@WiscWeeds

Palmer Amaranth: It Comes Herbicide Proof and Adapts Well to Wisconsin

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BRIEN HYBRIDS

Outline

WiscWeeds
Research Coalition

- Palmer amaranth - why should we care?
- Proper identification
- Palmer adaptation to the upper Midwest US
- PRE herbicide resistance screening
- POST herbicide resistance screening

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Palmer amaranth – why should we care?

Palmer amaranth – why should we care?

Soil residual at planting + 2 pass POST-emergence program
Timing and lack of additional residual activity in the soil

Glyphosate (waterhemp & Palmer amaranth)

Waterhemp

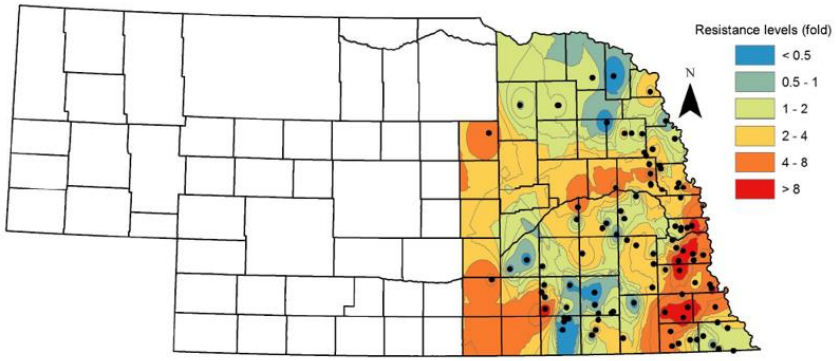

Figure 3. Distribution and glyphosate resistance level of waterhemp populations in Nebraska. Resistance ratios were calculated by the ratio of the GR_{90} of each population and the glyphosate label rate (22 oz ac^{-1}).

Palmer amaranth

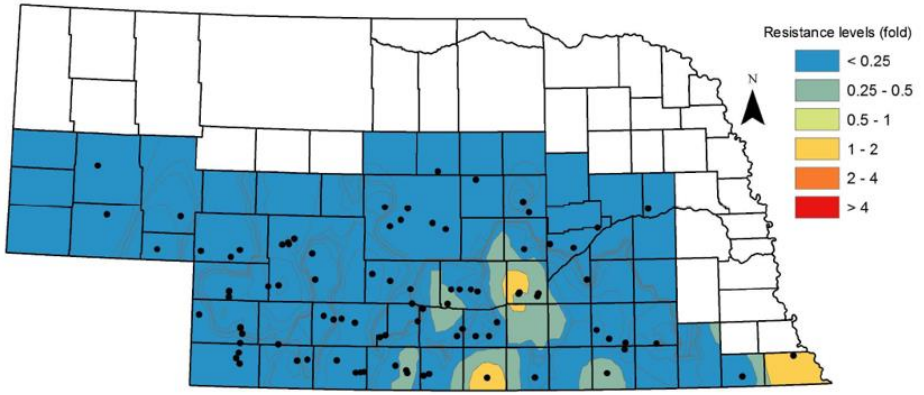

Figure 2. Distribution and glyphosate resistance level of Palmer amaranth populations in Nebraska. Resistance ratios were calculated by the ratio of the GR_{90} of each population and the glyphosate label rate (22 oz ac^{-1}).

RESULTS: Glyphosate resistance was widespread in common waterhemp (81% of the screened populations), few Palmer amaranth populations were glyphosate-resistant (6% of the screened populations), whereas no glyphosate-resistant redroot pigweed populations were identified in Nebraska. Weed species, geographic region within the state, and current crop were the most important factors predicting the occurrence of glyphosate resistance in fields infested with *Amaranthus* species in Nebraska.

CONCLUSION: The intensive glyphosate selection pressure exerted in soybean (*Glycine max*) fields in eastern Nebraska is one of the major factors causing widespread occurrence of glyphosate resistance in common waterhemp in the state. The relatively low frequency of glyphosate-resistant Palmer amaranth in the state highlights the importance of the application timing and the adoption of multiple modes of action in weed management practices to delay the evolution of glyphosate resistance.

Research Article

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Distribution of glyphosate-resistant *Amaranthus* spp. in Nebraska

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Glyphosate & PPO (Palmer amaranth)

Table 1. Number and percentage of Palmer amaranth populations resistant to PPO and/or glyphosate.

Resistance	Populations
PPO	30 (59%)
Glyphosate	24 (47%)
PPO + glyphosate	14 (27%)
Total	51

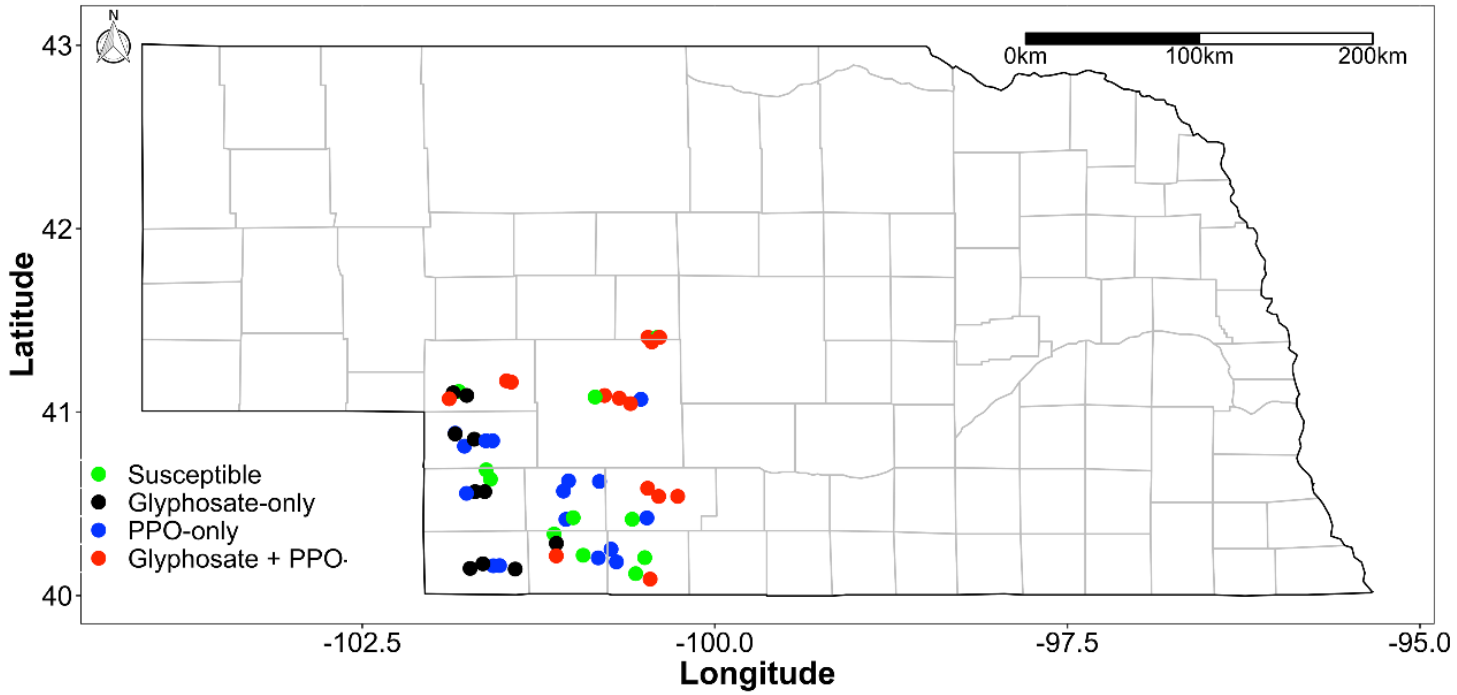
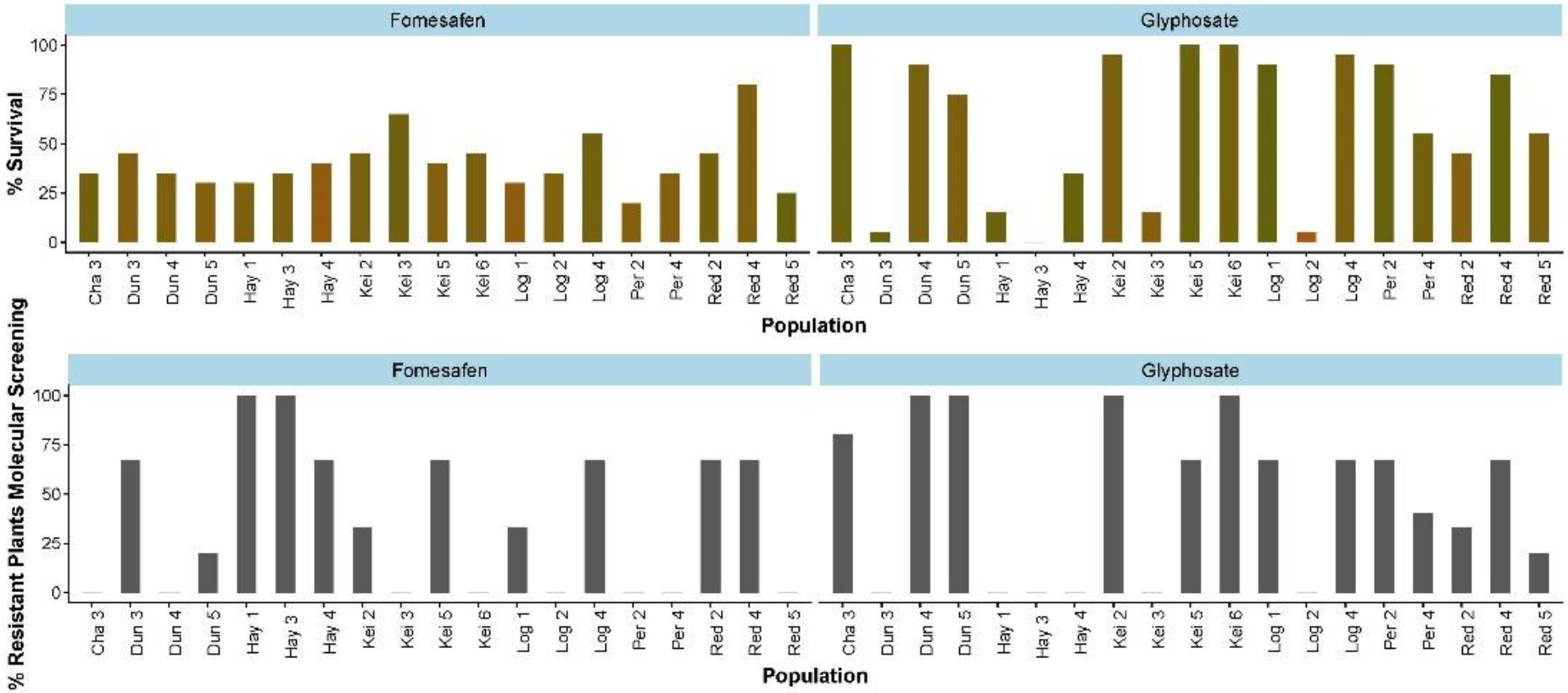


Table 2. Number and percentage of Palmer amaranth populations resistant to PPO and/or glyphosate from the different crops where samples were collected in 2017.

Crop	PPO	Glyphosate	PPO+glyphosate
Soybeans	9 (30%)	14 (58%)	7 (50%)
Corn	11 (37%)	7 (29%)	5 (36%)
Sorghum	3 (10%)	0 (0%)	0 (0%)
Fallow	1 (3%)	1 (4%)	0 (0%)
Other	6 (20%)	2 (8%)	2 (14%)
Total	30	24	14

Glyphosate & PPO (Palmer amaranth)



← greenhouse screening

← molecular screening U of I

PPO = 1 pt acre^{-1} Reflex (0.25 lb ai/A fomesafen)
Glyphosate = 22 fl oz acre^{-1} Roundup WeatherMax

*Seeds were collected in the fall/2017 and screened in the greenhouse in 2018

PALMER AMARANTH THAT RESISTS 2,4-D AND DICAMBA CONFIRMED IN KANSAS

THIS IS THE FIRST CONFIRMED CASE OF GROUP 4 HERBICIDE RESISTANCE IN PALMER AMARANTH.

By Kansas State University
3/5/2019

Kansas State University (KSU) weed scientists have confirmed a Palmer amaranth population that resists the synthetic auxin (Group 4) herbicides dicamba and 2,4-D. New formulations of dicamba and 2,4-D are used on soybeans in the Roundup Ready Xtend System and the Enlist Weed Control System.

Gil Gullickson

The resistant population was collected from a long-term conservation tillage study at the KSU Agronomy Ashland Bottoms Experiment Field in southern Riley County in northeastern Kansas. This is the first confirmed case of resistance to dicamba and 2,4-D in Palmer amaranth, further magnifying the challenge to manage this weed in conservation tillage systems, noted KSU weed scientists Dallas Peterson, KSU Extension weed specialist and Extension agronomy state leader; Mithila Jugulam, KSU weed physiology professor; Chandrima Shyam, KSU weed science graduate student; and Ednaldo Borgato, KSU weed science graduate student. The KSU weed scientists compiled this report outlining the 2,4-D

MDA FINDS PALMER AMARANTH IN FEED SCREENINGS

Farmers are encouraged to scout fields this spring for signs of the weed

April 22, 2019

The Minnesota Department of Agriculture (MDA) has found a new route for the invasive weed Palmer amaranth to enter and spread through Minnesota: grain and seed screenings used as feed.

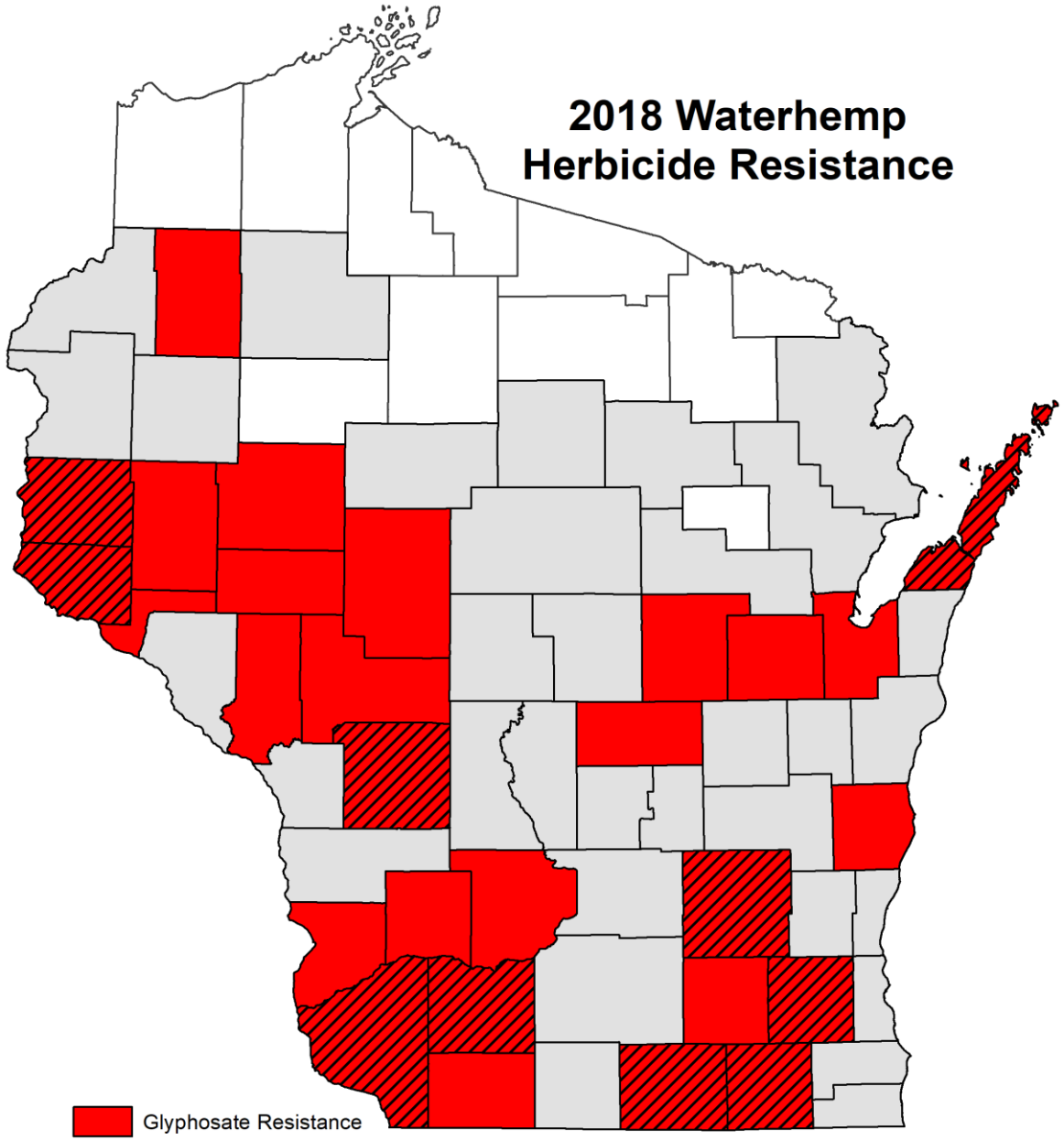
After an investigation into a Palmer amaranth find in Redwood County, the MDA determined the weed found its way into a soybean field through cattle manure. The cattle had been fed screenings from contaminated sunflower seed.

The MDA has since sampled screenings throughout the state and has found Palmer amaranth seed in numerous screenings – some containing as much as 250 Palmer amaranth seeds per pound of screenings.

"This newly discovered path for Palmer amaranth shows the difficultly in stopping the spread of invasive weeds," said Agriculture Commissioner Thom Petersen, "However, the MDA is committed to continuing our monitoring of screenings, educating crop and livestock farmers about this development, and helping eradicate any new finds."

https://www.mda.state.mn.us/mda-finds-palmer-amaranth-feed-screenings

2018 Waterhemp Herbicide Resistance



Glyphosate Resistance

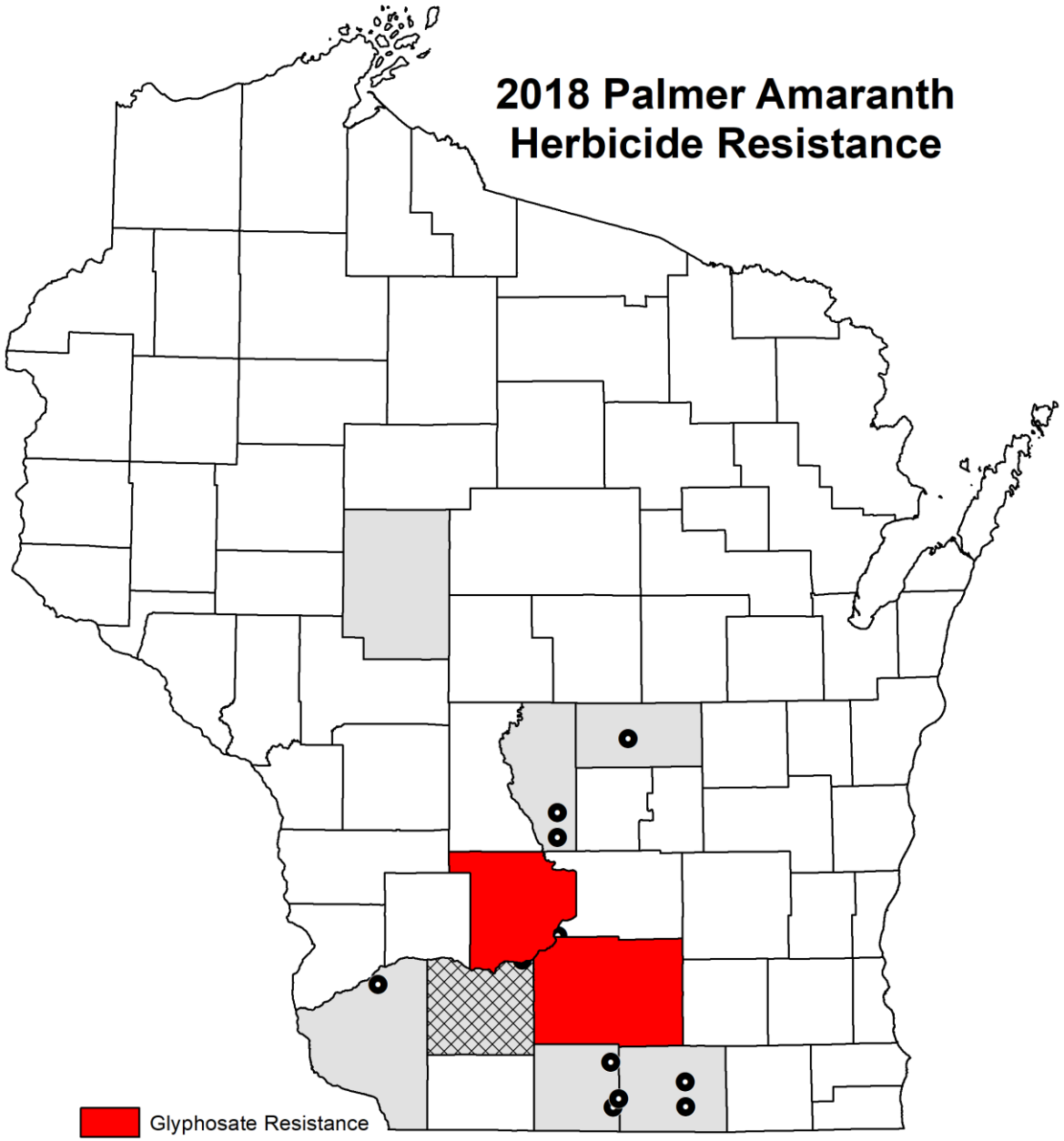
PPO Inhibitor Resistance

Present, No Confirmed Resistance

Updated November 2018

Resistance confirmation tests conducted at
UW-Madison and University of Illinois Plant Clinic

2018 Palmer Amaranth Herbicide Resistance



Glyphosate Resistance

HPPD + ALS Inhibitor Resistance

Present, No Confirmed Resistance

Updated November 2018

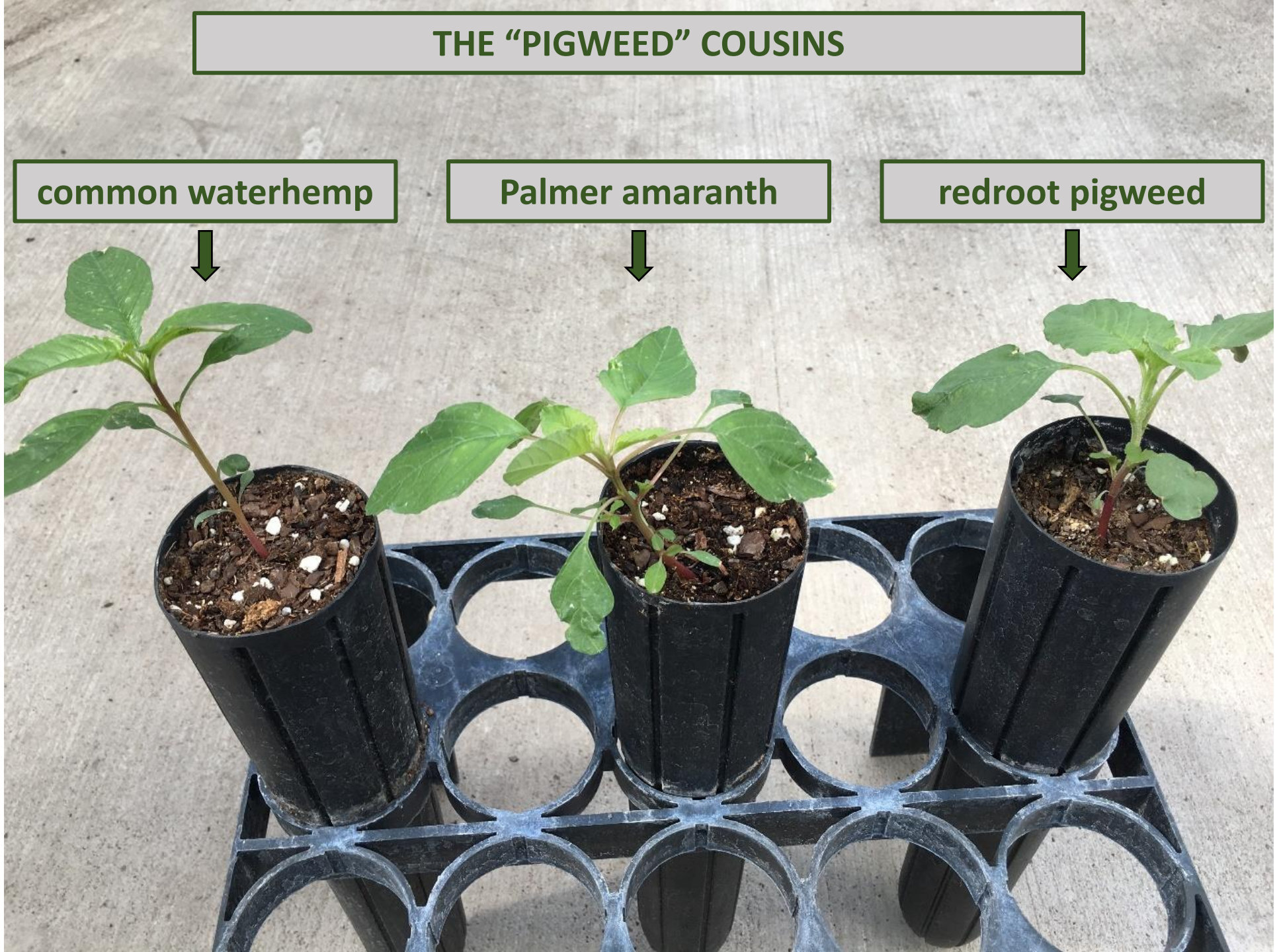
Resistance confirmation tests conducted at
UW-Madison and University of Ilinois Plant Clinic

Junction Green/Rock Counties, WI (2018)

NE Green County, WI (2018)

NE Iowa County, WI (2019)

THE “PIGWEED” COUSINS



Young Vegetative ID

Leaf Shape

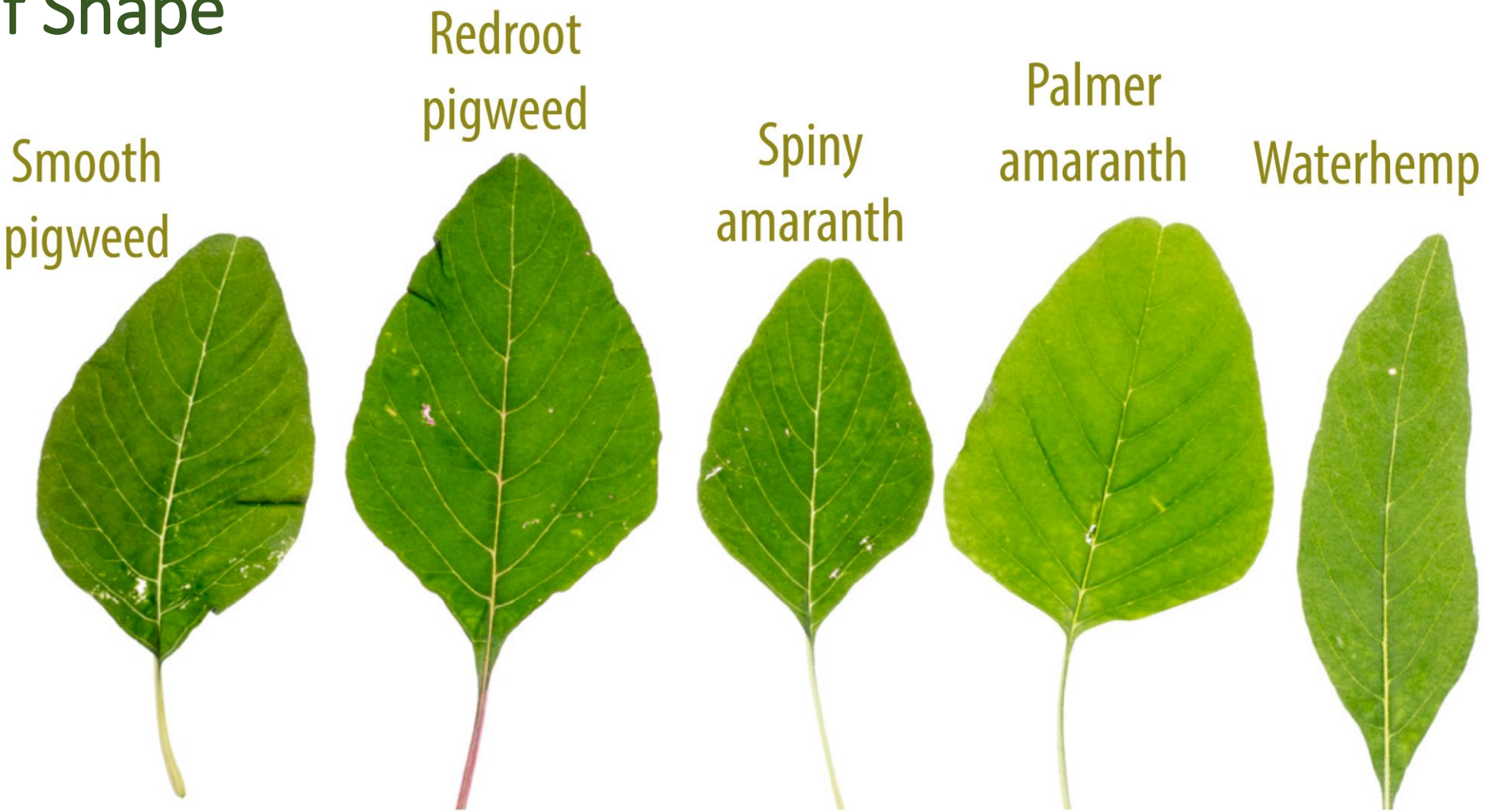


Image courtesy of NPM

Young Vegetative ID

Leaf Shape

leaves are wide and diamond-shaped

- long petioles
- hairless stems

Palmer amaranth

Image courtesy of NPM

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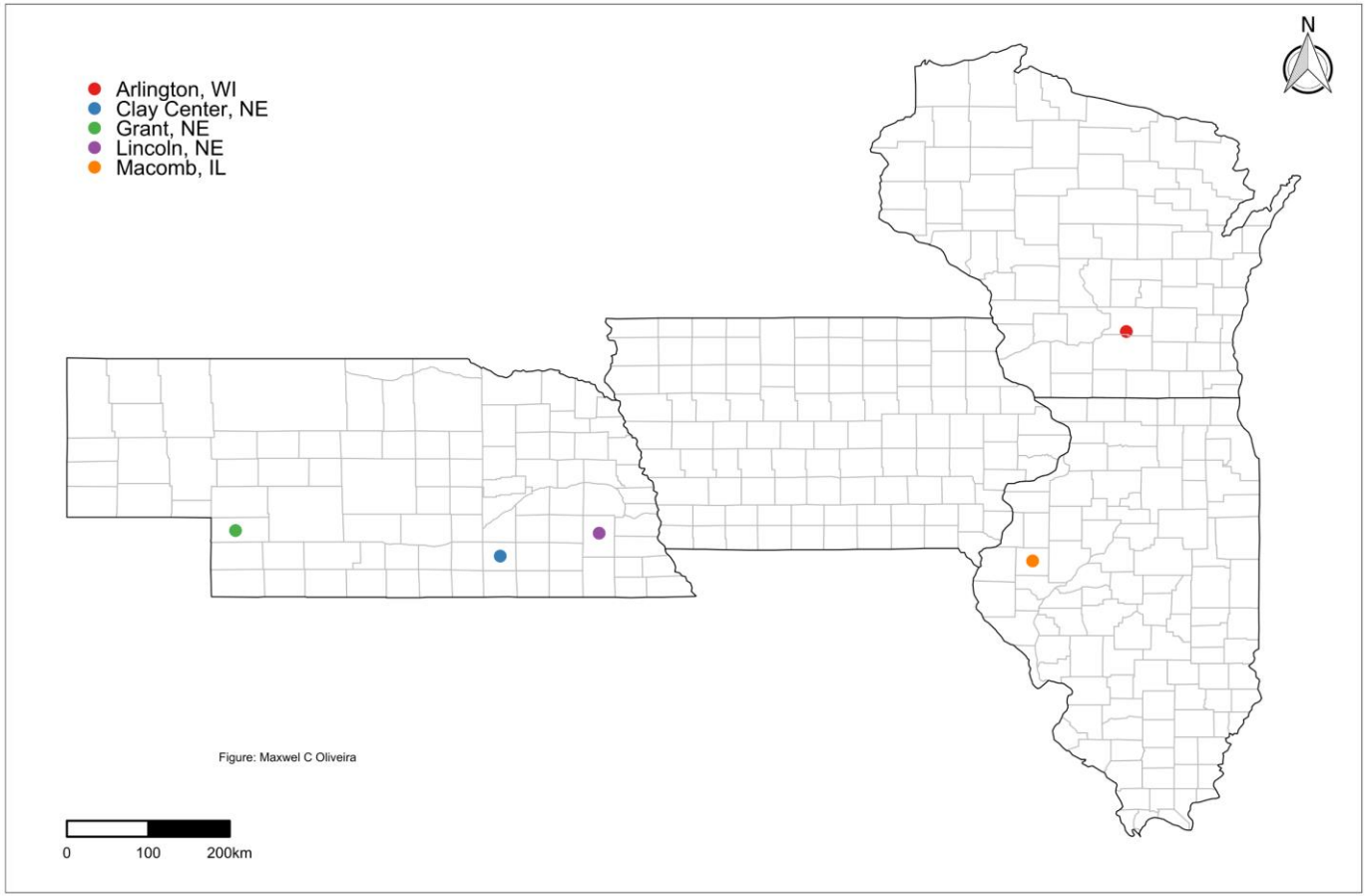
Palmer amaranth

Palmer amaranth?

Adaptation to the Upper Midwest



- 2018 and 2019 growing seasons
- 5 locations in NE, IL, and WI
  - Arlington, WI
- **Objective:** Evaluate the adaptation of Palmer amaranth to different cropping systems (corn, soybeans, and fallow) across the US Midwest

WESTERN ILLINOIS UNIVERSITY

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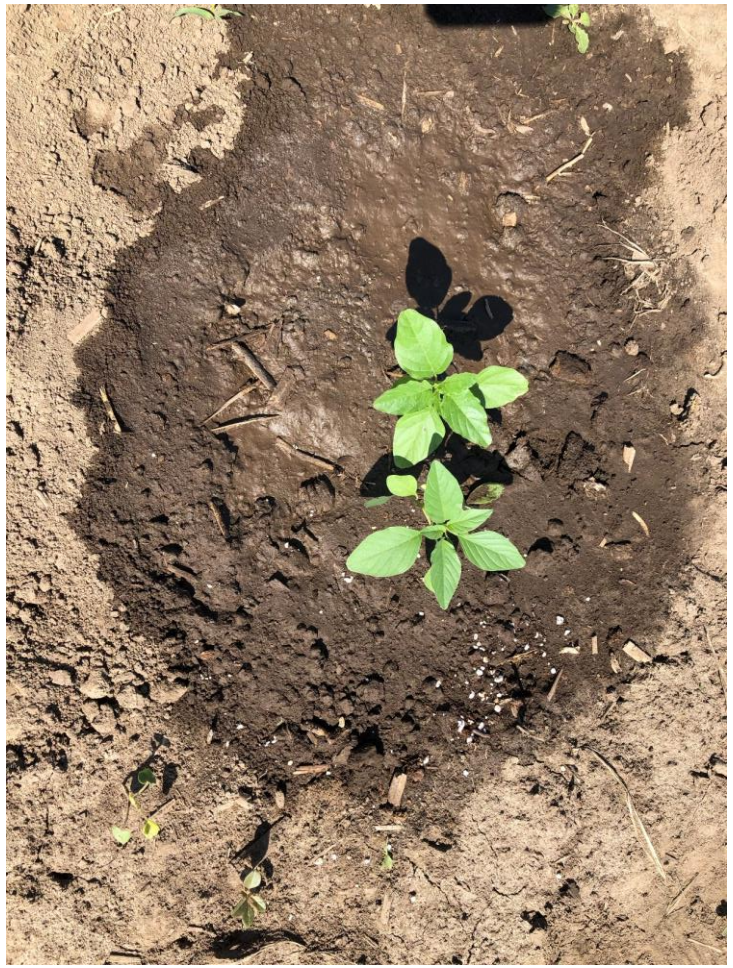
Adaptation to the Upper Midwest



- Palmer transplanted at 2-3 leaf stage into 3 cropping systems
  - Fallow
  - Corn
  - Soybeans
- 2 timings throughout season
  - June 1
  - July 1
- Plants were removed when they began flowering

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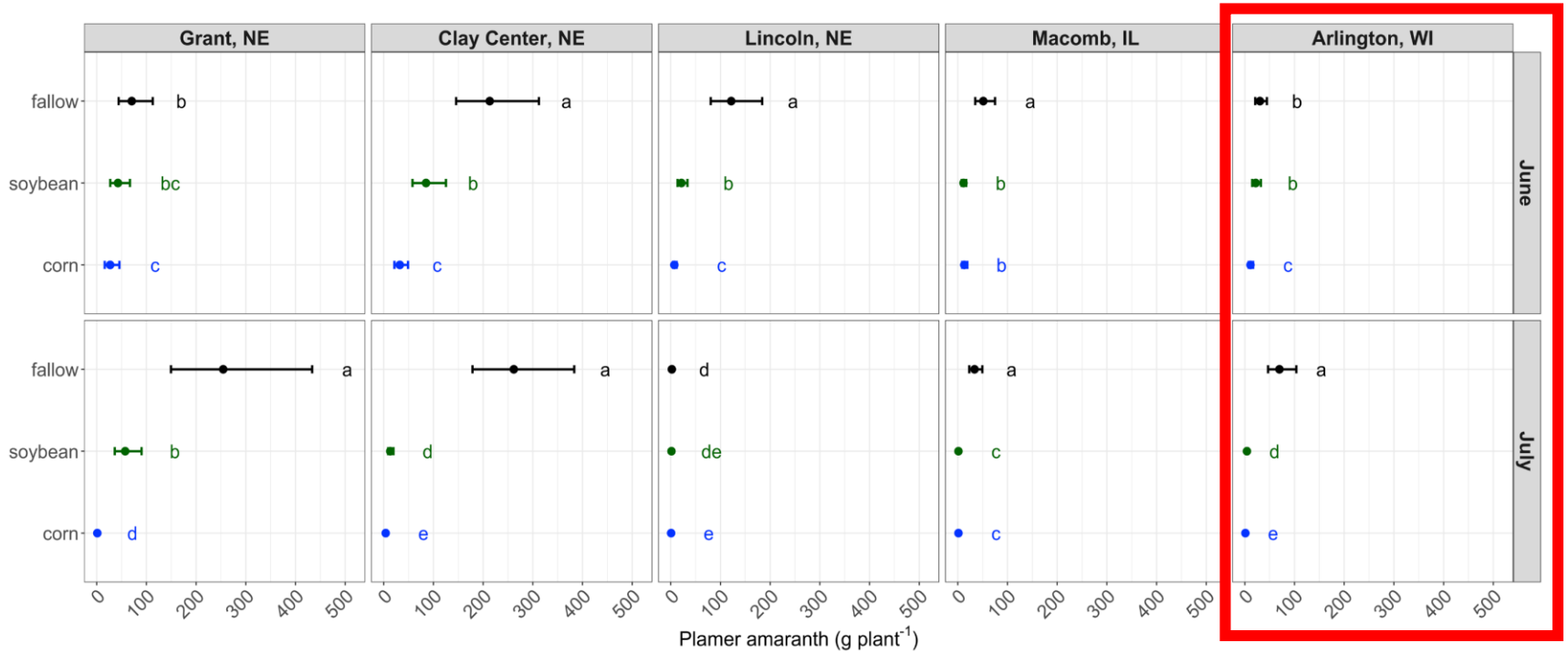
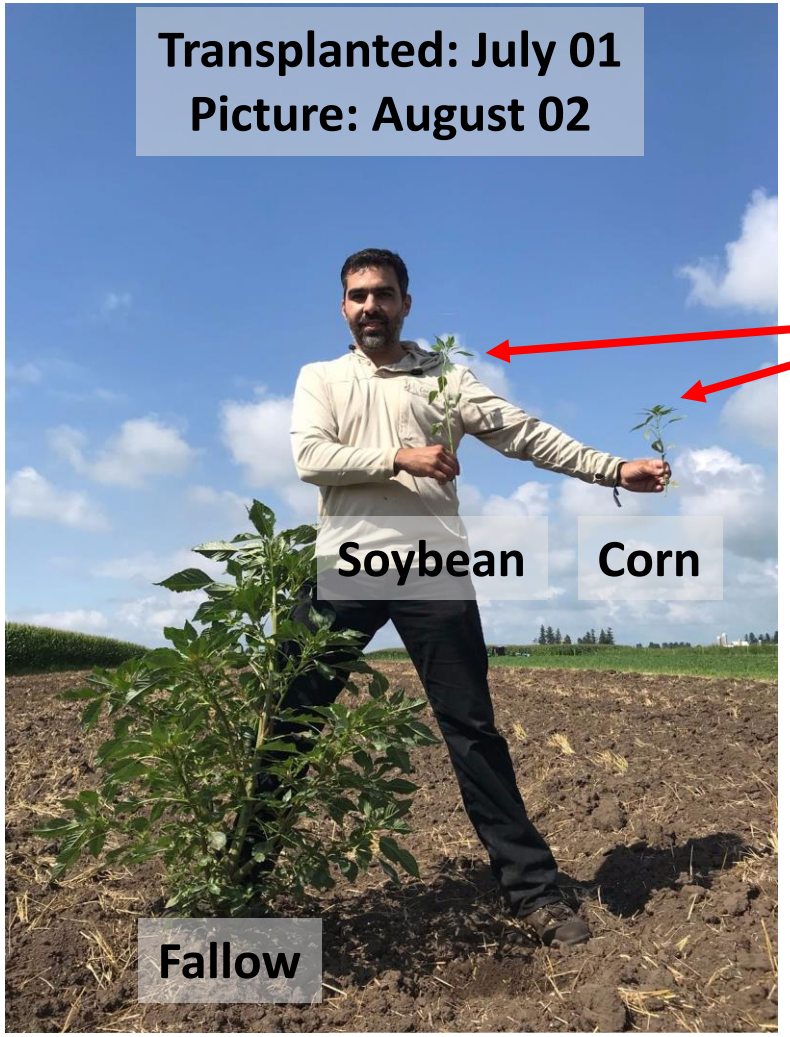
Adaptation to the Upper Midwest



- <u>June transplanting:</u>
  - Corn reduced Palmer biomass at all 5 locations
  - Soybean reduced Palmer biomass at 3 of 5 locations
- <u>July transplanting:</u>
  - Corn and soybean reduced palmer biomass at all 5 locations

Dr. Maxwel Oliveira, UW-Madison WiscWeeds Program

Adaptation to the Upper Midwest



Arlington, WI 2018

These plants can still produce seeds!

- **If not effectively controlled, Palmer amaranth plants will thrive in Wisconsin!**

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Herbicide Resistance Screening

- Greenhouse evaluation
- 3 populations
  - WI – WI glyphosate resistant*
  - NE-GR – NE glyphosate resistant
  - NE-S – NE glyphosate susceptible
- **Objective:** Determine the resistance level of a Palmer amaranth population detected in Wisconsin in 2018 to PRE and POST herbicides commonly used in corn and soybean systems.

* Wisconsin population collected from a field in the junction of Green/Rock counties.

MS Research: Felipe Faleco, UW-Madison WiscWeeds Program

PRE Herbicide Materials and Methods

PRE Treatments

Treatment:	atrazine	mesotrione	metribuzin	sulfentrazone	S-metolachlor
Product:	Aatrex 4L	Callisto	Tricor DF	Spartan 4F	Dual II Magnum
Formulation:	4 lb ai gal^{-1}	4 lb ai gal^{-1}	0.75 lb ai lb^{-1}	4 lb ai gal^{-1}	7.64 lb ai gal^{-1}
1x Dose:	4 pts/acre	7.7 fl oz/acre	10.7 oz ac^{-1}	8.0 fl oz/acre	26.7 fl oz/acre

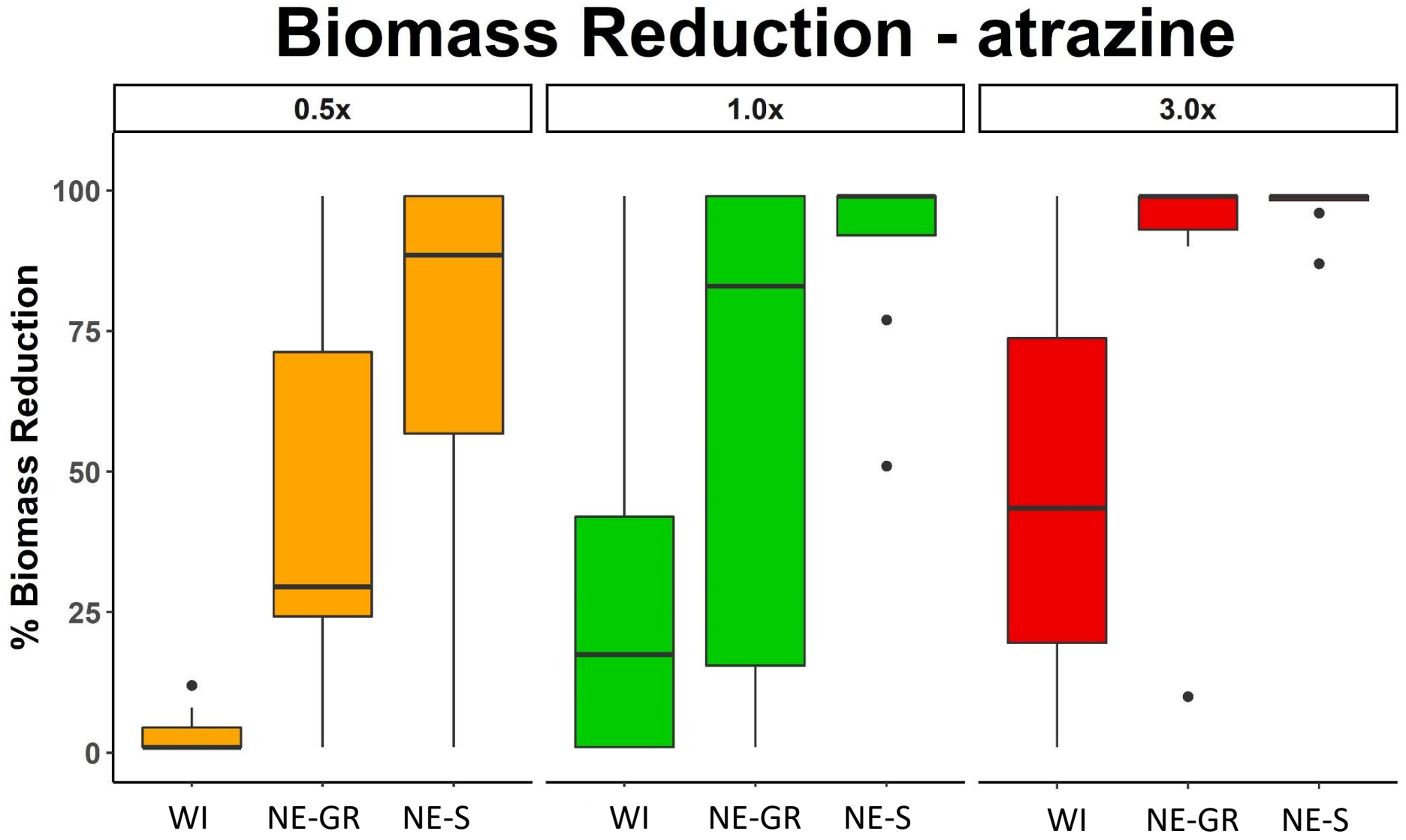
* 15 gal/acre and AI9502EVS nozzles in all applications. Applied immediately after planting.

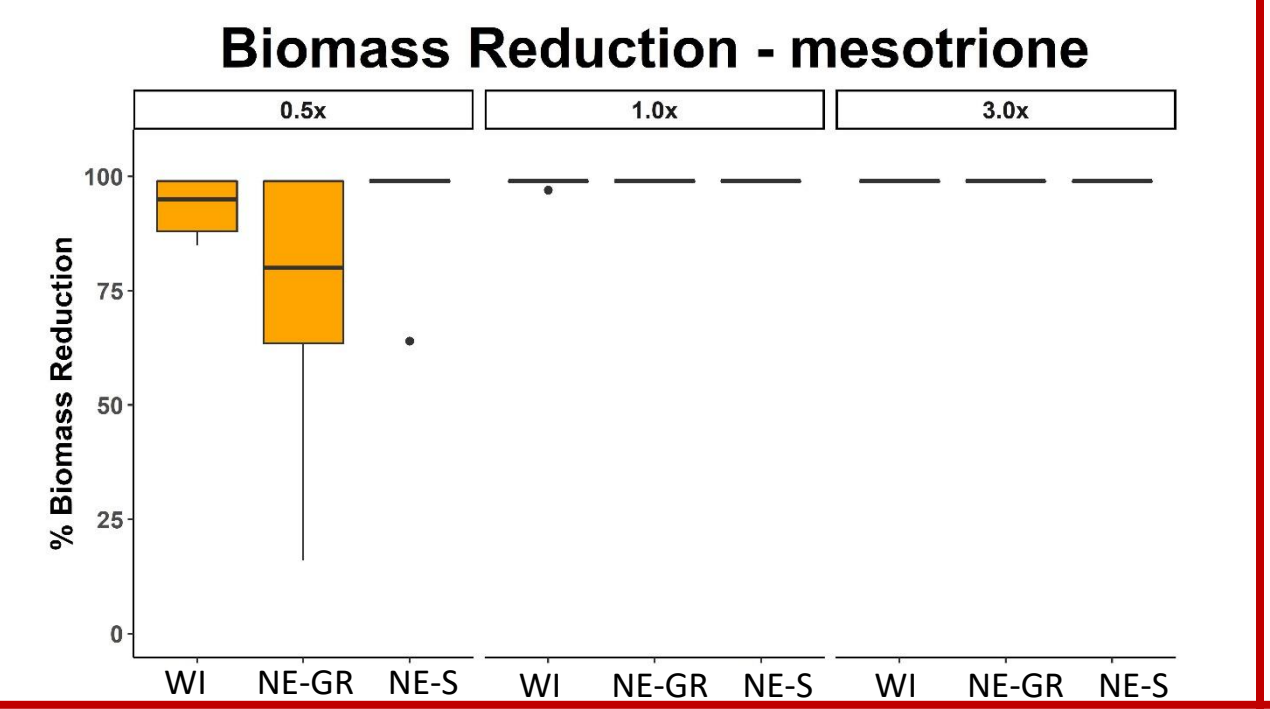
25 Days After Treatment

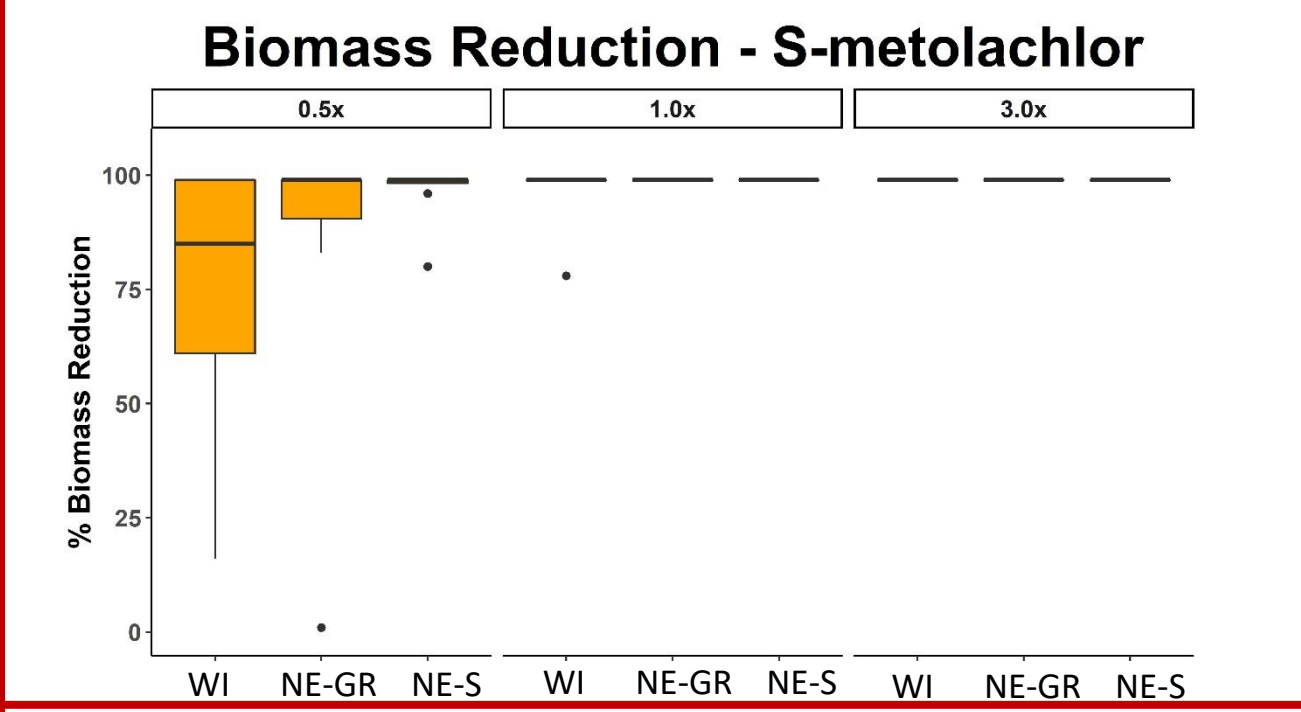
- plants were harvested and dried to constant weight
- Aboveground biomass reduction

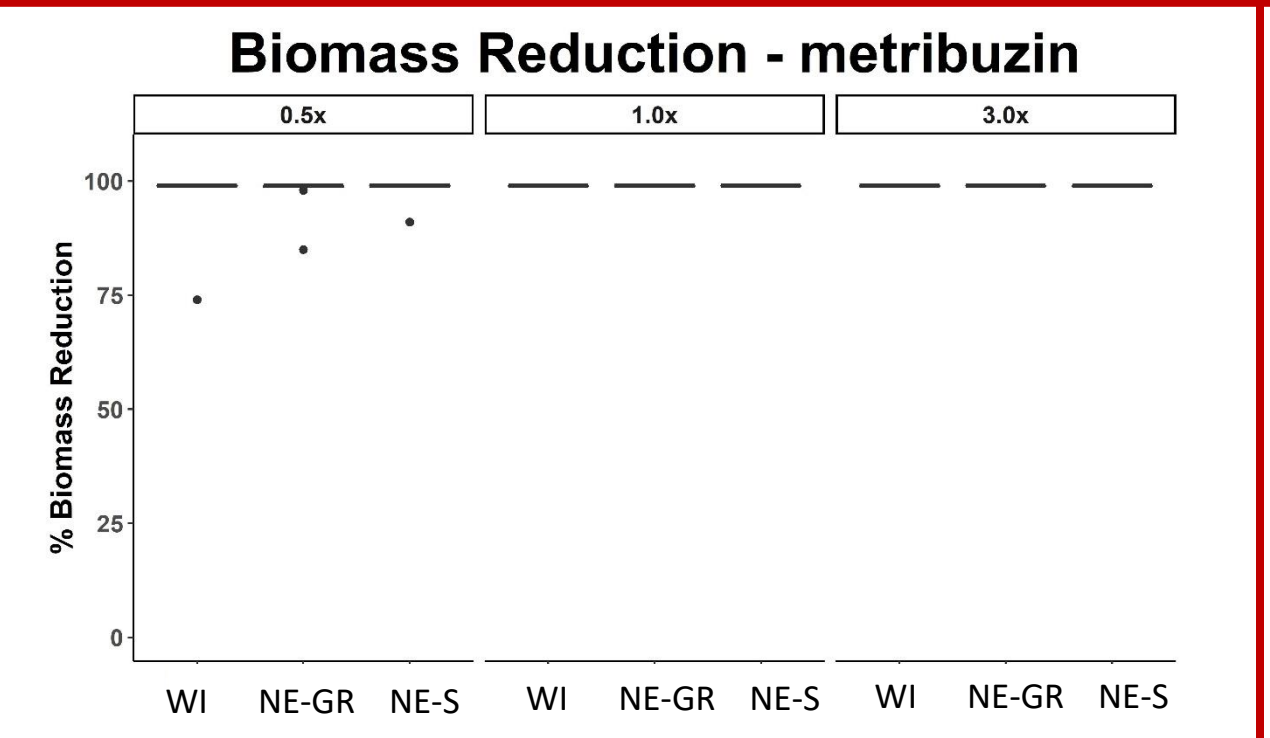
* 15 gal/acre and TP8002EVS nozzles in all applications except synthetic auxins.

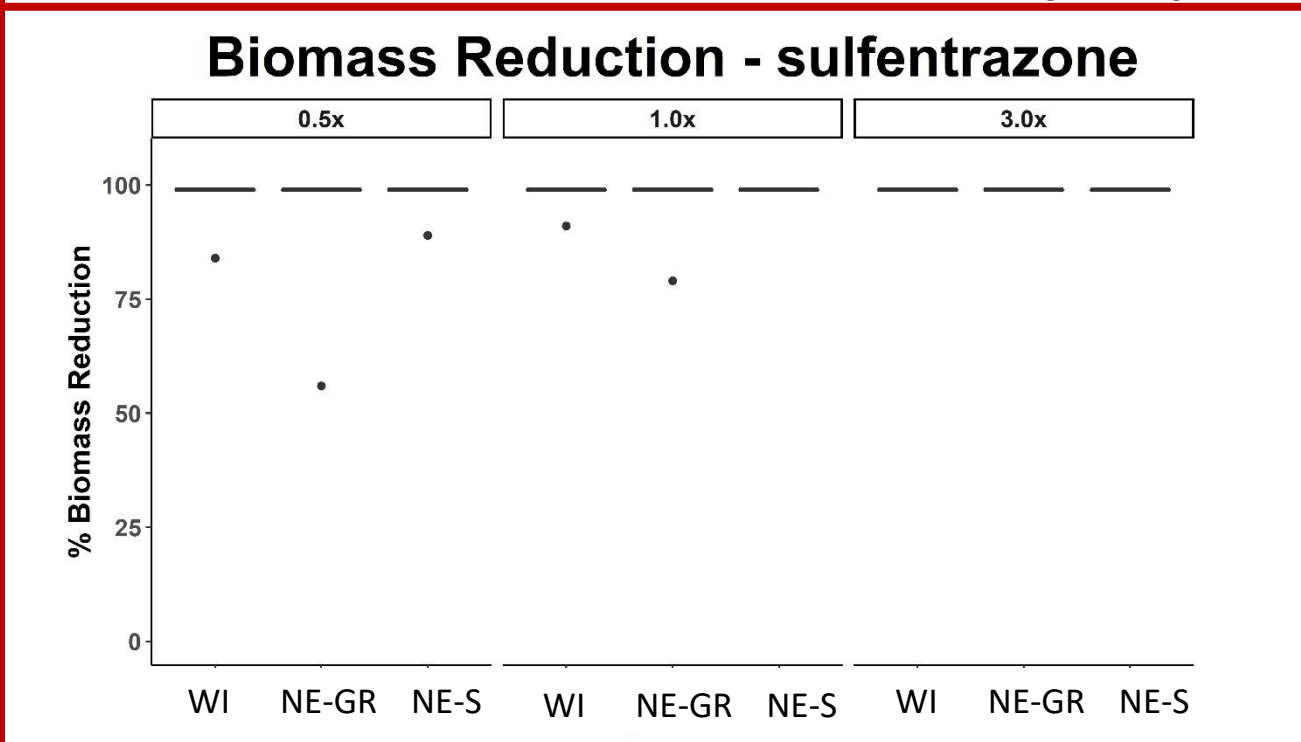
PRE Results


Biomass Reduction - atrazine
0.5x
1.0x
3.0x
% Biomass Reduction
100
75
50
25
0
WI
NE-GR
NE-S
WI
NE-GR
NE-S
WI
NE-GR
NE-S

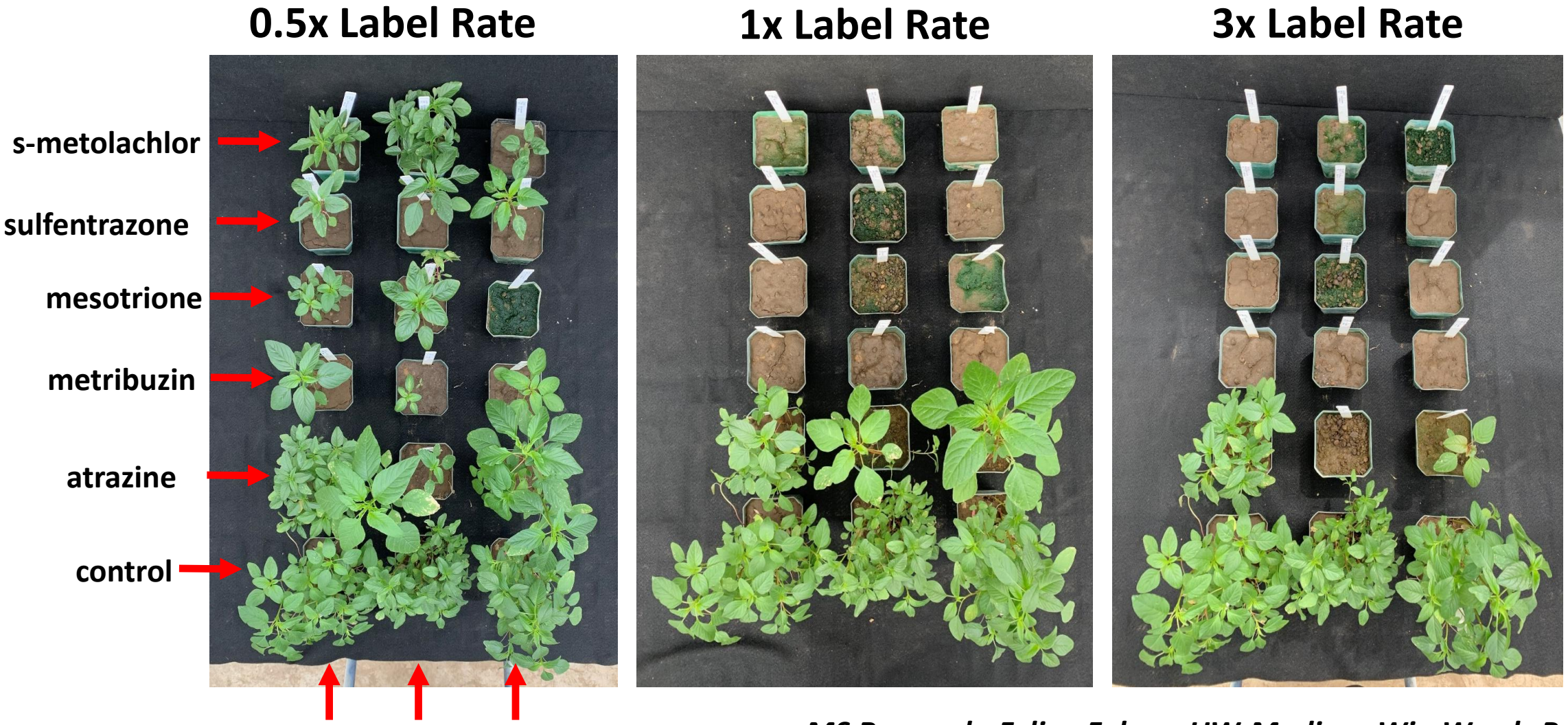

Biomass Reduction - mesotrione
0.5x
1.0x
3.0x
% Biomass Reduction
100
75
50
25
0
WI
NE-GR
NE-S


Biomass Reduction - S-metolachlor
0.5x
1.0x
3.0x
% Biomass Reduction
100
75
50
25
0
WI
NE-GR
NE-S


Biomass Reduction - metribuzin
0.5x
1.0x
3.0x
% Biomass Reduction
100
75
50
25
0
WI
NE-GR
NE-S


Biomass Reduction - sulfentrazone
0.5x
1.0x
3.0x
% Biomass Reduction
100
75
50
25
0
WI
NE-GR
NE-S

PRE Results



MS Research: Felipe Faleco, UW-Madison WiscWeeds Program

POST Herbicide Materials and Methods

POST Treatments

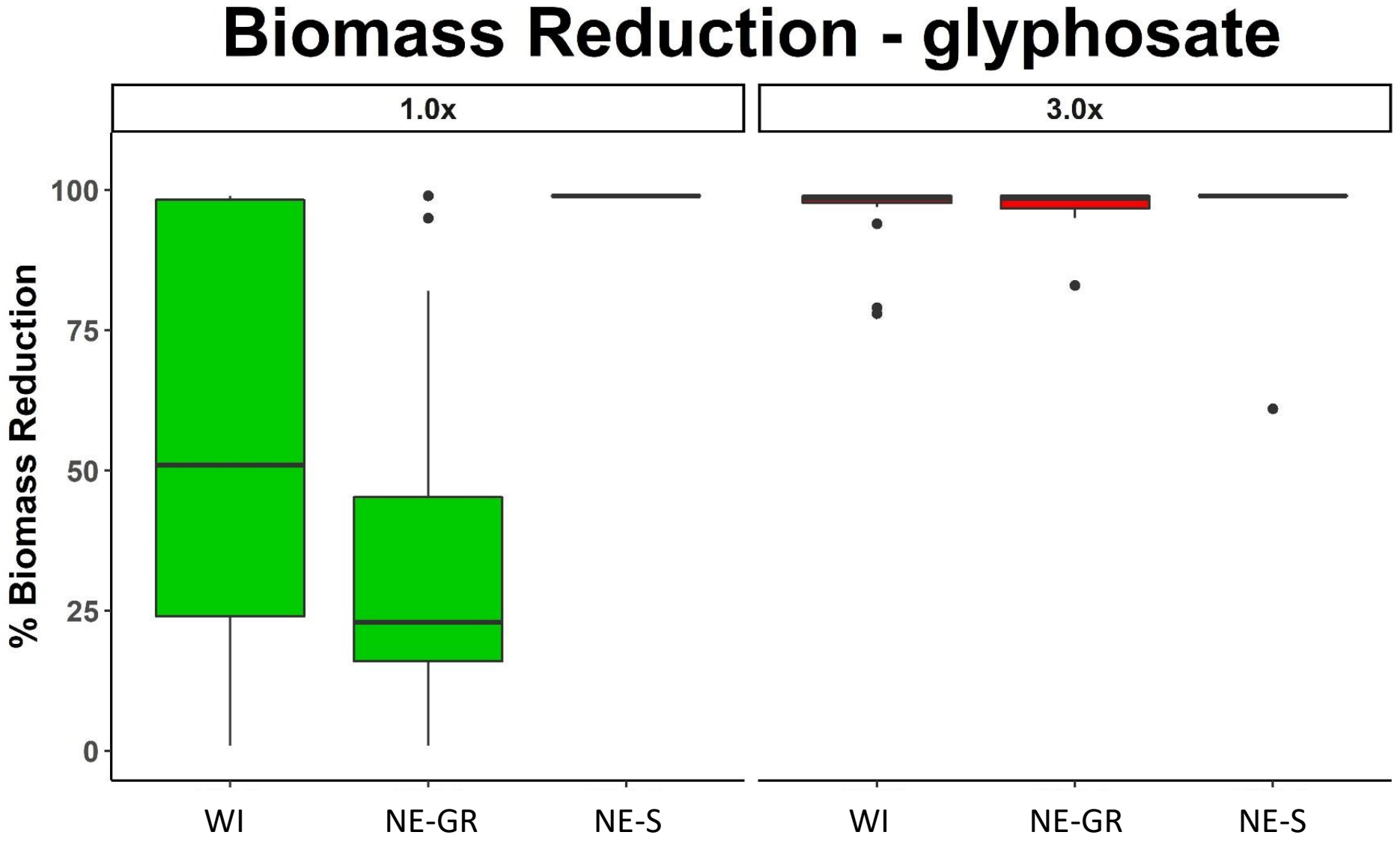
Treatment:	glyphosate	imazethapyr	atrazine	lactofen	mesotrione	glufosinate	2,4-D	dicamba
Product:	Roundup PowerMax	Pursuit	Aatrex 4L	Cobra	Callisto	Liberty 280 SL	Enlist One	XtendiMax
Formulation (lb ai/ae gal^{-1}):	5.5	2.0	4.0	2.0	4.0	2.34	3.8	2.9
1x Dose (fl oz ac^{-1}):	22.0	4.0	4 pts/acre	12.5	3.0	32.0	1.5 pt/acre	22.0
AMS Rate (lb ac^{-1}):	2.0	2.0	-	0.5	1.3	2.0	-	-
COC Dose (% v/v):	-	0.63	0.83	0.42	0.5	-	-	-

* 15 gal/acre and TP8002EVS nozzles in all applications except synthetic auxins. Treatments applied to 3-4” waterhemp.

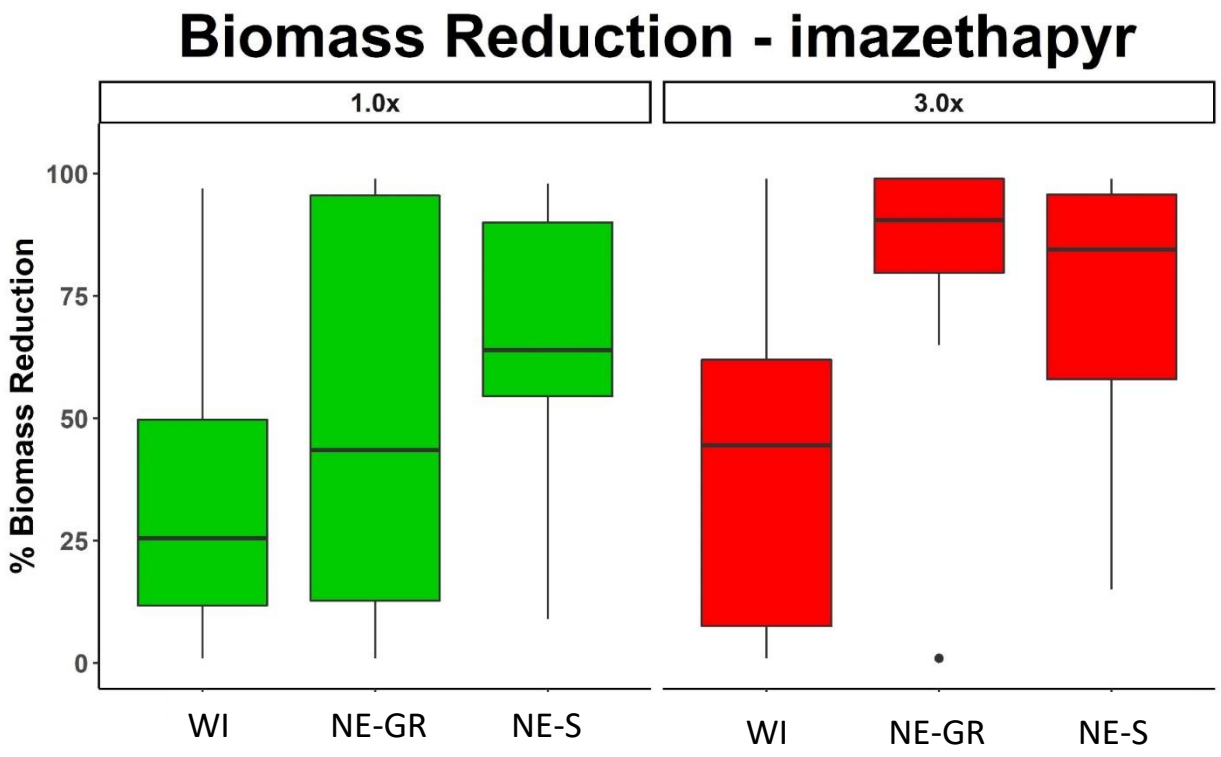
21 Days after Treatment

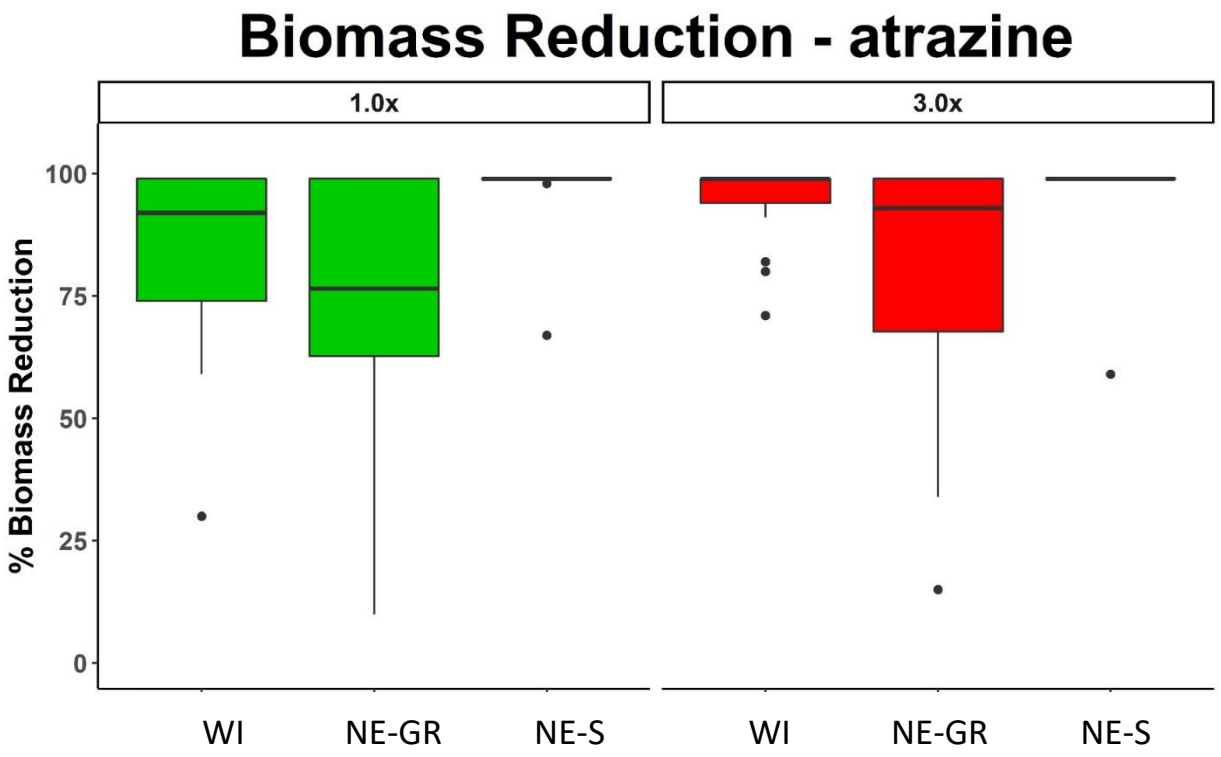
- Visual evaluation (VE) of plant growth on a scale of 1 to 10
- Aboveground biomass reduction
- Considered resistant if ≥ 50% of treated plants had VE ≥ 7 (healthy plants).

Results POST



Results POST





WI Population

glyphosate

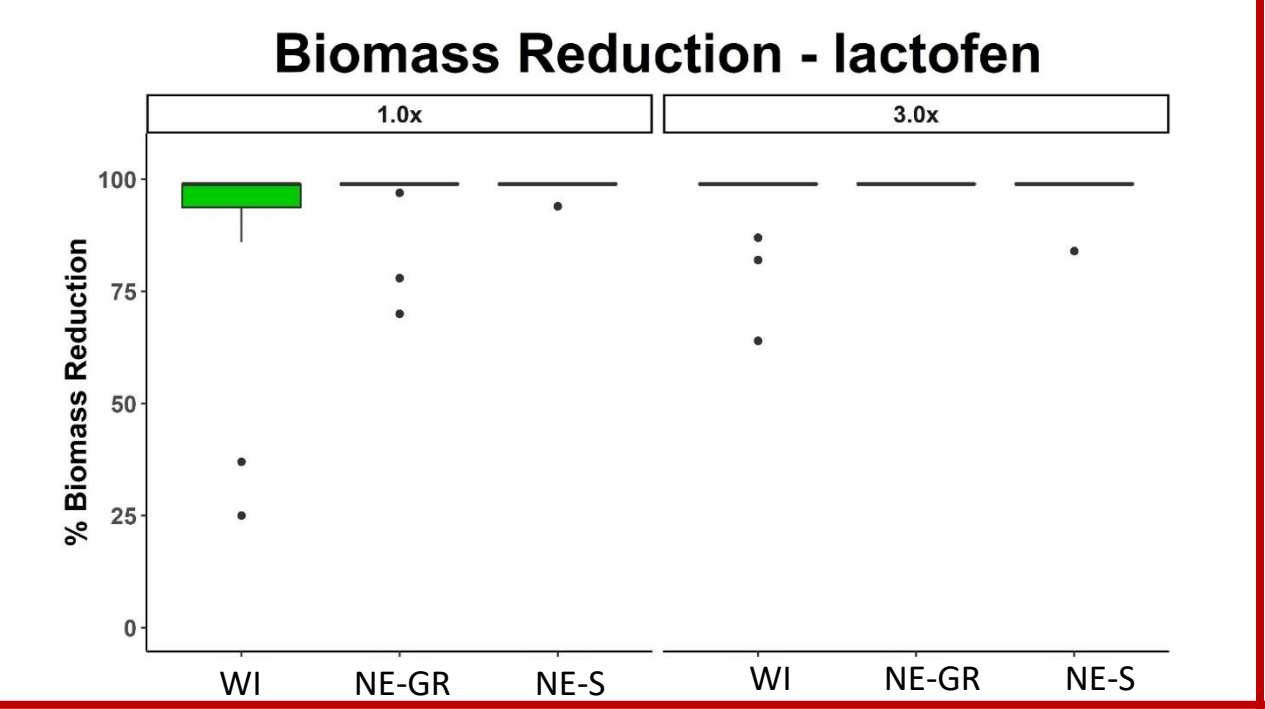
Control 1x 3x

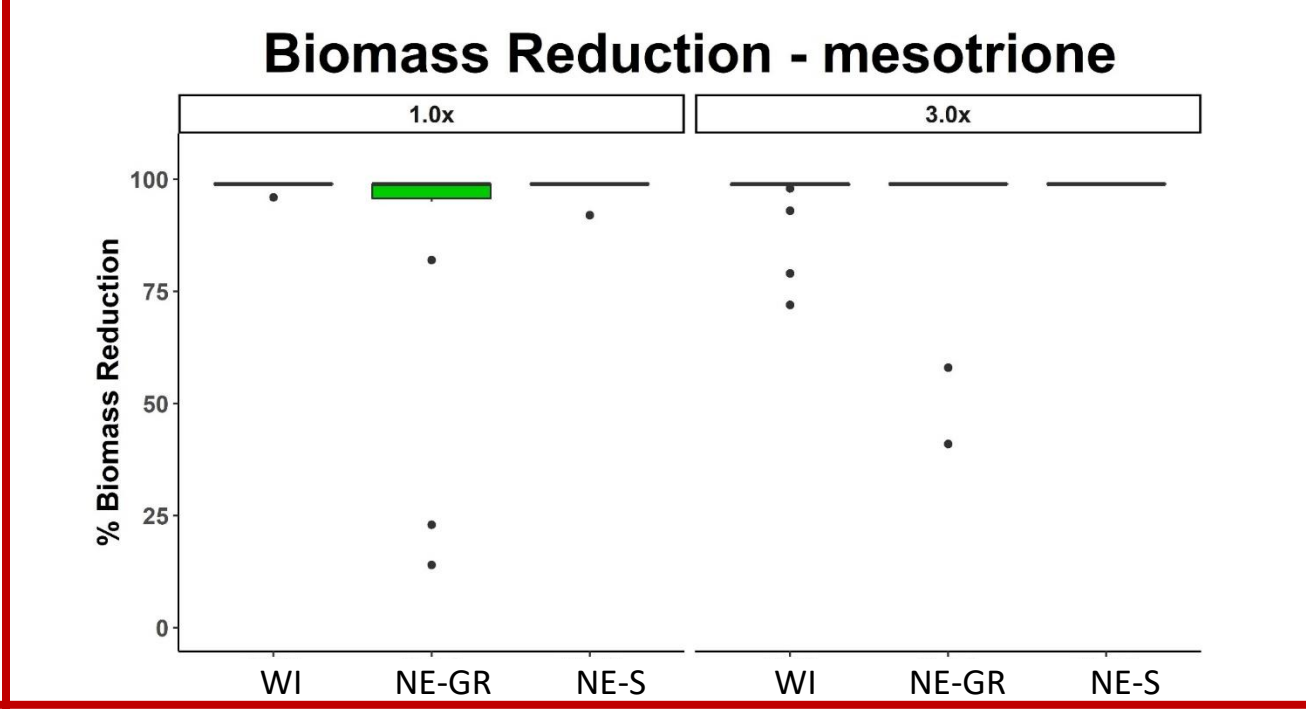
imazethapyr

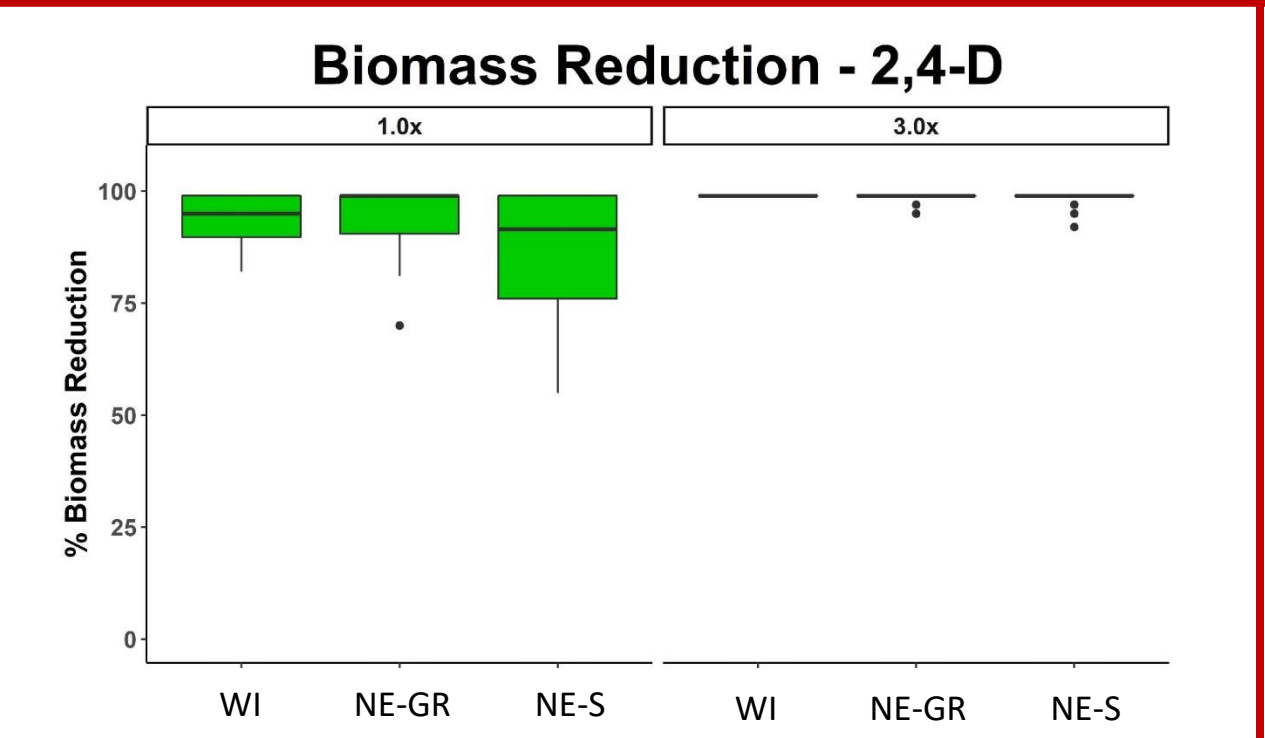
Control 1x 3x

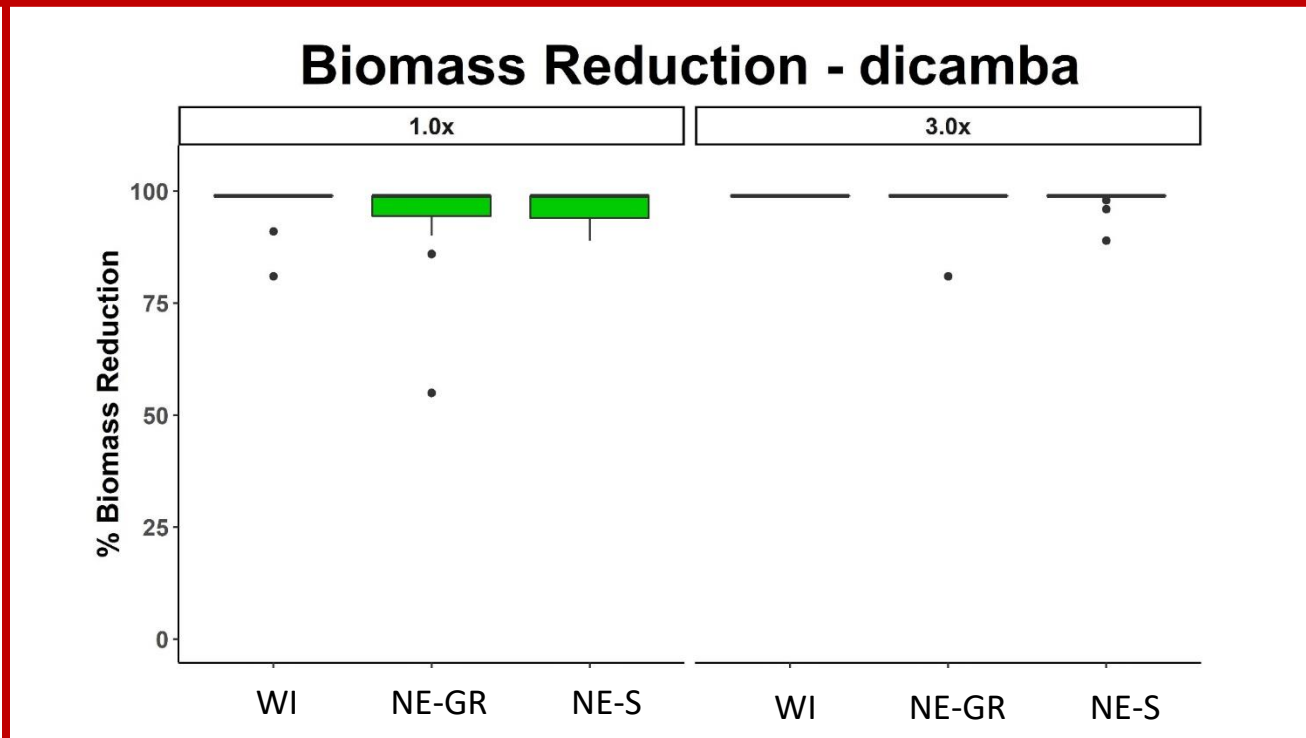
atrazine

Control 1x 3x


Biomass Reduction - lactofen
1.0x
3.0x
% Biomass Reduction
100
75
50
25
0
WI
NE-GR
NE-S
WI
NE-GR
NE-S


Biomass Reduction - mesotrione
1.0x
3.0x
% Biomass Reduction
100
75
50
25
0
WI
NE-GR
NE-S
WI
NE-GR
NE-S


Biomass Reduction - 2,4-D
1.0x
3.0x
% Biomass Reduction
100
75
50
25
0
WI
NE-GR
NE-S
WI
NE-GR
NE-S


Biomass Reduction - dicamba
1.0x
3.0x
% Biomass Reduction
100
75
50
25
0
WI
NE-GR
NE-S
WI
NE-GR
NE-S

WI Population

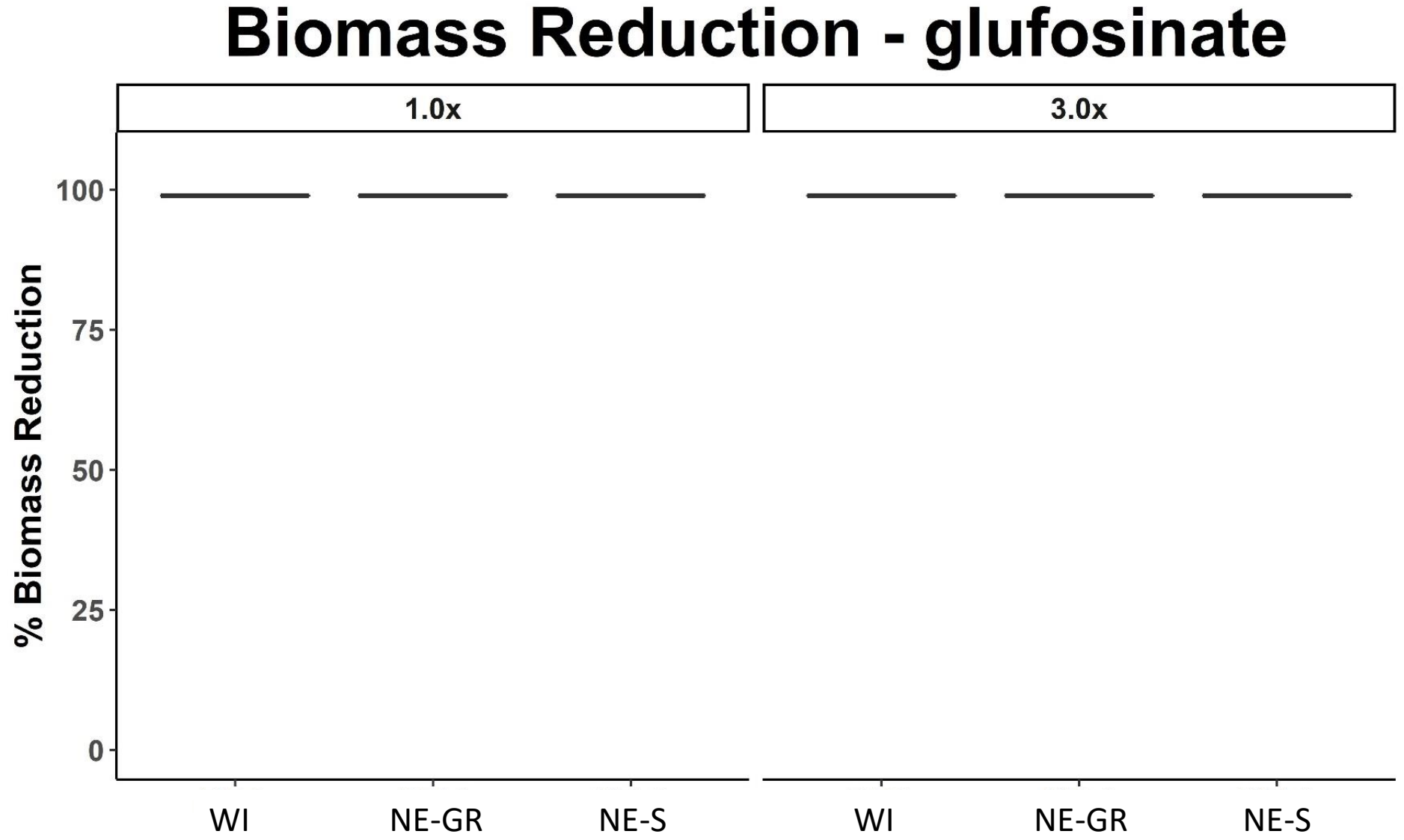
2,4-D

Control 1x 3x

dicamba

Control 1x 3x

Results POST



glufosinate

WI

Control 1x 3x

NE-GR

Control 1x 3x

NE-S

Control 1x 3x

Take-Home

- Palmer amaranth is not widespread in Wisconsin
- If presented the opportunity, Palmer amaranth will establish and likely be herbicide-resistant
- Be vigilant, proactive and take action immediately if Palmer amaranth presence is detected

- **Let’s keep Wisconsin Palmer FREE!**

Thanks!

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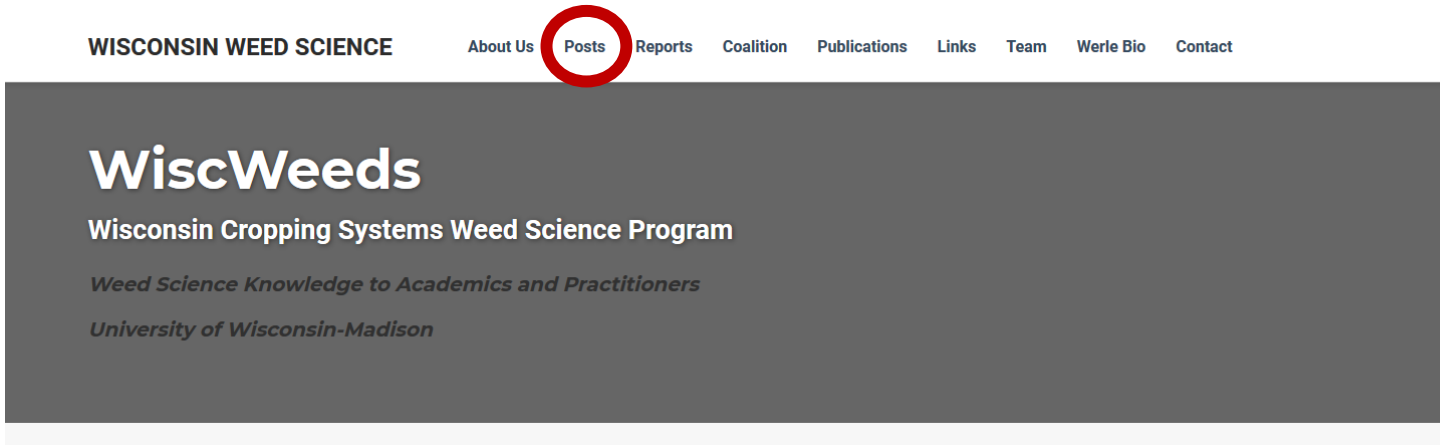
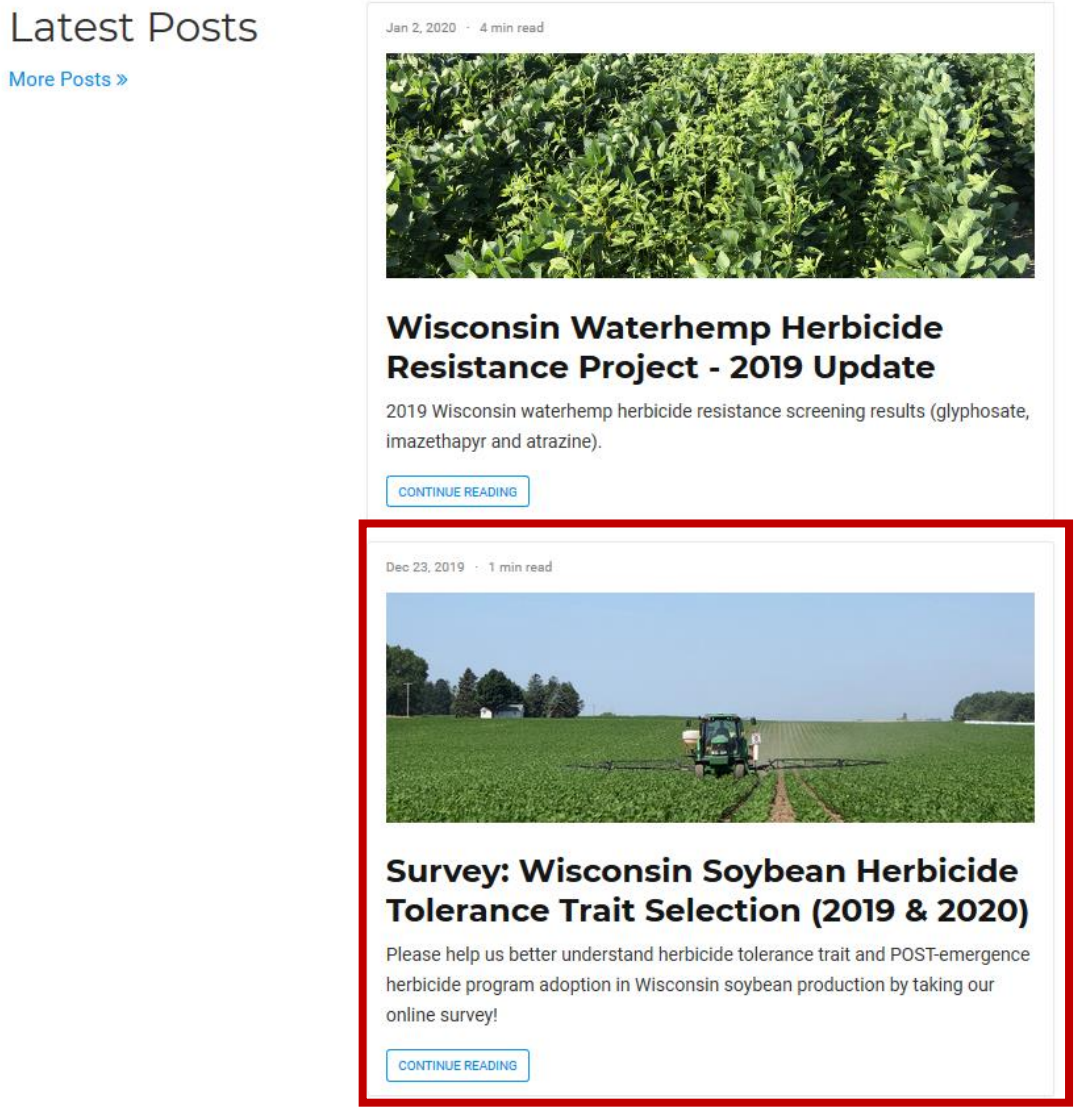
Questions?

Survey: Wisconsin Soybean Herbicide Tolerance Trait Selection (2019 & 2020)

www.WiscWeeds.info





Objective: better understand herbicide tolerance trait and POST-emergence herbicide adoption in Wisconsin soybean production during 2019 and plans for 2020.