MICHIGAN STATE UNIVERSITY

Characterization of *Cercospora beticola* populations to support integrated Cercospora leaf spot management approaches in Michigan

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Cercospora leaf spot research

Project GREEEN · Sugarbeet Advancement · Pioneer • Big Chief Michigan Sugar · Beet Sugar Development Foundation · USDA · ARS

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Ph.D. Graduate

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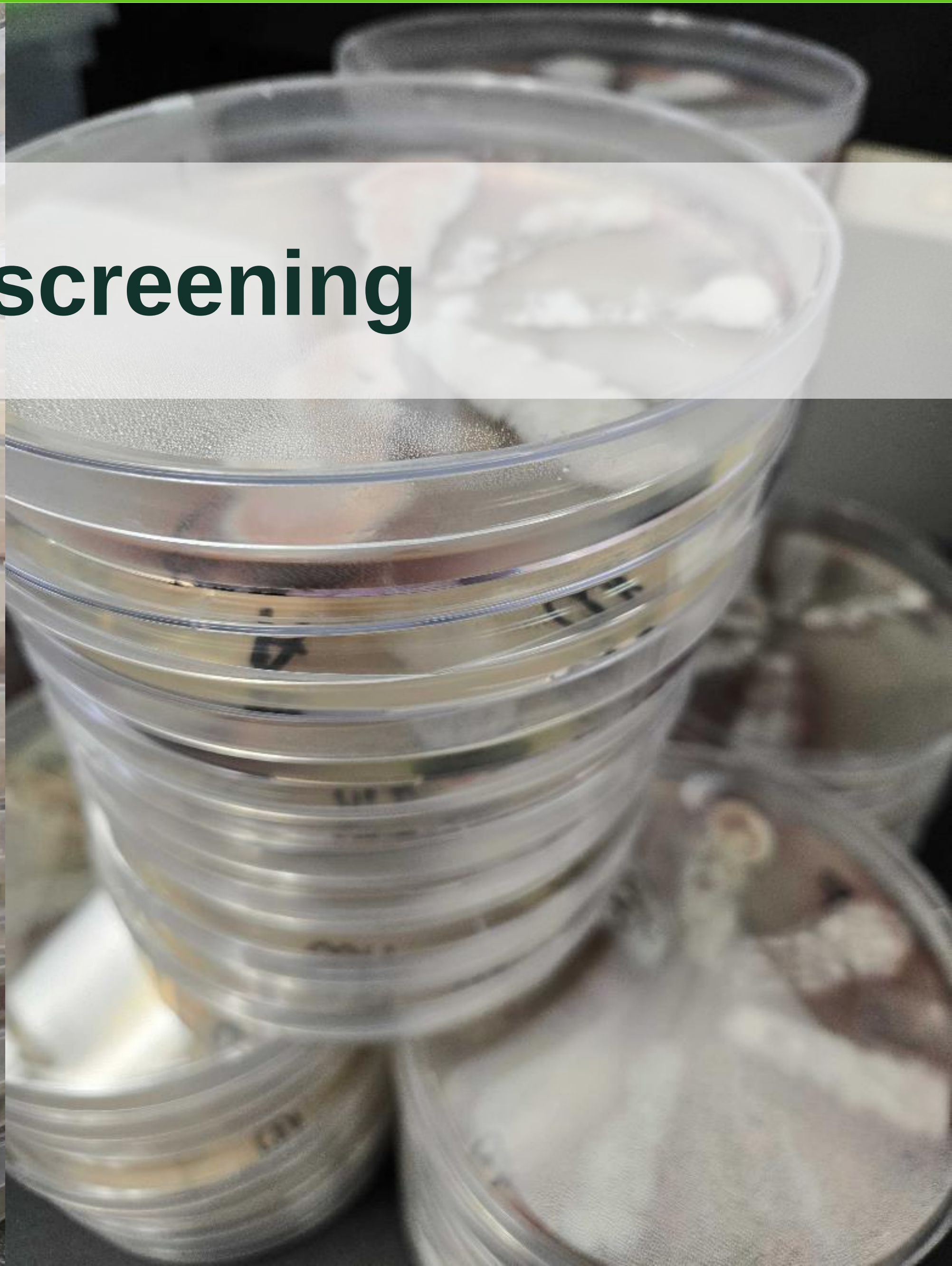
Objectives

1. **Characterize fungicide resistance** in *Cercospora beticola* populations from sugarbeet (*Beta vulgaris*) in Michigan

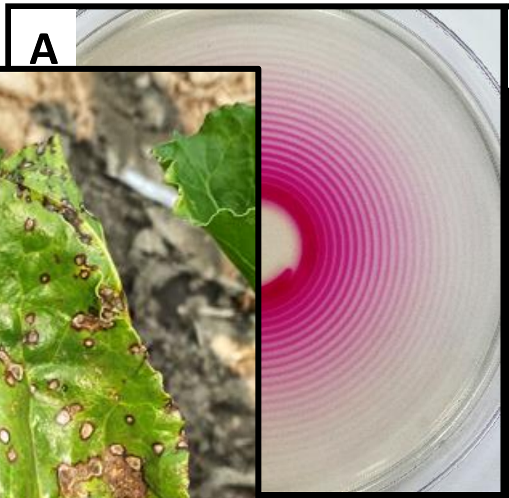
2. **Develop and validate spore-based models** to predict early-season *Cercospora beticola* risk and inform CLS management

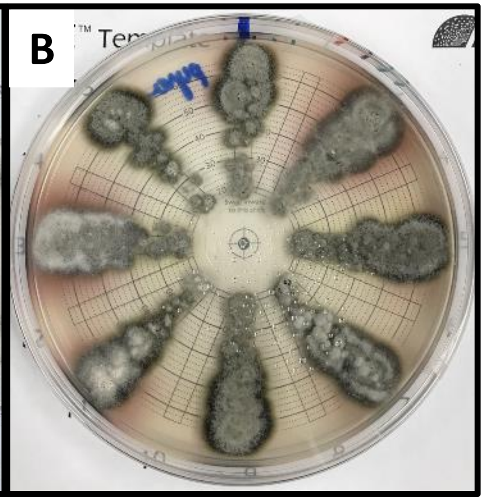
3. **Investigate tillage-alternative strategies** to reduce *Cercospora beticola* survival in plant residue and improve CLS management

Fungicide resistance screening



Fungicide resistance monitoring



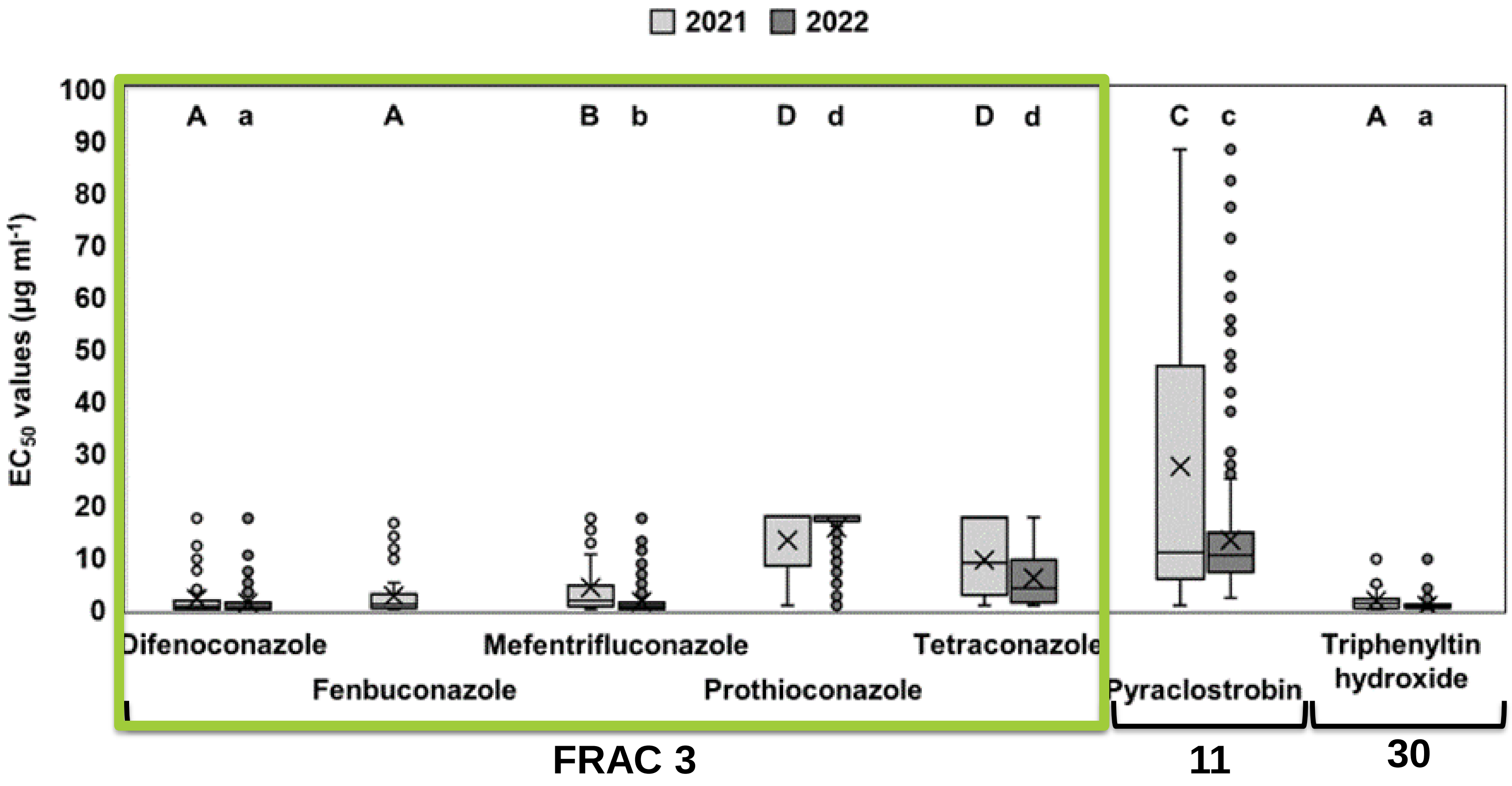


…cross the gradient where **50%** …**n inhibition (EC_{50})** occurs on …gicide amended plate

Cooperators: Michigan Sugar Company & Michigan Sugarbeet Advancement

Förster et al. 2004

Various levels of sensitivity were observed for different active ingredients (*P* < 0.0001)



Mean comparisons using Fisher's protected LSD ($\alpha = 0.05$)

Hernandez et al., *in prep*

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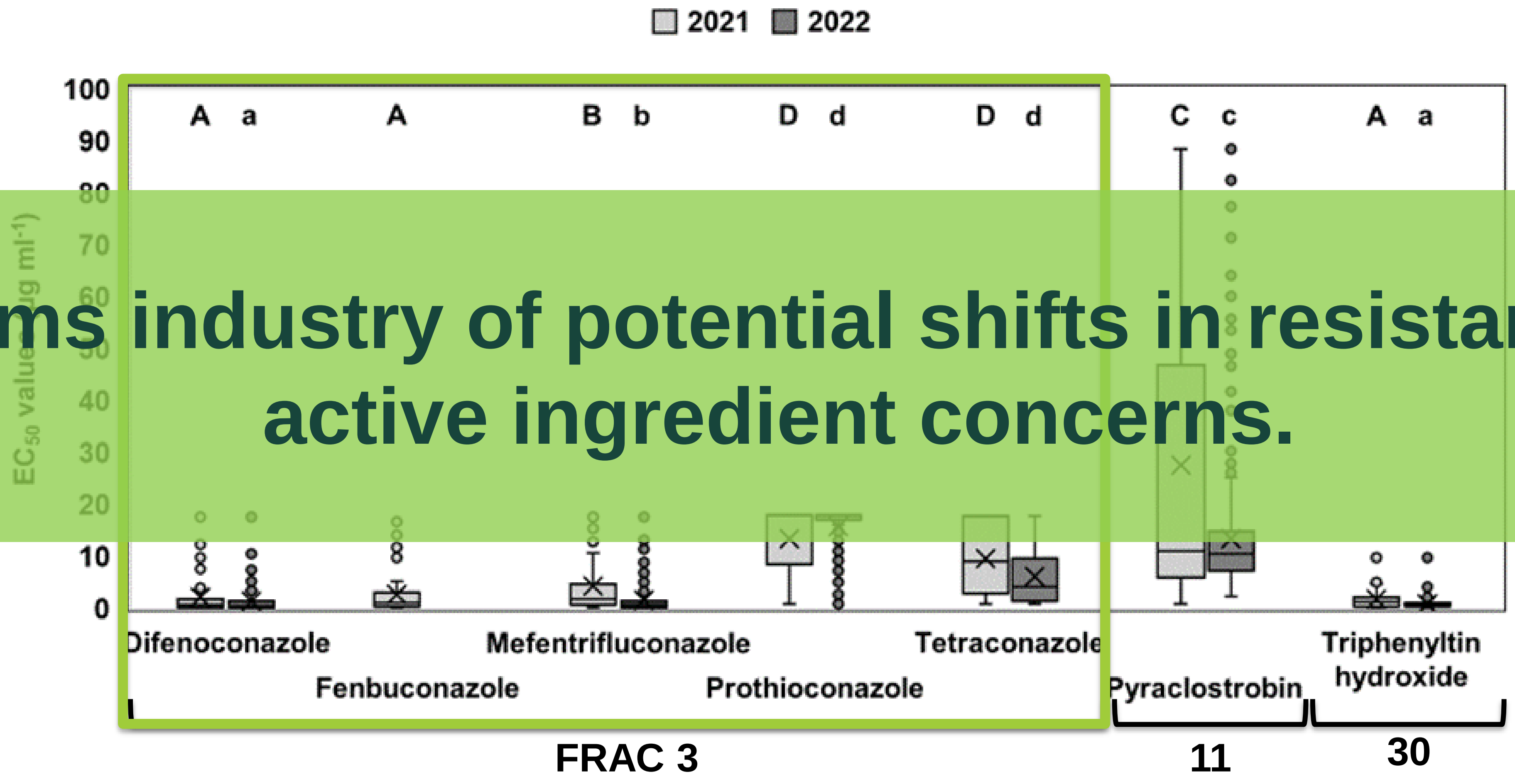


Informs industry of potential shifts in resistance or active ingredient concerns.

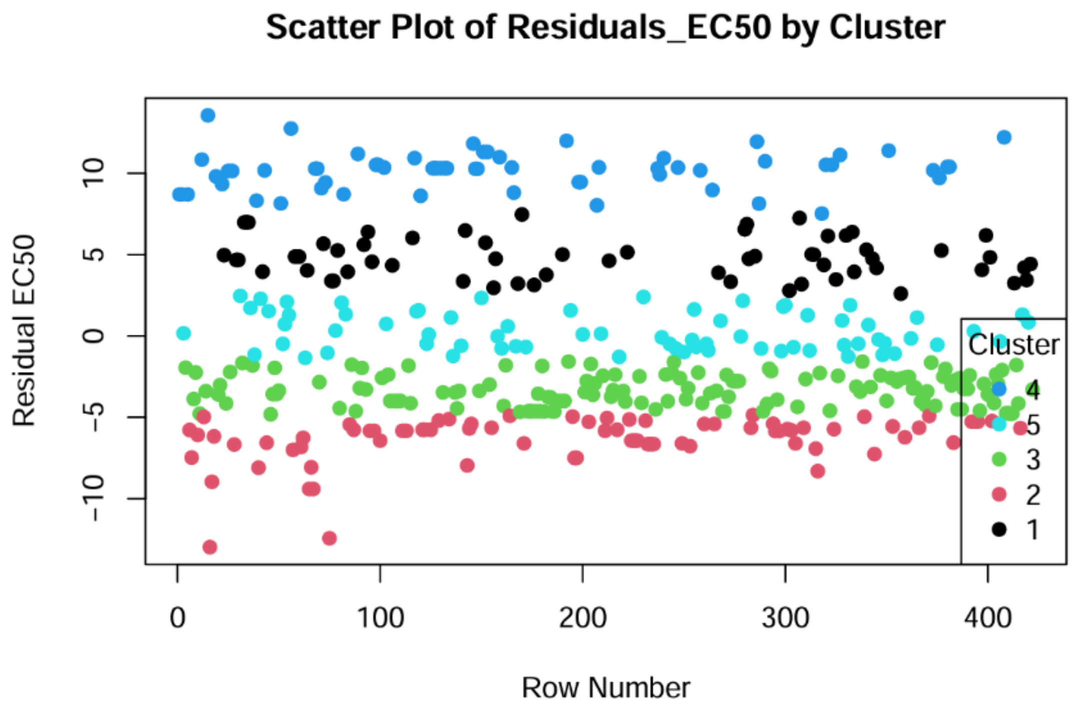
Mean comparisons using Fisher's protected LSD (α = 0.05)

Hernandez et al., *in prep*

Sensitivity threshold determinations

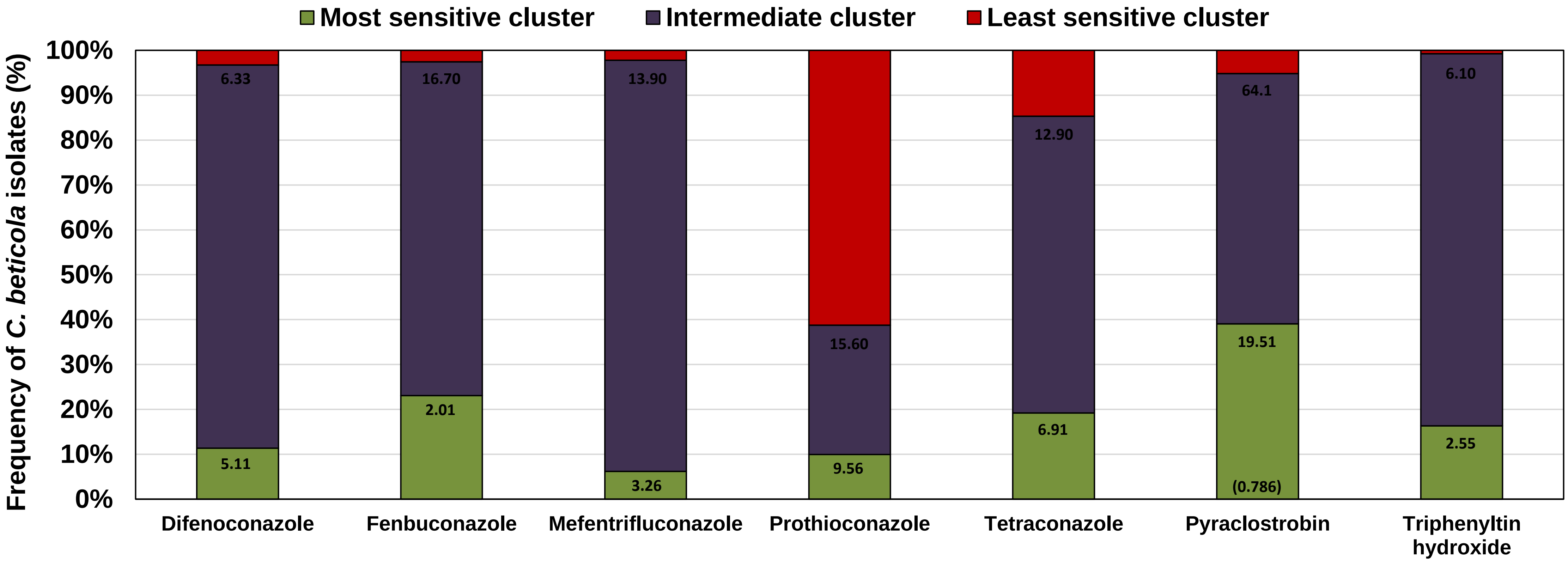
- K-means cluster analyses of residuals, accounting for field*year sampling structure (Rangel et al. 2024; Talas et al. 2024)
- By active ingredient, determined thresholds for most and least sensitive clusters
- Cluster maximum or minimum limits, plus the interquartile range

tetraconazole



Hernandez et al., *in prep*

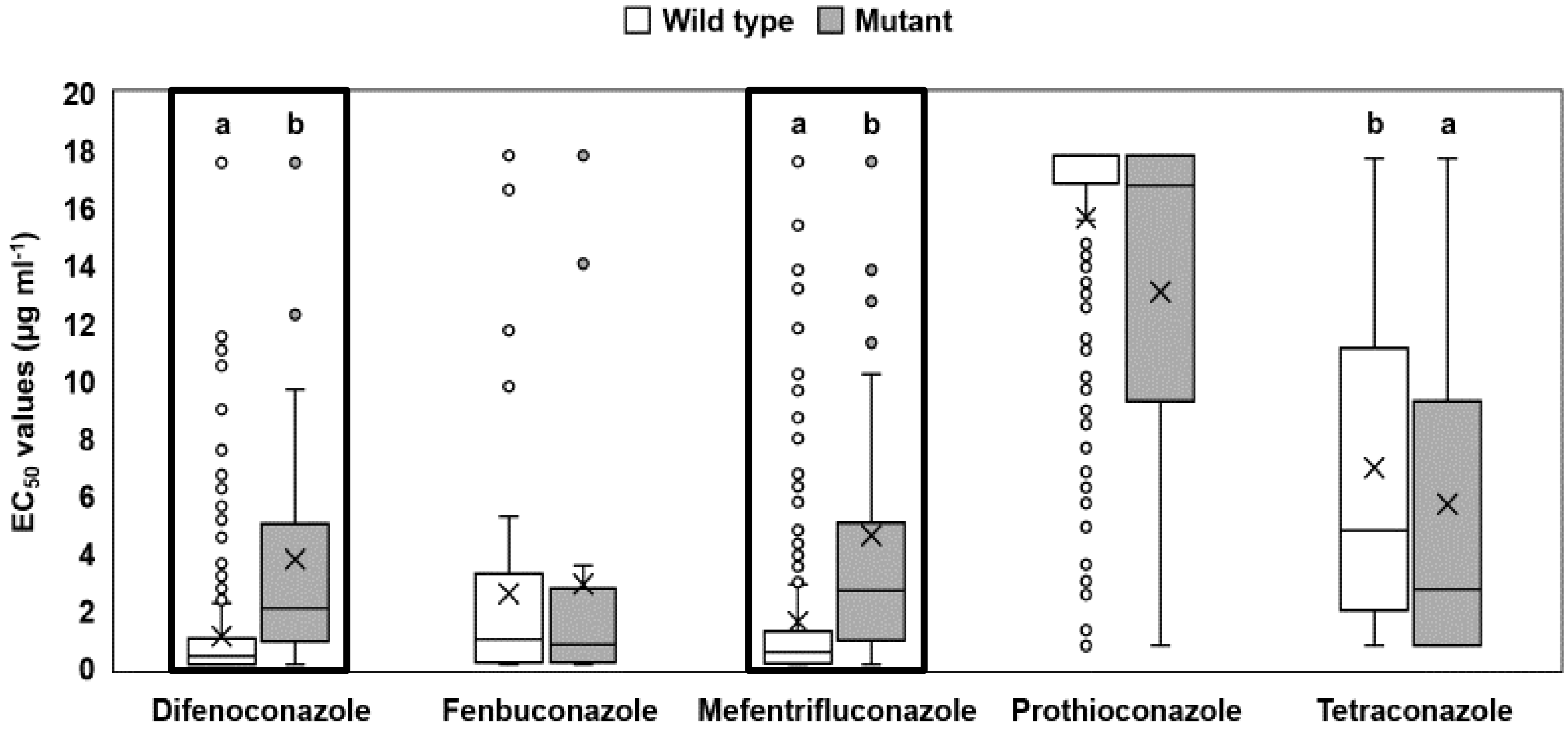
C. beticola resistance frequencies



Hernandez et al., *in prep*

**From 2021-2022, all 451 C. beticola isolates screened possessed the G143A mutation associated with QoI resistance (100%).*

Mutations associated with resistance were not consistently associated with *in vitro* findings.



**Screened via PCR-RFLP for Glu169 mutation (Nikou et al. 2009)*

Hernandez et al., *in prep*

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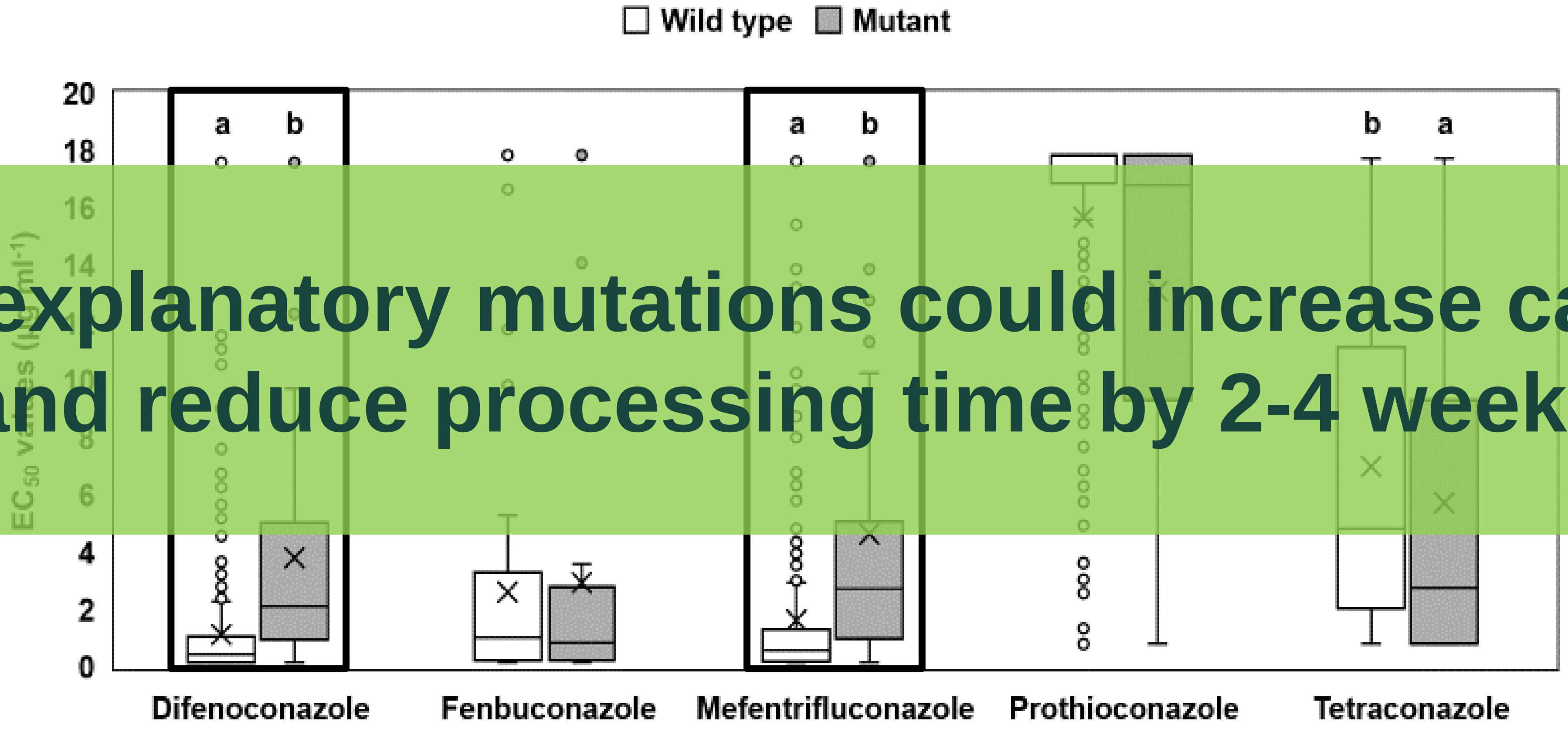


More explanatory mutations could increase capacity and reduce processing time by 2-4 weeks.

**Screened via PCR-RFLP for Glu169 mutation (Nikou et al. 2009)*

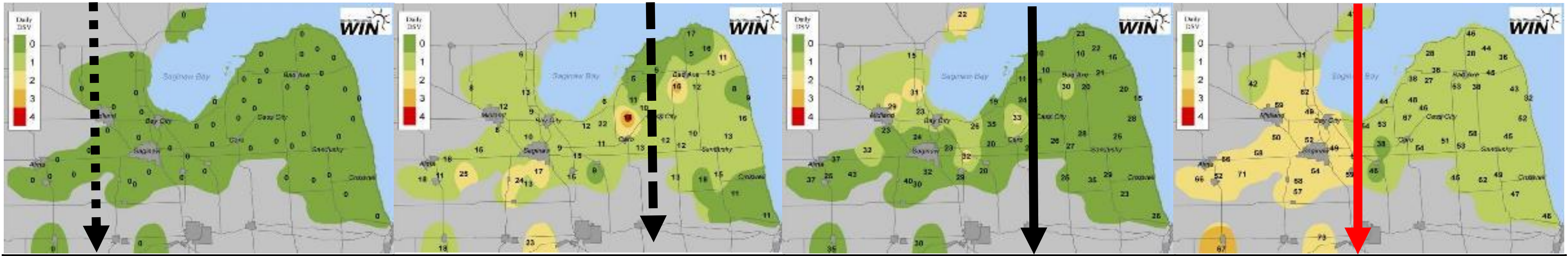
Hernandez et al., *in prep*

Spore-based model development

BEETcast model performance

- Predicts risk for infection using temperature and leaf wetness
- Spray thresholds are determined based on cumulative values
- Observed 1st infections near elevated spore levels and favorable weather conditions

1st spores 5/7 | ~1st infections | 1st spots | ~initiate spray programs



May 15 (0 DSVs)	**June 1** (5-25)	**June 15** (10-43)	**July 1** (28-73)

http://www.michiganbeets.com/dsv.cfm

Tedford et al. 2018, Bublitz et al. 2021, Hernandez et al. *accepted*

Daily spore collection

Spore trap with sentinel beets

2019

Frankentrost and East Lansing, MI and Ridgetown Ontario from May to July

- 8 weeks

Burkard spore trap at Saginaw Valley Research and Extension Center in 2020

Sentinel beets

2020

SVREC from June to August

- 11 weeks

2021

SVREC and Ontario from May to July

- 10 weeks

2022

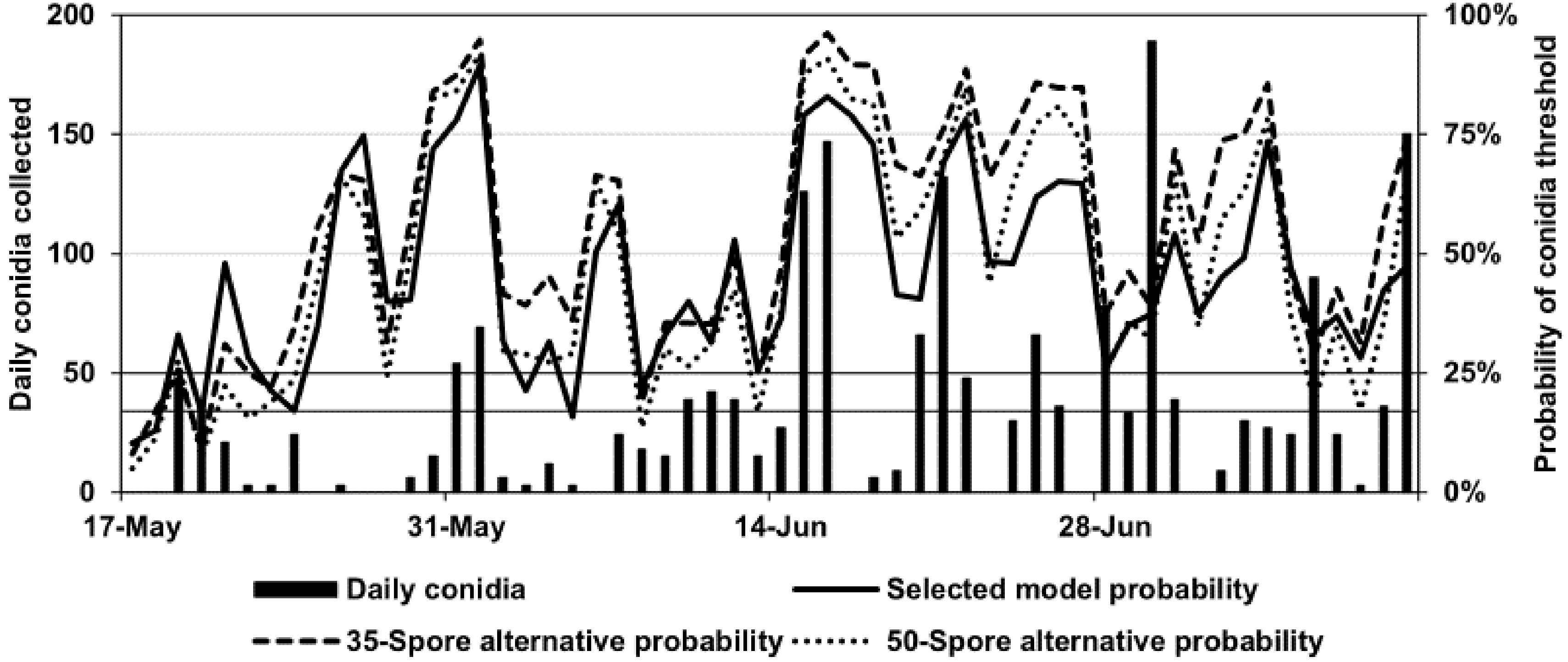
SVREC from May to July

- 8 weeks

8 site-years (n = 449 daily counts)

(since 2014) Tedford et al. 2018, Bublitz et al. 2021, Hernandez et al. *accepted*

Generated models accurately predicted early-season spore levels (78%).



Threshold	Variables
Spore35	**DurLW, AvgSoilTemp**, MaxWS
Spore35	**DurLW, AvgTemp**, AvgRH
Spore35	**DurLW, AvgTemp**, MaxWS
Spore50	**DurLW, MinTemp**, AvgRH

Hernandez et al., **Plant Dis.** *accepted with revision*

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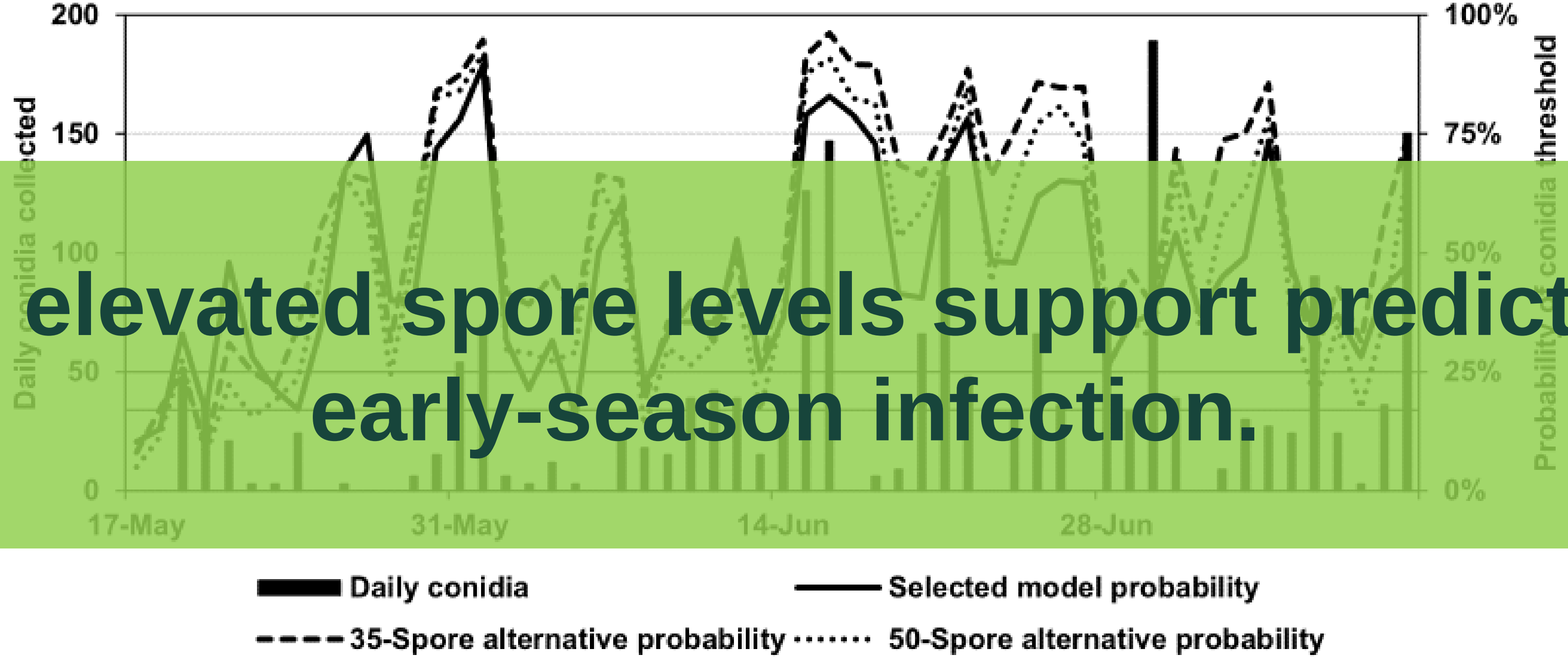


Risk of elevated spore levels support predictions of early-season infection.

Threshold	Variables
Spore35	**DurLW, AvgSoilTemp**, MaxWS
Spore35	**DurLW, AvgTemp**, AvgRH
Spore35	**DurLW, AvgTemp**, MaxWS
Spore50	**DurLW, MinTemp**, AvgRH

Hernandez et al., **Plant Dis.** *accepted with revision*

Tillage-alternative inoculum reduction

Inoculum reduction treatments

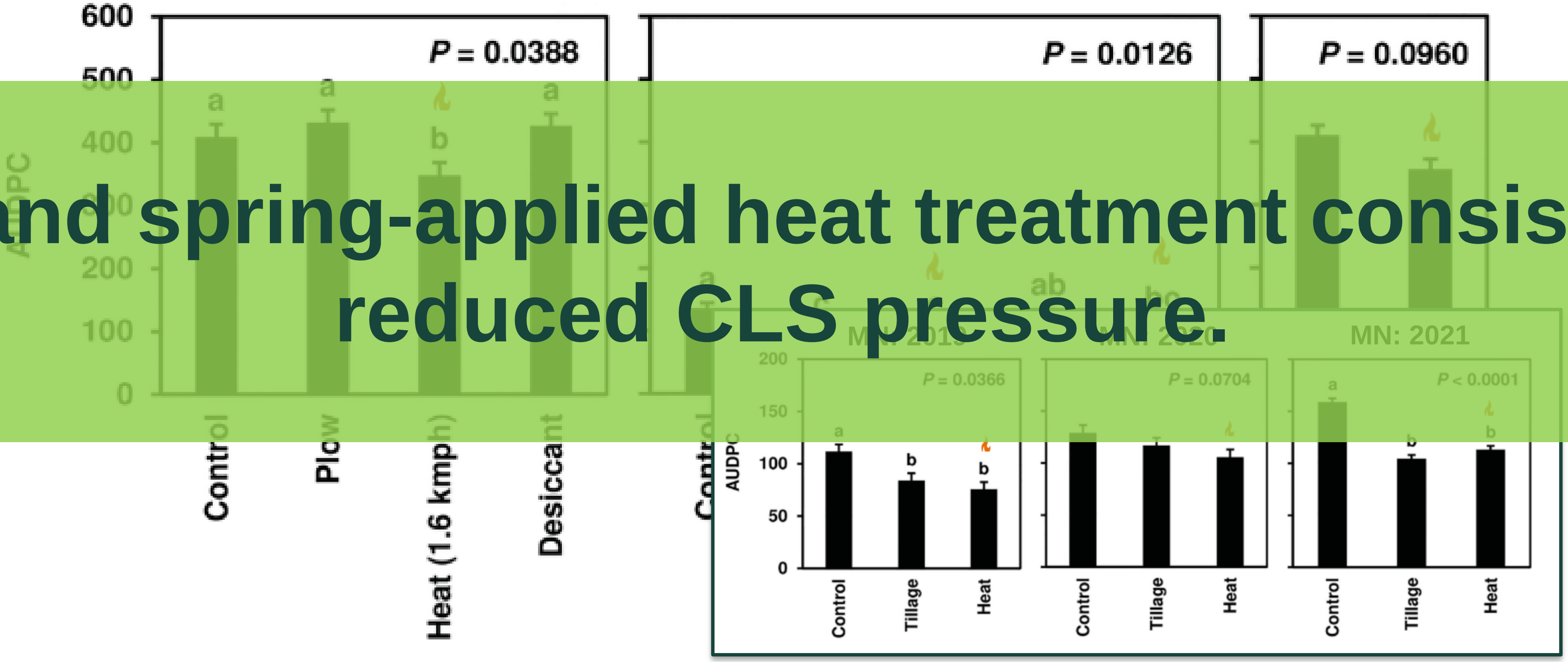
- *C. beticola* overwinters on infected leaf residue and is sensitive to temperatures above 114º F (45.5º C) (Pool and McKay 1916)

- Burying leaf residue reduces inoculum over time (Khan et al. 2008) but deep tillage not common practice in Michigan

Multi-Trail Enterprises Burner, Bublitz and Wenzel

Heat treatment reduced CLS ($P < 0.05$)

MI: 2019-2020 MI: 2020-2021 MI: 2021-2022

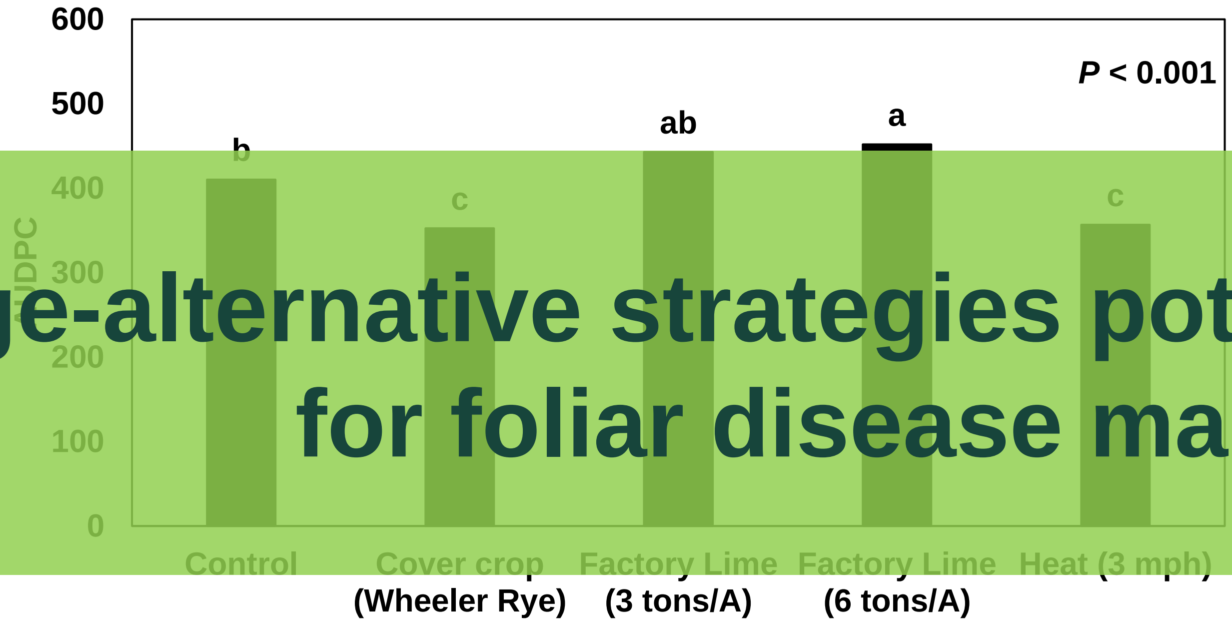


Fall- and spring-applied heat treatment consistently reduced CLS pressure.

Collaborators: Southern Minnesota Beet Sugar Cooperative

Hernandez et al. 2023, **Front. Plant Sci.**

Cover crops also may impact CLS



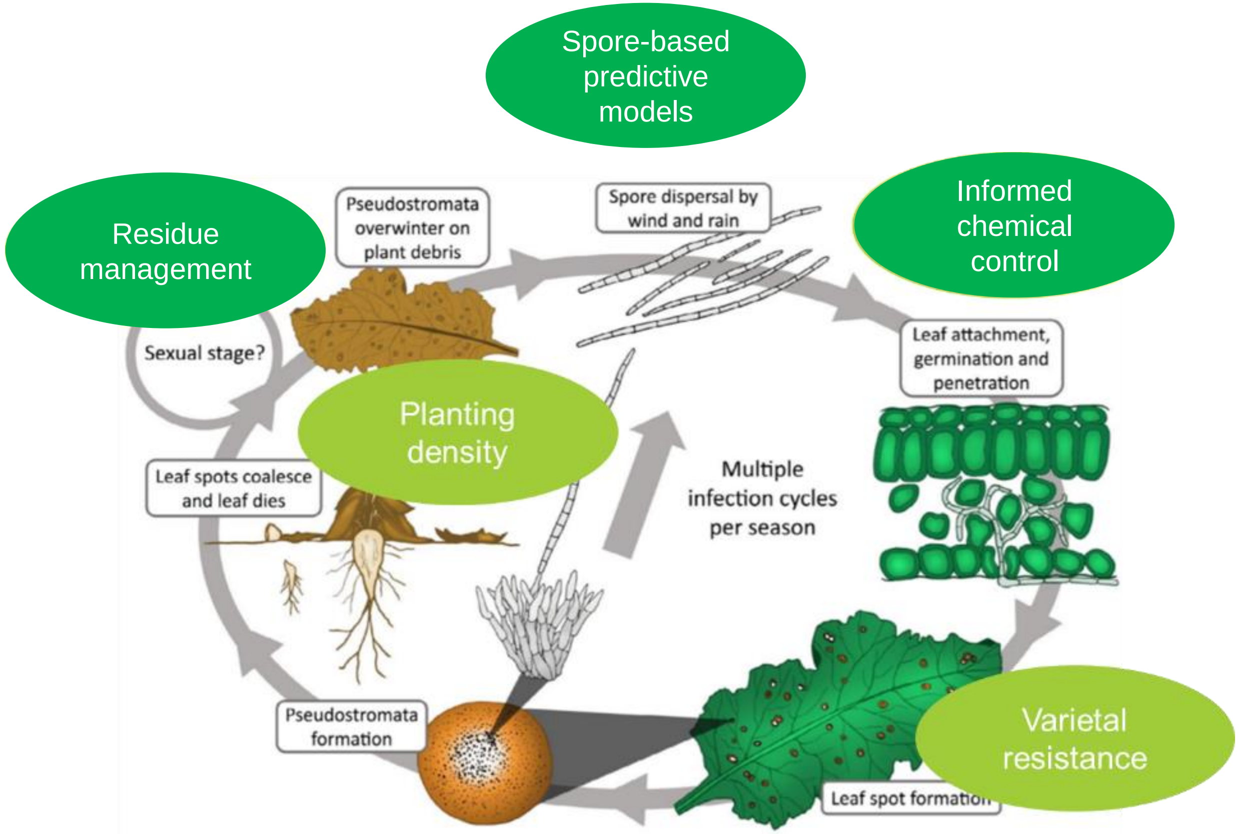
Tillage-alternative strategies potentially valuable tools for foliar disease management.

- Continuing to investigate other strategies to target *C. beticola* survival and leaf degradation
- **Rye cover crop reduced disease pressure** the following season
- **Clover reduced the growth of *C. beticola*** in the absence of antibiotics ($P < 0.01$)
- **Rye reduced *C. beticola* growth** when antibiotics were added ($P < 0.005$)

Hernandez et al., **USDA-ARS-SSBRI**

Overall summary

- **Providing critical in- and pre-season fungicide resistance information**
- **Developed novel risk prediction tools to inform timing of disease control**
- **Identifying heat and cover crop treatments with long-term disease management potential**



Hernandez et al. 2023, **Front. Plant Sci.**;
Hernandez et al. 2024, **Crop Prot.**

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- Dr. David Douches, Potato Breeding
- Chris Long, Potato Outreach
- Dr. Martin Chilvers

Internal - Other Departments
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MICHIGAN SUGARBEET REACH Research & Education Advisory Council

PIONEER • BIG CHIEF MICHIGAN SUGAR

Sugarbeet Advancement

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Project GREEEN

MICHIGAN STATE UNIVERSITY Extension

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Questions?

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