# Plant Pathology Highlights and Future Directions in Sugarbeet

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# Outline

**About Me**

**Plant Pathology Foundations for Sugarbeet**

**2023 Field Trials – Cercospora Leaf Spot**

**Additional Disease Management Concerns**

# About Me

Family farm in Alexandria, MN

- High tunnel crops
- Vegetables and small fruits

Education:

University of Minnesota (B.S.)

Cornell University (Ph.D.)

- Plant Pathology

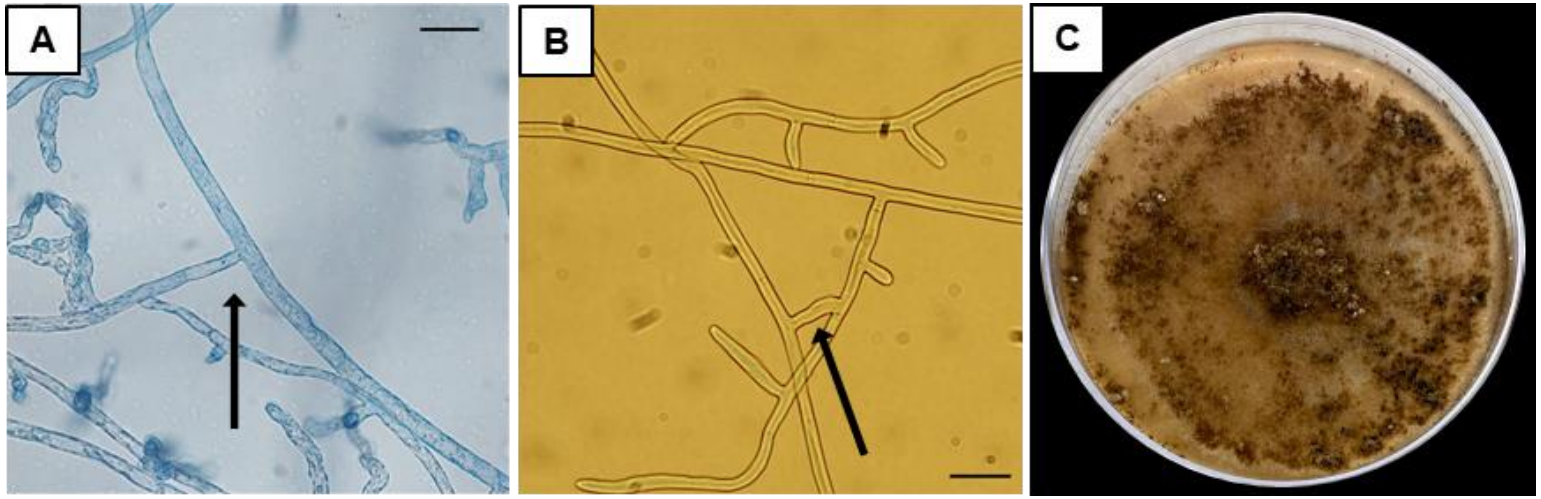

# Research background

Management and biology of *Rhizoctonia solani* in table beet

- Optimizing use of conventional and biological pesticides
- In-furrow vs. post-emergent

Root and foliar microbiomes

- Linked to plant health?




*Rhizoctonia solani* under the microscope and in the lab (E. Branch)

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# Principles of plant pathology can guide management

"Know your enemy…"

- Backbone of applied plant pathology

**Plant disease triangle**

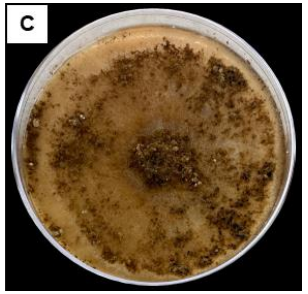
- What are the factors involved in and promoting infection?

**Pathogen life cycles**

- How can we interrupt and limit growth and reproduction of the pathogen?
- Optimize timing of control measures (fungicides)

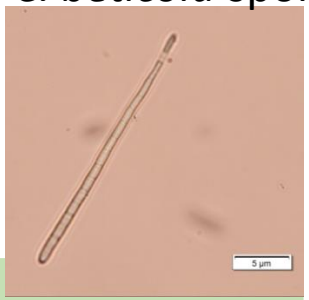

Historical example:
stem rust of wheat and
common barberry eradication
(Pederson 2013; DOI: 10.1094/APSFeature-2013-08)

Susceptible Host




*R. solani*

*C. beticola* spore



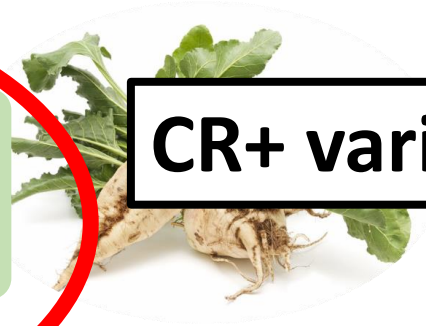
# Plant Disease Triangle

Pathogen

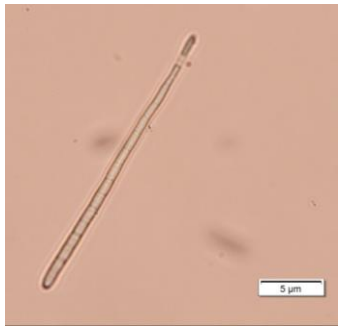
Favorable Environment

# Cercospora leaf spot disease triangle

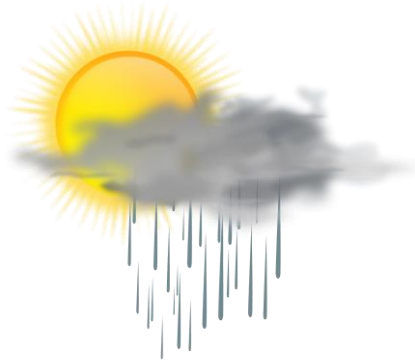
Susceptible Host



**CR+ varieties**



**Plant Disease Triangle**



Pathogen:

*C. beticola*

Favorable Environment

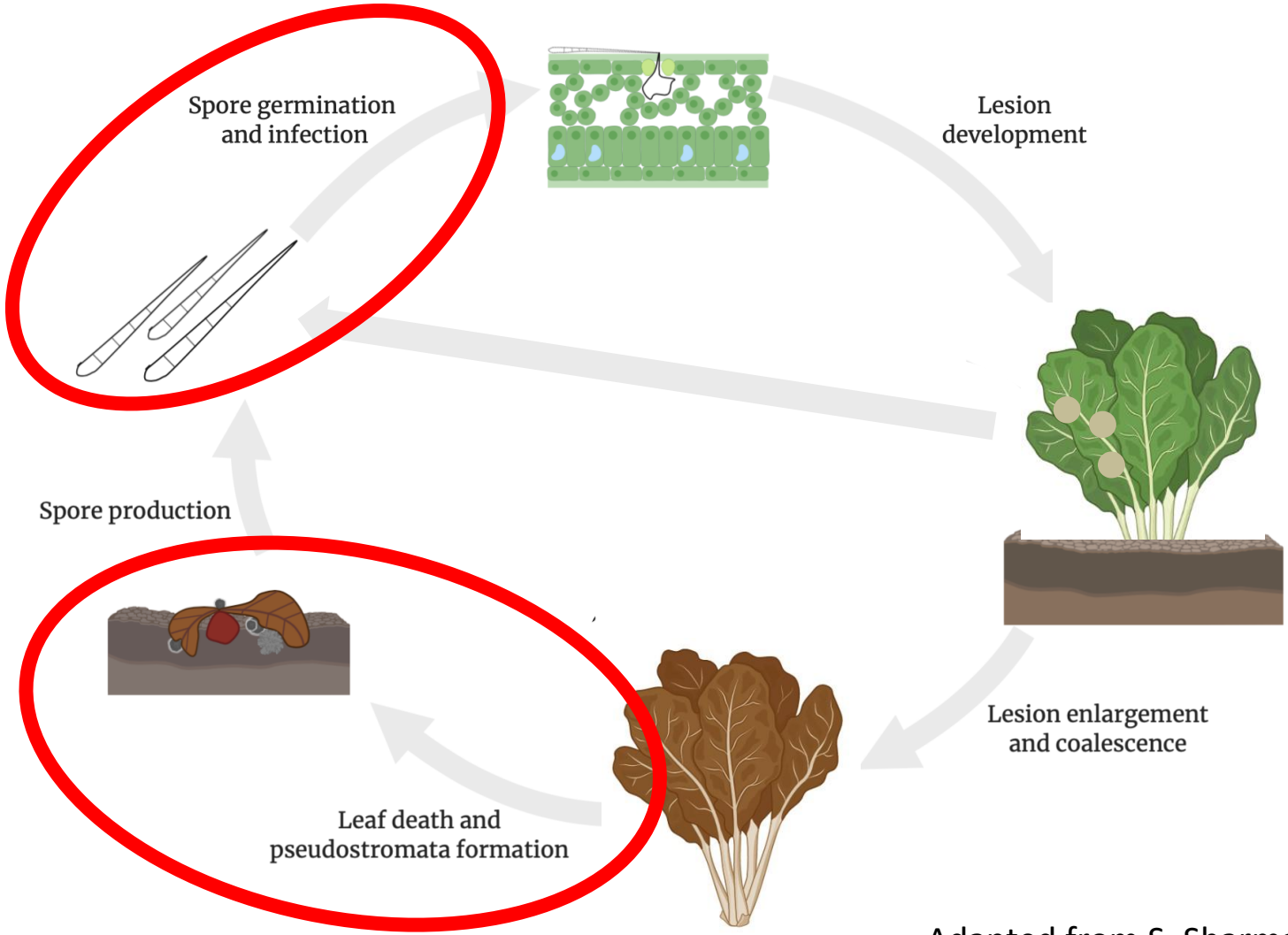
# Life cycle of *Cercospora beticola*

Multiple opportunities for CLS control:

- Crop rotation
- Residue Management
- In-season fungicides

Polycyclic disease

- Inoculum increases over the season




Adapted from S. Sharma

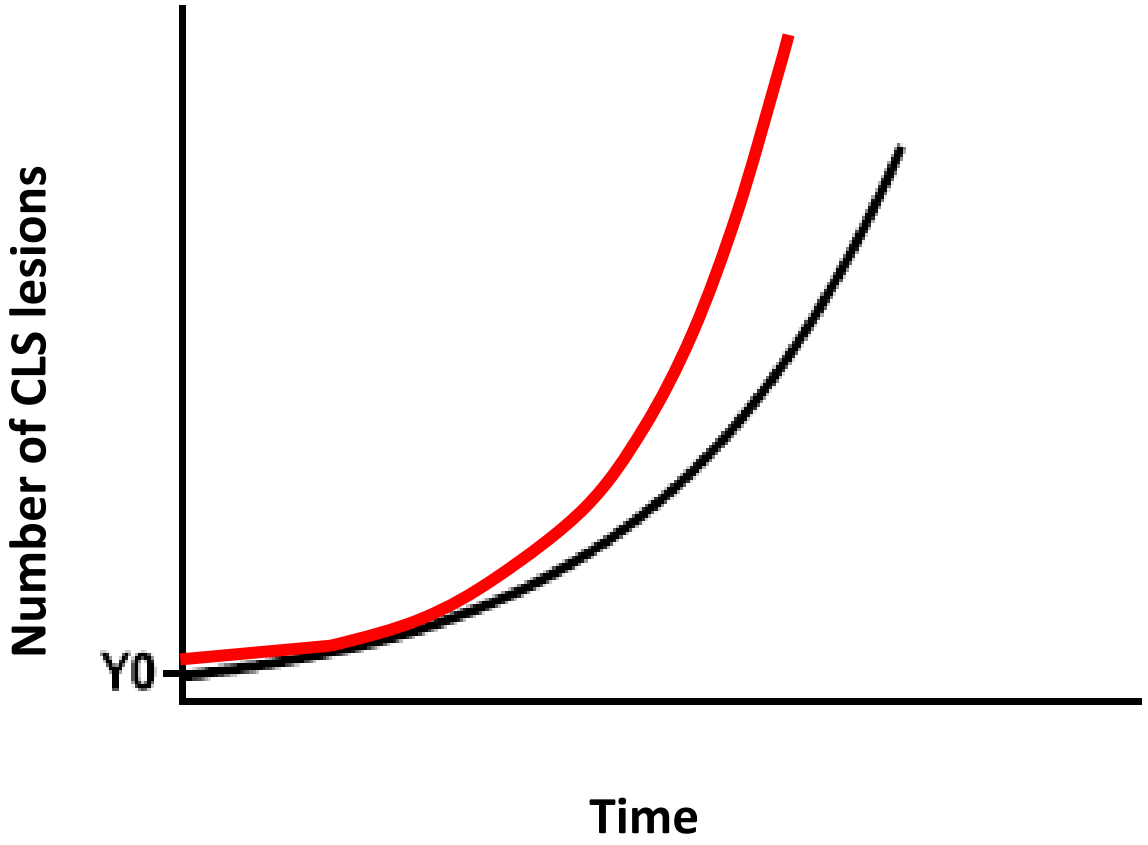
# CLS disease progression is exponential

Low numbers of CLS lesions can quickly develop into CLS epidemics if conditions favor disease

- 80°F daytime, 60°F night temperatures
- Row closing (increases humidity)

Insights from latent infection data

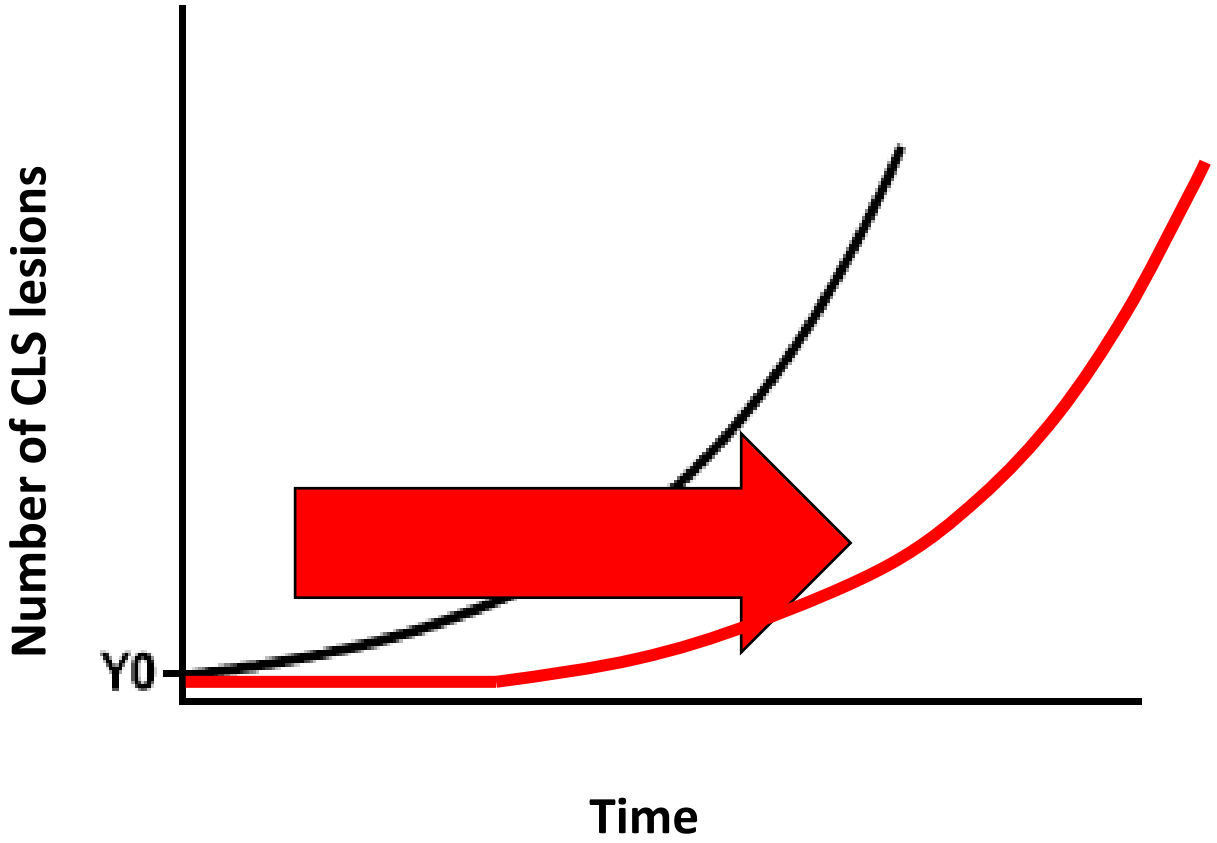
- Disease onset may be already too late!



# How to delay CLS disease progression?

Decrease host susceptibility or limit pathogen infection and growth

- CR+ genetics
- Apply effective fungicides at optimal timing, rotate FRAC groups
- Combining tools is necessary to prolong useful life of CLS control options



# Fungicide timing for CLS control

2023 CLS severity trial

- Three locations: Moorhead, Prosper, Foxhome
- Harvested September 18th
- Dr. Mohamed Khan and Sunil Bhandari
- Prosper data shown (highest CLS pressure)

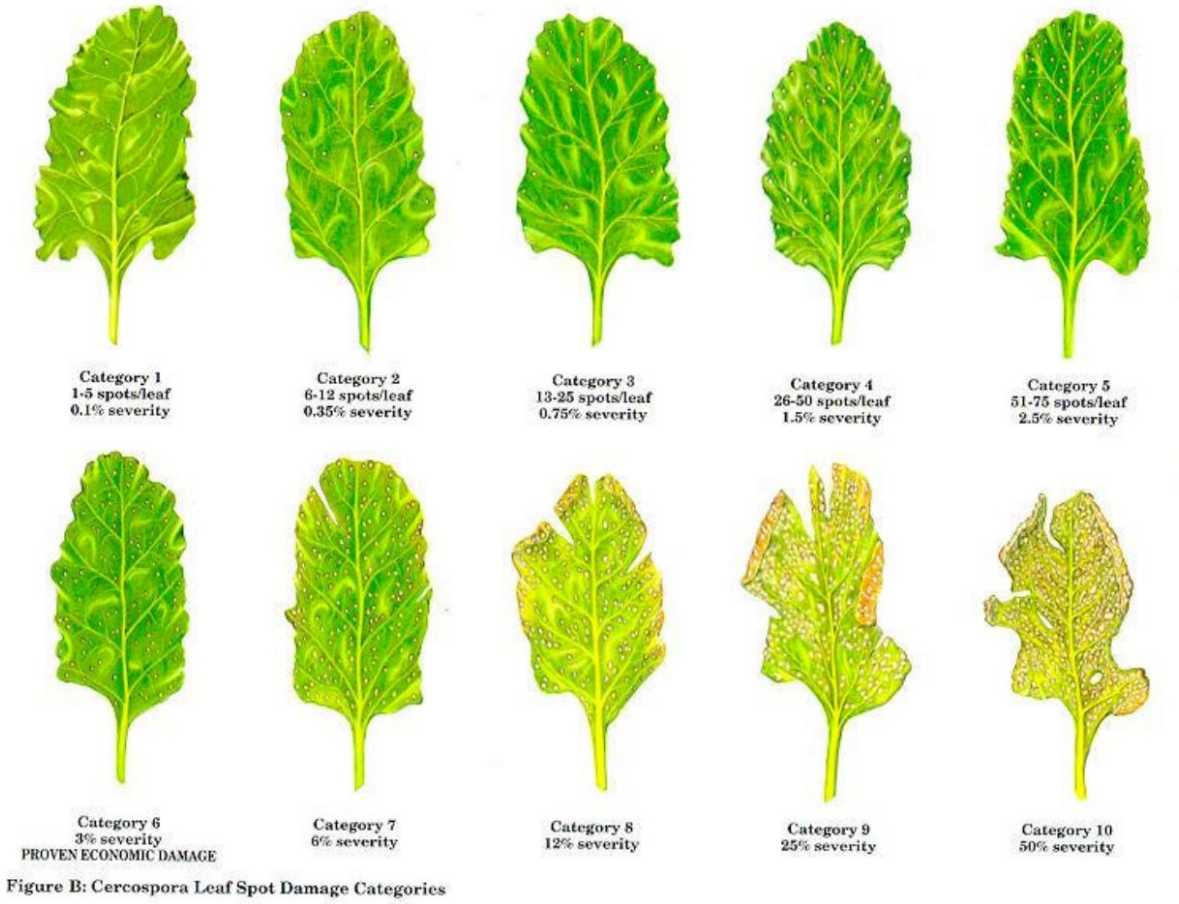


Figure B: Cercospora Leaf Spot Damage Categories

Jones and Windels 1991

Jones and Windels, 1991

# Fungicide timing for CLS control

All treatments used the same product rotation:

1. Super Tin + Badge SC
2. Minerva + Manzate Max
3. Super Tin + Badge SC
4. Inspire XT + Manzate Max
5. Super Tin + Badge SC
6. Proline + Manzate Max (+ Preference)

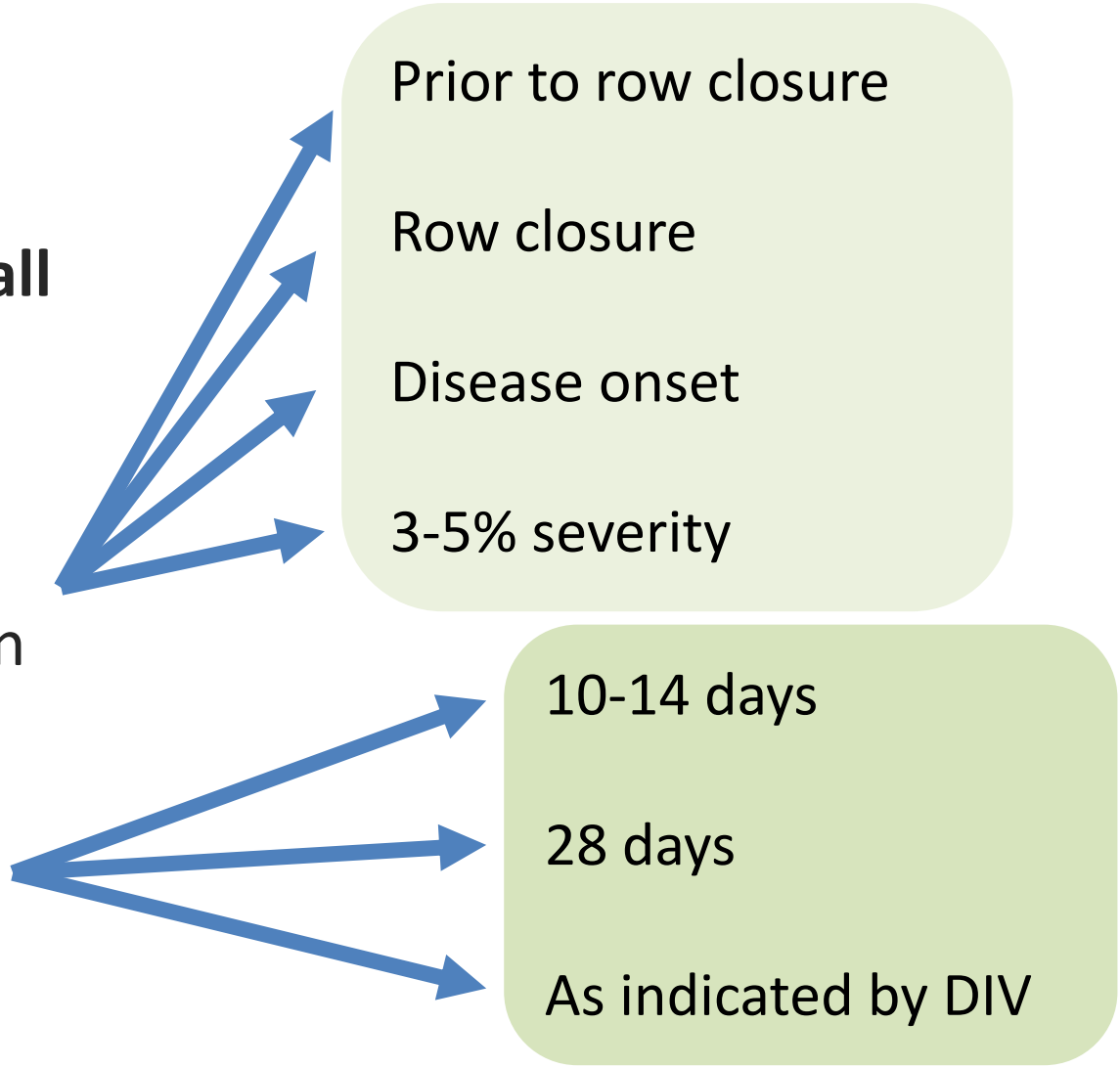
# Fungicide timing for CLS control

All treatments used the same product rotation

**Not all treatments used all 6 applications**

Treatments differed:

- Timing of 1st application
- Interval between fungicide applications



# Effect on Application Timing and Interval: CR+

| 1st application timing | Intervals | Total applications | Final CLS Rating | Yield (Ton/A) | Sugar (%) | SLM (%) | Sugar (lbs./A) |
|---|---|---|---|---|---|---|---|
| Nontreated control | - | 0 | **4.5 def** | 34.38 | 16.45 | 0.955 | 10,810 |
| Prior to row closure | 10-14 day | 6 | **2.0 a** | 35.8 | 15.75 | 1.02 | 10,107 |
| Row closure | 10-14 days | 5 | **2.0 a** | 38.85 | 15.56 | 0.96 | 11,386 |
| Row closure | 28 days | 3 | **2.5 ab** | 37 | 15.87 | 0.96 | 11,137 |
| Row closure | DIV | 4 | **2.5 ab** | 41.88 | 16.10 | 0.95 | 12,697 |
| Disease onset | 10-14 days | 3 | **2.3 ab** | 40.43 | 16.02 | 0.93 | 12,262 |
| Disease onset | 28 days | 2 | **3.3 abcd** | 41.73 | 16.29 | 0.91 | 12,869 |
| Disease onset | DIV | 3 | **2.8 abc** | 41.48 | 16.25 | 0.89 | 12,735 |
| 3-5% severity | 10-14 days | 1 | **5.3 f** | 32.03 | 15.97 | 0.94 | 10,014 |
| 3-5% severity | DIV | 1 | **4.5 def** | 33.03 | 15.97 | 1.01 | 10,188 |

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# Effect on Application Timing and Interval: non-CR+

| 1st application timing | Intervals | Total applications | Final CLS Rating | Yield (Ton/A) | Sugar (%) | SLM (%) | Sugar (lbs./A) |
|---|---|---|---|---|---|---|---|
| Nontreated control | - | 0 | **10.0 f** | 32.88 | 15.58 | 0.98 | 9,626 |
| Prior to row closure | 10-14 days | 6 | **3.0 a** | 41.55 | 16.68 | 0.94 | 13,080 |
| Row closure | 10-14 days | 5 | **4.0 abc** | 42.85 | 17.01 | 0.82 | 13,887 |
| Row closure | 28 days | 3 | **8.5 de** | 39.58 | 16.42 | 0.93 | 12,265 |
| Row closure | DIV | 4 | **5.3 c** | 40.38 | 16.66 | 0.92 | 12,617 |
| Disease onset | 10-14 days | 4 | **5.0 c** | 38.08 | 17.3 | 0.98 | 12,494 |
| Disease onset | 28 days | 2 | **7.3 d** | 40.05 | 16.56 | 0.93 | 12,540 |
| Disease onset | DIV | 4 | **4.8 bc** | 40.93 | 16.69 | 0.98 | 12,881 |
| 3-5% severity | 10-14 days | 3 | **9.5 ef** | 36.03 | 16.53 | 0.85 | 11,341 |
| 3-5% severity | DIV | 3 | **9.0 ef** | 38.10 | 16.16 | 0.98 | 11,616 |

# Effect on Application Timing and Interval: non-CR+

| 1st application timing | Intervals | Total applications | Final CLS Rating | Yield (Ton/A) | Sugar (%) | SLM (%) | Sugar (lbs./A) |
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| Nontreated control | - | 0 | **10.0 f** | 32.88 | 15.58 | 0.98 | 9,626 |
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# Fungicide Timing Summary for CLS:

1. The most effective programs include a fungicide application made at or prior to row closure

2. 3-4 fungicide applications may lead to increased recoverable sugar/Acre for CR+ varieties and non-CR+ varieties

3. Extended interval program is generally acceptable for CR+
   - Still requires early application
   - Need to monitor environment and DIV
   - Extended interval = 2-3 weeks

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# Optimizing CLS control through spray quality

Successful disease management also depends on spray coverage

Best practices include:

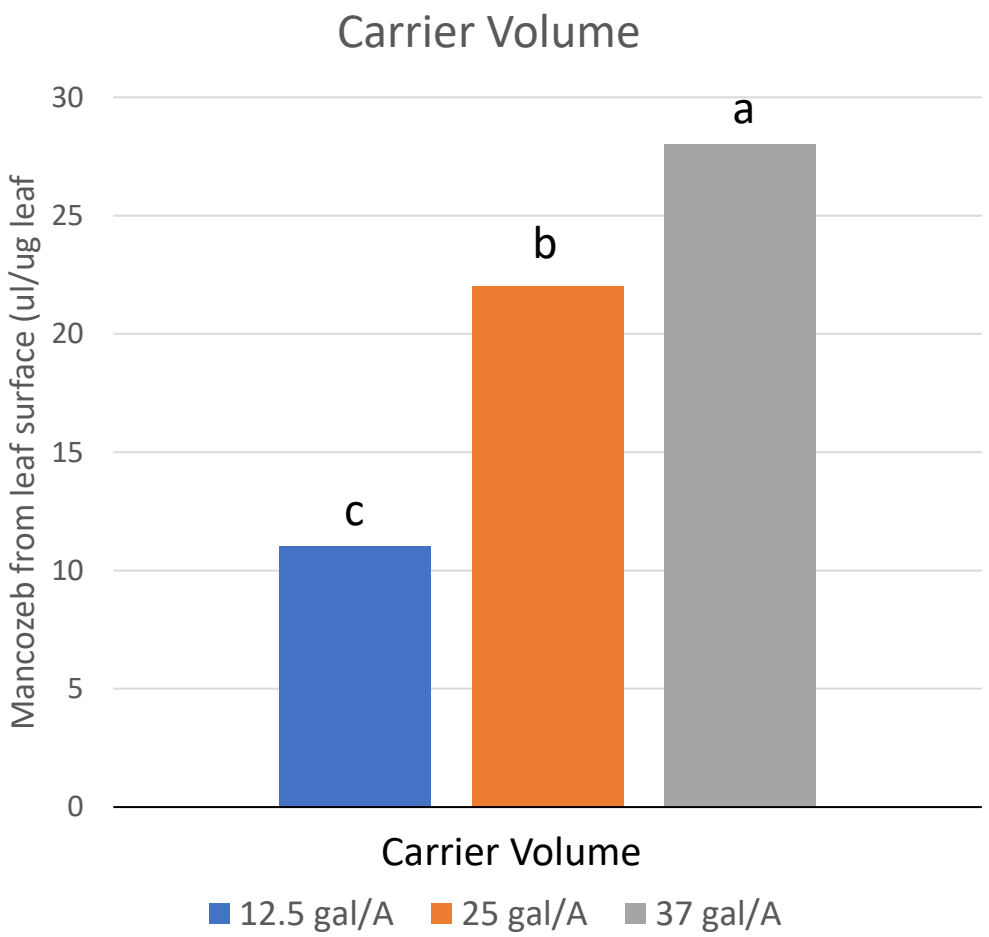
- Medium droplet sizes (300-350 microns)
- High pressure (80 psi)

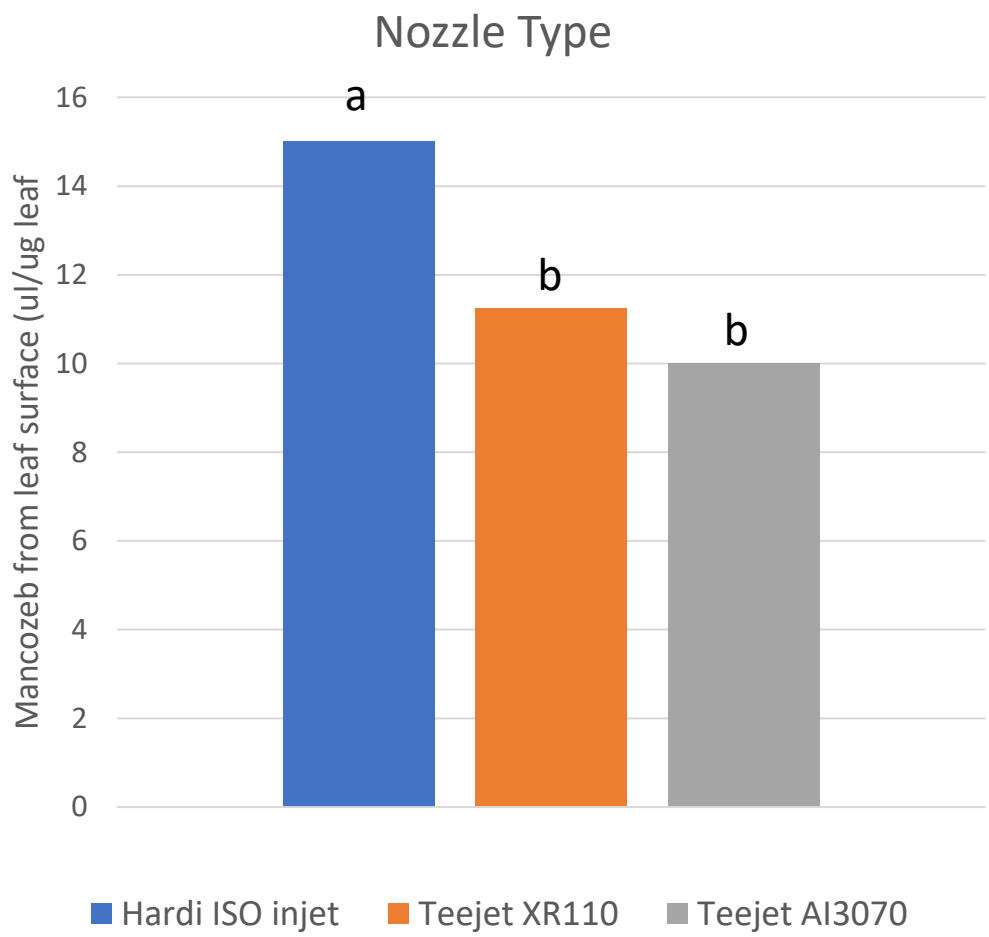
# Effect of nozzle type and carrier volume

- 2023 sugarbeet field trial from Ontario, Canada
- Quantified amount of Mancozeb recovered leaf surfaces
- Importance of considering droplet size, carrier volume, and coverage
  - Refer to nozzle manufacture guidelines

Thornton et al. 2023 *Crop Protection* 167:106198

# Effect of nozzle type and carrier volume




Adapted from Thornton et al. 2023 *Crop Protection* 167:106198

# CLS fungicides are best applied alone

Changing weed pressure and earlier foliar fungicide applications has led to questions about tank mixes of herbicides and fungicides

Applying herbicides and foliar fungicides **separately** is still the best recommendation

Concerns:

- Crop injury

- Efficacy of weed or disease control

# Emerging (or Re-emerging) Diseases

Rhizomania

- Beet Necrotic Yellow Vein Virus (BNYVV) / *Polymyxa betae* (soilborne protist)
- New BNYVV strains ?

Alternaria leaf spot

- *Alternaria* spp.

Effective Scouting and Diagnosis!

# Rhizomania

Symptoms include yellowing of leaves, and stunted, “wineglass” shaped roots with rootlets.

https://www.uidaho.edu/extension/ipm/ag-pests/nematodes/rhizomania

# Alternaria leaf spot

Reports of increased Alternaria isolations in 2023

- Frequently isolated with *C. beticola*

Alternaria may be a primary pathogen, secondary pathogen, or both.

https://apsjournals.apsnet.org/doi/10.1094/PHP-03-22-0025-DG

# Acknowledgements

**Sugarbeet Research & Education Board of MN and ND**

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**NDSU/UMN colleagues**

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