

NDSU Invasive and Noxious Weeds Update

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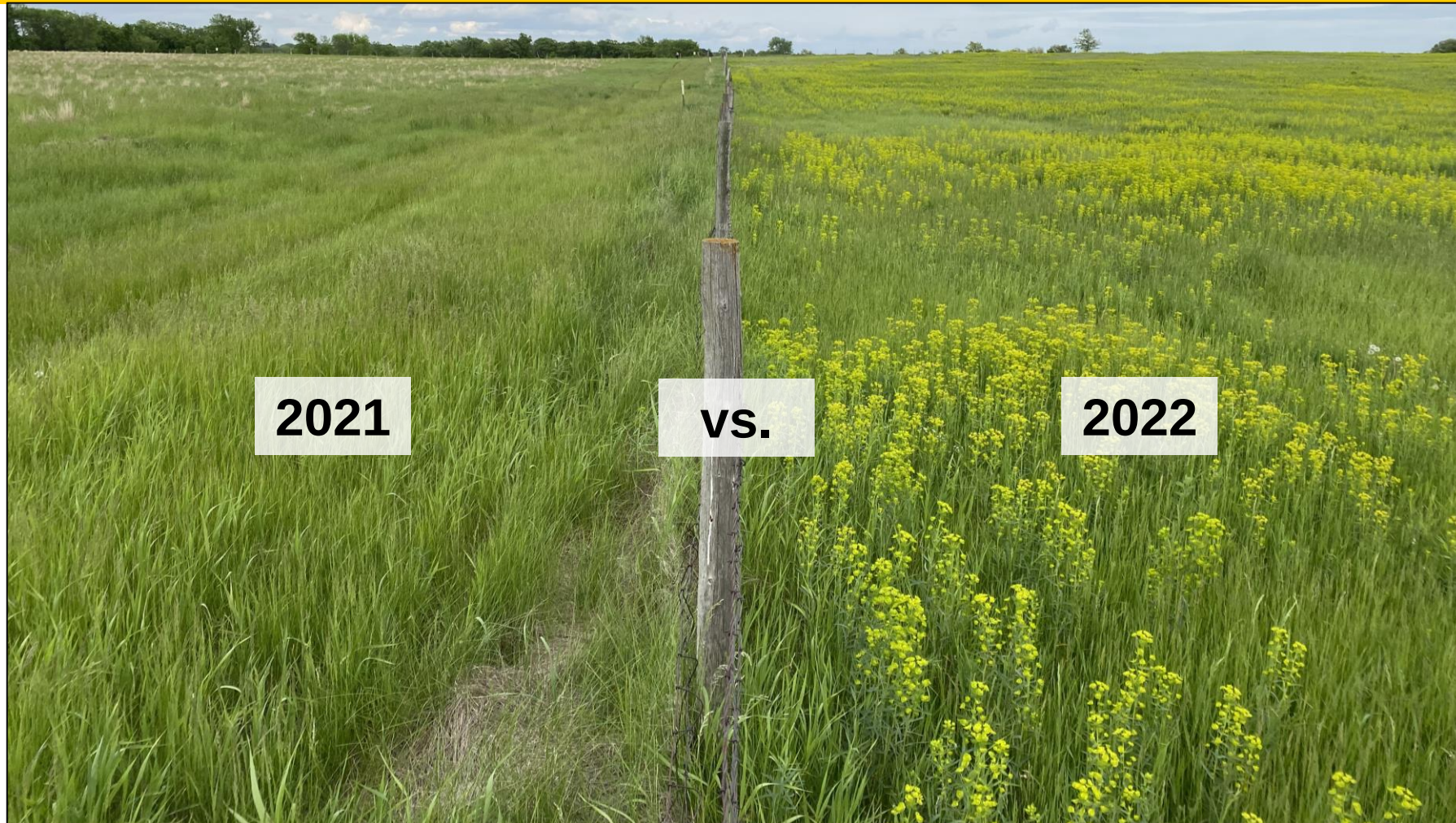
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PLANT SCIENCES

Outline

- Leafy spurge – 2023 Weed of the Year
- 2023 ND Weed Control Guide
- Palmer amaranth update
- 2022 research update
 - Group 15 herbicide efficacy on pigweeds in sunflower
 - Soybean and corn yield interference of Palmer amaranth

Leafy Spurge – 2023 Weed of the Year



Leafy Spurge – 2023 Weed of the Year

- Drought in 2020 through 2021 enabled leafy spurge to thrive in 2023
- Many plants escaped control
 - Reduced efficacy for both chemical and biological control
 - Skipped applications
- Dr. Lym noted a similar trend following the 1988 drought



Leafy Spurge – 2023 Weed of the Year

- Introduced to ND in 1909
 - ND area infested peaked at 1.5 million acres
- Costs an estimated \$75 million annually in lost production
 - Approximately 40% of leafy spurge-infested rangeland has a carrying capacity below the herbicide break-even point
- Use of flea beetles + chemical control is better than either used alone



Herbicide	Mode(s) of action	Amaranth, Palmer	Hounds-tongue	Knapweed, Diffuse	Knapweed, Russian	Knapweed, Spotted	Loosestrife, Purple	Saltcedar	Spurge, Leafy	Thistle, Canada	Thistle, Musk	Toadflax, Dalmatian	Toadflax, Yellow	Wormwood , Absinth
Arsenal (imazapyr)	2	C*	-	C*	C*	C*	C	C	-	C	-	-	-	-
Banvel (dicamba)	4	C*	-	C	C	C	-	-	C	C	C	C	-	C
Casoron 4G (dichlobenil)	29	-	-	-	C	-	C*	-	C	C	-	-	-	C*
Chaparral (aminopyralid + metsulfuron methyl)	4+2	C*	C	C	C	C	C	-	-	C	C	-	-	C
Comet (fluroxypyr)	4	-	-	-	-	C	-	-	S	-	C	-	-	-
Curtail (clopyralid + 2,4-D)	4+4	-	-	C	S	C	-	-	-	C	C	-	-	-
Detail (saflufenacil)	14	C	-	-	-	-	-	-	T	S	-	-	-	-
DuraCor (aminopyralid + florpyrauxifen-benzyl)	4+4	C	-	C	C	C	C	-	-	C	C	-	-	C
Escort XP (metsulfuron-methyl)	2	-	C	-	S	T	C	-	-	S	C	S	S	-
Express XP (tribenuron)	2	-	-	-	-	-	-	-	-	C	-	-	-	-
Facet L (quinclorac)	4/26	-	-	-	-	-	-	-	S	S	-	-	-	-
Freelexx (2,4-D choline)	4	C*	-	-	-	-	-	-	-	C	C	-	-	C
Garlon 3A/4 (triclopyr amine/ester)	4	-	-	-	-	-	C	C	-	C	-	-	-	-
Krenite (fosamine)	27	-	-	-	-	-	-	-	C	-	-	-	-	-
Method (aminocyclopyrachlor)	4	-	-	C	C	C	-	-	C	C	C	C	-	-
Milestone (aminopyralid)	4	-	-	C	C	C	C	-	-	C	C	-	-	C
Overdrive (diflufenzopyr + dicamba)	19+4	C	-	C	-	C	-	-	-	C	C	-	-	-
Plateau (imazapic)	2	C*	C	-	C	-	-	-	C	-	C	C	-	-
Rodeo (glyphosate)	9	-	-	-	C	-	C	P	-	C	-	-	-	-
Stinger/Transline (clopyralid)	4	-	-	C	S	C	-	-	-	C	C	-	-	-
Tordon (picloram)	4	C*	-	C	C	C	-	-	C	C	C	C	C	C
Vastlan (triclopyr-choline)	4	-	-	-	-	-	C	C	-	C	C*	-	-	-

Page 64 of ND Weed Control Guide
 C = control
 P = partial control
 S = suppression
 T = requires tank-mix for control
 * Listed as a genus/plant family

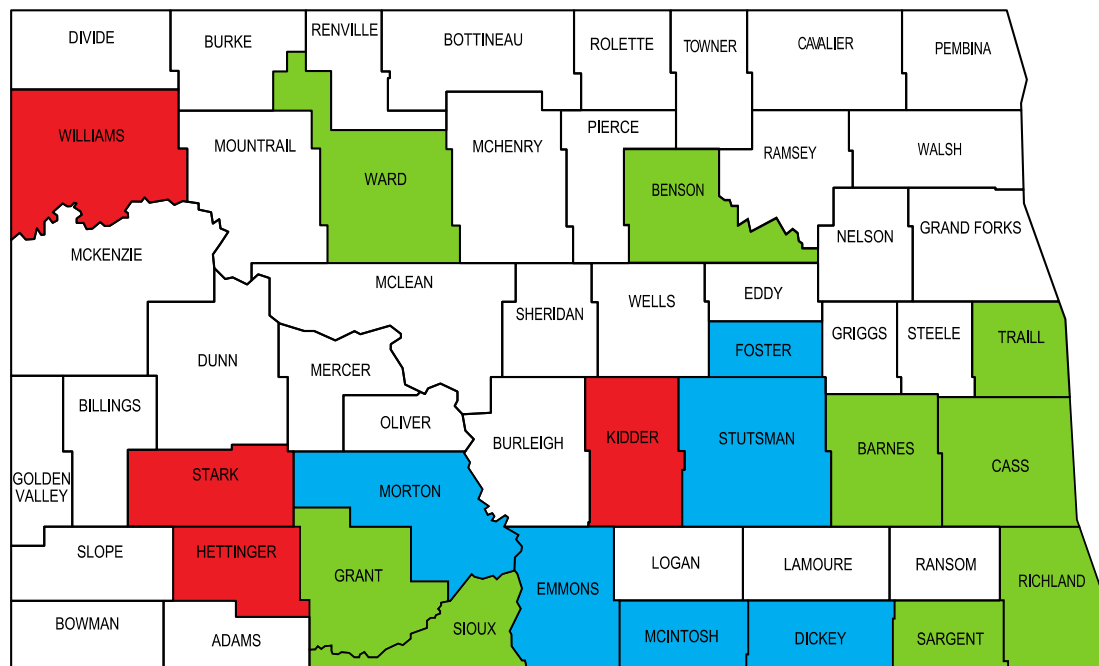
Pigweeds (*Amaranthus* spp.)

- Monoecious pigweeds
 - Redroot pigweed, Powell amaranth, others
- Dioecious pigweeds
 - Waterhemp, Palmer amaranth



Palmer amaranth Update

North Dakota Department of Agriculture Palmer Amaranth Distribution



- Previously found but no longer detected. Counties will continue to be monitored.
- Previously found and still detected, under management.
- Detected in 2022, but no longer found. Counties will continue to be monitored.

As of 10/7/2022

- Confirmed in 5 new counties in 2022
- 19 total counties since 2018

Hettinger County, ND



Trail County, ND



Evaluating Group 15 Herbicide Efficacy on Pigweed Species in Sunflower

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Pigweed Control in Sunflower

- No effective foliar herbicides for ALS-resistant pigweed control in sunflower
 - Reliance on soil residual herbicides and crop competition



Pigweed Control in Sunflower

- No effective foliar herbicides for ALS-resistant pigweed control in sunflower
 - Reliance on soil residual herbicides and crop competition
- Soil residual options limited to Groups 3, 14, and 15
 - Pigweed species are resistant to all three SOAs

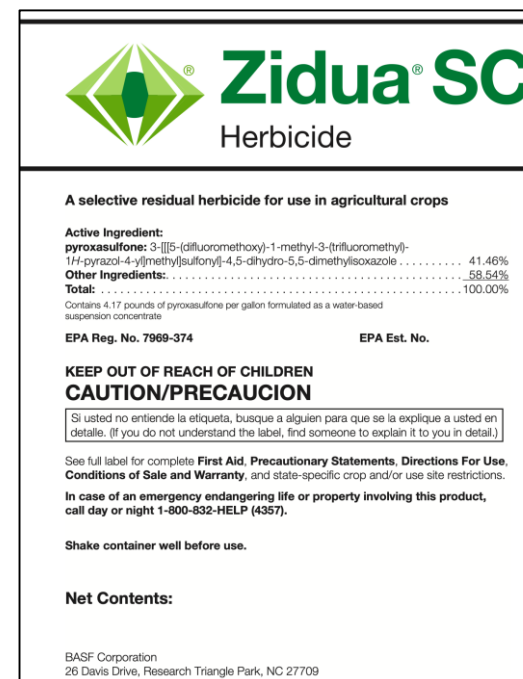


Pigweed Control in Sunflower



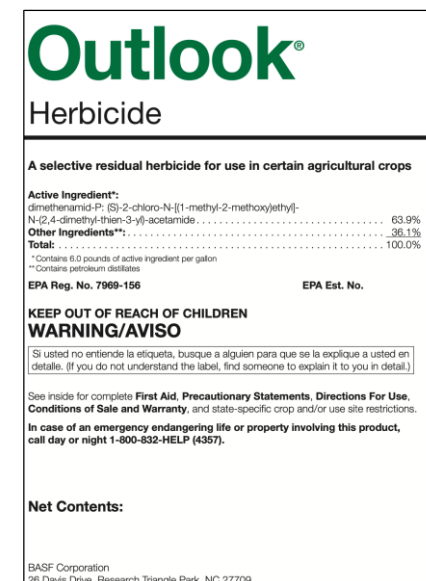
Group 15 Herbicides in Sunflower

- Group 15 herbicides inhibit very long-chain fatty acid synthesis
 - S-metolachlor and pyroxasulfone are labeled in sunflower



Background

- Group 15 herbicides inhibit very long-chain fatty acid synthesis
 - S-metolachlor and pyroxasulfone are labeled in sunflower
- Acetochlor, dimethenamid-P, and flufenacet are three other Group 15 herbicides that may be:
 - Safe on sunflower
 - Efficacious on pigweeds



Objectives

- Determine the efficacy/influence of Group 15 herbicides, with and without sulfentrazone, on:
 - Pigweed control
 - Sunflower injury
 - Sunflower yield
 - Pesticide residue



Methodology

- Field trial, randomized complete block design
 - 4 blocks
 - 8×2 factorial
 - 16 total treatments
 - 8 herbicides
 - 2 sulfentrazone rates
 - 0 oz a.i. A^{-1}
 - 4 oz a.i. A^{-1}
- Non-oilseed hybrid

Herbicide	Trade name	Rate	Product rate
		lb a.i. A^{-1}	A^{-1}
Non-treated	n/a	n/a	n/a
Hand-weeded	n/a	n/a	n/a
S-metolachlor	Dual Magnum	1.9	2 pt EC
Pyroxasulfone	Zidua	0.21	6.5 fl oz SC
Acetochlor	Warrant	1.5	2 qt ME
Dimethenamid-P	Outlook	1.5	2 qt EC
Flufenacet	Sunfire, Cadou	0.75	23 fl oz SC
Pendimethalin	Prowl H2O	1.5	3.2 pt ACS



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Research Sites

- **Site 1:** Fargo, ND
 - Waterhemp and other monoecious pigweeds
 - Bare ground
- **Site 2:** Valley City, ND
 - Palmer amaranth, waterhemp, and other monoecious pigweeds
- **Site 3:** Fargo, ND
 - Waterhemp and other monoecious pigweeds
 - Yield, residue analysis



Data Collected

- Visual pigweed control (%) and herbicide injury (%) were evaluated every 2 weeks after planting (WAP)
- Pigweed biomass collected from all three sites
- Sunflower biomass collected from Site 2
- Sunflower yield and herbicide residue samples collected from Site 3

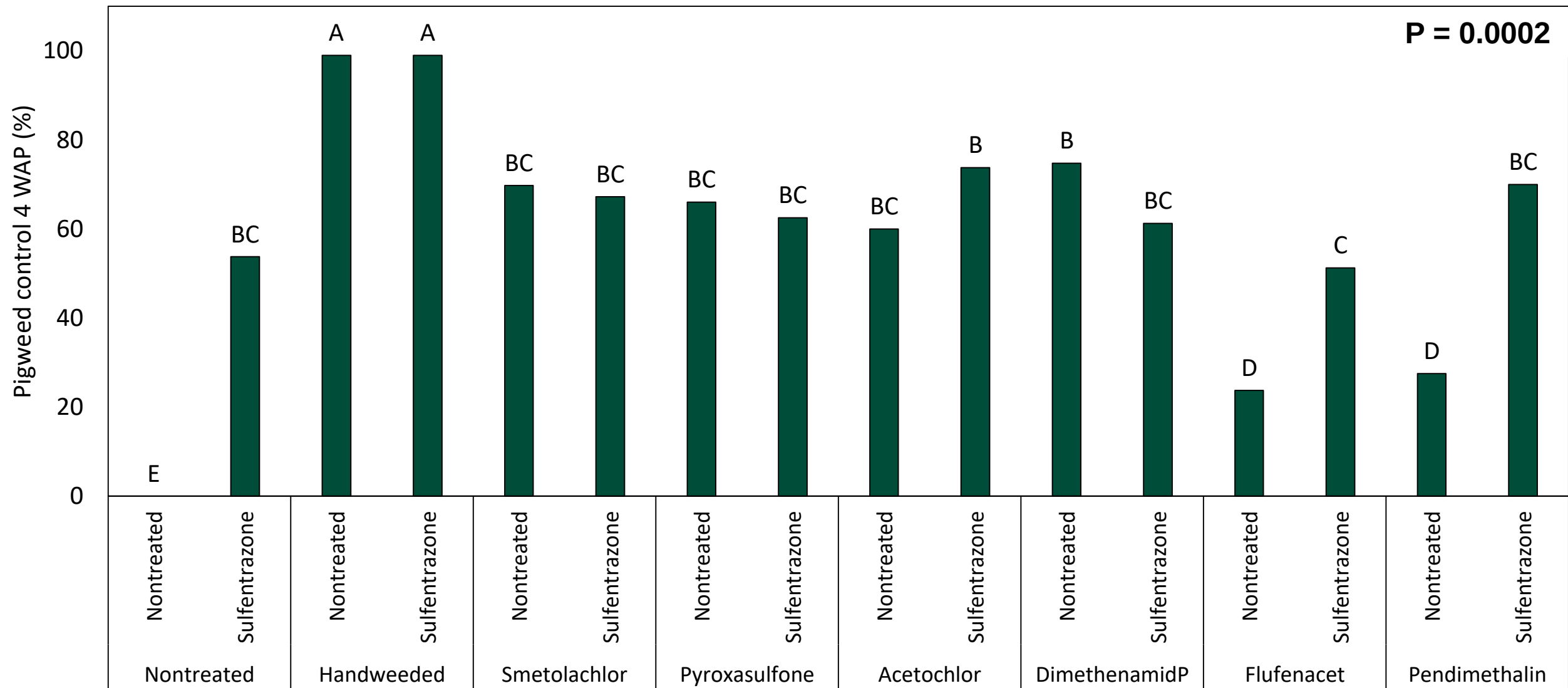


Results – Sunflower Injury

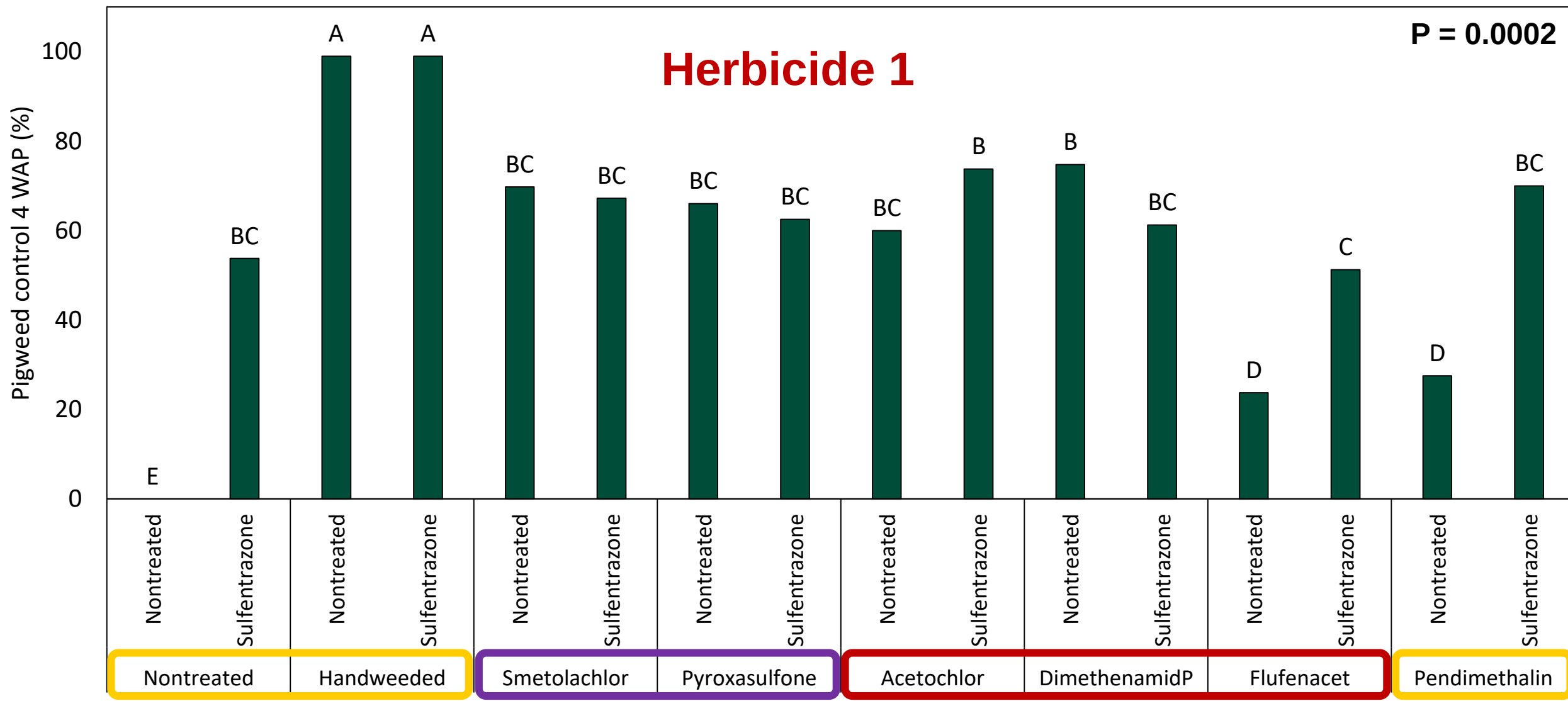
- Apparent injury observed on young, individual plants
 - Plot-level injury $\leq 10\%$
 - Not statistically significant



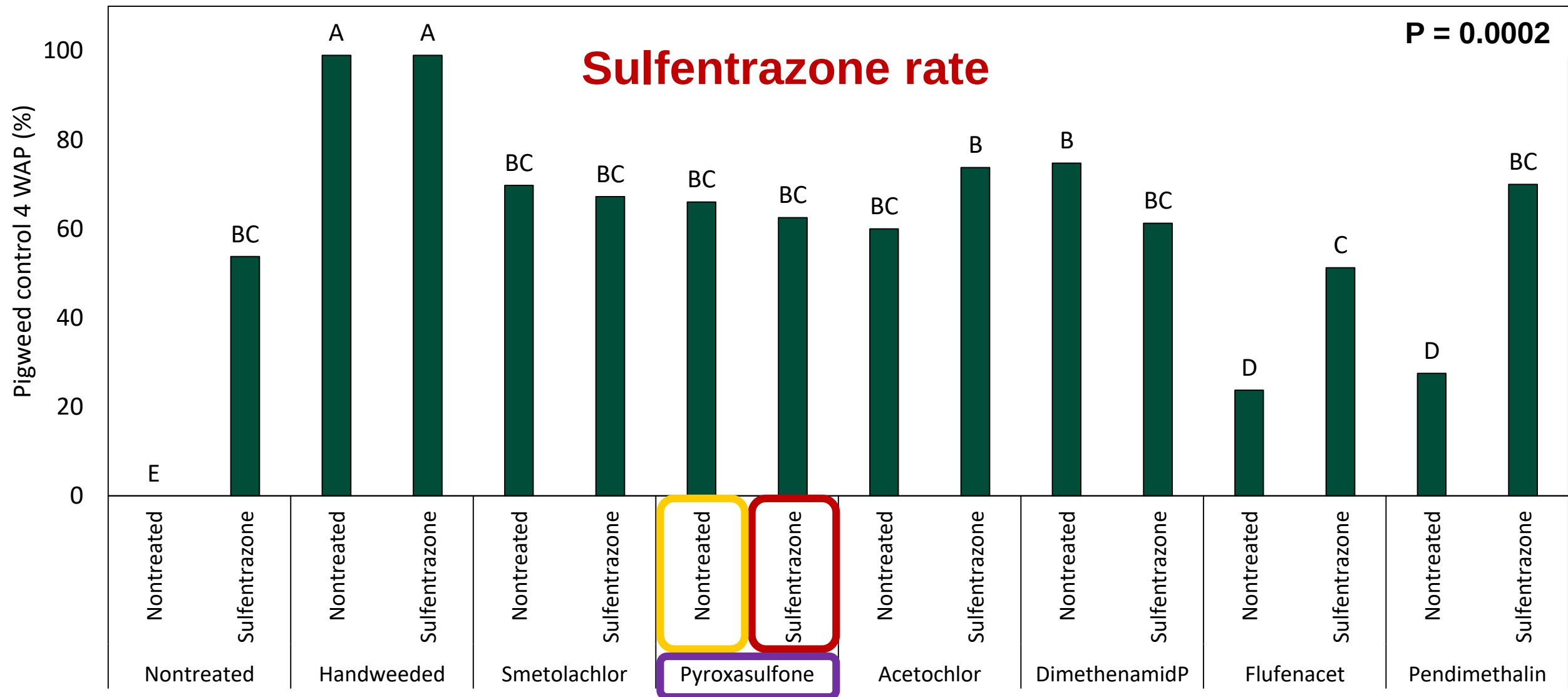
Results – Pigweed Control 4 WAP (Site 1)



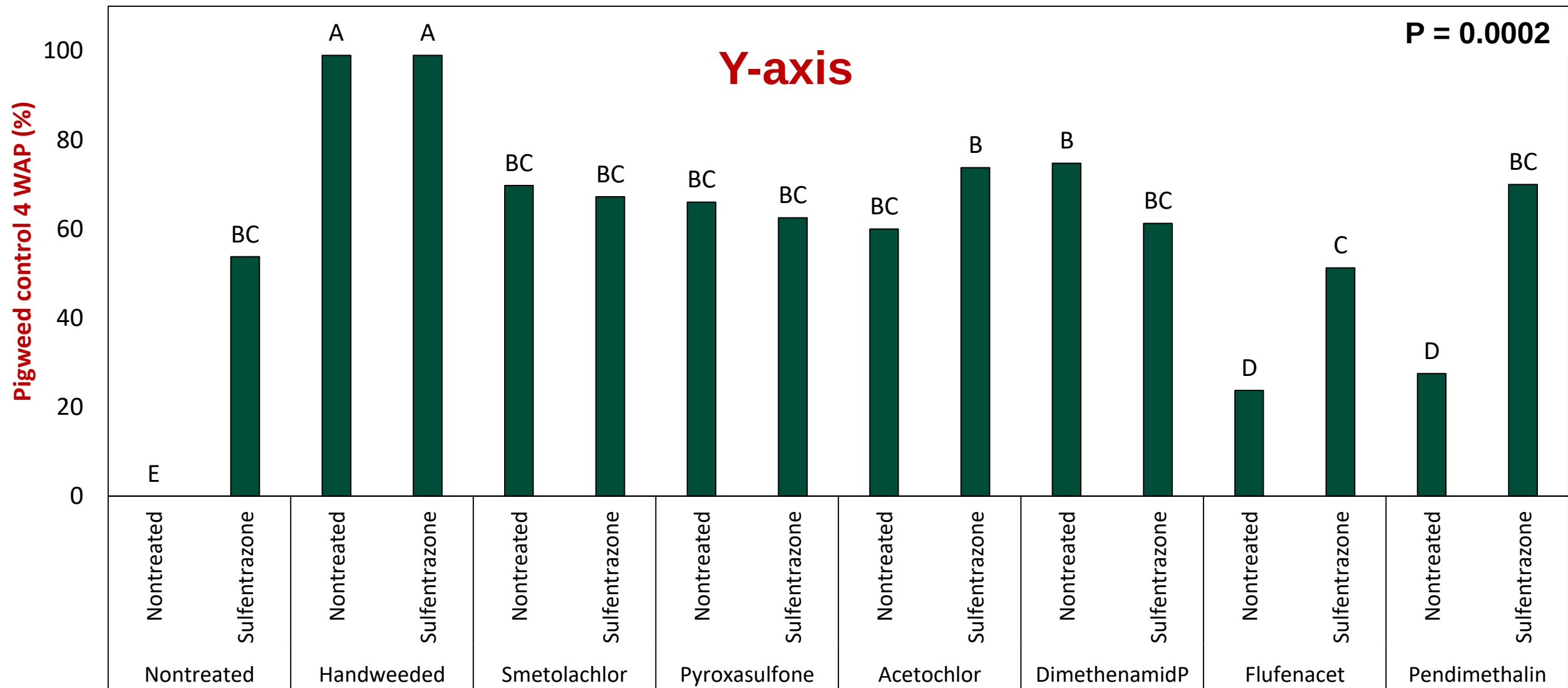
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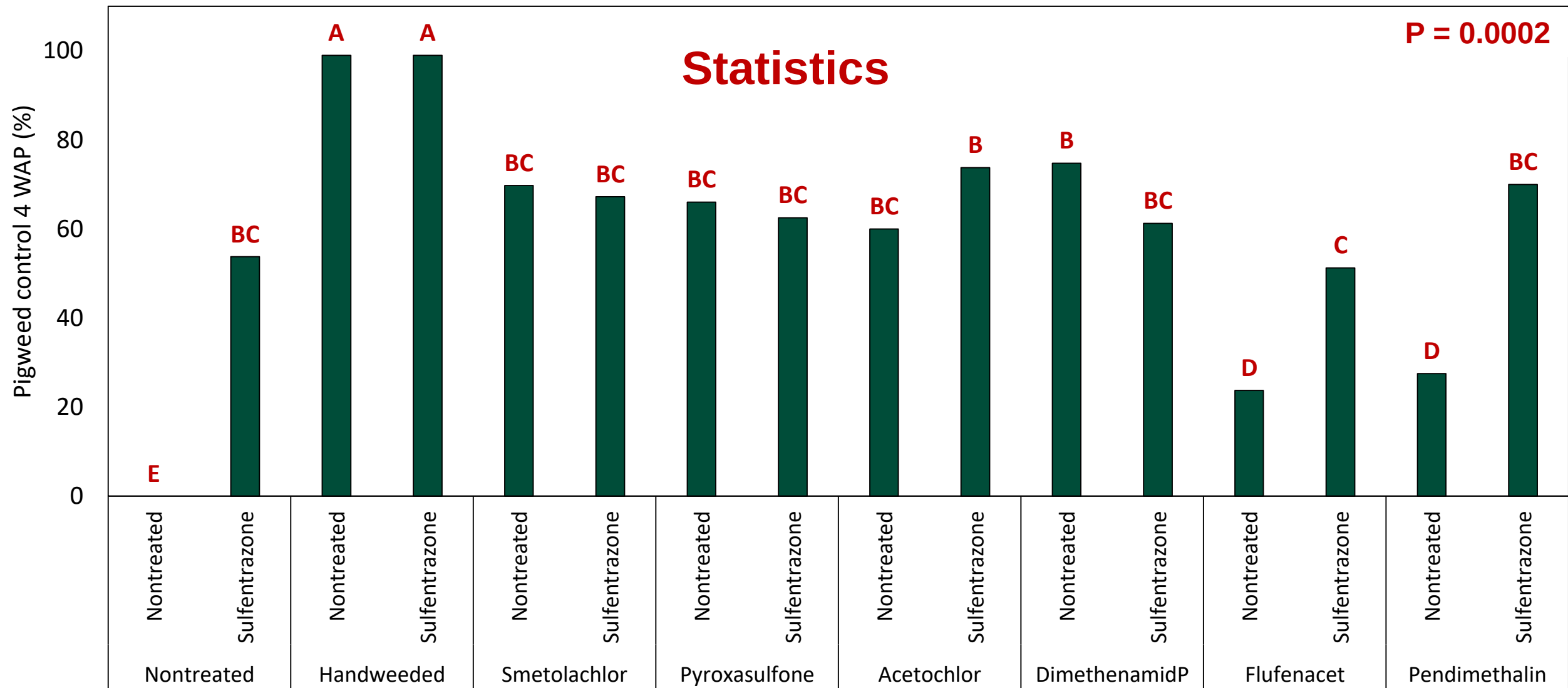
Results – Pigweed Control 4 WAP (Site 1)



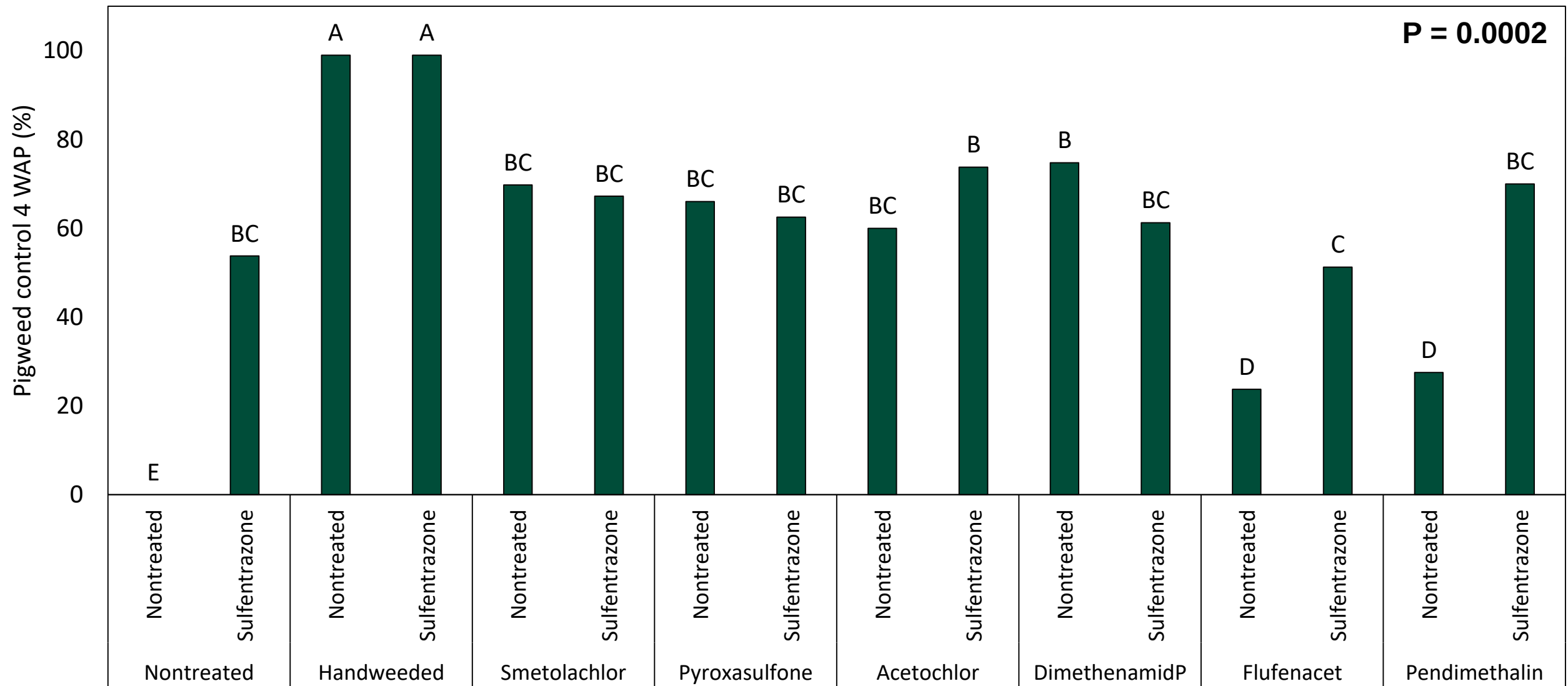
Results – Pigweed Control 4 WAP (Site 1)



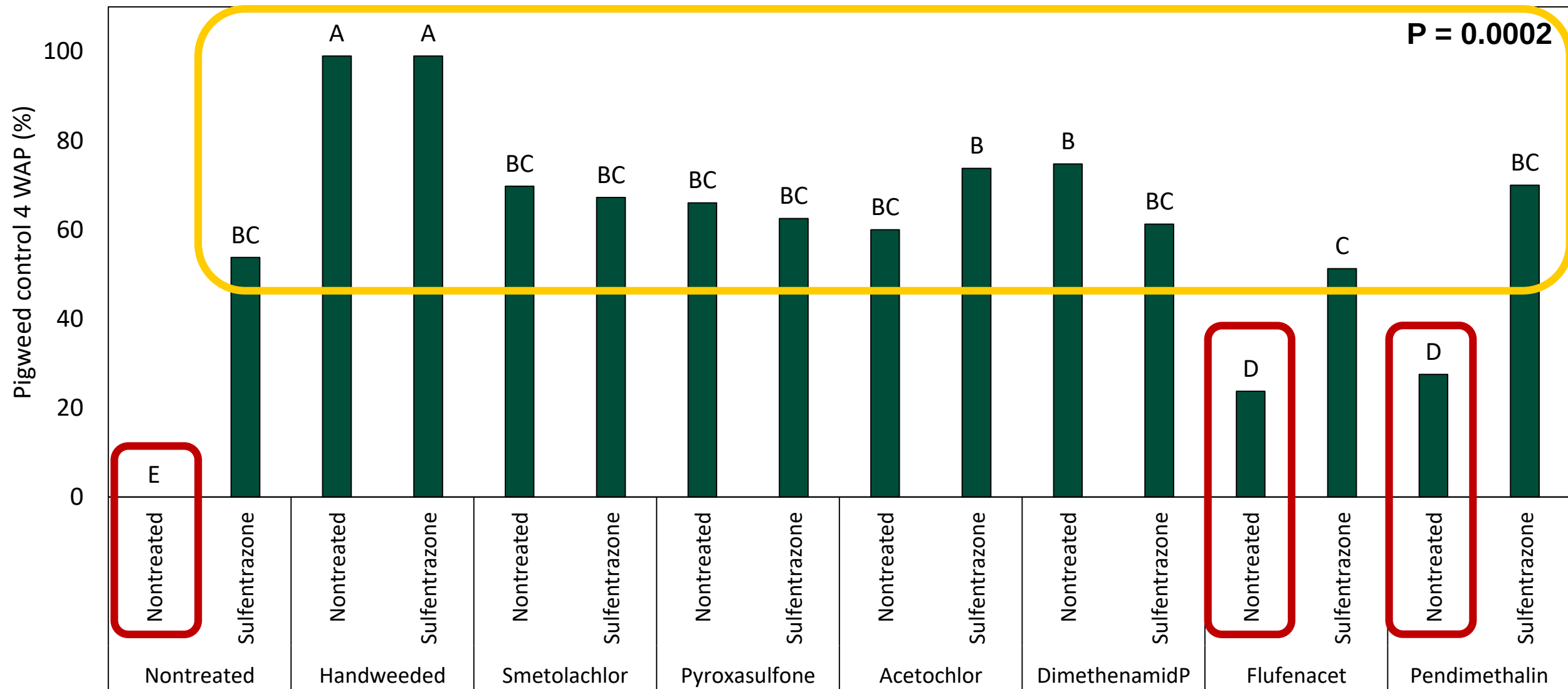
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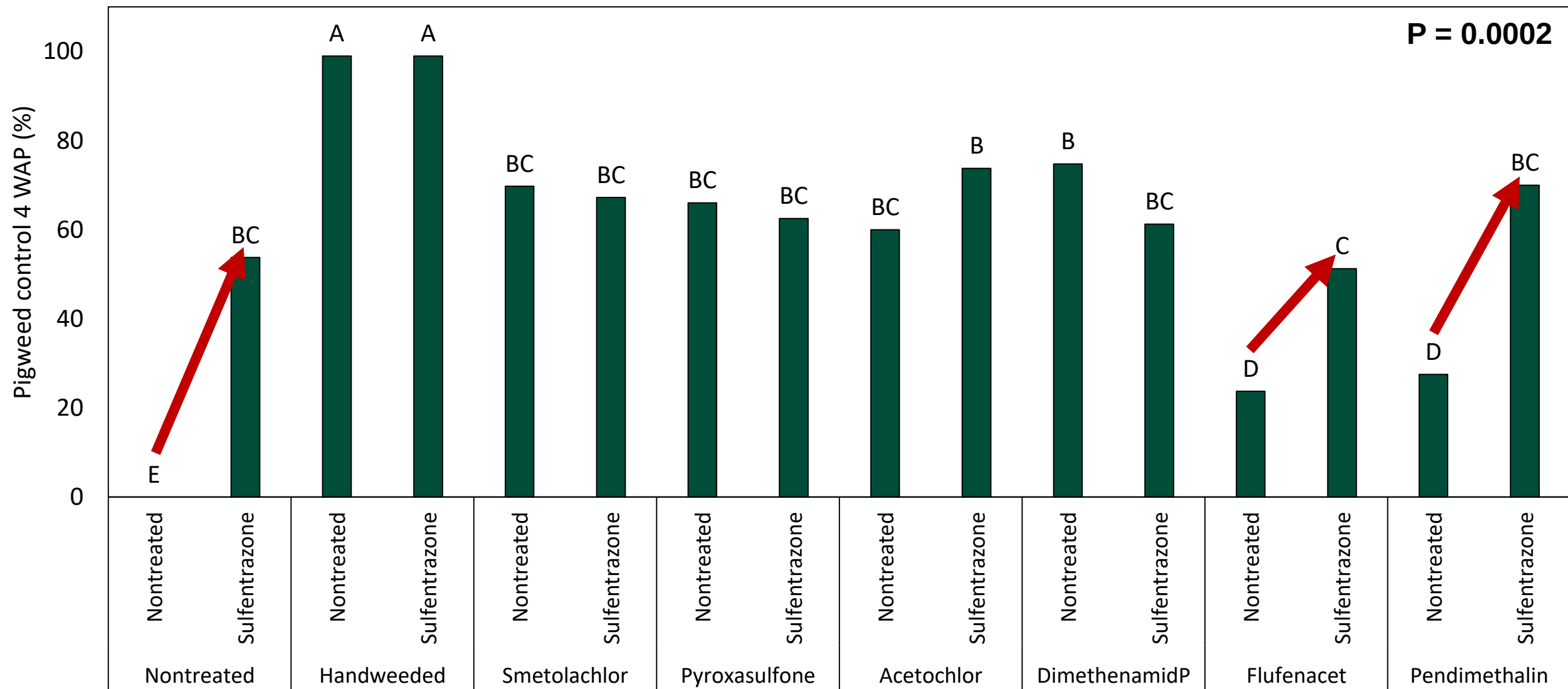
Results – Pigweed Control 4 WAP (Site 1)



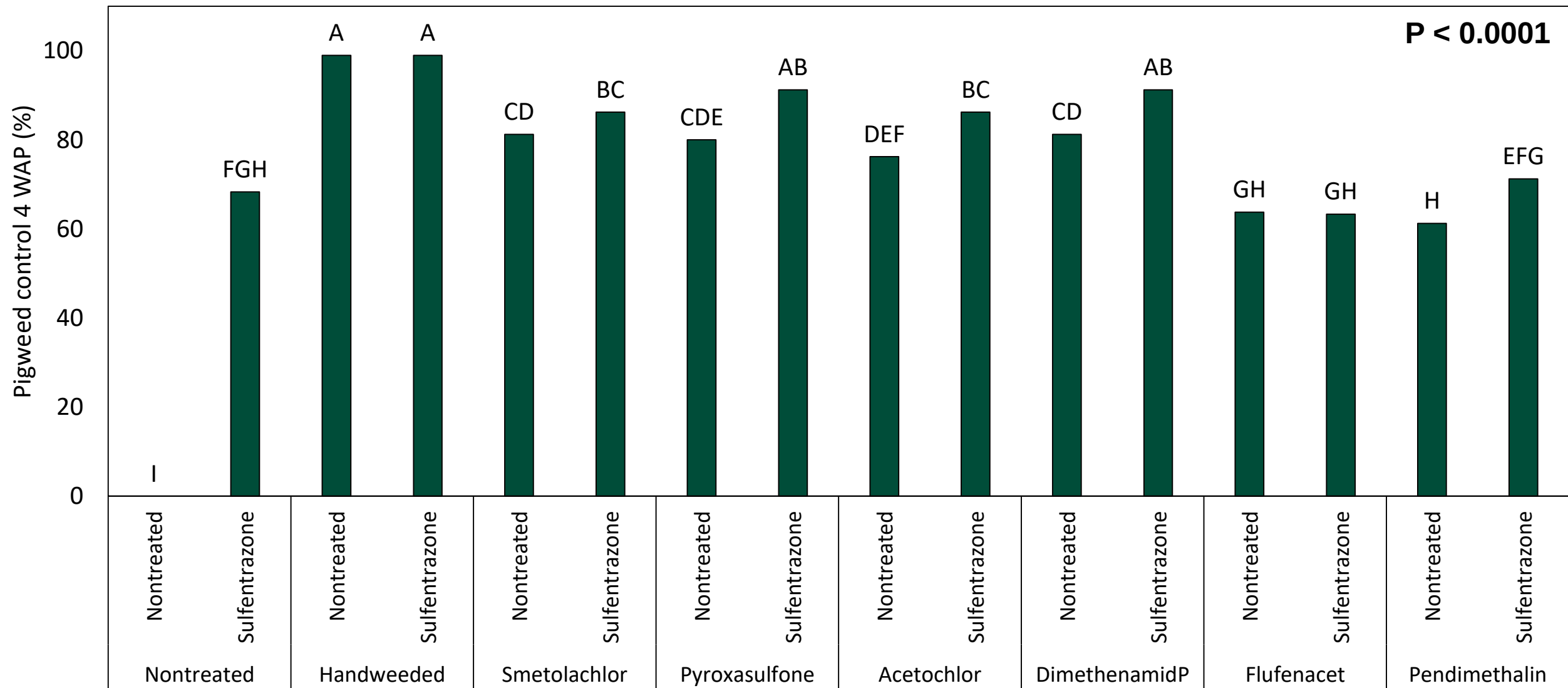
Results – Pigweed Control 4 WAP (Site 1)



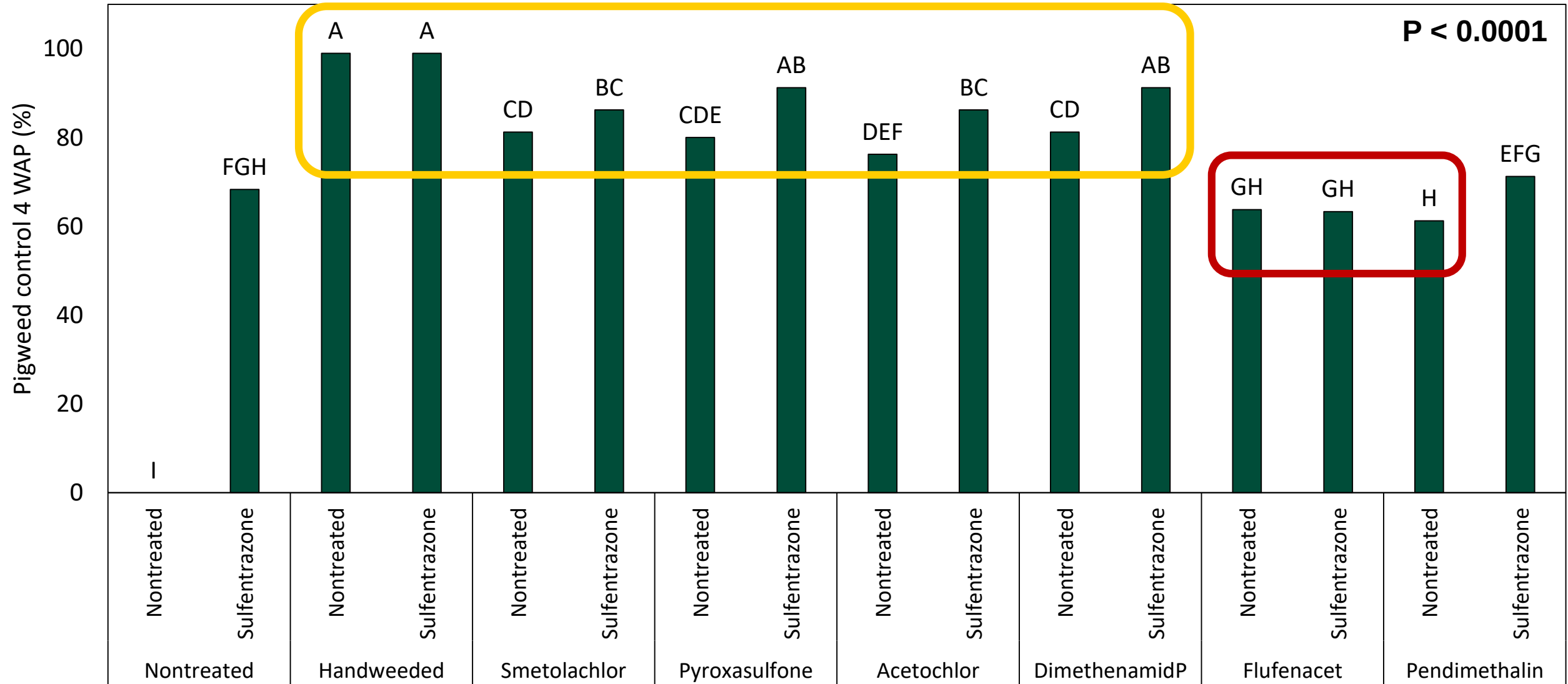
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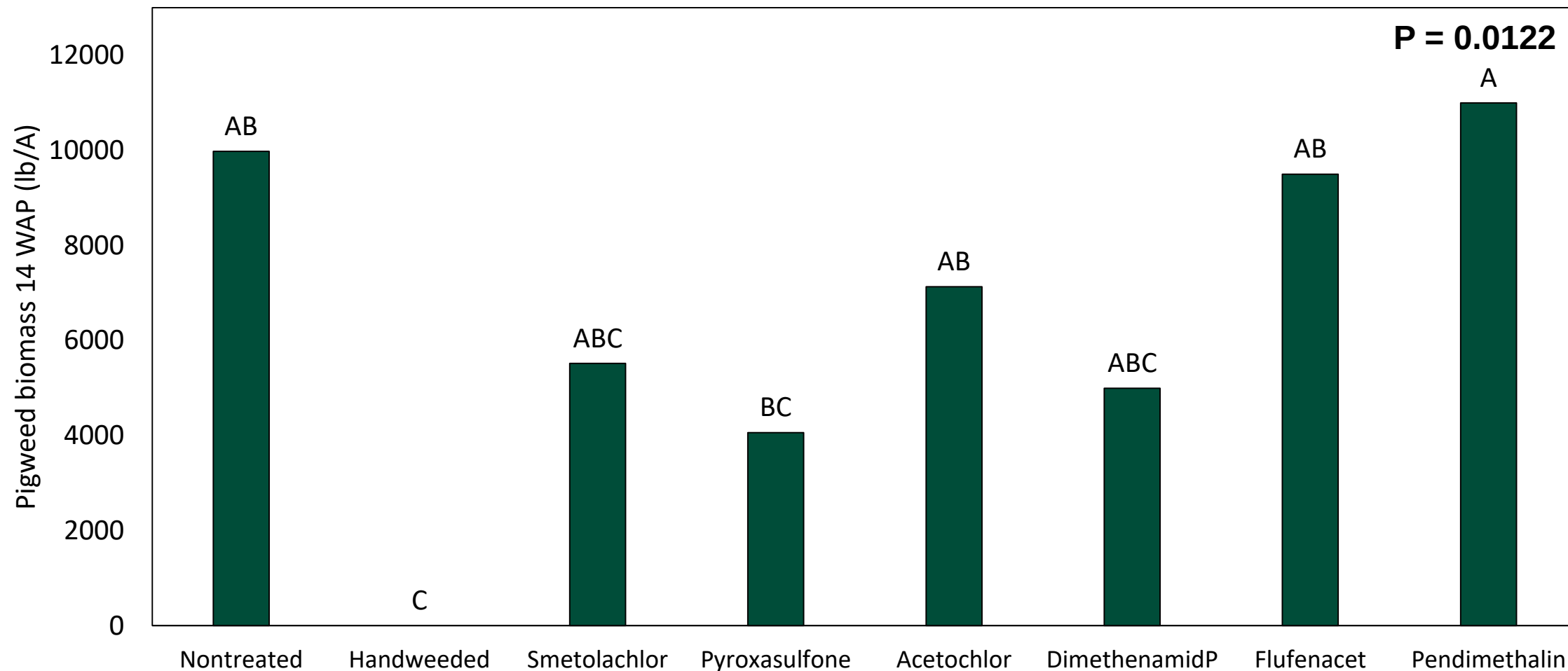
Results – Pigweed Control 4 WAP (Site 2)



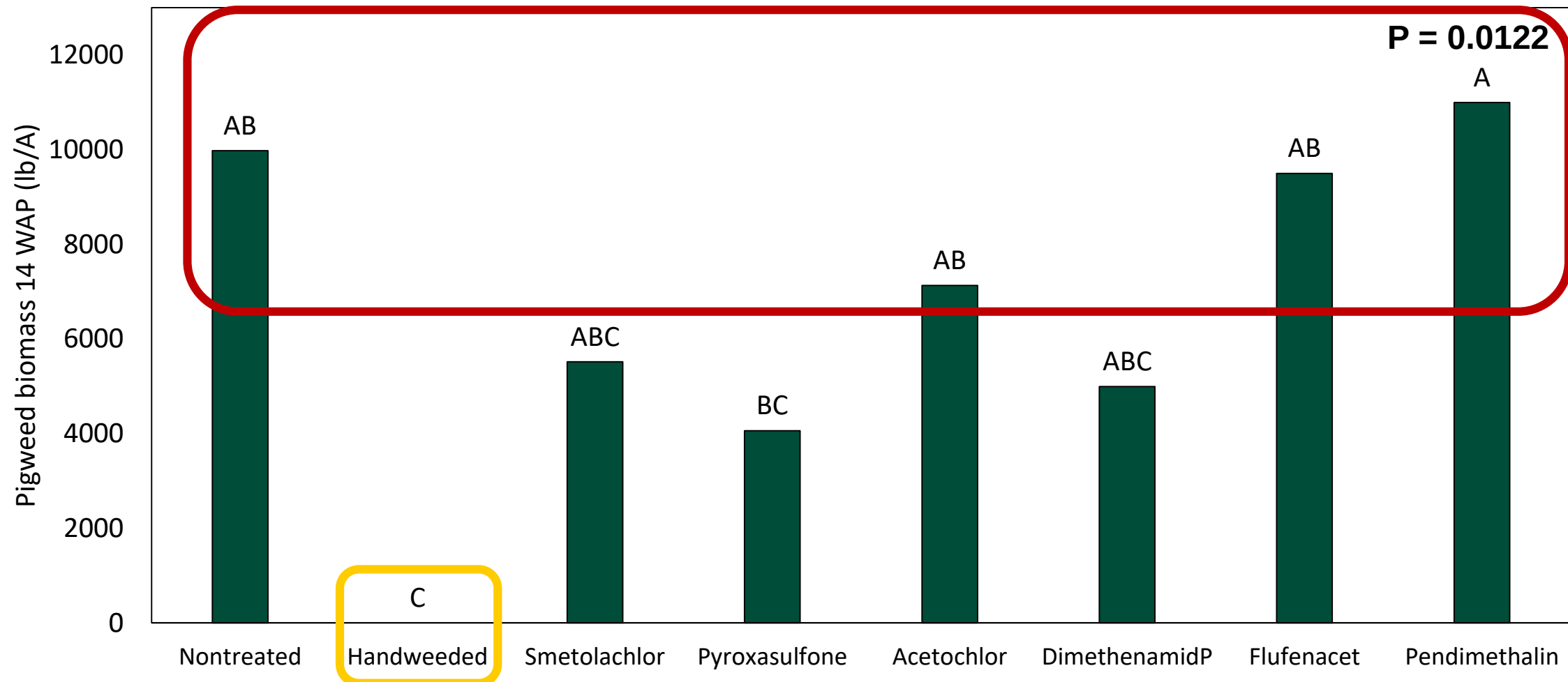
Results – Pigweed Control 4 WAP (Site 2)



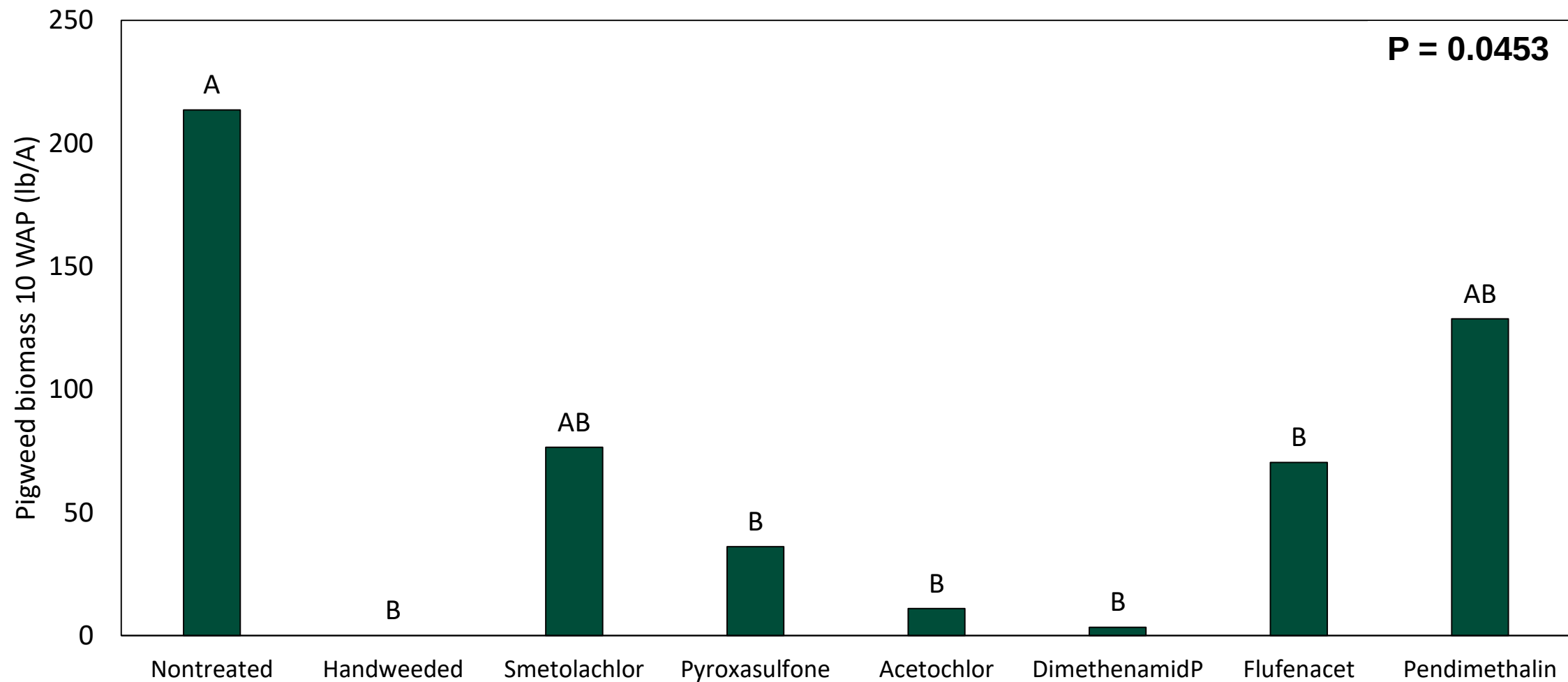
Results – Pigweed Biomass 14 WAP (Site 1)



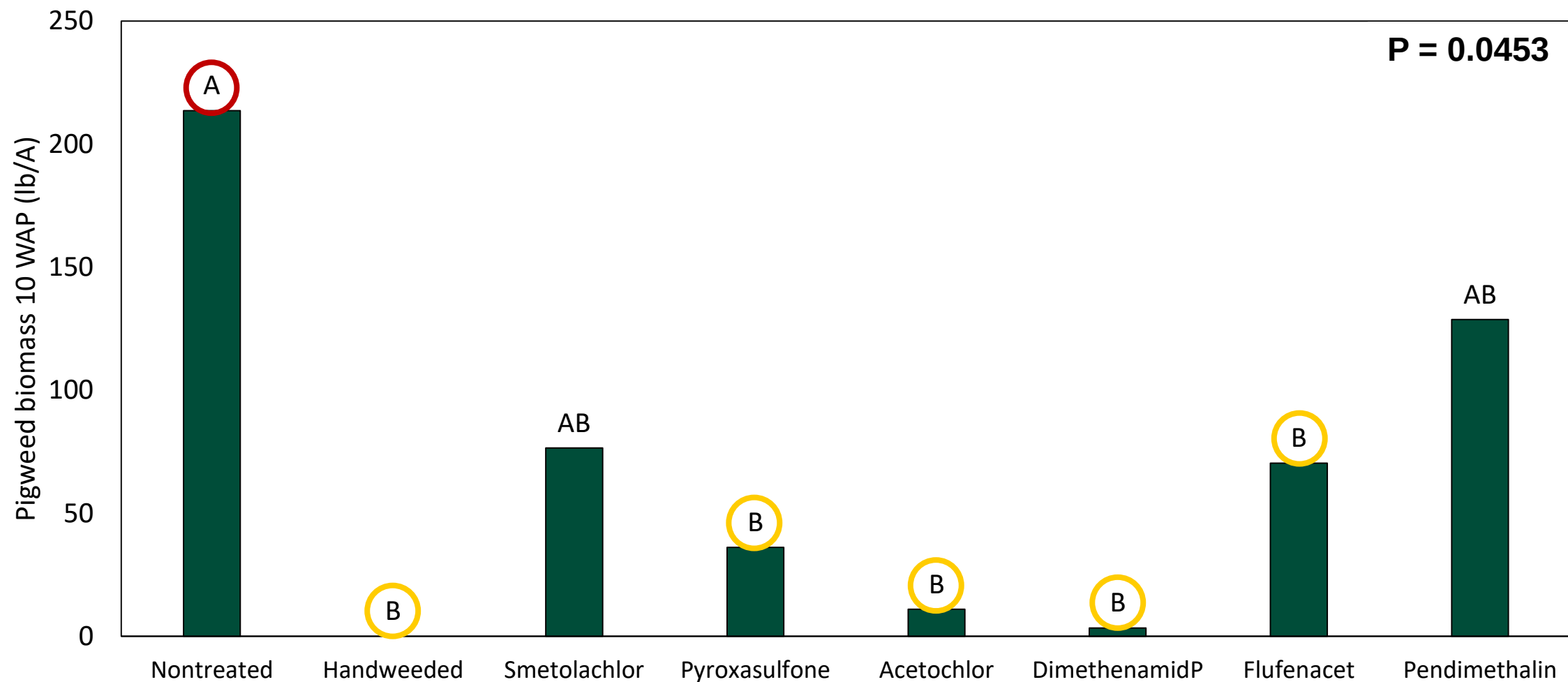
Results – Pigweed Biomass 14 WAP (Site 1)



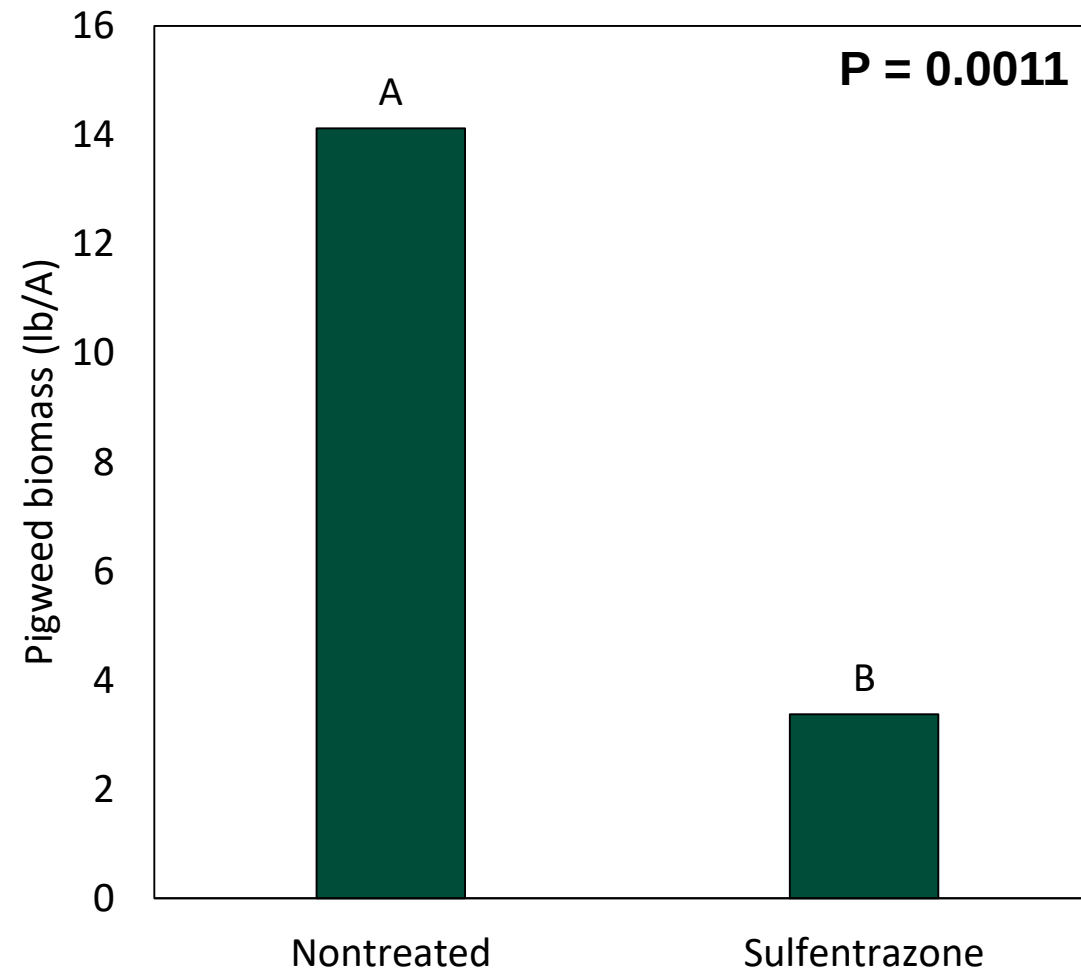
Results – Pigweed Biomass 10 WAP (Site 2)



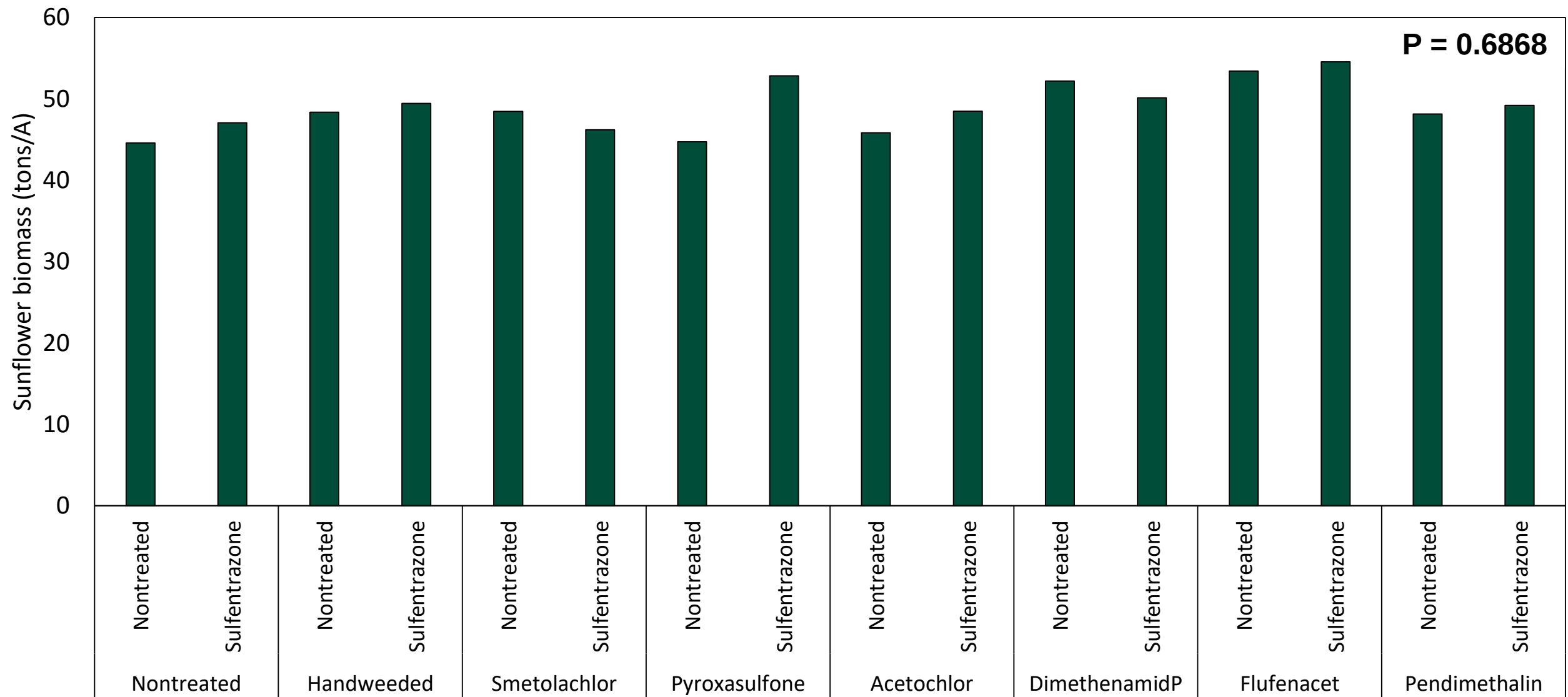
Results – Pigweed Biomass 10 WAP (Site 2)



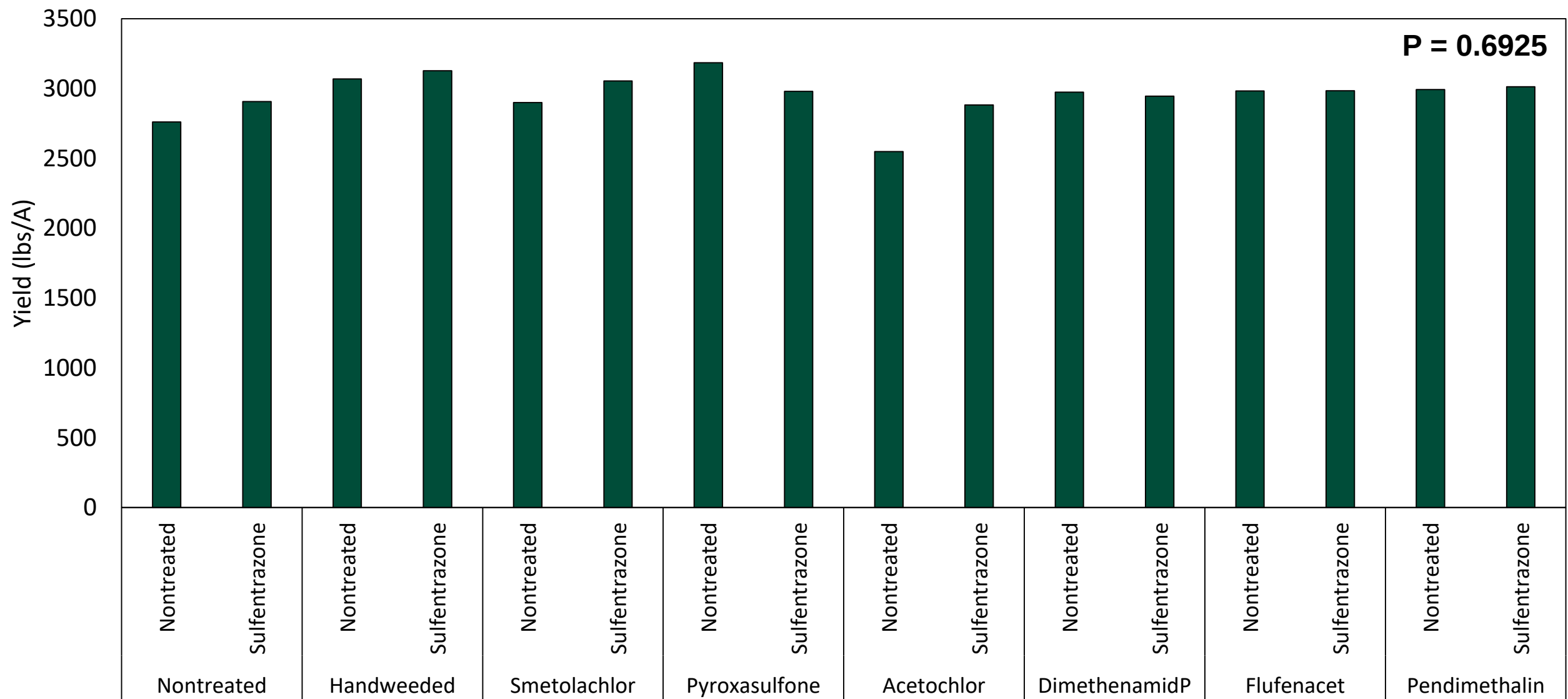
Results – Pigweed Biomass (Site 3)



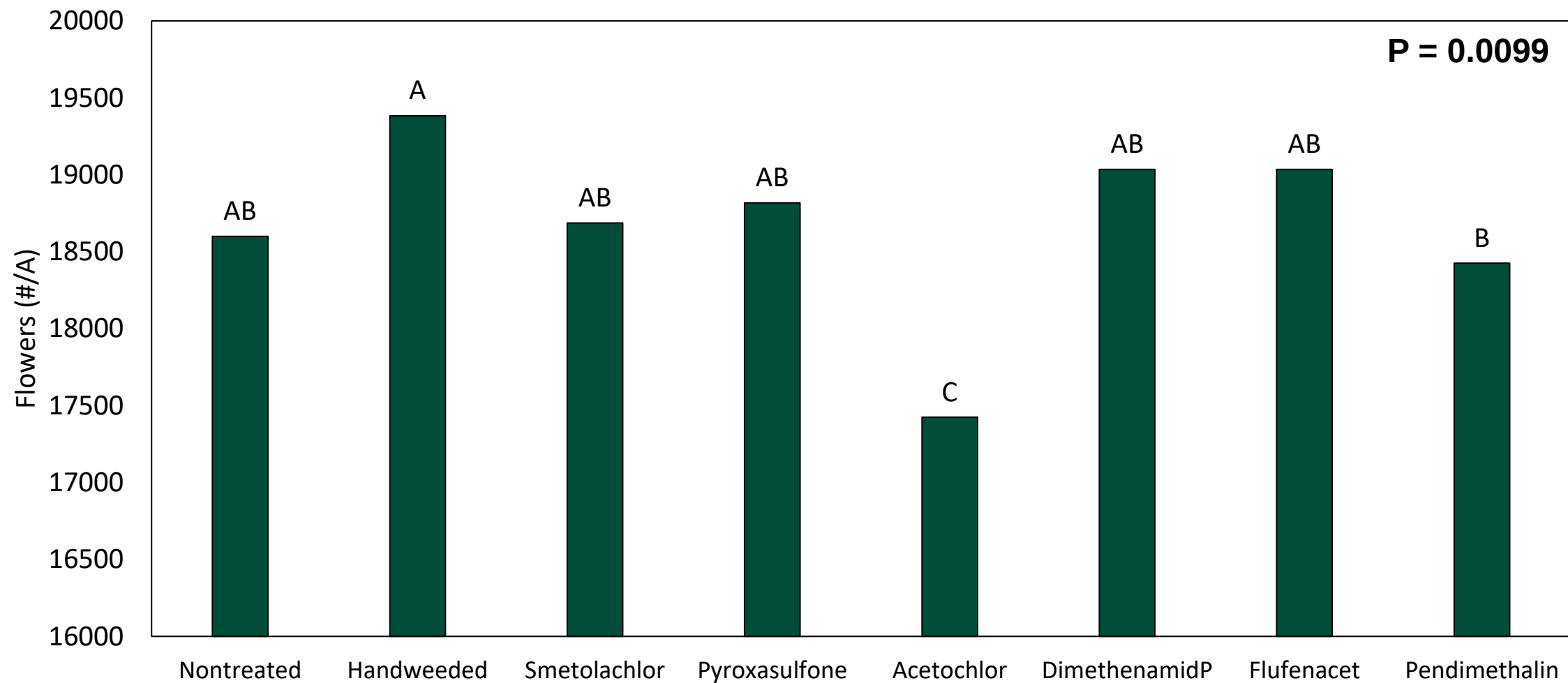
Results – Sunflower Biomass 10 WAP (Site 2)



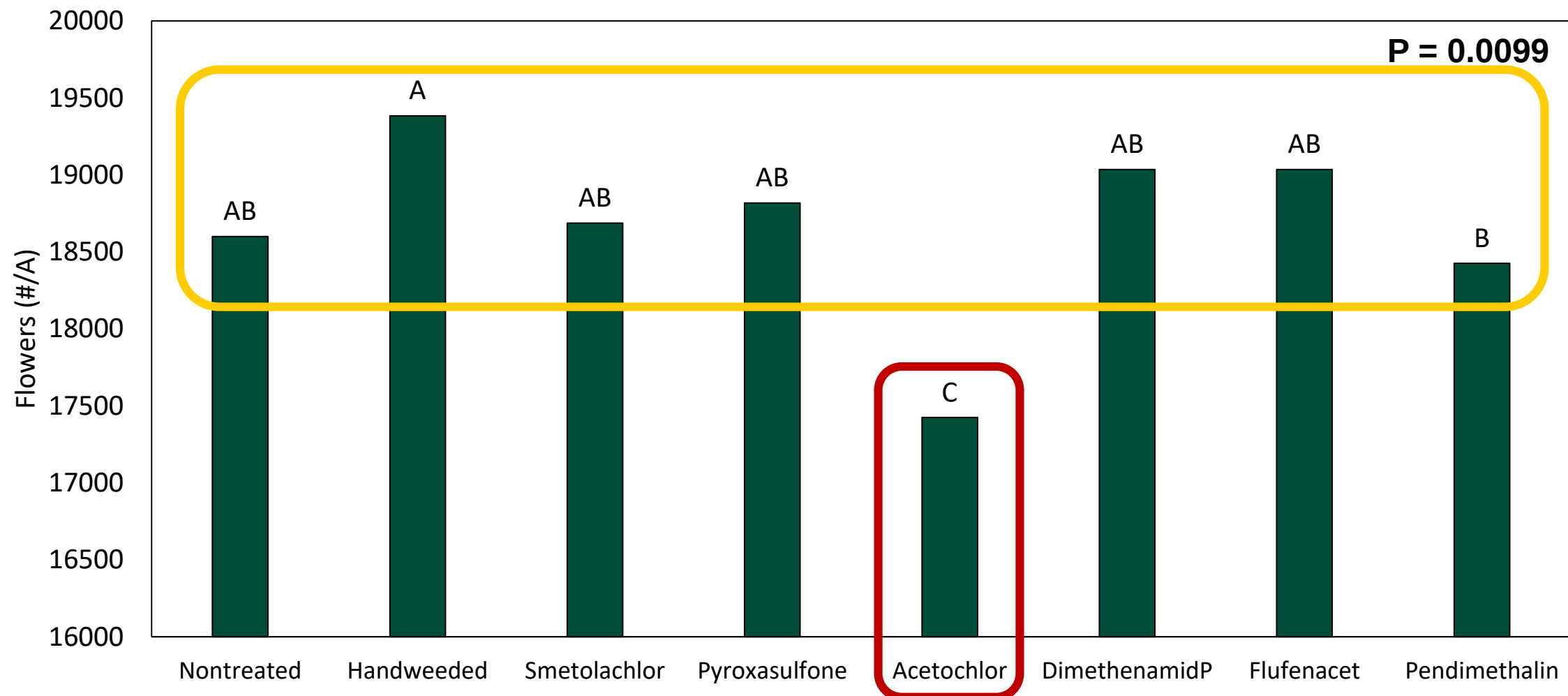
Results – Sunflower Yield (Site 3)



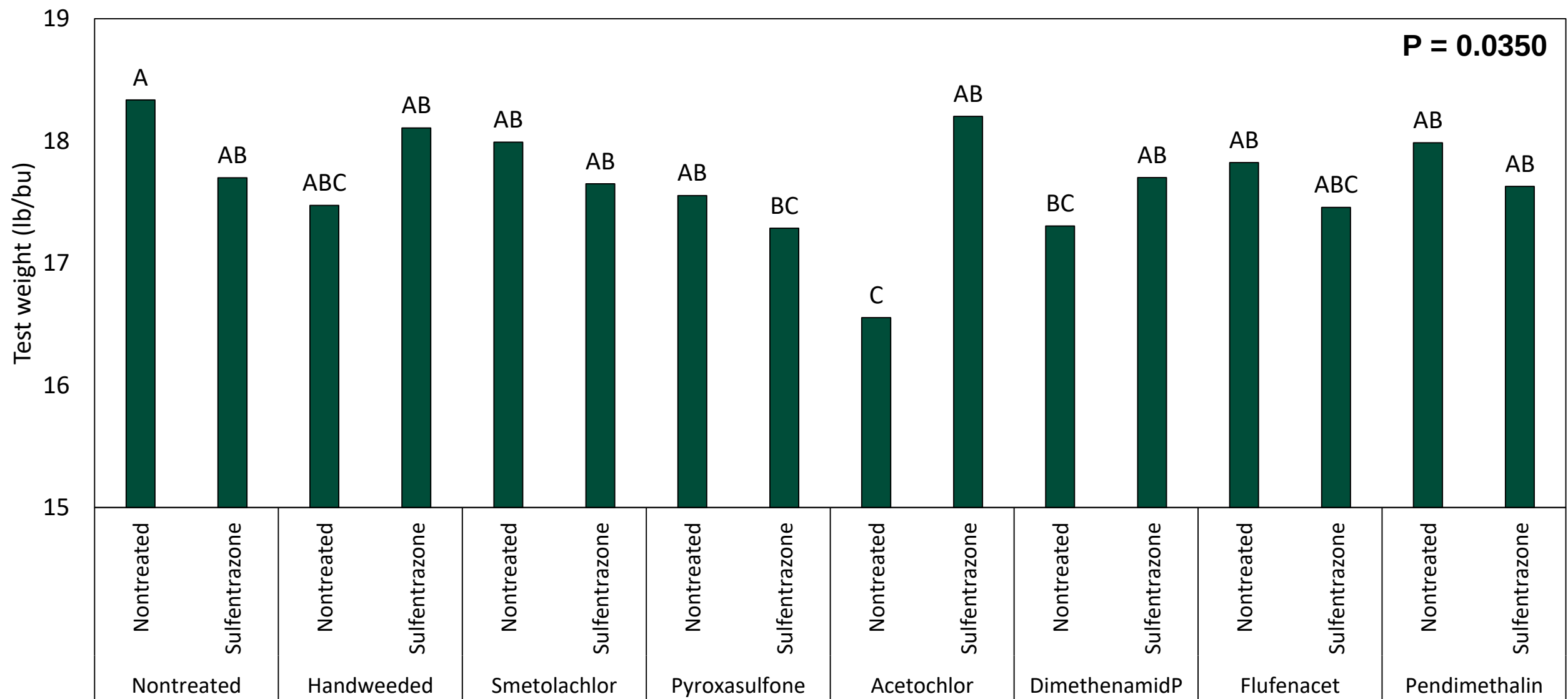
Results – Harvestable Flowers (Site 3)



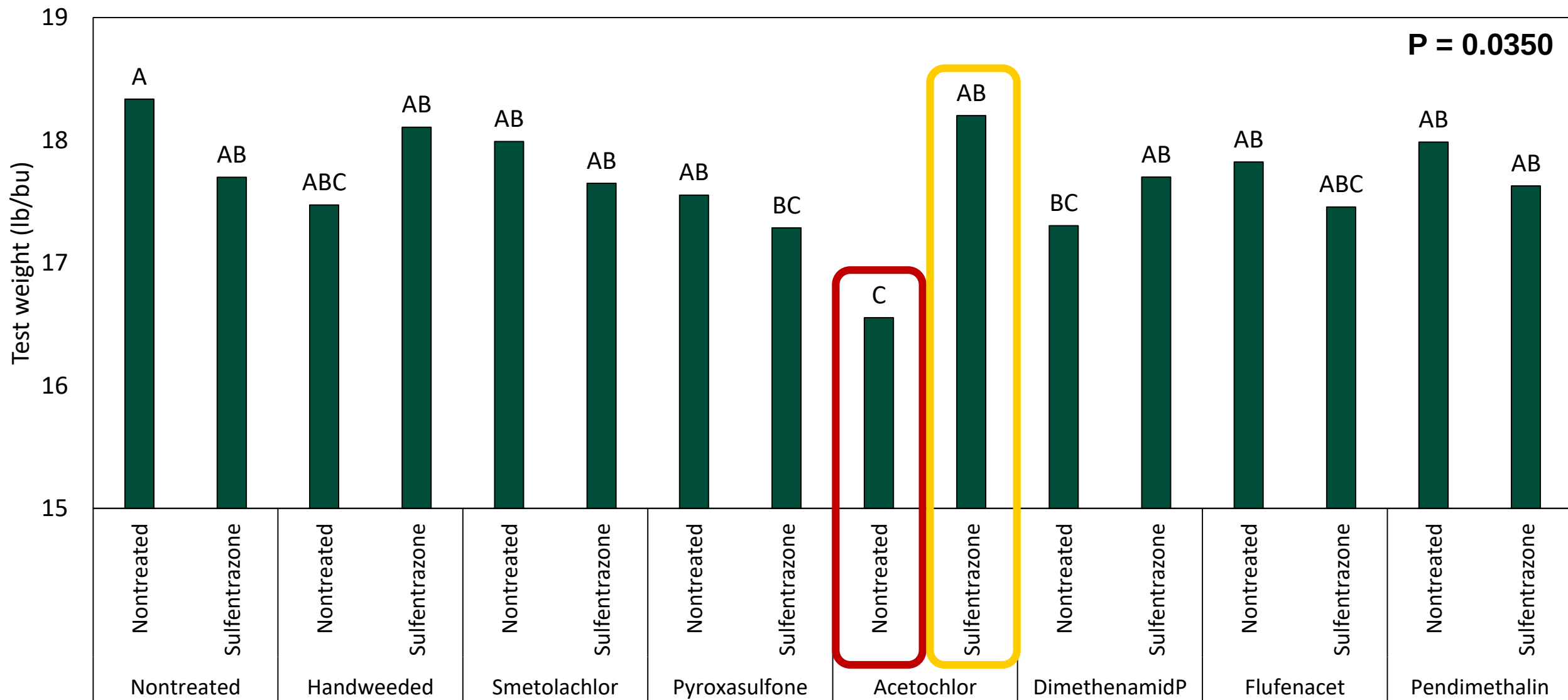
Results – Harvestable Flowers (Site 3)



Results – Test Weight (Site 3)



Results – Test Weight (Site 3)



Results – Herbicide Residue (Site 3)



The Leader in Pesticide Residue Analysis...

ANALYTICAL REPORT



CLIENT: Quincy Law
NDSU, Plant Sciences, Dept 7670
PO Box 6050
Fargo, ND 58108

November 16, 2022

Phone: (701) 318-0242
Fax: (701) 231-8474

quincy.law@ndsu.edu

P. O. No: Law.22.Sun

Project: NSA/SBARE 22-W01

Client Sample	EMA Sample No	Sample	Date Analyzed	Method	Chemical	Amount	RL	Units
Law.22.Sun.103 10/27/22	22110321-01	Sunflower Seeds	11/15/22	LC/MS/MS Extended Screen	Acetochlor	ND	0.01	ppm
			11/15/22	LC/MS/MS Extended Screen	Dimethenamid-P	ND	0.01	ppm
			11/15/22	LC/MS/MS Extended Screen	Flufenacet	ND	0.01	ppm
Law.22.Sun.208 10/27/22	22110321-02	Sunflower Seeds	11/15/22	LC/MS/MS Extended Screen	Acetochlor	ND	0.01	ppm
			11/15/22	LC/MS/MS Extended Screen	Dimethenamid-P	ND	0.01	ppm
			11/15/22	LC/MS/MS Extended Screen	Flufenacet	ND	0.01	ppm
Law.22.Sun.303 10/27/22	22110321-03	Sunflower Seeds	11/15/22	LC/MS/MS Extended Screen	Acetochlor	ND	0.01	ppm
			11/15/22	LC/MS/MS Extended Screen	Dimethenamid-P	ND	0.01	ppm
			11/15/22	LC/MS/MS Extended Screen	Flufenacet	ND	0.01	ppm
Law.22.Sun.408 10/27/22	22110321-04	Sunflower Seeds	11/15/22	LC/MS/MS Extended Screen	Acetochlor	ND	0.01	ppm
			11/15/22	LC/MS/MS Extended Screen	Dimethenamid-P	ND	0.01	ppm
			11/15/22	LC/MS/MS Extended Screen	Flufenacet	ND	0.01	ppm
Law.22.Sun.109 10/27/22	22110321-05	Sunflower Seeds	11/15/22	LC/MS/MS Extended Screen	Acetochlor	ND	0.01	ppm
			11/15/22	LC/MS/MS Extended Screen	Dimethenamid-P	ND	0.01	ppm
			11/15/22	LC/MS/MS Extended Screen	Flufenacet	ND	0.01	ppm
Law.22.Sun.214 10/27/22	22110321-06	Sunflower Seeds	11/15/22	LC/MS/MS Extended Screen	Acetochlor	ND	0.01	ppm
			11/15/22	LC/MS/MS Extended Screen	Dimethenamid-P	ND	0.01	ppm
			11/15/22	LC/MS/MS Extended Screen	Flufenacet	ND	0.01	ppm

Date: 11/16/22 Reviewed by:  Don Peterson, Laboratory Director

Page: 1 of 2

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Client Sample	EMA Sample No	Sample	Date Analyzed	Method	Chemical	Amount	RL	Units
Law.22.Sun.308 10/27/22	22110321-07	Sunflower Seeds	11/15/22	LC/MS/MS Extended Screen	Acetochlor	ND	0.01	ppm
			11/15/22	LC/MS/MS Extended Screen	Dimethenamid-P	ND	0.01	ppm
			11/15/22	LC/MS/MS Extended Screen	Flufenacet	ND	0.01	ppm
Law.22.Sun.409 10/27/22	22110321-08	Sunflower Seeds	11/15/22	LC/MS/MS Extended Screen	Acetochlor	ND	0.01	ppm
			11/15/22	LC/MS/MS Extended Screen	Dimethenamid-P	ND	0.01	ppm
			11/15/22	LC/MS/MS Extended Screen	Flufenacet	ND	0.01	ppm

ND = None Detected at the Reporting Limit (RL)
RL = Reporting Limit.
Excess sample and extracts are stored for a minimum 30 of days from the date of analytical report. Special storage arrangements possible.
Results relate only to items tested.
Samples are analyzed as received.
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Results – Herbicide Residue (Site 3)



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Law.22.Sun.214 10/27/22	22110321-06	Sunflower Seeds	11/15/22	LC/MS/MS Extended Screen	Acetochlor	ND	0.01	ppm
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Law.22.Sun.308 10/27/22	22110321-07	Sunflower Seeds	11/15/22	LC/MS/MS Extended Screen	Acetochlor	ND	0.01	ppm
			11/15/22	LC/MS/MS Extended Screen	Dimethenamid-P	ND	0.01	ppm
			11/15/22	LC/MS/MS Extended Screen	Flufenacet	ND	0.01	ppm
Law.22.Sun.409 10/27/22	22110321-08	Sunflower Seeds	11/15/22	LC/MS/MS Extended Screen	Acetochlor	ND	0.01	ppm
			11/15/22	LC/MS/MS Extended Screen	Dimethenamid-P	ND	0.01	ppm
			11/15/22	LC/MS/MS Extended Screen	Flufenacet	ND	0.01	ppm

No acetochlor, dimethenamid-P, or flufenacet residue detected in any sunflower seed sample

Date: 11/16/22 Reviewed by: Don Peterson, Laboratory Director

Page: 2 of 2

460 N. East Street, Woodland, CA 95776 (530) 666-6890 emalab@emalab.com www.emalab.com



Discussion

- No injury or yield loss observed
- No residues detected in/on seed
- **Acetochlor**
 - Fewer flowers
- **Dimethenamid-P**
 - Good to excellent control
- **Flufenacet**
 - Inconsistent results

Dimethenamid-P + sulfentrazone



8'7" Palmer amaranth 10 WAP



Soybean and Corn Yield Interference of Palmer amaranth and Waterhemp in North Dakota



NDSU

PLANT SCIENCES

Yield Loss Due to Palmer amaranth

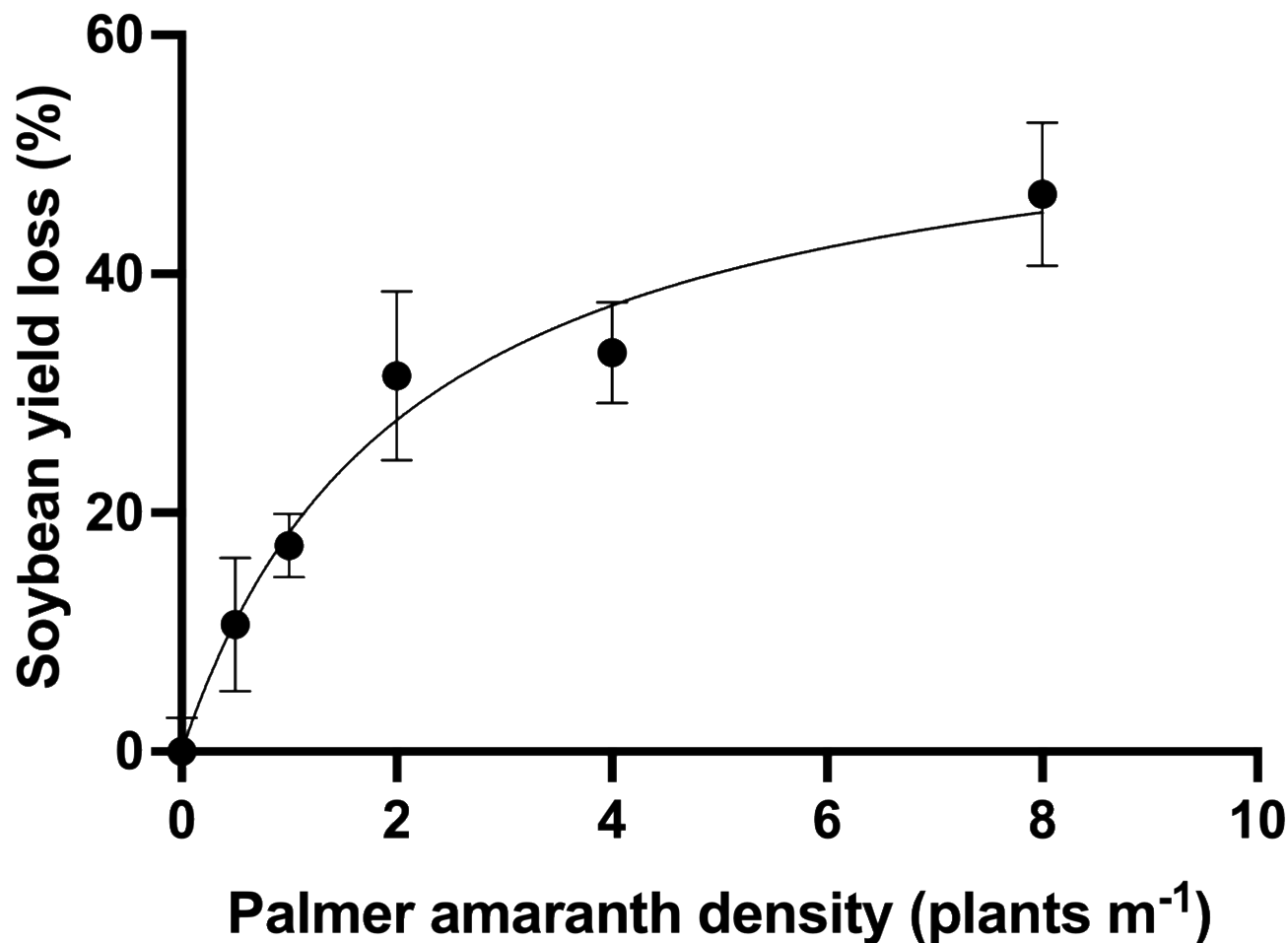
- Yield losses due to Palmer amaranth interference have been reported as high as:
 - 91% in corn (Massinga et al., 2001)
 - 79% in soybeans (Bensch et al., 2003)
 - 92% in cotton (Rowland et al., 1999)
 - 63% in grain sorghum (Moore et al., 2004)
- The objective of this research was to measure the corn and soybean yield loss due to Palmer amaranth in ND



Methodology

- Separate field trials conducted in Barnes County, ND
- RCBD with 4 blocks and six Palmer amaranth densities
 - 0, 0.5, 1, 2, 4, and 8 waterhemp plants m⁻¹ row
- Soybeans and corn planted 6/6/22
- Palmer amaranth transplanted 6/30/22 in soybeans and 7/1/22 in corn
- Soybeans and corn harvested 10/18/22

Soybean Yield Loss Due to Palmer amaranth



$$\text{Yield loss (\%)} = \frac{I \times \text{weed density}}{1 + \left(\frac{I}{A}\right) \times \text{weed density}}$$

I = yield loss per unit weed density as density nears 0

A = yield loss as weed density nears ∞

For year 1 of this research:

$I = 27.0$

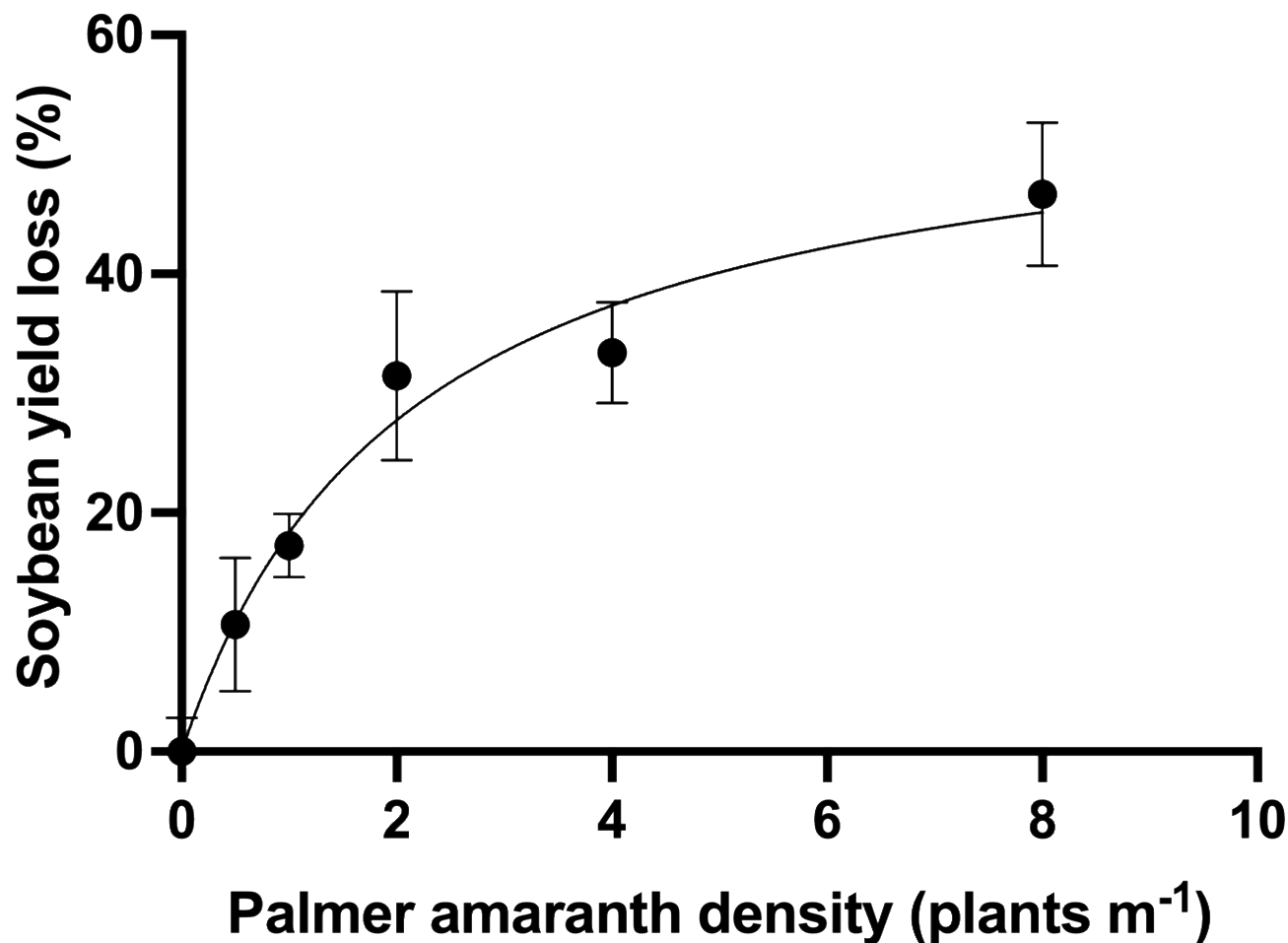
$A = 57.0$

$R^2 = 0.9072$

Mean weed-free yield = 58.4 bu A⁻¹

Palmer amaranth transplanted 24 DAP

Soybean Yield Loss Due to Palmer amaranth



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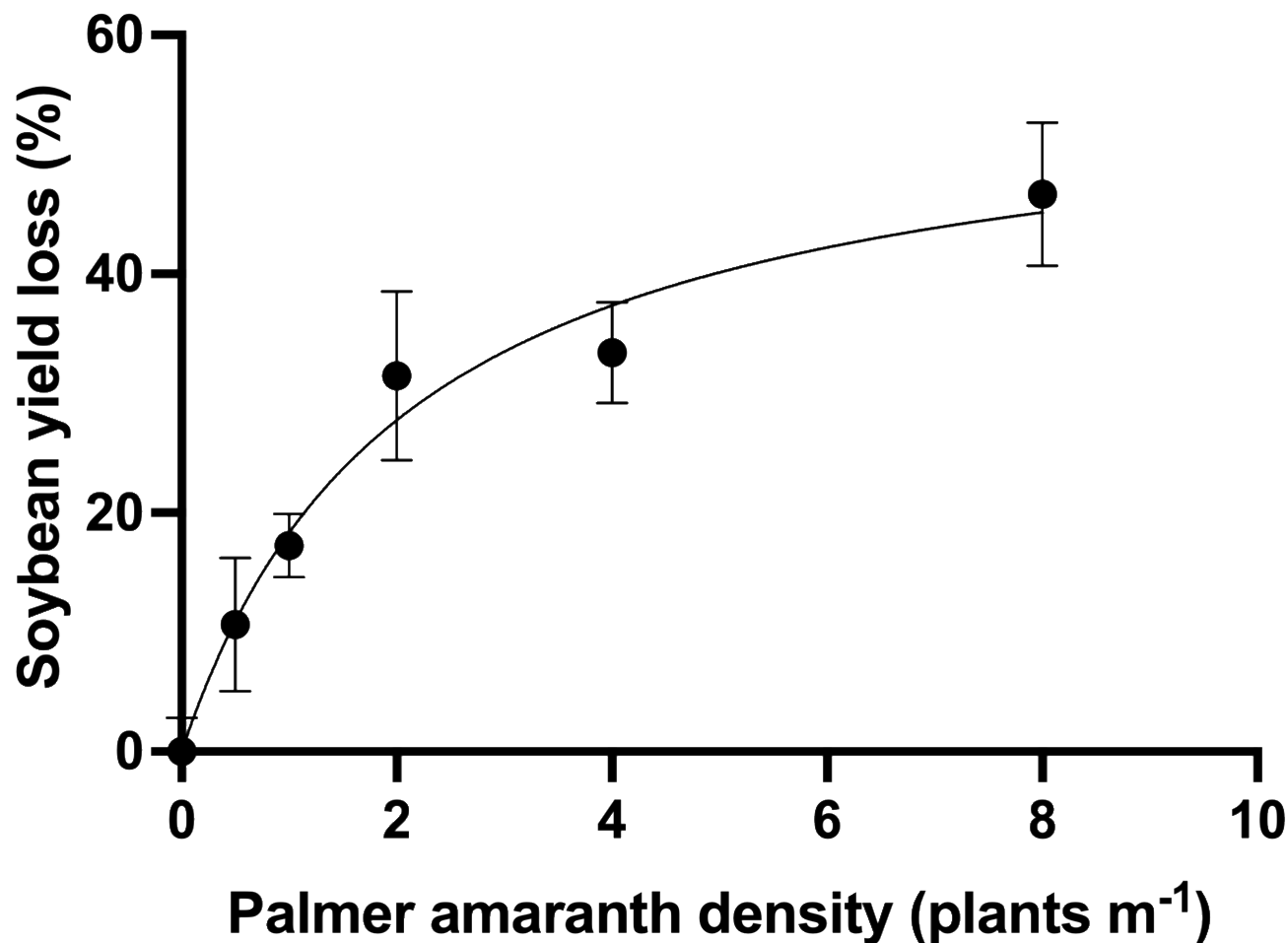
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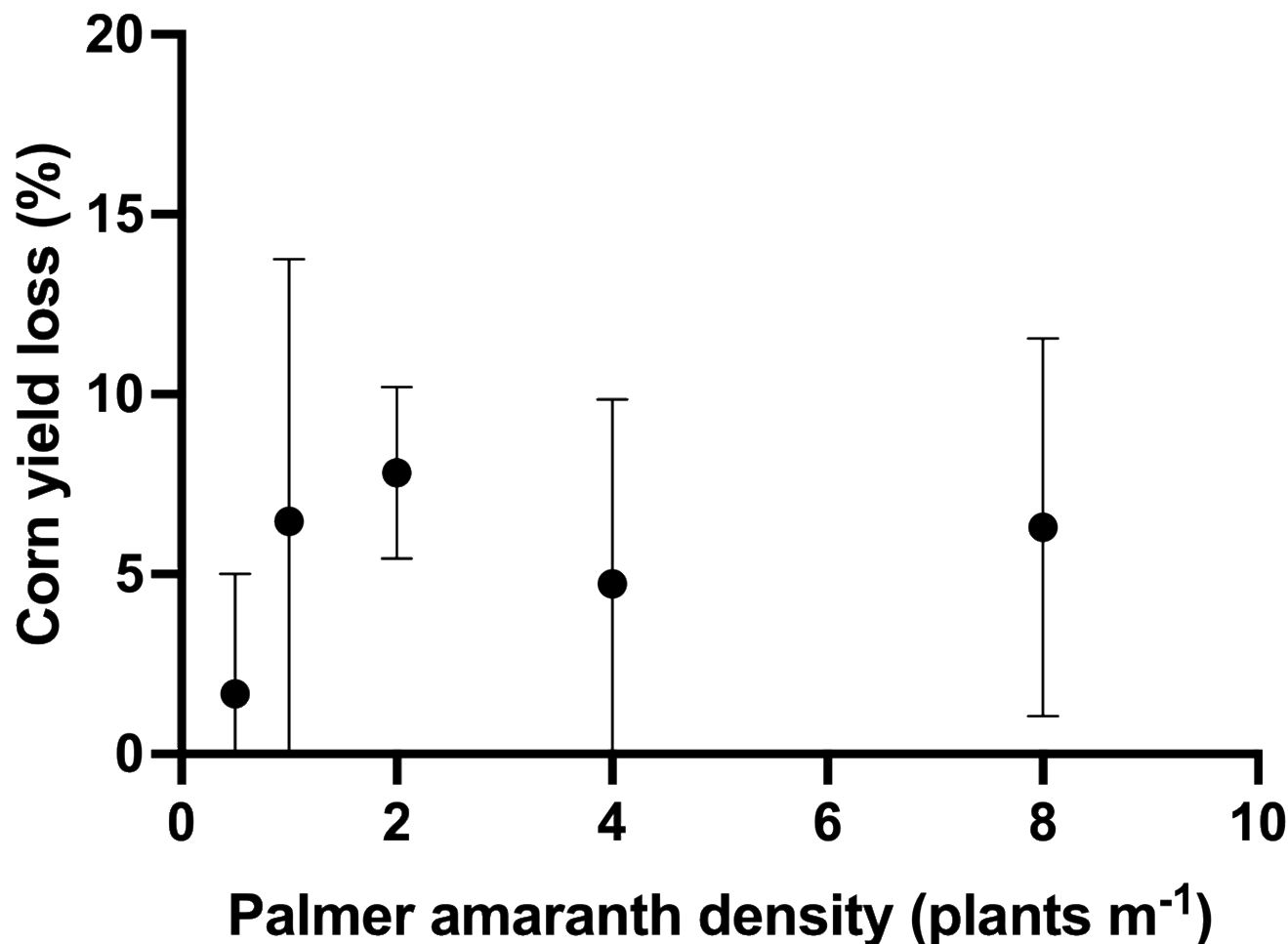
Mean weed-free yield = 58.4 bu A⁻¹

Palmer amaranth transplanted 24 DAP

Photo taken 9/28/22



Corn Yield Loss Due to Palmer amaranth



$$\text{Yield loss (\%)} = \frac{I \times \text{weed density}}{1 + \left(\frac{I}{A}\right) \times \text{weed density}}$$

I = yield loss per unit weed density as density nears 0

A = yield loss as weed density nears ∞

For year 1 of this research:

Corn yield loss data do not fit this model

Mean weed-free yield = 246.2 bu A⁻¹

Palmer amaranth transplanted 25 DAP

Corn Yield Loss Due to Palmer amaranth

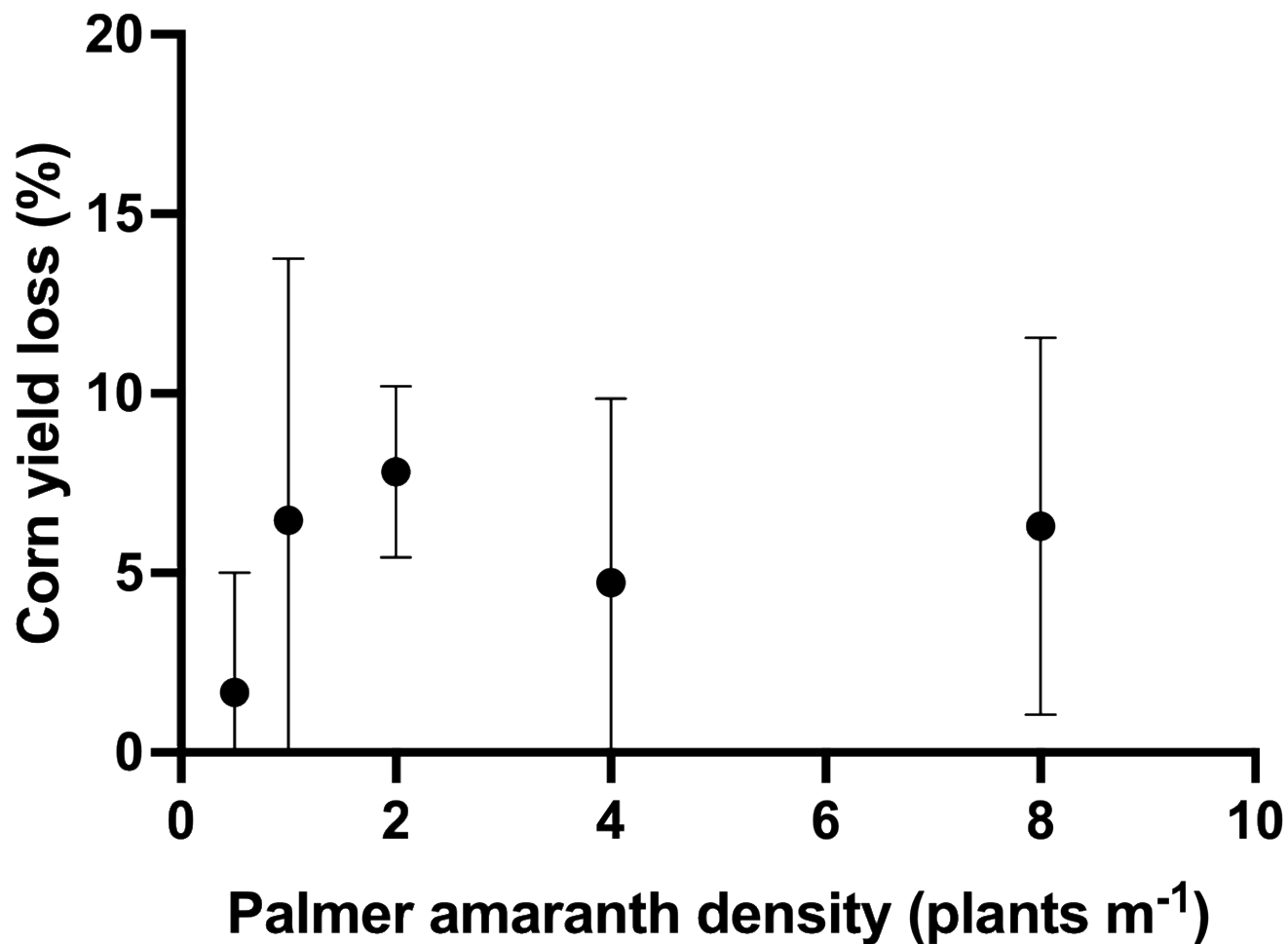


Photo taken 9/28/22

Photos taken 9/28/22
Transplanted 1 day apart



Acknowledgments

- North Dakota SBARE
- Hatch Project #ND01532
- Law, Howatt, and Ikley Labs



Questions?

quincy.law@ndsu.edu



Pop quiz

How many pigweed species are pictured?

