Selecting Preemergence Herbicides for Effective Soil Residual Weed Control and Successful Establishment of Interseeded Cover Crops in Wisconsin Corn Production Systems

WHAT A CHALLENGE!

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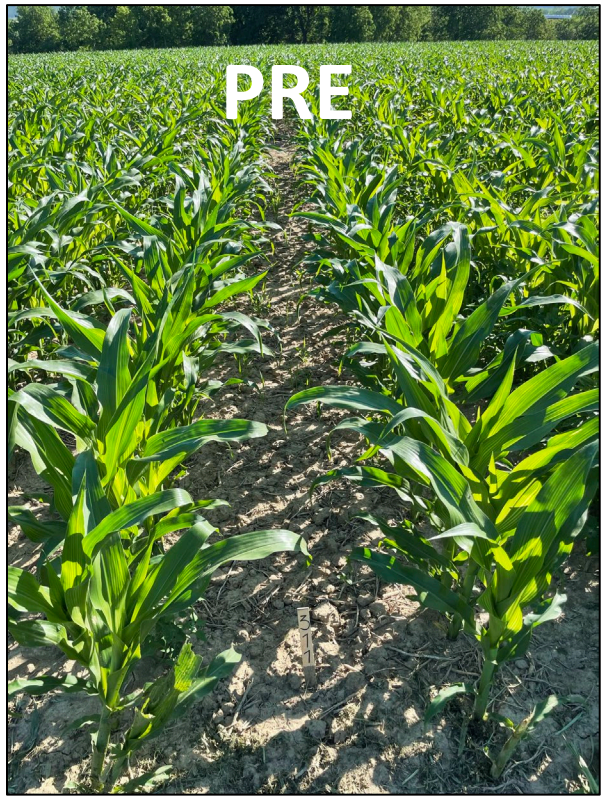
Introduction

Why PRE herbicides?



X

40 DAT

- Early-season weed control.
- Preemergence (PRE) can delay the time and reduce the reliance on post-emergence applications.

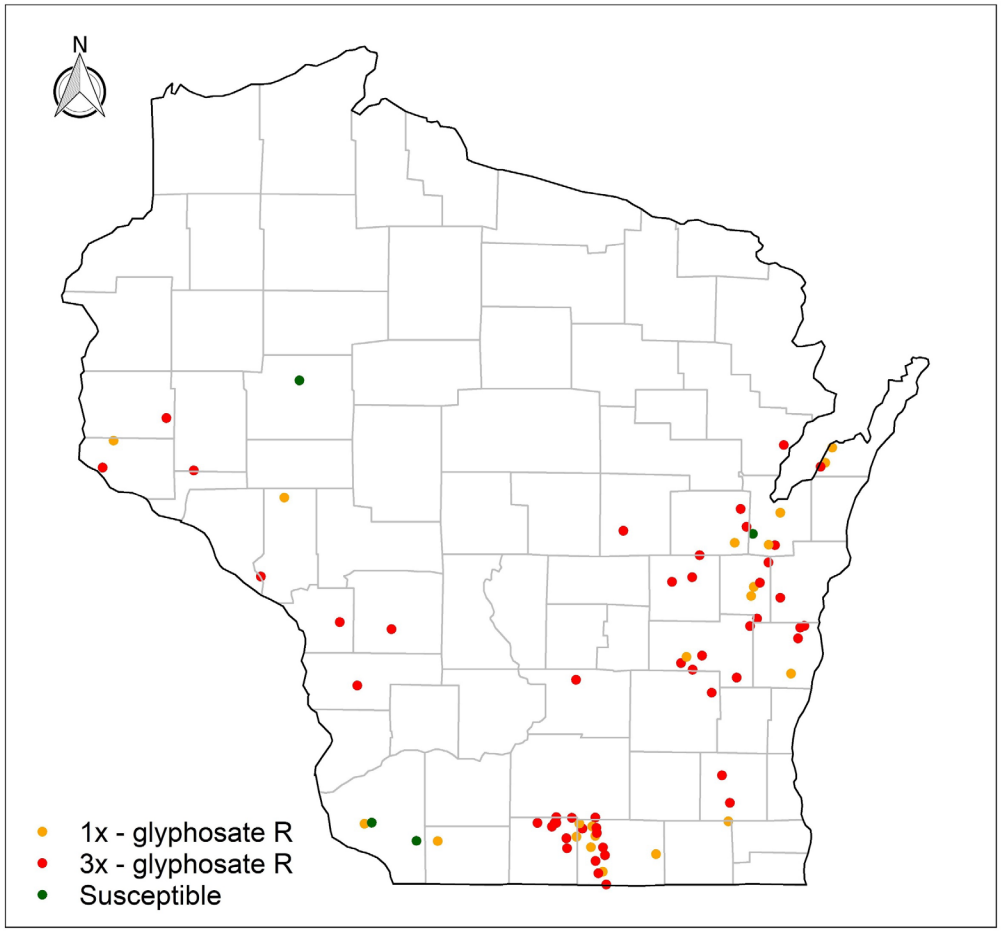
Selection pressure for further resistance to POST herbicides.

Wallace et al., 2017, Striegel et al., 2022

Introduction

Why PRE herbicides?

Glyphosate resistance in Wisconsin waterhemp – 2019 update



Source: University of Wisconsin - Madison

Osipitan et al., 2018; Faleco et al., 2020; Grint et al., 2022

Introduction

Integrated Weed Management

Why cover crops?

Wallace et al., 2017, Palhano et al., 2018

Introduction

Why interseeding?

Lack of growing degree days after corn is harvested

Late planting window limits the diversity of CC species that can be used

CC may not successfully establish if interseeded too late

Introduction

When to interseed?

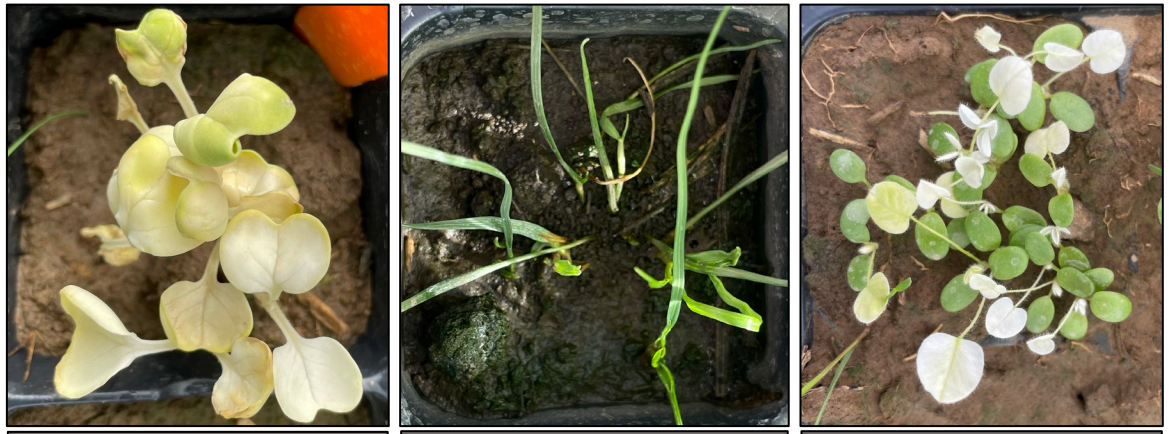
CAUTION!

From **V3**-V7 corn growth stage

V3 stage
30 DAT

Smith and Ruark, 2022

Residues of PRE herbicides (CC injury)



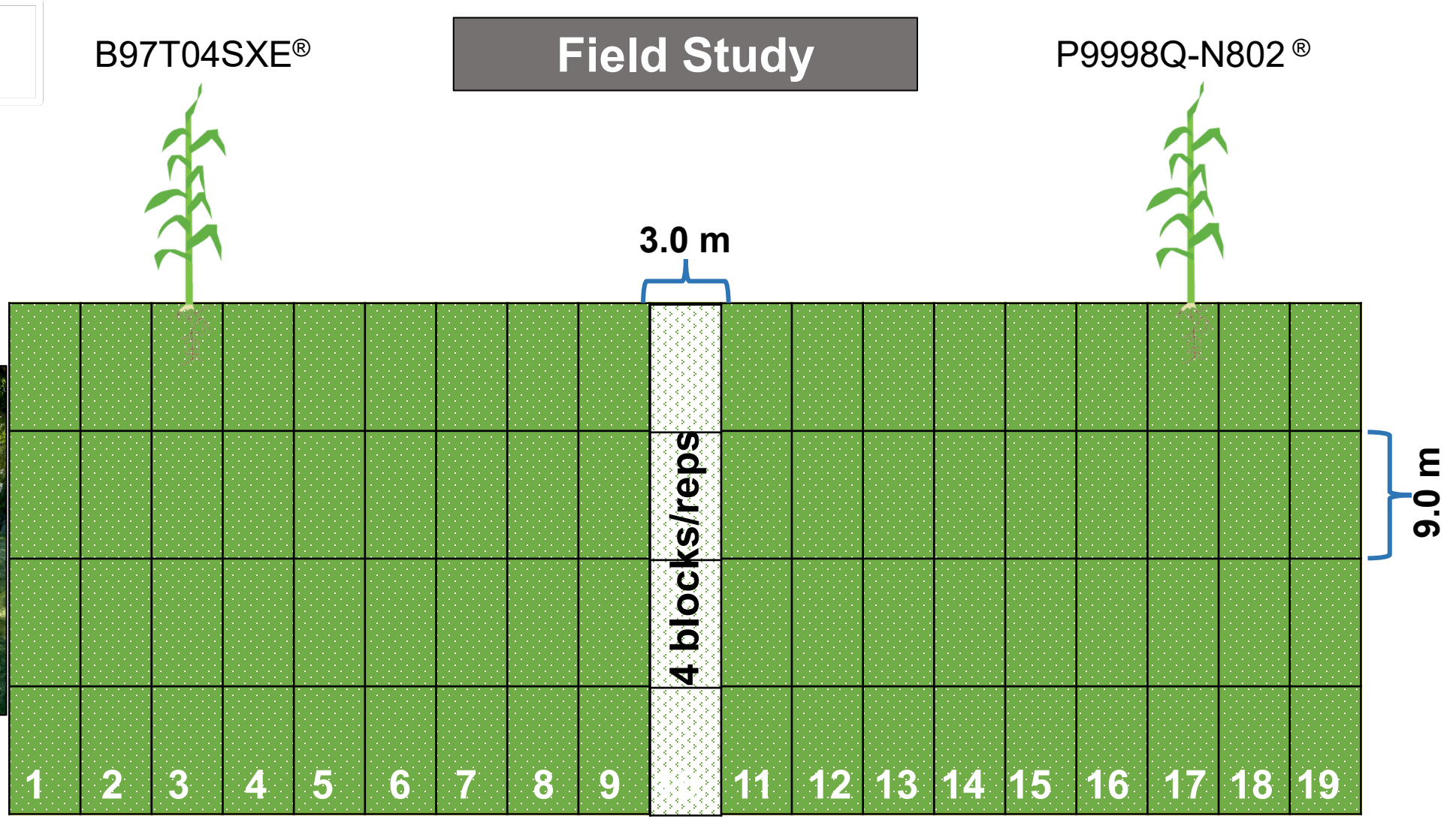
Radish | **Annual rye** | **Red clover**

Cornelius and Bradley, 2022

Objective: Evaluate residual PRE herbicides for effective waterhemp control with minimal impact on establishment of interseeded cover crops in Wisconsin corn production

Hypothesis: Not all PRE herbicides provide effective waterhemp control with minimal impact on cover crops interseeded into corn at **V3** growth stage

Materials & methods



Trade name	Active ingredients (ai)	Abbreviation	Rate g ai (ae) ha^{-1}	Site of action (SOA) Group
Diflexx®	dicamba	DICAM	560	4
AAtrex®	atrazine	ATZ	1120	5
Princep 4FL®	simazine	SMZ	2240	5
Harness®	acetochlor	ACET	1960	15
Dual II Magnum®	S-metolachlor	S-MET	1791	15
Balance Flexx®	izoxaflutole	IFT	79	27
Callisto®	mesotrione	MES	175	27
Harness MAX®	acetochlor + mesotrione	ACET + MES	1971 + 185	15 & 27
Corvus®	thiencarbazone-methyl + isoxaflutole	TCM + IFT	34 + 85	2 & 27
Bicep Lite II Magnum®	atrazine + S-metolachlor	ATZ + S-MET	1310 + 1634	5 & 15
Harness Xtra®	atrazine + acetochlor	ATZ + ACET	952 + 2408	5 & 15
Verdict®	saflufenacil + dimethenamid-P	SAFL + DIM-P	75 + 655	14 & 15
Hornet WDG®	flumetsulam + clopyralid	FLUM + CLOP	52 + 168	2 & 4
Acuron® Flexi	S-metolachlor + bicyclopyrone + mesotrione	S-MET + BIP + MES	1602 + 45 + 179	15 & 27
Acuron®	atrazine + bicyclopyrone + S-metolachlor + mesotrione	ATZ + CLOP + S-MET + MES	700 + 42 + 1498 + 168	5 & 15 & 27
Surestart II®	flumetsulam + clopyralid + acetochlor	FLUM + CLOP + ACET	42 + 133 + 1315	2 & 4 & 15
Resicore®	clopyralid + acetochlor + mesotrione	CLOP + ACET + MES	133 + 1960 + 210	4 & 15 & 27
Maverick®	clopyralid + pyroxasulfone + mesotrione	CLOP + PYRO + MES	194 + 194 + 233	4 & 15 & 27

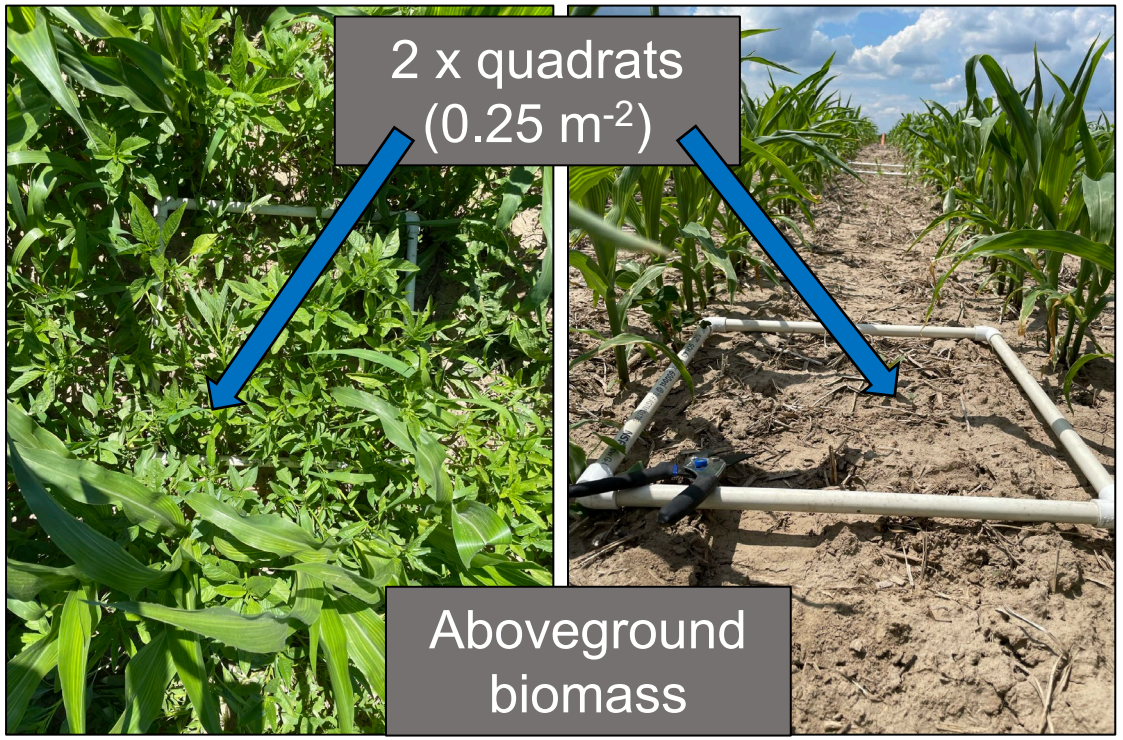
Materials & methods

Data Collection - Biomass

Herbicide application

2021-2022

6 WAT



Materials & methods

Data Analysis

4.2.1

- **Waterhemp** biomass reduction (%) compared to the NTC within each year.

- Generalized linear mixed model - beta distribution and logit family.

"glmmTMB"

- Comparison between herbicide **ai** (1, 2, and 3 or more ai).

"emmeans"

- Biomass reduction # response variable
- Herbicide # fixed variable
- (1|block) # randomized effects

- Fisher's LSD ($p \leq 0.05$).

Bioassay Experiment

Materials & methods

4 bioindicator species

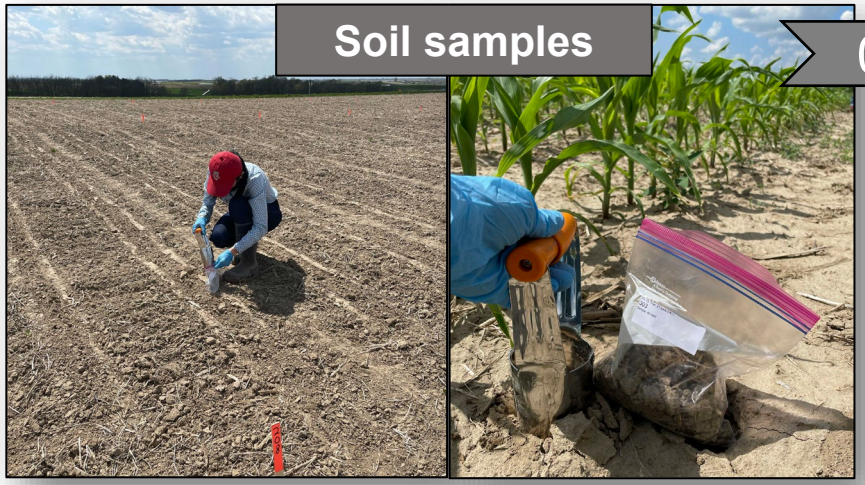
Radish (*Raphanus sativus* L.)

Red clover (*Trifolium pratense* L.)

Cereal rye (*Secale cereale* L.)

Annual rye (*Lolium multiflorum* L.)

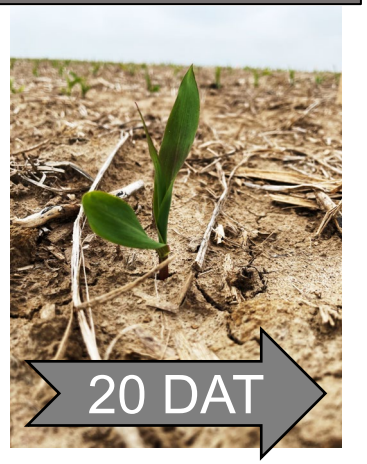
Materials & methods



0 DAT

10 DAT

V1: 1st leaf colar



V3: 3rd leaf colar

V5: 5th leaf colar

V7: 7th leaf colar

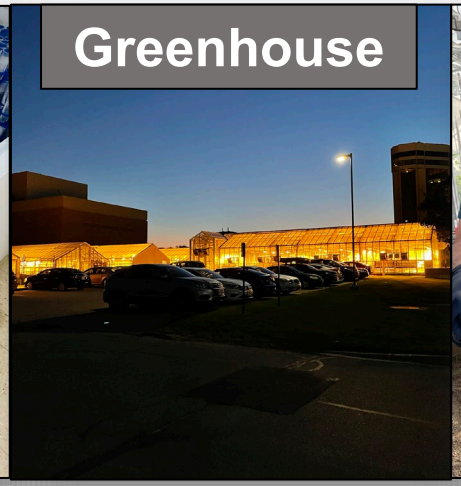
V9: 9th leaf colar

V11: 11th leaf collar

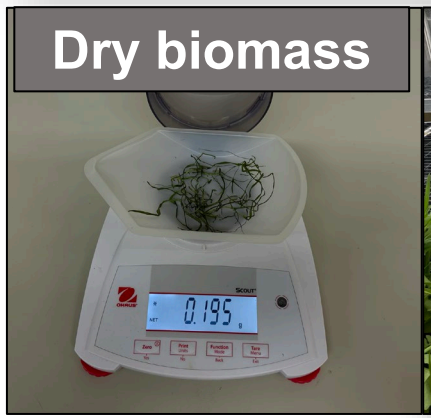
Materials & methods


Soil samples


Transportation & storage


Greenhouse


Setup


Dry biomass

Harvest


Plant growth


Watering


Planting

Materials & methods

Data Analysis

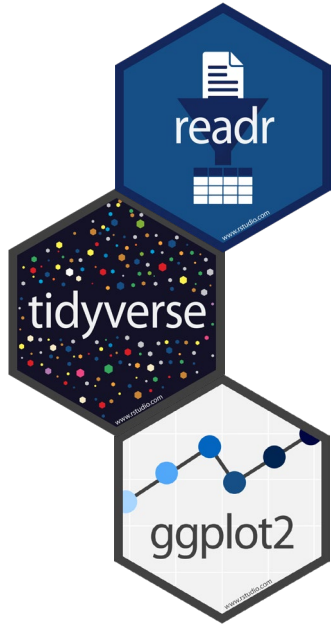
R 4.2.1

- **2021 - AR, CR, RA & RC** biomass reduction (%) compared to the NTC.

- Three-parameter log-logistic function

$$y = 0 + \frac{d - 0}{1 + \exp(b(\log(x) - \log(e)))}$$

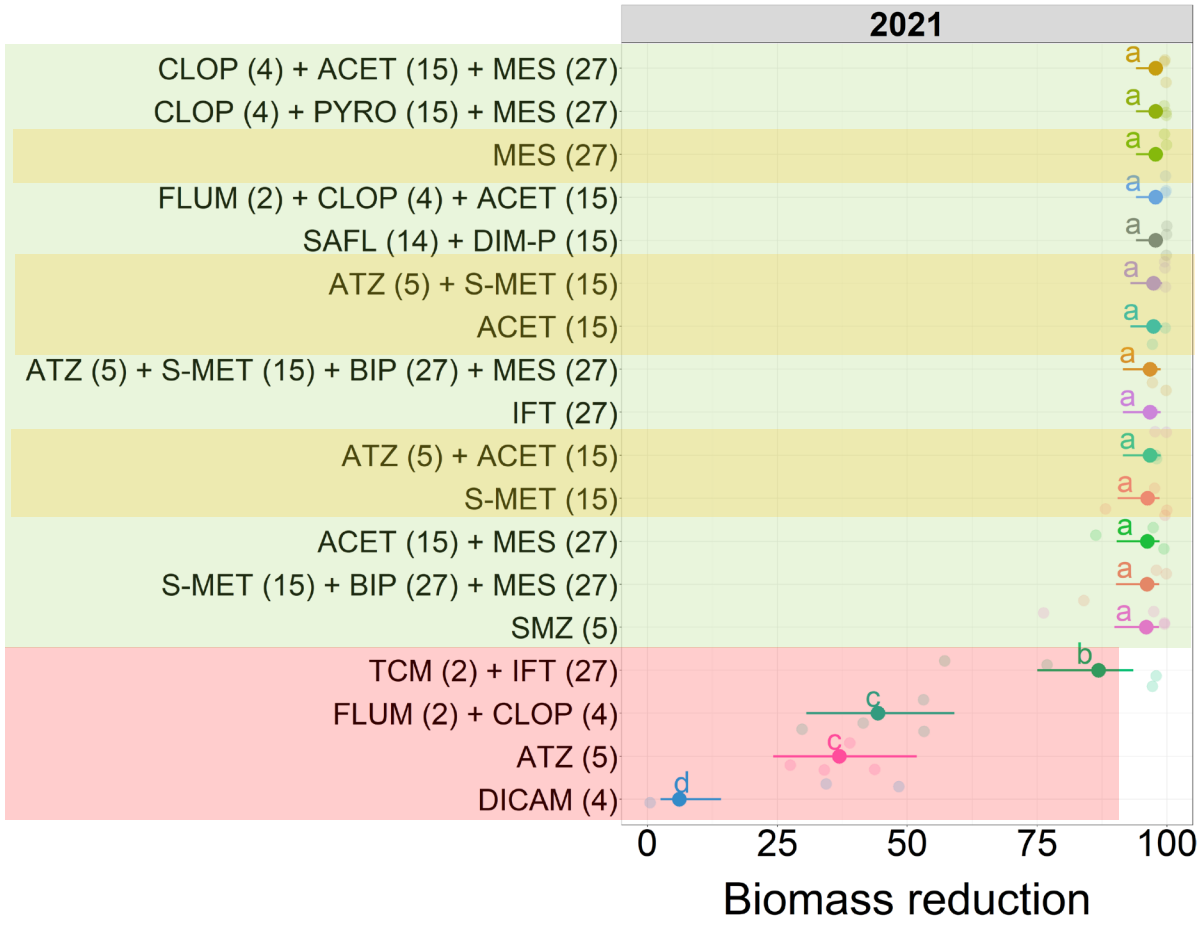
"drc" package

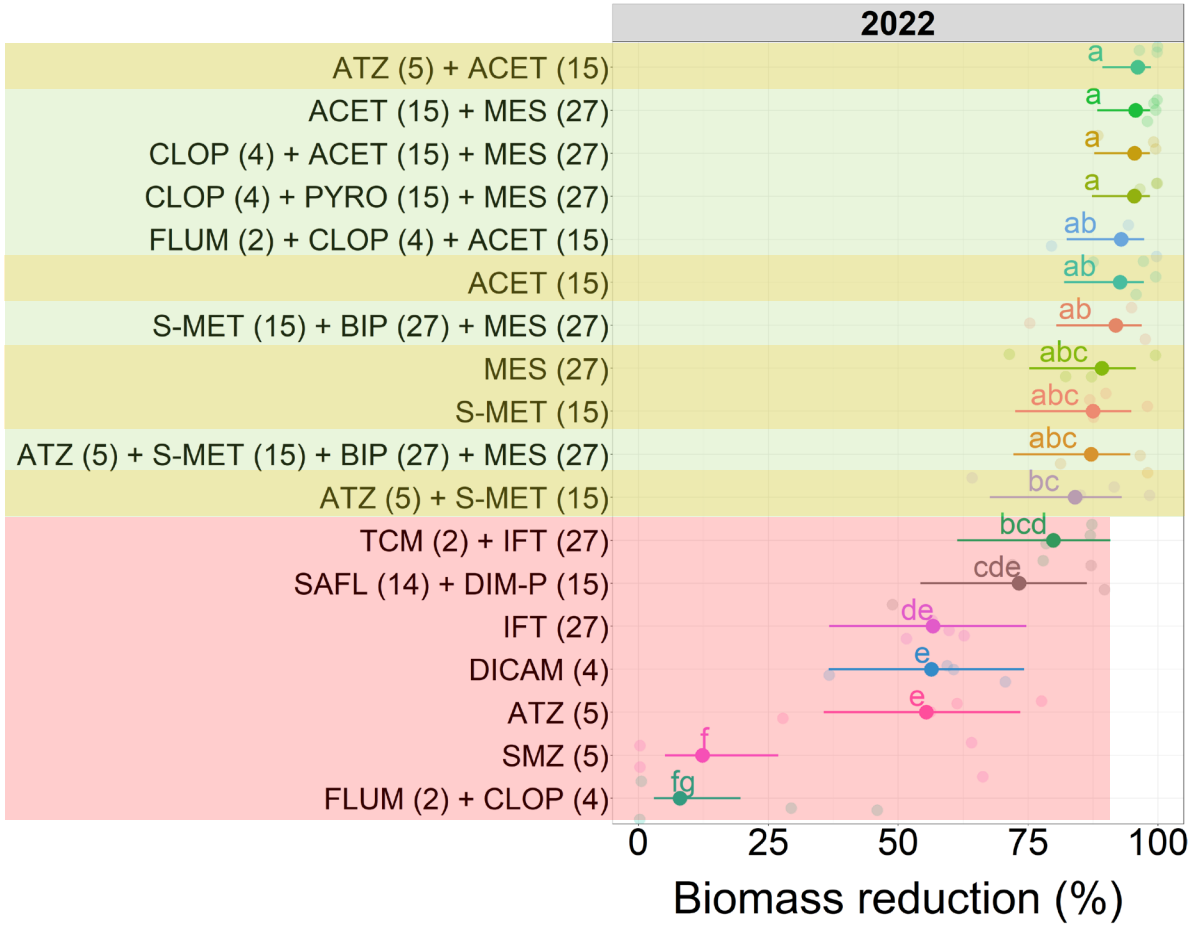


CHEAL_21_22_Control.Rmd

Results & Discussion

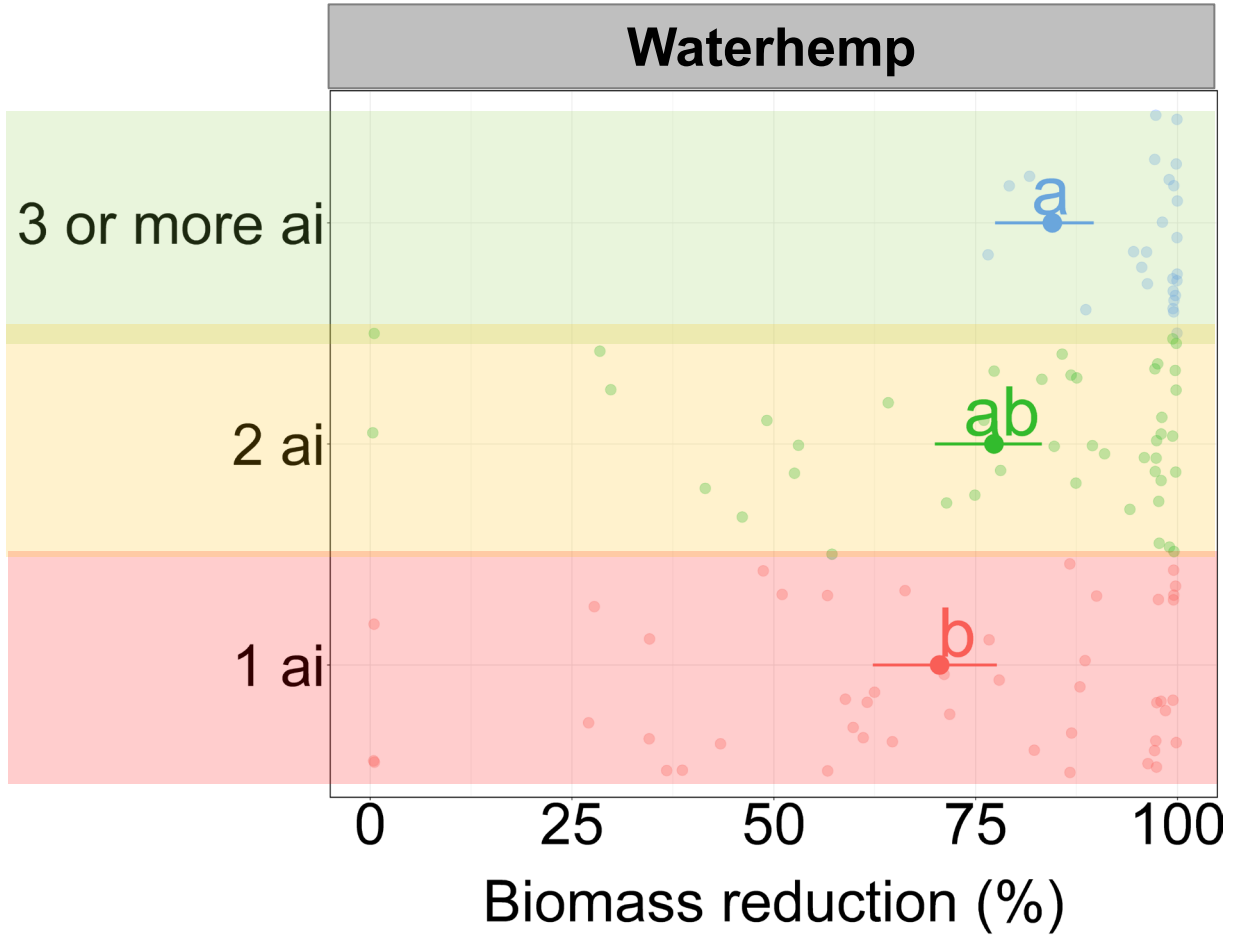
Waterhemp – biomass reduction



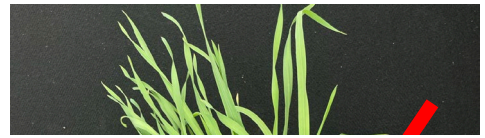


Results & Discussion

Number of active ingredients (ai)



Results & Discussion



Weed Technology

Article contents

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Published online by Cambridge University Press: **06 September 2017**

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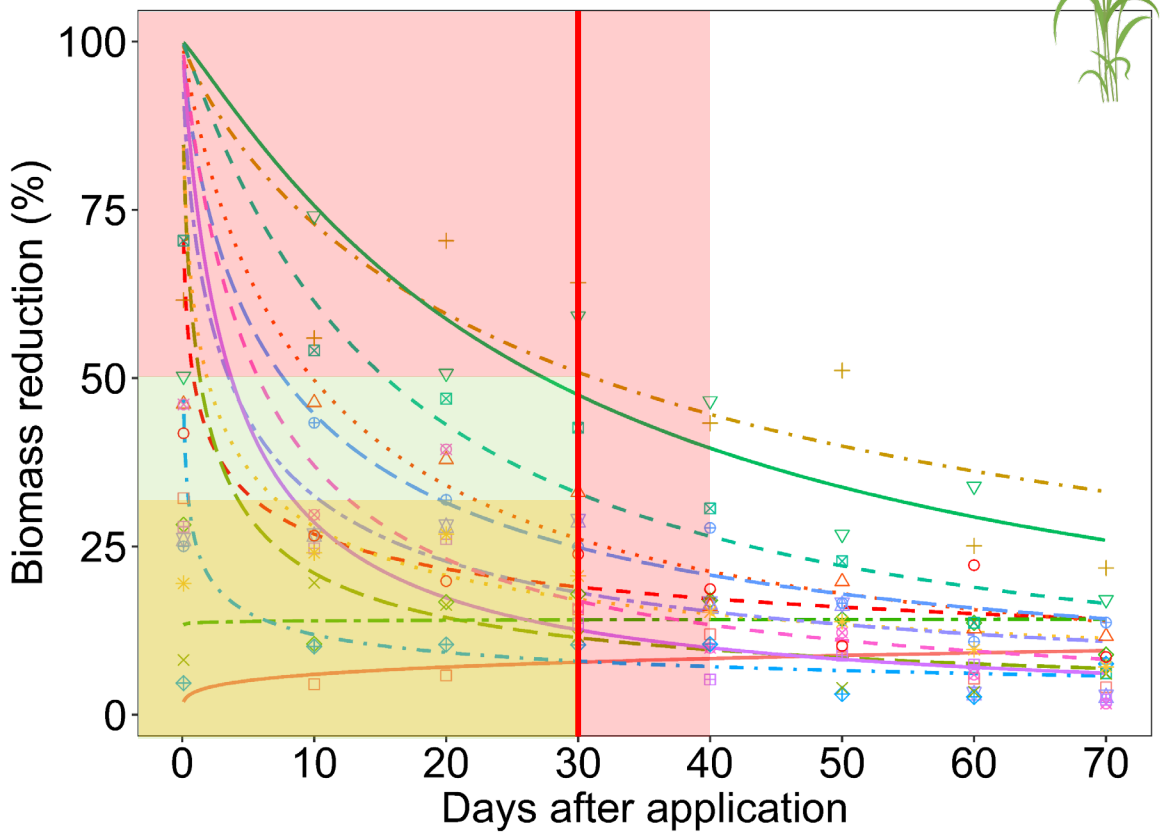
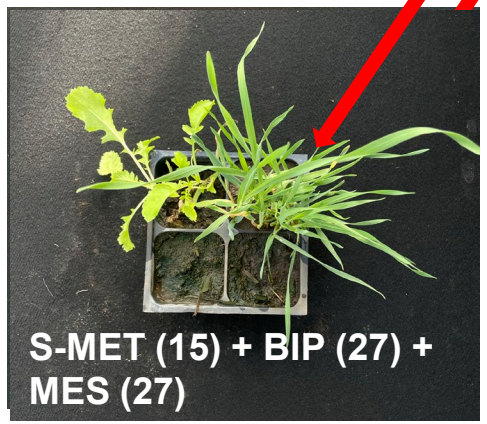
Results & Discussion

Cereal rye

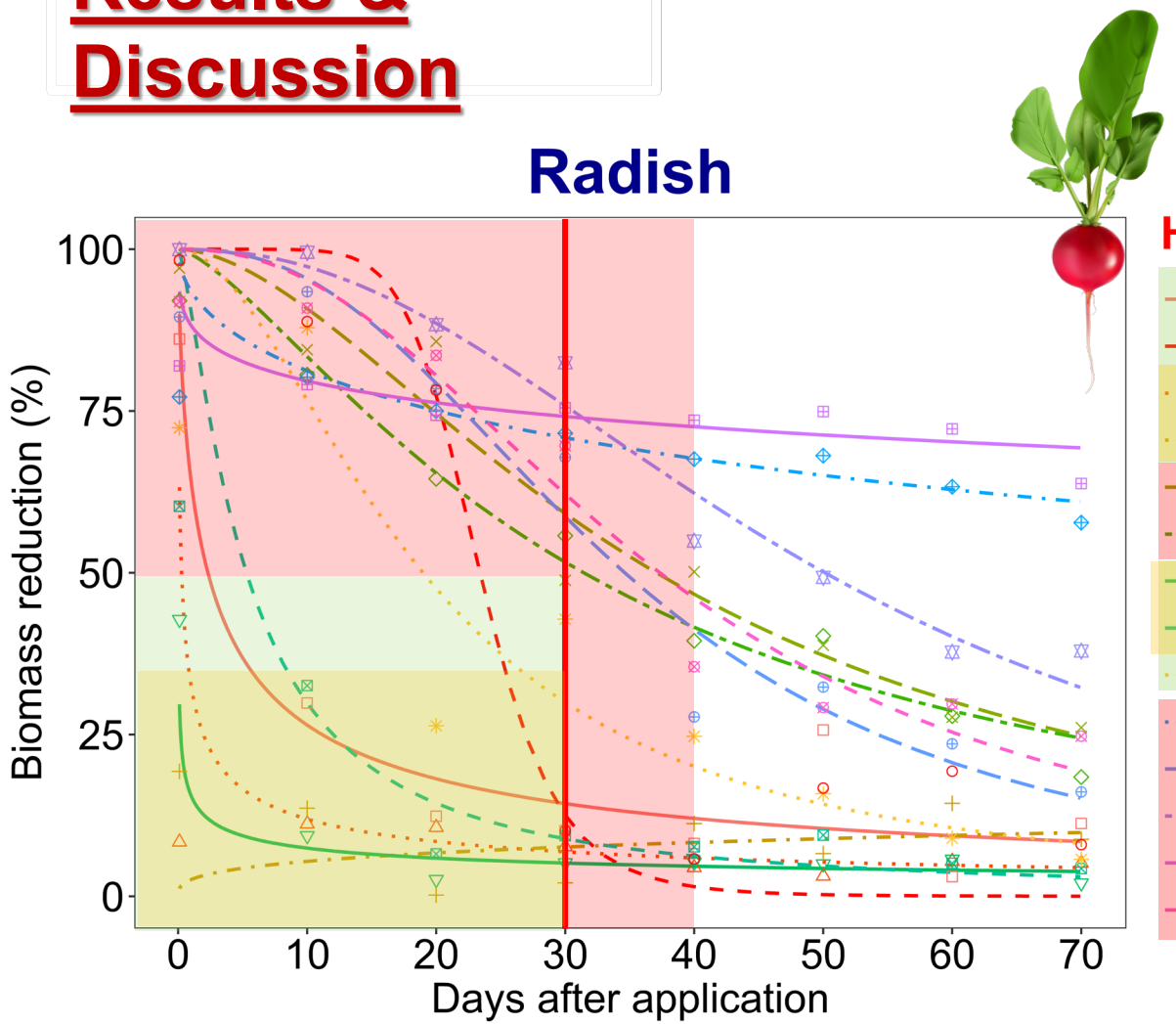


Herbicide

- ATZ (5)
- SMZ (5)
- ACET (15)
- S-MET (15)
- MES (27)
- ACET (15) + MES (27)
- ATZ (5) + S-MET (15)
- ATZ (5) + ACET (15)
- SAFL (14) + DIM-P (15)
- FLUM (2) + CLOP (4)
- S-MET (15) + BIP (27) + MES (27)
- ATZ (5) + S-MET (15) + BIP (27) + MES (27)
- FLUM (2) + CLOP (4) + ACET (15)
- CLOP (4) + ACET (15) + MES (27)



Results & Discussion



Herbicide

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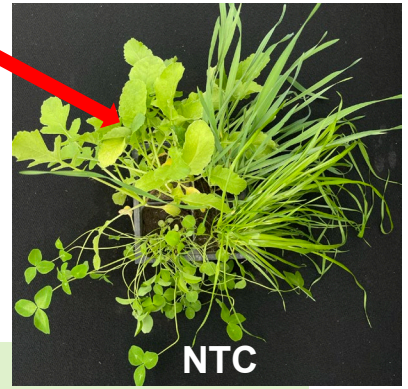

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S-MET (15)

Conclusions

- PRE herbicide premixes had a better overall performance in waterhemp control compared to PRE with a single ai, but had a high negative impact on cover crops.
- **Cereal rye** was the least sensitive species to the most effective herbicides for weed control, followed by **radish**. **Red clover** and **annual rye** were the most sensitive.
- PRE herbicides should be carefully selected when multispecies cover crop mixes will be interseeded into corn at **V3** growth stage.

Field Validation

What Are The PRE herbicide Options?

- Considering the PRE herbicides that provided effective waterhemp control, **annual rye** can be interseeded into **V3** corn following a PRE application of **mesotrione.**
- **Radish** & **Red clover** can be interseeded into **V3** corn following acetochlor, S-metolachlor, atrazine + S-metolachlor, and atrazine + acetochlor PRE application.
- Most PRE herbicides evaluated allow interseeding **cereal rye** into **V3** corn.

Future Directions

- The data from the 2022-bioassay study is being analyzed to validate these results and support the herbicide selection for future field studies.
- Results will be used to develop further field studies and recommendations to growers for effective weed control and safe cover crop establishment in such systems.

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Acknowledgments

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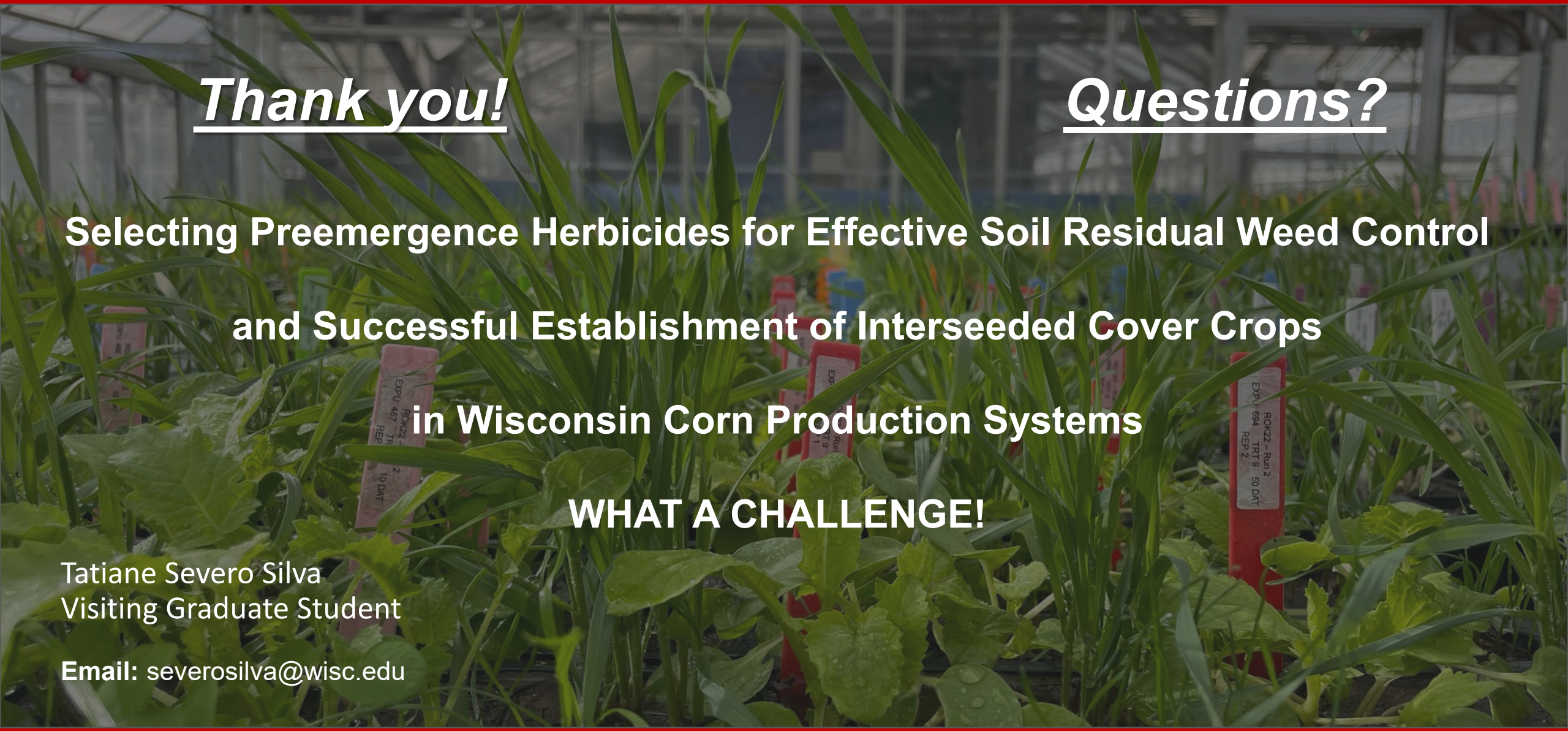

Thank you! *Questions?*

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