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Cover Crops and Targeted Herbicide Applications: Implications for Modern Weed Management

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Cropping Systems Weed Science

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NPM

WAPAC

Wisconsin Soybean Marketing Board

Take ACTION Herbicide-Resistance Management

Wisconsin Corn

NCSRP North Central Soybean Research Program

USB United Soybean Board

National Corn Growers Association

BRIEN HYBRIDS

CROP PROTECTION INDUSTRY

Rock County Wisconsin

USDA

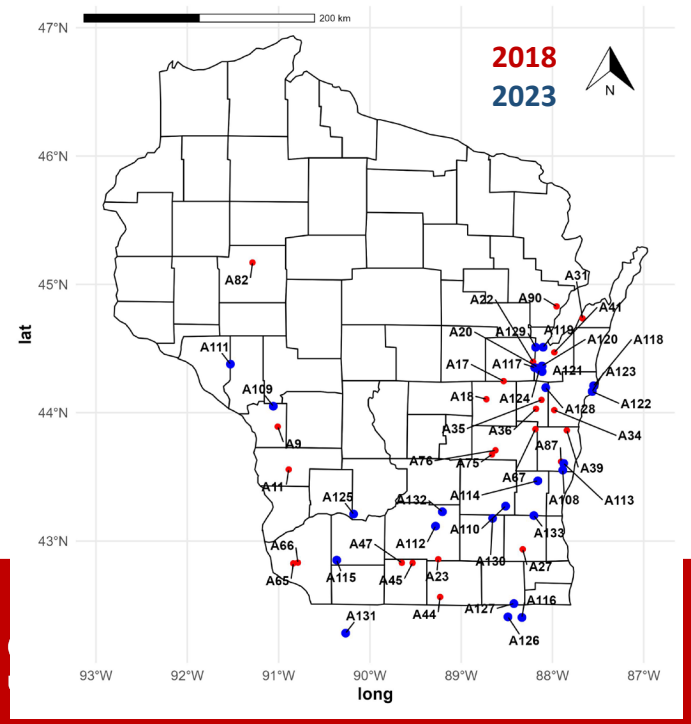
SARE North Central Sustainable Agriculture Research and Education

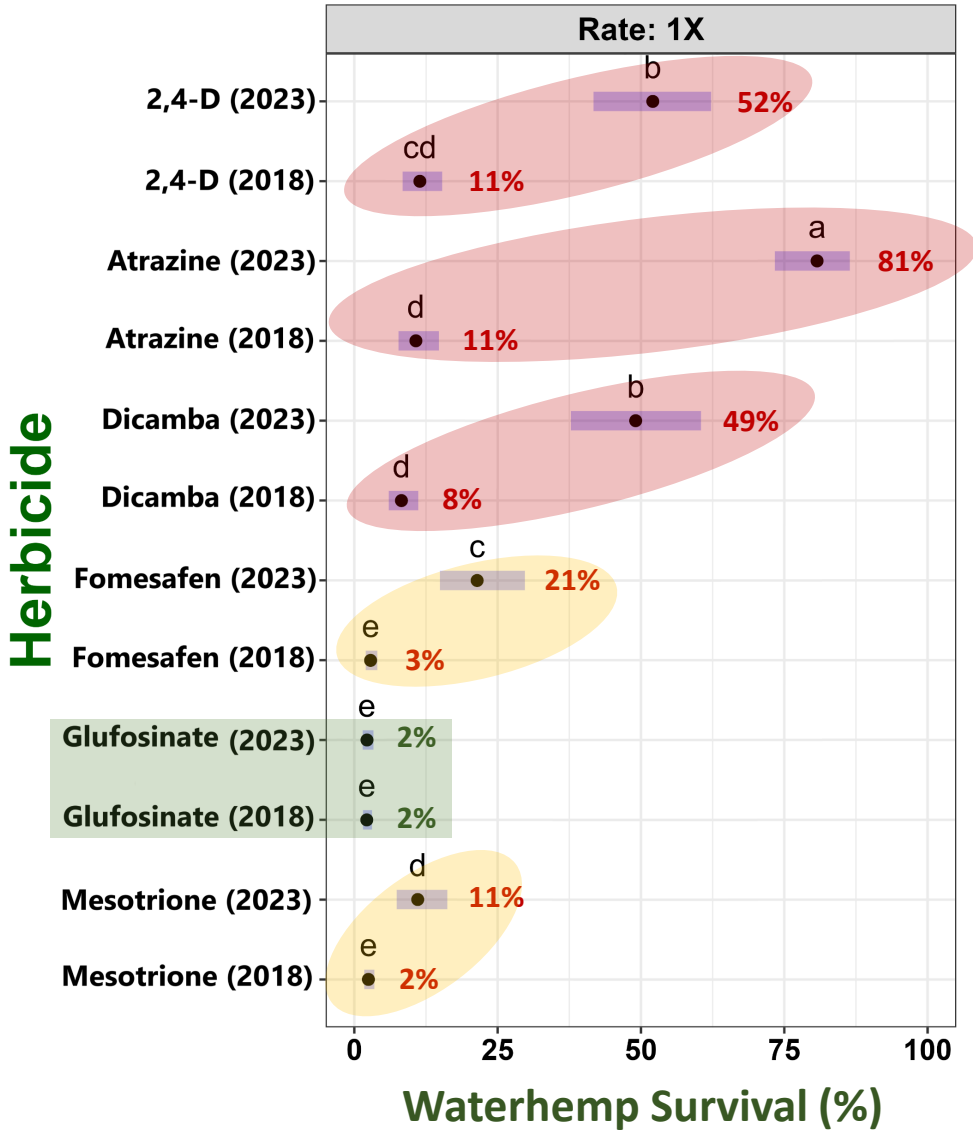
rwerle@wisc.edu | @WiscWeeds | www.BadgerCropNetwork.info

Wisconsin Waterhemp Herbicide Resistance Screening

Herbicide	Product	Rate (fl oz/ac)	SOA Group
Mesotrione	Callisto	3.0	27
Imazethapyr	Pursuit	4.0	2
Glyphosate	Roundup PM	22	9
Glufosinate	Liberty	32	10
Fomesafen	Flextar	16	14
Dicamba	XtendiMax	22	4
Atrazine	Aatrex 4L	32	5
2,4-D	Enlist One	24 - 32*	4

**Enlist One at 24 and 32 fl oz/ac for 2018 and 2023 accessions, respectively.*





2018: "≥88% of the accessions evaluated are resistant to both imazethapyr and glyphosate applied POST." Faleco et al (2022)

WISCONSIN SOYBEAN MARKETING BOARD

Research by Dr. Ahmad Mobli, Luma Loureiro & Felipe Faleco, WiscWeeds Program
26 different populations collected in 2018 and 2023

WI Waterhemp Resistance Update:

Accession	County	2,4-D (POST)	ATRAZINE (PRE & POST)	FOMESAFEN (PRE & POST)	MESOTRIONE (POST)	*S*-METOLACHLOR (PRE)
A101	Dane	X	X	X	X	
A117	Outagamie	X	X	X	X	
A125	Richland	X	X	X	X	
A133	Washington	X	X	X		X

Research by Luma Loureiro, Ahmad Mobli, Felipe Faleco, WiscWeeds Program

2024 Soybean Herbicide Costs (SW Wisconsin)*

PRE

Authority First	4	$ 31.50	$ 7.88
Metribuzin	10	$ 10.75	$ 6.72
Metolachlor	17	$ 30.00	$ 3.98
Glyphosate 5 pound	24	$ 15.00	$ 2.81
AMS	2.5	$ 0.29	$ 0.73
			$ 22.12

POST

Enlist One	32	$ 48.00	$ 12.00
Metolachlor	16	$ 30.00	$ 3.75
Liberty	32	$ 22.00	$ 5.50
Glyphosate	24	$ 15.00	$ 2.81
Clethodim	10	$ 28.00	$ 2.19
AMS	3	$ 0.29	$ 0.87
			$ 27.12

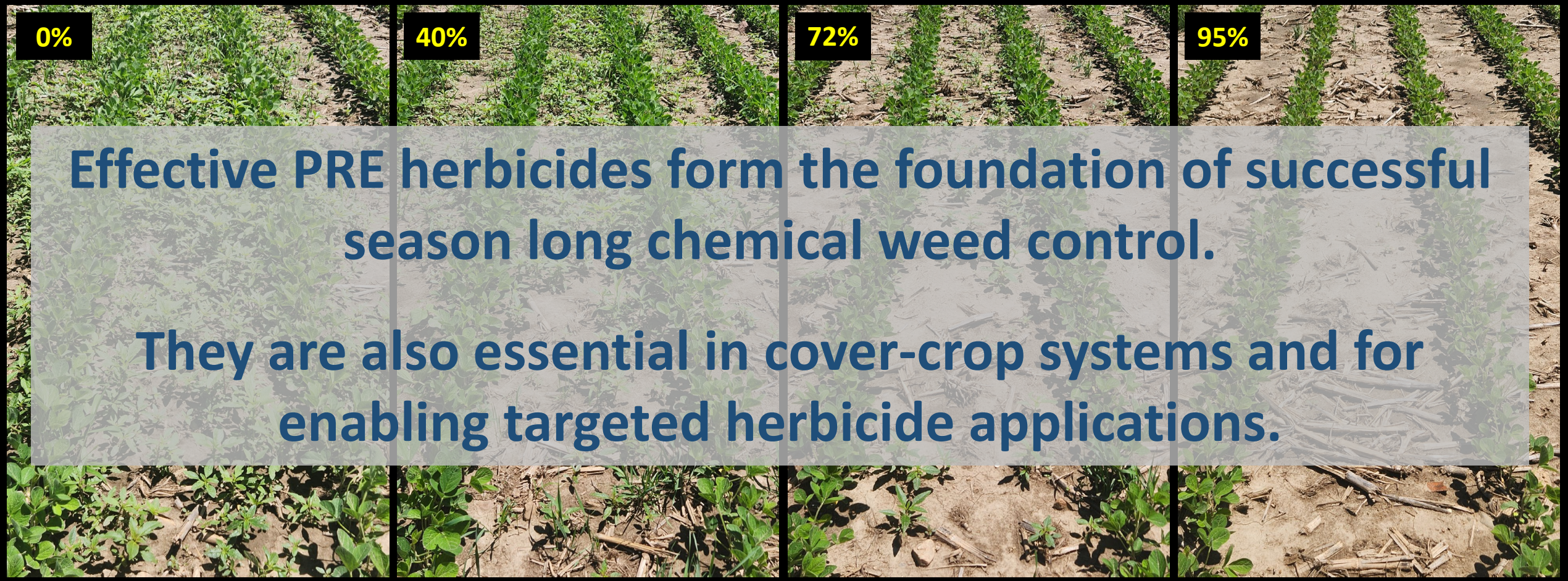
**Target weeds: waterhemp, giant ragweed, foxtail species. Values provided by a Wisconsin farmer.*

Total cost = $49.24/acre

WiscWeeds research in partnership with Douglas Wiedenbeck, UW LARS

PRE-emergence Herbicide Programs (2024 – O'Brien Family Farm, Brooklyn, WI)

Waterhemp control 34 days after PRE application



Effective PRE herbicides form the foundation of successful season long chemical weed control.

They are also essential in cover-crop systems and for enabling targeted herbicide applications.

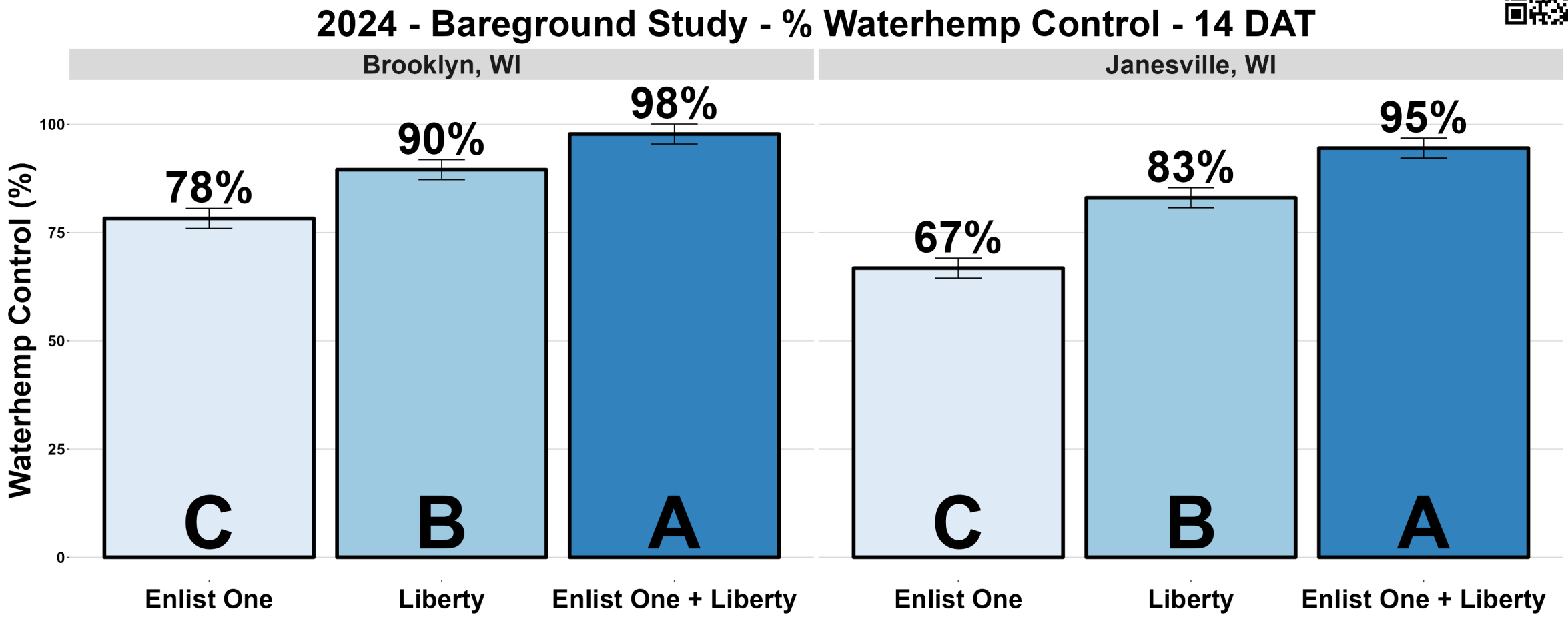
Untreated Check	**PRE:** Tricor @ 7 oz	**PRE:** Boundary @ 1.75 pt (Tricor @ 5.8 oz + Dual II Magnum @ 19.2 fl oz)	**PRE:** Fierce EZ @ 6 fl oz (Valor SX @ 2 oz + Zidua SC @ 2.5 fl oz)

AMVAC, BASF, FMC, Syngenta, UPL, Valent sponsored trial.

Slide by Ryan DeWerff, Research Specialist

Cropping Systems Weed Science
UNIVERSITY OF WISCONSIN-MADISON

POST Waterhemp Control – Enlist E3 Soybean

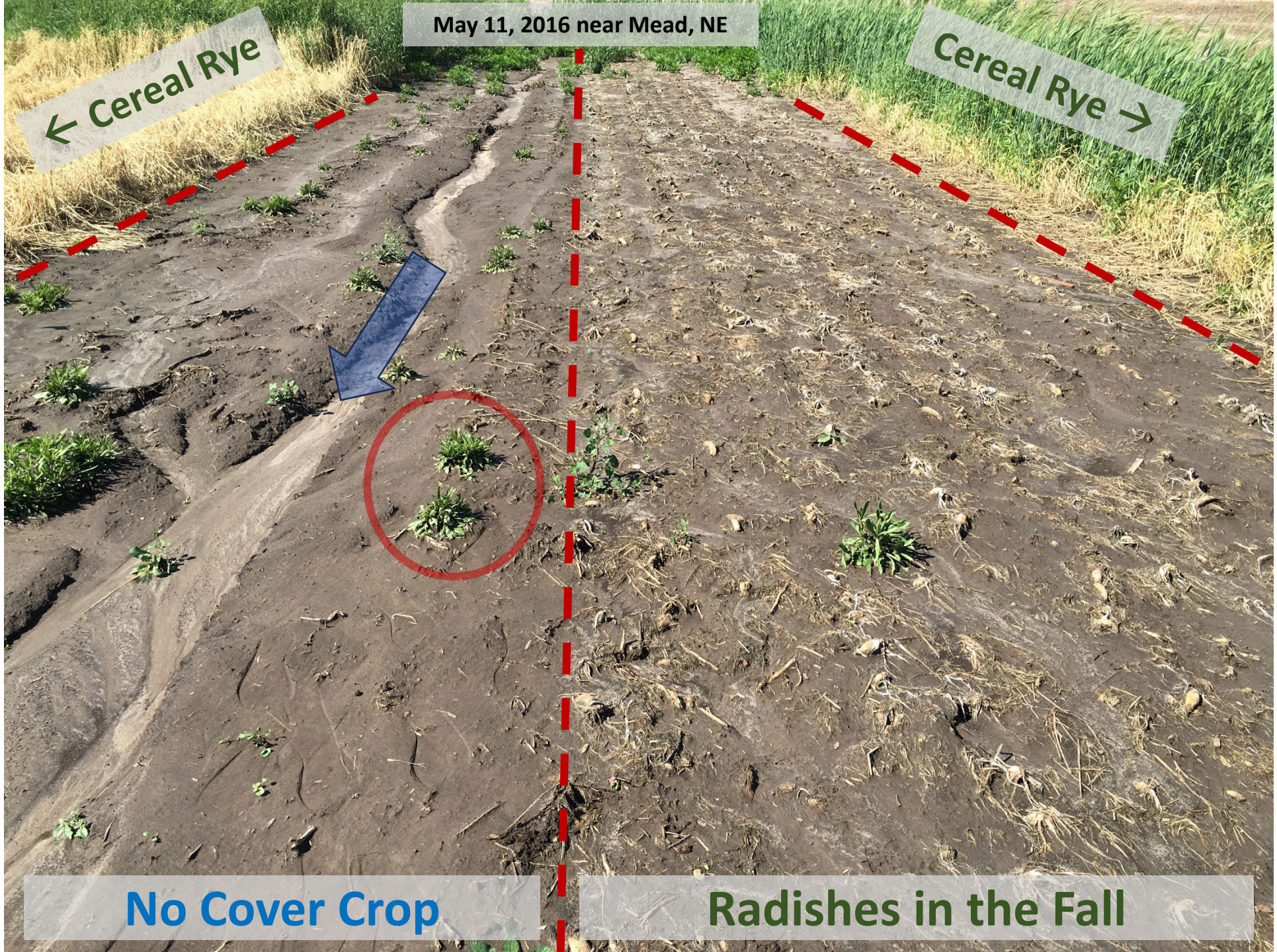


Enlist One @ 2 pts/acre; Liberty @ 32 fl oz/acre; AMS @ 3 lbs/acre; 15 GPA; AIXR nozzles.

Waterhemp plants were ~3 inches all at application. DAT = days after treatment.

Research by Zaim Ugljic, PhD Student, WiscWeeds Program

Cropping Systems Weed Science
UNIVERSITY OF WISCONSIN–MADISON

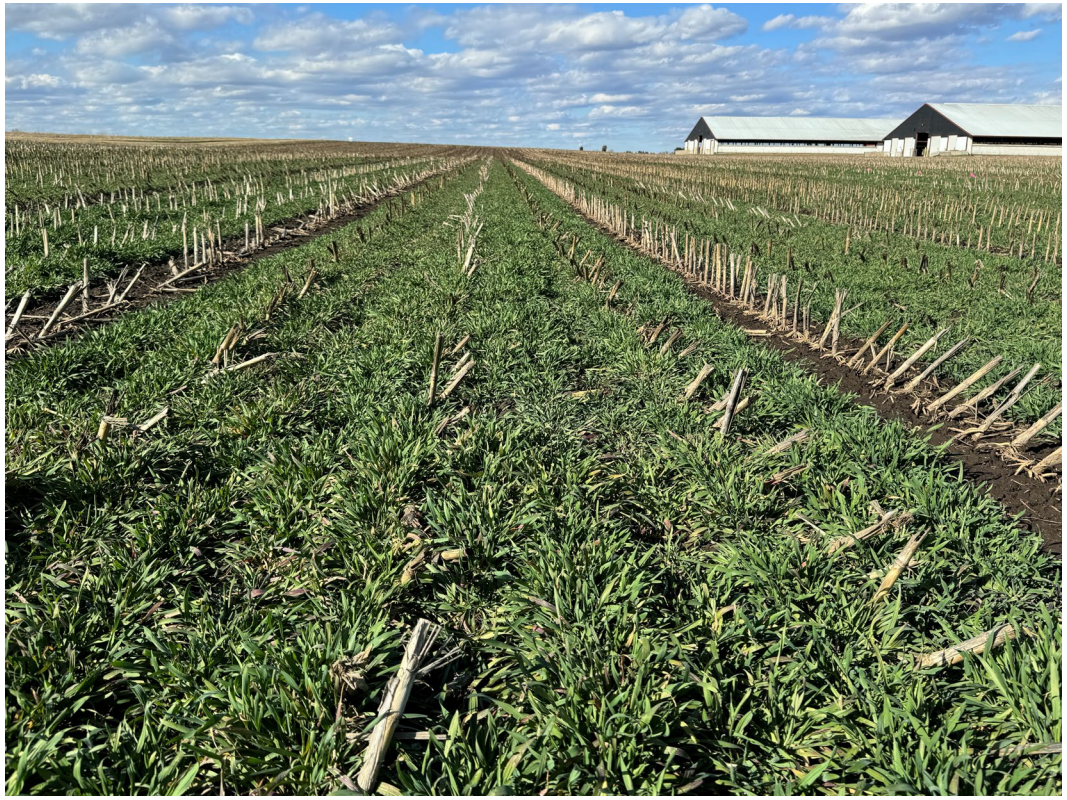

May 11, 2016 near Mead, NE
← Cereal Rye
Cereal Rye →
No Cover Crop
Radishes in the Fall

According to WI Farmers & Crop Advisers Adoption of Cover Crops Have:

- positively influenced water retention in their farms/clients' farms = **85%**
- reduced soil erosion in their farms/clients' farms = **98%**
- **improved overall weed control in their farms/clients' farms = 68%**

n = 136 Wisconsin respondents (2023 cover crop survey)

Cover Crop Incentive Programs



Chudzik et al (2024)

Cereal Rye Cover Crop

March 30, 2021

May 18, 2021

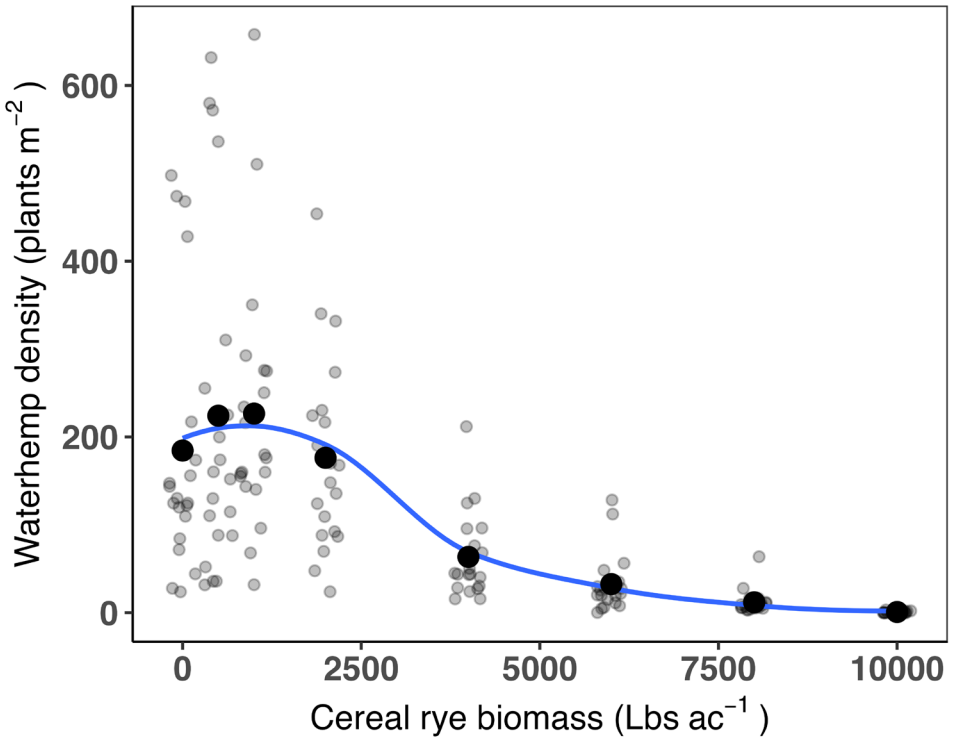
Waterhemp Suppression| Cereal Rye Biomass Dose-response

NO COVER CROP

YES COVER CROP

~4,500 lbs/ac of dry cereal rye biomass for ≥50% waterhemp density reduction (Nunes et al 2024)

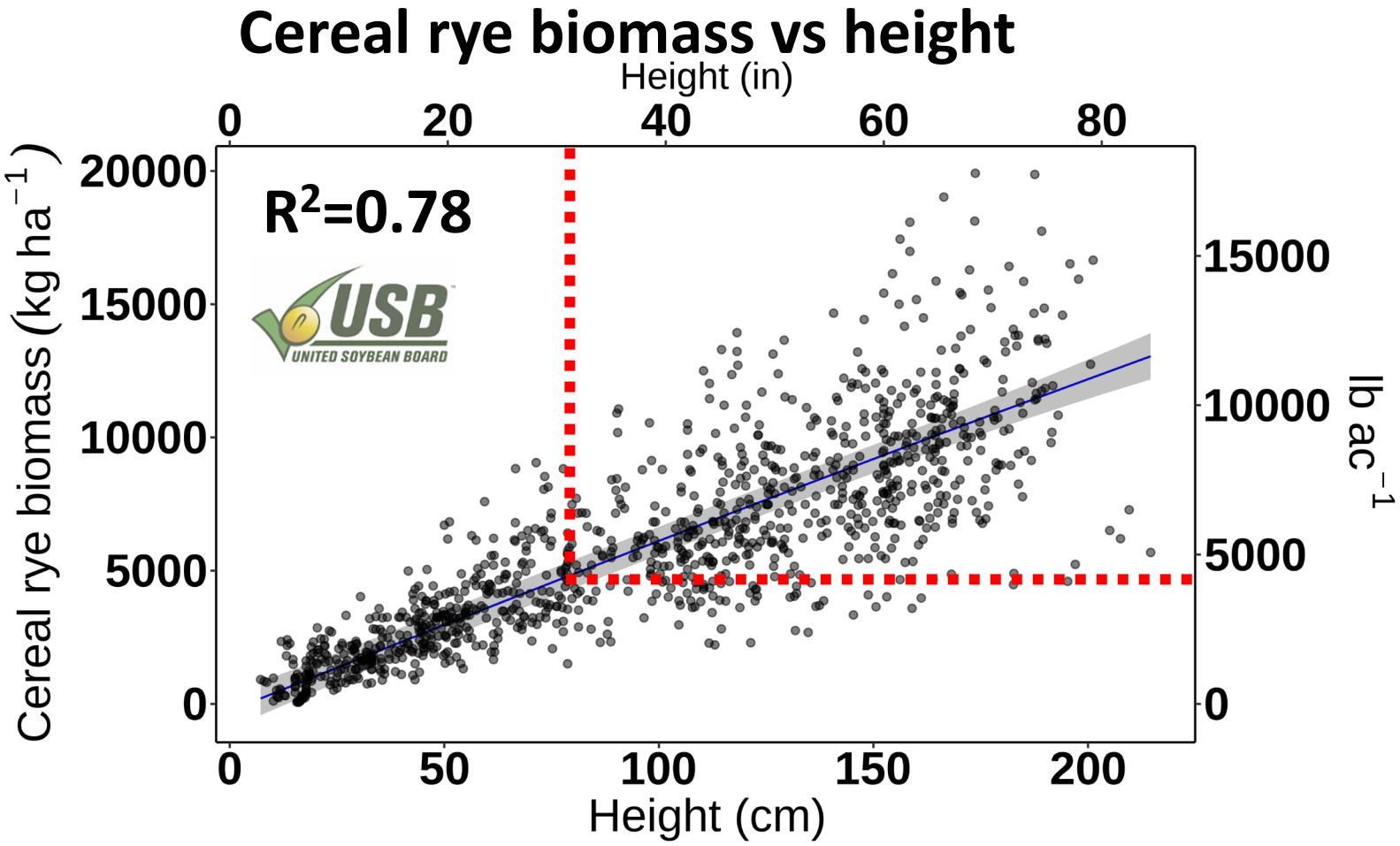
Waterhemp density (plants m^{-2})



Average ED_{50} ~4,500 Lbs ac^{-1}

Research by Jose Junior Nunes, PhD Student, UW-Madison WiscWeeds Program
Nunes et al (2024)

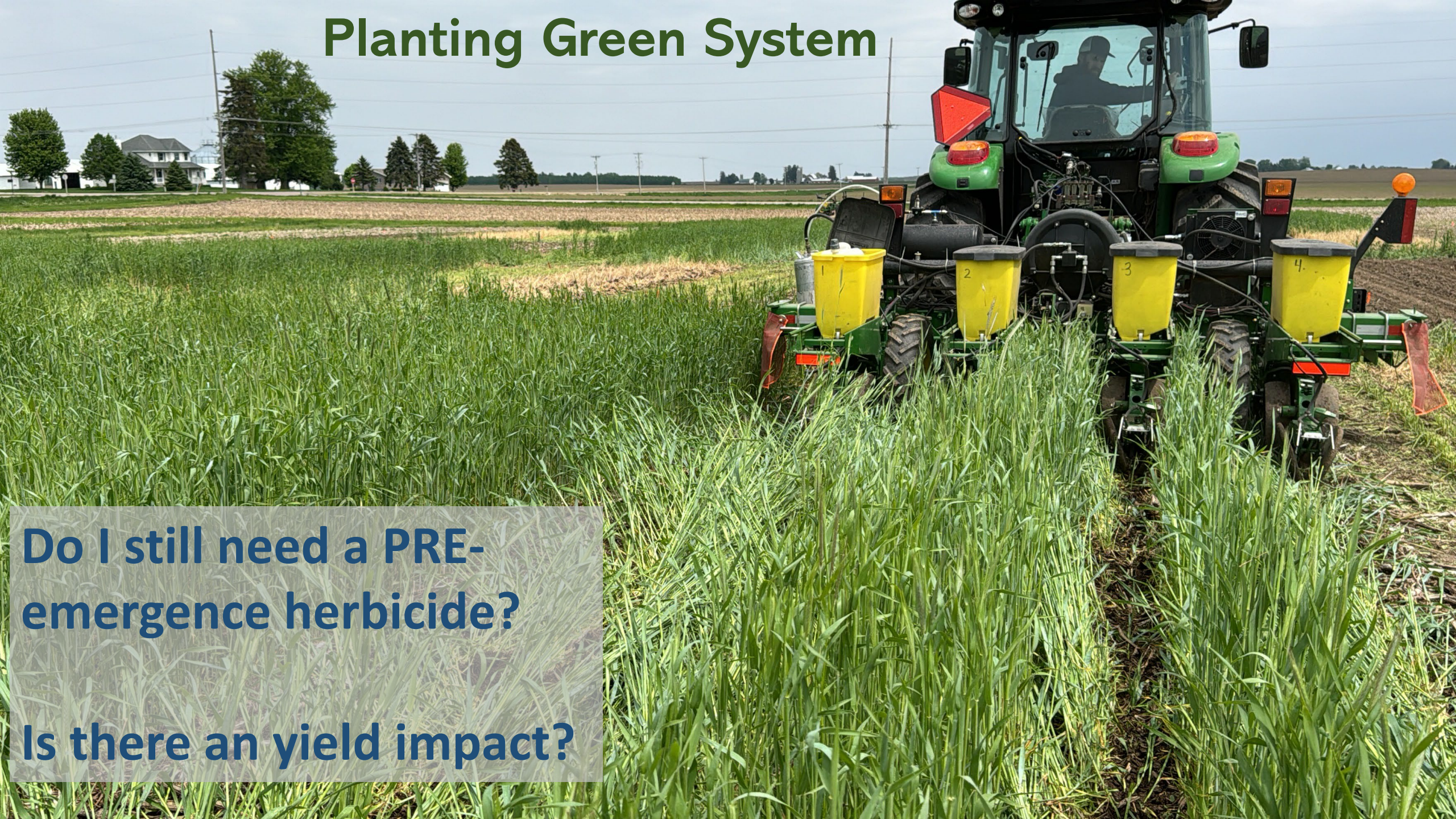
What does 4,500 lbs/acre look like?



(20 site-years, n=1120)

Cereal rye height can be used as a proxy for biomass

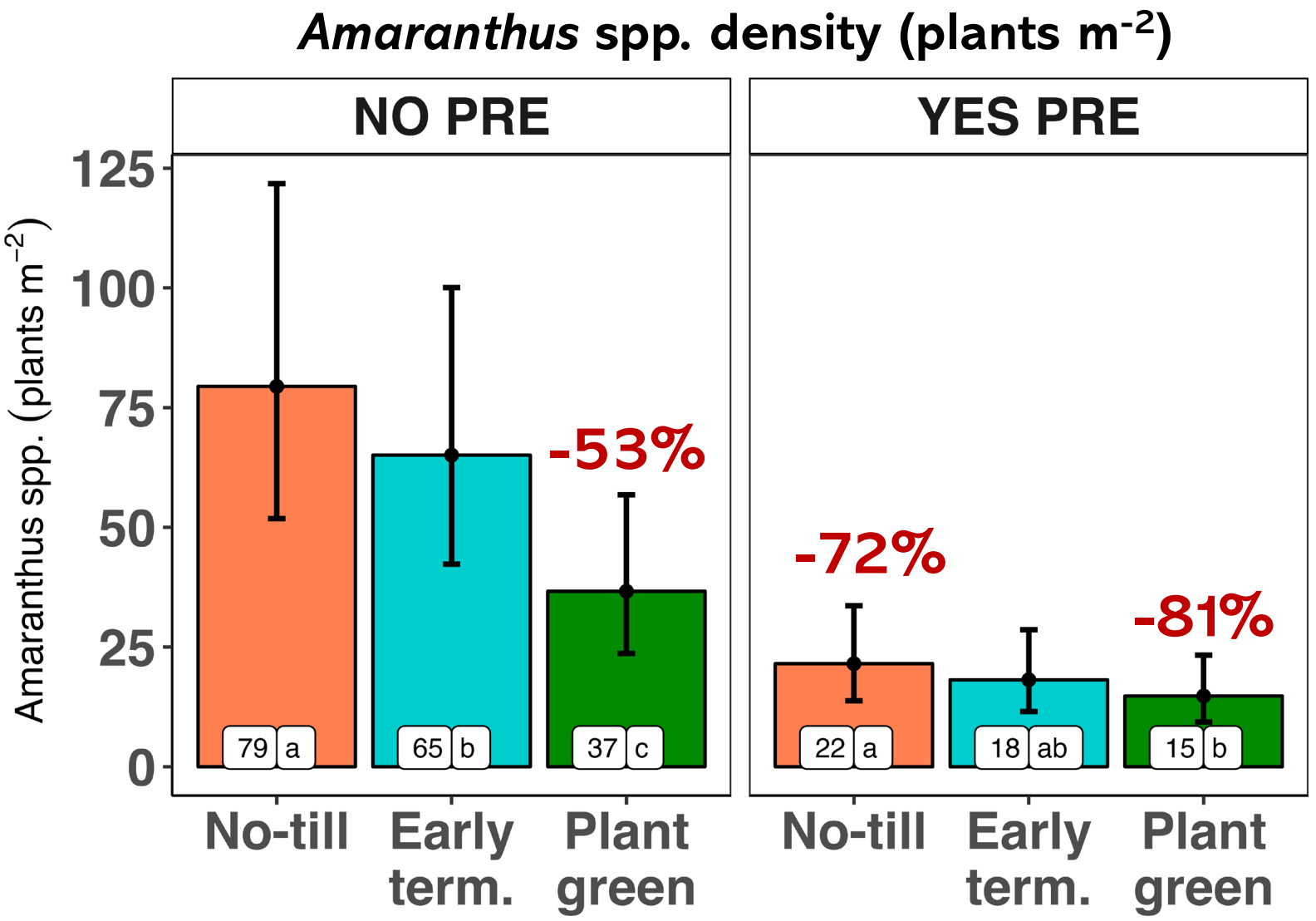
Planting Green System



Do I still need a PRE-emergence herbicide?

Is there an yield impact?

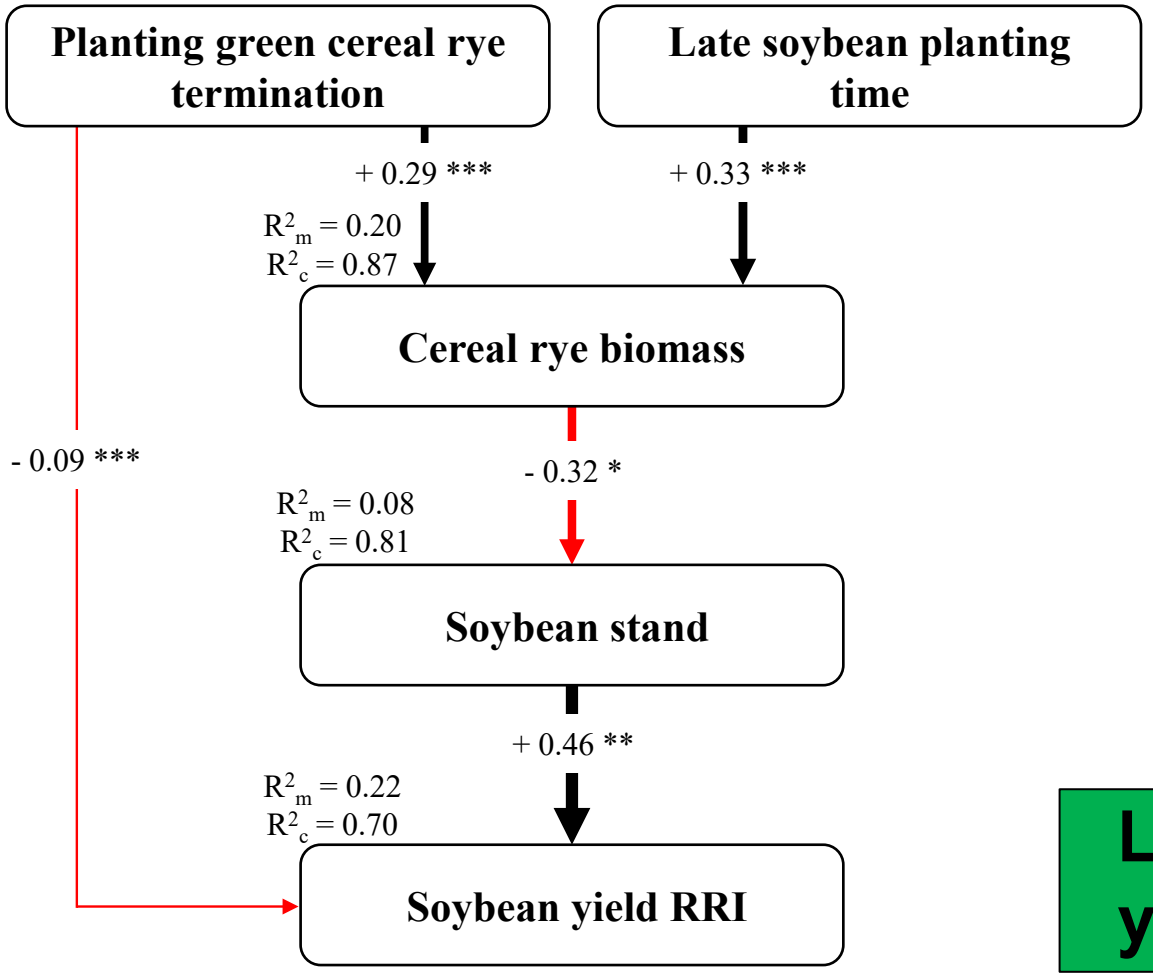
Results | *Amaranthus* spp. Density at POST Application

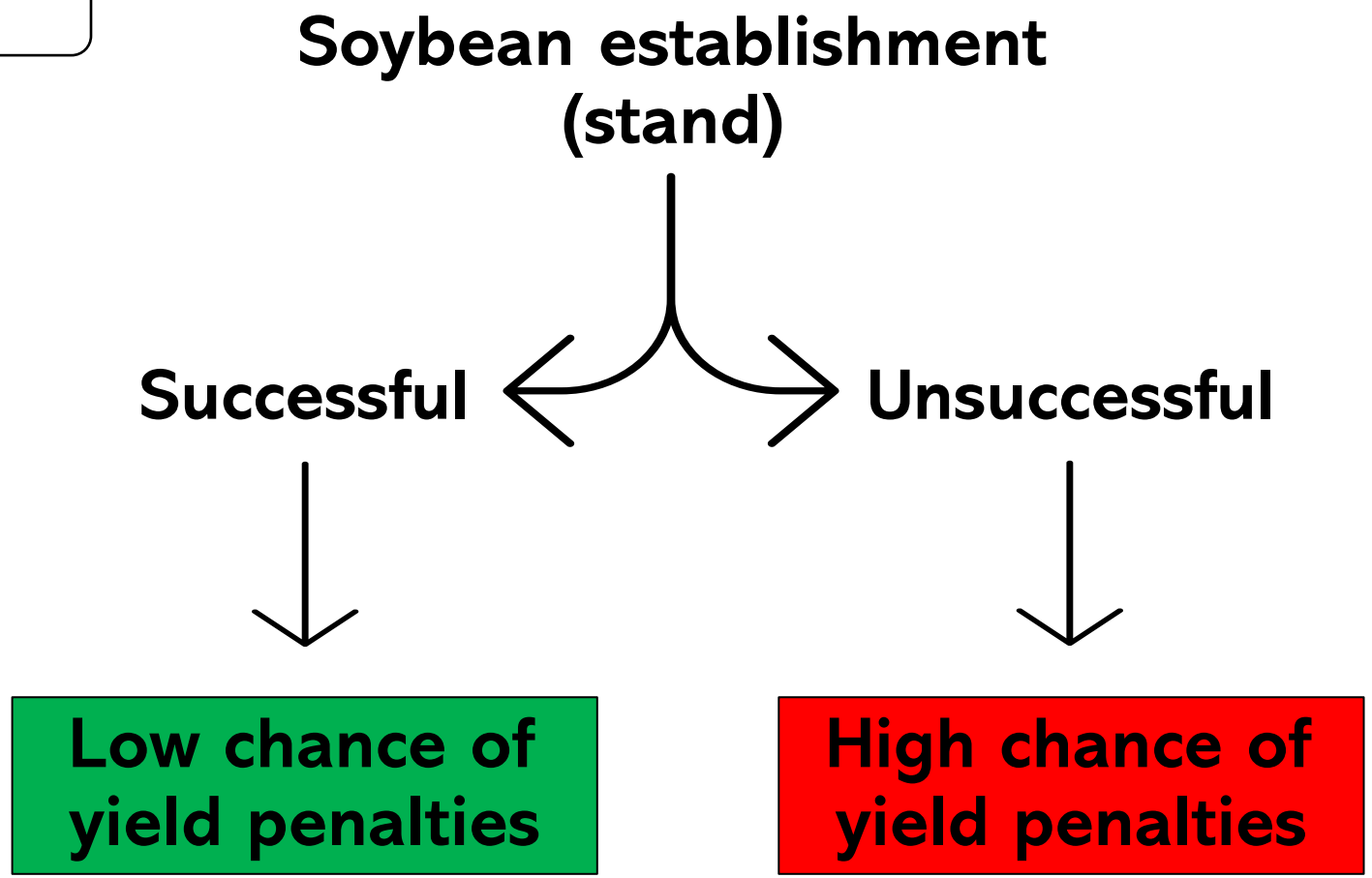


Cereal Rye + PRE

Nunes et al. (Weed Science, 71[5], 493-505, 2023)
(8 site-years)

Piecewise Structural Equation Model (SEM) - Soybean Yield





Nunes et al. (Weed Science, 72:615–629, 2024)
(19 site-years)

Shallow planting (2021)

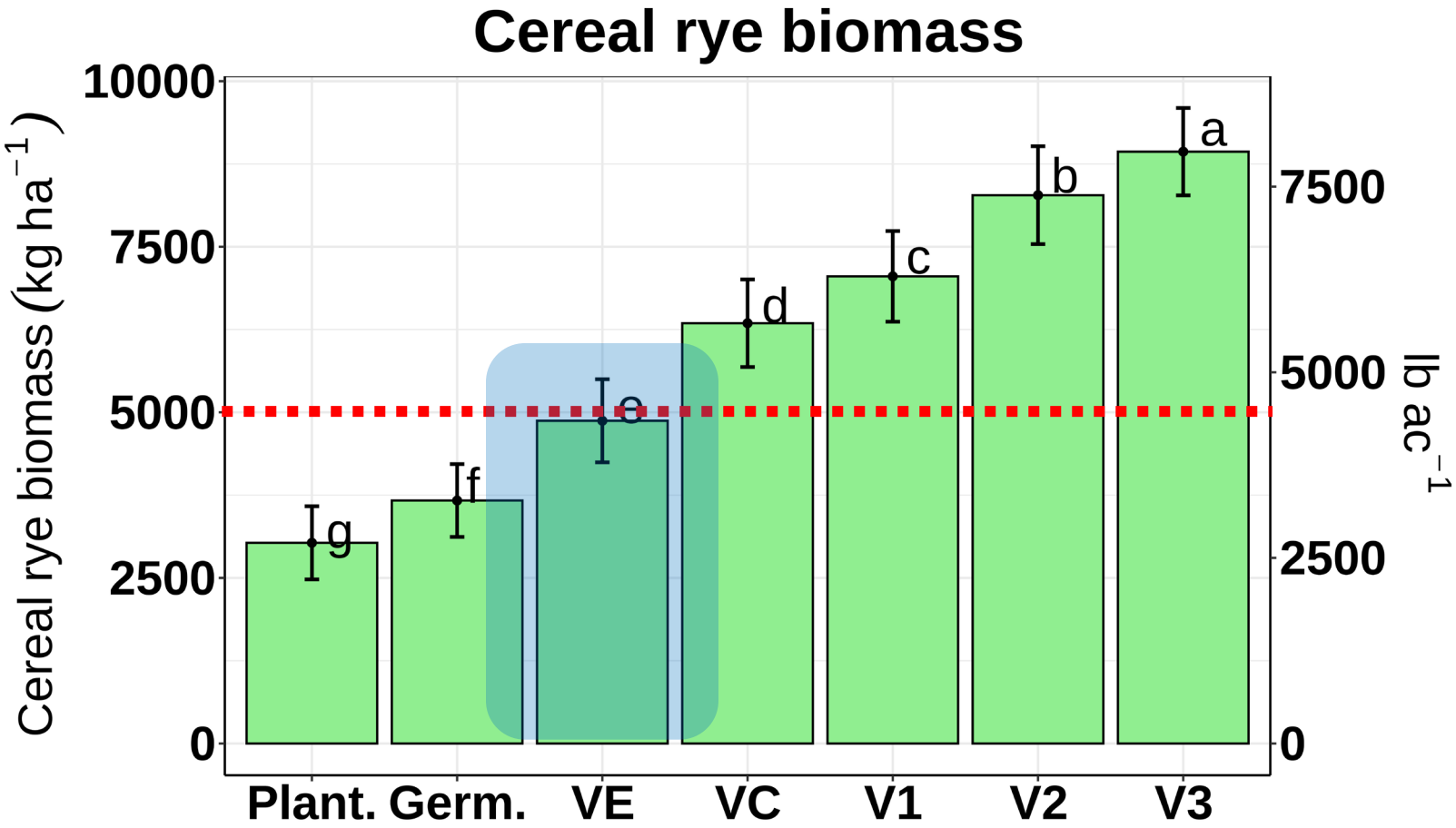
Uneven emergence (2023 drought)

← Planting Soybean Early & Green ?

When should I terminate the cereal rye?

When to spray the residuals herbicides?

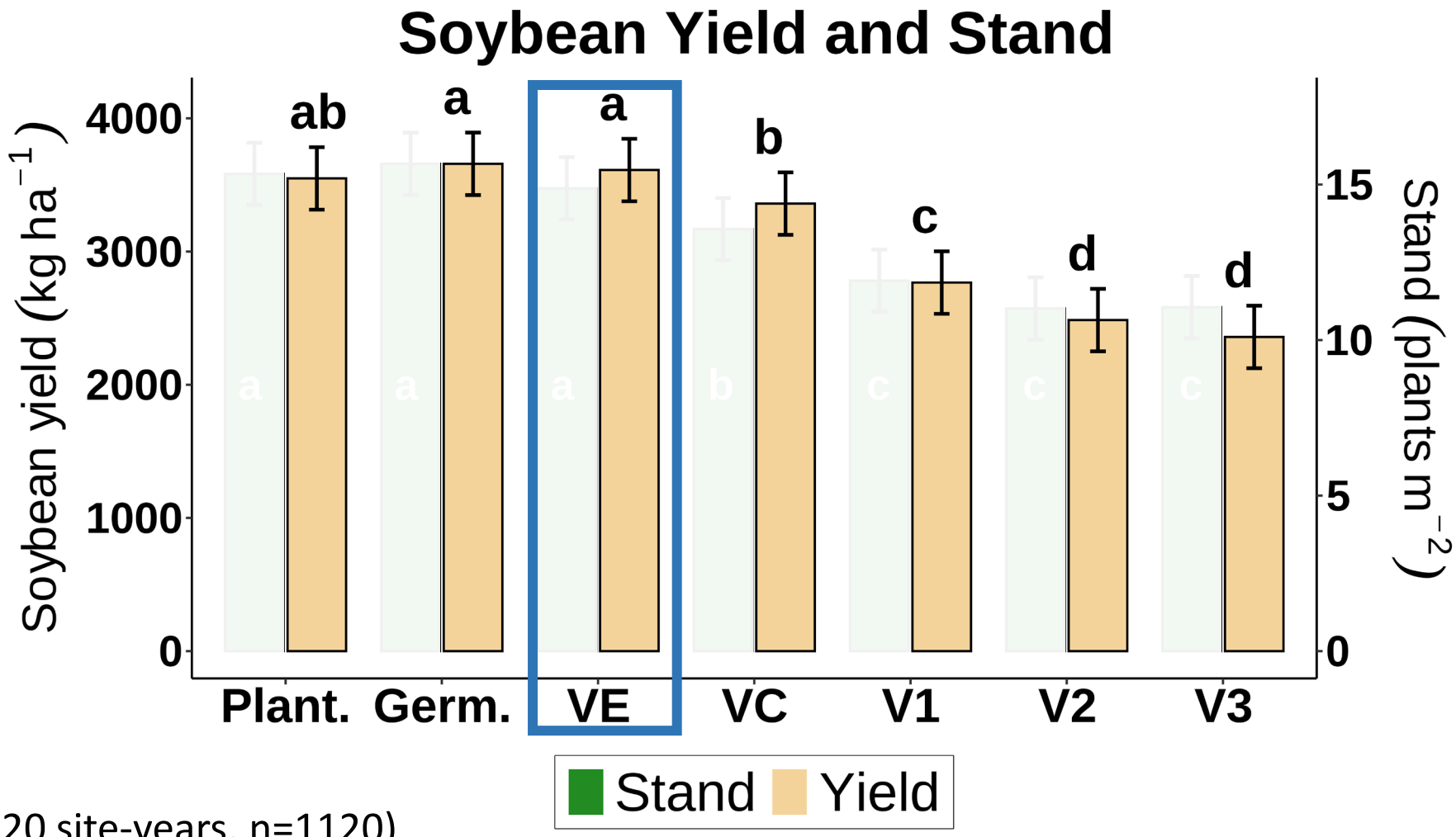
Results – Cereal Rye Biomass



(20 site-years, n=1120)

Biomass increased as cereal rye termination was delayed

Results – Soybean Yield



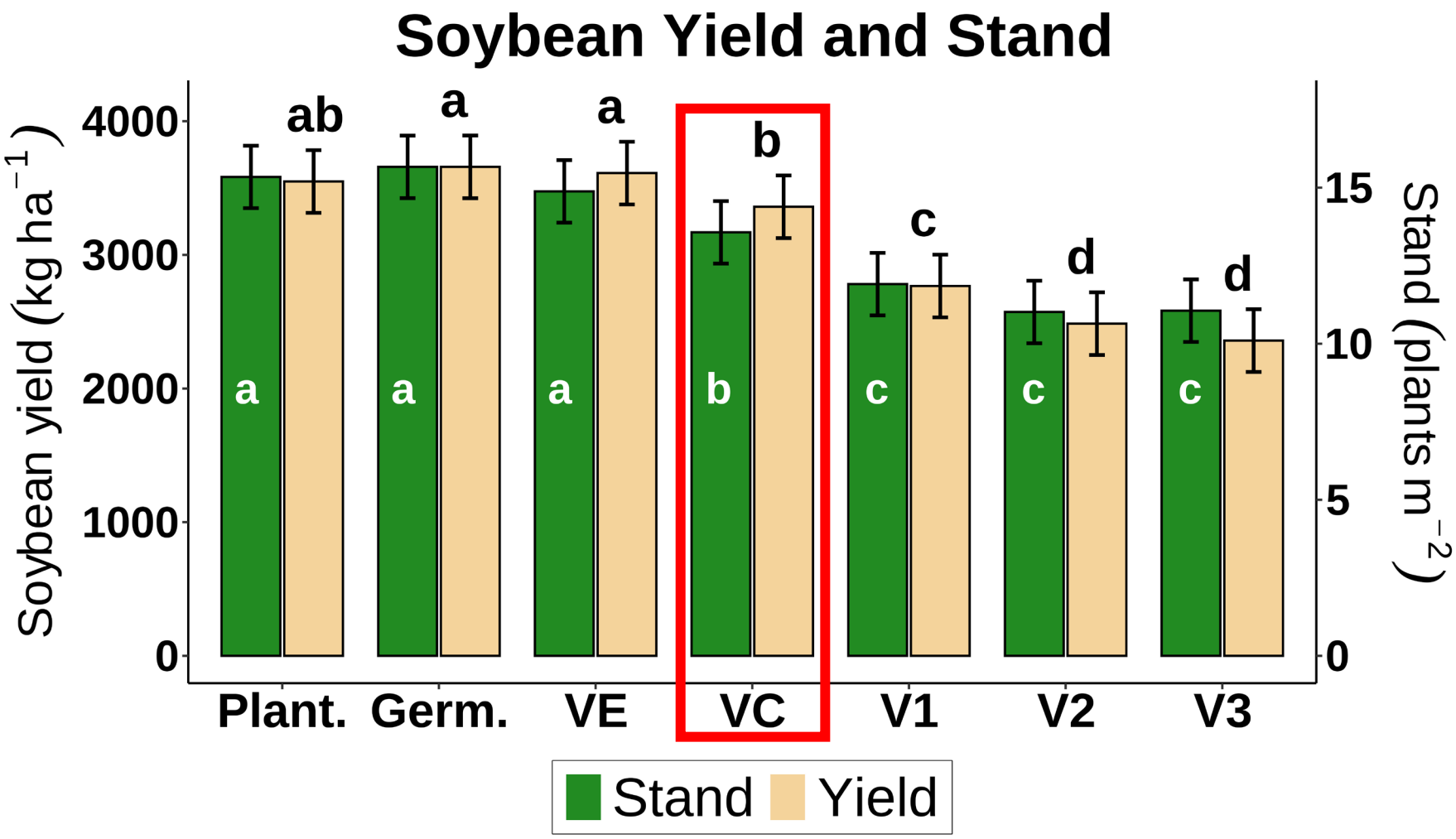
(20 site-years, n=1120)

Emergence

Yield reduction when terminated later than cotyledon stage

Results – Soybean Yield

Cotyledon stage might be too late!



Stand loss and Yield reduction when terminated later than cotyledon stage

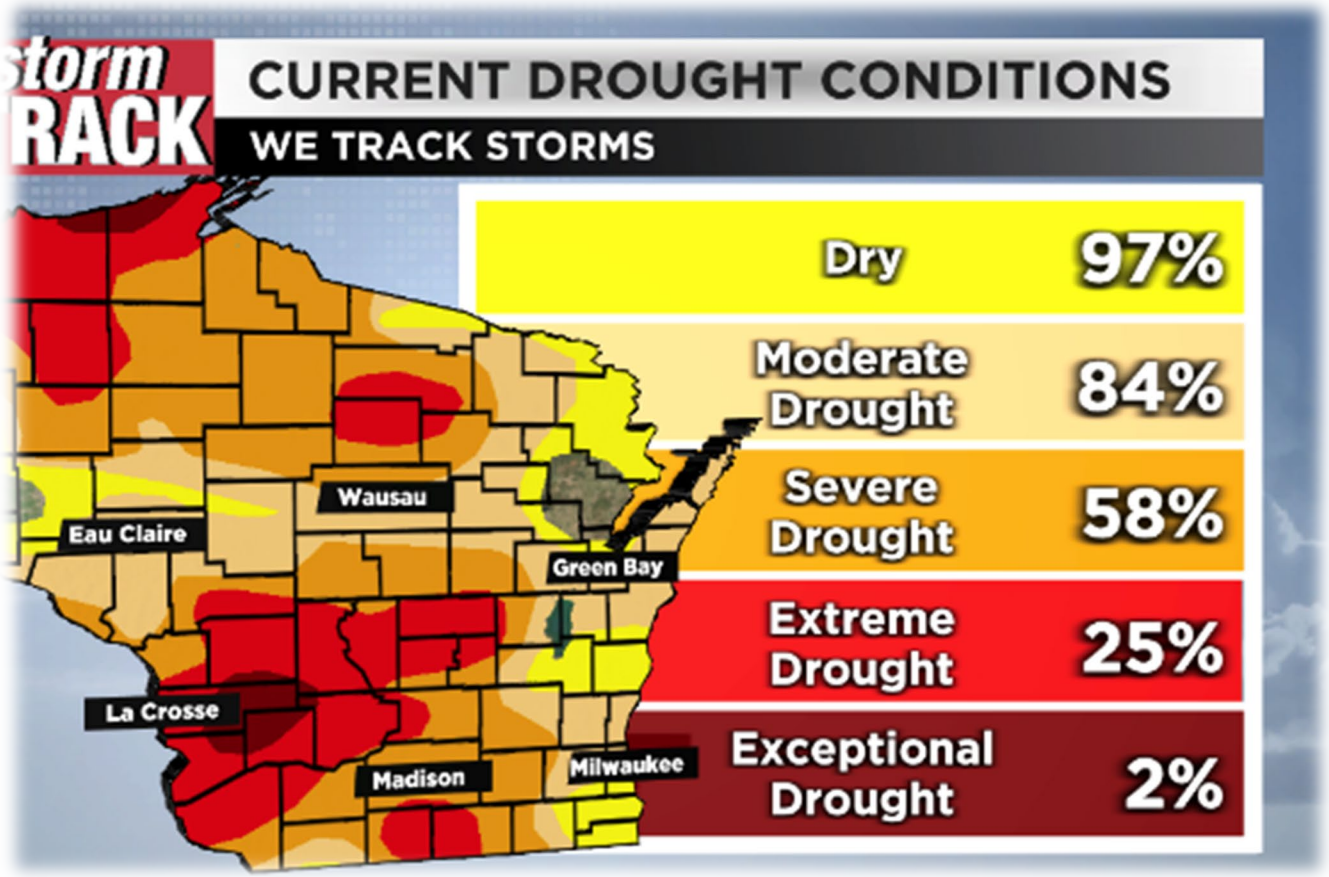
When should I terminate the cereal rye?

Cereal rye at ~30 inches

Whichever happens first

Soybean at emergence stage

When should I terminate the cereal rye?



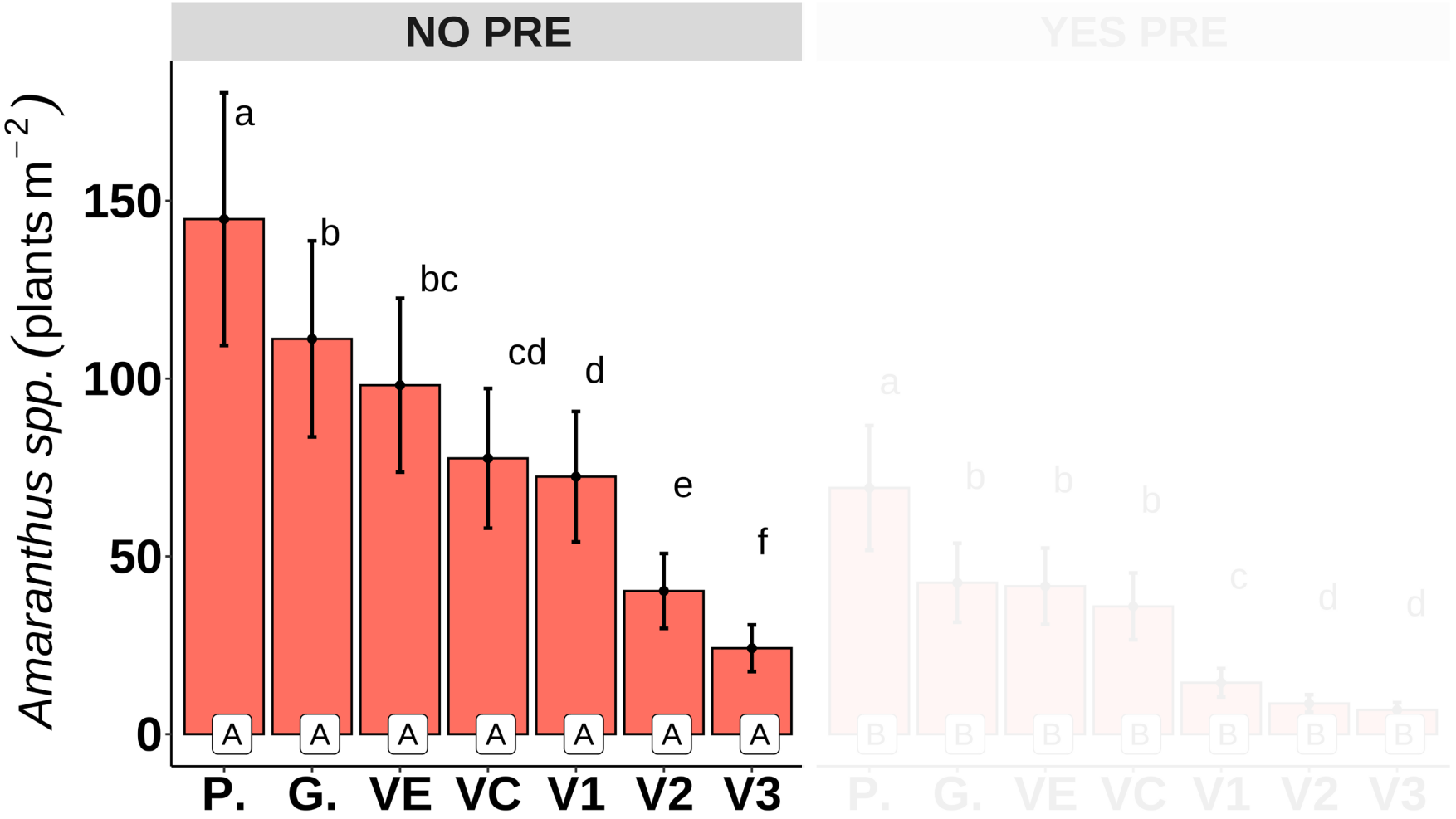
Drought?

Terminate it sooner rather than later

Crespo et al. 2024

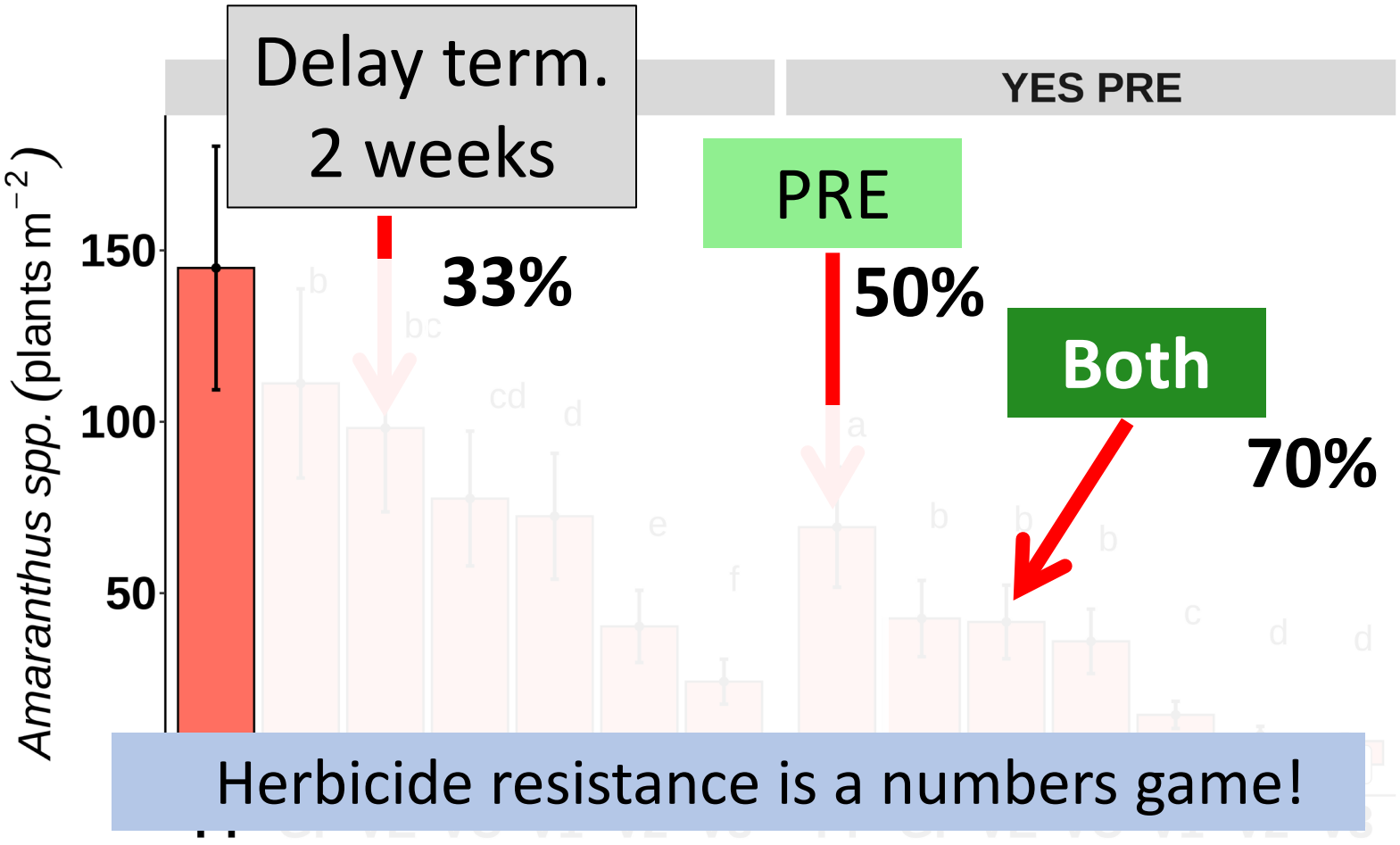
Results – Into the Weeds

Amaranthus spp. density at POST

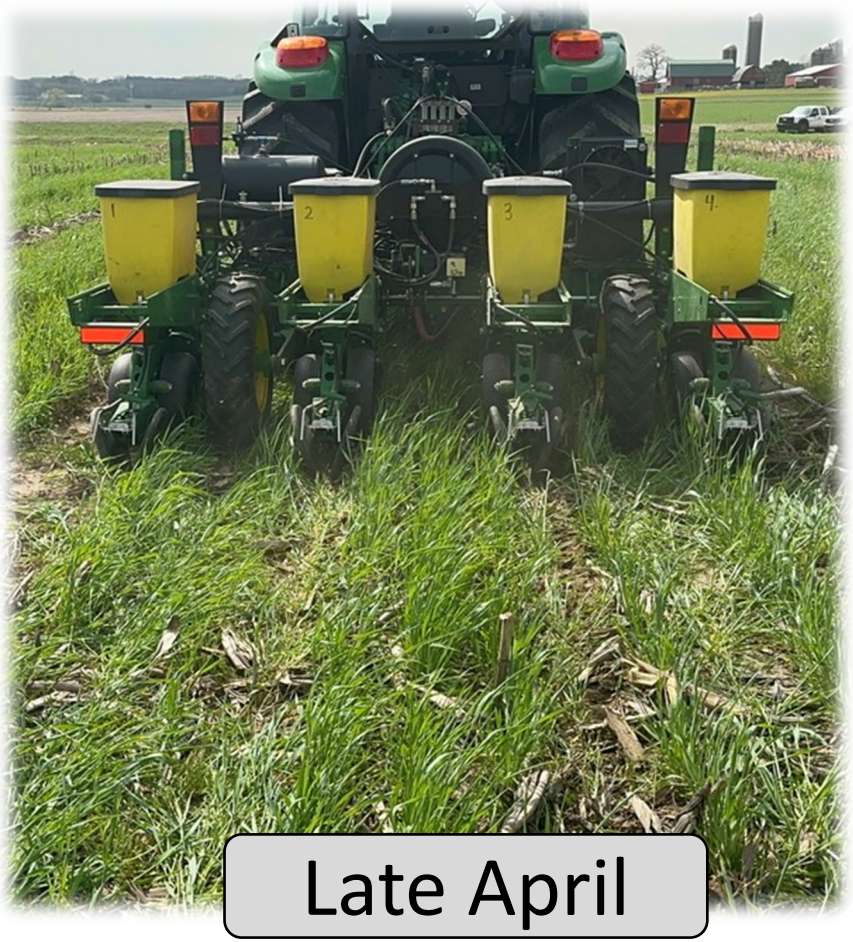


Higher biomass reduced Amaranthus spp. density

What are the benefits of delaying termination and using residuals?



(20 site-years, n=1120)



Combined strategies worked better than single strategies

Take home messages

Cereal rye height can be used to estimate biomass

Yes, soybeans can coexist with cereal rye!

Control rye when it reaches ~30 inches or around soybean emergence.

Residual herbicides showed effective even with high biomass levels

The Mixing Bowl

https://www.mixingbowlhub.com/landscape/the-2025-crop-robotics-landscape

2025 WiscWeeds Targeted Herbicide Application Research

WISCONSIN SOYBEAN MARKETING BOARD

USB UNITED SOYBEAN BOARD

TeeJet TECHNOLOGIES

NATIONAL CORN GROWERS ASSOCIATION

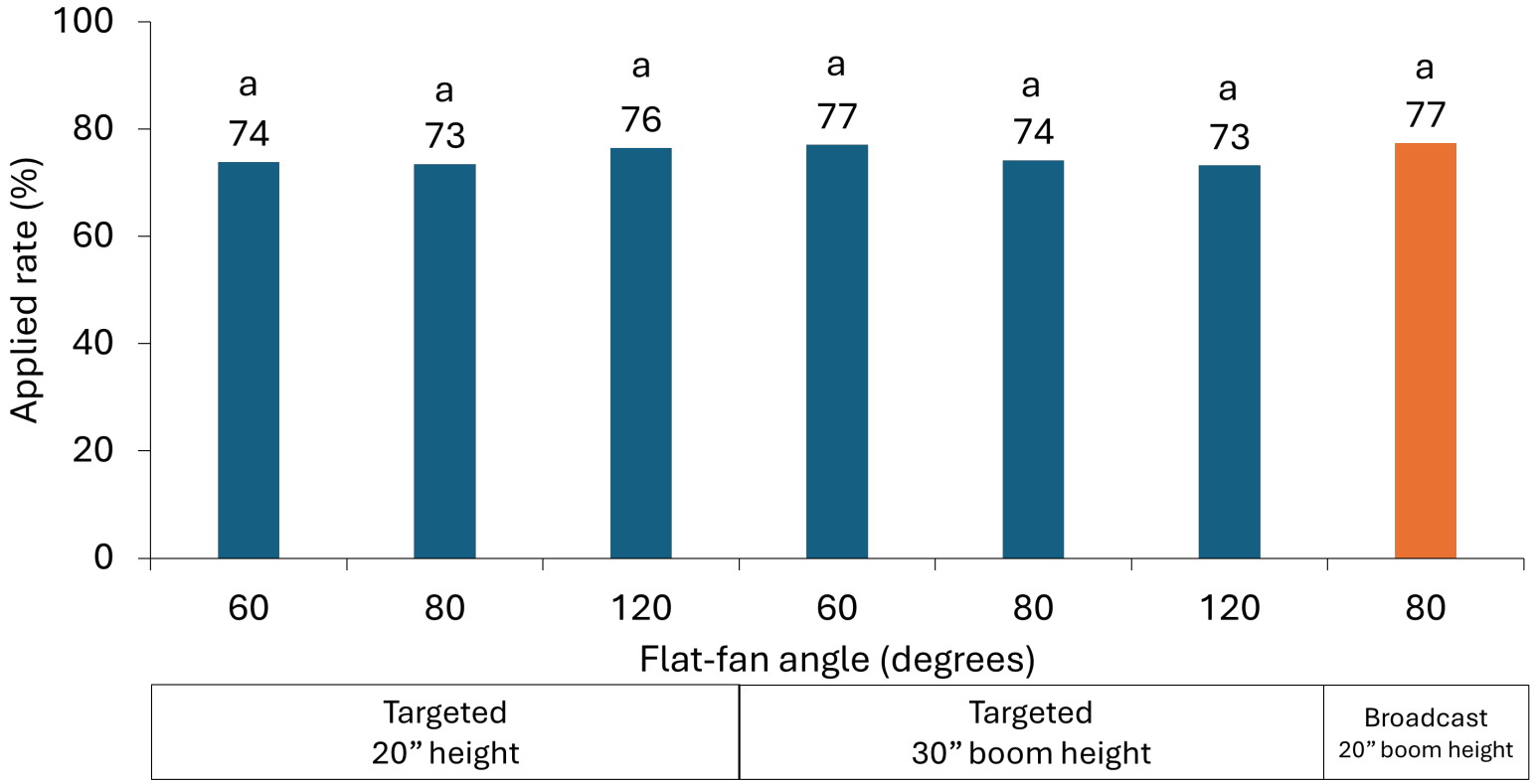
syngenta

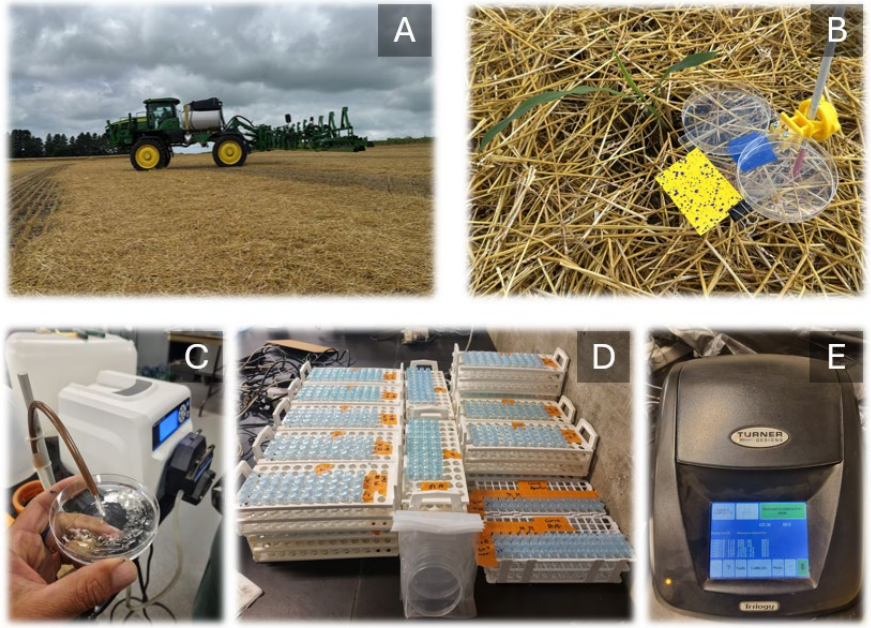
2025 Wisconsin Large-Scale Herbicide Trials

John Deere See & Spray Premium (120 ft boom)

2025 Wisconsin Large-Scale Herbicide Trials (Spray Deposition)

John Deere See & Spray Premium (120 ft boom)



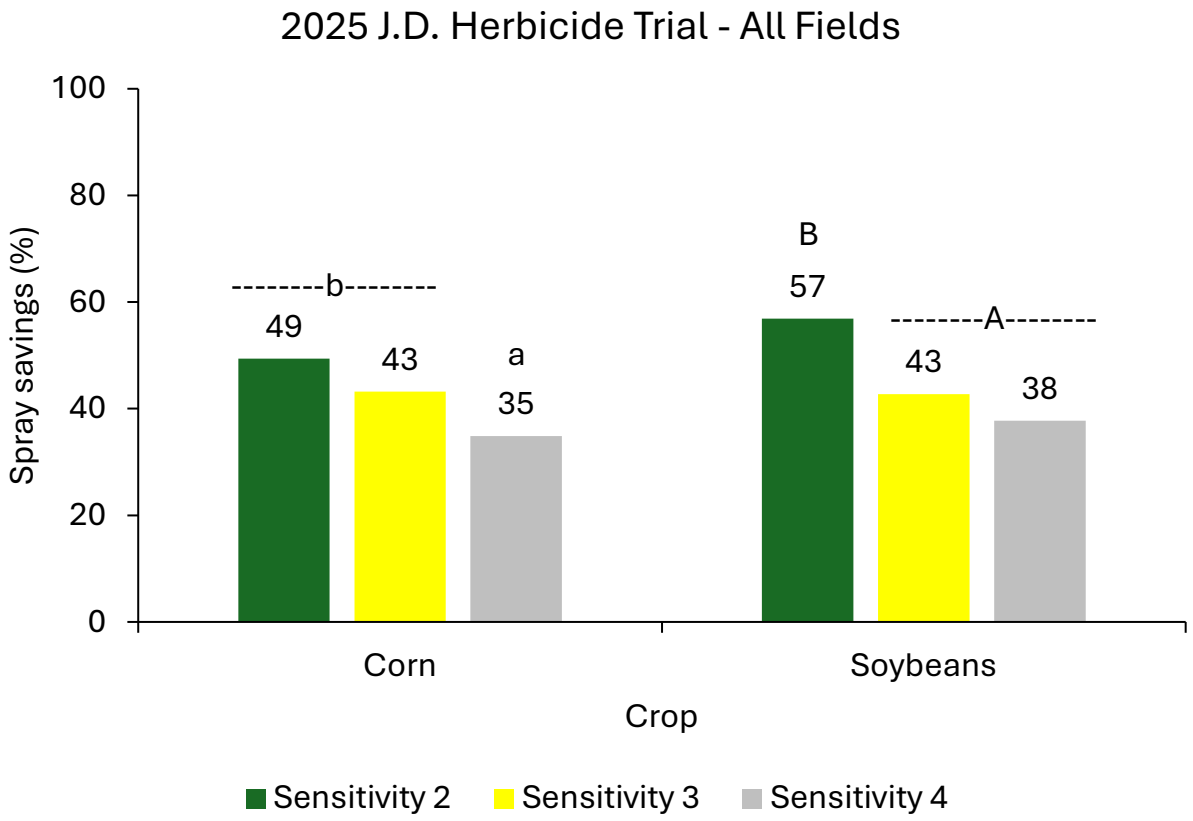


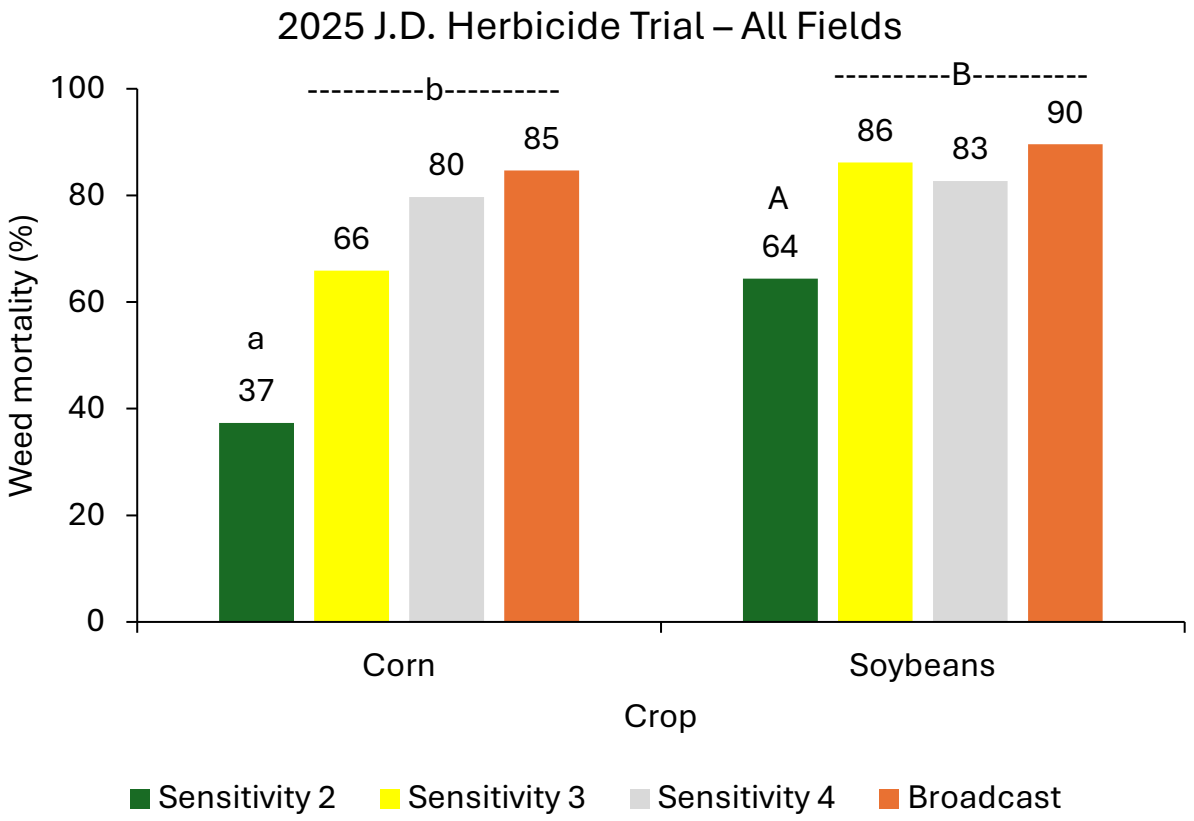
3 nozzle types (TSL 6005, TSL 8005, and ULD 12005)
Ultra-coarse droplets; 15 GPA; 12 mph

2025 WiscWeeds research led by Dr. Guilherme Alves

2025 Wisconsin Large-Scale Herbicide Trials (Savings and Weed Mortality)

John Deere See & Spray Premium (120 ft boom)





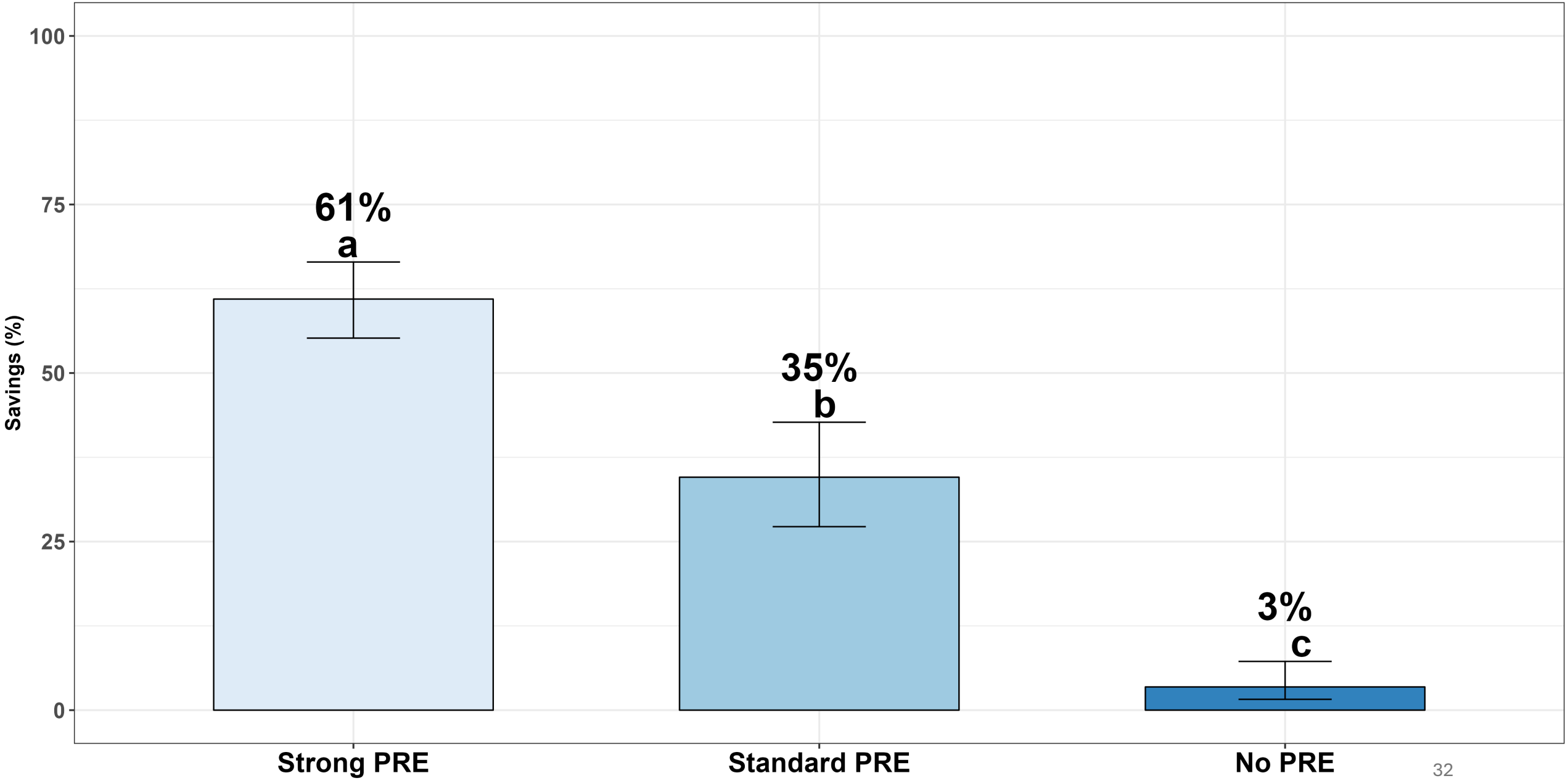
Bars with similar letters, within crop, do not differ from each other using Tukey's test at α = 0.05.

5 corn fields (53 acres)
6 soybean fields (51 acres)

2025 WiscWeeds research led by Dr. Guilherme Alves

Coarse droplets
16.5 GPA; 10 mph

Effect of PRE Herbicide on POST Herbicide Savings - Brookyln, WI
Corn

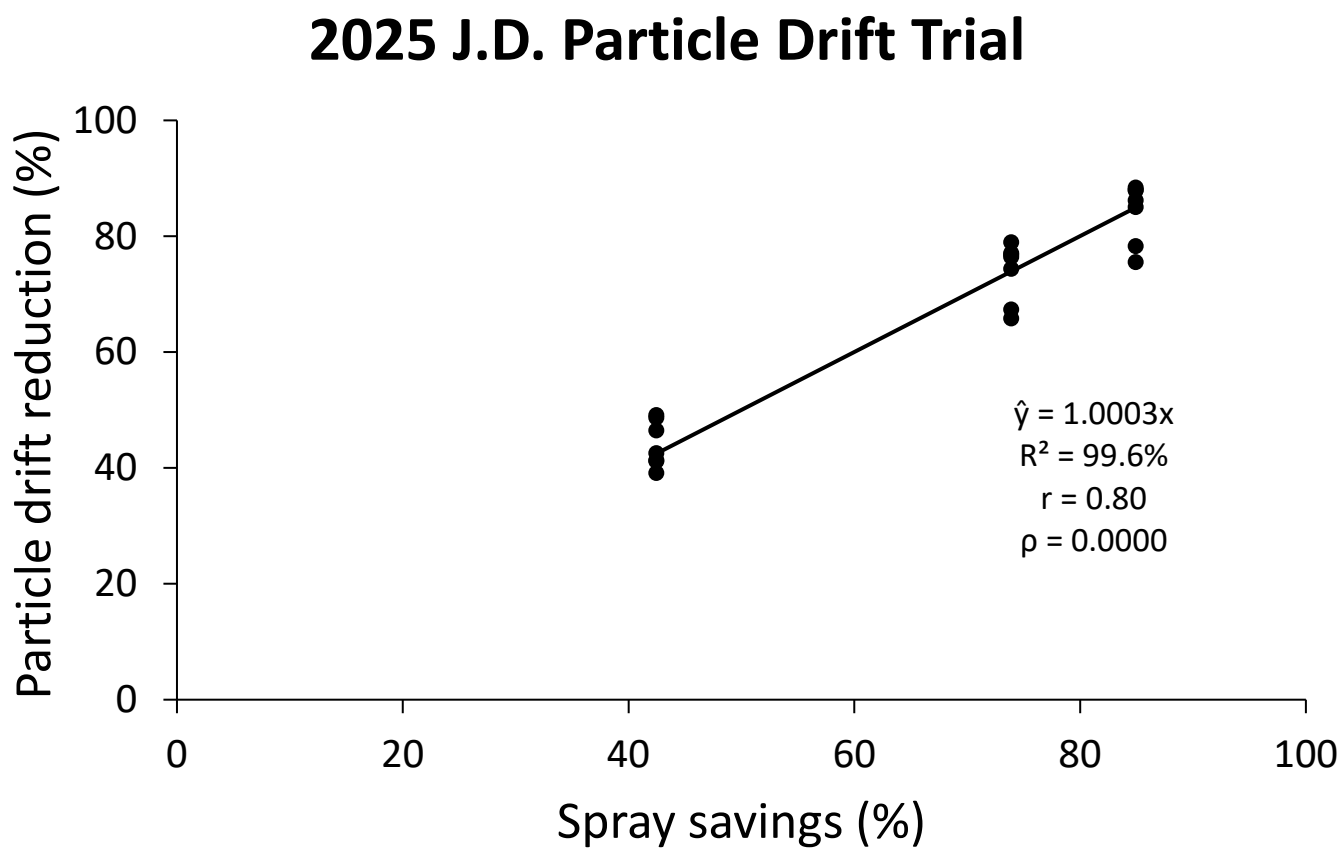


2025 research led by WiscWeeds PhD student Zaim Ugljic using ONE Smart Spray Technology

2025 Particle Drift Trial (Off-Target Movement)

Pearson's Correlation

Drift reduction vs Spray savings

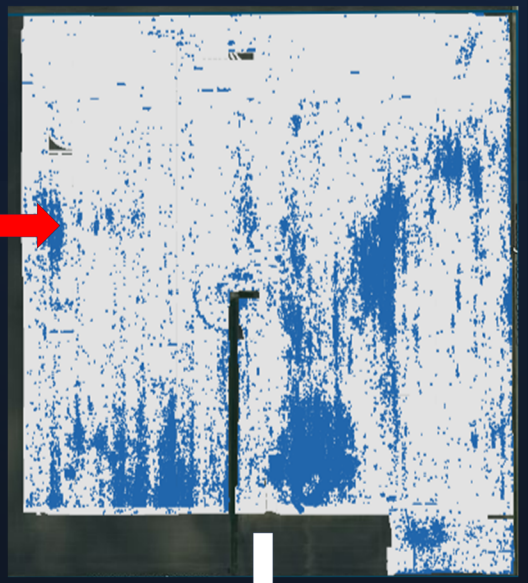


Targeted Herbicide Applications
Novel Spot Spraying Technologies

Zaim Ugljic, PhD Student, and Rodrigo Werle, Associate Professor, UW-Madison
Kalvin Miller, Field Engineer, BASF

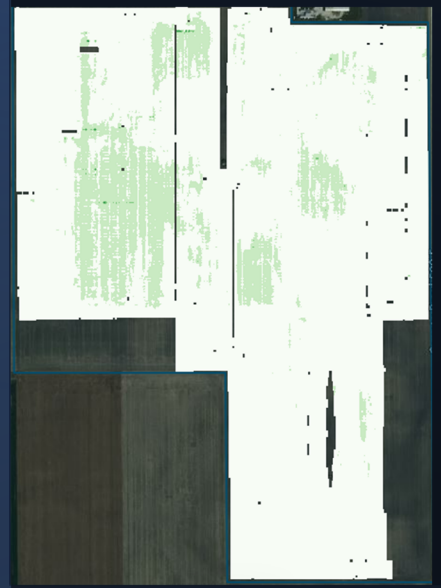
AS APPLIED MAPS

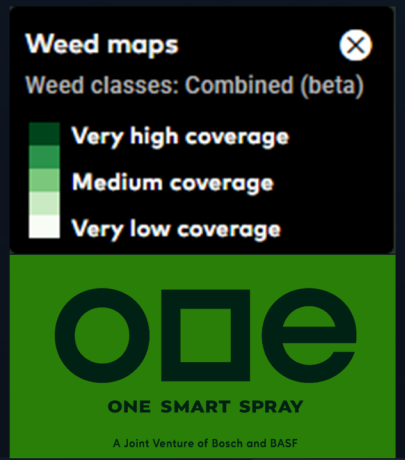
AREA: 124.7 ac
AREA SPRAYED: 18.3 ac
SAVINGS: 85.4%

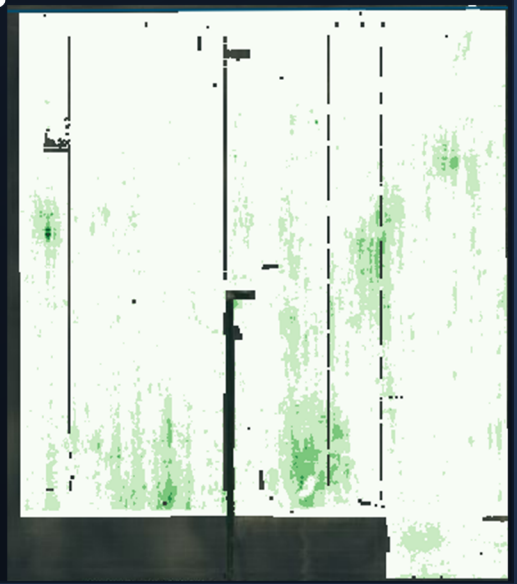


AREA: 153.5 ac
AREA SPRAYED: 74.4 ac
SAVINGS: 51.5%

WEED INFESTATION MAPS







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Main Takeaways: WiscWeeds Targeted Herbicide Application Research

🔑 **GET THE BASICS RIGHT FIRST:** Agronomy, weed management, and herbicide application fundamentals remain critical

💧 **SPRAY QUALITY MATTERS:** Dynamic systems that can potentially deliver lower quality compared to traditional broadcast spraying

⚙️ **TECHNOLOGY SETUP IS KEY:** Sensitivity, nozzle choice, boom height + stability drive success, etc.

🌱 **LIMITATIONS EXIST:** In-row weeds and/or very small weeds between rows may be missed

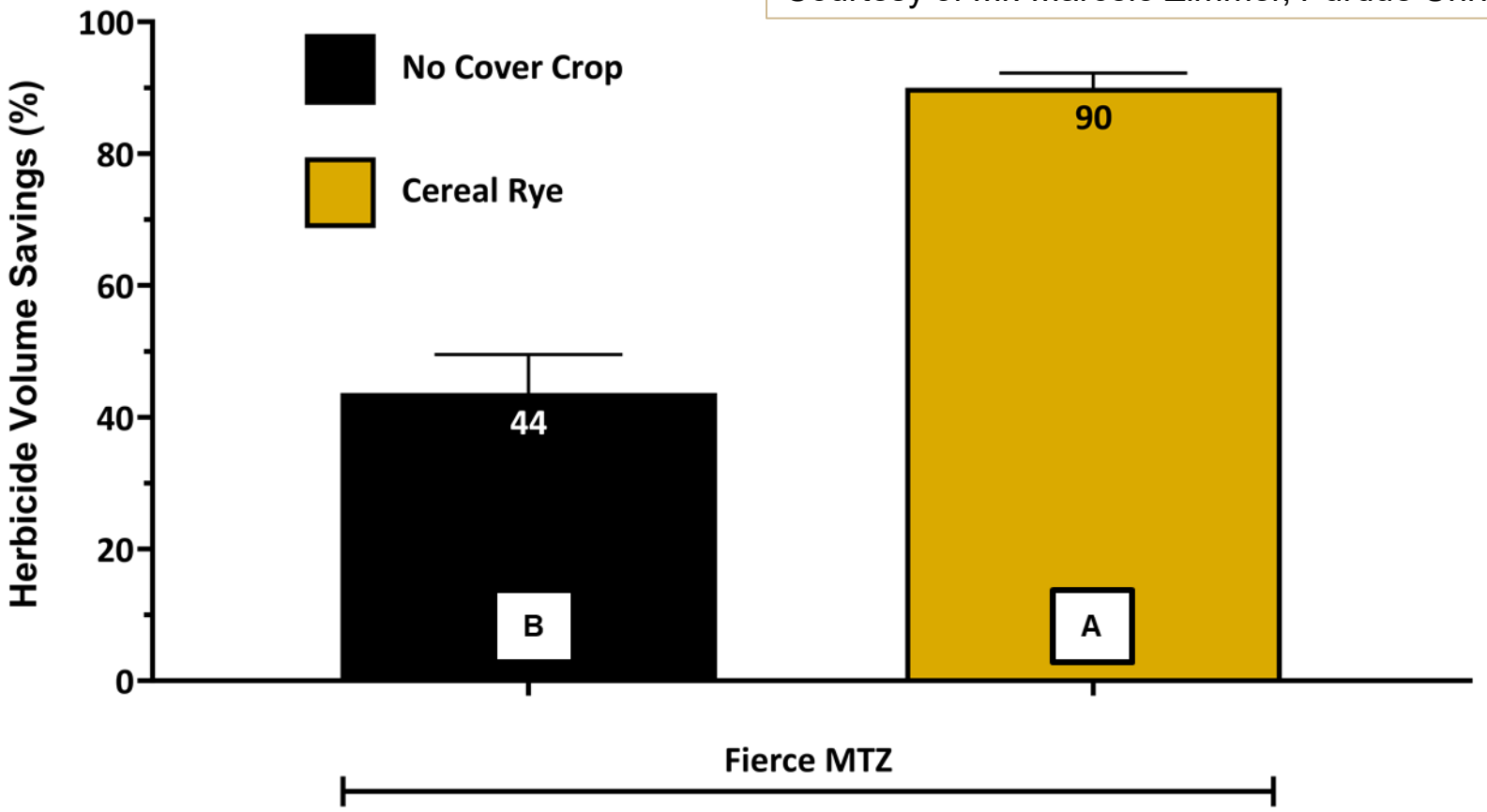
📉 **GREATEST BENEFITS UNDER LOW WEED PRESSURE/DENSITY AND YOUNG UNIFORM CROP CANOPY:** Higher savings potential

🔄 **BEYOND HERBICIDE SAVINGS:** An opportunity to revisit and reinvent chemical weed control approaches; opportunity for crop monitoring and weed mapping

🌾 **WEED MANAGEMENT IS MORE COMPLEX THAN EVER:** Integrated strategies remain essential

Herbicide Spray Volume Reduction at POST (%)

Courtesy of Mr. Marcelo Zimmer, Purdue University



Disclaimer: Treatments applied with John Deere See & Spray Ultimate using experimental methods. Specific application methods and herbicide treatments may not be supported commercially. Read and follow all pesticide labels.

Thank you!

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@WiscWeeds
WiscWeeds.info

YouTube

UW-Mad About Weeds