

Incorporating disease onset indicators for *Cercospora* leaf spot risk modeling and fungicide application management

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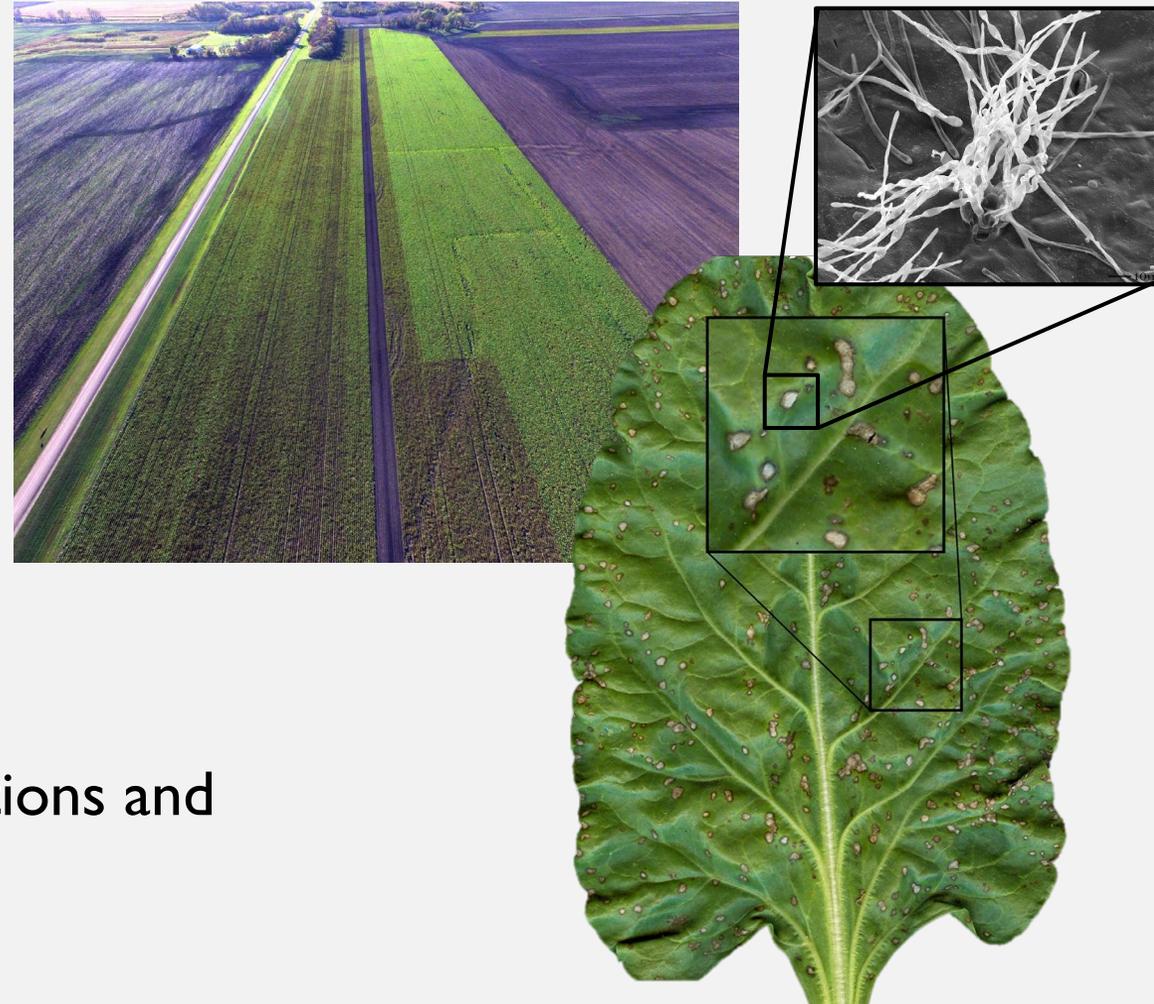
Long Beach, CA



U.S. DEPARTMENT OF AGRICULTURE

Cercospora beticola

- Cercospora leaf spot (CLS) on sugarbeet
- Hemibiotrophic fungus
 - Asymptomatic biotrophic phase
 - Symptomatic necrotrophic phase
- Polycyclic and genetically diverse
 - Cryptic sexual cycle
- Primarily controlled through fungicide applications and resistant sugarbeet varieties.



Forecasting CLS risk

Shane and Teng 1985 model

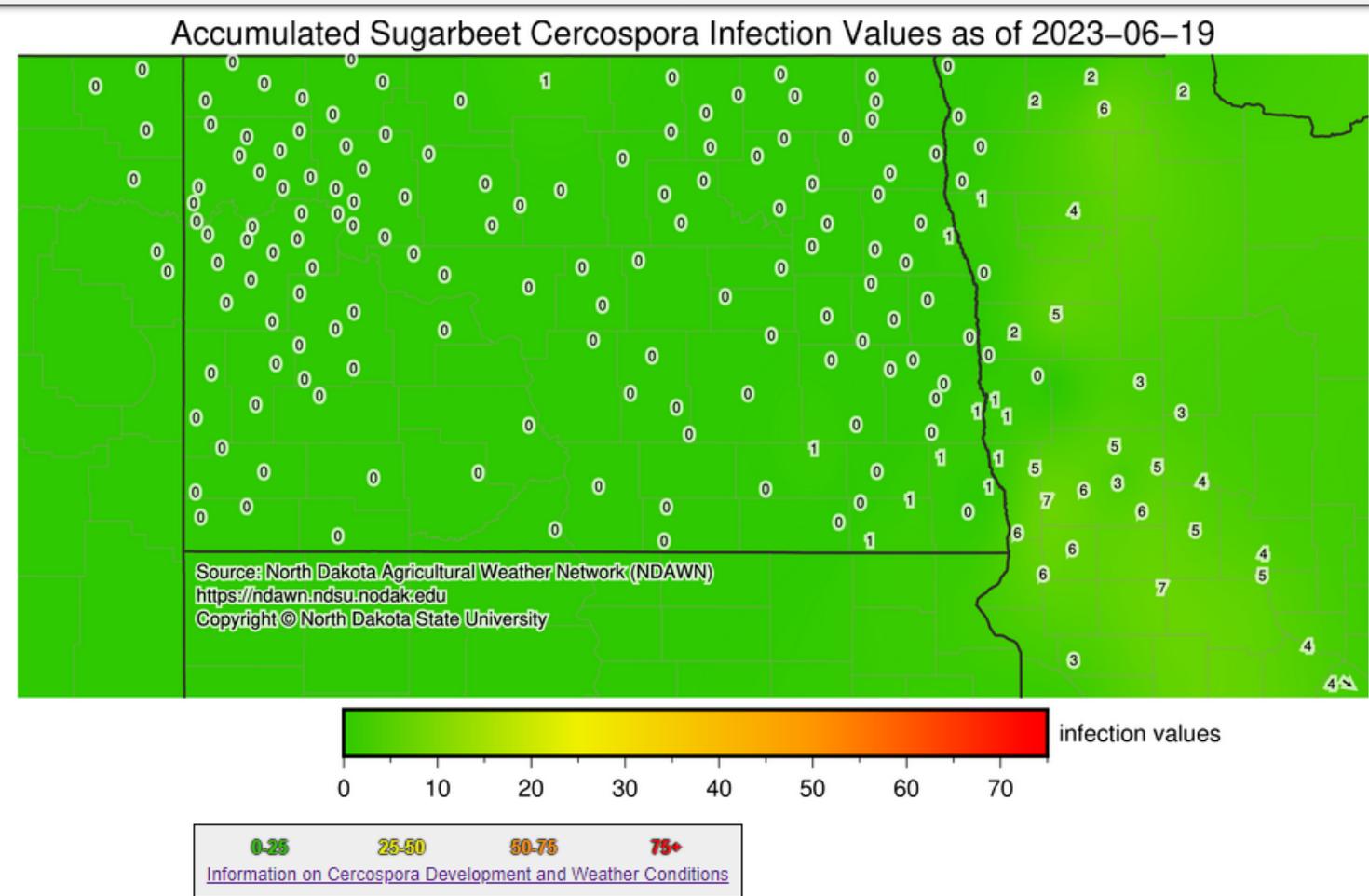
- Developed to predict emergence of CLS symptoms

Daily infection values:

- Relative humidity (RH) over 85%
- Rise with temperatures

Two-day total DIV equal to 6 is marginal, and > 6 means conditions are favorable for infection.

Cumulative DIV are summed throughout the year.



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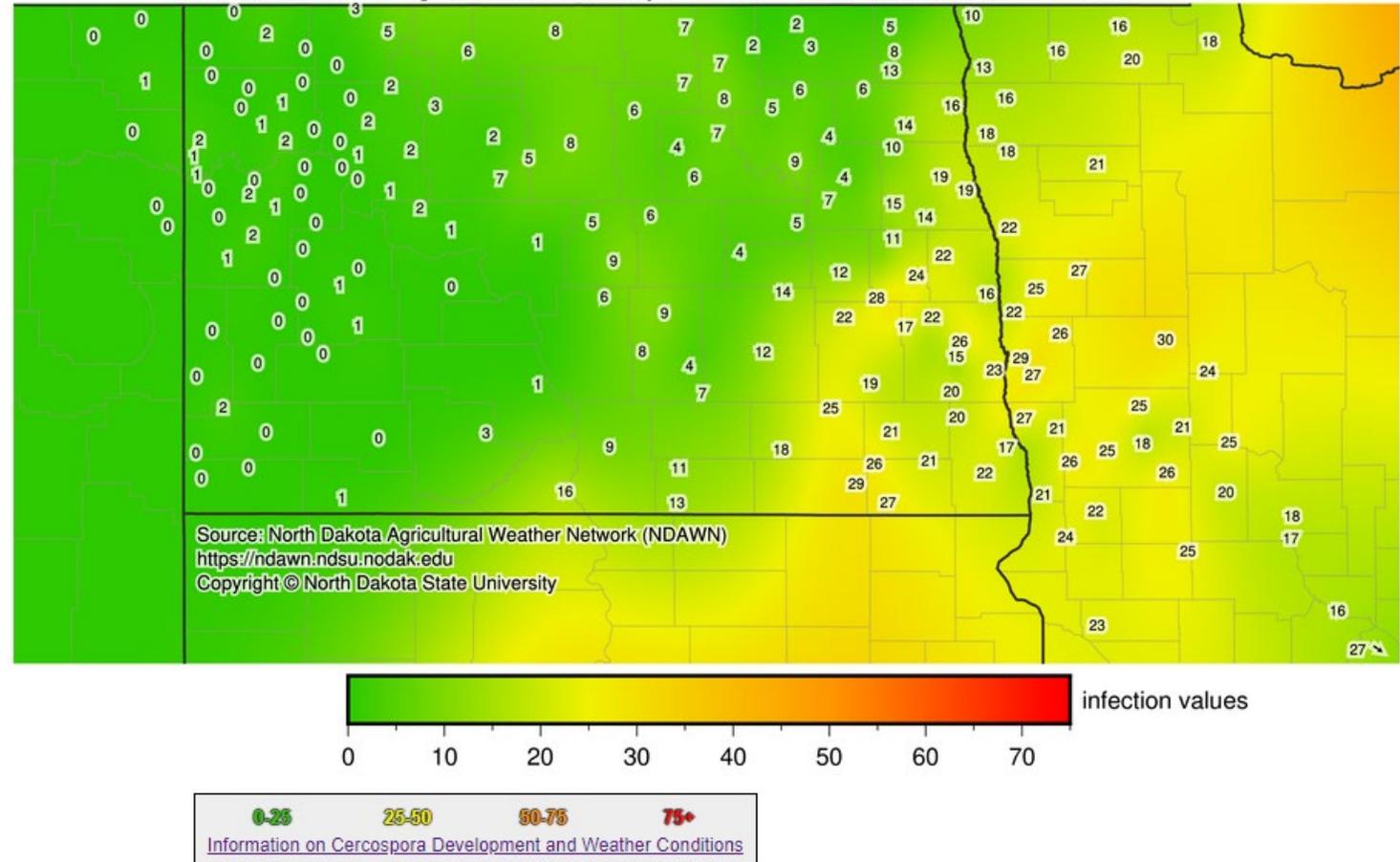
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Accumulated Sugarbeet Cercospora Infection Values as of 2023-07-03



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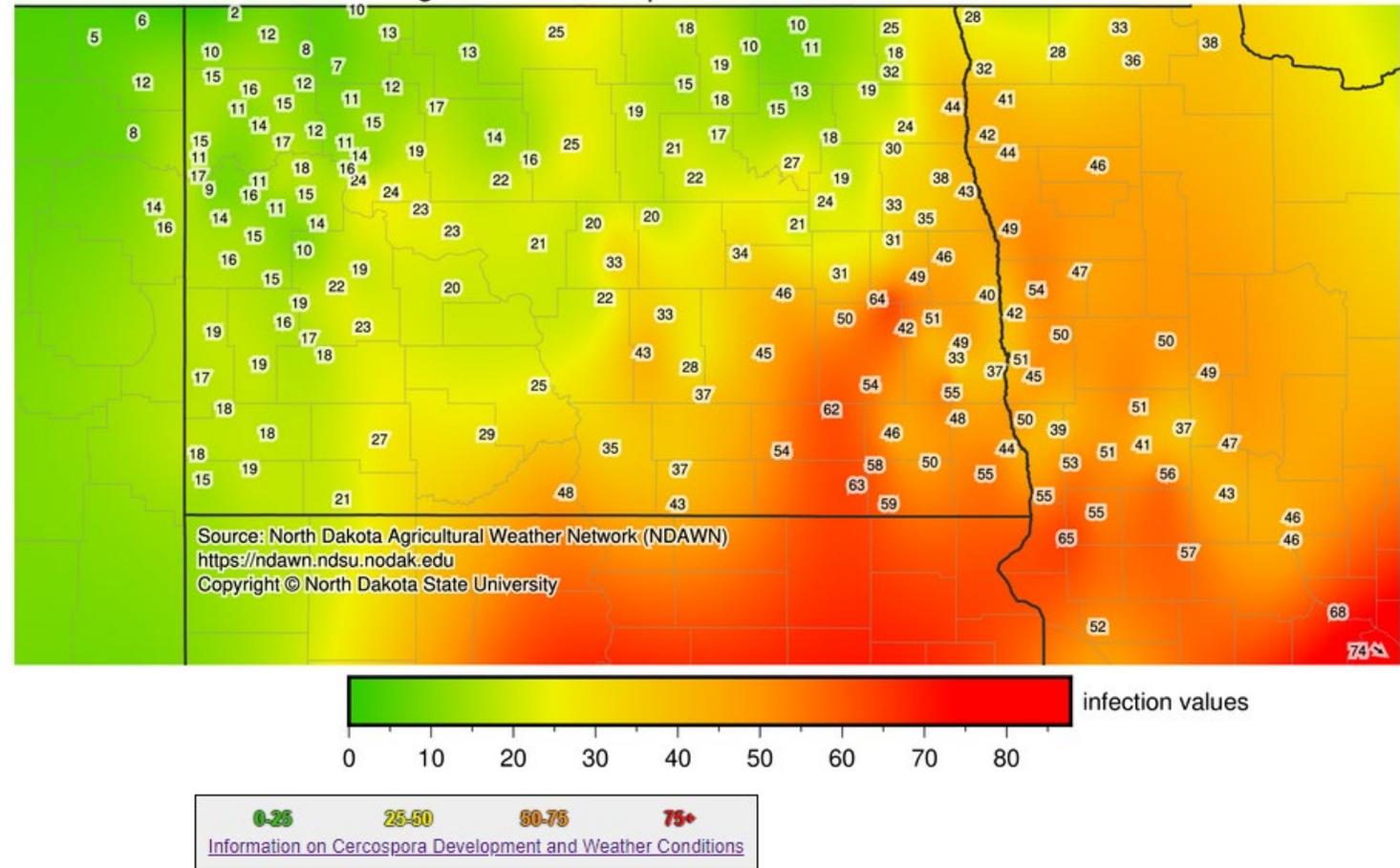
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Accumulated Sugarbeet Cercospora Infection Values as of 2023-08-07



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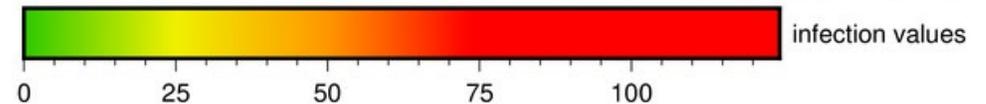
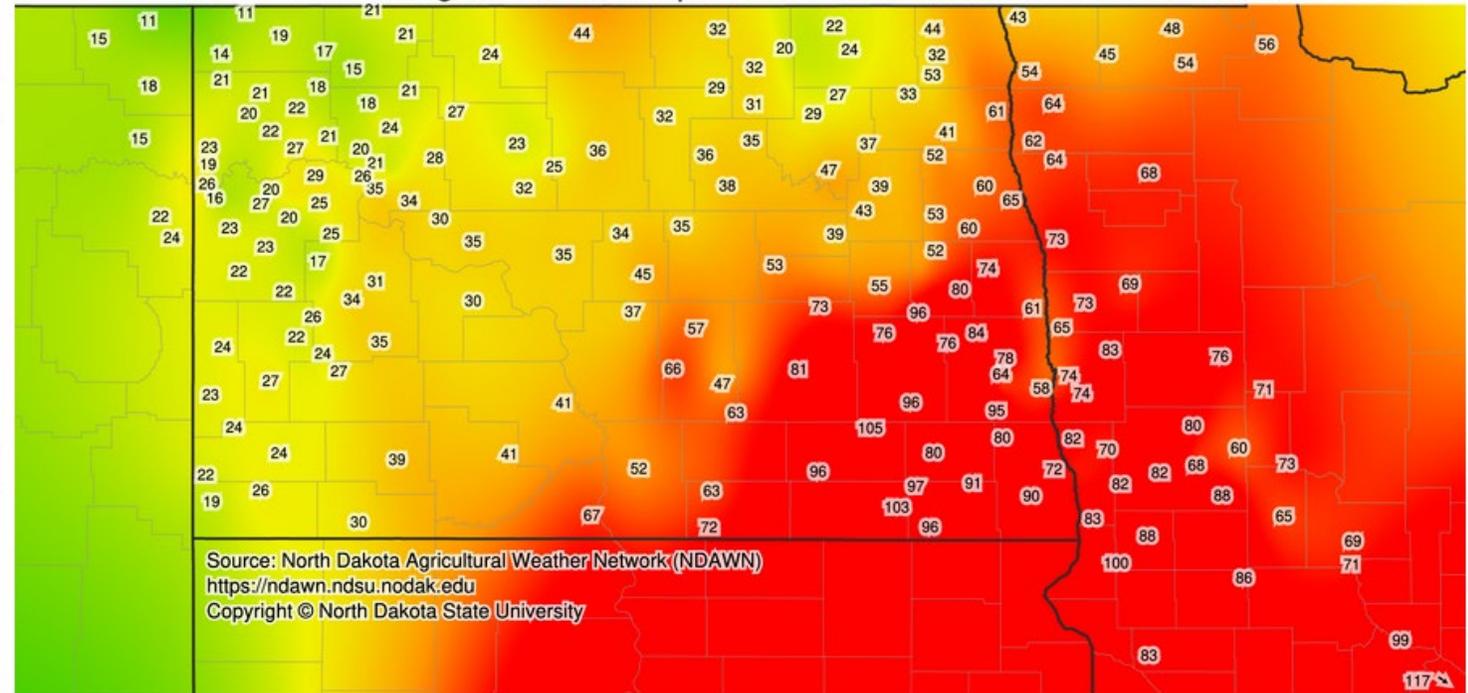
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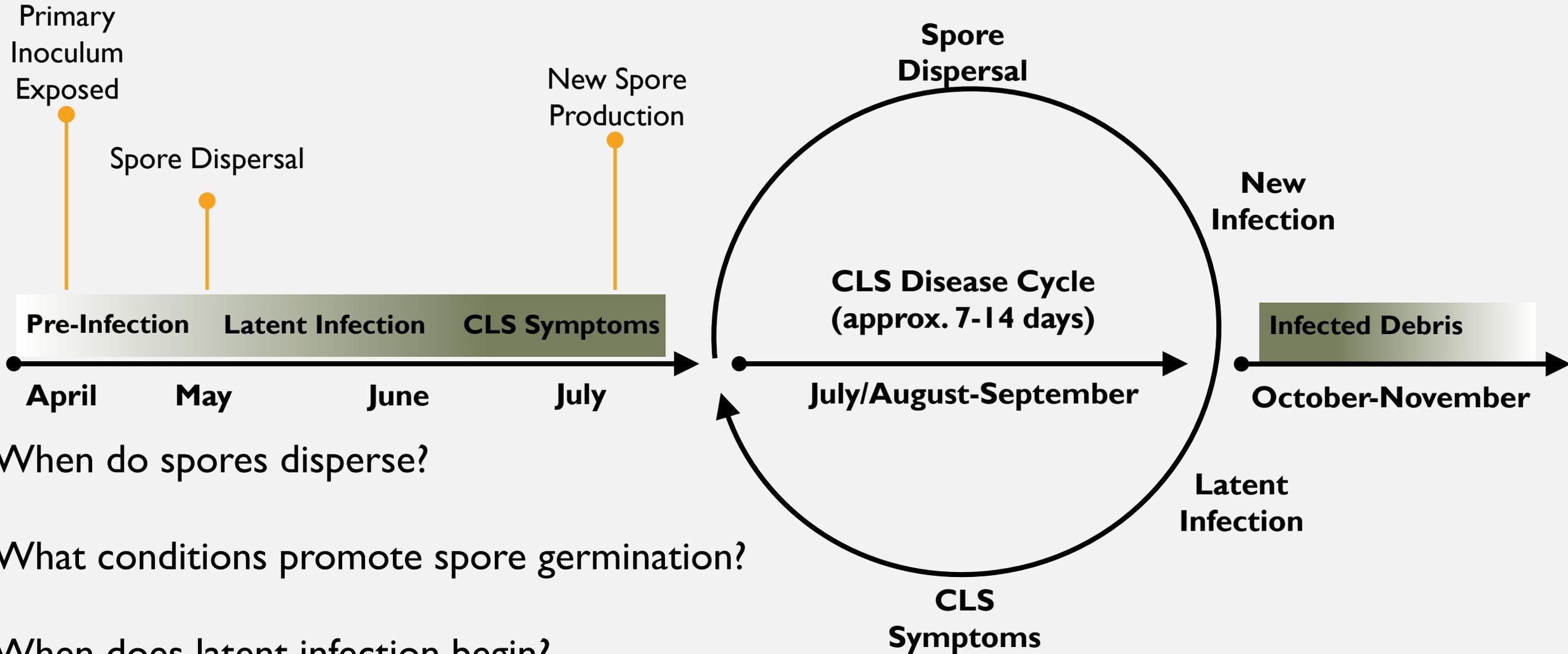
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Accumulated Sugarbeet Cercospora Infection Values as of 2023-09-04



CLS disease cycle

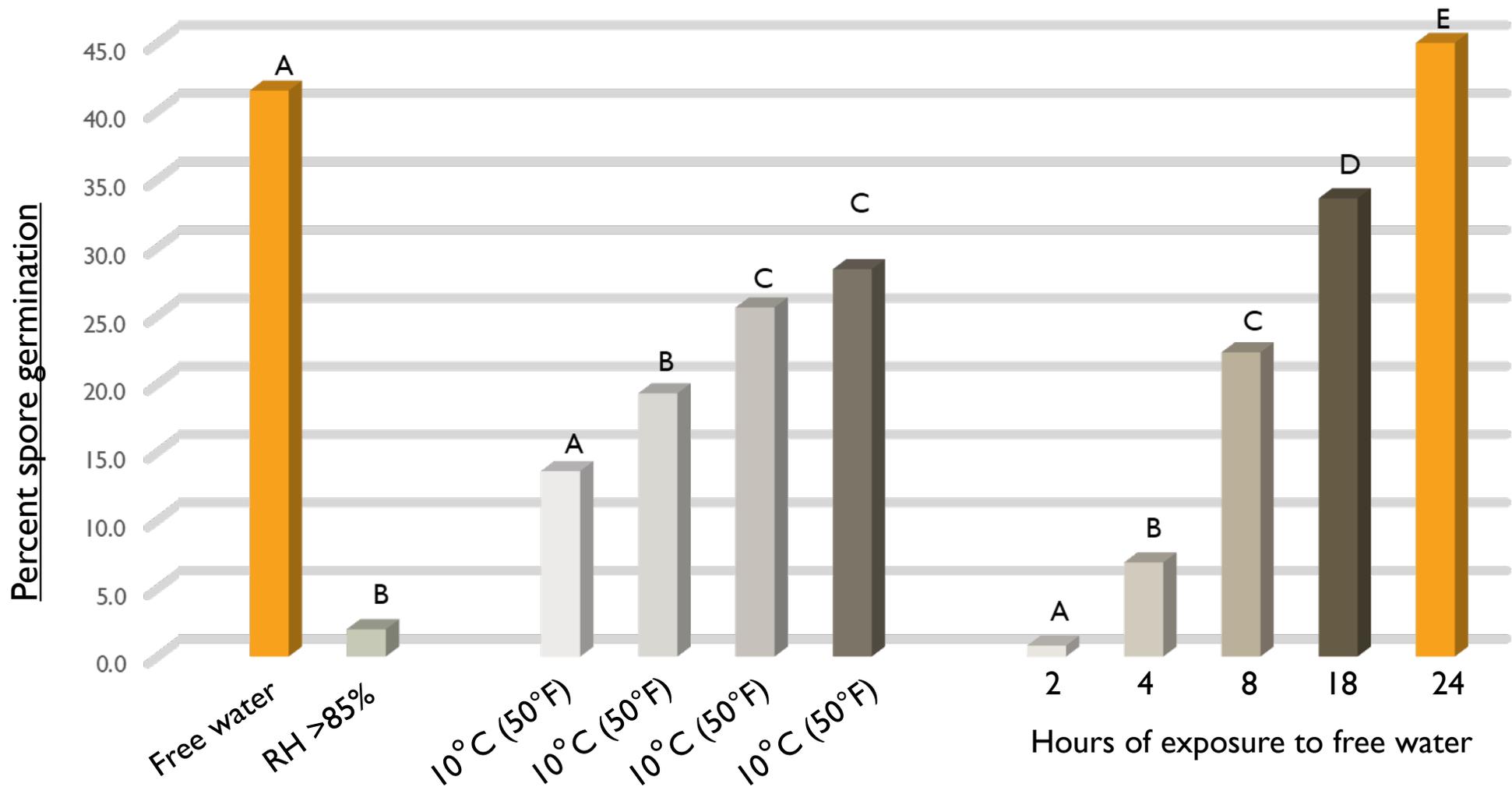


When do spores disperse?

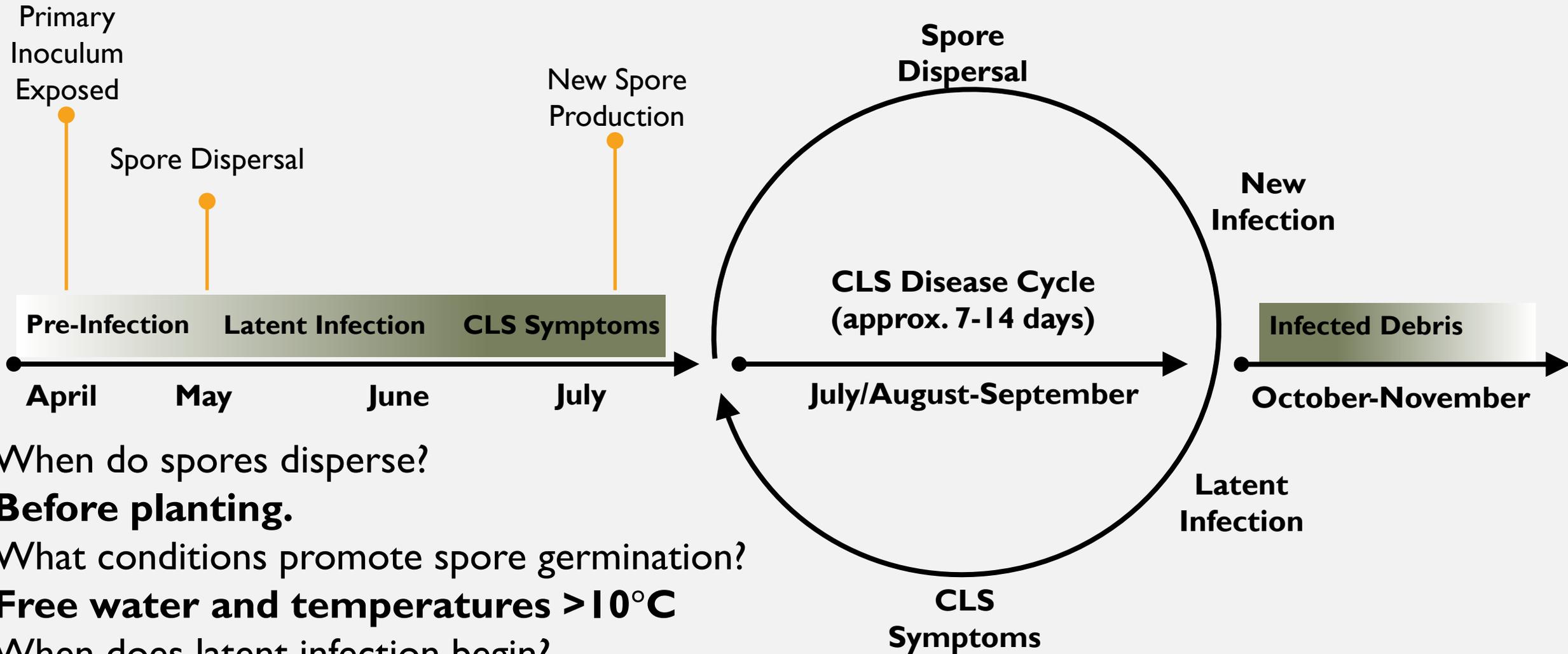
What conditions promote spore germination?

When does latent infection begin?

Spore germination



CLS disease cycle



When do spores disperse?

Before planting.

What conditions promote spore germination?

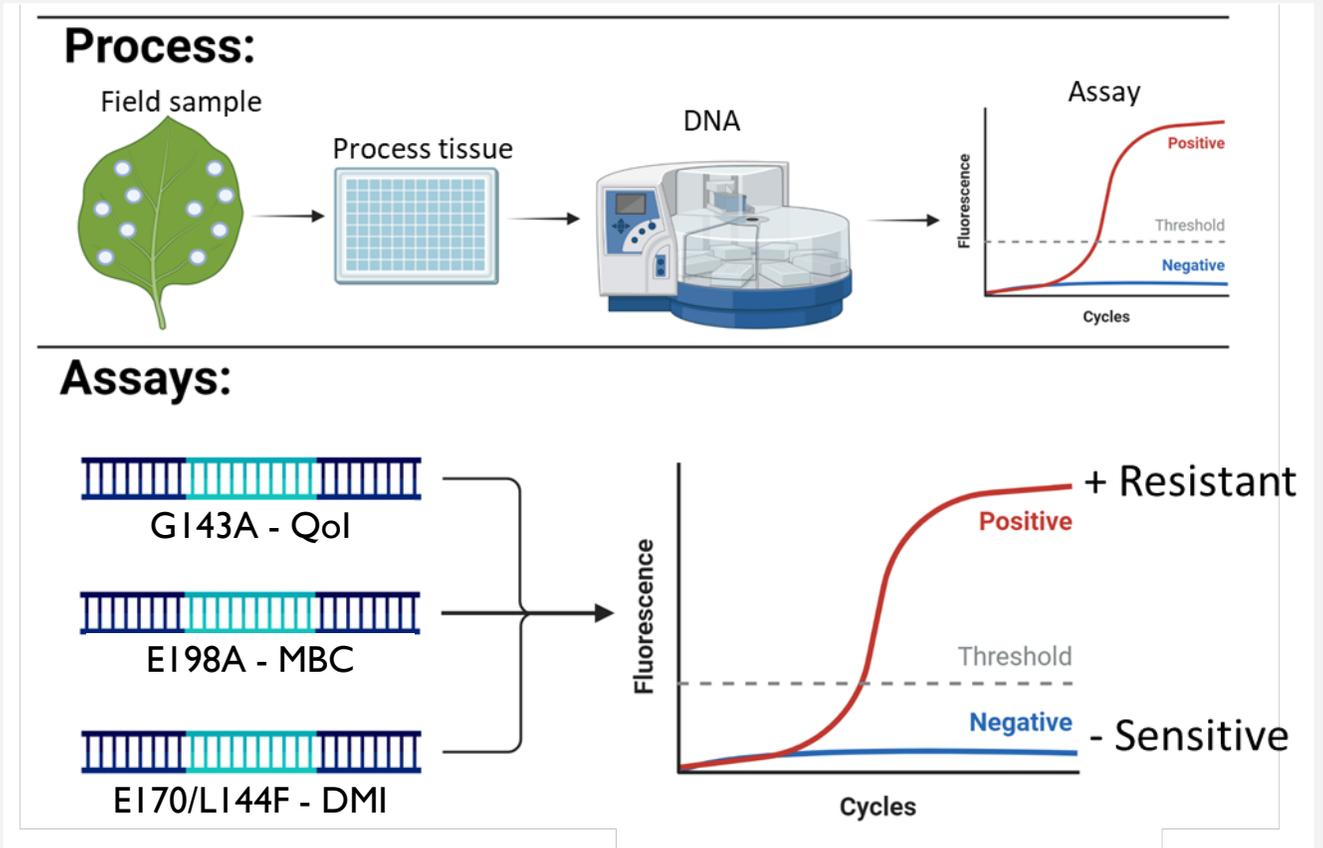
Free water and temperatures $>10^{\circ}\text{C}$

When does latent infection begin?

Latent infection screening

Survey of commercial sugarbeet fields

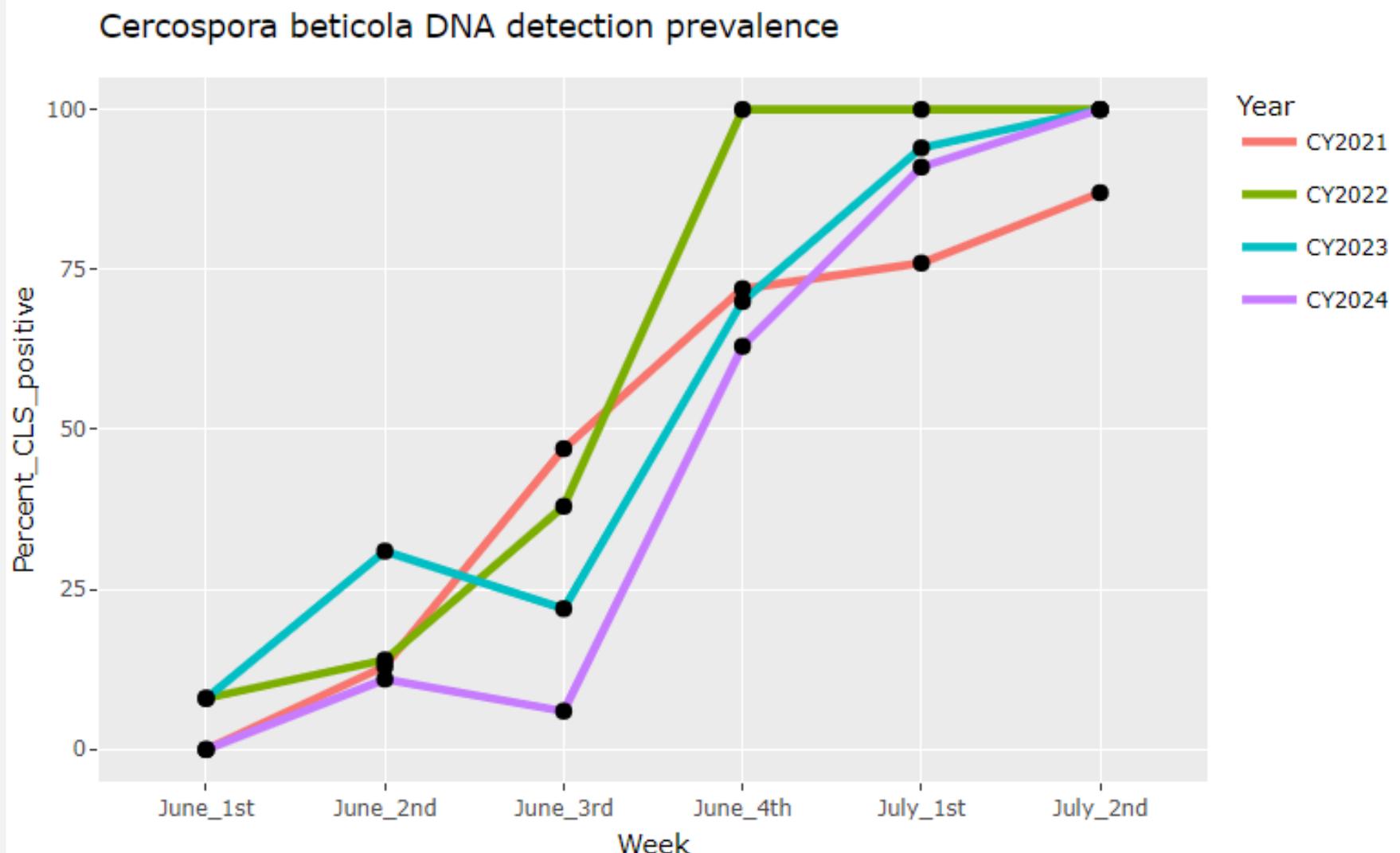
- Conducted in 2021 – 2024
- 280 commercial sugarbeet fields
 - Weekly sampling starting at the 4-6 leaf stage
- Multiplex qPCR assay
 - Bolton Lab USDA
 - GI43A – Qol marker
 - wildtype and mutant
 - EI98A – MBC marker
 - EI70/LI44F – DMI markers



2021-2024 Latent CLS prevalence

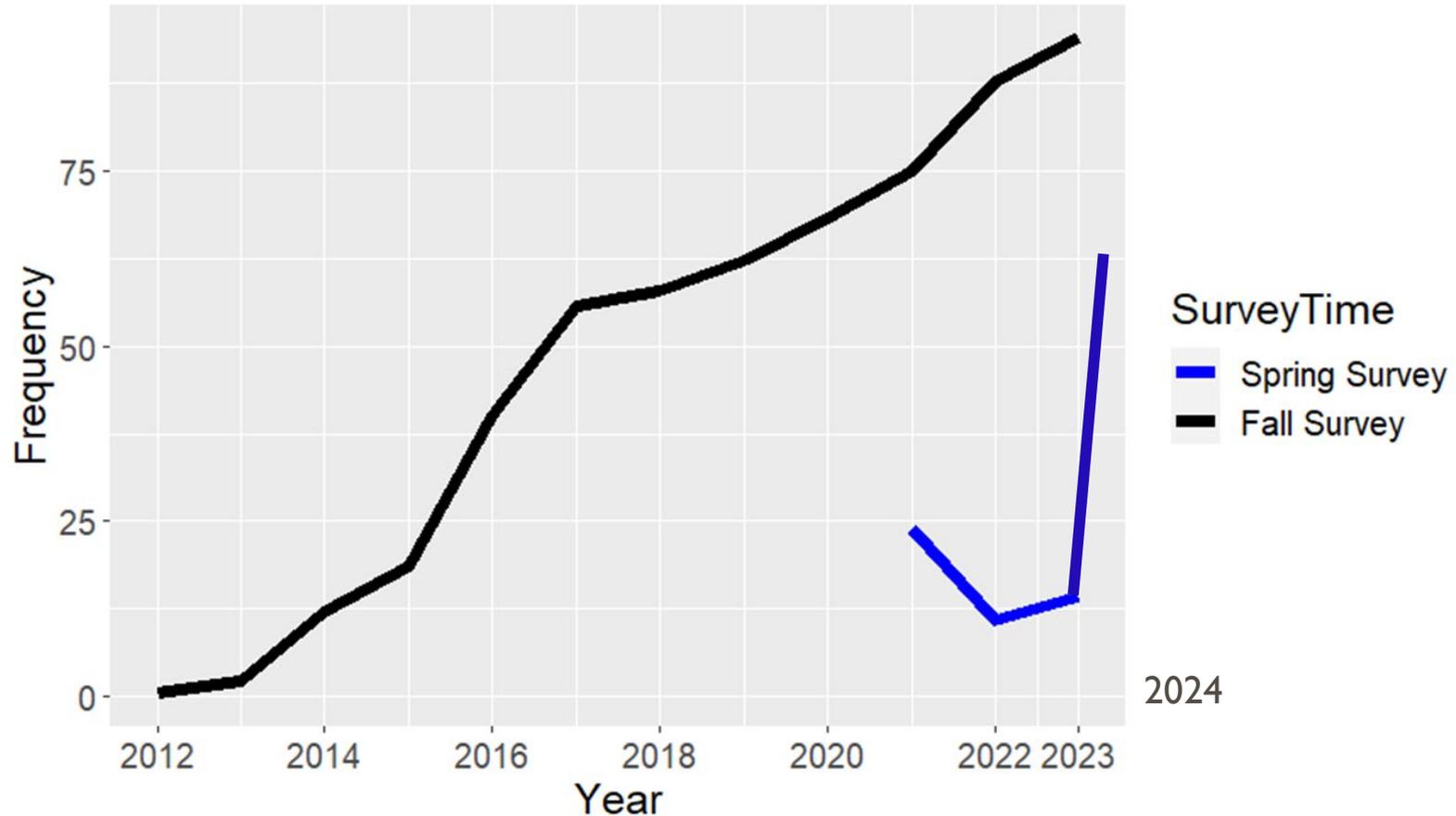
Primary results

Latent infection onset consistently occurs at or just prior to row closure in the RRV



Annual Strobilurin Resistance Fluctuations

G143A Strobilurin Resistance Frequency



Primary results

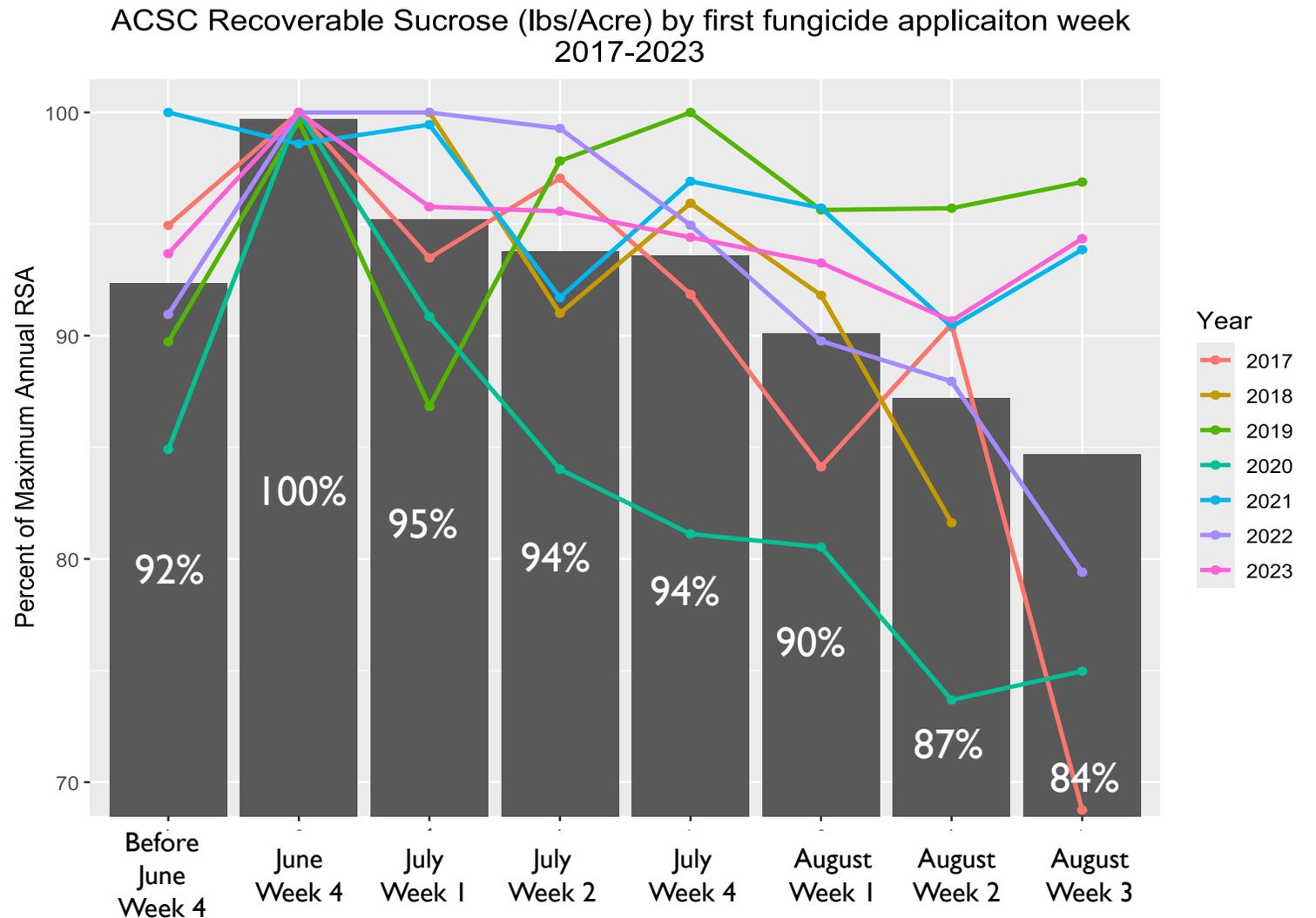
- Strobilurin resistance is lower in the spring
- Spring survey based on Spore trap data and Latent infection data
- What caused the increase in 2024 Strobilurin resistance in the spring

Why focus on asymptomatic latent infection?

Why do we care if there are no symptoms?

Primary results

- Highest average annual RSA obtained when CLS fungicide control began in the last week of June.
- ~5% RSA reduction from June Week 4 to July Week 1
- 2019: Low CLS pressure year
- 2020: High CLS pressure year
- 2022: Low CLS pressure year

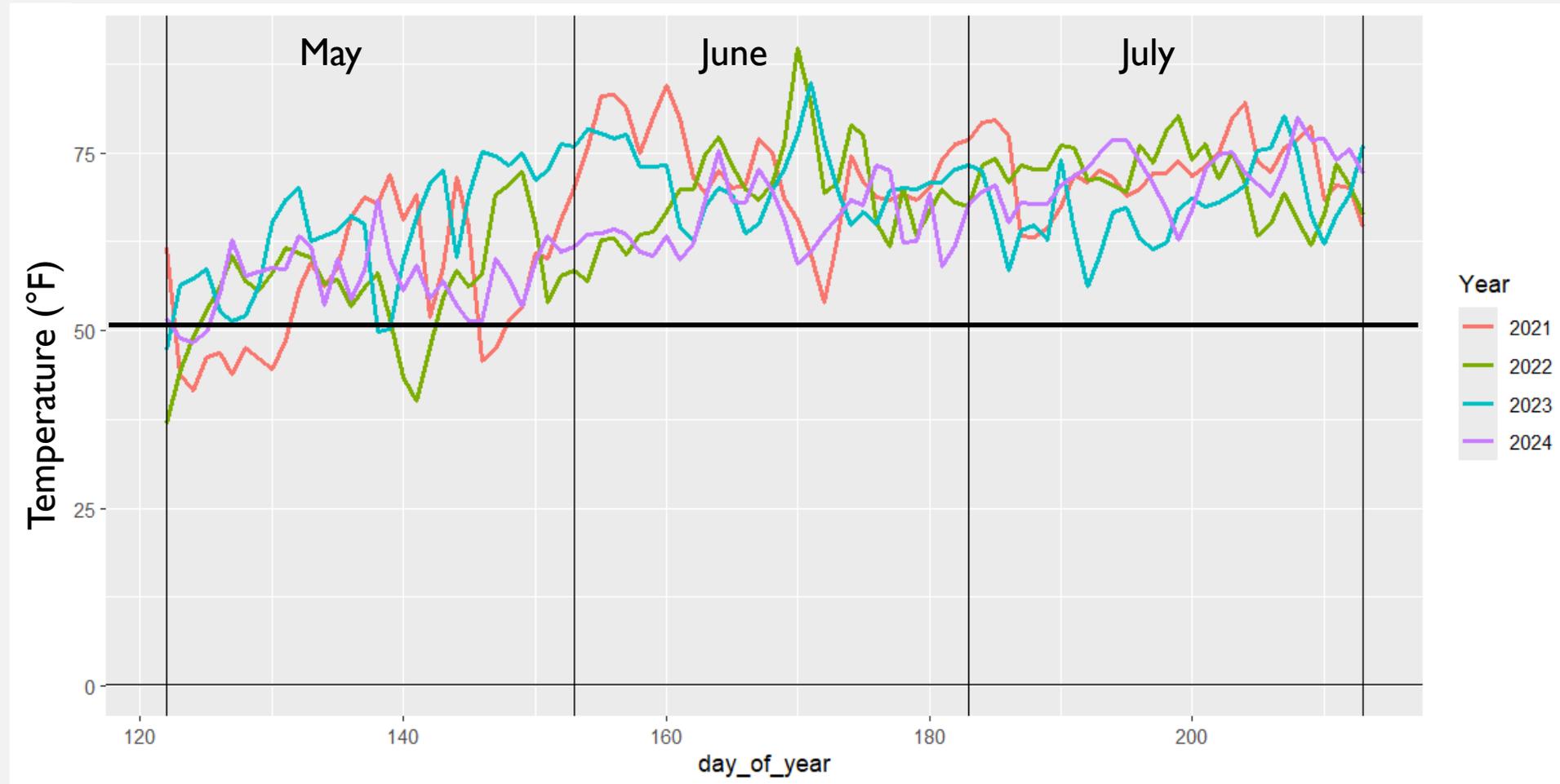


Availability of free water

Objectives

- Add to the Shane and Teng model to incorporate parameters that predict the start of infection:
 - Temperature threshold of greater than 10°C (50°F)
 - Free water availability greater than 6 hours
 - Rain fall
 - Dew formation
- Use 83 weather stations distributed throughout the growing region

Temperatures $\geq 10^{\circ}\text{C}$ (50°F)



Summary and next steps

- Latent infection in the RRV has consistently been detected at ~row-closure.
- Starting fungicide applications early to target primary inoculum results in higher RSA on average.
- In the RRV, conditions for spore germination occur consistently in May and June prior to latent infection detection.
 - Multiple instances throughout the growing region
- Future work to focus on the mid-late season to model disease progression and adjust the current model.
 - i.e. Identify environmental conditions that lead to reduced CLS risk
- Evaluate infection onset in growing regions with relatively lower disease pressure

Acknowledgements

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Sugarbeet Research & Education Board



BEET SUGAR DEVELOPMENT FOUNDATION

NDSU NORTH DAKOTA STATE UNIVERSITY



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