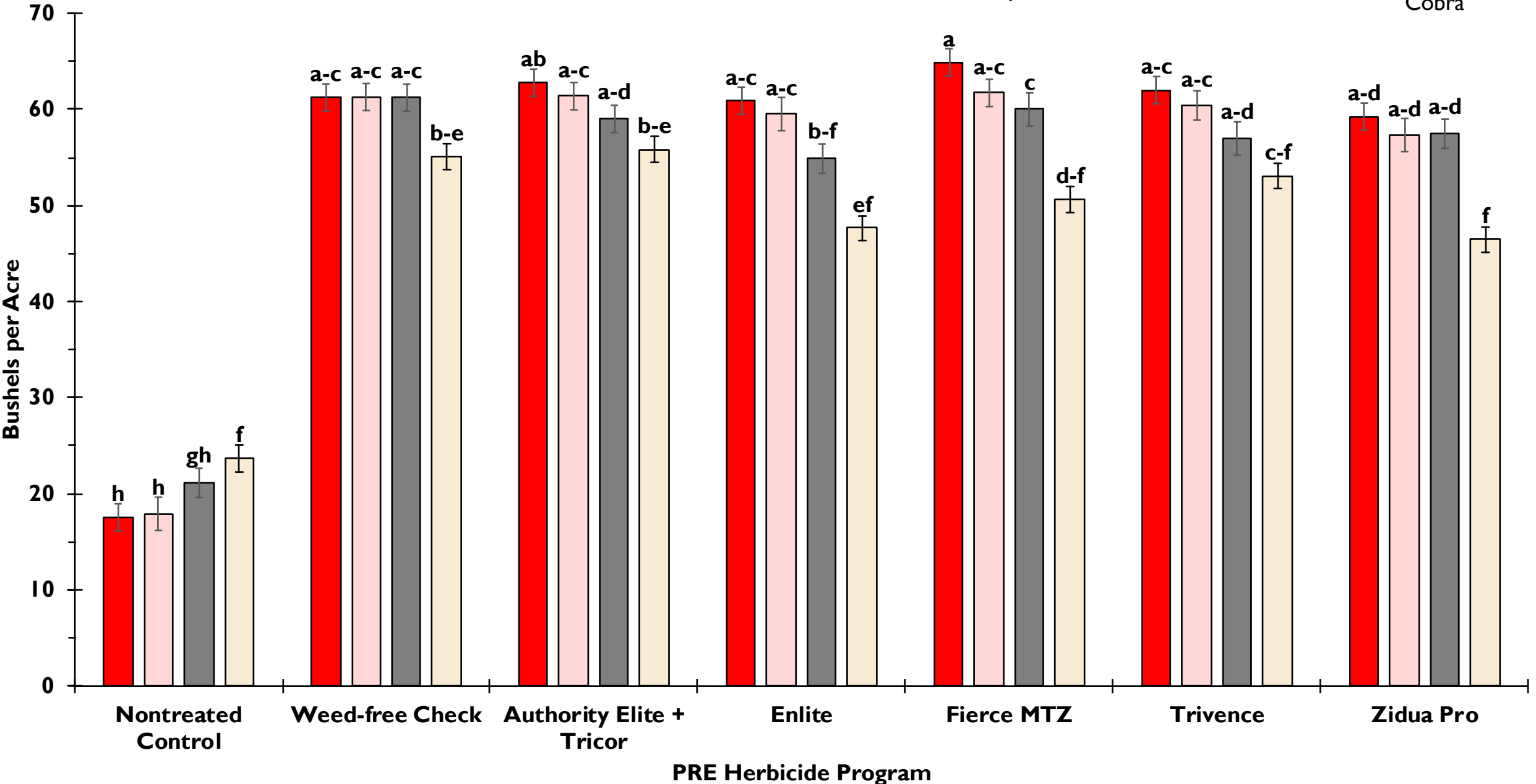
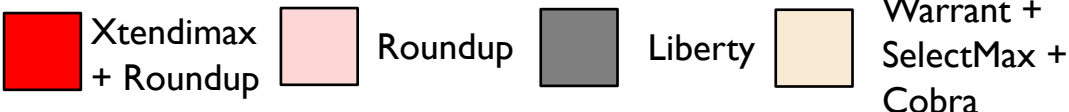
PRE Herbicide Injury:

- $\geq 4\%$ crop injury at 28 days after PRE

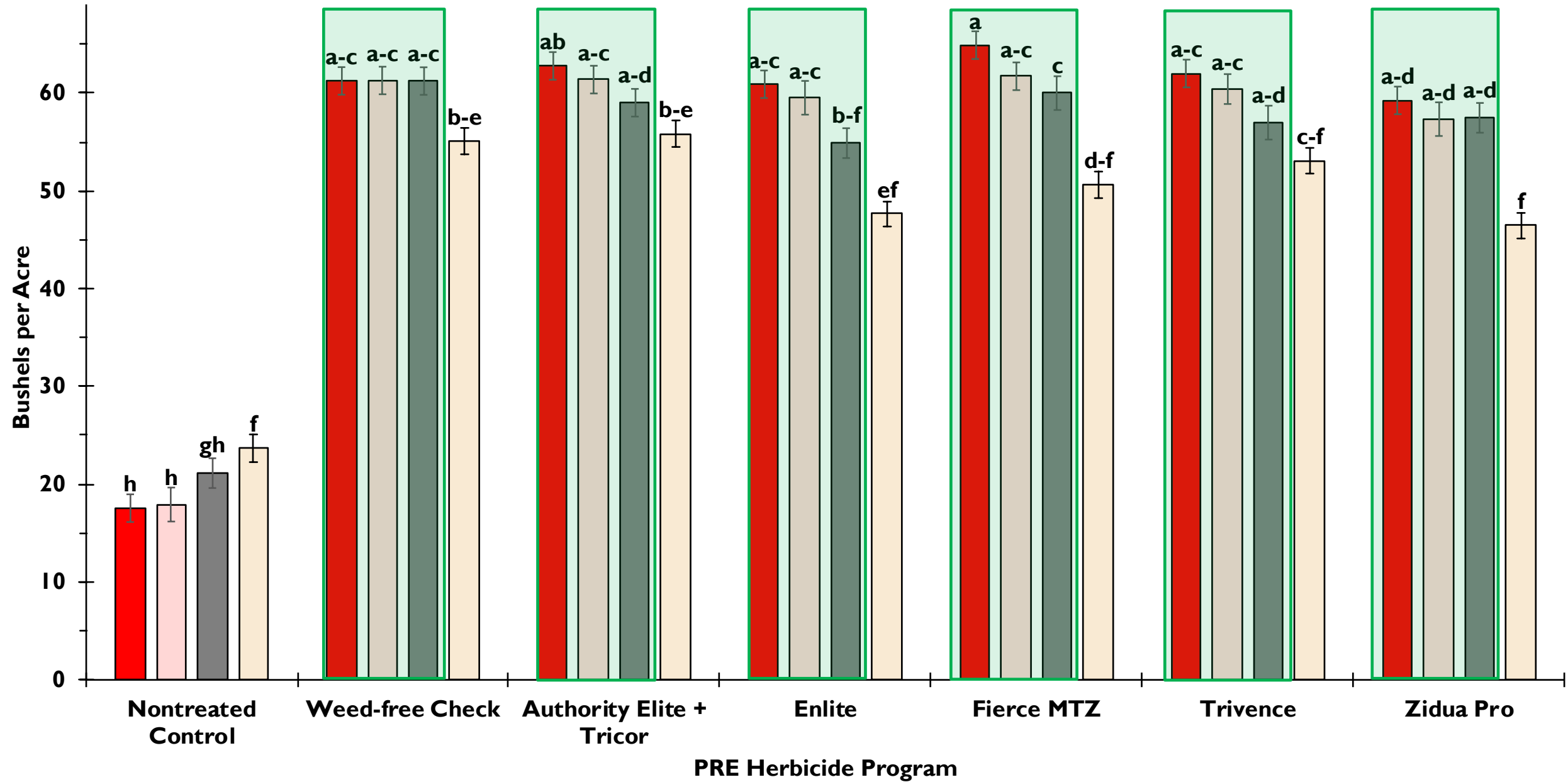
POST Herbicide Injury:

- RR2X varieties had no crop injury
- LibertyLink varieties had 12% dicamba injury (**0 to 30%**)
- Conventional varieties had 9% PPO-burn and 12% dicamba injury

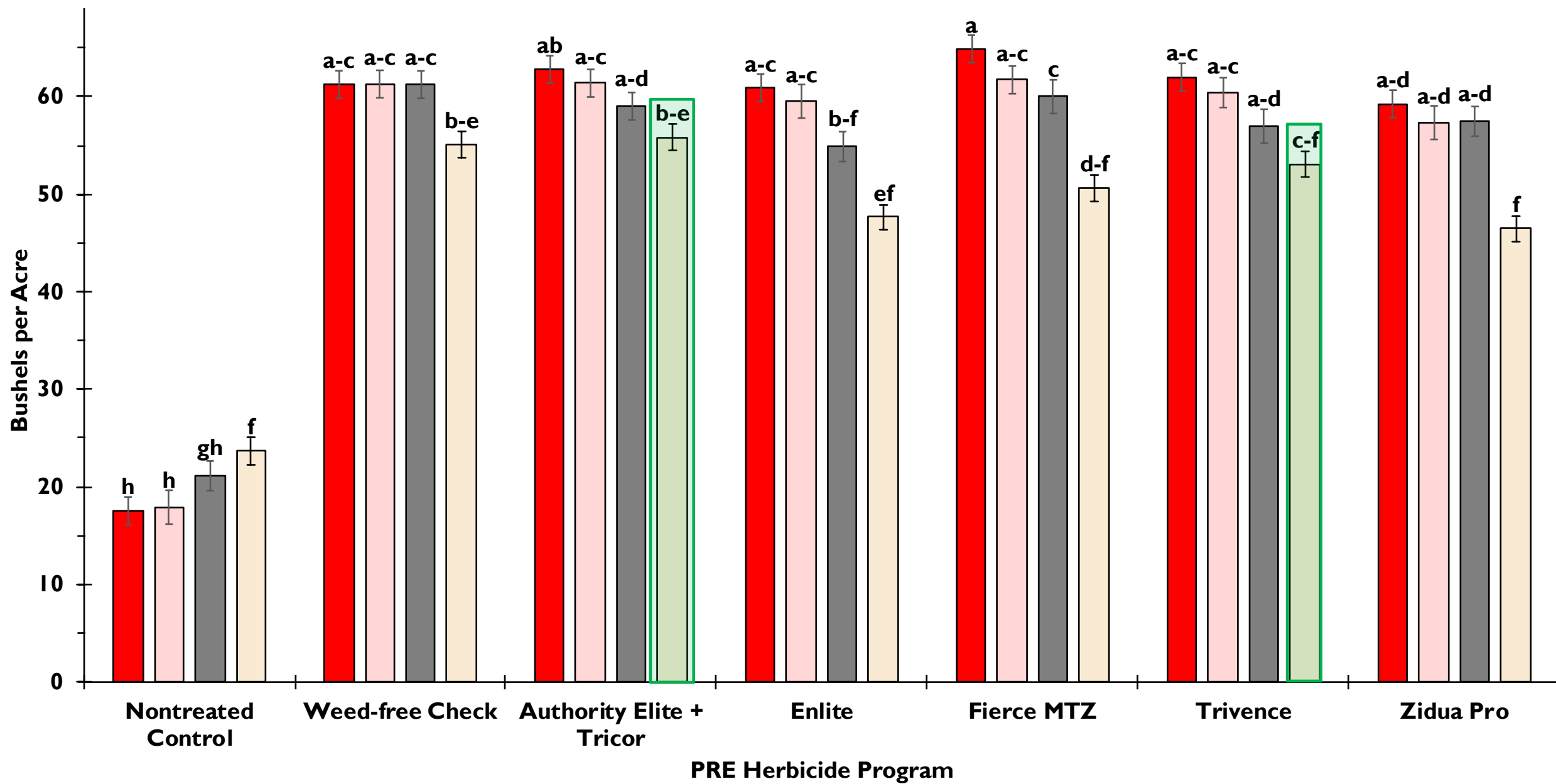
Crop Yield in PRE fb POST Herbicide Programs



LibertyLink varieties yielded comparable to RR2X cultivars



Some PRE fb POST programs in conventional varieties were comparable to RR2X cultivars



ECONOMIC ANALYSIS

USDA: \$8.50 per bushel for GMO-soybeans, \$9.54 per bushel for Non-GMO soybeans

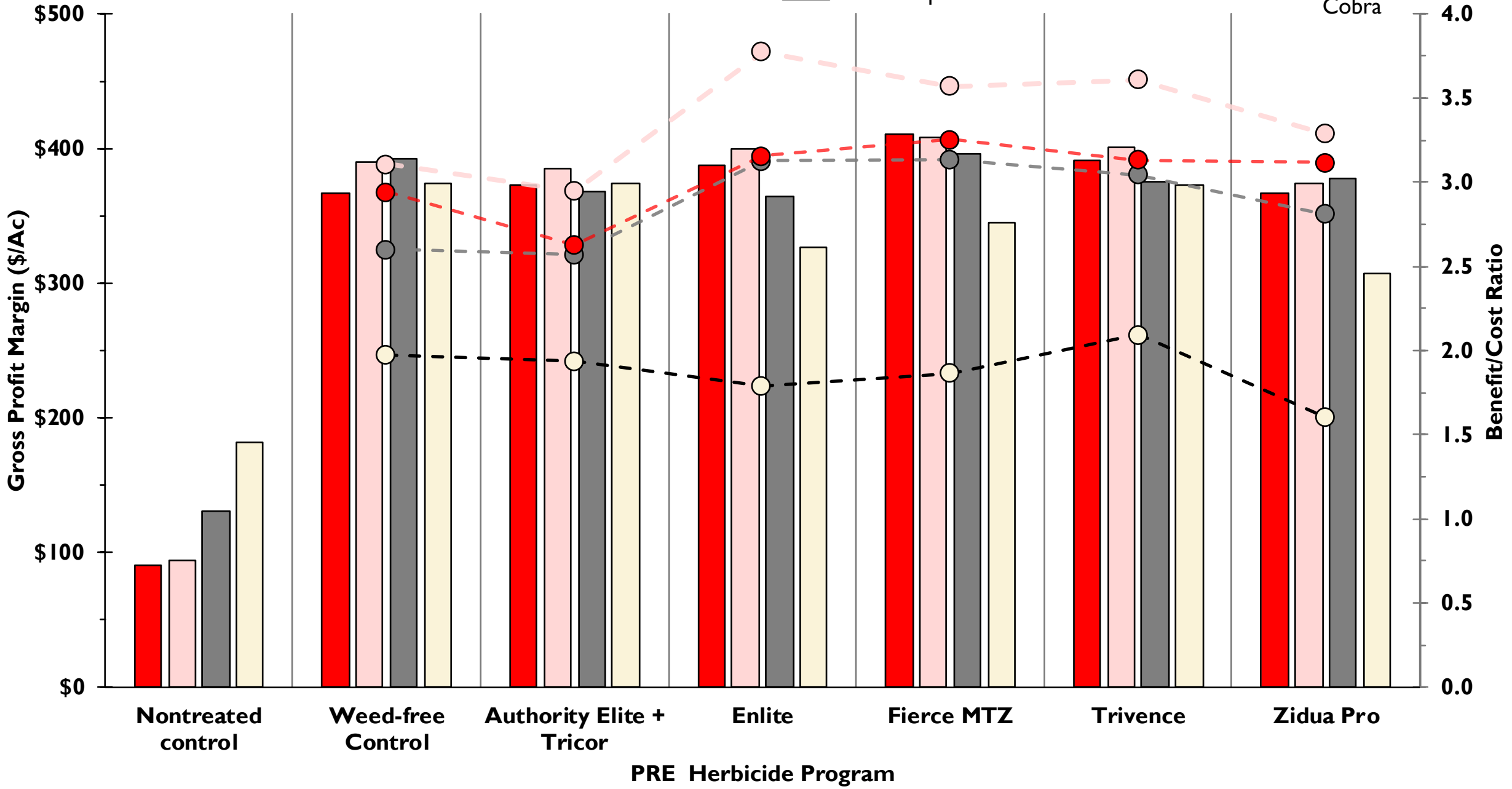
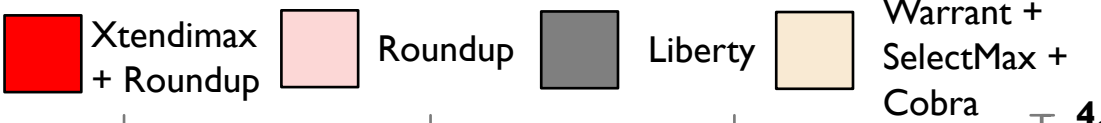
Gross Profit Margin:

- Gross Revenue per Acre – Weed Management Program Costs
 - Herbicides, adjuvants, custom application, and HR-Trait costs
- **“After paying for the weed management program, how much gross revenue remains?”**

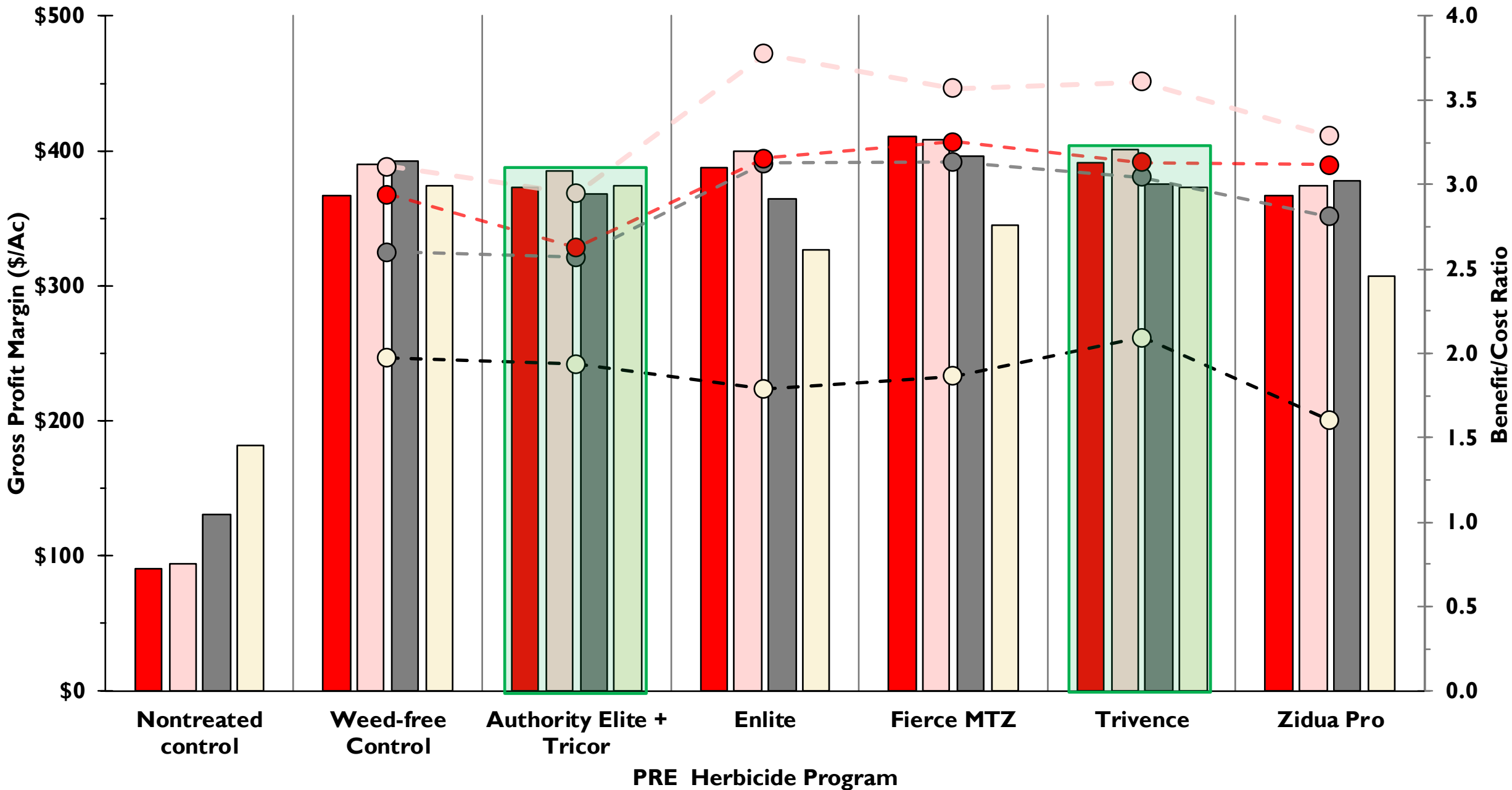
Benefit-Cost Ratio:

- $(\text{Gross Revenue per Acre} - \text{Gross Revenue per Acre for nontreated control}) \div \text{Weed Management Program Cost}$
- **“Per dollar invested into a weed management program how much benefit was obtained?”**

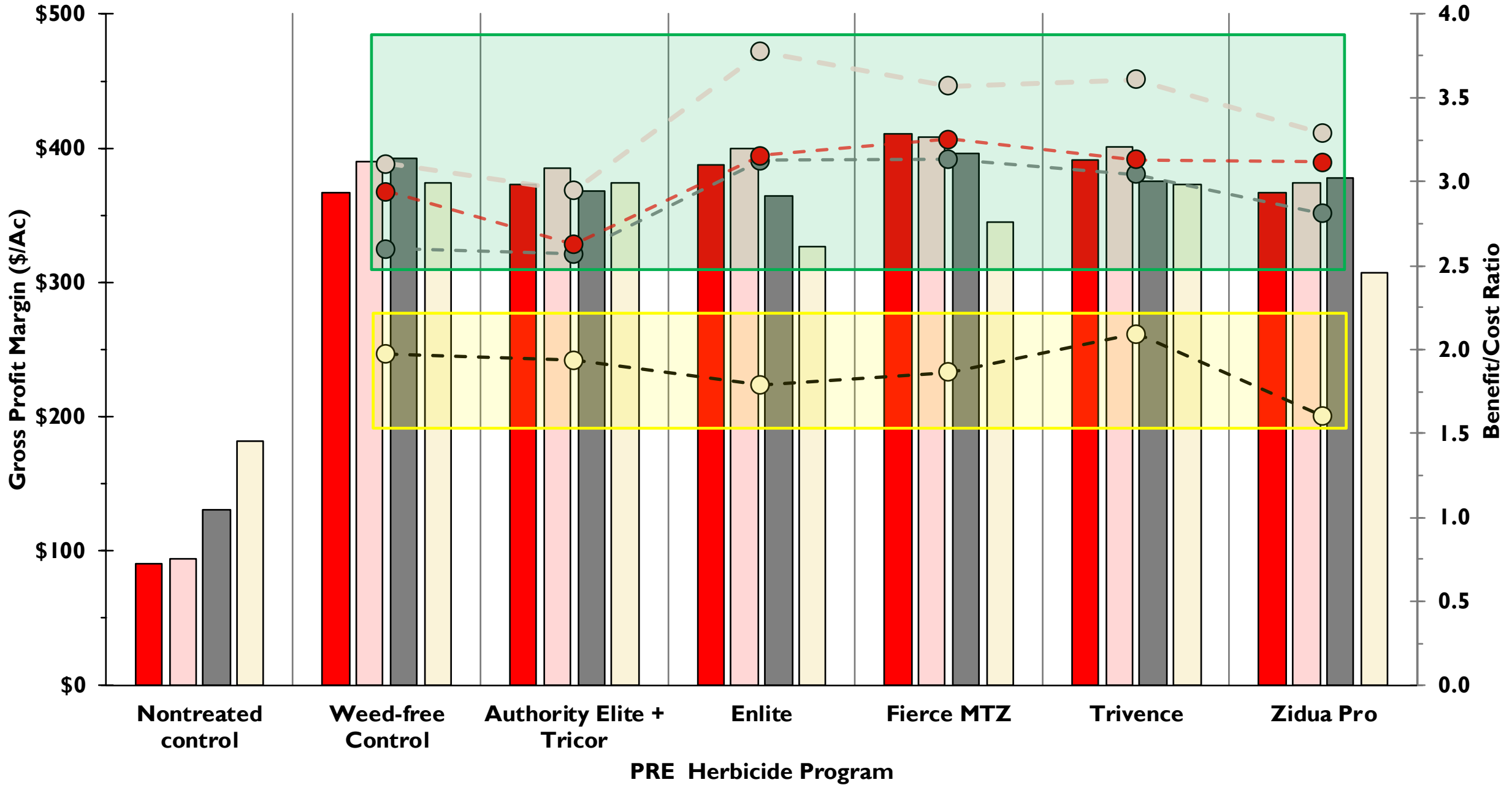
Economic Analysis of PRE fb POST Herbicide Programs



Gross Profit Margin for Conventional/HR-Soybean are Comparable For Some Programs



Benefit/Cost Ratio for Conventional PRE fb POST is Lower



CONCLUSIONS

WEED CONTROL:

- All PRE fb POST programs worked well to control weed species (excluding Kochia)
 - **≥80%** control 28 days after PRE
 - **≥ 85-95%** control 28 days after POST

CROP YIELD:

- LibertyLink varieties were similar to RR2X in most programs
- Two conventional programs were similar to RR2X

ECONOMICS:

- In areas supported by price premiums, conventional soybeans can offer similar gross profit margins to HR-soybean
 - **If weed spectrum is right. Limited POST options!**
- LibertyLink soybeans were comparable to RR2X for many programs

Control of Roundup Ready/LibertyLink Volunteer Corn in Enlist™ Corn

2021 Crop Production Clinics



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VOLUNTEER CORN IS A PROBLEMATIC WEED SPECIES

Well Documented In Many Crops: 1970s - Present

- Reduction in crop yield or crop quality
- Management of volunteer corn



6% to 87%



4 to 8%



19% sucrose reduction

MANAGEMENT OF VOLUNTEER CORN IN CORN HAS REQUIRED HR-TRAIT ROTATION

Planted Crop HR Trait	Volunteer Conventional	Volunteer Roundup Ready	Volunteer LibertyLink	Volunteer RR/LL
Conventional				
Roundup Ready				
LibertyLink				
RR/LL				

ENLIST™ – A NEW MANAGEMENT OPTION

Enlist™ hybrids:

- ❖ New multiple herbicide-resistant trait developed by Corteva Agriscience
 - 2,4-D choline
 - glyphosate
 - aryloxyphenoxypropionate (FOPs)
 - glufosinate (separate trait)



ENLIST™ DOES NOT PROVIDE RESISTANCE TO ALL ACCASE HERBICIDES

ACCASE INHIBITORS (Group 1)

Chemical Family	Common Name	Trade Name	Manufacturer
Aryloxyphenoxypropionate (FOPs)	clodinafop	<i>Discover® NG</i>	<i>Syngenta</i>
	cyhalofop	<i>Clincher®</i>	<i>Corteva</i>
	fenoxaprop	<i>Ricestar®</i>	<i>Bayer</i>
	fluazifop	<i>Fusilade® DX</i>	<i>Syngenta</i>
	quizalofop	<i>Assure® II</i>	<i>Corteva/AMVAC</i>
Cyclohexanediones (DIMs)	clethodim	<i>Select Max®</i>	<i>Syngenta</i>
	sethoxydim	<i>Poast Plus®</i>	<i>BASF</i>
Phenylpyrazolin (DENs)	pinoxaden	<i>Axial® XL</i>	<i>Syngenta</i>

RESEARCH OBJECTIVES & HYPOTHESES

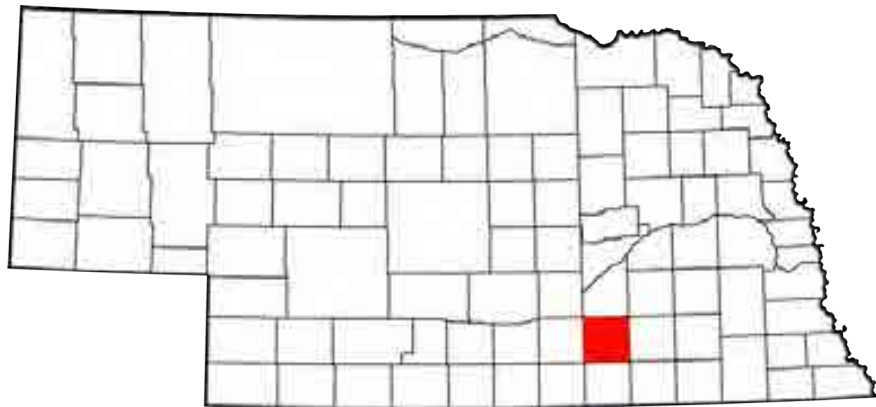
Objectives:

- Evaluate 6 Group 1 herbicides applied at two application times for:
 - ❖ Control of Roundup Ready/LibertyLink volunteer corn
 - ❖ Crop injury and yield loss (*and yield loss from volunteer corn*)

2018-2019 EXPERIMENTAL LOCATION

South Central Agricultural Laboratory (Clay Center, NE)

- Pivot Irrigated with four replications
- Cross-planted Volunteer Corn:
 - 15,000 plants per acre
 - April 26, 2018 & April 23, 2019







HYBRIDS & PRE/POST HERBICIDE PROGRAM

- **Enlist Hybrids:** 36,000 plants per acre
 - 05/07/2018- Mycogen MY10V09
 - 05/01/2019- Mycogen MY11V17

- **PRE:**
 - Acuron at 2.5 qt/Ac

- **Blanket POST: 1 week after treatments**
 - 2018- Roundup PowerMAX at 32 fl oz/Ac
 - 2019- Liberty at 44 fl oz/Ac

HERBICIDE TREATMENT APPLICATIONS

- CO₂-pressurized backpack sprayer: 15 GPA at 40 psi.
- **Early POST (E-POST) – 12” height**
 - June 12, 2018, June 13, 2019
- **Late POST (L-POST) – 20” height**
 - June 18, 2018, June 24, 2019

HERBICIDE TREATMENTS

Treatment	Rate (fl oz/Ac)	
	E-POST (12")	L-POST (20")
Nontreated Control	--	--
Weed-free Control	--	--
Fusilade DX	4	6
Assure II	4	5
Fusion	6	10
Select Max	8	14
Poast Plus	12	16
Axial XL	12	16.4

Enlist Corn Heights:

- **E-POST: (V7, 22")**
- **L-POST: (V8, 57-59")**

} FOPS
 } DIMS
 } DEN

} V5
 } V7-V8

RESULTS TO DISCUSS TODAY

1. Control of volunteer corn
2. Crop injury
3. Yield

FOPS PROVIDED 99% CONTROL OF VOLUNTEER CORN REGARDLESS OF APPLICATION TIME



Fluazifop (Fusilade DX)



Quizalofop (Assure II)



Fluazifop/fenoxaprop (Fusion)



DIMS & DENS CAUSE UNACCEPTABLE CROP INJURY

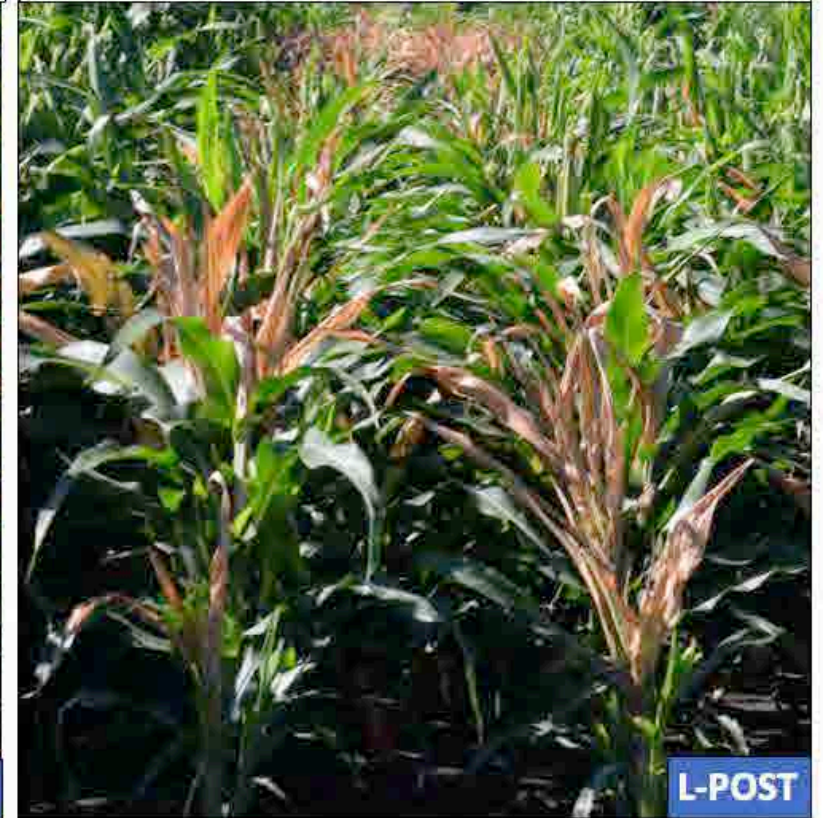
clethodim (SelectMax)



sethoxydim (Poast Plus)



pinoxyden (Axial XL)



2019 GROWING SEASON CHALLENGES

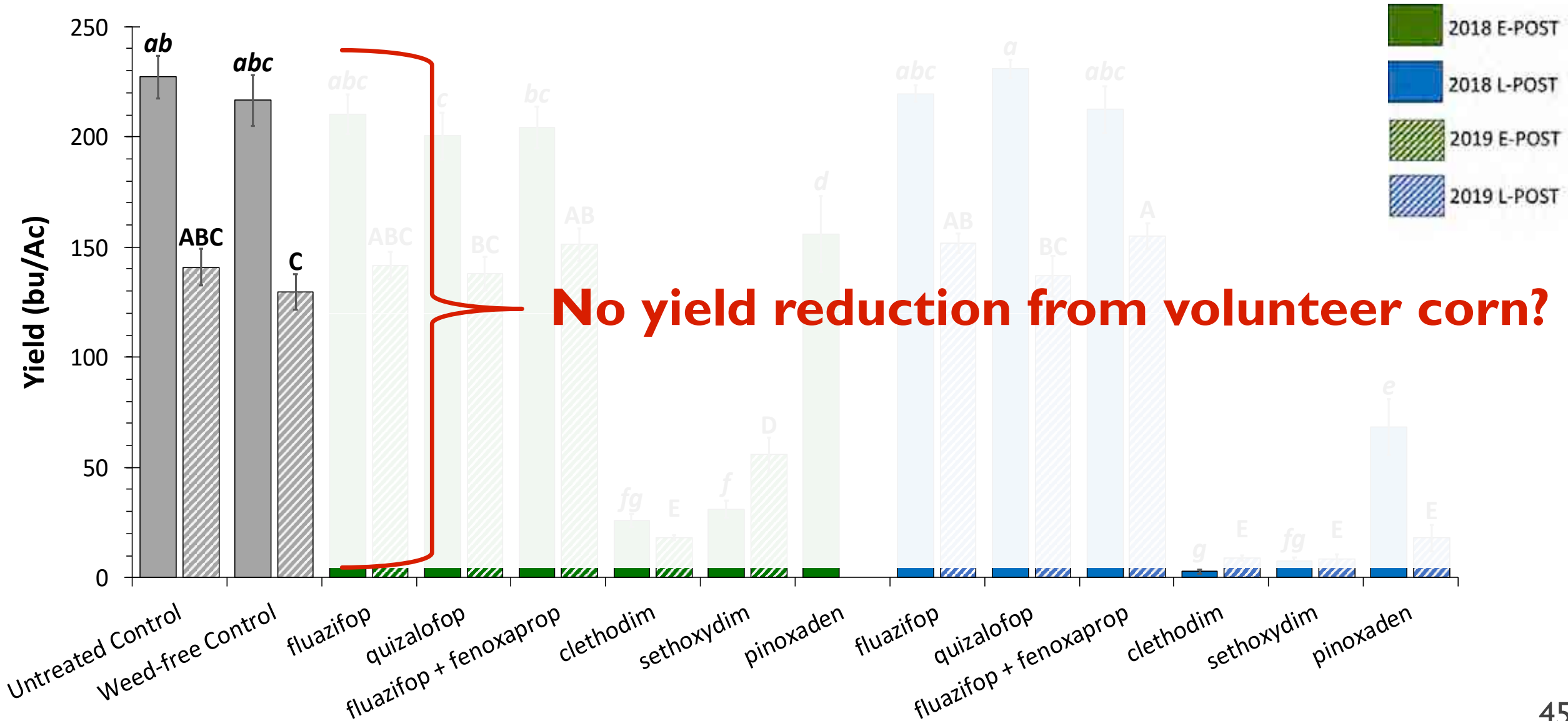
Mother Nature:

- Cool, wet spring (wind damage)
- 3+ strong windstorms early/mid season (green snap \approx 34k to 22k ppa)
- 50% defoliating hail at R3...

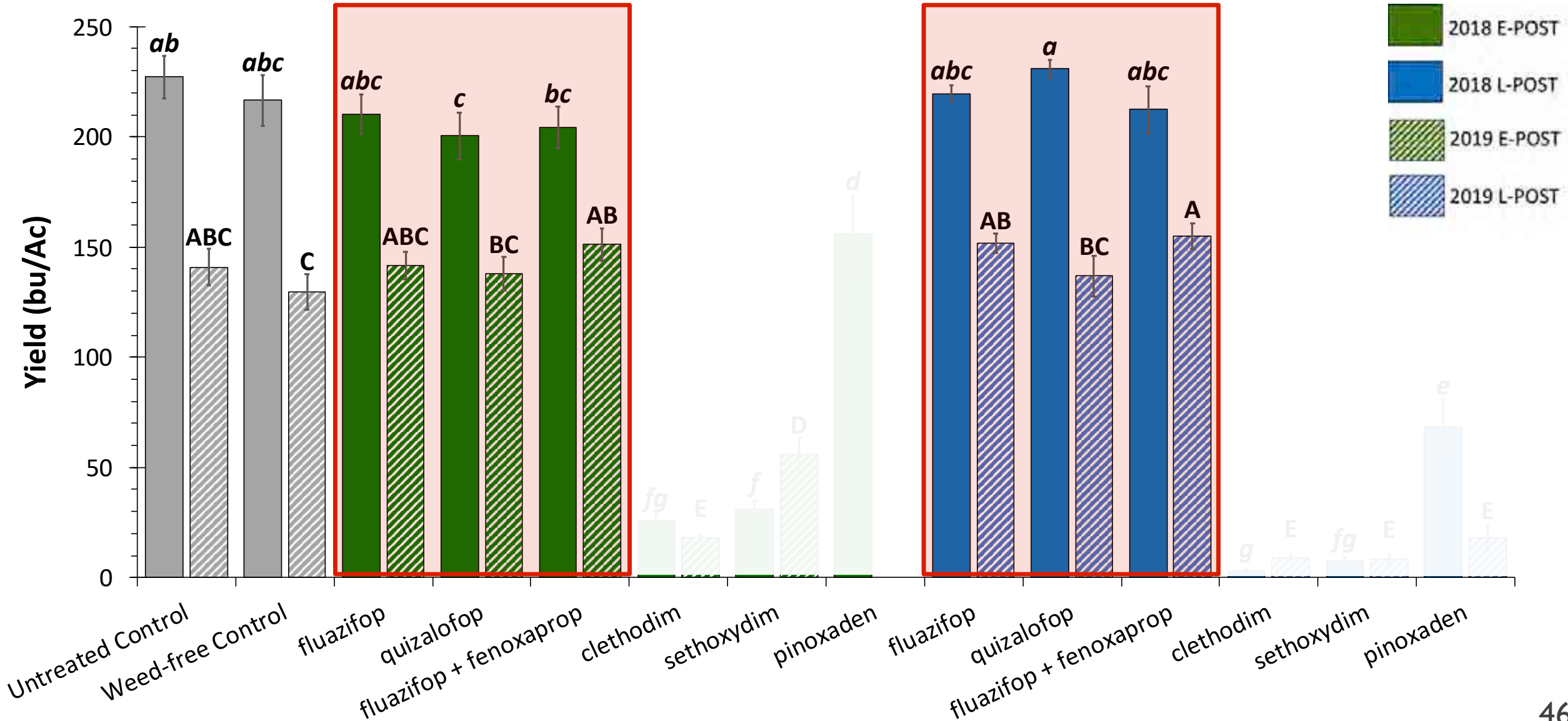
Our Workaround:

- Separate 2018 and 2019 for analysis of yield!

2018-2019 Crop Yield:

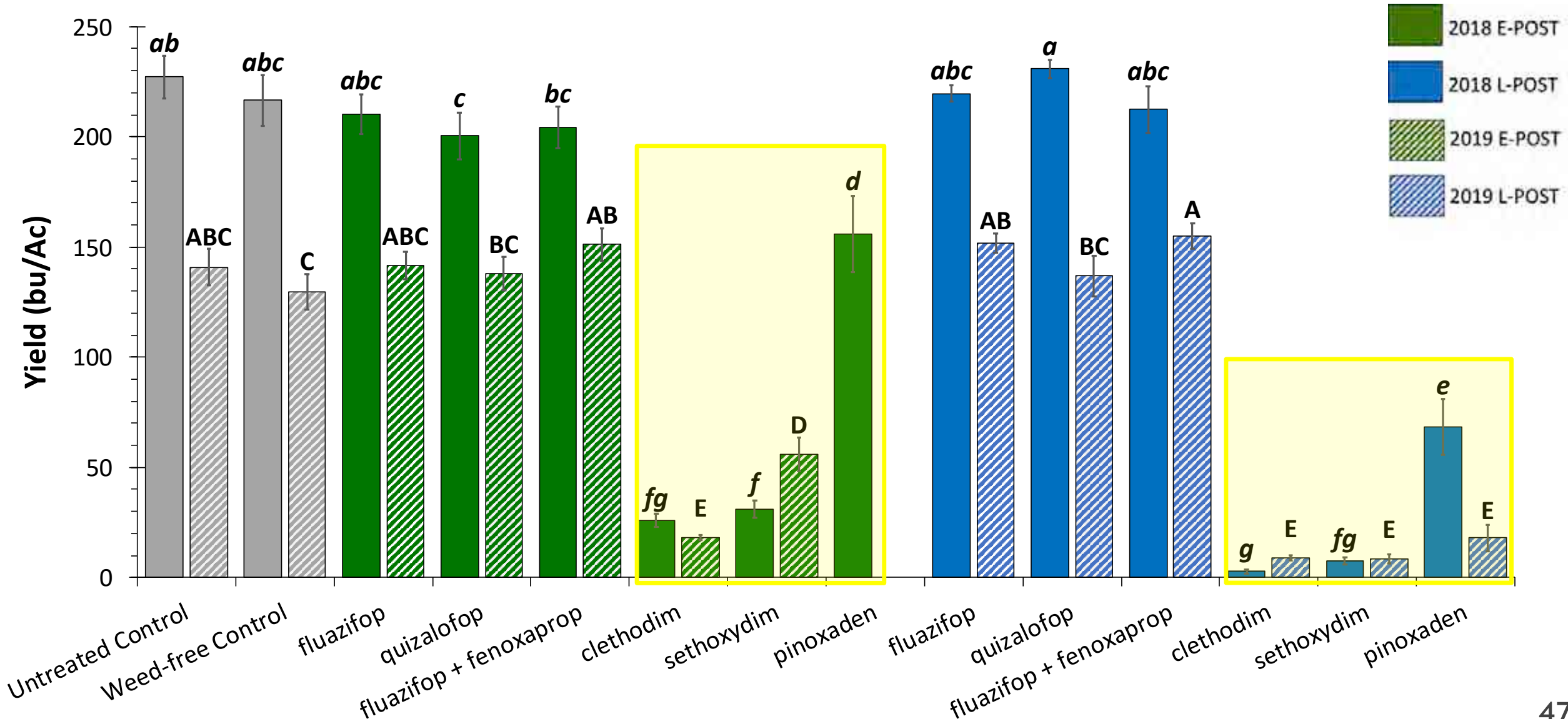


2018-2019 Crop Yield: No yield loss for FOP herbicides



2018-2019 Crop Yield:

DIM & DEN herbicides result in unacceptable yield loss



YIELD LOSS FROM VOLUNTEER CORN?

- 15,000 plants per acre did not directly reduce crop yield.
 - Distribution, **(clumped vs. individual plants)**
 - Contributed to yield?!



FINAL THOUGHTS

- Quizalofop (Assure II) is the only currently labeled ACCase product for use in Enlist.

Future Direction:

- Yield effects of other spatial distributions of volunteer corn (**clumped**)
- Pollen-mediated gene flow of Enlist HR-trait into non-tolerant hybrids.












SUGGESTED ROTATION

Year 1: Roundup Ready Corn

Year 2: Roundup Ready/LibertyLink Corn

Year 3: Enlist Corn

Year 4: Soybeans (with Select or Poast)

Planted Crop HR Trait	Volunteer Conventional	Volunteer Roundup Ready	Volunteer LibertyLink	Volunteer RR/LL	Volunteer Enlist
Conventional					
Roundup Ready					
LibertyLink					
RR/LL					
Enlist					

NEED TO ROTATE TO SOYBEANS AFTER ENLIST CORN TO CONTROL VOLUNTEER CORN

A photograph of a cornfield. The corn plants are in various stages of maturity. Some leaves are green and healthy, while many others are yellowed, brown, and appear to be withering or damaged. The plants are densely packed. In the center of the image, there is a red-bordered rectangular box containing the word "QUESTIONS?" in a bold, red, sans-serif font.

QUESTIONS?