Evaluating biological control for Sclerotinia stem rot of canola

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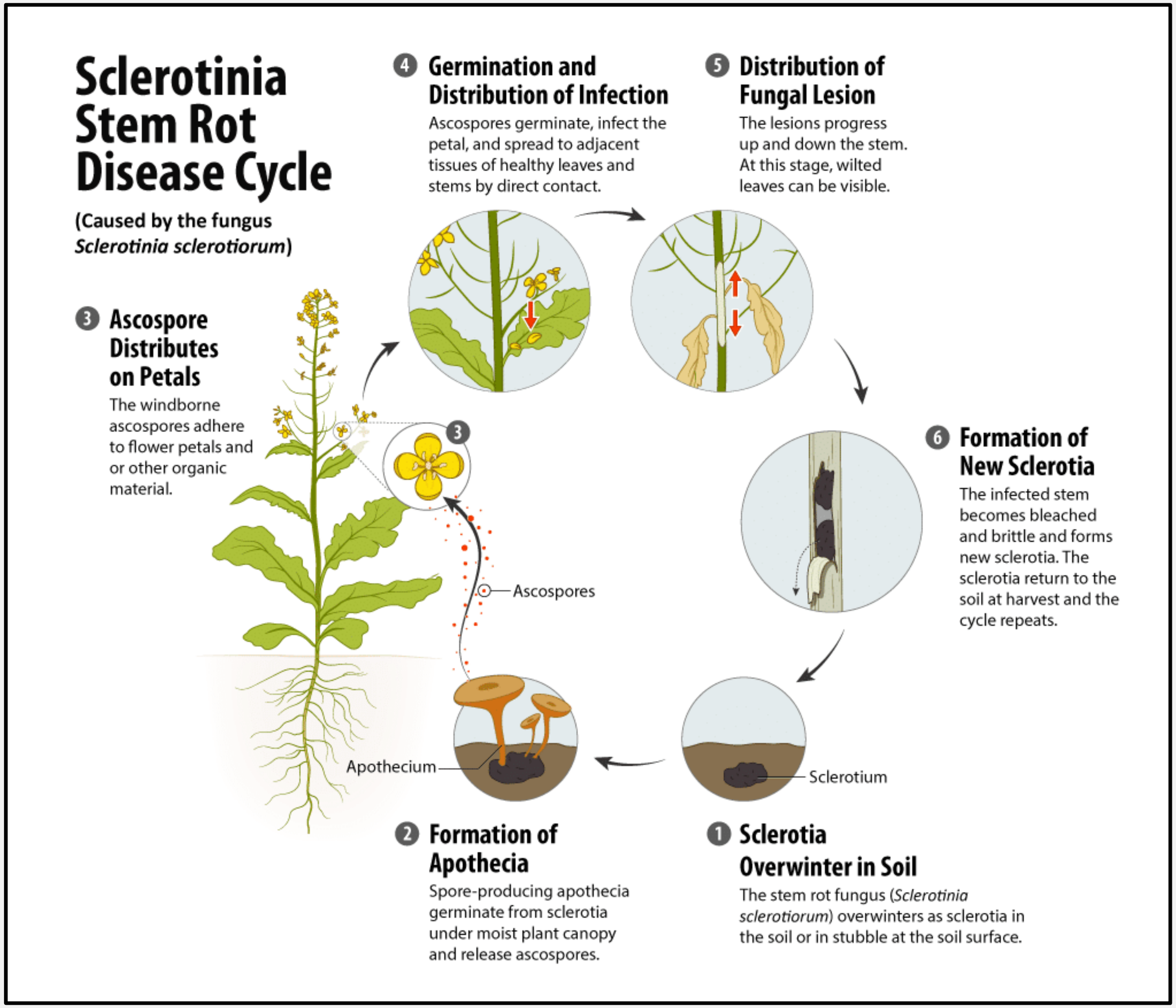
2024 Canola Symposium

Sclerotinia stem rot
Sclerotinia sclerotiorum

www.canolacouncil.org



Sclerotinia stem rot
Signs and symptoms in canola

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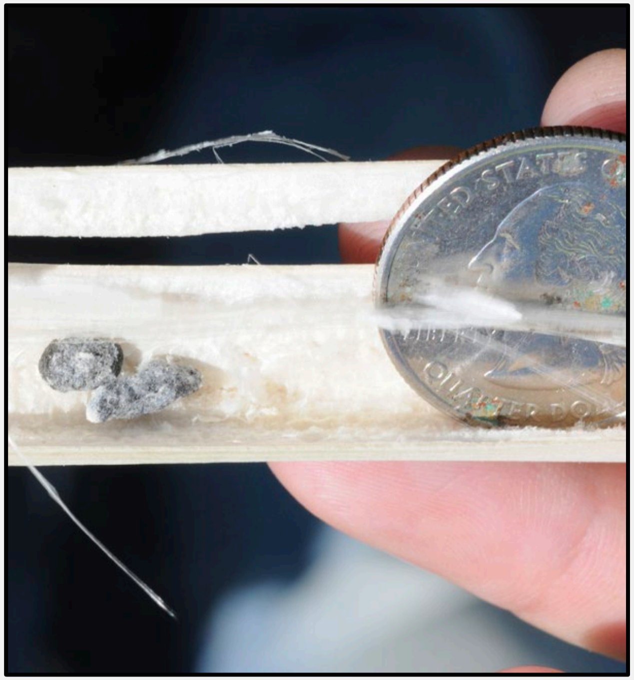
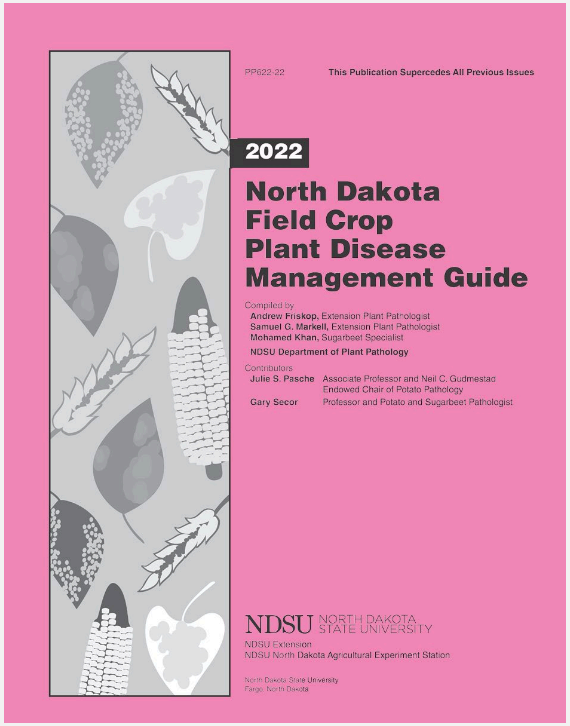
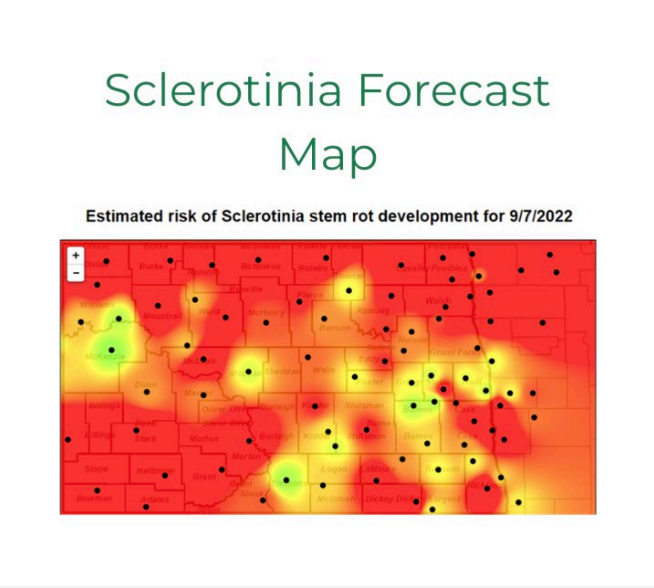


www.northerncanola.com Luis del Rio

Sclerotinia stem rot in canola– management

- Fungicide application timing is critical (20-50% of flowering)- look for apothecia
- Forecasting tools are available
- Various options: Ex. Boscalid and Azoxystrobin AI
- Hybrids with tolerance and upright architecture
- Rotation with non-susceptible crops (grasses) to reduce inoculum (does not eliminate)





Dr. Sam Markell
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Translational tools towards SSR management

1. Integrated management of soilborne diseases- pathogen ecology considerations

2. Enhancing white mold/*Sclerotinia* tolerance through genetic and architectural strategies

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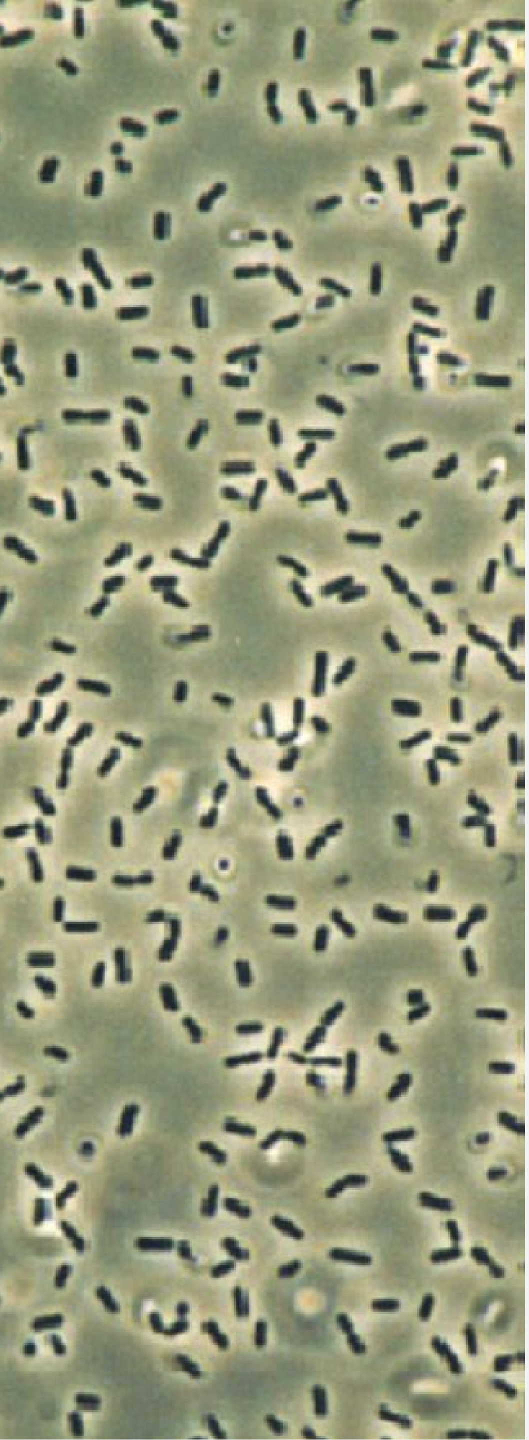


Biological control products to manage Sclerotinia stem rot in canola

Biofungicide mechanisms to control pathogens:

1) The production of toxins (antibiosis)
2) Parasitism that attacks the pathogen
3) Competition for resources
4) Induced resistance of the crop plant

Benefits:

- Can be used in organic production (premium price)
- Can be used with conventional fungicides to avoid resistance
- Some may have long lasting effects
- Short reentry period

Challenges:

Application timing is key and results may vary

Biological control products to manage Sclerotinia stem rot in canola

Biological control products to manage Sclerotinia stem rot in canola

Coniothyrium minitans

- A mycoparasite of sclerotia (reduction by as much as 95%), will persist in the soil
- Applied to the soil — pre-plant, at planting, after cultivation or post-harvest
- Can be applied at higher rate in spring (3-4 lb) or lower rate in fall (1-2 lb): must contact sclerotia

horticulture.oregonstate.edu

Biological control products to manage Sclerotinia stem rot in canola

Bacillus subtilis

- Applied during flowering
- Works as an antagonist (antibiosis)
- Stops the growth of mycelia and germination of ascospores
- May activate host defense response

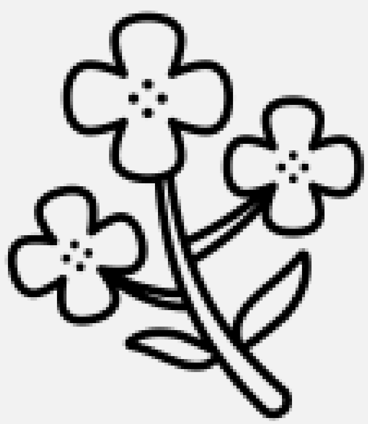
Biological control products to manage Sclerotinia stem rot in canola

Bacillus amyloliquefaciens

- Applied during flowering or to soil
- Antibiosis: Inhibits mycelial growth, suppresses of sclerotia formation, reduces ascospore germination, and induces structural abnormalities within the apothecia
- Plant growth-promotional activity
- Suppression comparable to conventional fungicides in snap bean (Pethybridge et al., 2019)

Objectives to evaluate biological control products to manage Sclerotinia stem rot in canola

1) Compare the efficacy of current, diverse biological control products at reducing disease and inoculum
2) Compare the impact of biological control products on yield
3) Evaluate the potential of fungi and bacteria isolated from sclerotia for novel biological disease control



Obj. 1: Compare the efficacy of current biological control products

Carah Anteck

- Trials were conducted at UMN St. Paul and Roseau CPC farms (planted 4/23 and 5/29)
- Each treatment was replicated four times in an RCBD
- Plots were 25’ long and 6’ wide
- Irrigation was applied through early flowering in SP (June 7)
- Sclerotia were spread to equal about 1 per sq ft

Biological control agents, rates, and timings

Treatment	Product	Active Ingredient	Application Timing	Application Rate
1	Untreated control	NA	NA	NA
2	Contans	*C. minitans*	May, pre plant, soil application	4 lb/ac
3	Double Nickel LC	*B. amyloliquefaciens*	20-30% bloom	5 qt/ac
4	Double Nickel LC	*B. amyloliquefaciens*	50-60% bloom	5 qt/ac
5	Double Nickel LC	*B. amyloliquefaciens*	20-30% bloom + 7 days later	5 qt/ac
6	Serenade OPTI	*B. subtillis*	20-30% bloom	20 oz/ac
7	Serenade OPTI	*B. subtillis*	50-60% bloom	20 oz/ac
8	Serenade OPTI	*B. subtillis*	20-30% bloom + 7 days later	20 oz/ac
9	Contans + Serenade OPTI	*C. minitans* + *B. subtillis*	May (pre plant soil app) + 20-30% bloom	4 lb/ac + 20 oz/ac
10	Endura*	Boscalid	20-30% bloom	5.5 oz/ac
11	Proline, Endura*	Prothioconazole, boscalid	20-30% bloom + 7 days later w/ Endura	5.5,5.7 oz/ac

Disease evaluation methods

- Disease was assessed from 15’ of each row at **full pod** (July 3rd, St. Paul and August 6th, Roseau)
- Both incidence and severity data were collected

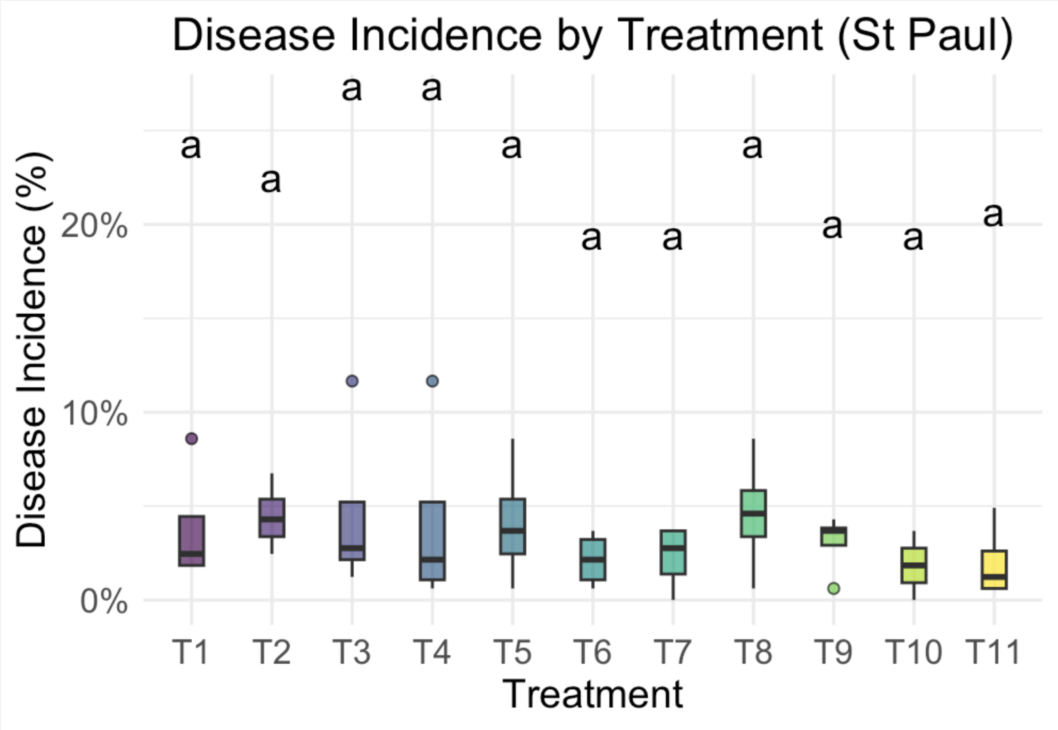
DSI = 100 * [(#plants * 1) + (#plants * 2) + (#plants * 3) + (#plants * 4) + (#plants * 5)]/(Total number of plants in the sample * 5)

Sclerotiniariskcalculator.com

Disease incidence– St. Paul

Jasper Tao

Trt	Product	Application Timing
1	Untreated control	NA
2	Contans	May, pre plant soil application
3	Double Nickel LC	20-30% bloom
4	Double Nickel LC	50-60% bloom
5	Double Nickel LC	20-30% bloom + 7 days later
6	Serenade OPTI	20-30% bloom
7	Serenade OPTI	50-60% bloom
8	Serenade OPTI	20-30% bloom + 7 days later
9	Contans + Serenade OPTI	May (pre plant soil app) + 20-30% bloom
10	Endura*	20-30% bloom
11	Proline+Endura*	20-30% bloom + 7 days later w/ Endura



Disease incidence did not differ between treatments.

Disease incidence– Roseau

Trt	Product	Application Timing
1	Untreated control	NA
2	Contans	May (pre plant soil application)
3	Double Nickel LC	20-30% bloom
4	Double Nickel LC	50-60% bloom
5	Double Nickel LC	20-30% bloom + 7 days later
6	Serenade OPTI	20-30% bloom
7	Serenade OPTI	50-60% bloom
8	Serenade OPTI	20-30% bloom + 7 days later
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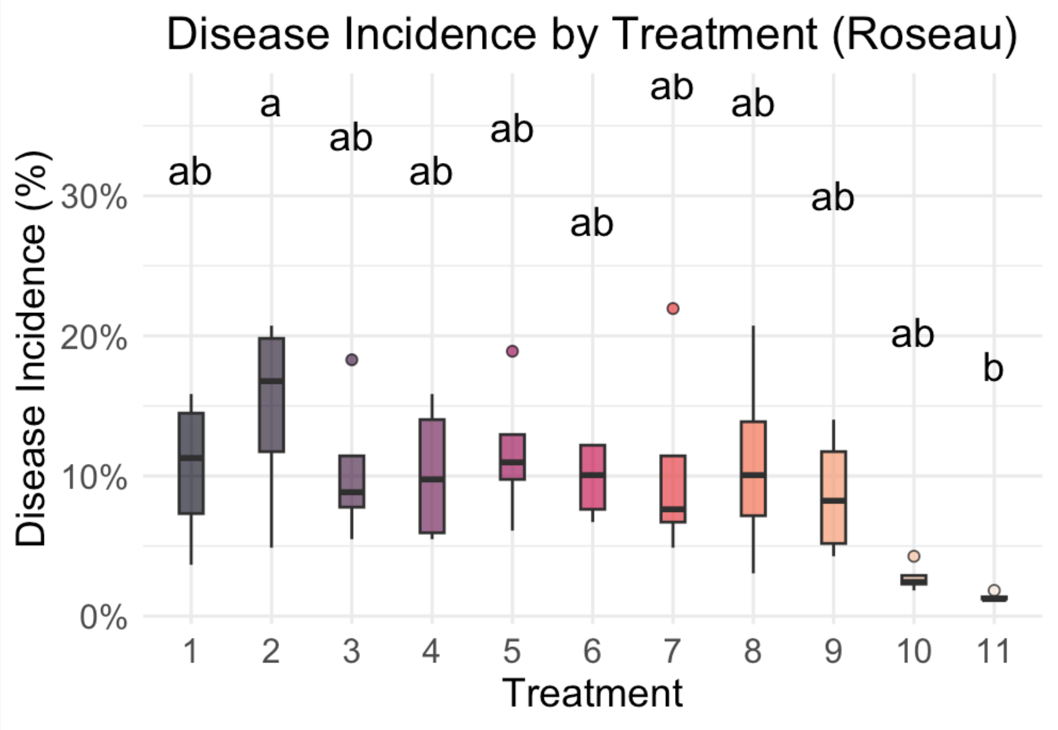

Disease incidence was lowest in plots treated with premium fungicides (compared to Contans)

Disease severity index – St. Paul

Trt	Product	Application Timing
1	Untreated control	NA
2	Contans	May, pre plant soil application
3	Double Nickel LC	20-30% bloom
4	Double Nickel LC	50-60% bloom
5	Double Nickel LC	20-30% bloom + 7 days later
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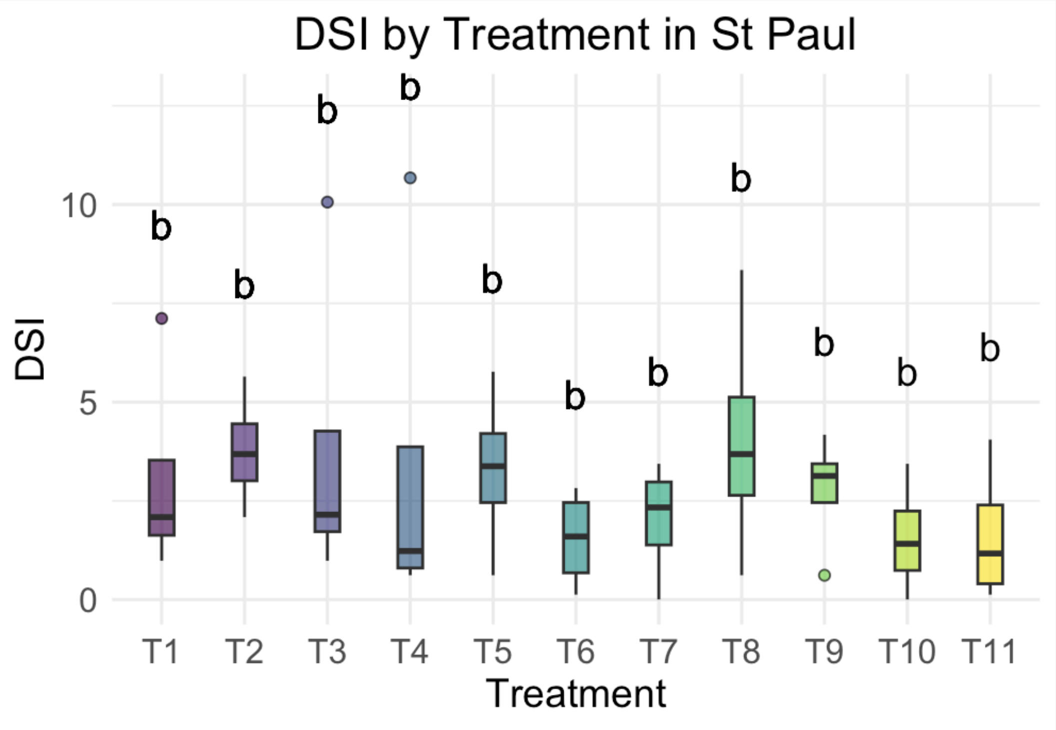

DSI did not differ between treatments.

Disease severity index – Roseau

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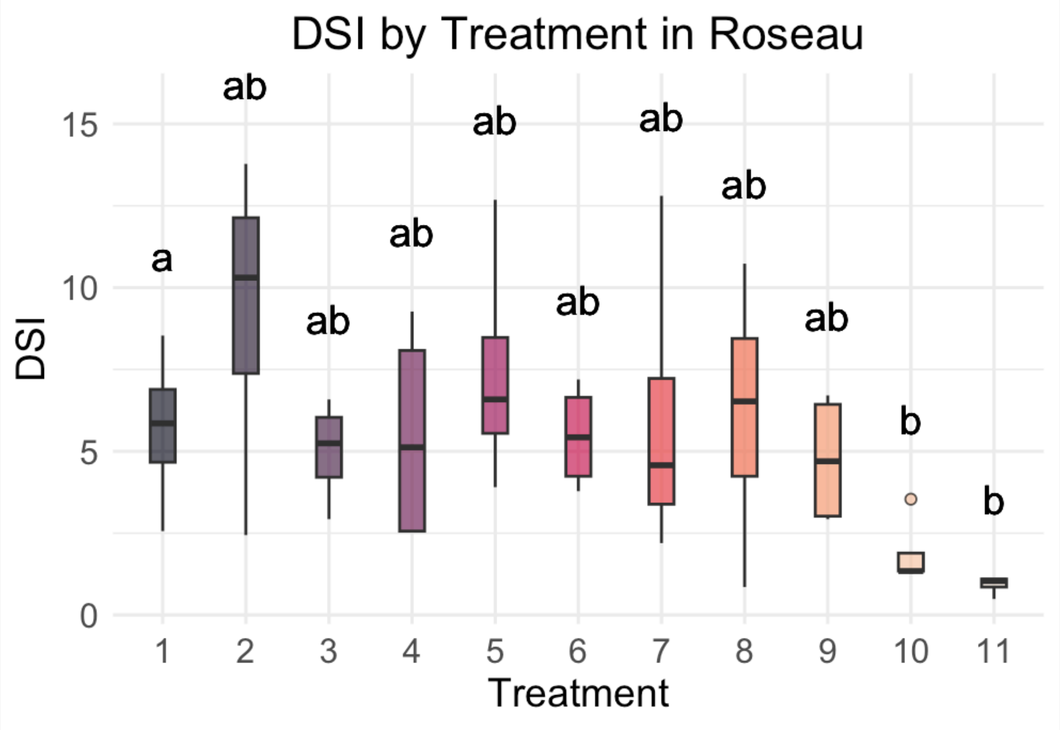
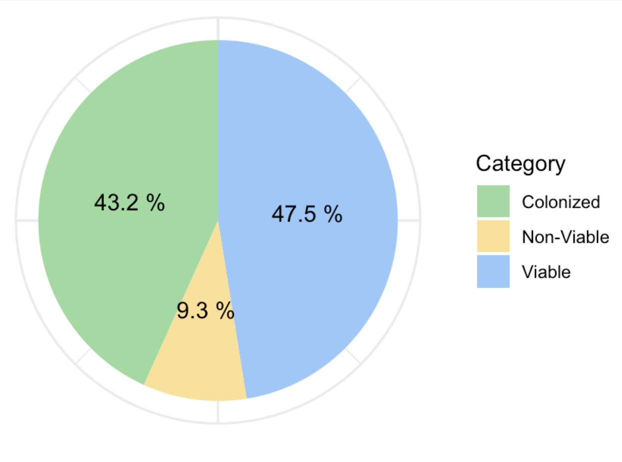


DSI was lowest in plots treated with Endura and premium fungicides compared to the control

Inoculum persistence

- At planting, bags of sclerotia (15 sclerotia per bag) were buried 2.5” in the untreated control and Contans- only containing plots
- Bags were removed at harvest



Obj. 2: Compare the impact of biological control products on yield

- Plots were harvested (Aug. 14th, St. Paul and Sept. 15th, Roseau).
- Plots were measured to increase the precision of yield measurements.
- Yield values were converted to 8.5% moisture.
- Grain quality metrics (oil and protein) were also assessed- *no significant difference between treatments*

Yield– St. Paul

Trt	Product	Application Timing
1	Untreated control	NA
2	Contans	May, pre plant soil application
3	Double Nickel LC	20-30% bloom
4	Double Nickel LC	50-60% bloom
5	Double Nickel LC	20-30% bloom + 7 days later
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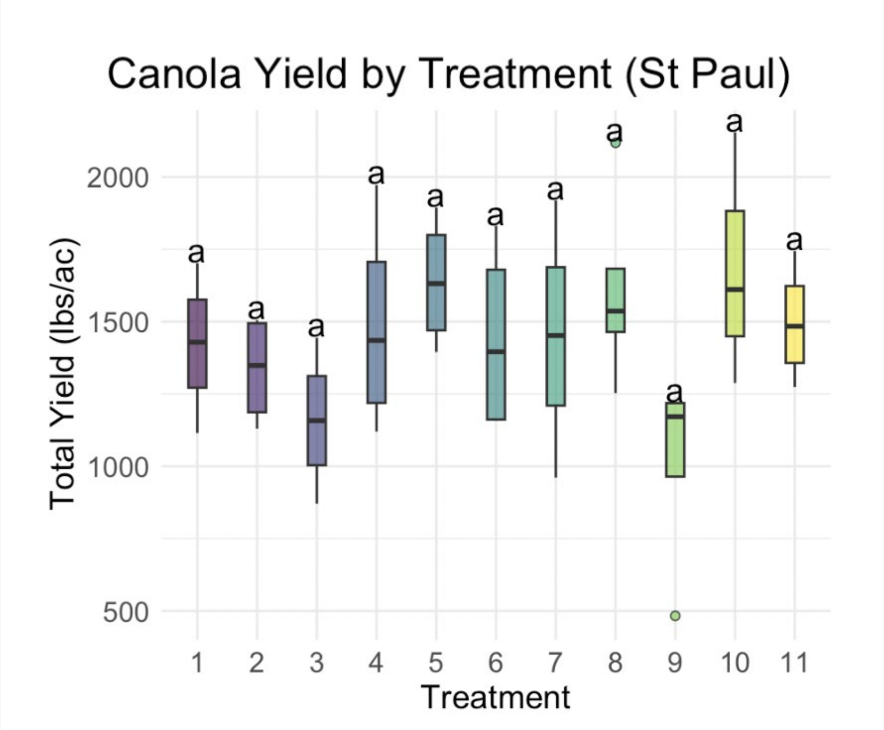

Yield did not differ between treatments.

Yield– Roseau

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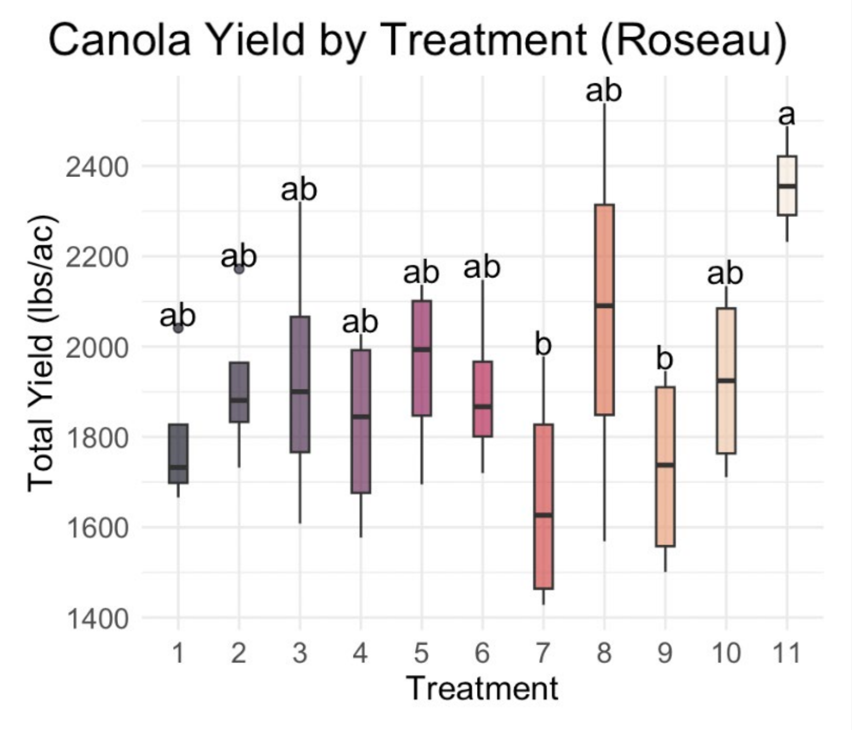
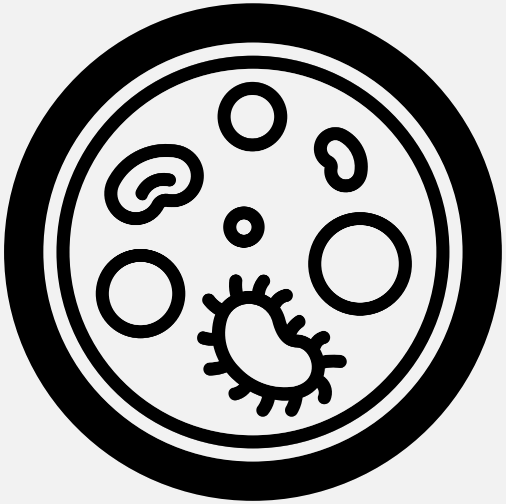


Premium fungicides resulted in higher yields than two Serenade treatments.

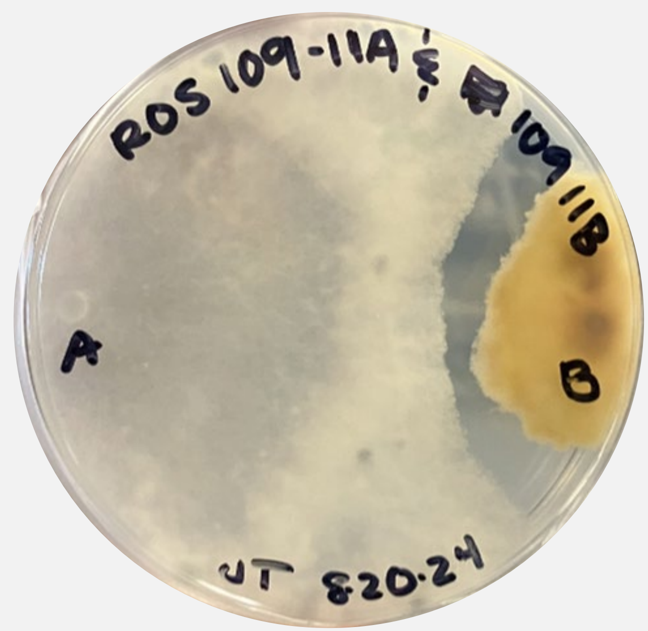
Obj: 3 Evaluate the potential of fungi and bacteria isolated from sclerotia for novel biological disease control

- Buried sclerotia were removed at harvest
- 18 sclerotia per plot were plated directly on fungi culture medium (9) or washed for bacteria (9)
- Pure cultures will then be grown in inhibition assays with *S. sclerotiorum* to observe antagonistic activity
- Fungi and bacteria with observed antagonism will be identified using molecular methods: DNA extraction and sequencing with ITS 1 and 4 primers (for fungi) and 16s (for bacteria)



Microbial isolations

- Inhibition assays will be conducted this winter: 68 unique bacterial isolates, 12 unique fungal isolates
- 12 isolates showed inhibition from viability assays!



Realized and expected outcomes:

- Biological control products (when evaluated at an incidence less than 20%) are not more effective at disease suppression than conventional fungicides
- We are on the path to identifying novel antagonists from disease inoculum

NEXT STEPS

- Evaluations with sprayed inoculum?
- Biofungicides + conventional fungicides?
- Antagonism assays with co-plating and buried sclerotia bags in controlled conditions

Translational tools towards SSR management

1 Integrated management of soilborne diseases- pathogen ecology considerations

2 Enhancing white mold/*Sclerotinia* tolerance through genetic and architectural strategies

Evaluating Ss aggressiveness determinants across crop species

Hsuan Fu Wang

Development of a screening panel for multiple crop species

- Isolates of *S. sclerotiorum* differ in their aggressiveness
- Each isolate (17 so far) was repeated 6 times on a susceptible variety
- Inoculated at V4-V5
- Third leaf excised at 0.75”

198
0

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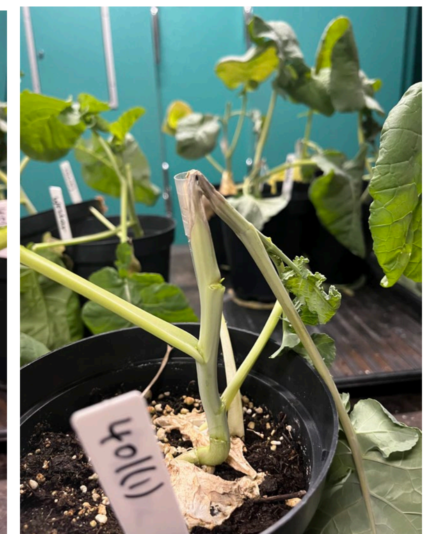
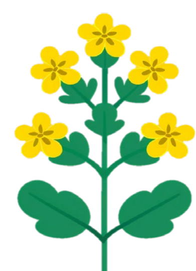
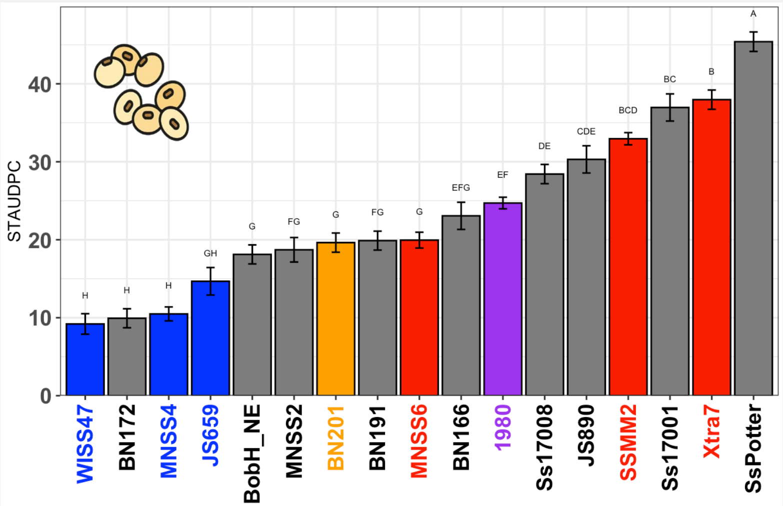
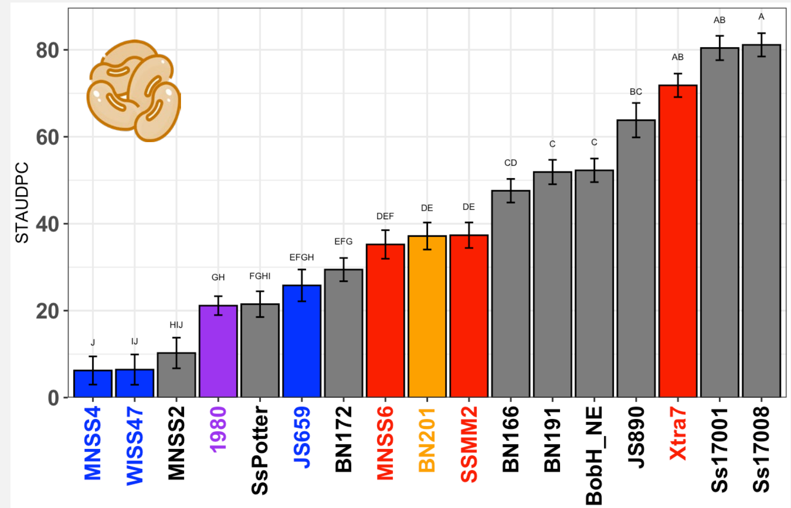


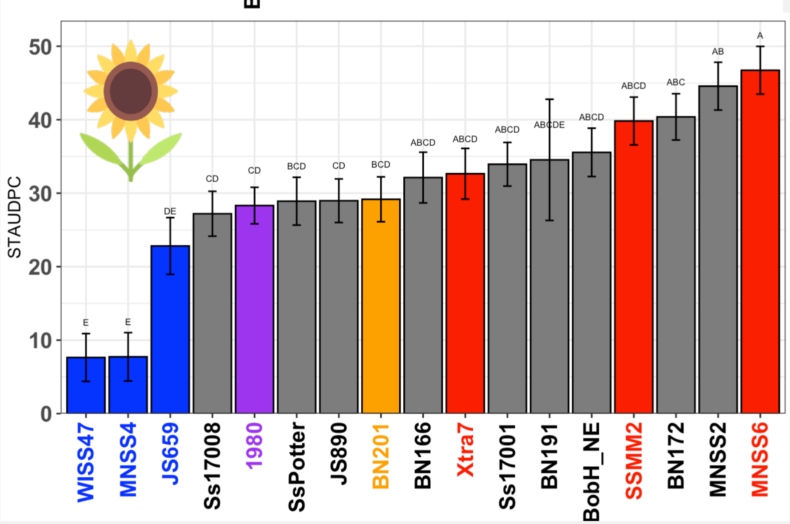
Cultivar	Plant (Scientific name)	Source
PI605719(Flint)	Canola (*Brassica napus*)	North Central Regional PI Station (NC7)
PI649150 (Westar)	Canola (*Brassica napus*)	North Central Regional PI Station (NC7)

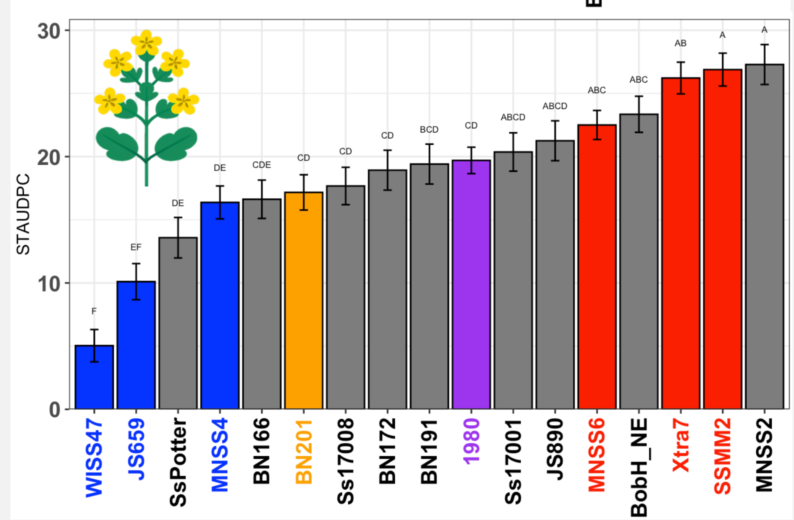


Development of a screening panel for multiple crop species









Evaluate Ss aggressiveness determinants across crop species– screening panel and transcriptomics to ID RNAi targets

Hsuan Fu Wang

Realized and expected outcomes:

- A *S. sclerotiorum* isolate collection
- Improved screening tools for breeders
- Targets for gene silencing that can have broad impact across crop species

NEXT STEPS

- Development of a subpanel and screening for resistance in R vs. S lines
- Transcriptomics to identify aggressiveness-related genes!

THANK YOU

Questions?

Special thanks to:

Donn Vellekson

Dave Grafstrom

Dr. Nancy Ehlke

Peter Aspholm

Carah Anteck

Jasper Tao

Hunter Kluegel

Alisha Mildenberger

Minnesota Canola Council

National Sclerotinia Initiative

Program of the USDA ARS

Additional ideas or thoughts?

Please email me: mmccaghe@umn.edu

Additional production notes

Variety- InVigor L345PC

Fungicide application – 18 GPA @28 PSI

Seed treatment- Helix Vibrance

Nutrient- PPI 140-40-40-20 R, 100-0-0-20 St Paul