WiscWeeds.Info

Reflecting on a Half-Decade of Farmer-Driven Integrated Weed Management Research in Wisconsin

Rodrigo Werle, PhD
Assistant Professor, Extension-Funded Campus-Based, Cropping Systems Weed Scientist

25th Annual Wild World of Weeds Workshop
January 17, 2023

The annual Wild World of Weeds Workshop will be held in person at the FargoDome on January 17, 2023. We are excited to be hosting this event in-person again this year. This full day event will provide updates on weed control and herbicide research conducted by NDSU faculty. Agenda is in development. The workshop will offer up to seven (7) pest management CEU credits for continued Certified Crop Advisor training.

The workshop is open to all, but we prefer that participants pre-register and pre-pay. Early-bird registration fee is $100 through January 9, 2023 and $140 from January 10, 2023 to January 17, 2023. Walk-in pricing is $140. We ask that attendees please register by January 12, 2023 to allow adequate time for arrangements to be made. The registration fee will cover a full lunch, morning and afternoon refreshments, and resource materials.

7:30 AM	**Registration & Posters on Display**
8:20 AM	**Opening Remarks – Joe Ikley**
8:30 AM	Tom Peters, Extension Sugarbeet Agronomist and Weed Control Specialist
9:00 AM	Greta Gramig, Nonchemical Weed Control
9:15 AM	Mike Ostlie, Director, Carrington R&E Center
9:30 AM	Kirk Howatt, Annual Weed Control in Small Grains and Row Crops
10:00 AM	**Break – 2nd Floor Hallway**
10:20 AM	Charlie Lim, Extension Weed Specialist, Williston R&E Center
10:40 AM	Greg Endres, Extension Crop Specialist, Carrington R&E Center
11:00 AM	Rodrigo Werle, University of Wisconsin, Keynote Address
11:45 PM	**Lunch – Lower Atrium**
1:00 PM	Brian Jenks, Research Weed Scientist, North Central R&E Center
1:30 PM	Caleb Dalley, Weed Control Research, Hettinger R&E Center
1:50 PM	Harlene Hatterman-Valenti, High Value Crop Production
2:10 PM	Mike Christoffers, Weed Genetics
2:30 PM	Andrew Thostenson and Bridgette Readel, Pesticide Program Coordinator and Corteva Agrisciences
3:00 PM	**Break – 2nd Floor Hallway**
3:20 PM	Quincy Law, Noxious Weed Control
3:50 PM	Joe Ikley, Extension Weed Control Specialist
4:20 PM	**Adjourn**

NDSU NORTH DAKOTA STATE UNIVERSITY

NDSU WEED SCIENCE

NDSU › NDSU Weed Science › Wild World of Weeds Workshop

ACKNOWLEDGEMENTS

Extension
UNIVERSITY OF WISCONSIN-MADISON

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Growing the future

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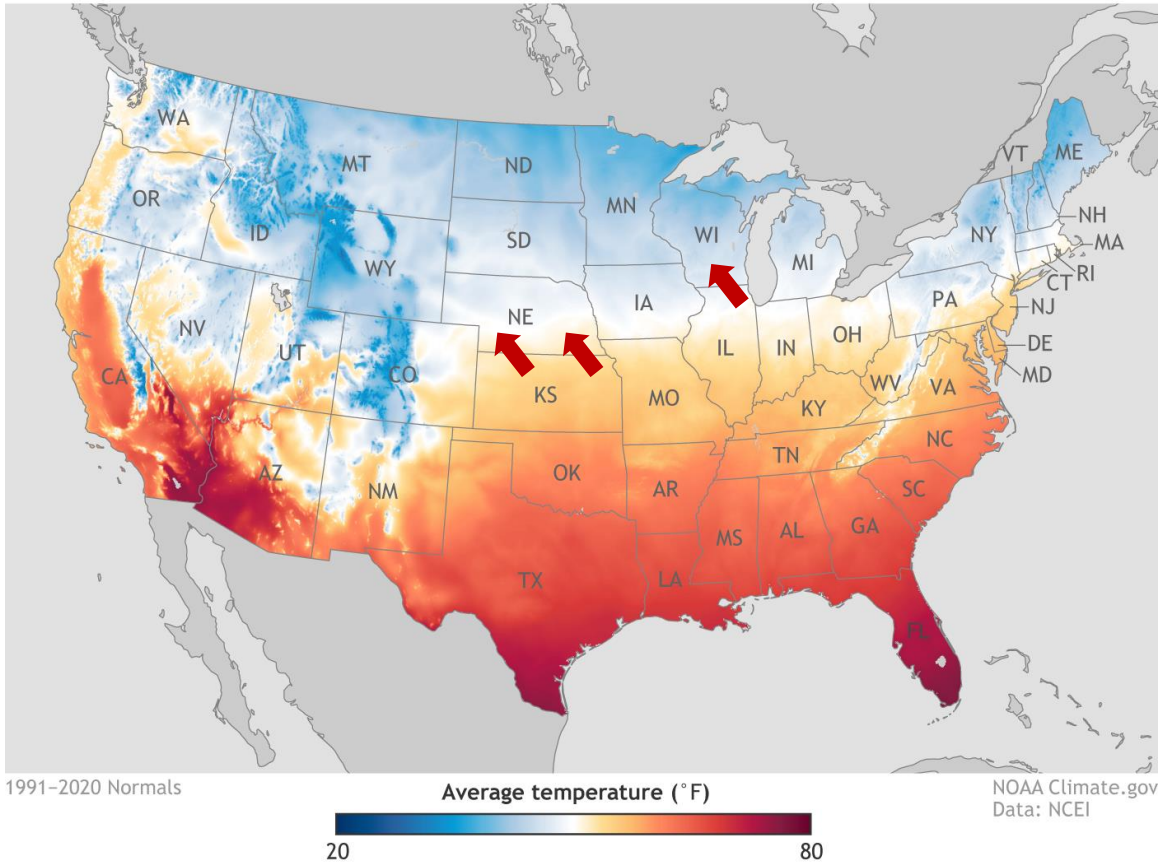
WiscWeeds
Research Coalition

Tentative Outline (Let's have a conversation…)

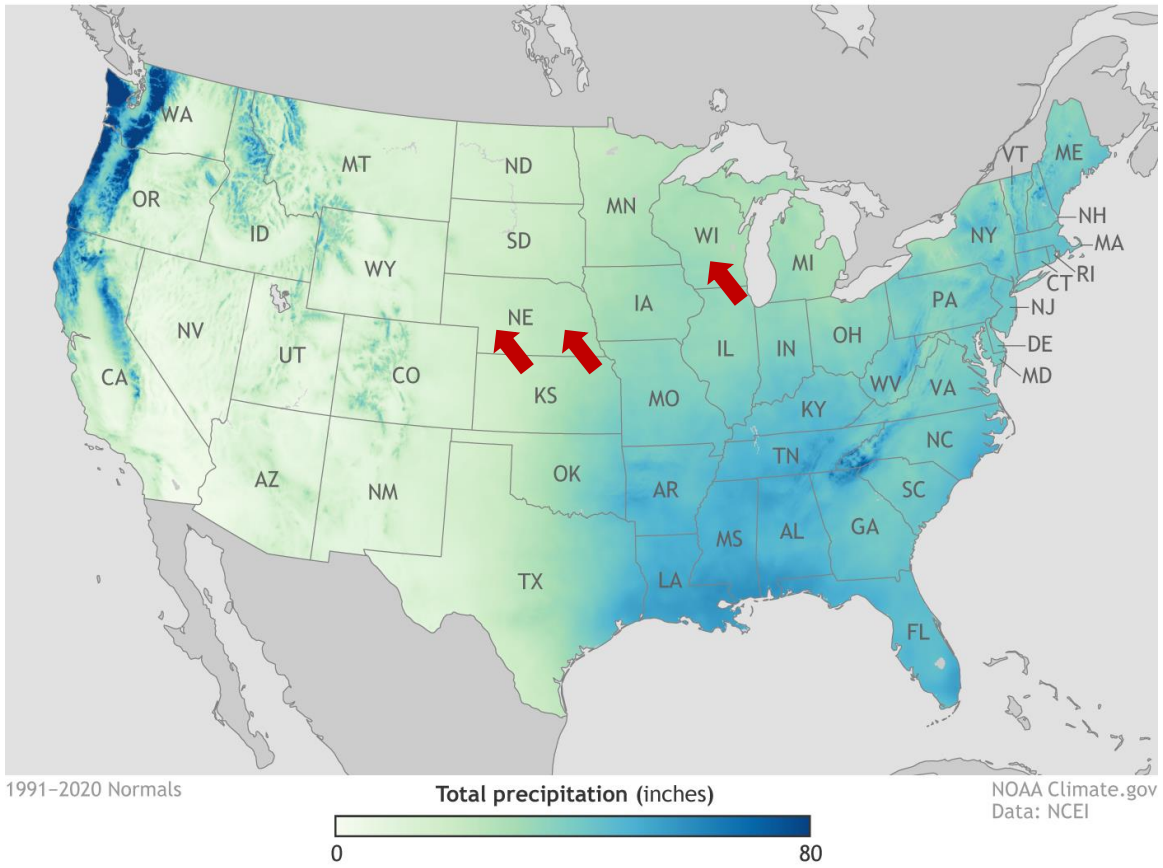
- **Waterhemp** (& giant ragweed) management in Wisconsin **soybean** (& corn)
- Cover crops: **planting soybean green** for Integrated Weed Management (IWM)

Annual Precipitation & GDD Accumulation

U.S. annual average temperature and precipitation (1991–2020)



U.S. annual average temperature and precipitation (1991–2020)

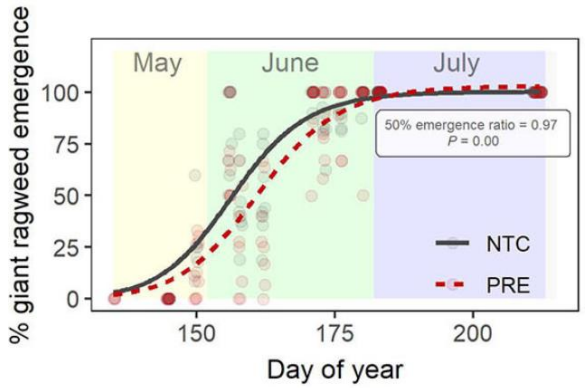


https://www.climate.gov/news-features/featured-images/new-maps-annual-average-temperature-and-precipitation-us-climate

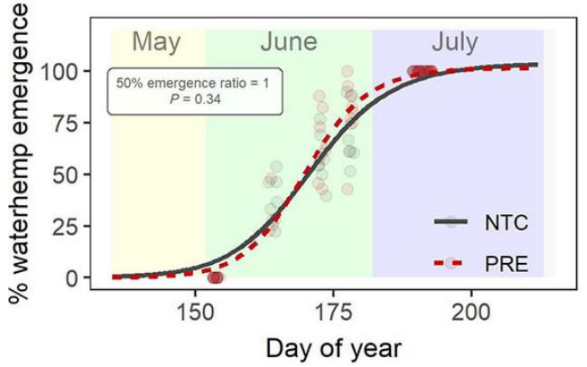
Climate.gov
SCIENCE & INFORMATION FOR A CLIMATE-SMART NATION

Most Troublesome Weed Species in Wisconsin Corn-Soybean Production

Giant ragweed (2018-2019)



Waterhemp (2019)



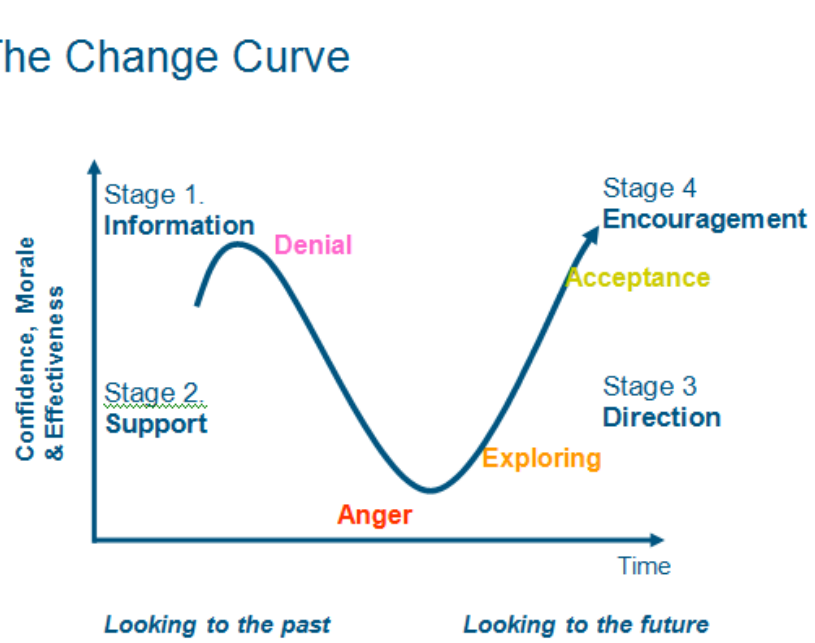
Striegel et al. 2021; Faleco et al. 2022

Herbicide resistance:

- Giant ragweed: groups 2, 9, **14, & 27**
- Waterhemp: groups 2, **4**, **5**, 9, **14**, & **27**

Wisconsin, 2018: Waterhemp?!

WE GOT NO WATERHEMP!



https://www.educational-business-articles.com/change-curve/

Arlington, WI →
(no waterhemp)

Lancaster, WI →
(yes waterhemp)

Wisconsin Combine Clinic Workshop – Weed Seed Movement

Extension
UNIVERSITY OF WISCONSIN–MADISON

Weed Seed Movement via Combines: 2019-2020 Case Study

Authors: Nicholas J. Arneson, Cropping Systems Weed Science Outreach Specialist; Daniel H. Smith, Southwest Regional Outreach Specialist, Nutrient and Pest Management Program; and Rodrigo Werle, Assistant Professor and Extension Cropping Systems Weed Scientist, University of Wisconsin-Madison

Acknowledgments: The authors would like to thank the UW-Madison Extension county educators and stakeholders who participated in this effort for their time taken in collecting and submitting samples and the members of the Cropping Systems Weed Science Lab for their technical assistance. We would also like to thank Mimi Broeske, NPM Program, for layout of the publication and Carl Duley, Buffalo County Educator for his review.

TAKE HOME POINTS

- ✓ Weed seeds replenish the soil seedbank and increase opportunity for herbicide resistance. **Do not let weeds go to seed. No Seed, No Weed!**
- ✓ The part of the combine with the highest number of weed seed was the header, followed by the feeder house, rock trap and rotor.
- ✓ Most frequently observed weeds were grasses, pigweeds & lambsquarters.

Weed Seeds in Wisconsin

Several of the common weeds (e.g., pigweeds, ragweeds, common lambsquarters) that Wisconsin grain crop farmers manage can retain their seed well into the time of harvest . When weeds are allowed to set seed, they replenish the soil seedbank creating potentially long-term problems for weed management.

How Do Weed Seeds Spread?

Weed seeds can be moved great distances by wildlife, particularly migratory waterfowl. Seeds can be introduced to new fields through feed, seed, bedding, and spreading of manure. Tillage and planting equipment can spread seeds from field to field through the movement of soil. Harvest equipment (combines) can be extremely effective at moving seed when weeds are left to set seed in crop fields; however, not much is known on where seeds will be deposited within a combine. Additionally, harvesting multiple crops with the same combine provides opportunities for the different crop residues to catch and remove weed seed from within the equipment.

Wisconsin Waterhemp Herbicide Resistance Screenings

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*	4

**use Enlist One at 32 fl oz/ac*

Weed Technology

www.cambridge.org/wet

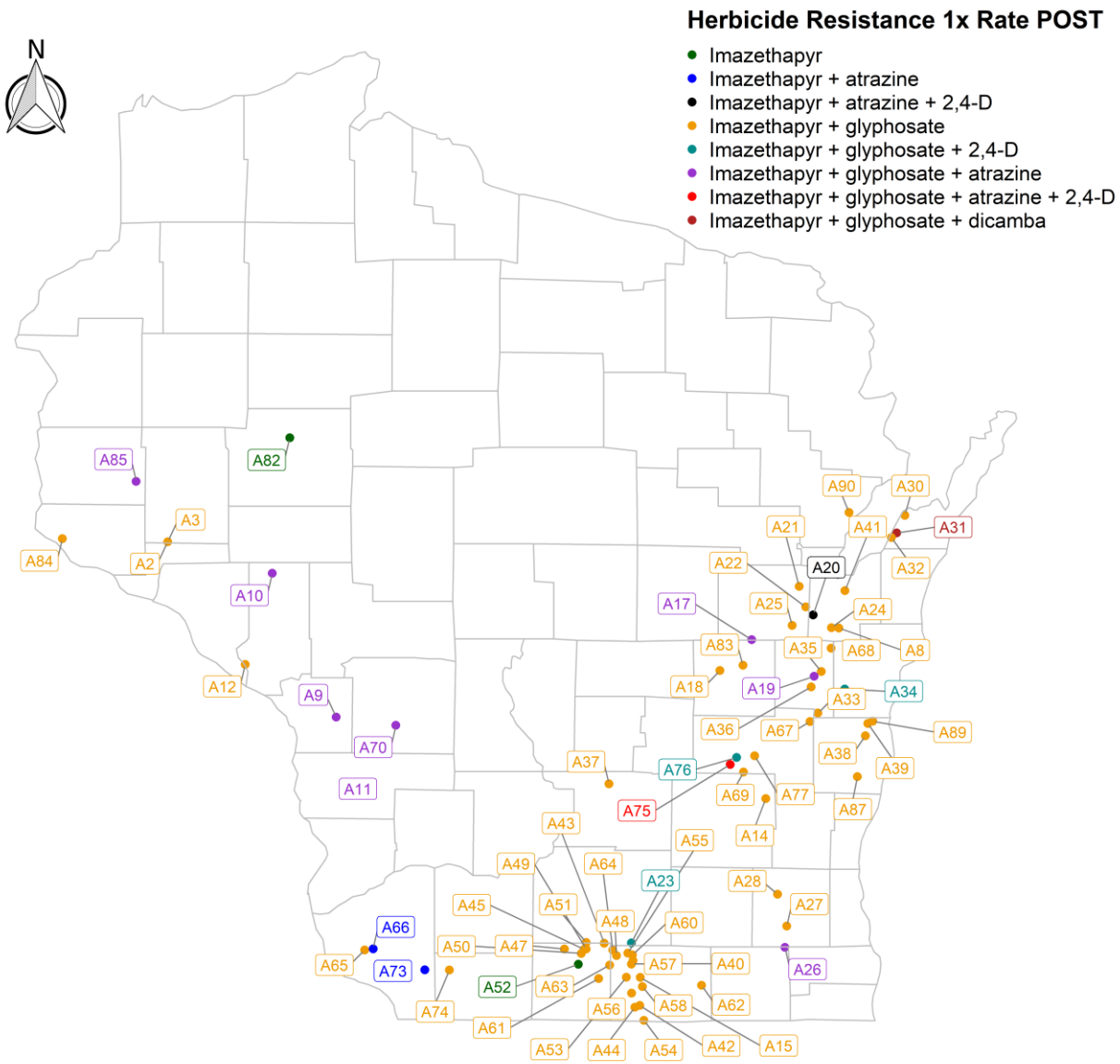
Research Article

Cite this article: Faleco FA, Oliveira MC, Arneson NJ, Renz M, Stoltenberg DE, Werle R (2022) Multiple herbicide resistance in waterhemp (*Amaranthus tuberculatus*) accessions from Wisconsin. Weed Technol. **36**: 597–608. doi: 10.1017/wet.2022.81

Multiple herbicide resistance in waterhemp (*Amaranthus tuberculatus*) accessions from Wisconsin

Felipe A. Faleco[1], Maxwel C. Oliveira[2], Nicholas J. Arneson[3], Mark Renz[4], David E. Stoltenberg[4] and Rodrigo Werle[5]

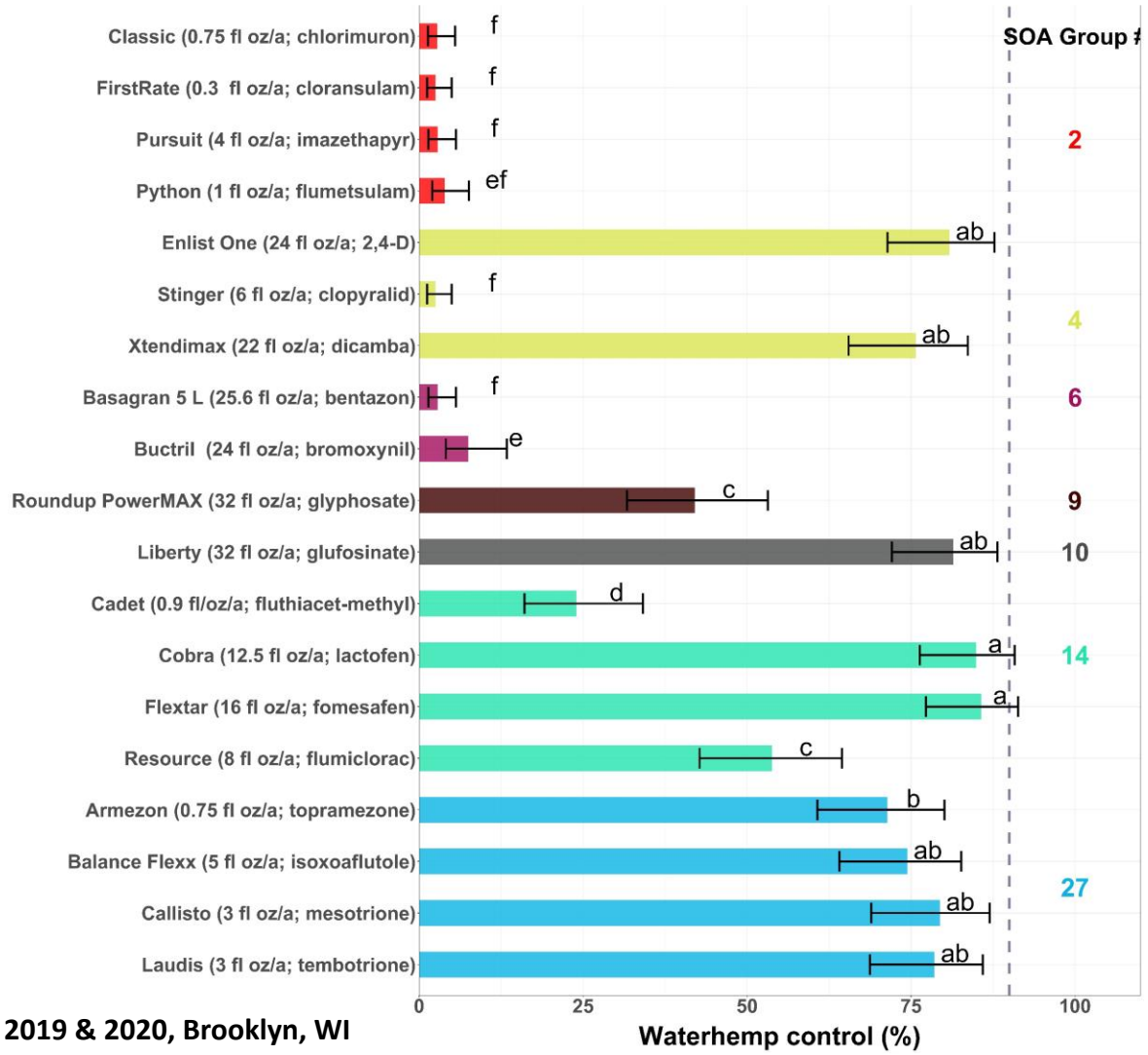
[1]Graduate Student, Department of Agronomy, University of Wisconsin-Madison, Madison, WI, USA; [2]Postdoctoral Researcher, Department of Agronomy, University of Wisconsin-Madison, Madison, WI, USA; [3]Outreach Program Manager, Department of Agronomy, University of Wisconsin-Madison, Madison, WI, USA; [4]Professor, Department of Agronomy, University of Wisconsin-Madison, Madison, WI, USA and [5]Assistant Professor, Department of Agronomy, University of Wisconsin-Madison, Madison, WI, USA



88 waterhemp accessions from 27 Wisconsin counties

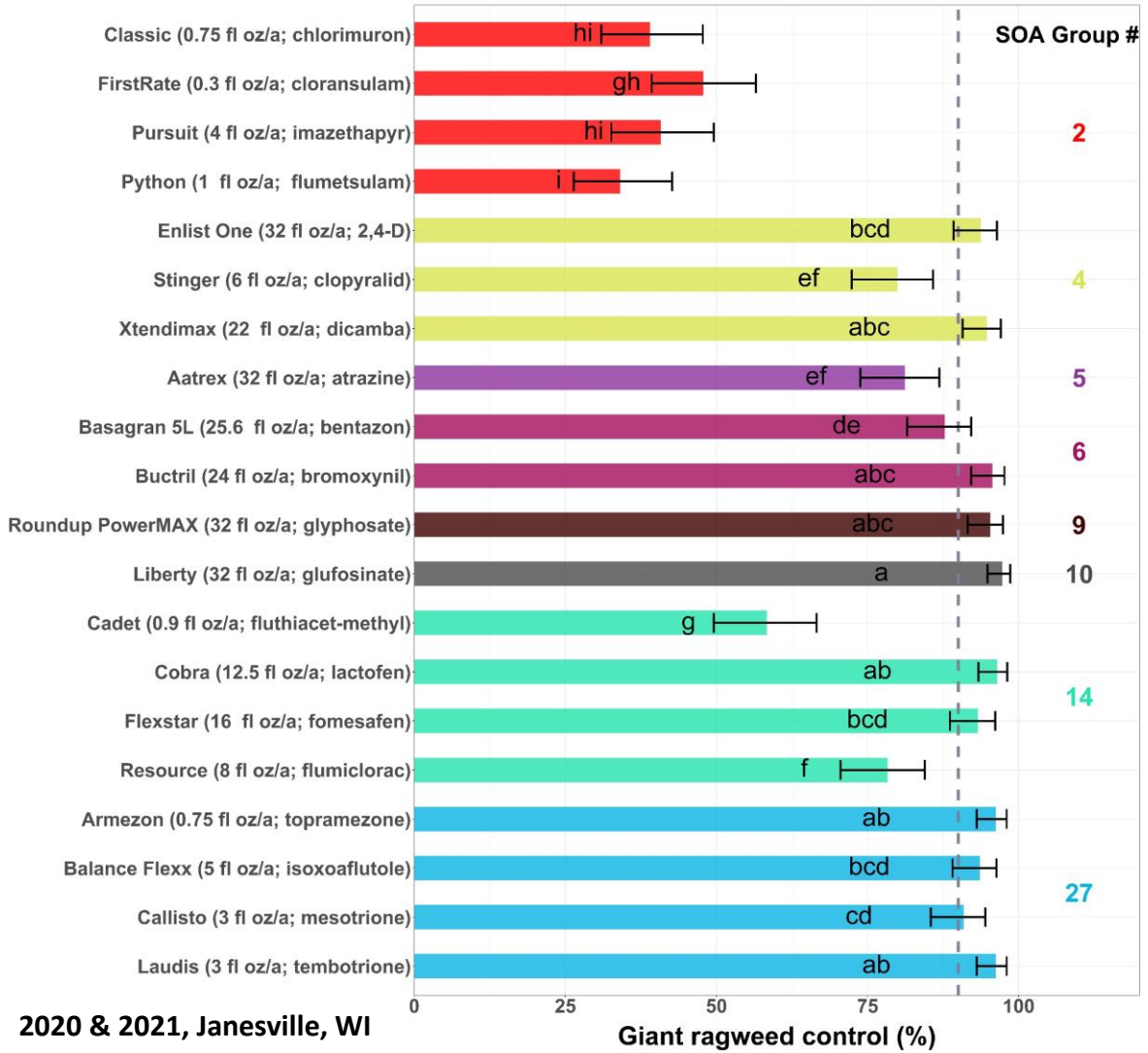
POST Foliar Control – Waterhemp & Giant Ragweed – 14 Days After Treatment

Waterhemp



2019 & 2020, Brooklyn, WI

Giant Ragweed



2020 & 2021, Janesville, WI

Figures by Dr. Ahmad Mobli; Werle, Mobli, et al *(In Press)*

Waterhemp Resistance to 2,4-D (Enlist One) POST

Rodrigo Werle @WiscWeeds · Aug 18

Growers & decision influencers in Enlist E3 #soybean system dealing with waterhemp and using Enlist One (2,4-D choline) herbicide for post-emergence weed control, how did Enlist One perform on #waterhemp this season in the fields you manage?

Thank you for participating!

Excellent control	14.7%
Good ctrl but few escapes	32.1%
Poor control	14.7%
Show results	**38.5%**

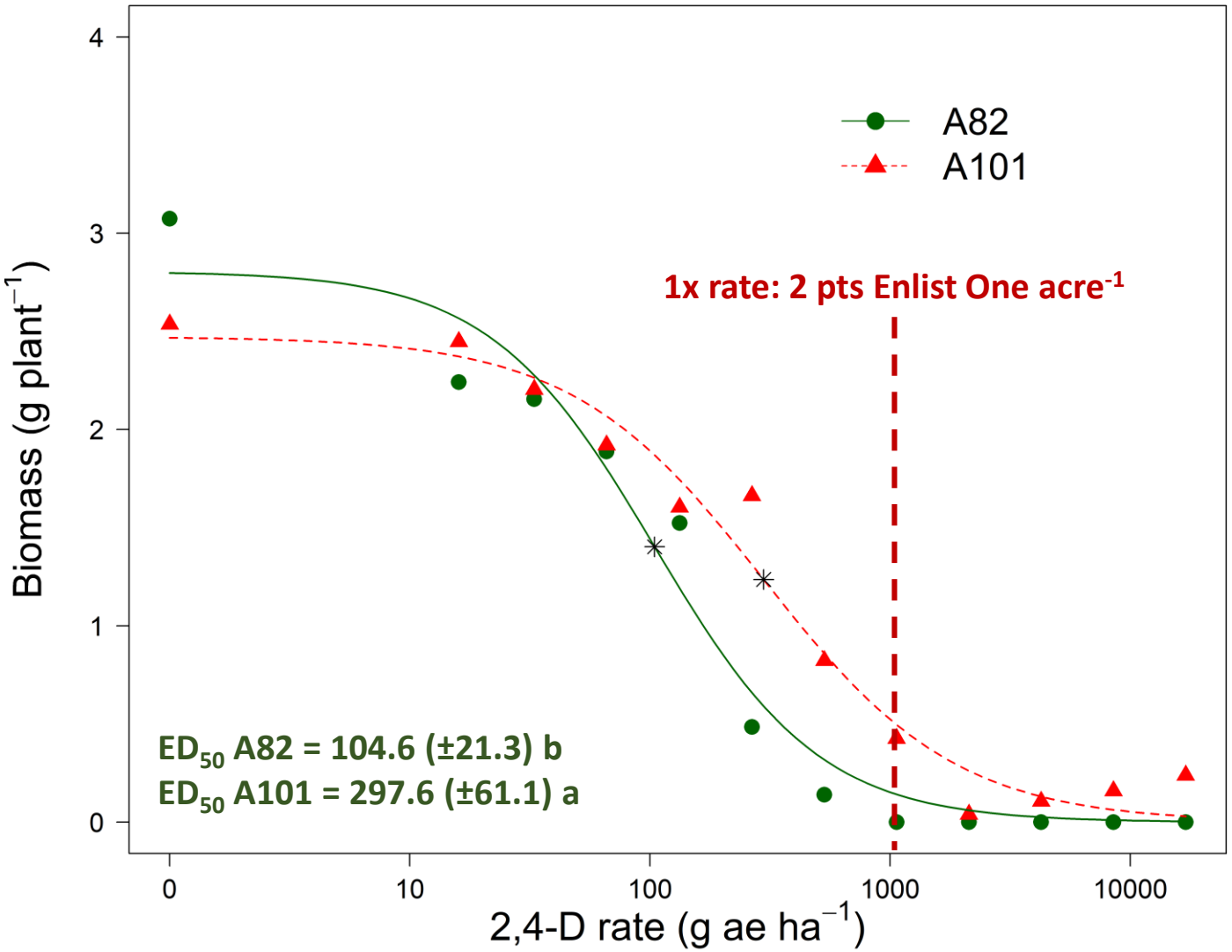
109 votes · Final results

7 4

What is going on?

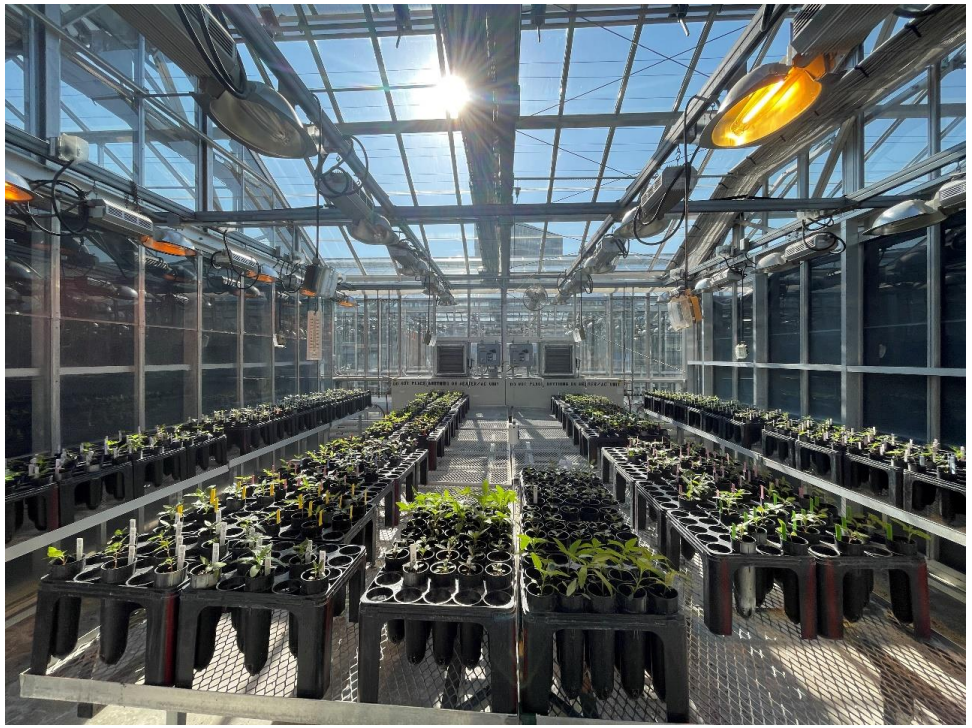
- 2,4-D resistance?
- Environmental conditions?

Waterhemp Resistance to 2,4-D (Enlist One) POST



Enlist One (2,4-D choline) Dose Response:

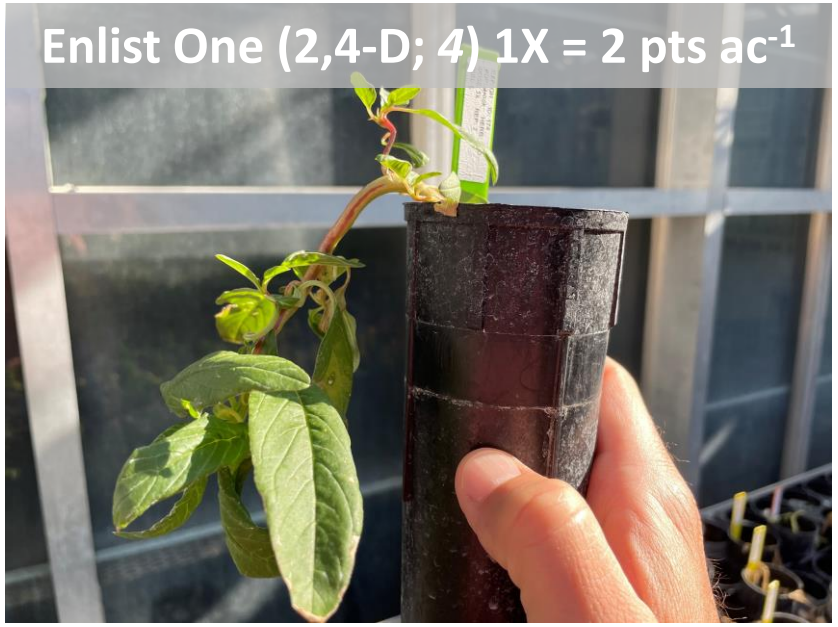
- A82: known susceptible; WI
- A101: suspected resistant; Brooklyn WI



Research by Felipe Faleco, PhD Student, UW-Madison WiscWeeds Program
Waterhemp plants were 3-4" in height at application time
Data collected 21 days after treatment

Waterhemp Resistance to 2,4-D (Enlist One) POST

Enlist One (2,4-D; *4*) 1X = 2 pts ac^{-1}



Enlist One (2,4-D; *4*) 2X = 4 pts ac^{-1}

Enlist One (2,4-D; *4*) 1X = 2 pts ac^{-1}

Enlist One (2,4-D; *4*) 16X = 32 pts ac^{-1}

What is going on?

- This population was not previously exposed to 2,4-D
- Metabolic resistance

Research by Felipe Faleco, PhD Student, UW-Madison WiscWeeds Program
Waterhemp plants were 3-4" in height at application time
Pictures taken ~14 days after treatment

Good Read on Metabolic Herbicide Resistance:

Integrated Pest and Crop Management
News and Resources for Wisconsin Agriculture from the University of Wisconsin-Madison

Home | WCM news | Publications | Video | Apps | Cover crops | NPM | IPM

HOME / WCM NEWSLETTER / WEEDS / METABOLIC HERBICIDE RESISTANCE

Metabolic Herbicide Resistance

Posted on September 22, 2022

Is Metabolic Herbicide Resistance the Straw That Will Break Weed Management's Back?

Jed Colquhoun, UW-Madison, Extension Weed Scientist

https://fruit.wisc.edu/2022/09/07/is-metabolic-herbicide-resistance-the-straw-that-will-break-weed-managements-back/

Elevated Temperature – Waterhemp Response to 2,4-D (Enlist One)

Rodrigo Werle @WiscWeeds · Aug 18

Growers & decision influencers in Enlist E3 #soybean system dealing with waterhemp and using Enlist One (2,4-D choline) herbicide for post-emergence weed control, how did Enlist One perform on #waterhemp this season in the fields you manage?

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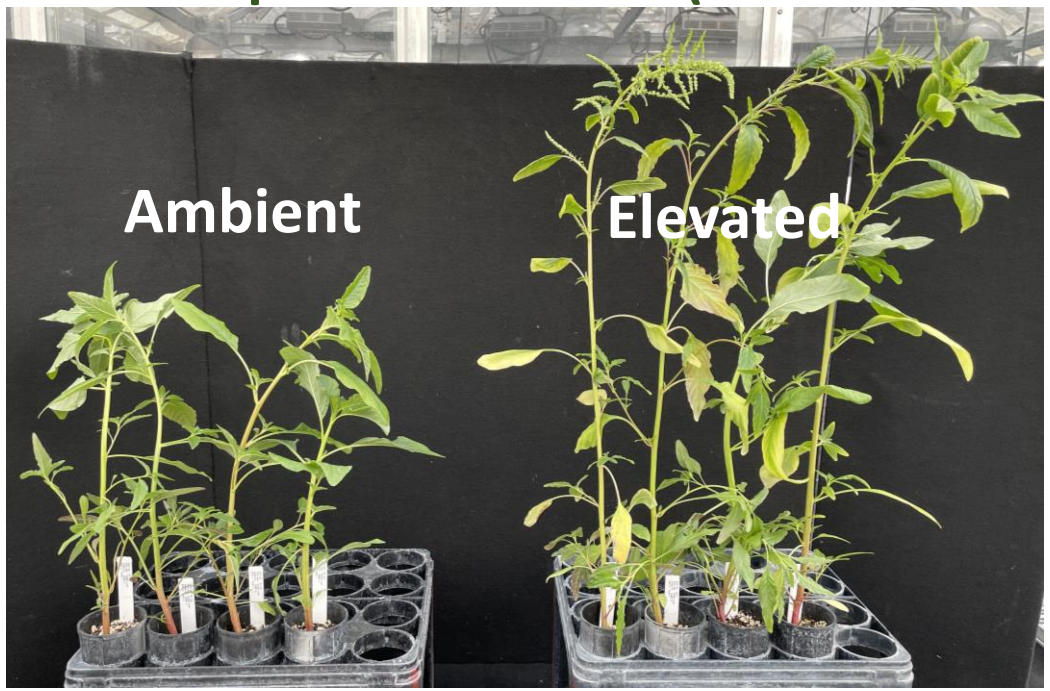
Waterhemp plants were 3-4" in height at application time
Pictures taken ~14 days after treatment

Elevated Temperature – Waterhemp Response to 2,4-D (Enlist One)

A82 susceptible accession (non-treated control plants [NTC]; 21 days after treatment [DAT]):



NTC A82 Accession 21 DAT	
	Biomass (±SE)
	g pot^{-1}
Elevated	5.7 (±0.2)a
Ambient	3.6 (±0.2)b

- **Elevated = 90 F (day)/66 F (night)**
- **Ambient = 81 F (day)/57 F (night)***

**(Avg. June temp in Dane County)*

Research by Felipe Faleco, PhD Student, UW-Madison WiscWeeds Program
Waterhemp plants were 3-4" in height at application time
Data collected 21 days after treatment

How Can We Help Our POST-Herbicides? Integrated Weed Management!

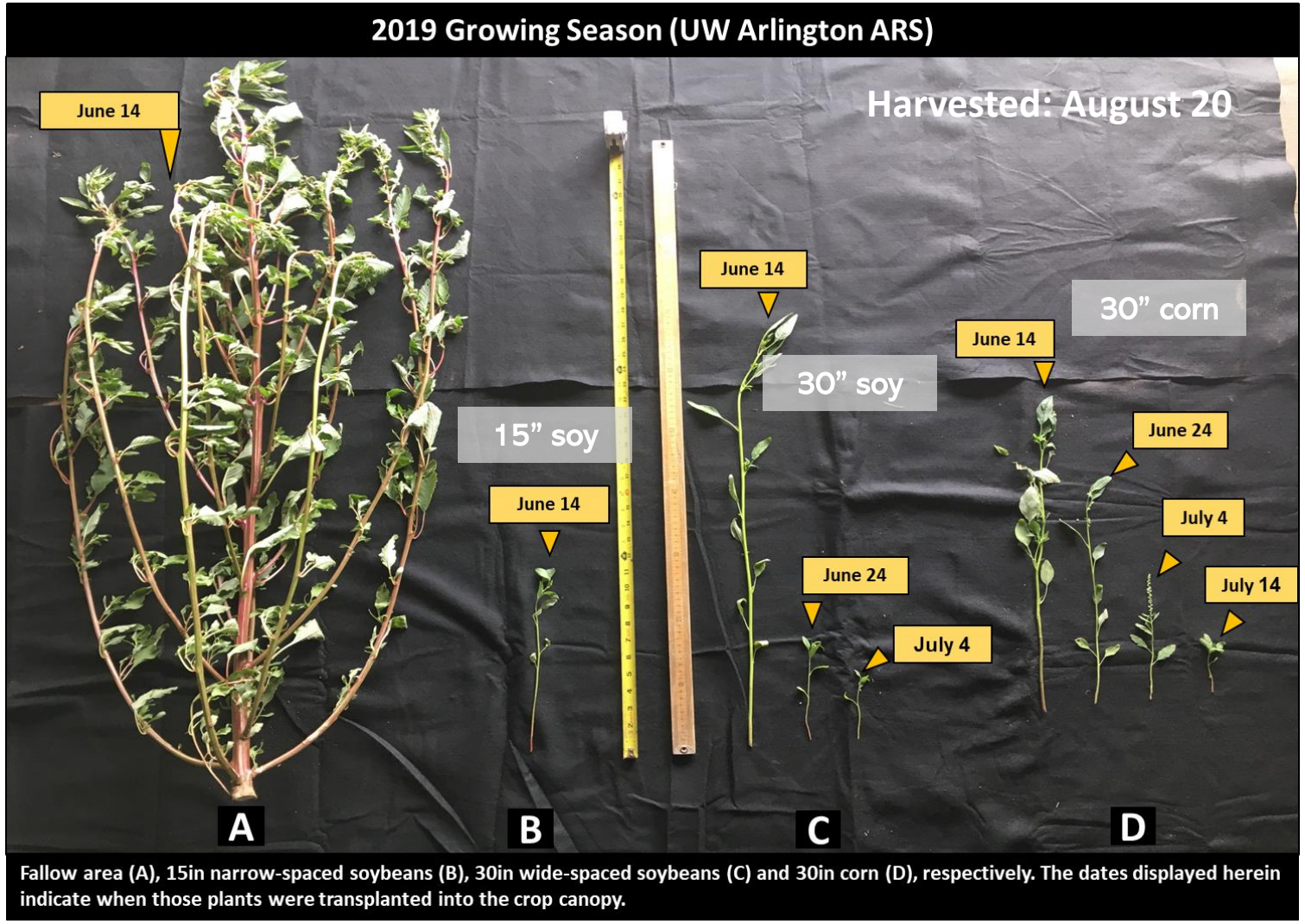
Planted: 05/22/20
140K seeds/acre

Picture: 07/02/20 (41 DAP)

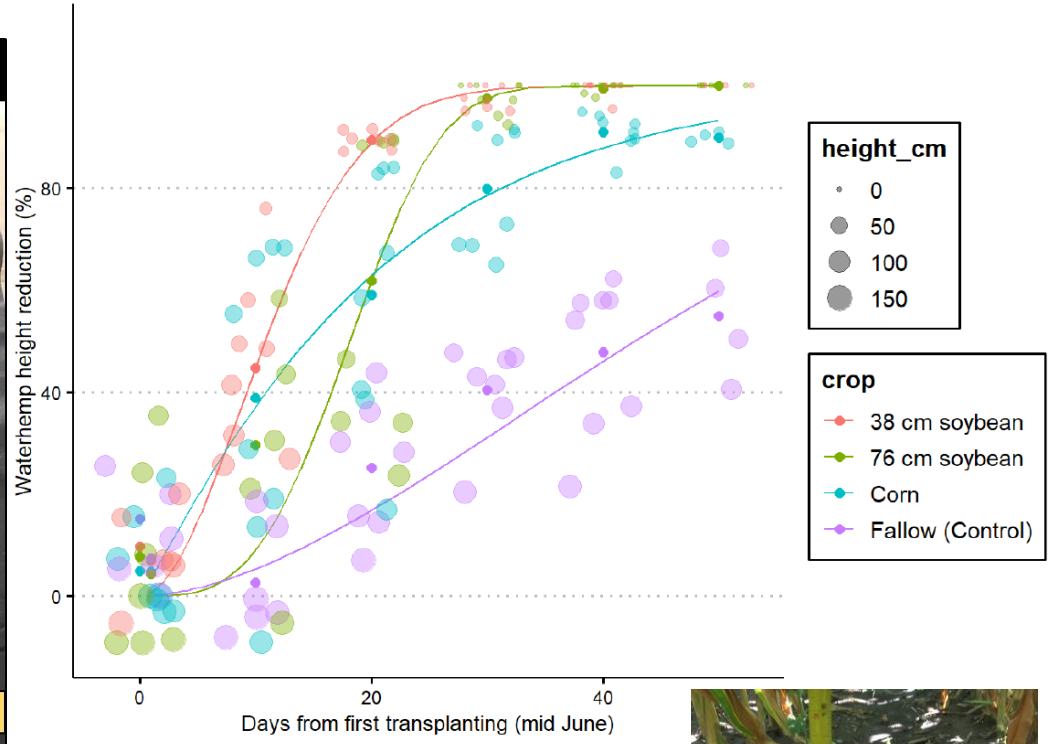

Weed Technology
www.cambridge.org/wet
Research Article
Influence of integrated agronomic and weed management practices on soybean canopy development and yield
Nikola Arsenijević[1], Ryan DeWerff[2], Shawn Conley[3], Matthew Ruark[4] and Rodrigo Werle[5]

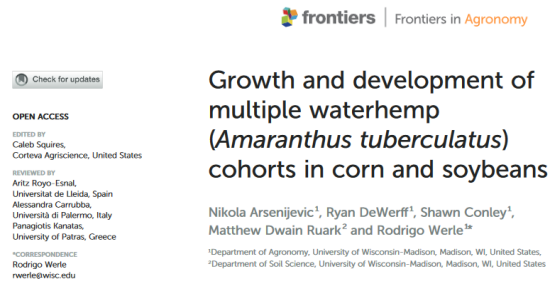
MS Research: Nikola Arsenijevic, UW-Madison WiscWeeds Program
Arsenijevic et al (2022)

Agronomic Practices - Integrated Weed Management



Fallow area (A), 15in narrow-spaced soybeans (B), 30in wide-spaced soybeans (C) and 30in corn (D), respectively. The dates displayed herein indicate when those plants were transplanted into the crop canopy.




frontiers | Frontiers in Agronomy

Check for updates

OPEN ACCESS

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Growth and development of multiple waterhemp (*Amaranthus tuberculatus*) cohorts in corn and soybeans

Nikola Arsenijevic[1], Ryan DeWerff[1], Shawn Conley[1], Matthew Dwain Ruark[2] and Rodrigo Werle[1]*

[1]Department of Agronomy, University of Wisconsin-Madison, Madison, WI, United States, [2]Department of Soil Science, University of Wisconsin-Madison, Madison, WI, United States

MS Research and Images: Nikola Arsenijevic, UW-Madison WiscWeeds Program
Arsenijevic et al (2022)

Start Clean and Stay Clean!
Effective PRE-Emergence Herbicide Program

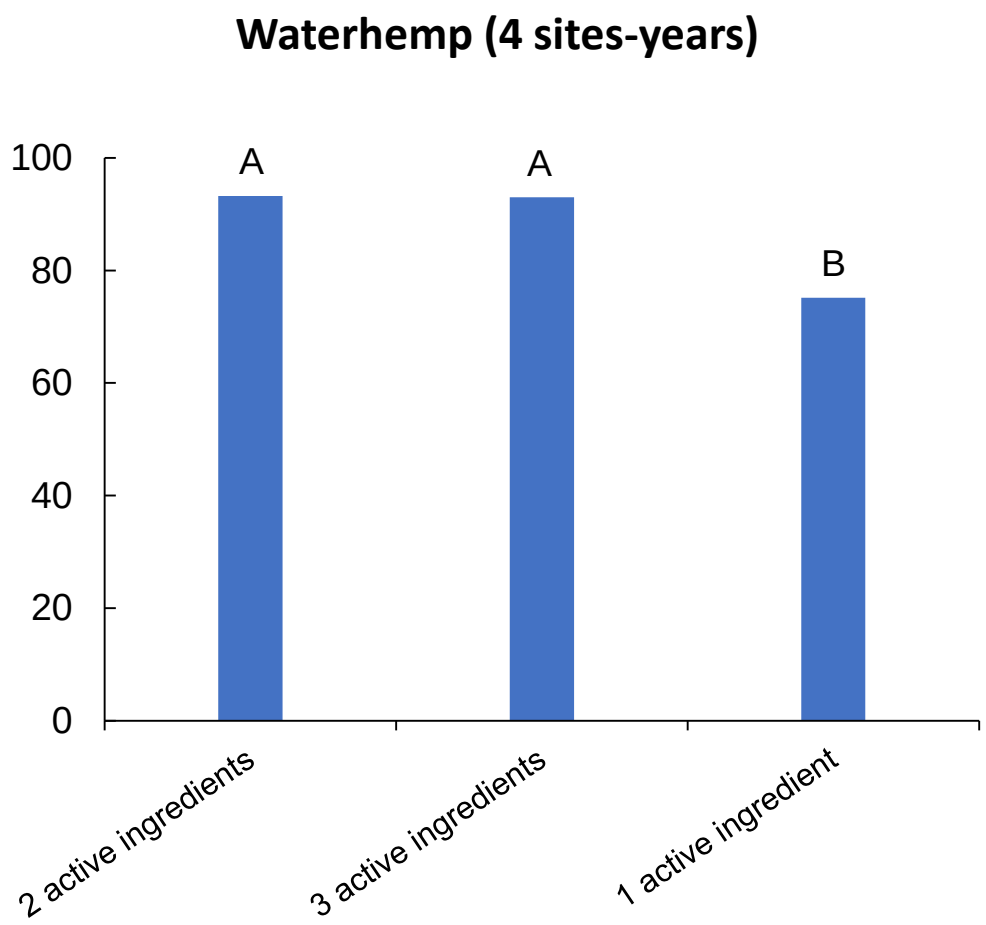
BENEFITS:

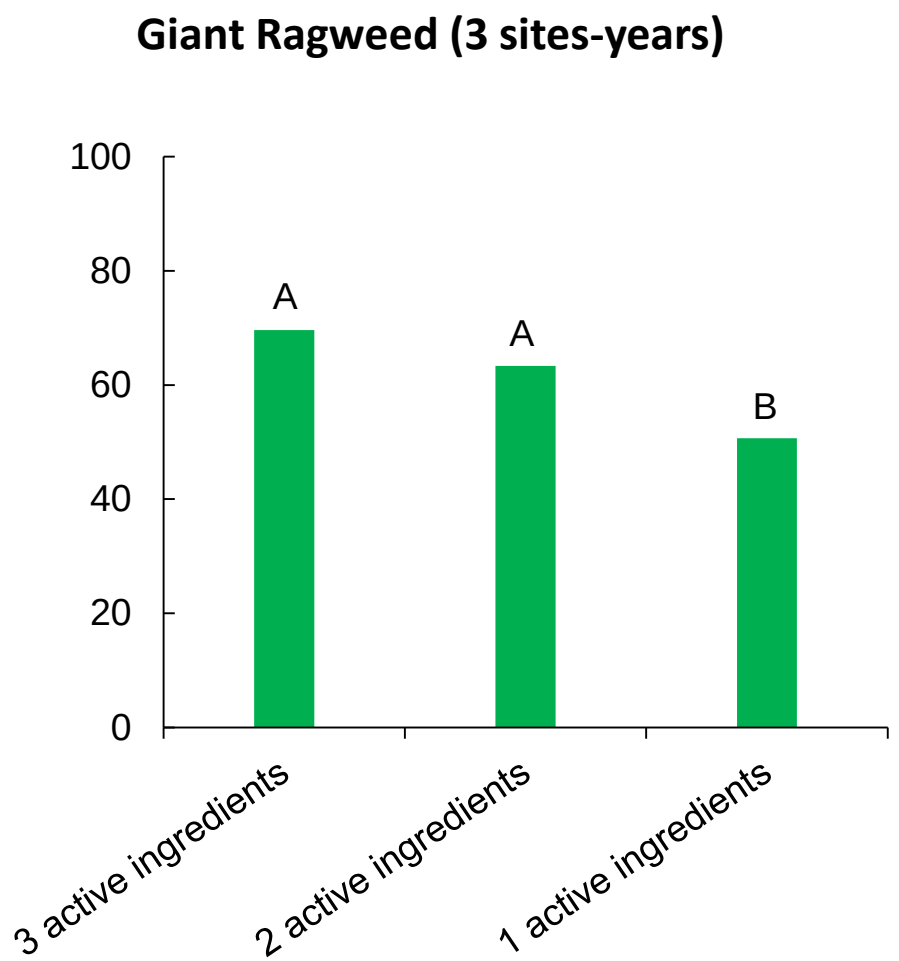
- Not dependent on HT trait
- Protects crop from early-season yield loss due to weed competition
- Buys time for a POST application
- Reduces weed density for POST control
- “Simpler” to spray

CONCERNS:

- Activation
- Crop response

How Many Sites of Action? PRE Residual Control 21 Days After Treatment



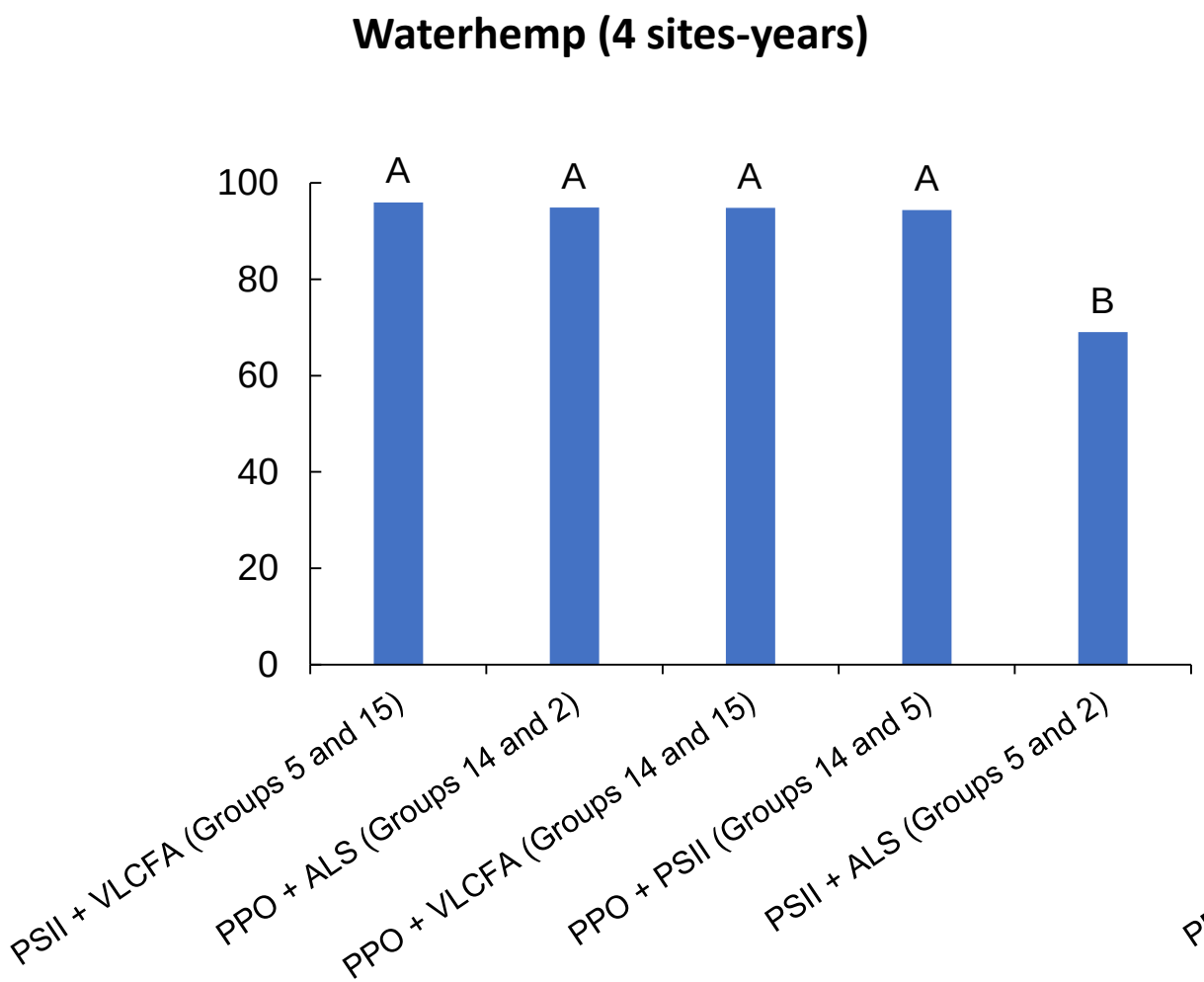


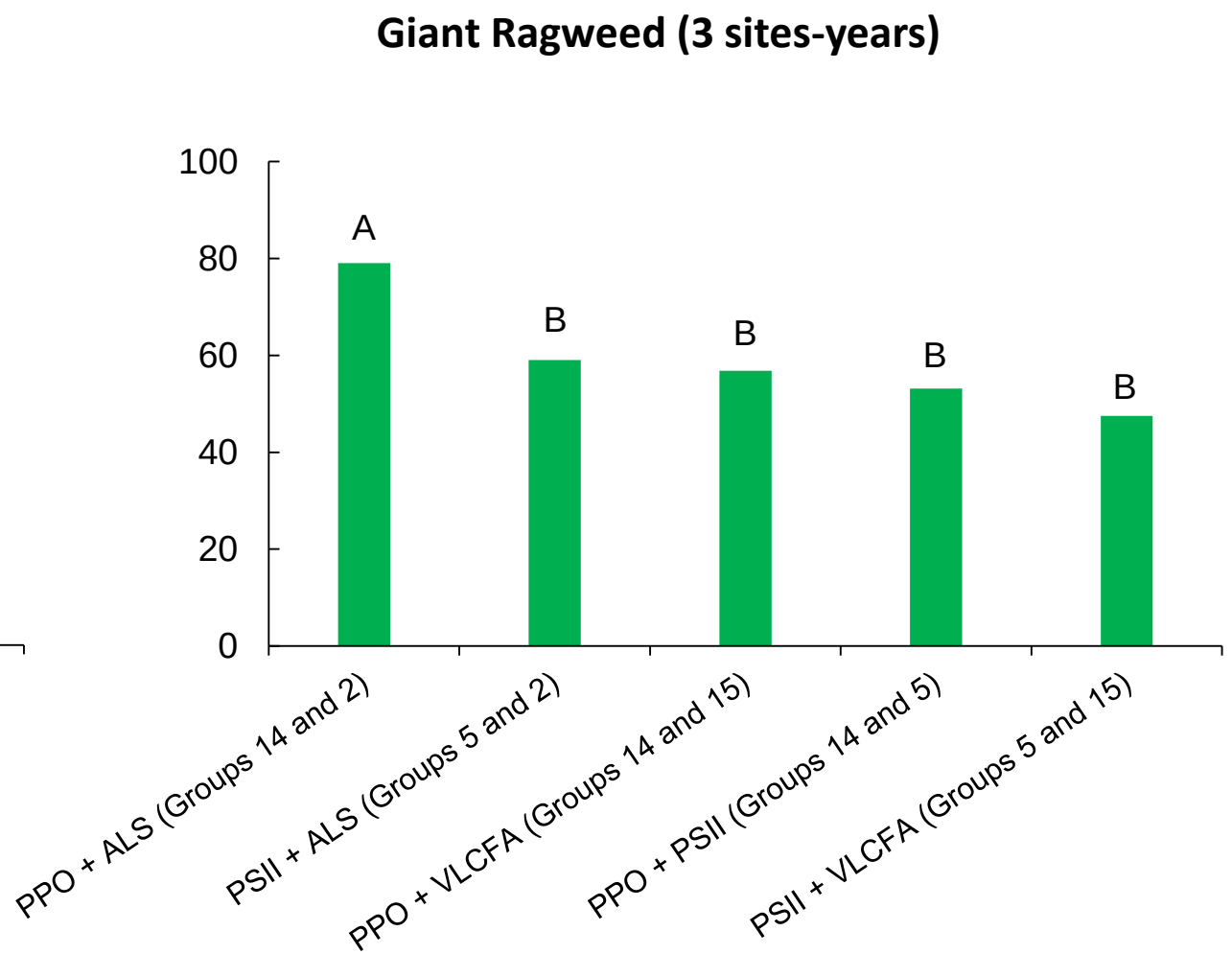
Figures by Dr. Vieira

Residual Control of Waterhemp with Pre-emergence Herbicides in Soybean

Nicholas J. Arneson, Daniel H. Smith, Ryan DeWerff, Maxwel Coura Oliveira, and Rodrigo Werle

Sites of Action Combination - PRE Residual Control 21 Days After Treatment





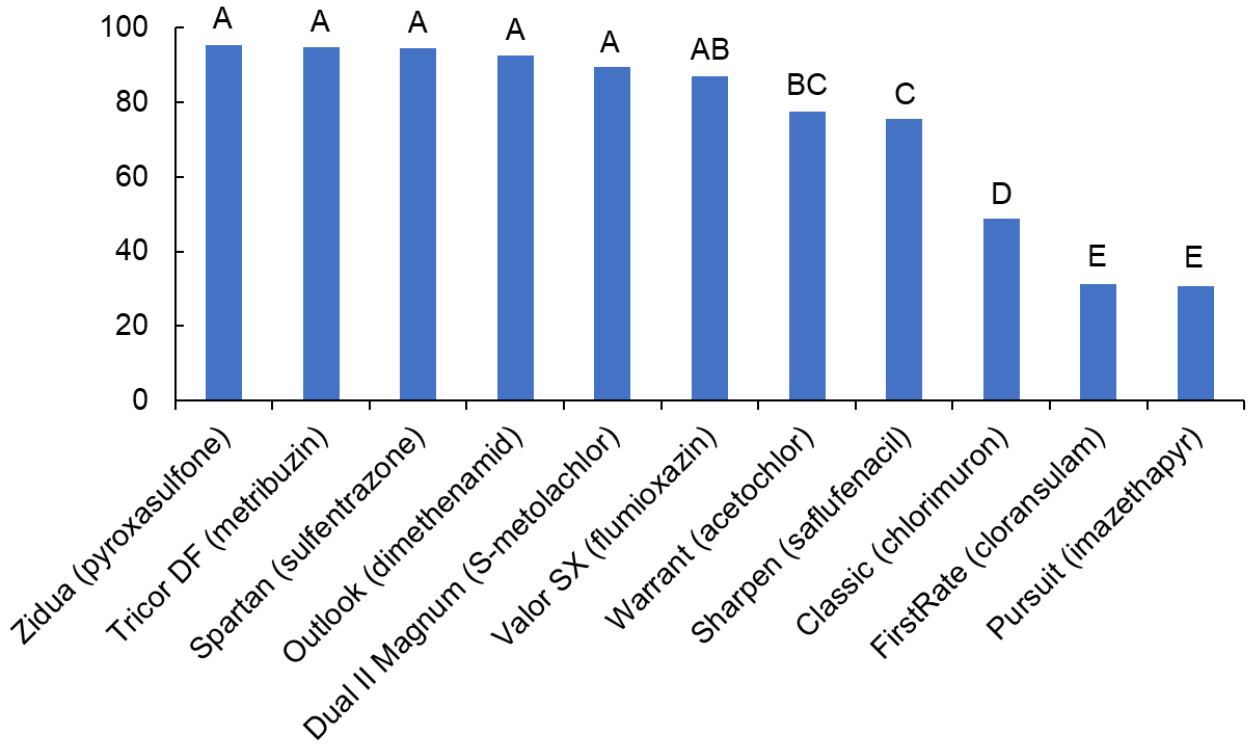
Figures by Dr. Vieira

Residual Control of Waterhemp with Pre-emergence Herbicides in Soybean

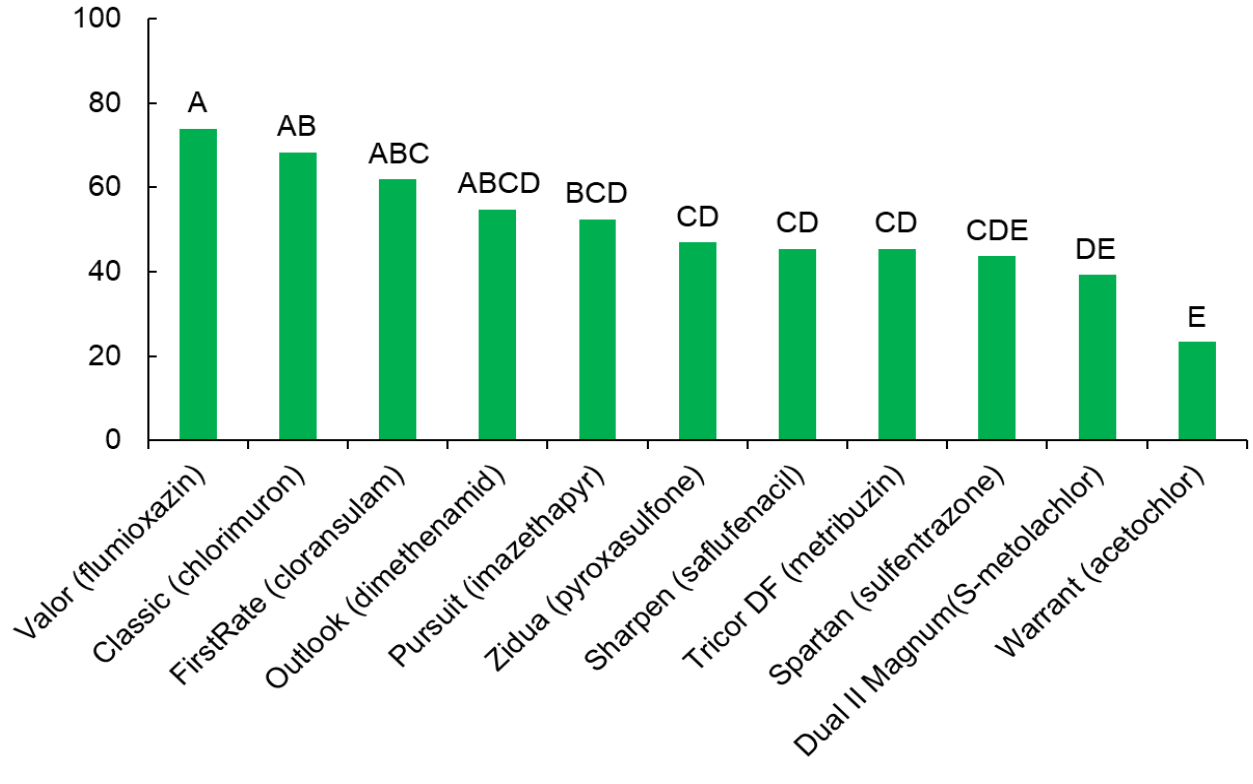
Nicholas J. Arneson, Daniel H. Smith, Ryan DeWerff, Maxwel Coura Oliveira, and Rodrigo Werle

Active Ingredient Comparison - PRE Residual Control 21 Days After Treatment

Waterhemp (4 sites-years)



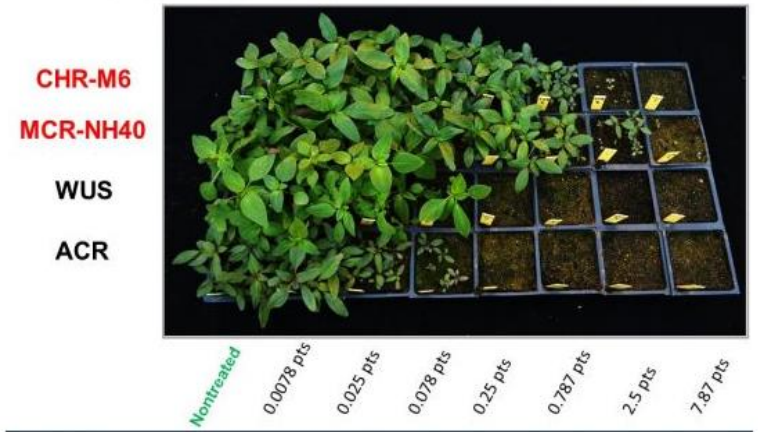
Giant Ragweed (3 sites-years)



Waterhemp Resistance to PRE-emergence Herbicides – Groups 14 & 15

Waterhemp Resistance to Group 15 – LCFA (Dr. Hager)

Results 21 DAT: *S*-metolachlor



UNIVERSITY OF ILLINOIS URBANA-CHAMPAIGN

College of Agricultural, Consumer and Environmental Sciences

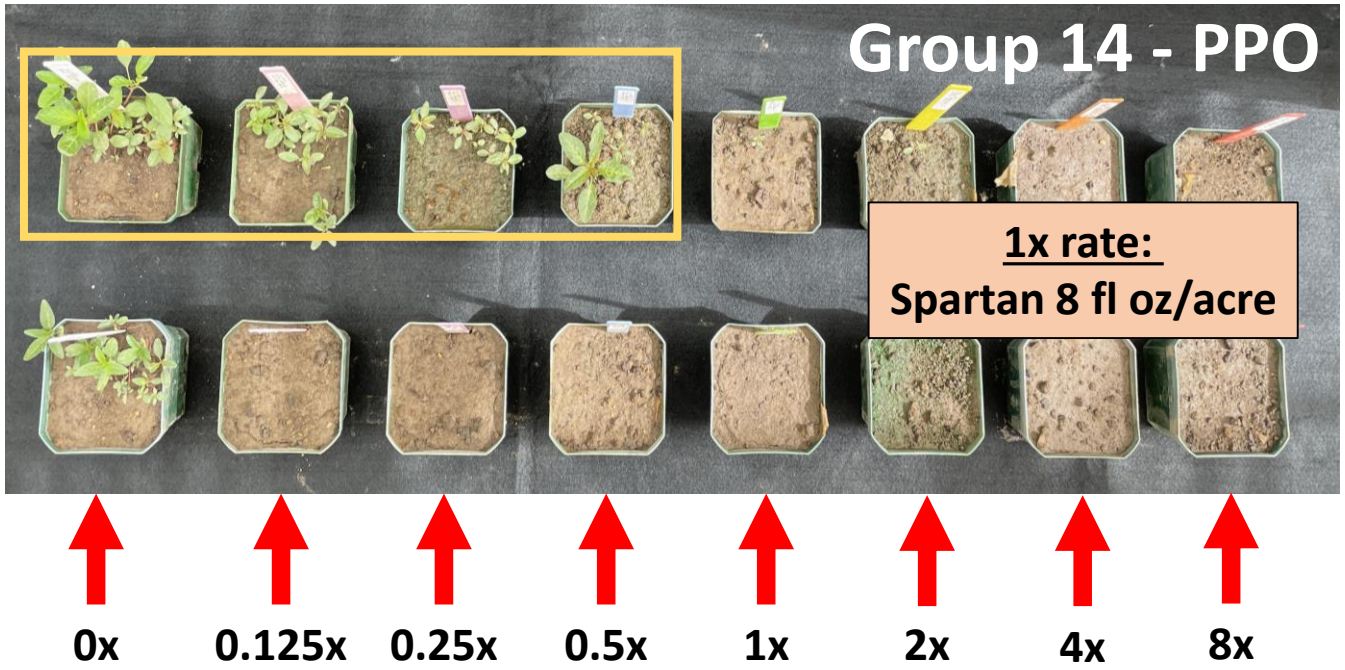
https://farmdoc.illinois.edu/field-crop-production/weeds/waterhemp-resistance-to-group-15-herbicides.html

Why is this important?

- Reduced length of soil residual weed control

PPO PRE Resistant →

Susceptible →



PPO PRE Resistant →

Susceptible →

Research by Felipe Faleco, PhD Student, UW-Madison WiscWeeds Program
Pictures taken 28 days after treatment

How Can We Help Our PREs? Planting Green for Waterhemp Suppression

Research by Jose Junior Nunes, PhD Student, UW-Madison WiscWeeds Program
Pictures taken 42 days after study establishment; Brooklyn, WI

Planting soybean green: agronomic and weed management benefits and challenges

Jose Nunes*, Arneson N, Johnson B, Young B, Ikley J, Wallace J, Gage K, Jha P, Lancaster S, Legleiter T, Kumar K, and Werle R.

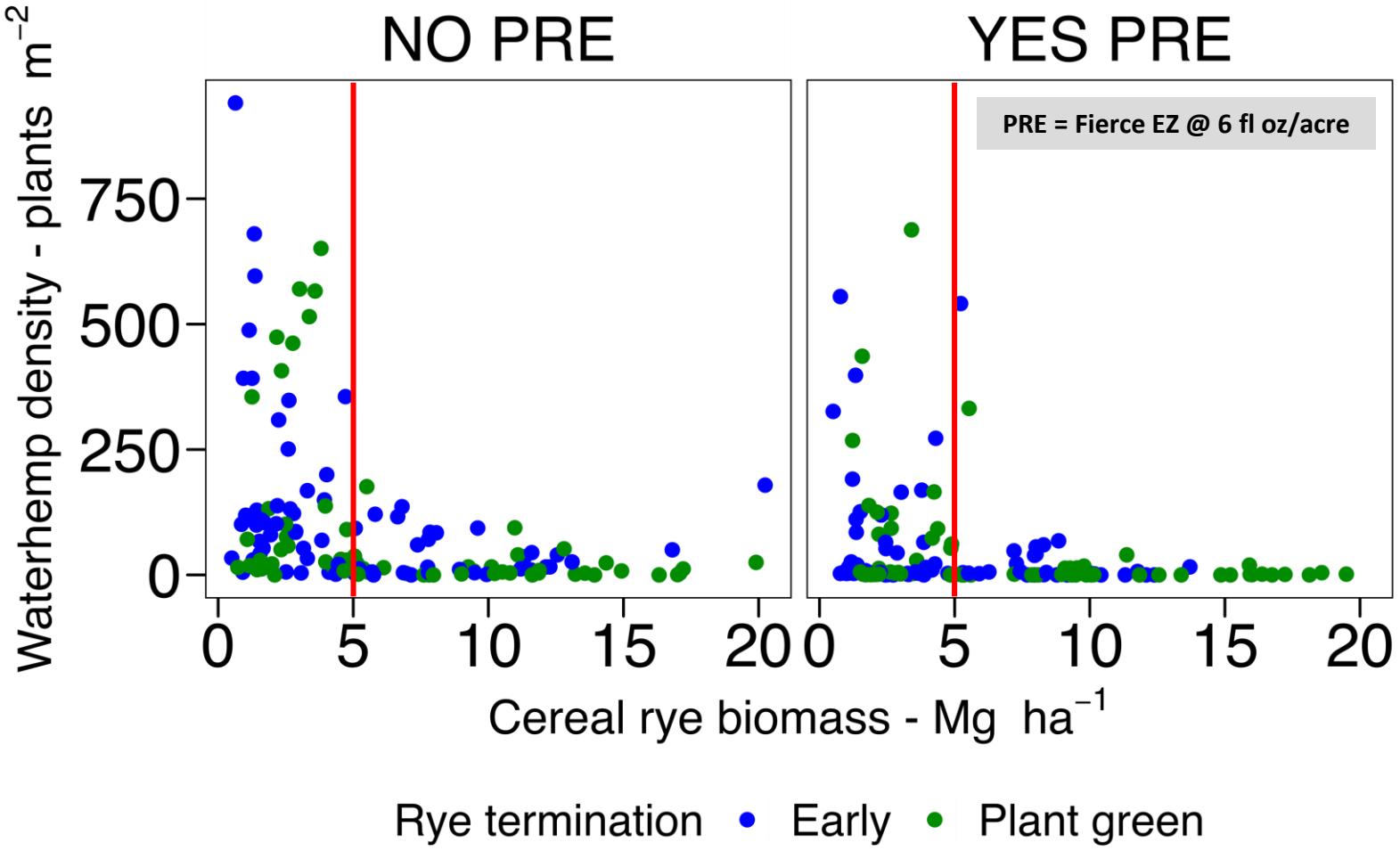
*Graduate student, University of Wisconsin-Madison

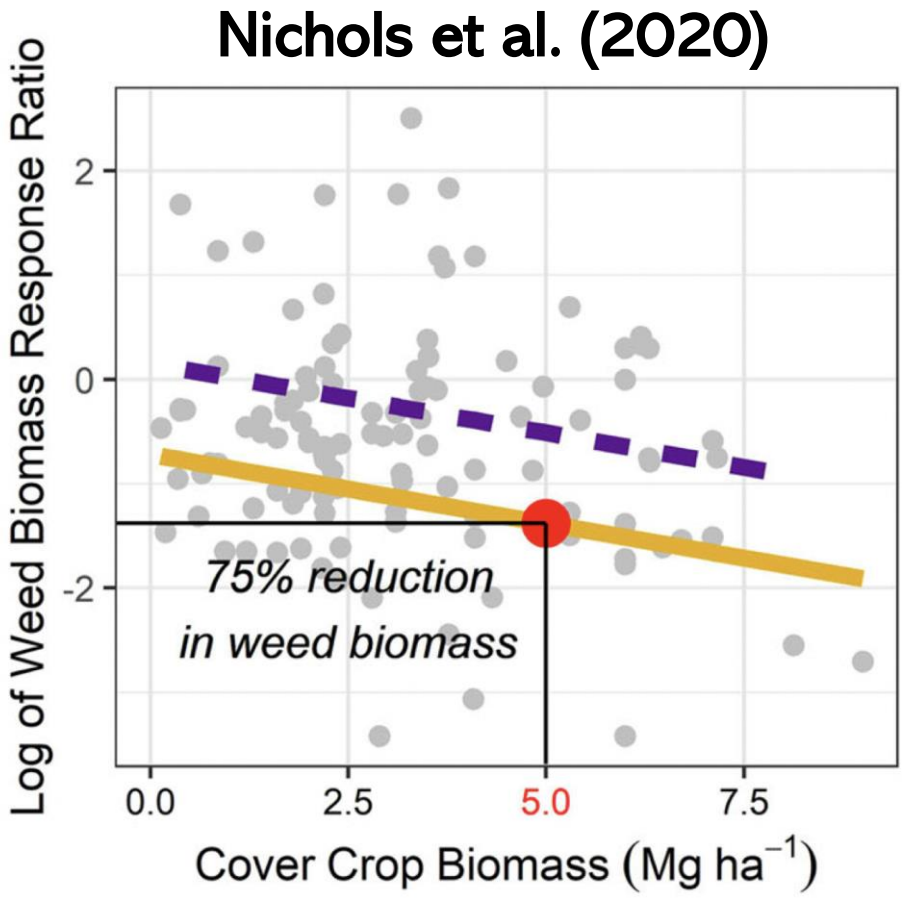
Cropping Systems Weed Science
UNIVERSITY OF WISCONSIN–MADISON

Department of Agronomy,
University of Wisconsin-Madison

Results | Waterhemp Density

5 Mg ha^{-1} = 4,460 Lbs ac^{-1}

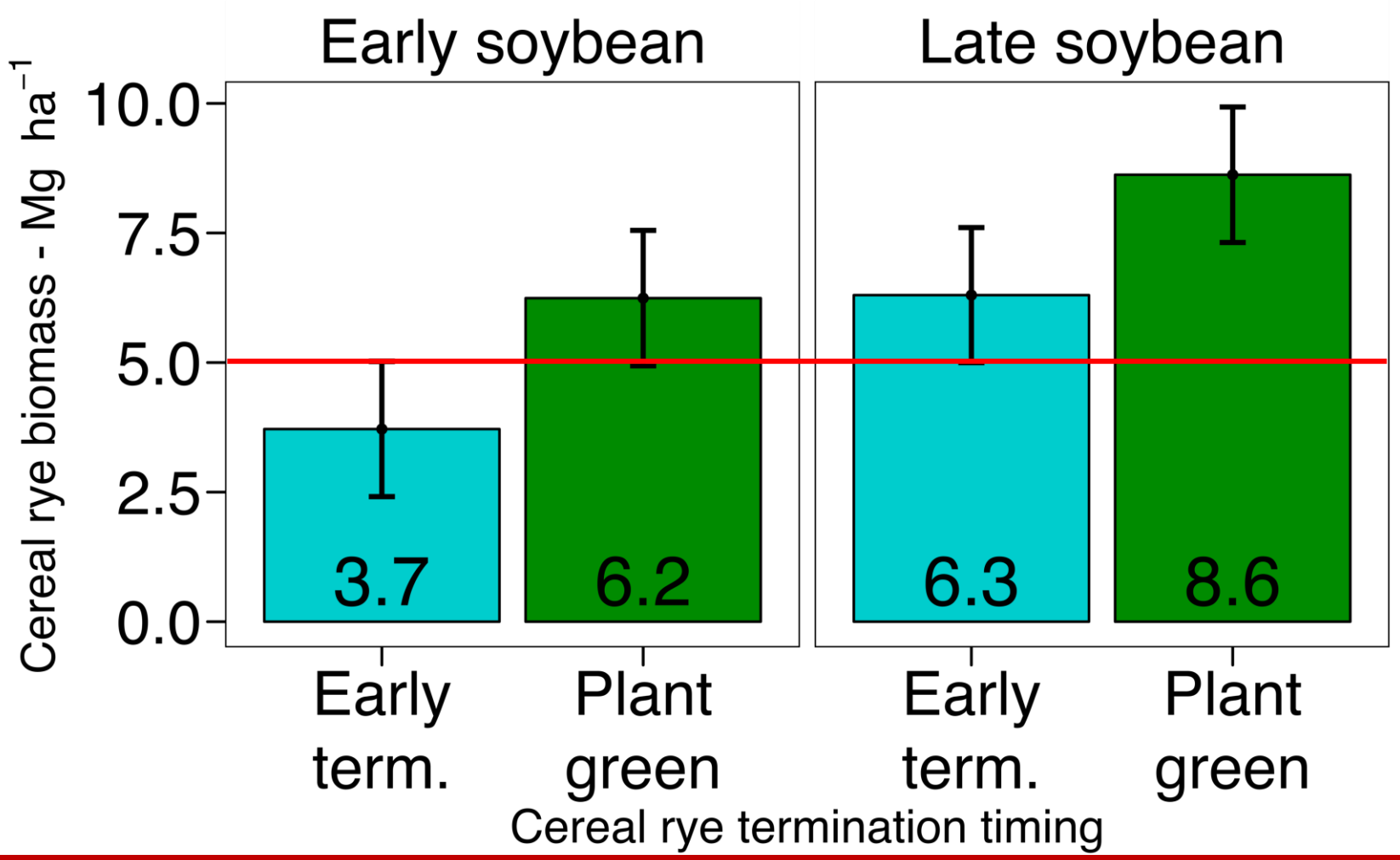




Research by Jose Junior Nunes, PhD Student, UW-Madison WiscWeeds Program

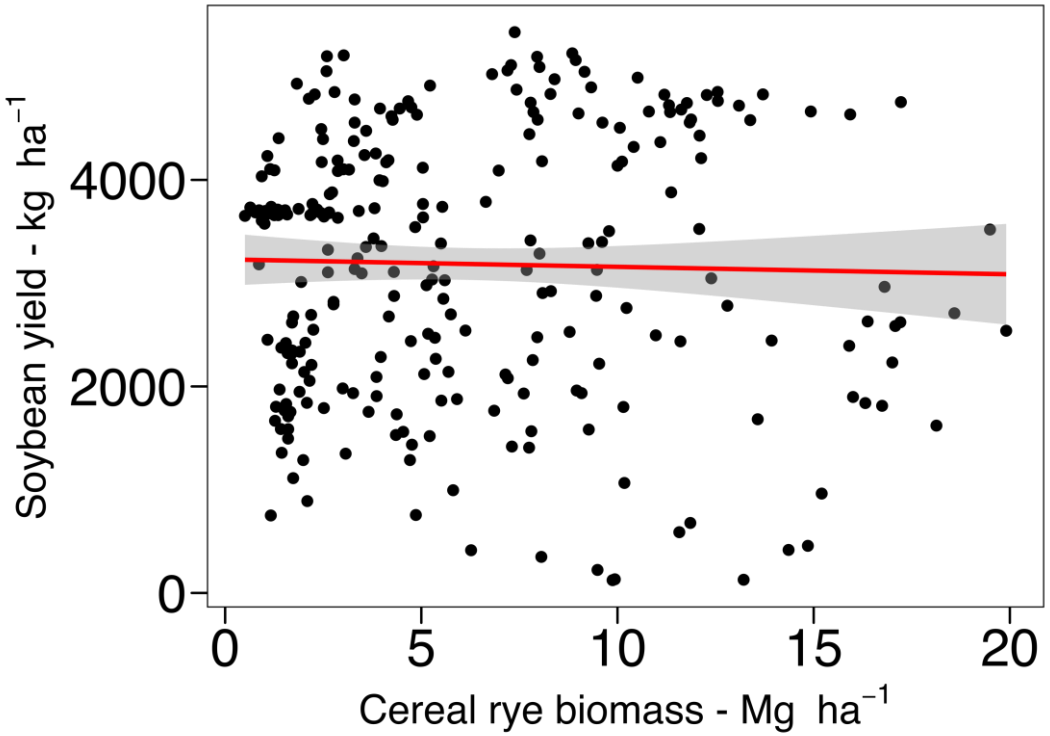
Results | Cereal Rye Biomass (WI, 2021)

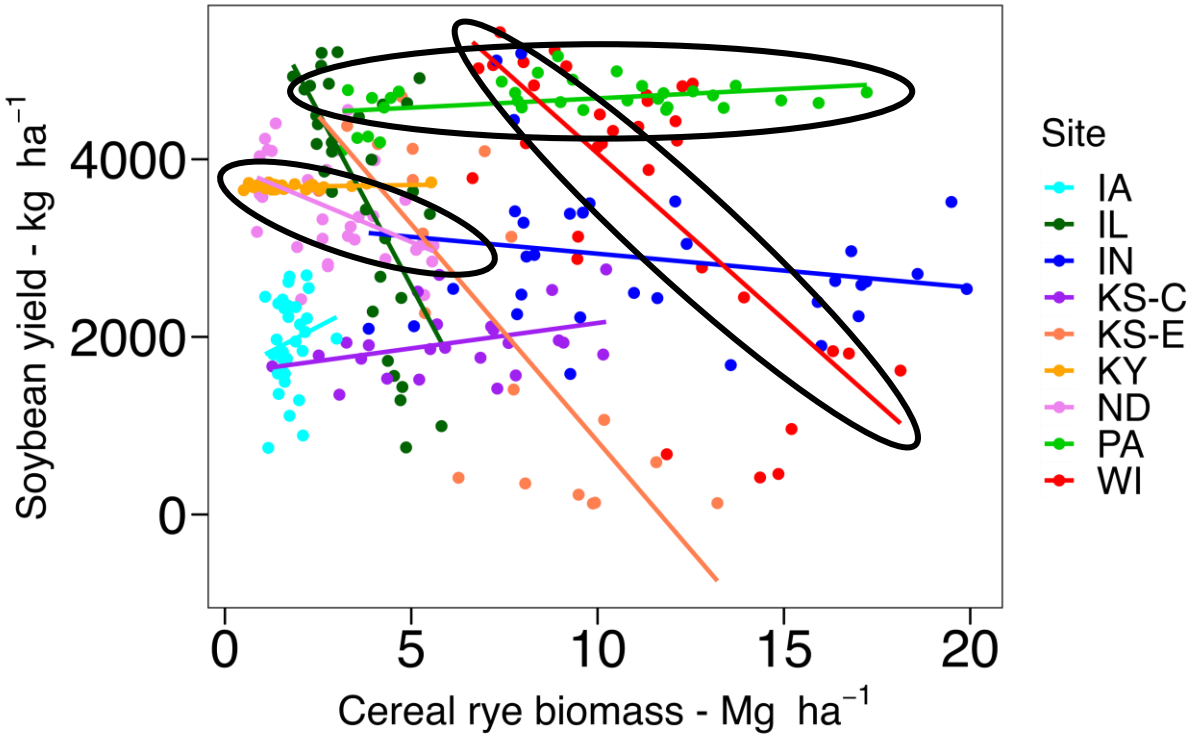
5 Mg ha^{-1} = 4,460 Lbs ac^{-1}



Research by Jose Junior Nunes, PhD Student, UW-Madison WiscWeeds Program

Impact of Cereal Rye Biomass on Soybean Yield (2021)





Research by Jose Junior Nunes, PhD Student, UW-Madison WiscWeeds Program

5 Mg ha^{-1} = 4,460 Lbs ac^{-1}

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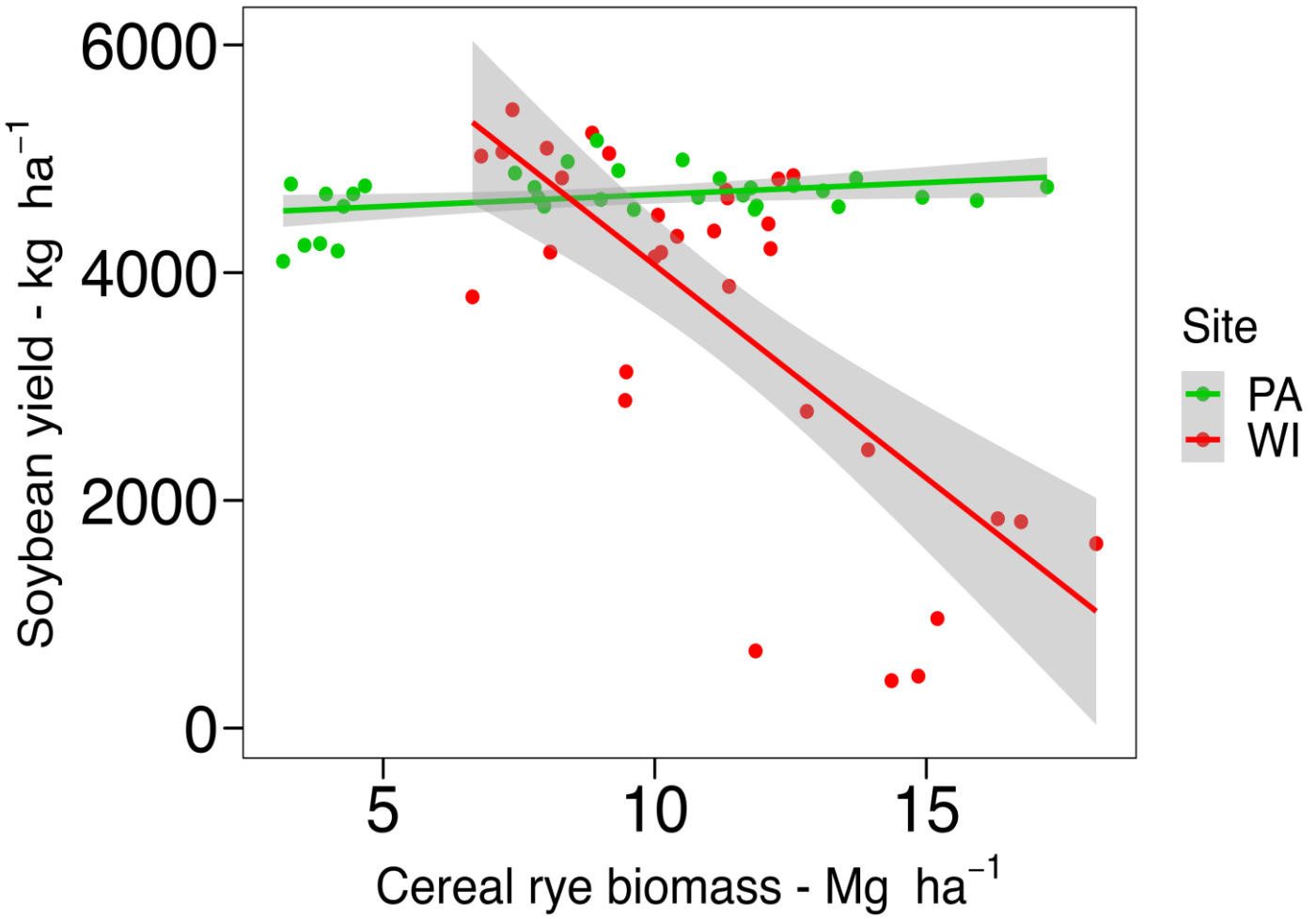

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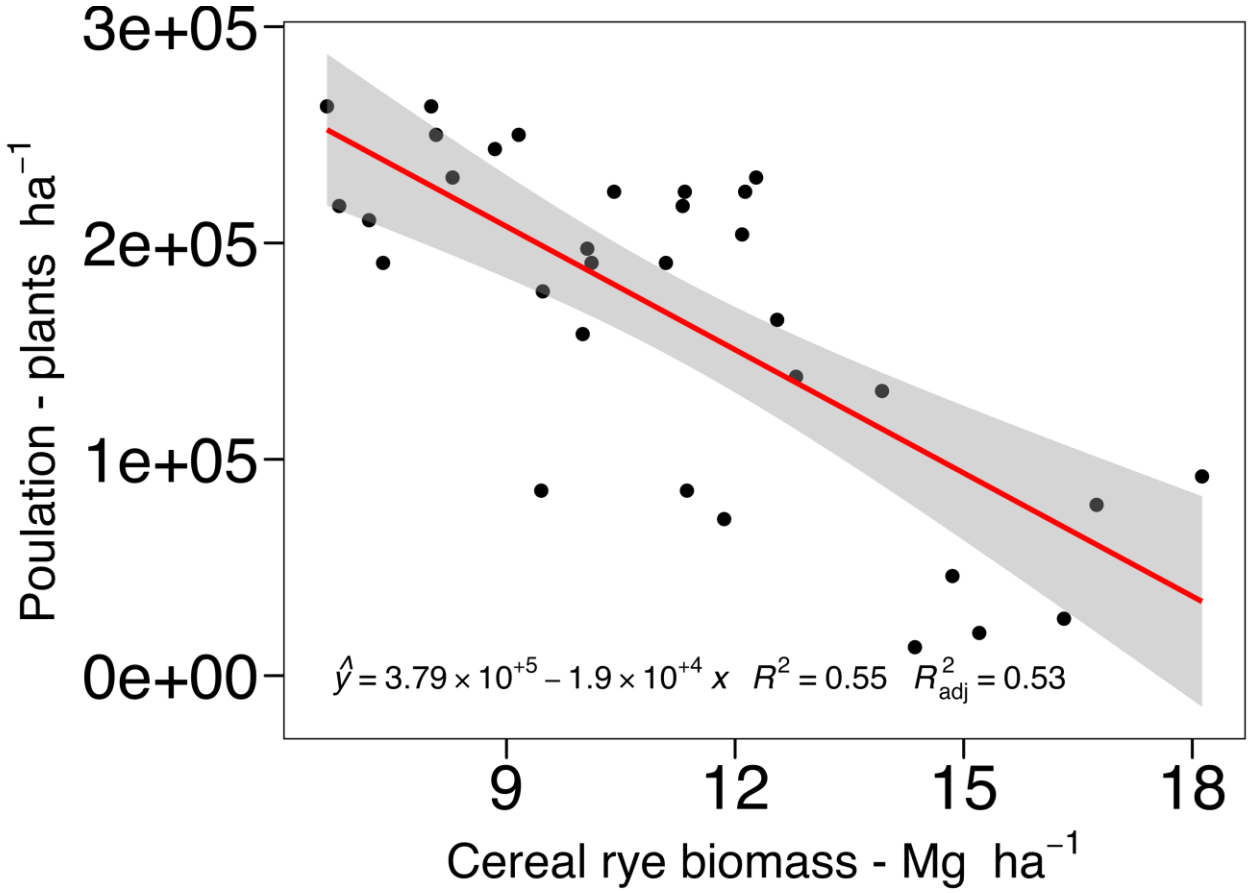
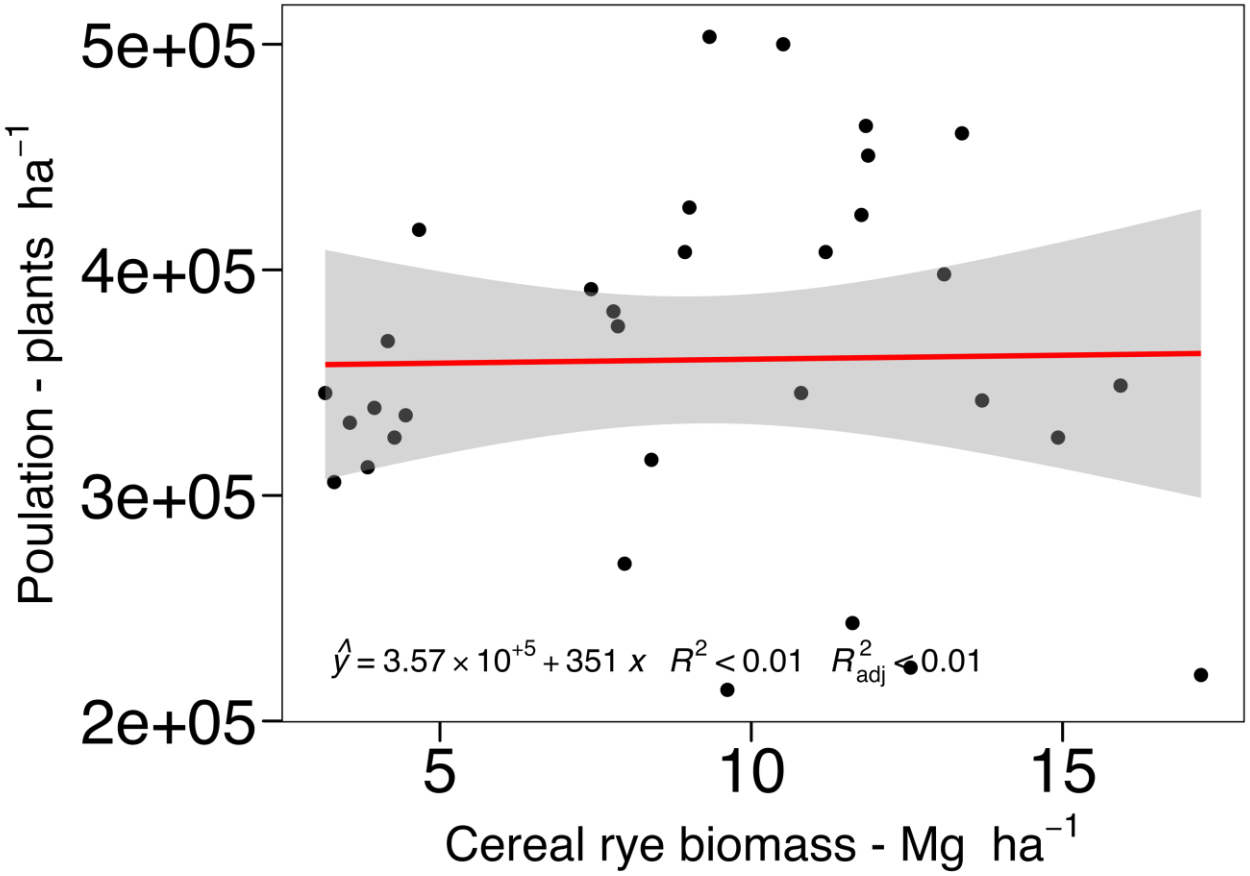
Impact of Cereal Rye Biomass on Soybean Population (2021)

Wisconsin



Pennsylvania



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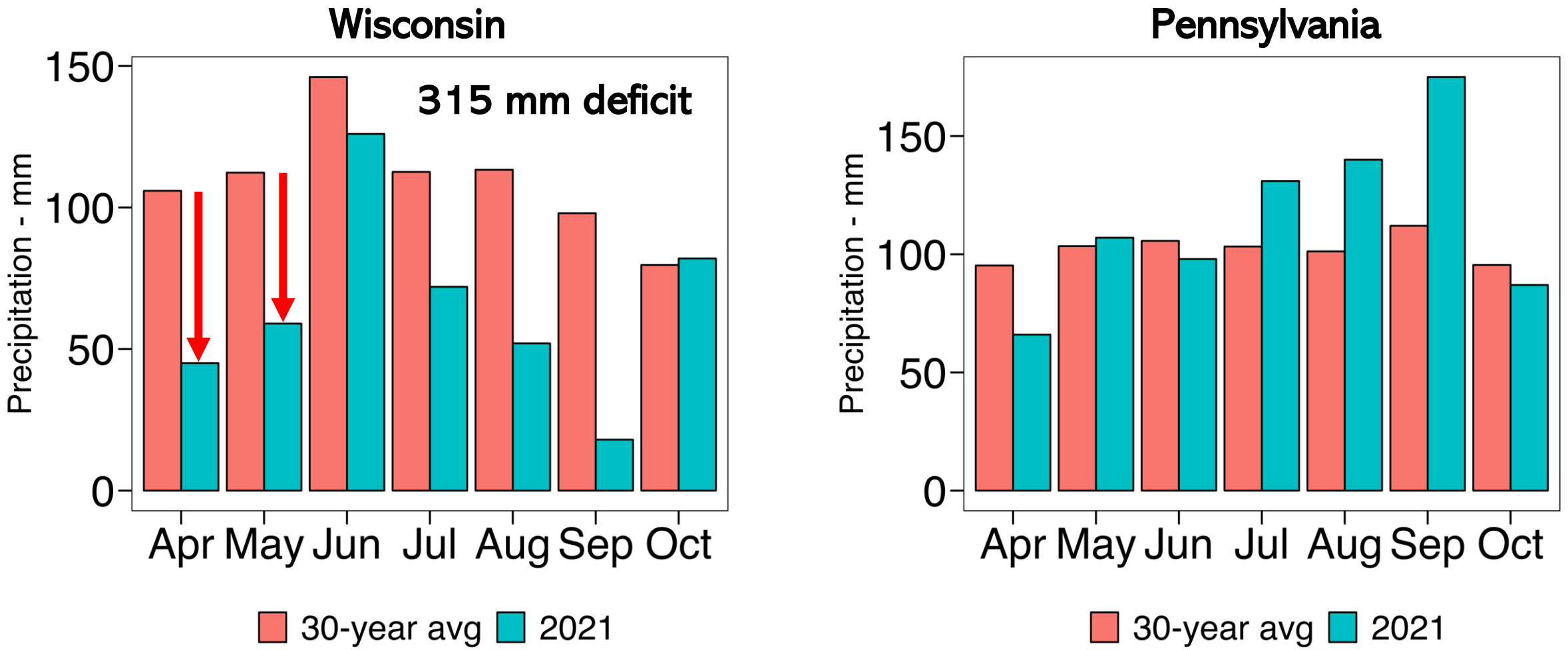
Precipitation (mm) During the Growing Season (2021)



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30-year average (1990-2020) source: DAYMET

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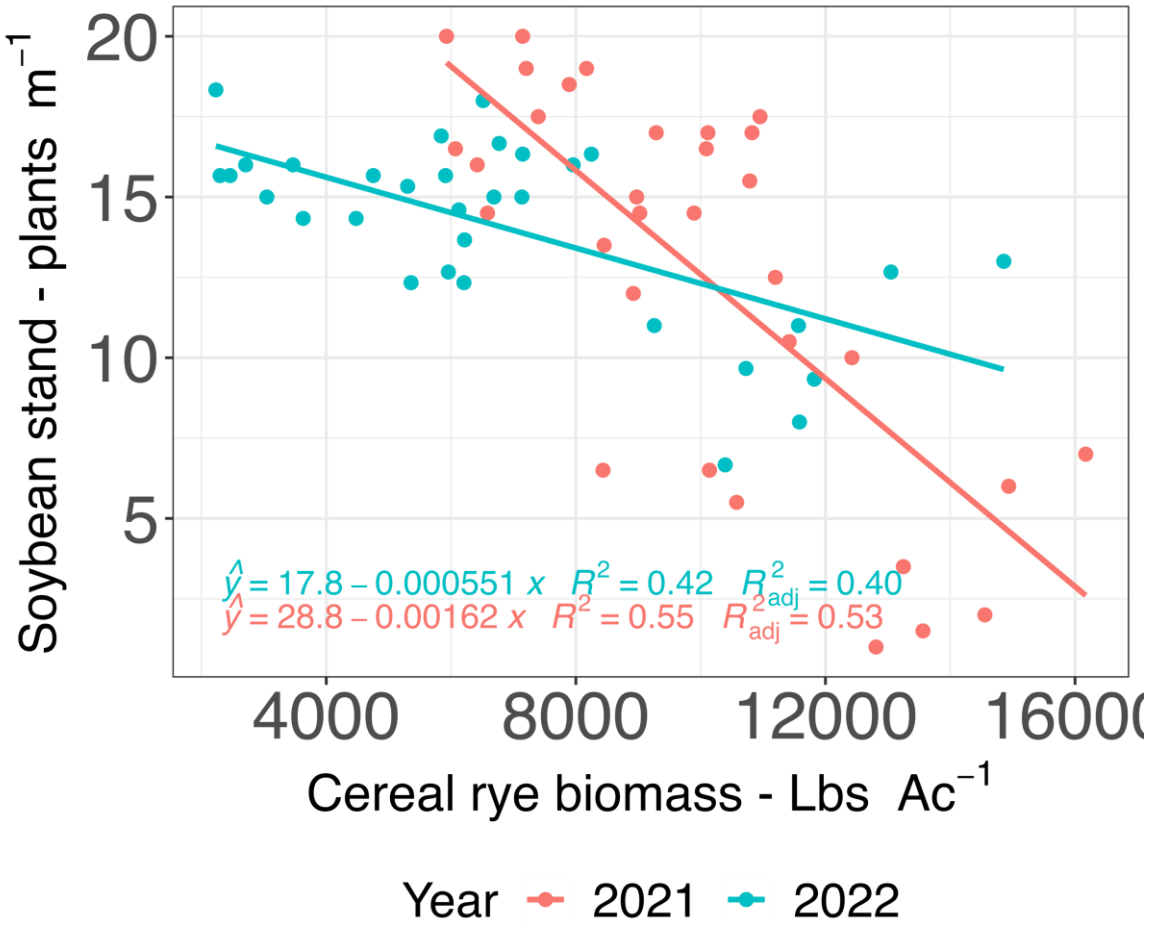
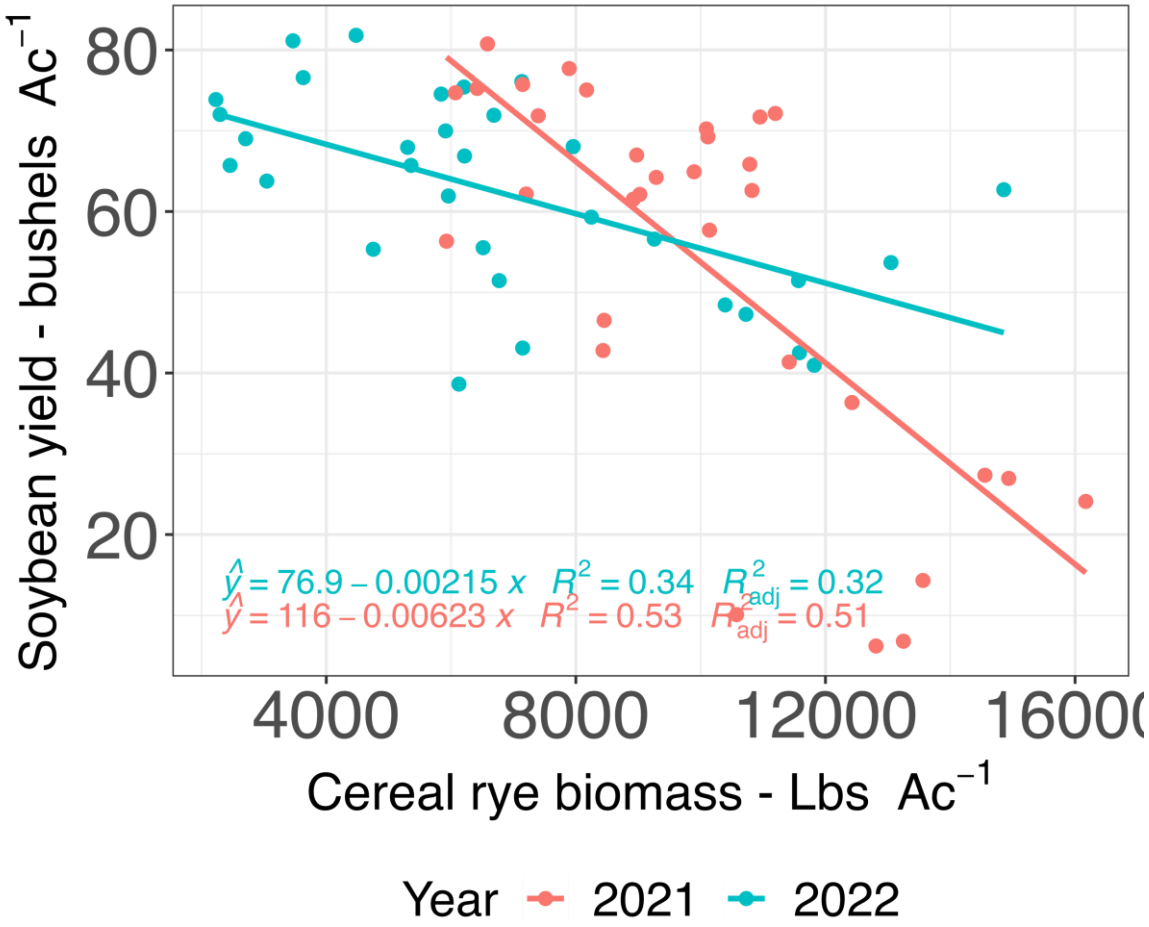
Impact of Cereal Rye Biomass on Soybean Population and Yield (Wisconsin)





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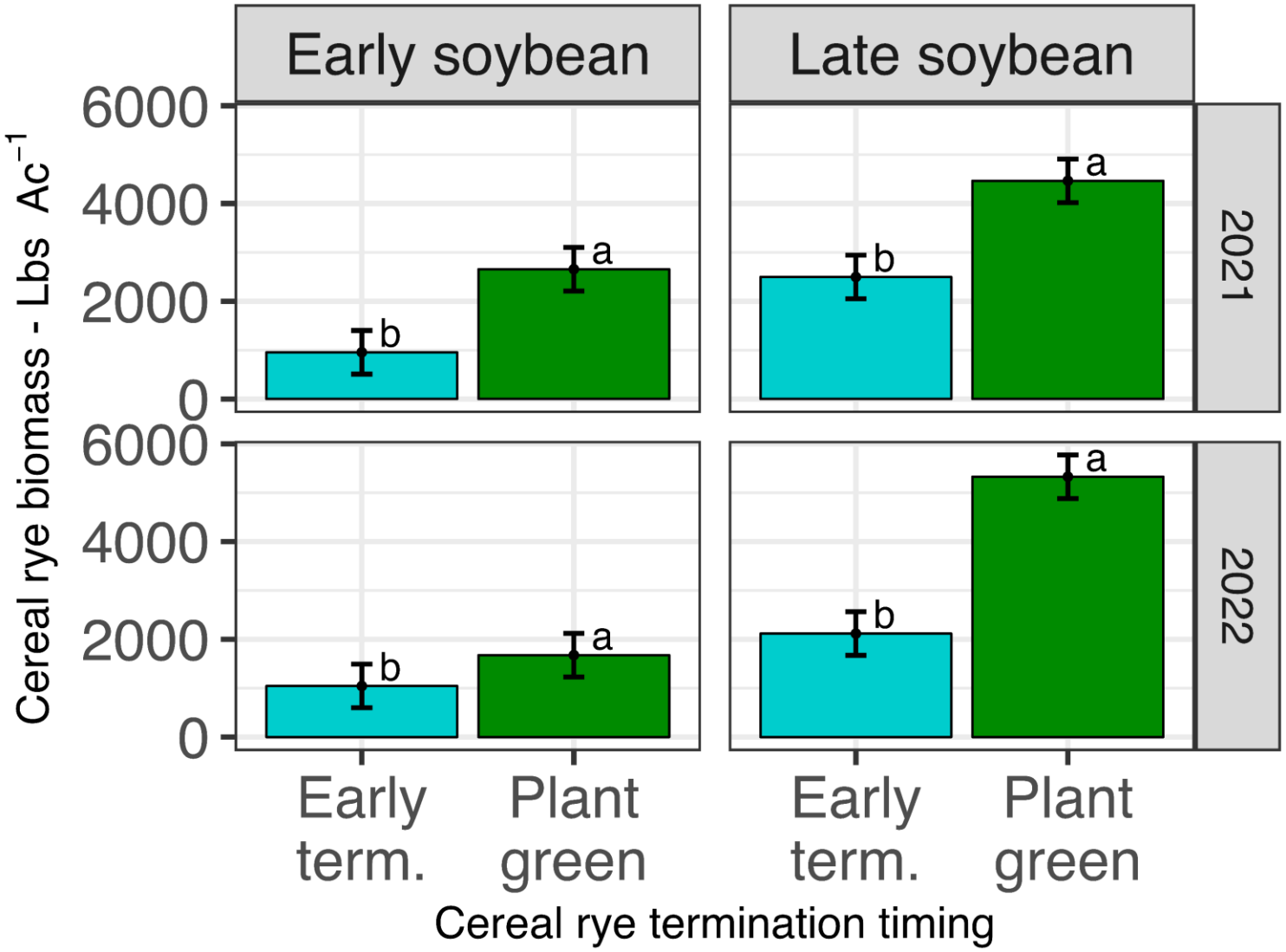
What About Dr. Ikley's Data (Fargo, ND)?



2021 USB Planting Green Study:

- Cereal rye planting: 09/16/2020
  - ✓ 60 lbs/acre; ND Gardner
- 05/10/2021: early rye term ahead of early soy
- 05/19/2021: early soybean planting green
- 05/19/2021: early rye term ahead of late soy
- 06/01/2021: late soybean planting green

2022 USB Planting Green Study:

- Cereal rye planting: 09/15/2021
  - ✓ 60 lbs/acre; ND Gardner
- 05/23/2022: early rye term ahead of early soy
- 06/03/2022: early soybean planting green
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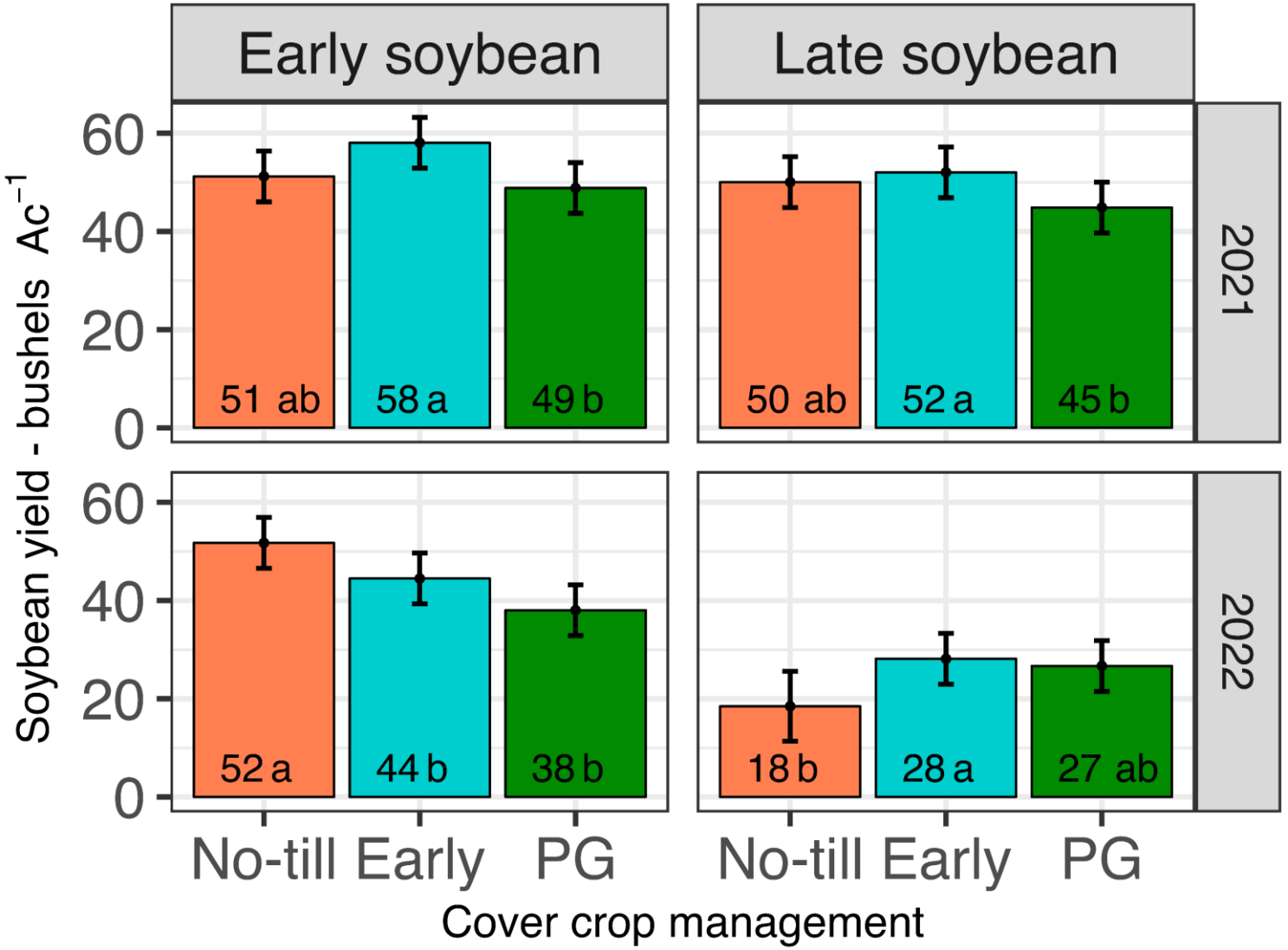

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Preliminary Conclusions from USB Planting Green Study

- Planting green optimized cereal rye biomass accumulation and reduced waterhemp density
- PRE-emergence herbicides played an important role in waterhemp control
- Soybean yield was not solely affected by cereal rye biomass accumulation

- **To minimize risk and optimize benefits**: site-specific and adaptative management approach

25th Wild World of Weeds Workshop – Fargo, ND

January 17, 2023

Thanks!

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