

# Management of Major Sugarbeet Diseases

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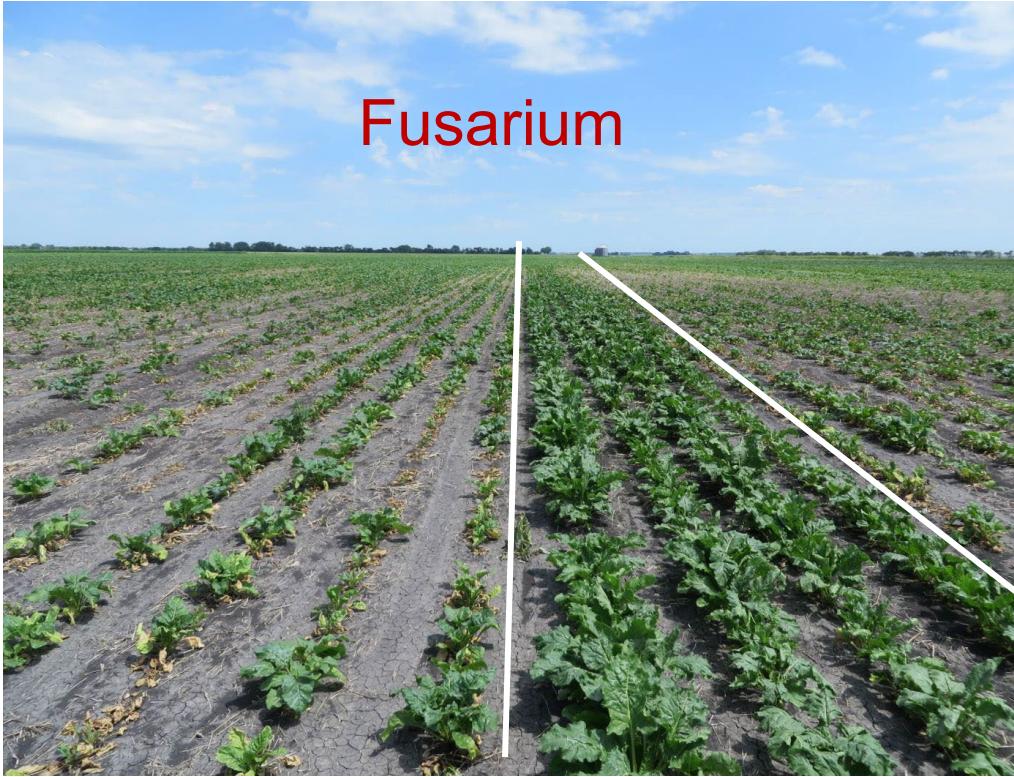
 @BeetPath



ACSC Grower Seminar, Feb 01, 2023



# Accurate Diagnosis is critical!



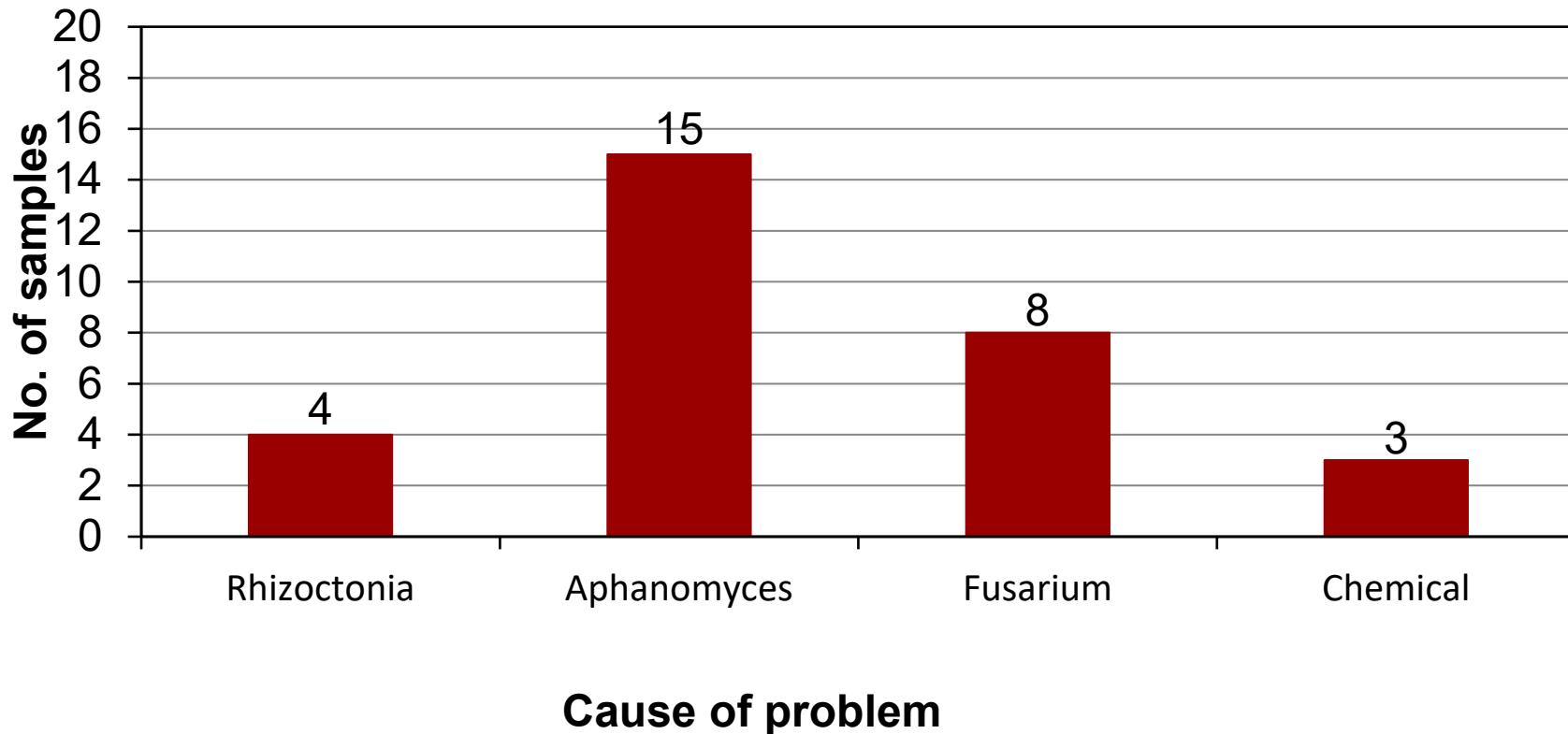
# More than one problem is very common

July 21, 2015

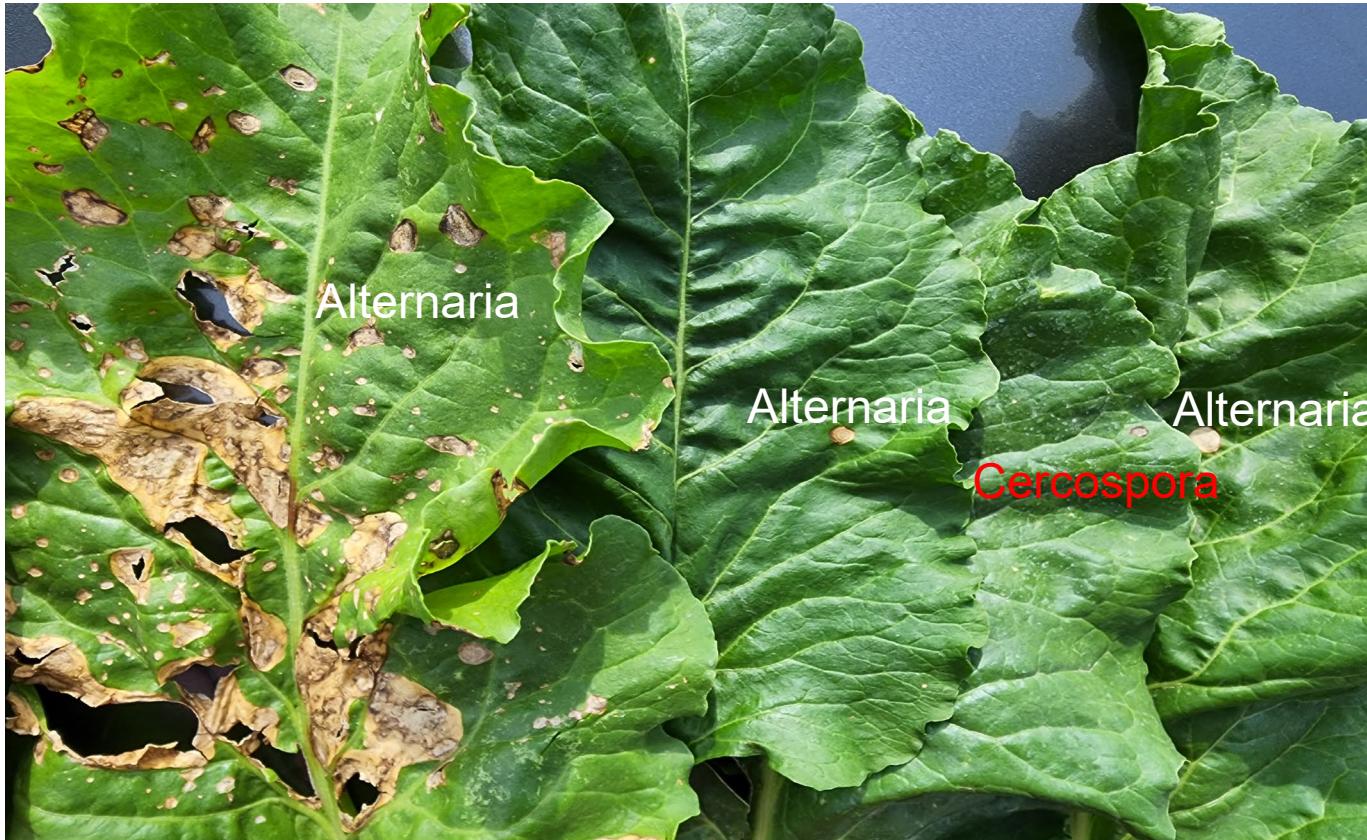
Rhizoctonia + Aphanomyces



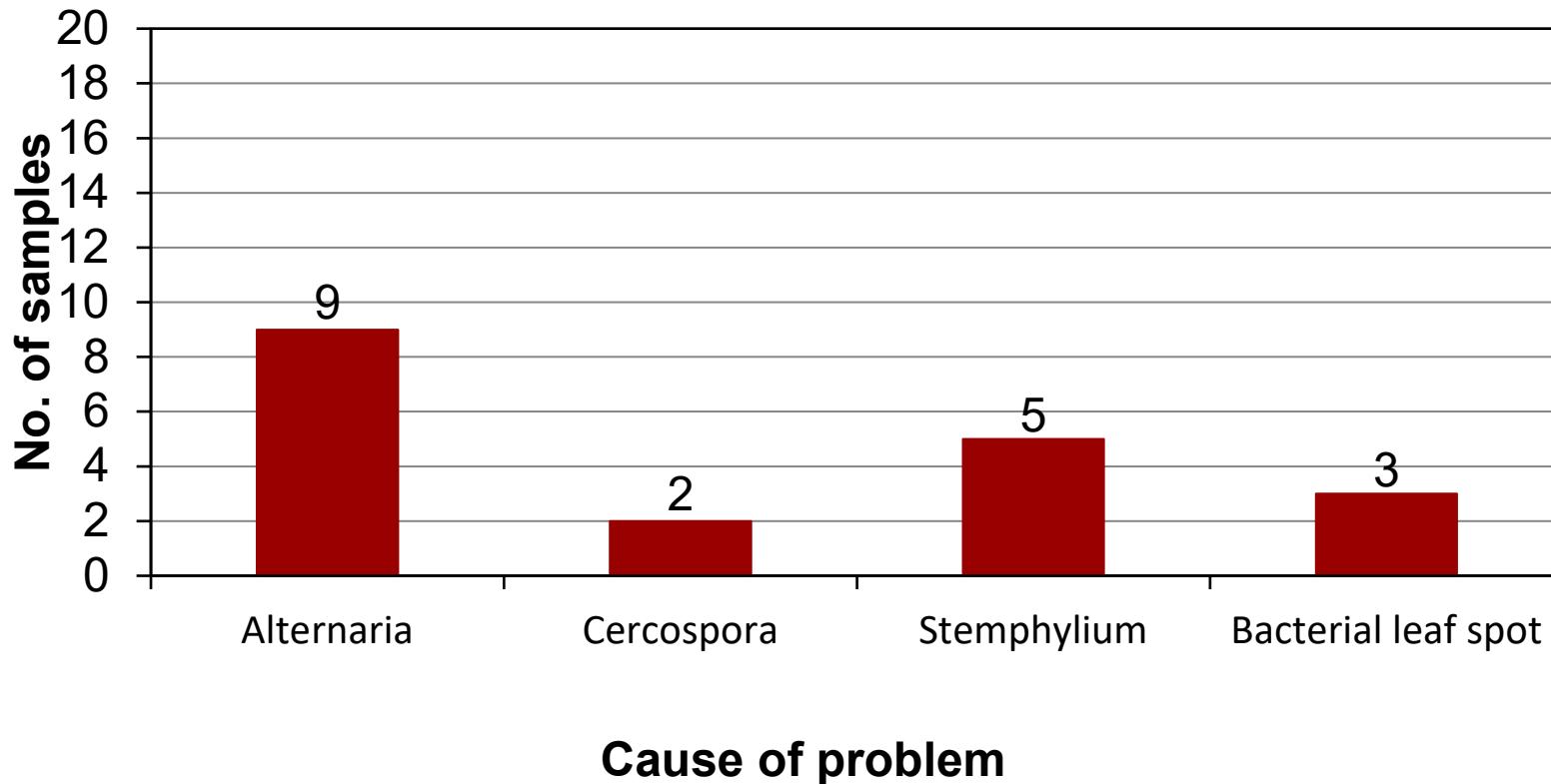
# Summary of 2022 Field Samples (roots)



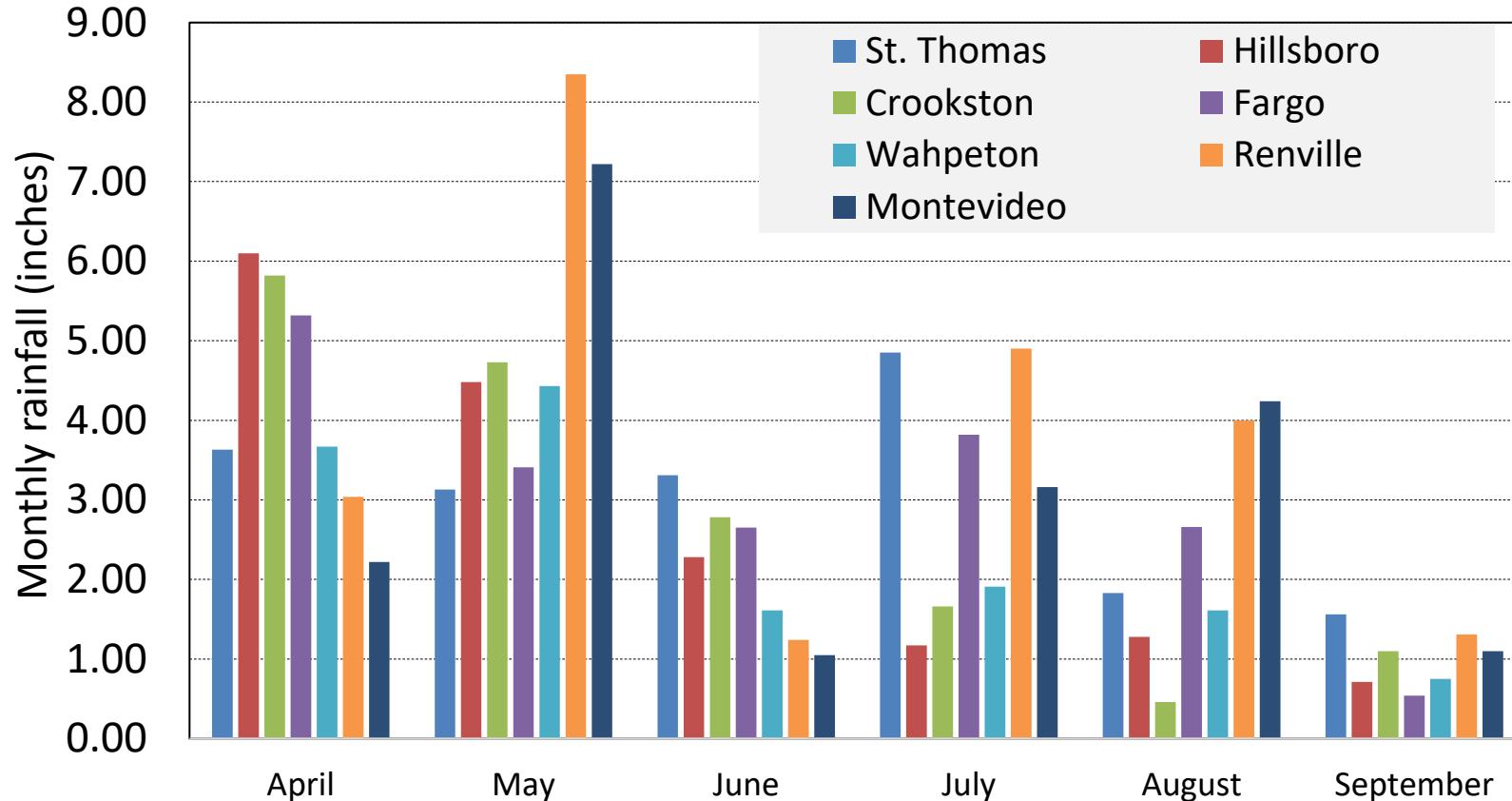
# Summary of 2022 Field Samples (leaves)



# Summary of 2022 Field Samples (leaves)



# 2022 Monthly Rainfall in the RRV and So. MN



Source: NDAWN Center, NDSU and <https://www.cocorahs.org/maps/>



# Rhizoctonia Damping-off



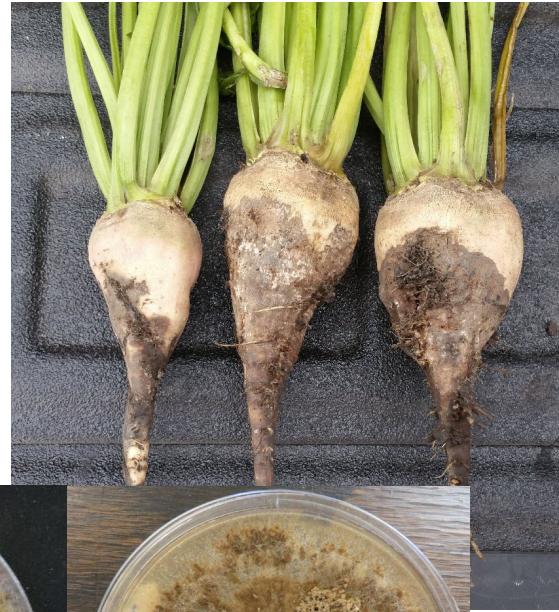
# Rhizoctonia Crown and Root Rot



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# Rhizoctonia Crown and Root Rot

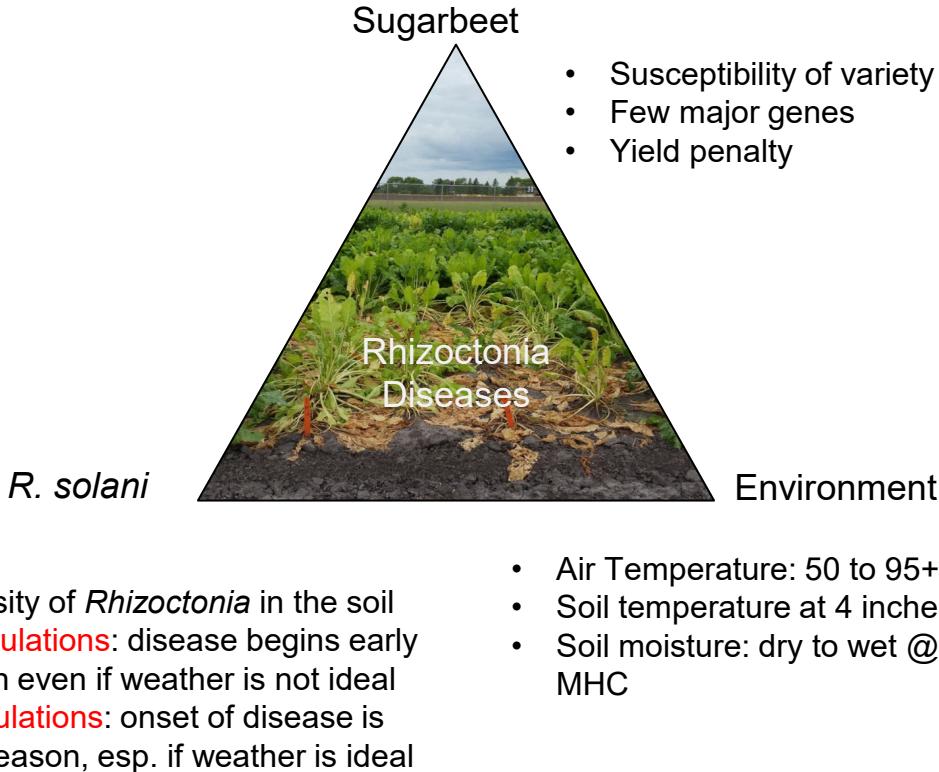


# Key points about Rhizoctonia

- *Rhizoctonia solani*-- AG 2-2 (IIB & IV), AG 4
- Wide host range-- Sugarbeet, soybean, edible beans, corn, weeds
- Can survive 2-3 years in soil as dormant sclerotia
- Distribution in a field– random vs patchy
- Inoculum depth varies from field to field (mostly top 4 inches)
- Row cultivation can increase the risk for crown rot
- Proper management can reduce the inoculum build up



# Factors affecting Disease Development



# Management of Rhizoctonia

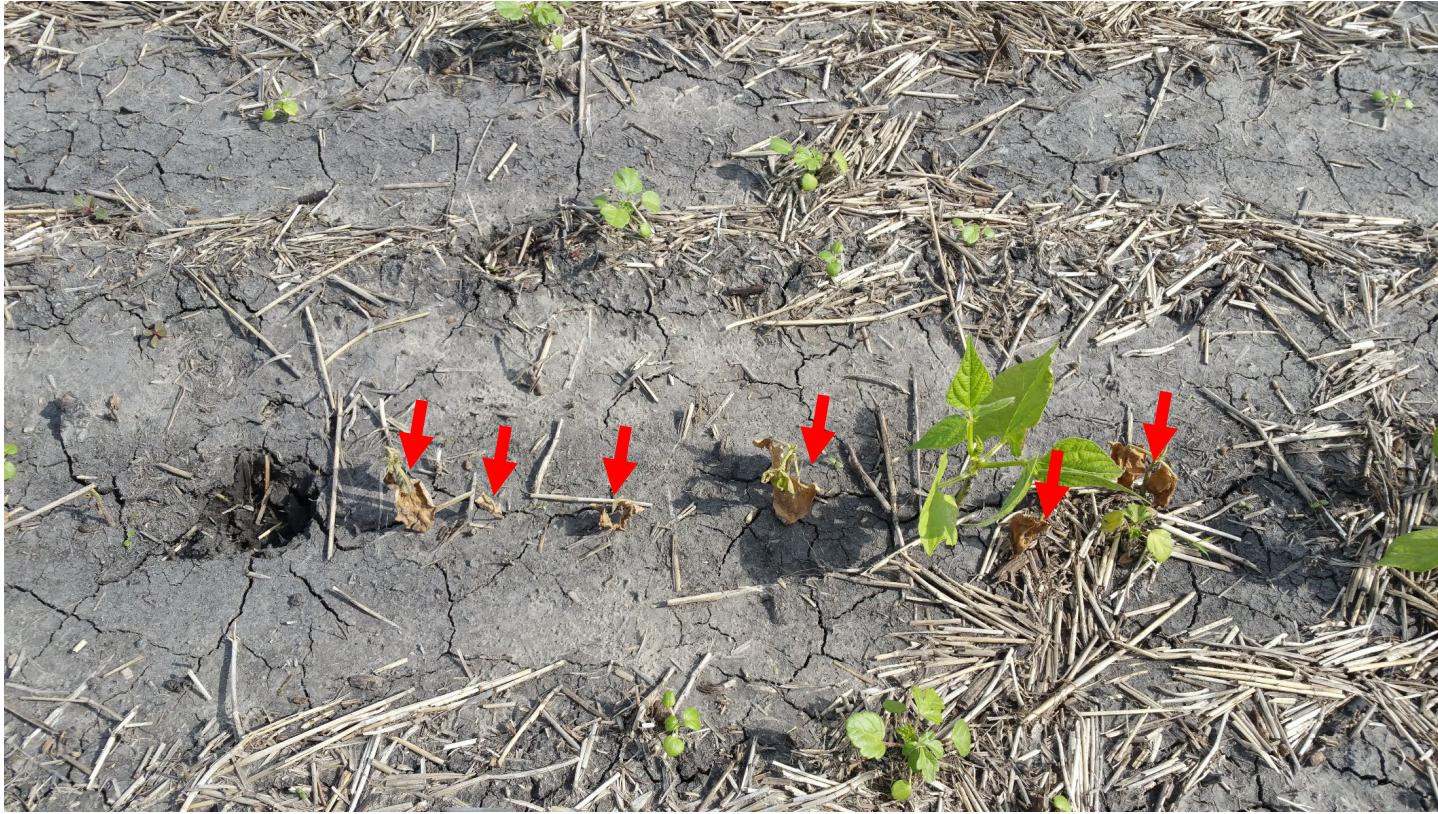
- Crop Rotation
  - Length
  - Crop choice & weed control
- Early planting



# Soybeans



# Navy beans



# Untreated Control



# Seed treatment



# Quadris In-furrow



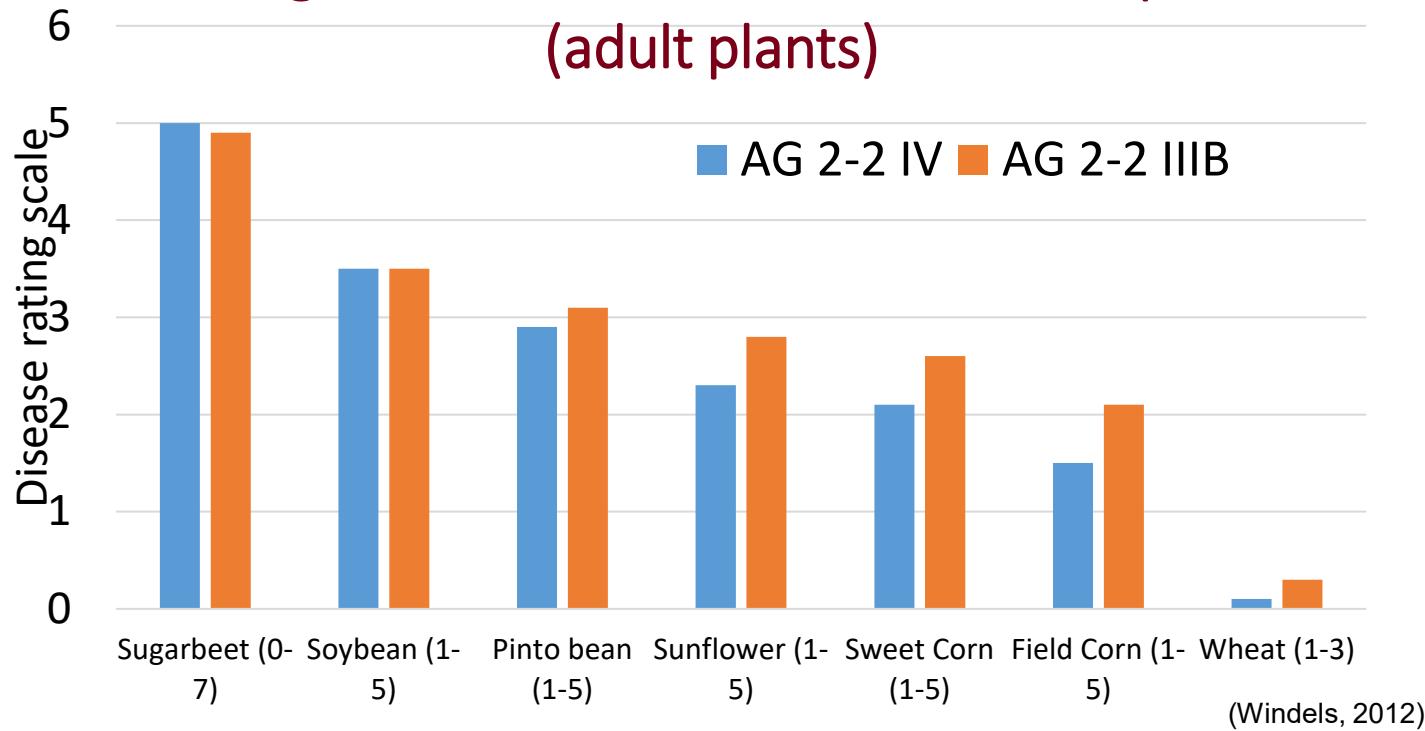
## Effect of fungicide treatment on plant population and yield of navy bean at Crookston, MN.

Treatment	Plant population (x 1000/A)			Yield (bu/A)
	14 DAP	25 DAP	40 DAP	
Untreated control	112 a	115 a	111 ab	38 b
Seed Treatment (Vibrance)	104 b	110 b	107 b	39 b
In-furrow (Quadris)	115 a	116 a	115 a	48 a

DAP = days after planting

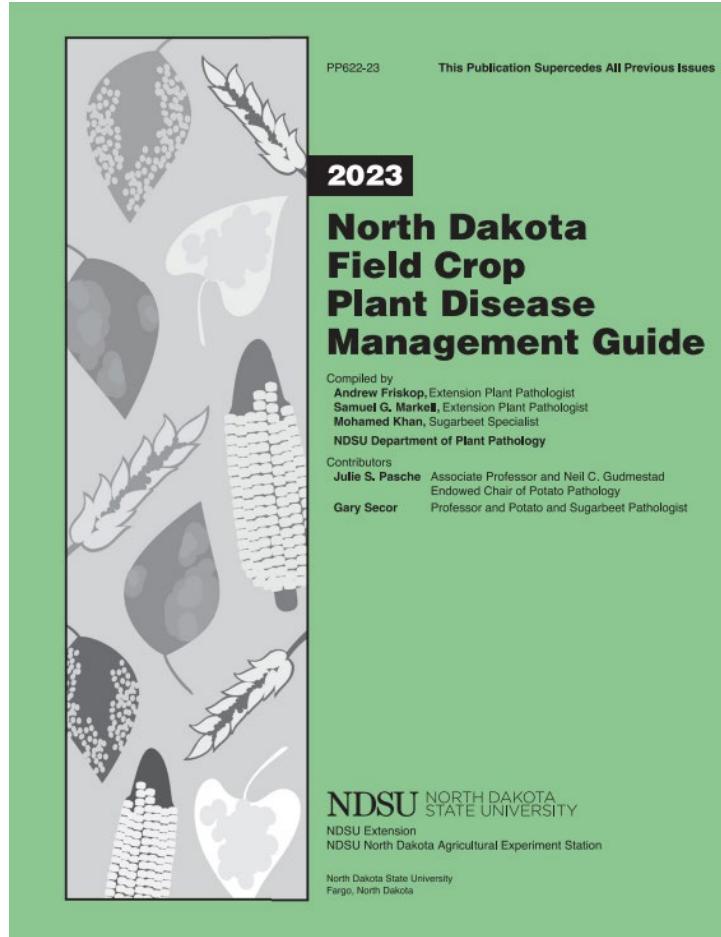


# Aggressiveness of AG 2-2 IV and 2-2 IIIB on sugarbeet and common rotation crops (adult plants)



(Windels, 2012)





# Soybean and dry beans

- Seed treatments
  - Fluxapyroxad, Sedaxane, Rizolex
- In-furrow application
  - Azoxystrobin, Pyraclostrobin
- POST application
  - Azoxystrobin, Pyraclostrobin

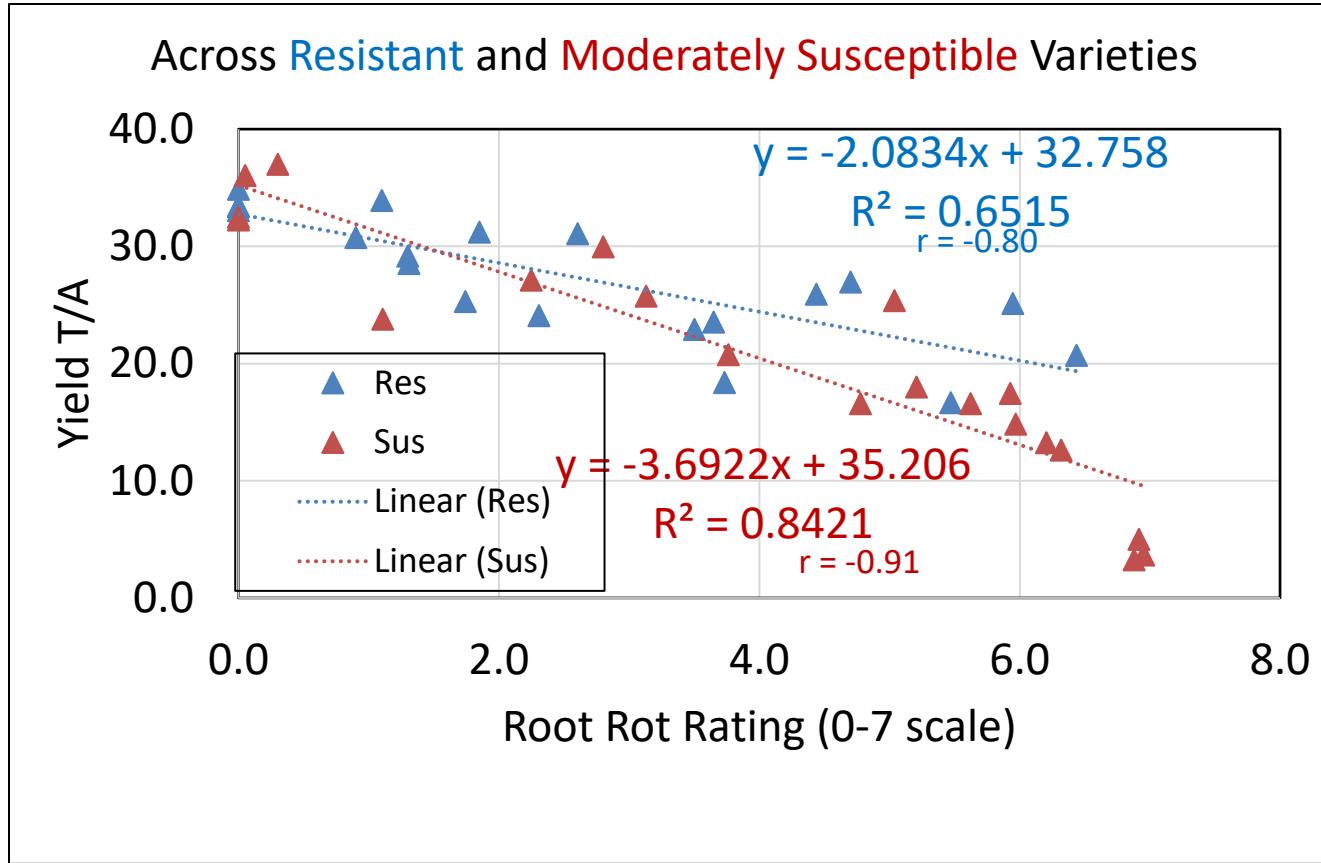


# Management of Rhizoctonia

- Crop Rotation
  - Length
  - Crop choice & weed control
- Early planting
- Resistant varieties



# Genetic Resistance Works!



# Management of Rhizoctonia

- Crop Rotation
  - Length
  - Crop choice & weed control
- Early planting
- Resistant varieties
- At-planting fungicides
  - Seed treatments



# Seed Treatments

- SDHI class of fungicides
- Single site of action (Succinate DeHydrogenase Inhibitor)
- Inhibit fungal respiration



# Seed treatments (rates per unit seed)

- Kabina 14 g (Penthiopyrad, since 2014)
- Vibrance 1.5 g (Sedaxane, since 2016)
- Systiva 5 g (Fluxapyroxad, since 2017)
- Zeltera 0.1 g (Inpyrfluxam, since 2022)
- Metlock Suite (**Metconazole + Rizolex**) + Kabina  
7g (Penthiopyrad) / Vibrance 1g (Penthiopyrad) /  
Zeltera

Metconazole and Rizolex are not SDHI



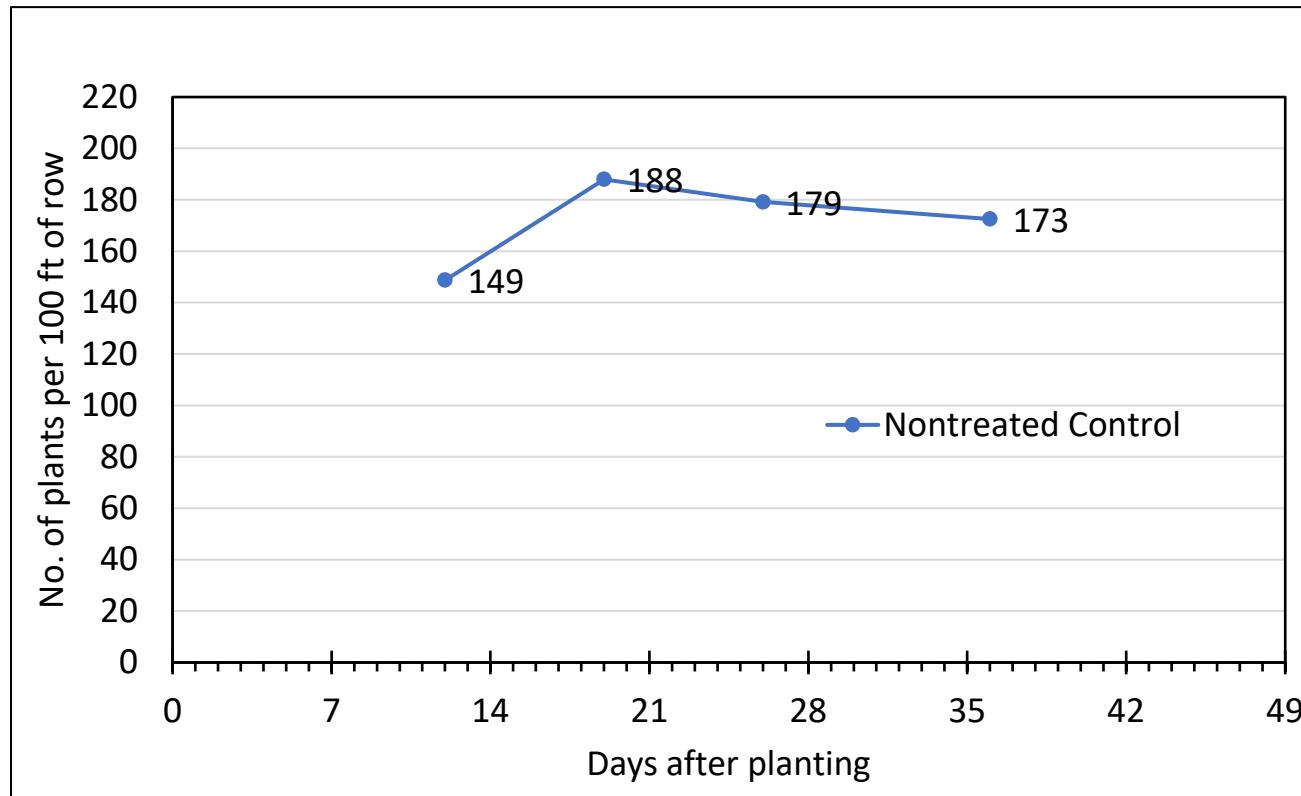
# Crookston Monthly Rainfall

Month	Rainfall (inches)	% of 10 yr. mean rainfall	% of 30 yr. mean rainfall
April	5.82	371	438
May	4.73	190	167
June	2.78	79	71
July	1.66	62	52
August	0.46	23	17
September	1.10	52	42
October	0.18	10	8
<b>Total</b>	<b>16.73</b>		

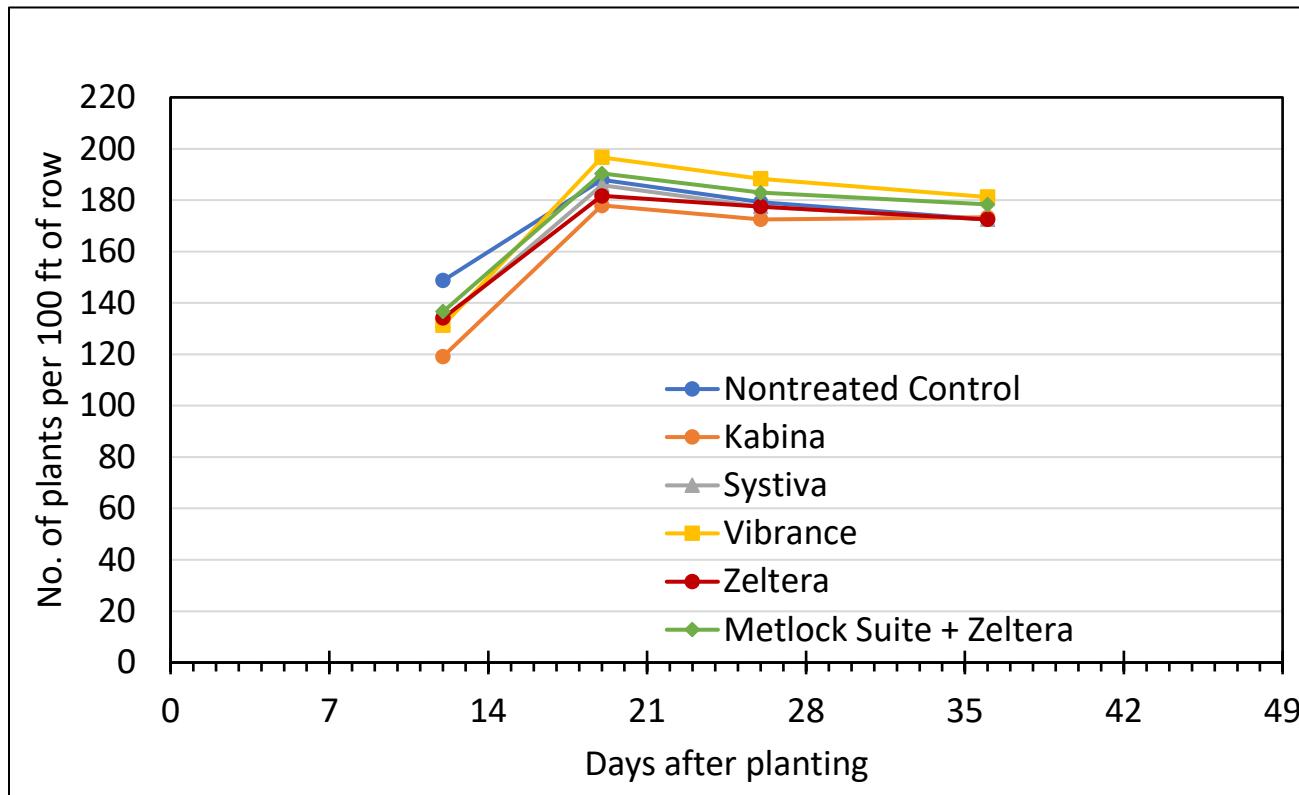


# Seed Treatments

(susceptible variety 4.7)



# Seed Treatments



# Management of Rhizoctonia

- Crop Rotation
  - Length
  - Crop choice & weed control
- Early planting
- Resistant varieties
- **At-planting fungicides**
  - Seed treatments
  - In-furrow fungicides



# In-furrow Fungicides



Fungicide in 3 gal. water + 10-34-0 @  
3 gal. applied via drip tube

# 10-34-0 + Fungicides: After 10 minutes



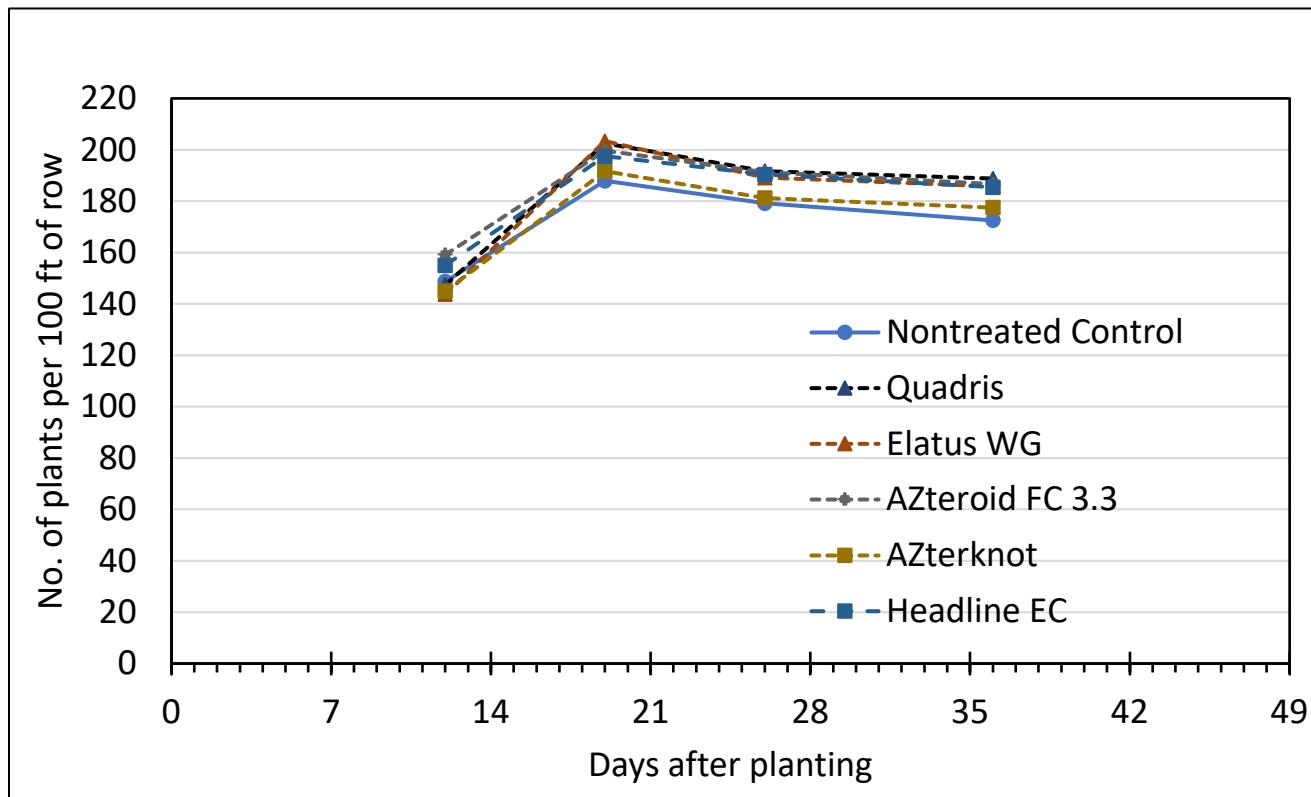
# In-furrow Fungicides (rates per acre)

- Quadris 9.5 fl oz
- AZteroid 5.7 fl oz
- AZterknot 16.6 fl oz
- Elatus 7.1 fl oz
- Headline 9 fl oz
- Priaxor 6.7 fl oz
- Proline 5.7 fl oz
- Propulse 13.6 fl oz

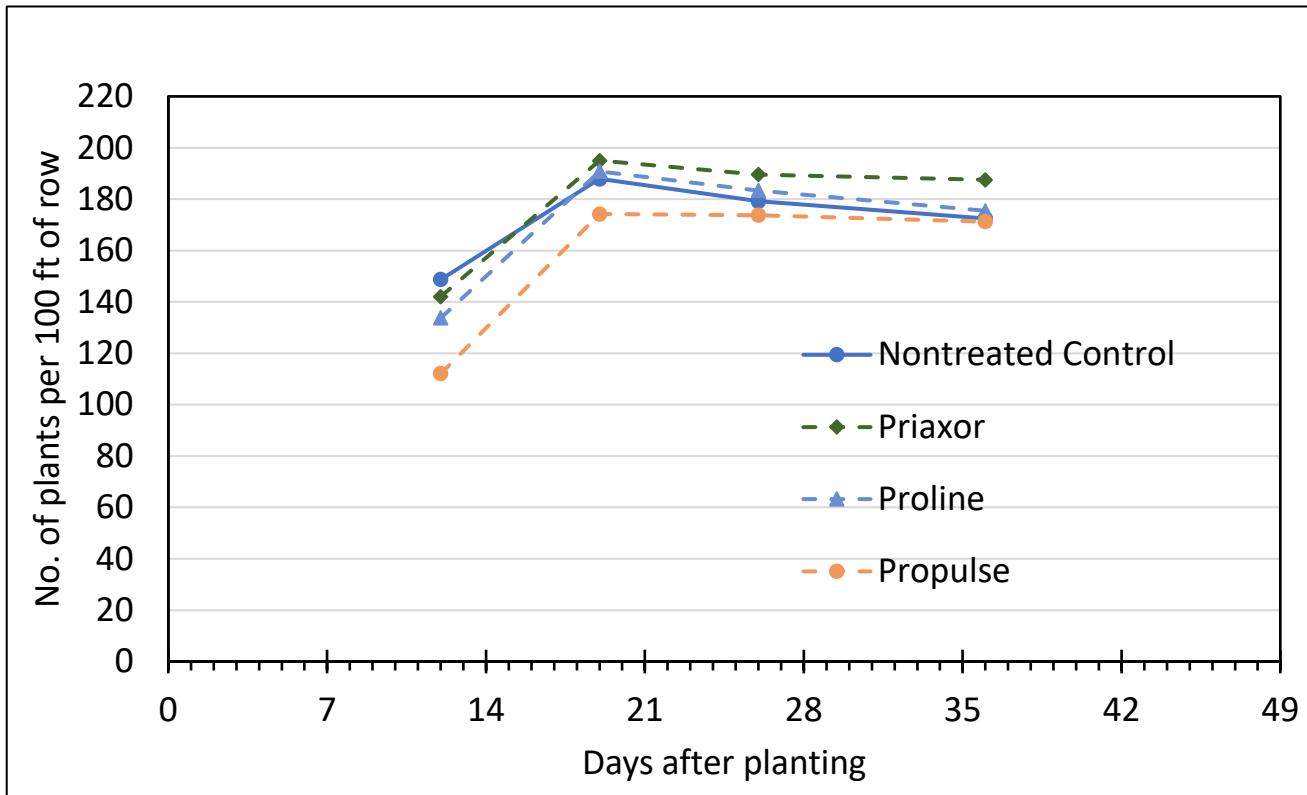


# In-furrow fungicides

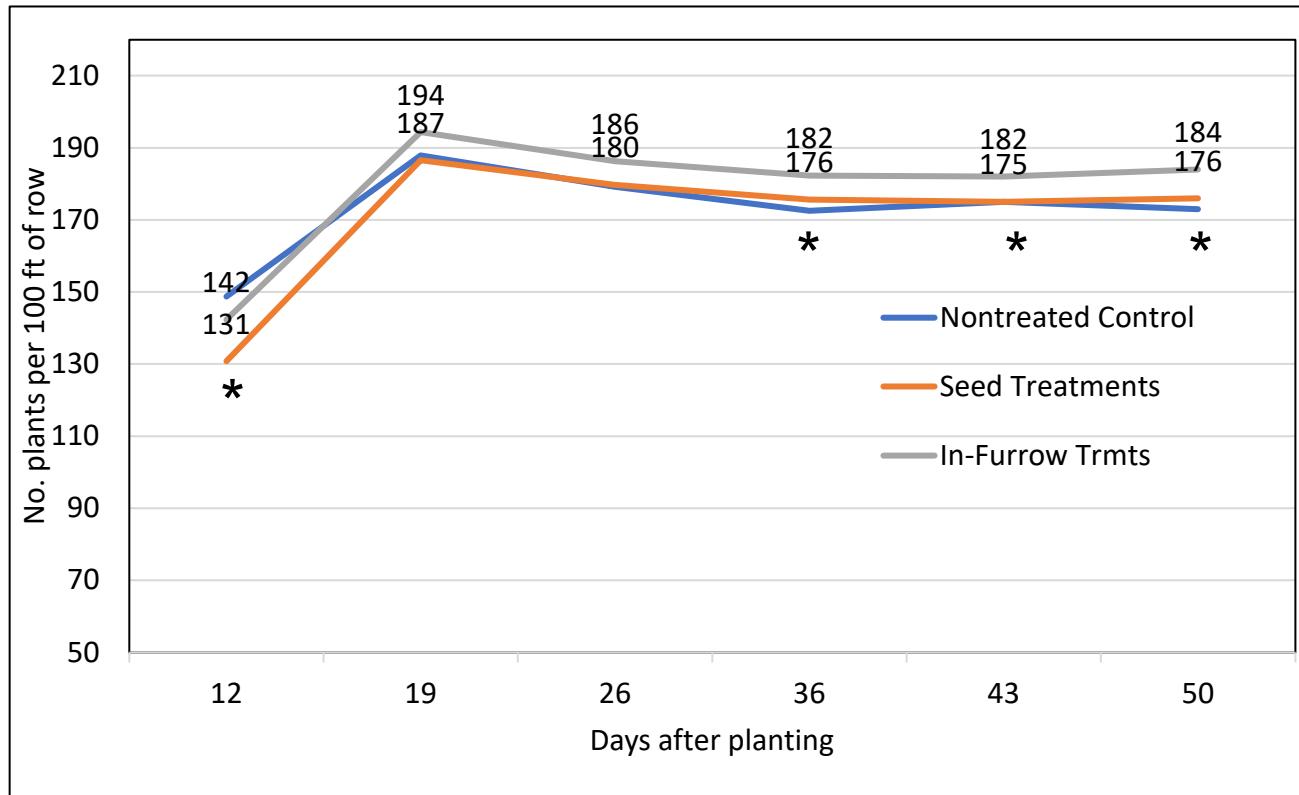
(susceptible variety 4.7)



# In-furrow fungicides



# Seed treatment vs In-furrow



\* Indicates significant difference between ST and IF



## Root rot rating scale 0-10



0    1    2    3    4    5    6    7    8    9    10

1 = 1 – 10% rot, 10 = 91 – 100 % rot

# Seed treatments vs In-furrow

Description	# Harvested roots	Root Rot Rating (%)	Root Rot Incidence (%)	Yield (T/A)	% Sugar	% SLM	RST (Lbs/T)	RSA (Lbs/A)
Untreated	152	11.9	30	27.5	18.0	1.03	340	9373
Seed treatments	153	11.6	30	26.9	17.3	1.10	324	8713
In-furrow treatments	164	7.7	25	27.6	17.5	1.11	327	9002
<b>Seed vs in-furrow contrast (P-value)</b>	<b><u>0.0033</u></b>	<b><u>0.0226</u></b>	NS	NS	NS	NS	NS	NS

(RST ~ EST, RSA ~ ESA)



# Starter fertilizer x In-Furrow Fungicides - Safety

- 2020 & 2021, NWROC, Crookston
- RCBD design, 4 reps
- Starter Fertilizers
  - None
  - 10-34-0, 3 gal
  - Paralign (5-15-3 + 0.8% Zn + Hemicellulase), 3 gal
- In-Furrow Fungicides
  - None
  - AZteroid FC 3.3, 9.2 fl oz
  - Elatus, 7.1 fl oz
  - Xanthion (Headline 9 fl oz + Biological 1.8 fl oz)



# Starter fertilizer x In-Furrow Fungicides - Efficacy

	# of harvestable roots (per 100 ft.)		Root Rot Rating (0-10)	
	2020	2021	2020	2021
<b>In-furrow Fungicide</b>				
No Fungicide	94 b	174 b	4.9 a	0.2
AZteroid FC 3.3	116 a	198 a	1.6 c	0.2
Elatus	117 a	193 a	1.5 c	0.1
Xanthion	108 a	199 a	3.2 b	0.3
P-value	0.0045	<0.0001	<0.0001	0.0855
LSD	13.4	10.2	0.8	NS
<b>Starter Fertilizer</b>				
No Fertilizer	115	191	2.7	0.2
Paralign	106	193	3.1	0.3
10-34-0 (APP)	105	189	2.6	0.1
P-value	0.1871	0.6773	0.2510	0.2307
LSD	NS	NS	NS	NS
P-value	0.8236	0.4066	0.6030	0.6413

NS = No significant difference at p < 0.05



# Starter fertilizer x In-Furrow Fungicides - Efficacy

	Sugar (%)		RSA (lbs/A)	
	2020	2021	2020	2021
<b>In-Furrow Fungicide</b>				
No Fungicide	14.8 b	18.1	4473 b	9141
AZteroid FC 3.3	15.6 a	17.9	6162 a	9376
Elatus	15.3 a	17.9	5825 a	9348
Xanthion	15.3 a	17.7	5340 ab	9503
P-value	0.0037	0.3430	0.0093	0.6300
LSD	0.4	NS	994	NS
<b>Starter Fertilizer</b>				
No Fertilizer	15.3	18.0	5718	9189
Paralign	15.2	17.9	5344	9523
10-34-0 (APP)	15.3	17.7	5287	9314
P-value	0.7347	0.4569	0.5477	0.3820
LSD	NS	NS	NS	NS
P-value	0.2734	0.3645	0.9890	0.7130

NS = No significant difference at p < 0.05



# Management of Rhizoctonia

- Crop Rotation
  - Length
  - Crop choice & weed control
- Early planting
- Resistant varieties
- At-planting fungicides
  - Seed treatments
  - In-furrow fungicides
- Postemergence fungicides



# Evaluation of Postemergence treatments

- Determine the effectiveness of postemergence fungicides on a susceptible cultivar (4.7 rating) for:
  - Mid-late season control of Rhizoctonia root rot
    - Planted on May 25, NWROC, Crookston
    - Jul 05, Fungicide treatments & Inoculation
    - Evaluated as 7 in. band & broadcast application



# Postemergence Fungicides (rates per acre)

- Quadris 10 & 14.5 fl oz
- AZteroid 9.2 fl oz
- Elatus 7.1 fl oz
- Excalia 0.64 fl oz (band), 2.0 fl oz (broadcast)



# Postemergence treatments

(susceptible variety 4.7)

Treatment and rate/A	Root Rot Rating (%)	Root Rot Incidence (%)	Sugar (%)	Yield (T/A)	RST (Lbs/T)	RSA (Lbs/A)
Nontreated Control	33.6 a	62.5 a	17.2	18.6 b	321 d	5985 c



# Postemergence treatments

Treatment and rate/A	Root Rot Rating (%)	Root Rot Incidence (%)	Sugar (%)	Yield (T/A)	RST (Lbs/T)	RSA (Lbs/A)
Nontreated Control	33.6 a	62.5 a	17.2	18.6 b	321 d	5985 c
Quadris SC (10 fl oz/A) Band	0.6 b	3.8 bc	18.2	26.4 a	345 abc	9087 ab
Quadris SC (10 fl oz/A) Broadcast	1.8 b	2.5 c	18.0	26.6 a	339 abc	9043 ab
Quadris SC (14.5 fl oz/A) Band	0.2 b	3.8 bc	18.1	26.0 a	341 abc	8868 ab
Quadris SC (14.5 fl oz/A) Broadcast	1.7 b	10.0 bc	18.1	25.2 a	343 abc	8665 b
LSD 0.05	3.8	9.43	0.94	2.99	19.2	1100
P- value	<0.0001	<0.0001	0.0924	<0.0001	0.0384	<0.0001



# Postemergence treatments

Treatment and rate/A	Root Rot Rating (%)	Root Rot Incidence (%)	Sugar (%)	Yield (T/A)	RST (Lbs/T)	RSA (Lbs/A)
Nontreated Control	33.6 a	62.5 a	17.2	18.6 b	321 d	5985 c
Excalia SC (0.64 fl oz/A) Band	1.3 b	6.3 bc	17.8	27.5 a	336 bcd	9245 ab
Excalia SC (2 fl oz/A) Broadcast	0.1 b	1.3 c	18.5	26.7 a	352 ab	9404 ab
LSD 0.05	3.8	9.43	0.94	2.99	19.2	1100
P- value	<0.0001	<0.0001	0.0924	<0.0001	0.0384	<0.0001



# Postemergence treatments

Treatment and rate/A	Root Rot Rating (%)	Root Rot Incidence (%)	Sugar (%)	Yield (T/A)	RST (Lbs/T)	RSA (Lbs/A)
Nontreated Control	33.6 a	62.5 a	17.2	18.6 b	321 d	5985 c
AZteroid FC <sup>3.3</sup> (9.2 fl oz/A) Band	0.3 b	2.5 c	18.8	27.6 a	356 a	9826 a
AZteroid FC <sup>3.3</sup> (9.2 fl oz/A) Broadcast	1.2 b	7.5 bc	17.4	27.2 a	328 cd	8920 ab
Elatus WG (7.1 oz/A) Band	0.7 b	12.5 b	17.5	25.9 a	331 cd	8566 b
Elatus WG (7.1 oz/A) Broadcast	1.7 b	5.0 bc	18.1	26.3 a	339 abcd	8927 ab
LSD 0.05	3.8	9.43	0.94	2.99	19.2	1100
P- value	<0.0001	<0.0001	0.0924	<0.0001	0.0384	<0.0001

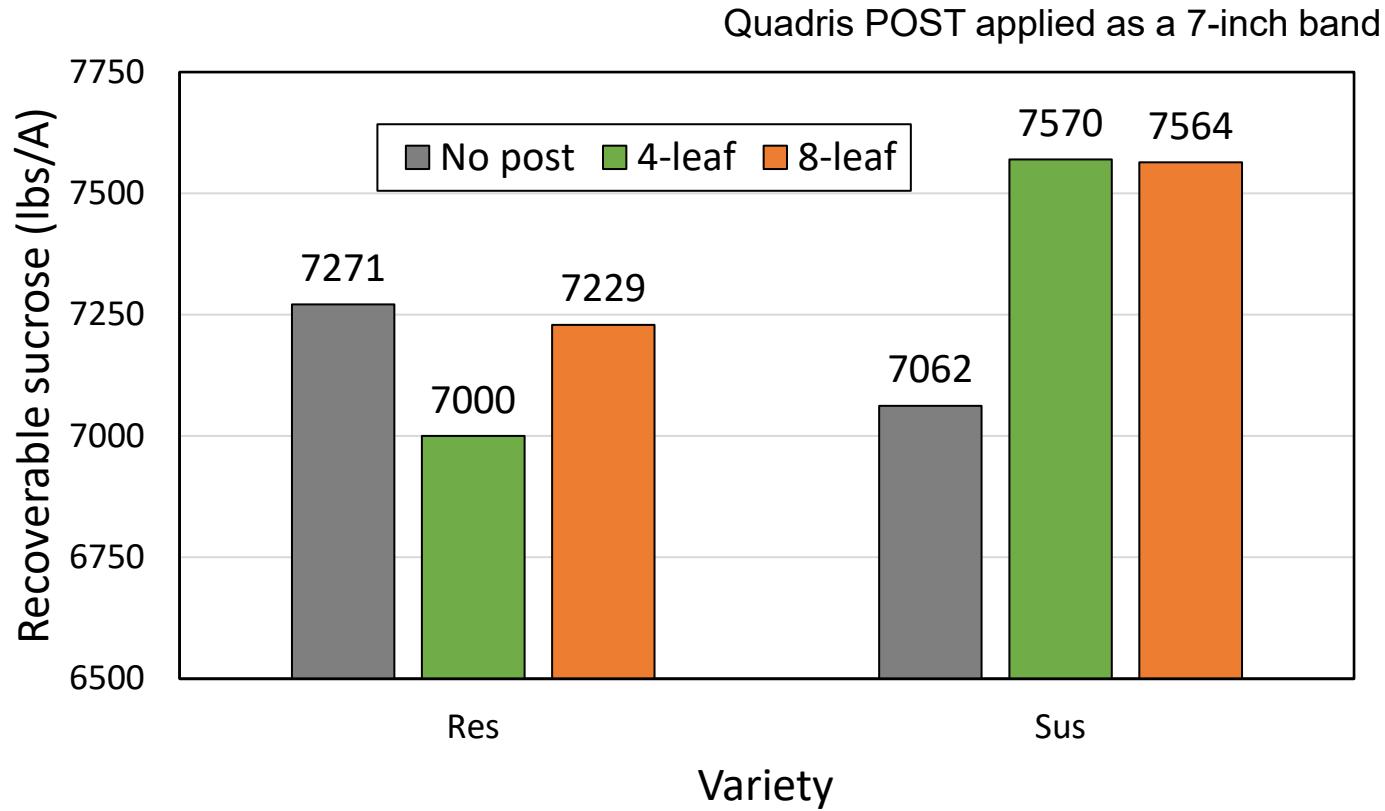


# Band vs Broadcast application

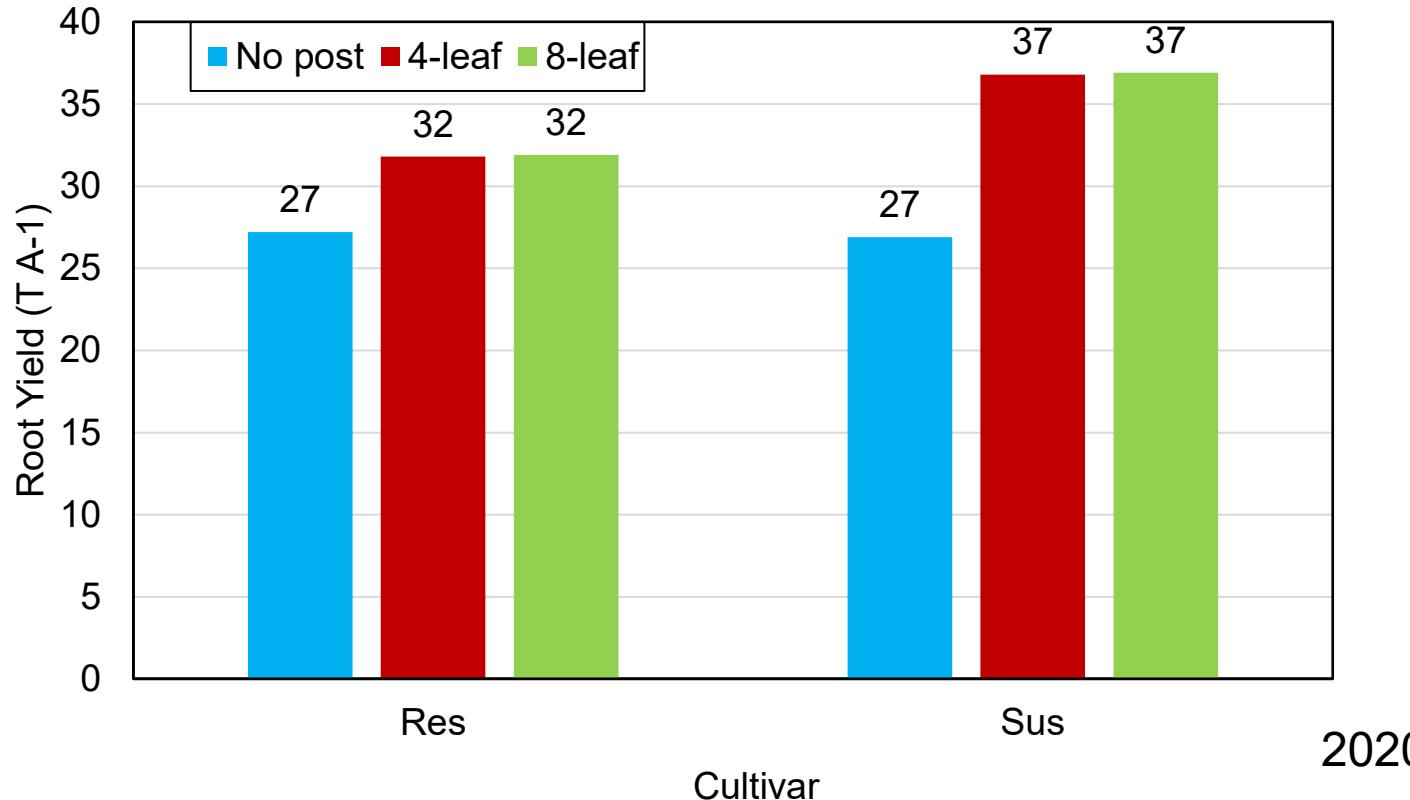
Application Type	% Plant Loss (%)	Root Rot Rating (%)	Root Rot Incidence (%)	Sugar (%)	Yield (T/A)	RST (Lbs/T)	RSA (Lbs/T)
7 in. Band	6.0	0.6	5.8	18.1	26.7	342	9119
Broadcast	7.9	1.3	5.3	18.0	26.4	340	8992
Band vs broadcast contrast P- value	0.3267	0.4483	0.8103	0.7926	0.6632	0.7063	0.6026



# Variety x POST Interaction on RSA



# Variety x POST interaction on yield - SMBSC



# Fungicide Options for Rhizoctonia

Seed Treatment		In-Furrow		POST	
Kabina		Headline		Quadris	
Systiva		Quadris		Elatus	
Vibrance		Elatus		AZteroid	
Zeltera		AZteroid		Excalia	
Metlock Suite		Proline		Topguard EQ	
		Propulse		Proline	
				Propulse	
				Priaxor	

SDHI

QoI

DMI

AH



# Strategies for full-season Rhizoctonia management

- Varietal Selection
  - Can make a difference under moderate to high disease pressure
- Seed treatment
  - Provide excellent early-season protection (Kabina, Systiva, Vibrance, Zeltera, Metlock suite + Kabina, alone or in combination)
- In-furrow fungicide application
  - Early to mid-season protection
  - Some stand loss under dry and/or cool conditions (2021 conditions), additional injury with starter fertilizers
- Postemergence fungicide application
  - 4- to 8-leaf stage window for application
  - July weather and disease history
  - Resistant variety can respond under severe disease pressure
- For susceptible varieties
  - Seed treatment + POST – best practice
  - Seed treatment + in-furrow + POST – may be needed for fields with severe history



# *Aphanomyces* can be a full-season pathogen

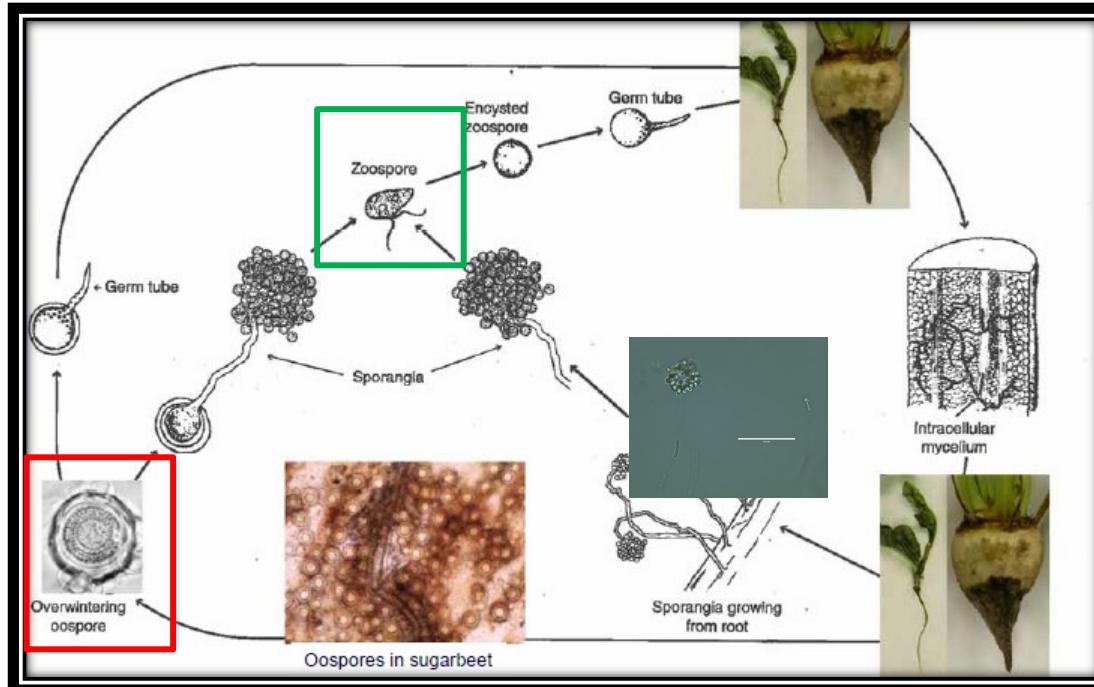


Aphanomyces damping-off



Aphanomyces root rot

# Life Cycle of *Aphanomyces cochlioides*



Primary inoculum

Secondary inoculum

C. Windels,  
2012



# Management of Aphanomyces

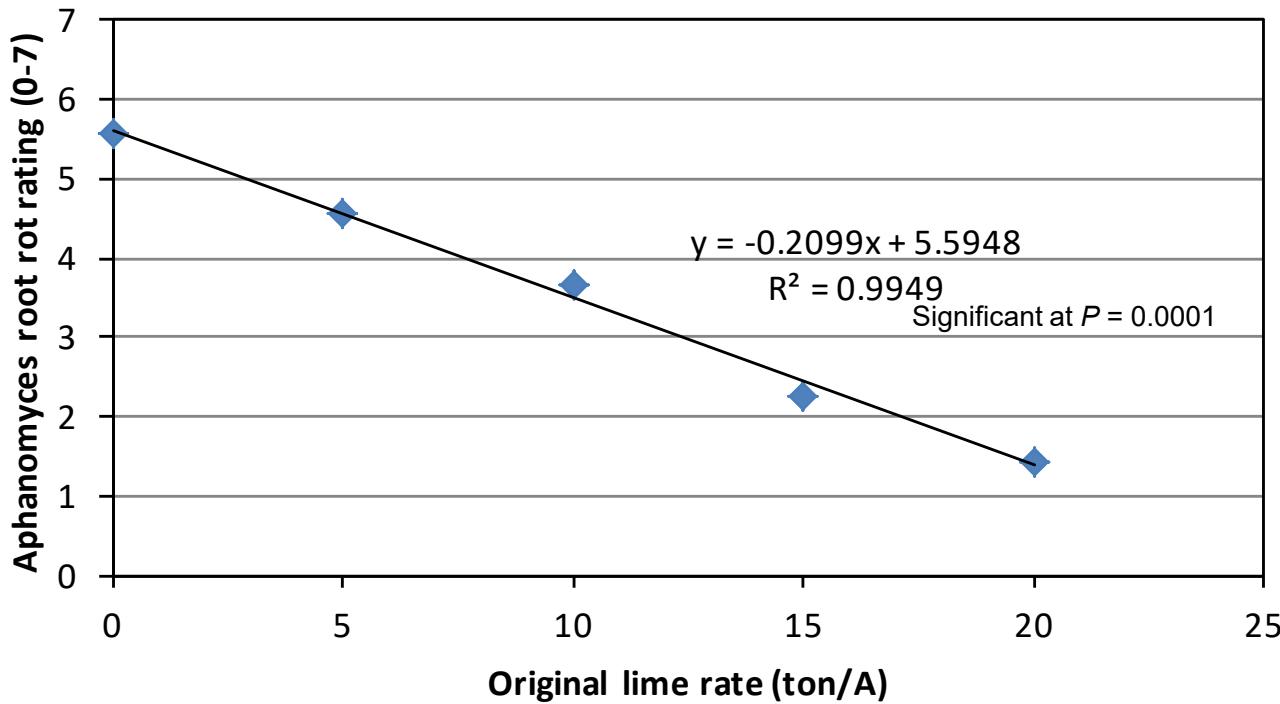
- Early planting
- Resistant varieties
- Seed treatments
  - Tachigaren
  - Intego Solo

# Management of Aphanomyces

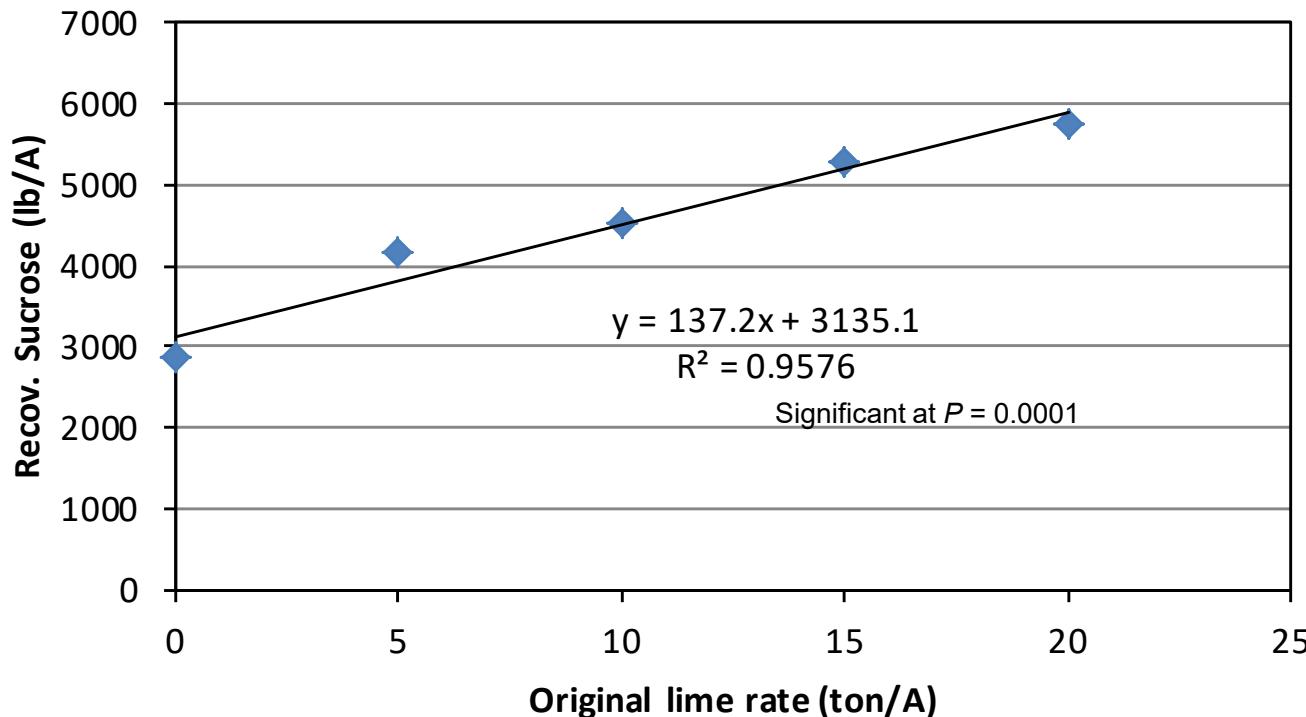
- Early planting
- Resistant varieties
- Seed treatments
- Waste lime



# Waste lime reduced Aphanomyces (12 years after application)



# Waste lime improved sugar yield (12 years after application)



# Fusarium Yellows



3 WAP



# Fusarium Yellows



# Fusarium Yellows

Jun 30



22-8  
6/30/12

Jul 06



Jul 06



22-9

June 27



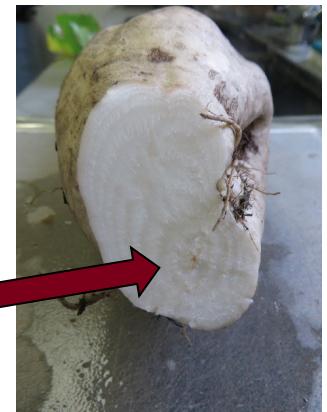
15-17



22-10



# Fusarium Yellows



Diagnosis is critical because only  
tolerant varieties can withstand  
Fusarium

# Acknowledgements

- Sugarbeet Research and Education Board of Minnesota and North Dakota
- American Crystal Sugar Company
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- American Crystal Sugar Company quality labs – East Grand Forks and Moorhead
- U of M, NWROC facilities



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# Thank You!



## Questions?

