Management of Rhizoctonia Diseases in Sugarbeet

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ACSC Sugarbeet Growers Seminar, 2022

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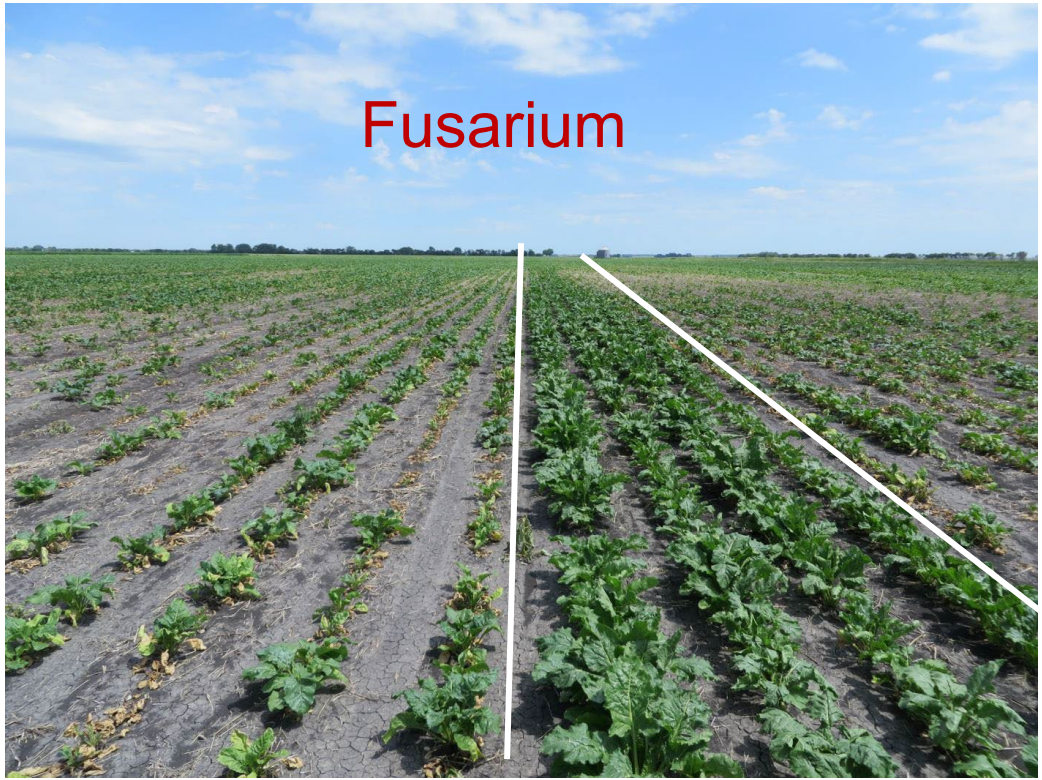
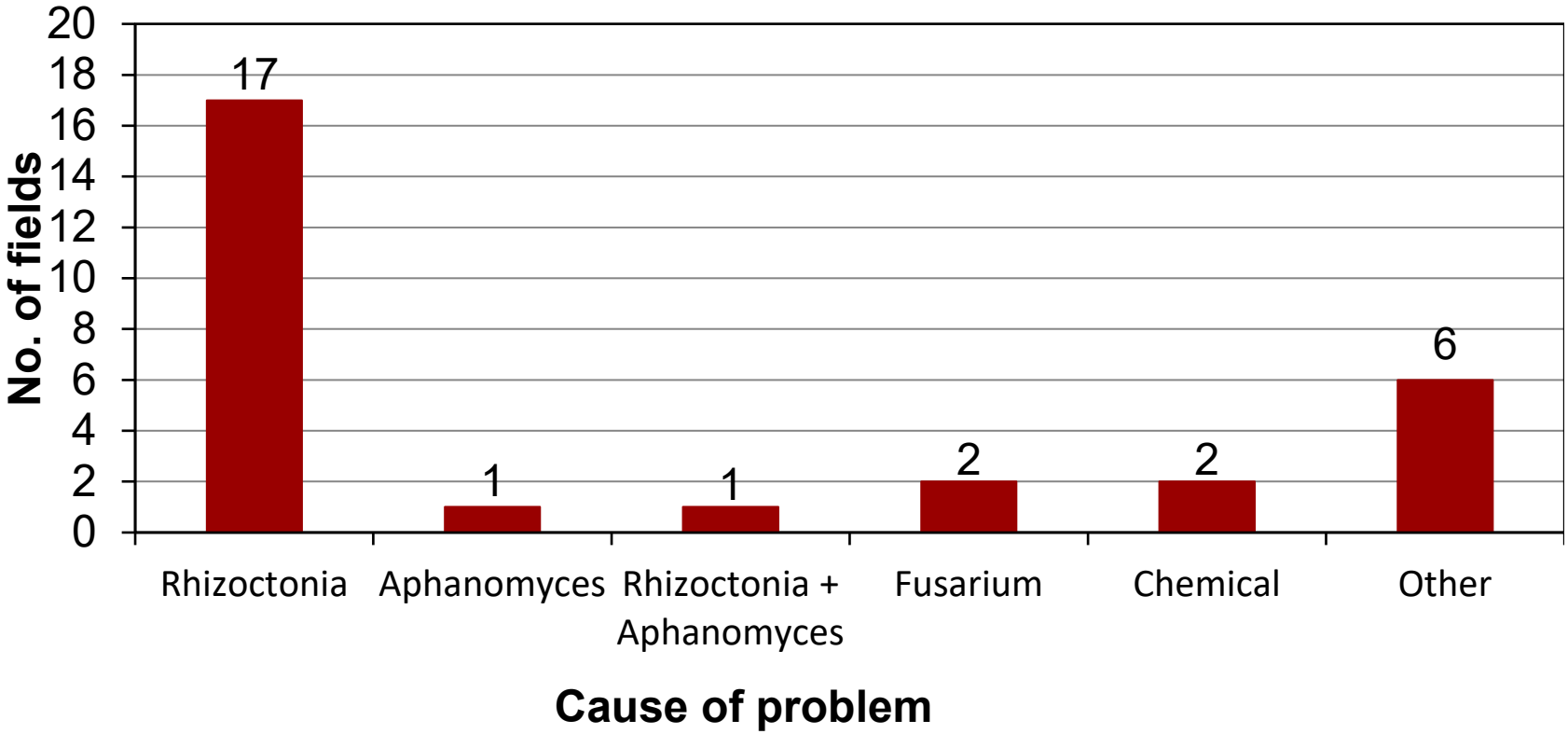
Accurate Diagnosis is critical!

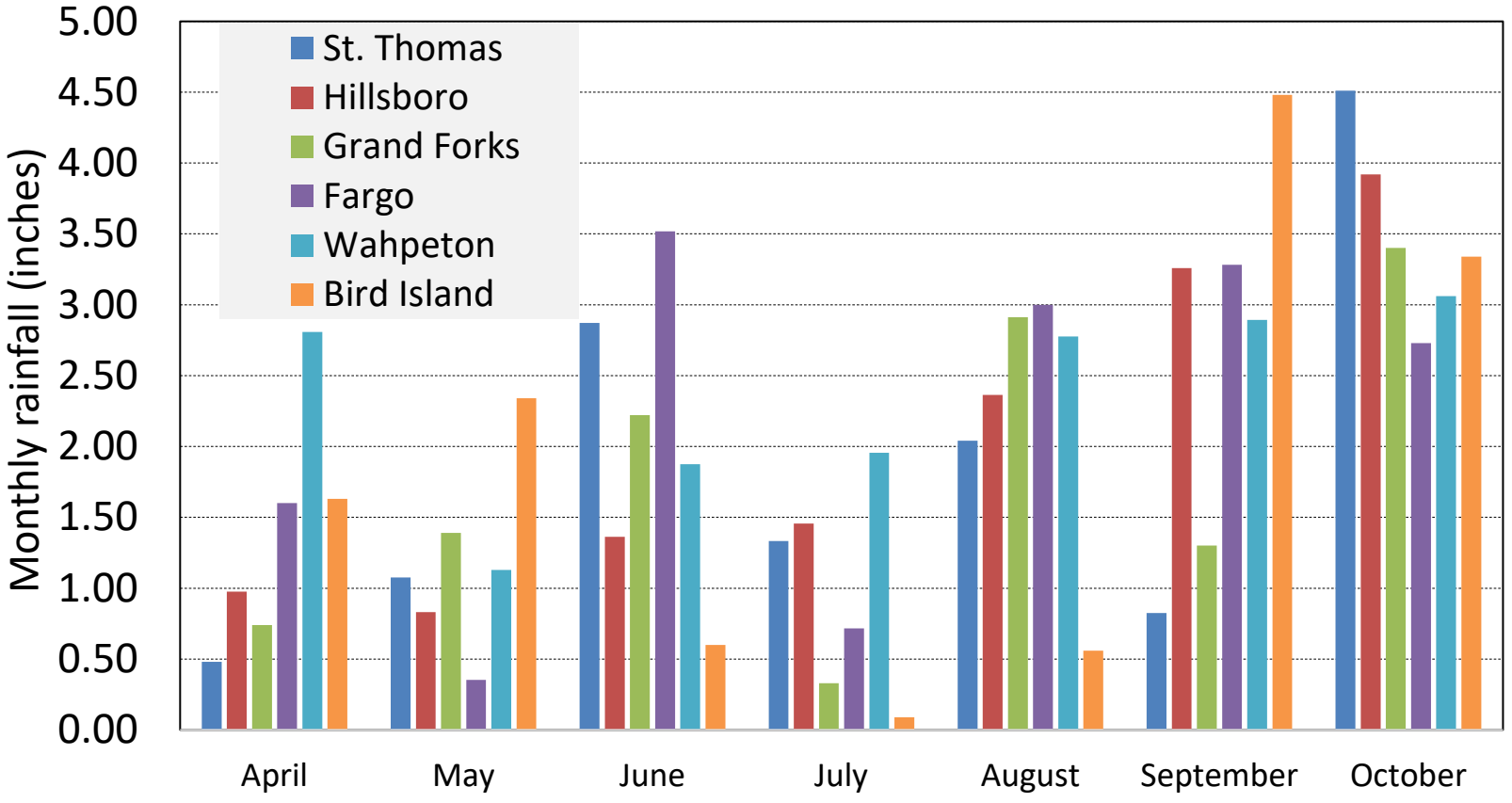


More than one problem is very common

Summary of 2021 Field Samples (n = 29)



2021 Monthly Rainfall in the RRV and Southern MN



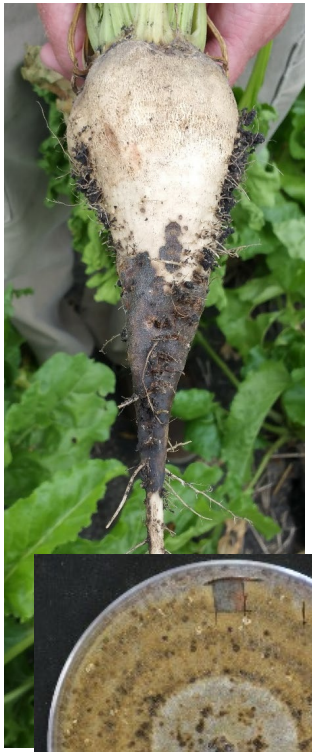
Source: NDAWN Center, NDSU and Wundergorund.com

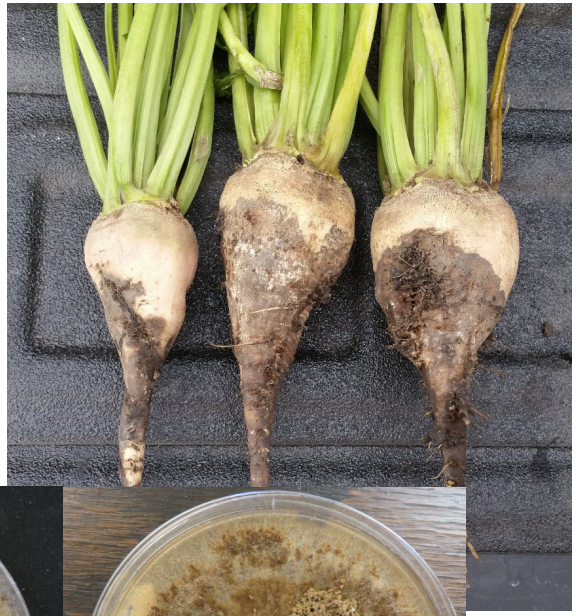
Rhizoctonia Damping-off

Rhizoctonia Crown and Root Rot

Rhizoctonia Crown and Root Rot

Rhizoctonia Crown and Root Rot



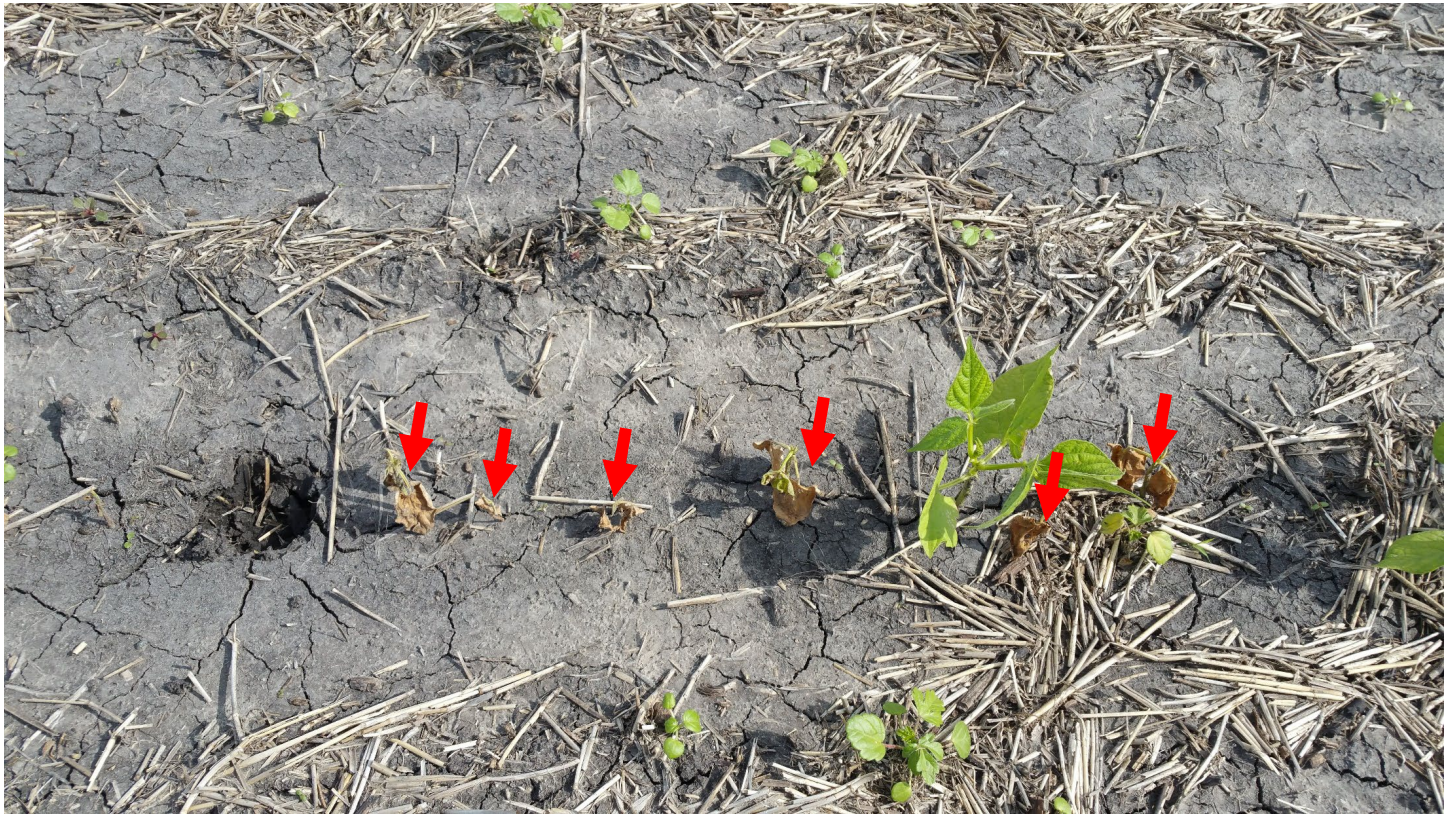


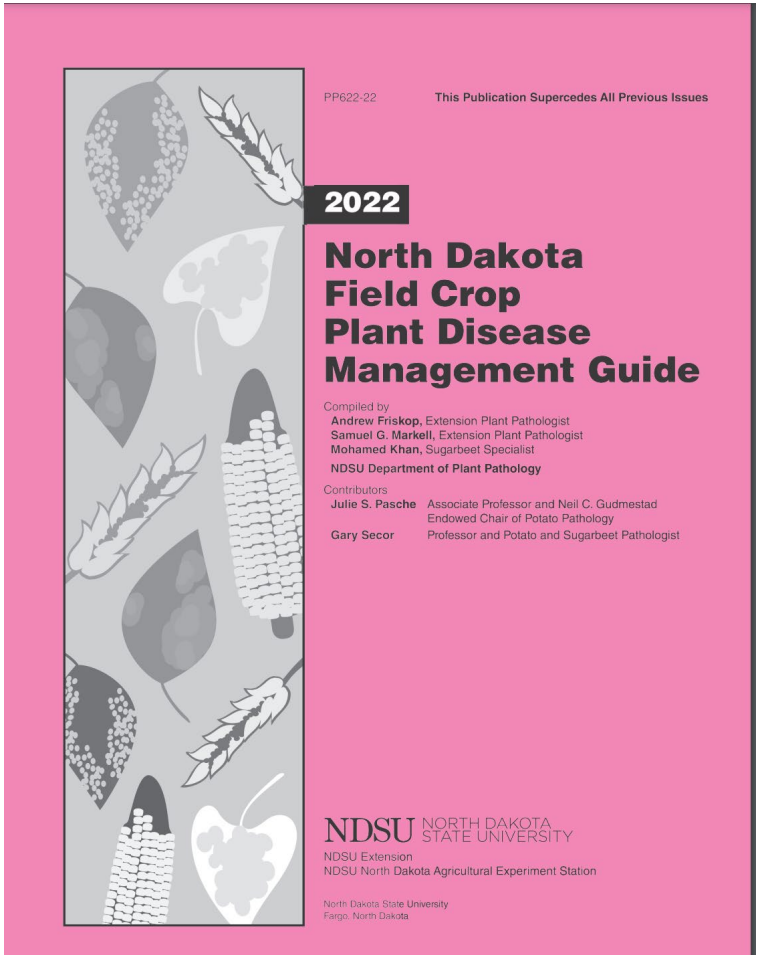
Key points about Rhizoctonia

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

Soybeans

Navy beans





Soybean and dry beans

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

Management of Rhizoctonia

- Crop Rotation
  - Length
  - Crop choice & weed control
- Early planting
- Resistant varieties
- At-planting fungicides
  - Seed treatments ($13+ per acre)
  - In-furrow fungicides ($15-24+ per acre)
- Postemergence fungicides ($15-24+ application cost)

Seed Treatments

- SDHI class of fungicides
- Single site of action (**S**uccinate **D**e**H**ydrogenase **I**nhibitor)
- Inhibit fungal respiration

Seed treatments (rates per unit seed)

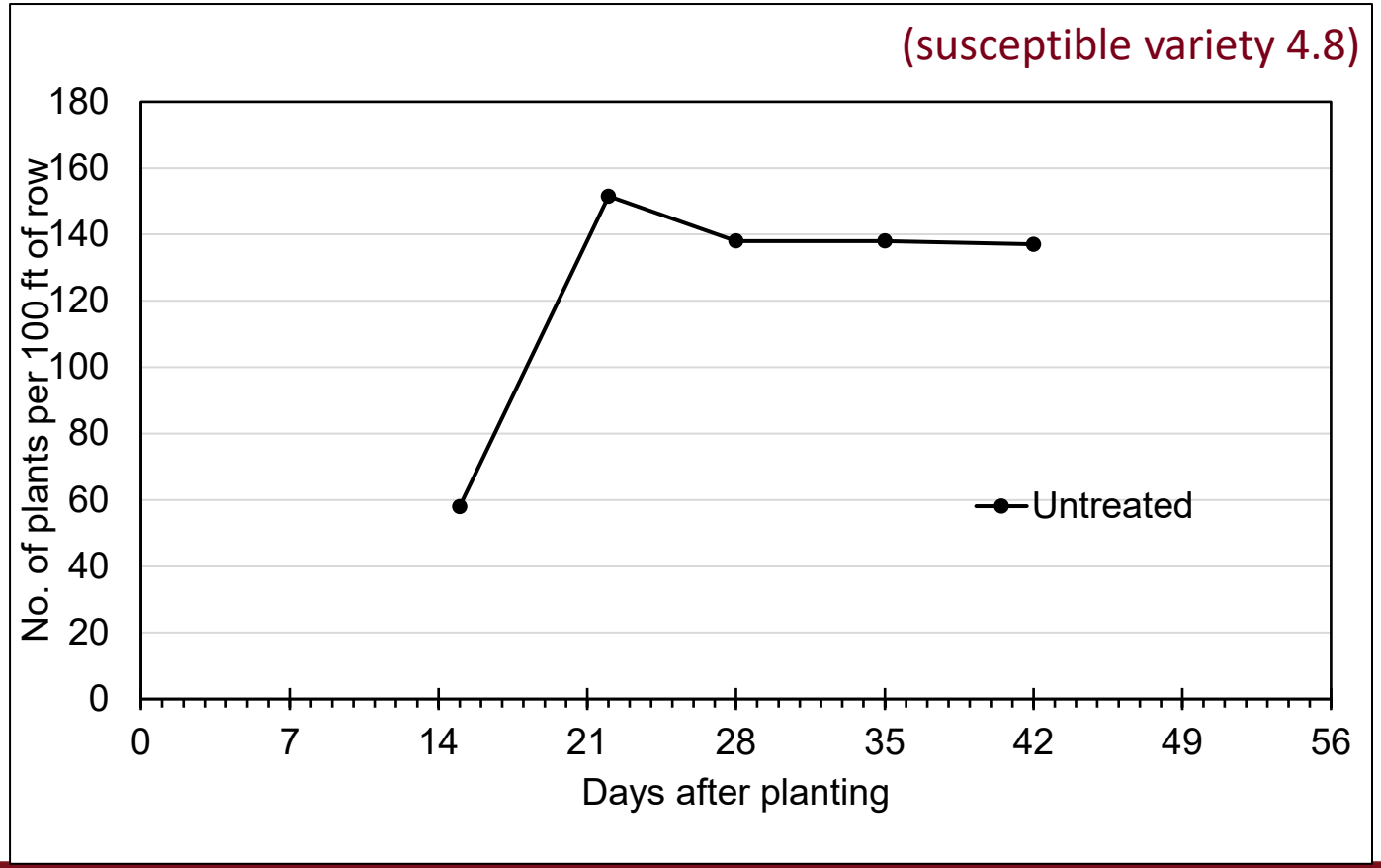
- Kabina 14 g (Penthiopyrad, since 2014)
- Vibrance 1.5 g (Sedaxane, since 2016)
- Systiva 5 g (Fluxapyroxad, since 2017)
- Zeltera 0.1 g (Inpyrfluxam, 2022)
- Metlock Suite [Metconazole + Rizolex) + Kabina 7g (Penthiopyrad), since 2014)
- Metlock Suite [Metconazole + Rizolex) + Vibrance 1g (Penthiopyrad), since 2018)

Metconazole and Rizolex are not SDHI

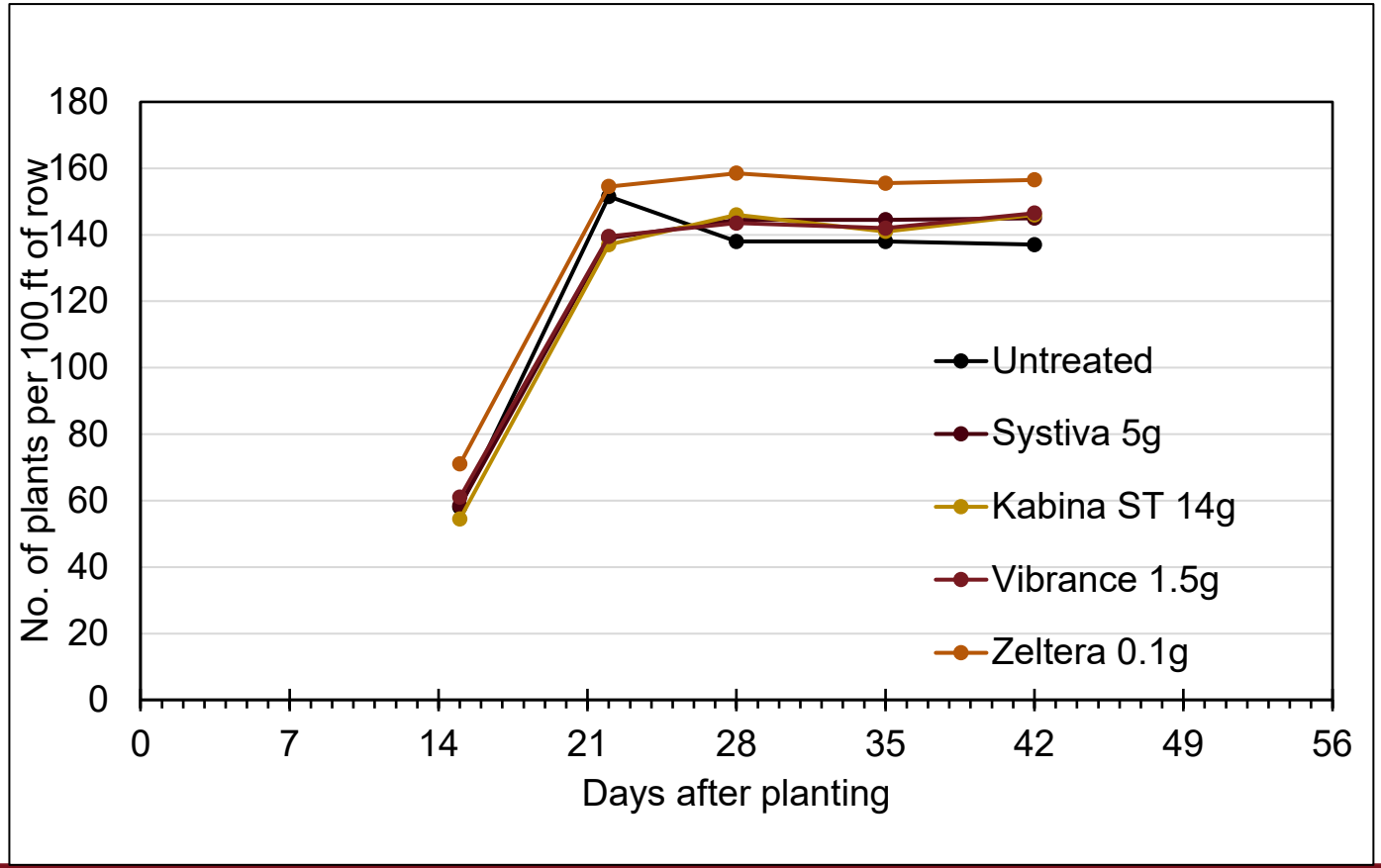
Crookston Monthly Rainfall

Month	Rainfall (inches)	% of 10 yr. mean rainfall	% of 30 yr. mean rainfall
April	0.67	56	56
May	0.95	40	34
June	1.65	44	42
July	0.32	11	10
August	2.3	105	82
September	2.41	108	106
October	4.95	245	226
Total	**13.25**		

At-planting treatments



At-planting treatments



Seed Treatments – stand counts

Treatment	15 DAP	22 DAP	28 DAP	35 DAP	42 DAP
Untreated control	58	152 ab	138 b	138 b	137 b
Kabina ST 14g	55	137 bc	146 ab	141 ab	146 ab
Systiva 5g	59	139 abc	145 ab	145 ab	145 ab
Vibrance 1.5g	61	140 abc	144 ab	142 ab	147 ab
Zeltera 0.1g	71	155 ab	159 a	156 a	157 a
LSD 0.05		**18.8**	**16.7**	**16.8**	**18.0**
P-value	NS	**0.000846**	**0.00912**	**0.0226**	**0.0167**

DAP = Days after planting, NS = No significant difference at $p < 0.05$

In-furrow application

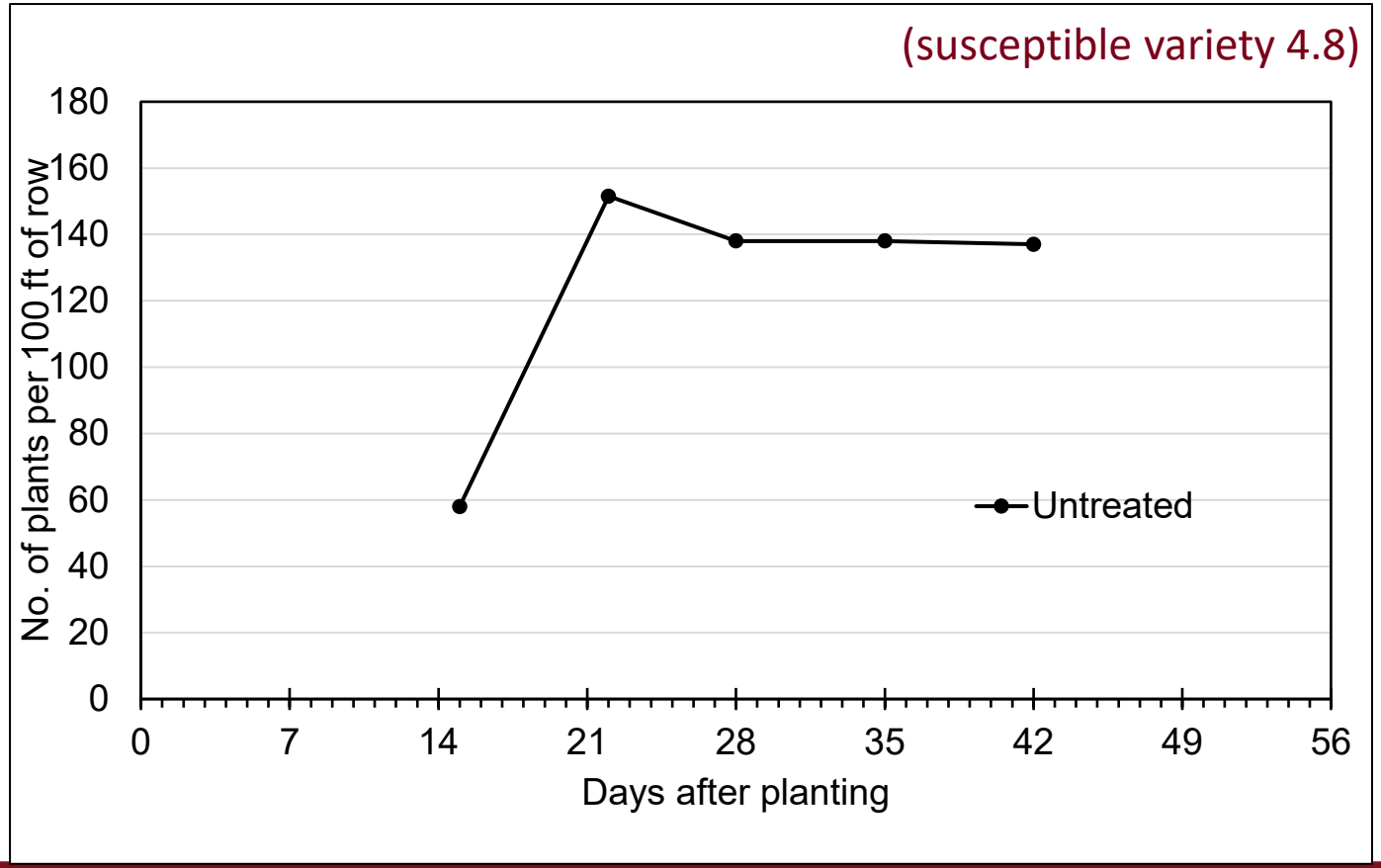
Fungicide in 3 gal. water + 10-34-0 @
3 gal. applied via drip tube

10-34-0 + Fungicides: After 10 minutes

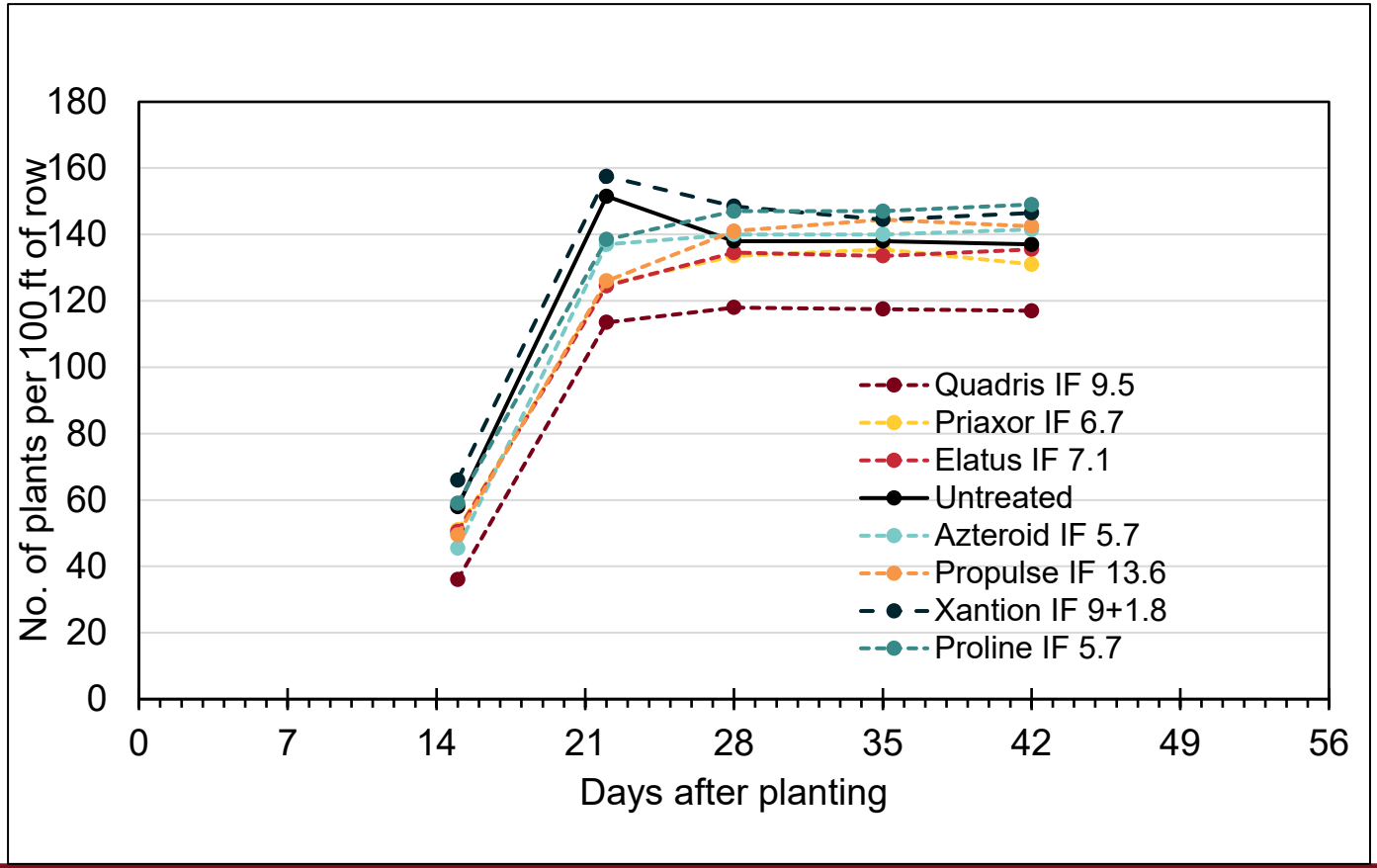
In-furrow application (rates per acre)

- Quadris 9.5 fl oz
- AZteroid 5.7 fl oz
- Elatus 7.1 fl oz
- Xanthion (Headline 9 fl oz + Integral 1.8 oz)
- Priaxor 6.7 fl oz
- Proline 5.7 fl oz
- Propulse 13.6 fl oz

At-planting treatments



At-planting treatments

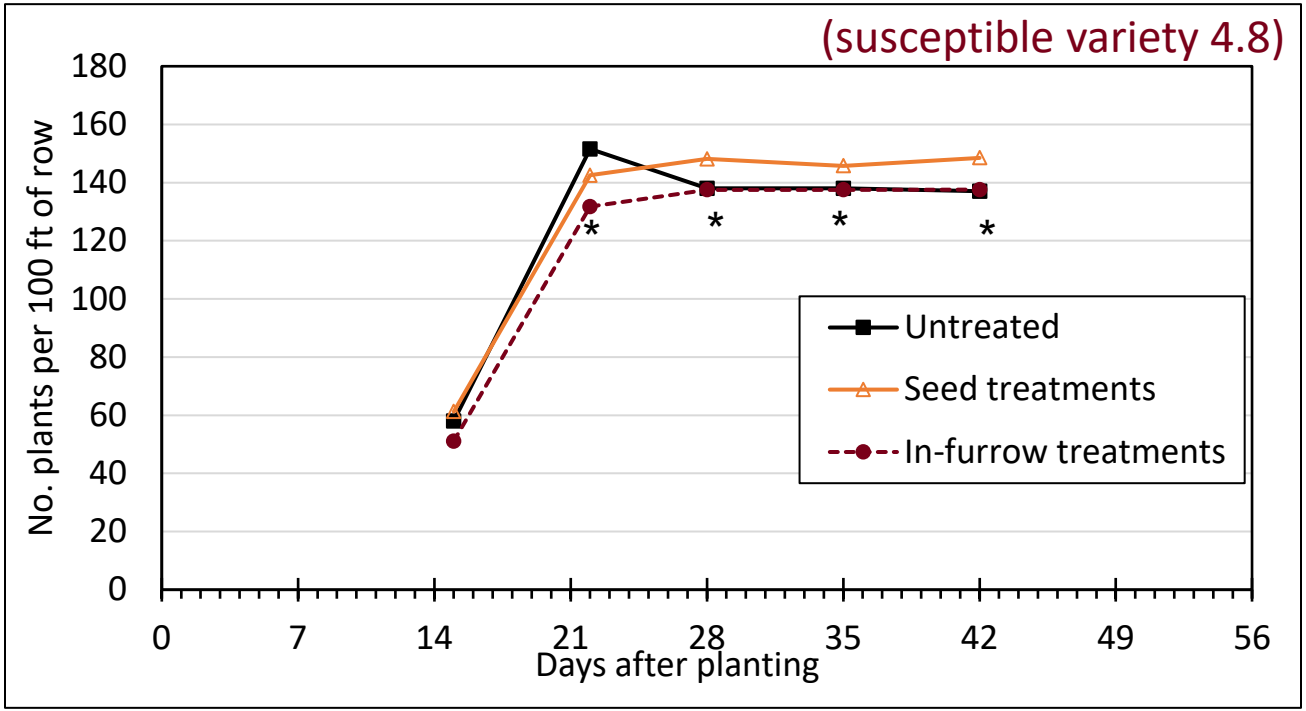


In-furrow treatments – stand counts

Treatment	15 DAP	22 DAP	28 DAP	35 DAP	42 DAP
Untreated control	58	152 ab	138 b	138 b	137 b
Azteroid IF 5.7	46	137 bc	140 b	140 ab	142 ab
Elatus IF 7.1	51	125 cd	135 bc	134 bc	136 b
Priaxor IF 6.7	51	125 cd	134 bc	136 b	131 bc
Proline IF 5.7	59	139 bc	147 ab	147 ab	149 ab
Propulse IF 13.6	50	126 cd	141 b	145 ab	143 ab
Quadris IF 9.5	36	114 d	118 c	118 c	117 c
Xanthion IF 9+1.8	66	158 a	149 ab	145 ab	147 ab
LSD 0.05		**18.8**	**16.7**	**16.8**	**18.0**
P-value	NS	**0.000846**	**0.00912**	**0.0226**	**0.0167**

DAP = Days after planting, NS = No significant difference at $p < 0.05$

At-planting treatments



Seed treatments vs In-Furrow contrast * $p < 0.05$

Root rot rating scale 0-10

0 1 2 3 4 5 6 7 8 9 10

Seed Treatments Vs In-furrow

Description	# Harvested roots	Root Rot Rating (1-10)	Root Rot Incidence (%)	Yield (t/A)	% Sugar	% SLM	RST (t/A)	RSA (lbs/A)
Untreated	114	0.71	15	23.3	17.5	1.20	327	7602
Seed treatments	131	0.24	10	25.0	**17.2**	1.24	**320**	8026
In-furrow treatments	126	0.32	9	24.1	**17.6**	1.21	**329**	7915
Seed vs in-furrow contrast (P-value)	NS	NS	NS	NS	**0.007**	NS	**0.0004**	NS

NS = No significant difference at $p < 0.05$

Starter fertilizer x In-Furrow Fungicides

- 2020 & 2021,NWROC, Crookston
- Safety and Efficacy Trials
- 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**, 5.7 fl oz
  - **Elatus**, 7.1 fl oz
  - **Xanthion** (Headline 9 fl oz + Biological 1.8 fl oz)

Starter fertilizer x In-Furrow Fungicides - Safety

	Max. plant Stands (per 100 ft.)	# of harvestable roots (per 100 ft.)	Sugar (%)	SLM (%)	Yield (t/A)	Recoverable sucrose (lbs/T)	Recoverable sucrose (lbs/A)
In-furrow Fungicide							
No Fungicide							
AZteroid FC 3.3							
Elatus							
Xanthion							
P-value							
LSD							
Starter Fertilizer							
No Fertilizer	**214 a**	**192 a**	16.9	1.19	27.6	315	8673
Paralign	**210 a**	**189 a**	16.9	1.19	27.7	313	8639
10-34-0	**194 b**	**178 b**	16.9	1.18	27.5	314	8589
P-value	**<0.0001**	**0.0014**	0.9210	0.8993	0.9687	0.9230	0.8964
LSD	7.2	7.79	NS	NS	NS	NS	NS
In-Furrow Fungicide x Starter Fertilizer							
P-value	0.4050	0.7397	0.9330	0.6160	0.9573	0.9270	0.5263

2020 & 2021

NS = No significant difference at $p < 0.05$

Starter fertilizer x In-Furrow Fungicides - Safety

	Max. plant Stands (per 100 ft.)	# of harvestable roots (per 100 ft.)	Sugar (%)	SLM (%)	Yield (t/A)	Recoverable sucrose (lbs/T)	Recoverable sucrose (lbs/A)
In-furrow Fungicide							
No Fungicide	210	188	16.5	1.23	27.2	306	**8290 c**
AZteroid FC 3.3	202	186	17.1	1.16	28.2	320	**8973 a**
Elatus	203	184	16.9	1.19	27.9	315	**8734 ab**
Xanthion	209	188	17.0	1.18	27.1	316	**8539 bc**
P-value	0.1690	0.7725	0.1220	0.0672	0.5785	0.1010	**0.0126**
LSD	NS	NS	NS	NS	NS	NS	**416**
Starter Fertilizer							
No Fertilizer							
Paralign							
10-34-0 (APP)							
P-value							
LSD							
In-Furrow Fungicide x Starter Fertilizer							
P-value	0.4050	0.7397	0.9330	0.6160	0.9573	0.9270	0.5263

2020 & 2021

NS = No significant difference at $p < 0.05$

Starter fertilizer x In-Furrow Fungicides - Efficacy

	# of harvestable roots (per 100 ft.)		Root Rot Rating (0-10)	
	2020	**2021**	**2020**	**2021**
In-furrow Fungicide				
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
Starter Fertilizer				
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
In-Furrow Fungicide x Starter Fertilizer				
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

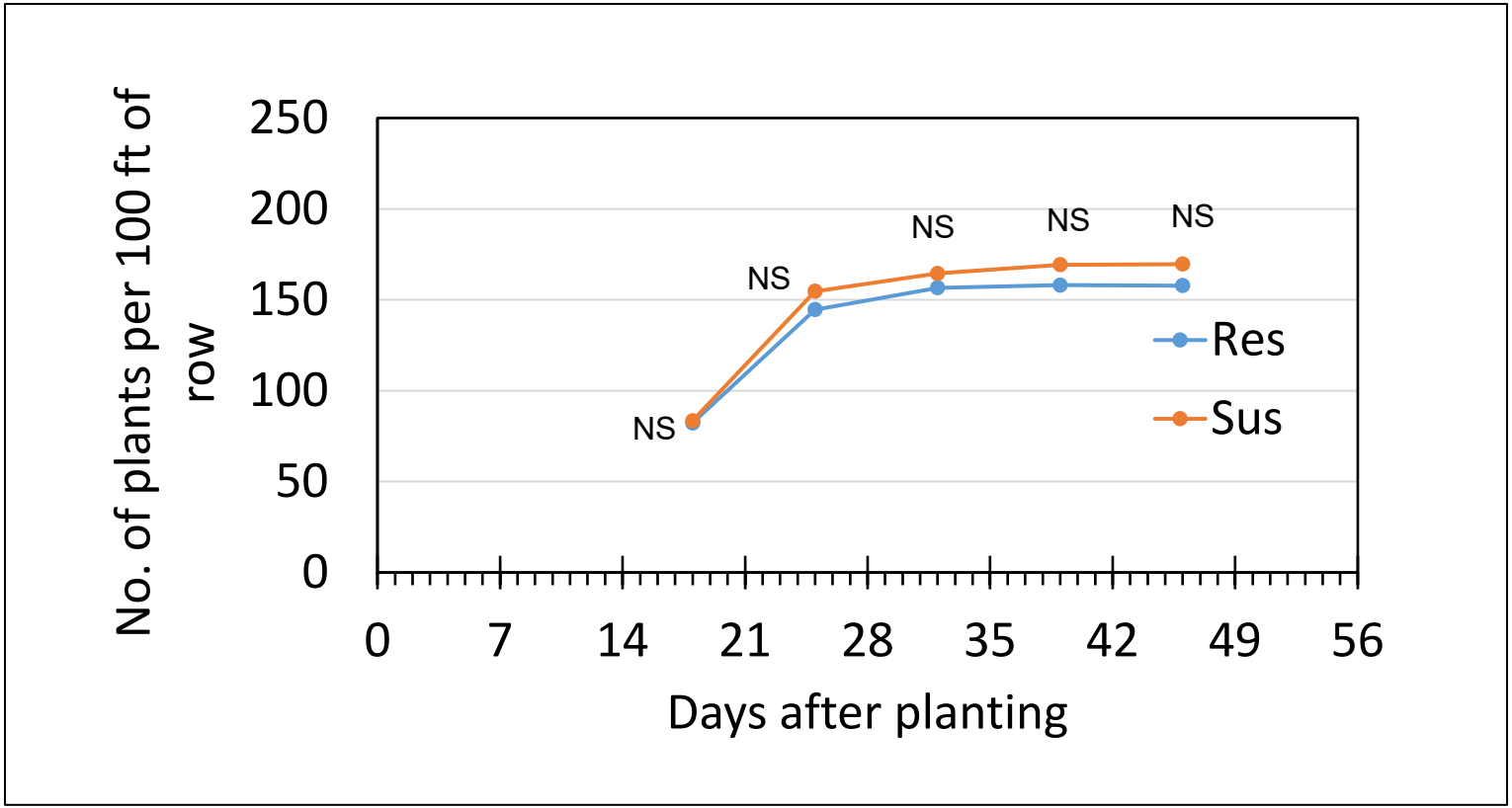
	Sugar (%)		RSA (lbs/A)	
	2020	**2021**	**2020**	**2021**
In-Furrow Fungicide				
No Fungicide	**14.8 b**	18.1	**4473 b**	9141
AZteroid FC 3.3	**15.6 a**	17.9	**6162 a**	9376
Elatus	**15.3 a**	17.9	**5825 a**	9348
Xanthion	**15.3 a**	17.7	**5340 ab**	9503
P-value	**0.0037**	0.3430	**0.0093**	0.6300
LSD	0.4	NS	994	NS
Starter Fertilizer				
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
In-Furrow Fungicide x Starter Fertilizer				
P-value	0.2734	0.3645	0.9890	0.7130

NS = No significant difference at $p < 0.05$

Integrated Management Trial

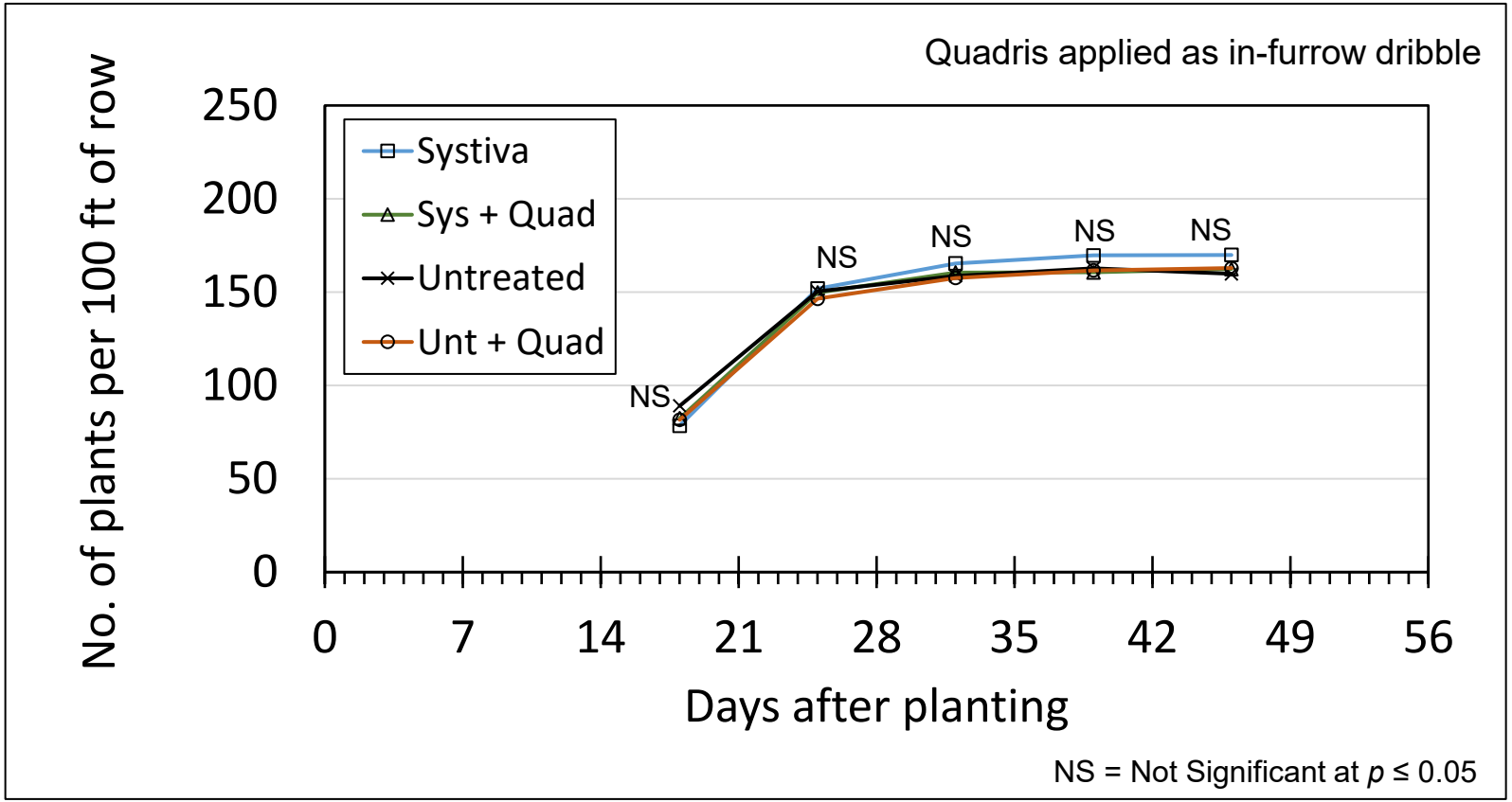
- NWROC, Crookston
- Split-split plot design, 4 reps (May 07)
- Rhizoctonia inoculum broadcast prior to planting (50 kg/ha) and incorporated
  - Variety (main plot)
    - **Resistant** (2-yr rating = **3.8**)
    - **Susceptible** (2-yr rating = **4.8**)
  - At-planting treatment (split plot)
    - No seed or in-furrow fungicide treatment
    - Systiva seed treatment (5 g a.i./unit)
    - Quadris in-furrow (9.5 fl oz/A) on Systiva
    - *Quadris in-furrow (9.5 fl oz/A) (no seed treatment)*
  - Postemergence treatment (POST, 7-inch band, split-split plot)
    - No postemergence fungicide
    - Quadris (14.3 fl oz/A or 0.6 fl oz/1000 ft) at **4-leaf** stage (Jun 10), **7-inch band**
    - Quadris (14.3 fl oz/A or 0.6 fl oz/1000 ft) at **8-leaf** stage (Jun 21), **7-inch band**

Varieties – Stands

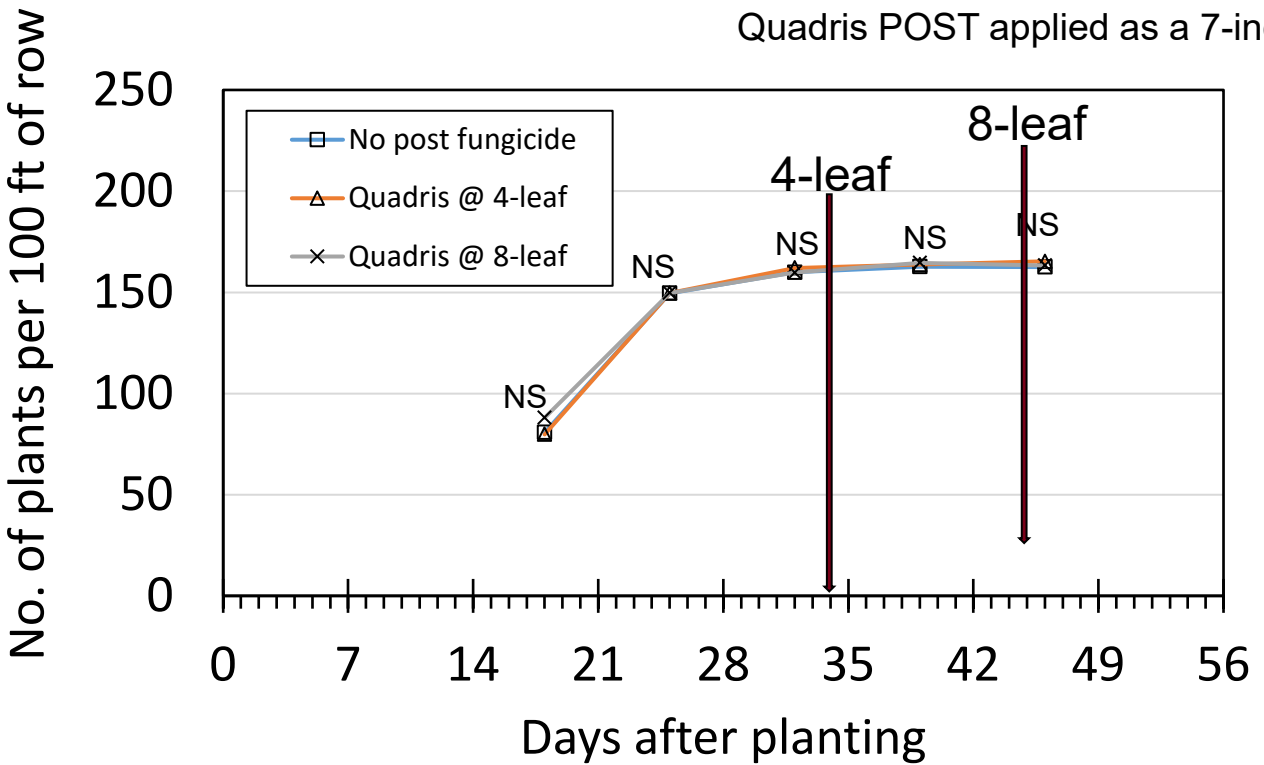


NS = Not Significant at $p \leq 0.05$

At-planting treatments – Stands

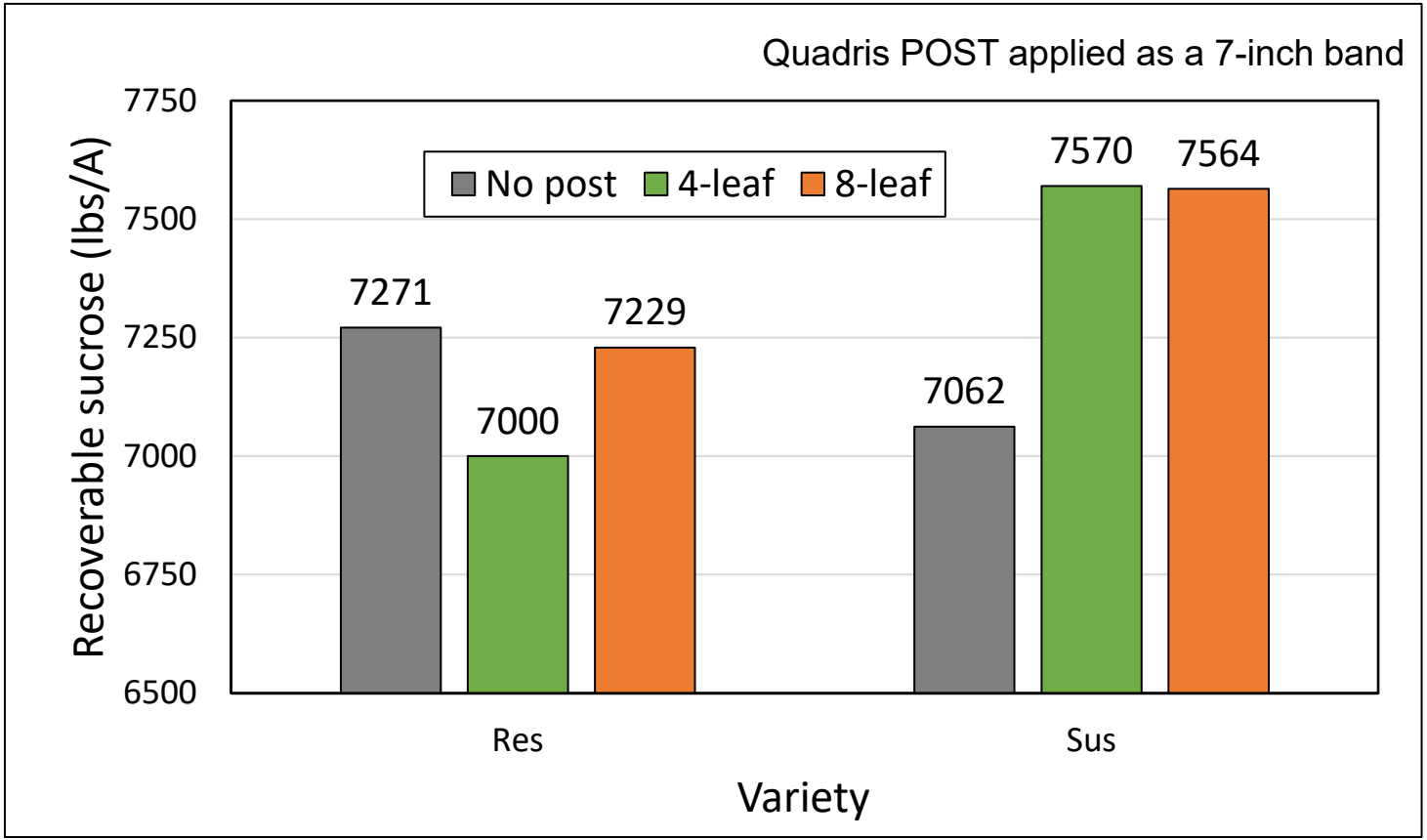


Postemergence treatments – Stands

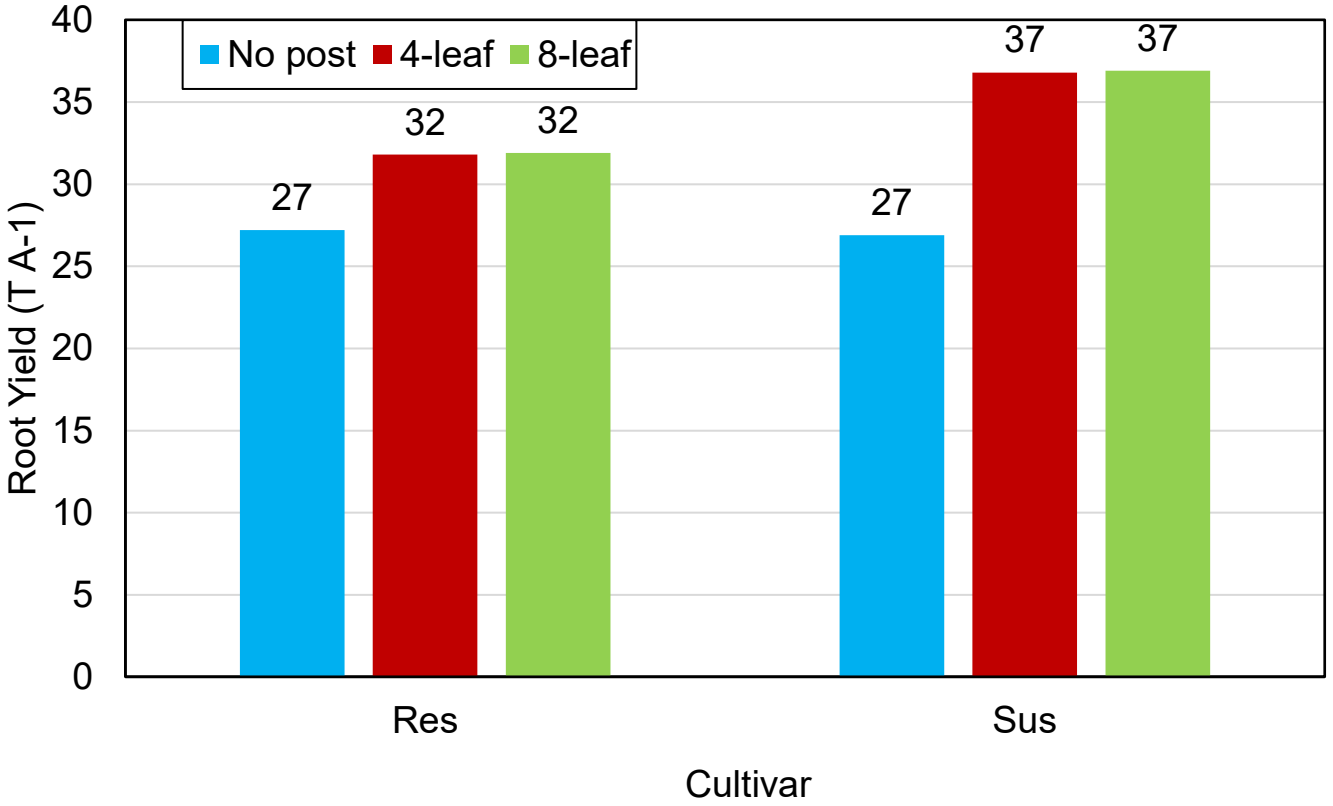


NS = Not Significant at $p \leq 0.05$

Variety x POST Interaction on RSA



Variety x POST interaction on yield - SMBSC



2020

Evaluation of Postemergence treatments

- Determine the effectiveness of postemergence fungicides on a susceptible cultivar (4.8 rating) for:
  - Mid to late season control of Rhizoctonia root rot
    - May 10, NWROC, Crookston
    - Jun 23, Rhizoctonia inoculation over the crowns
    - Jun 24, Fungicide treatments as a 7-inch band

Postemergence treatments

Treatment and rate/A	Active Ingredient (FRAC Group)	% Plant Loss (%)	Root Rot Rating (1-10)	Root Rot Incidence (%)	Sugar (%)	Yield (tons/A)	RST (lbs/T)	RSA (lbs/A)
Excalia SC 0.64 fl oz/A	Inpyrfluxam (7)	13.3 d	0.18 d	12.5 d	17.7	29.5 a	330	9732 a
Quadris SC 14.5 fl oz/A Broadcast	Azoxystrobin (11)	18.1 cd	0.50 bcd	12.5 d	17.5	29.3 a	324	9499 a
Quadris SC 10 fl oz/A	Azoxystrobin (11)	19.3 cd	0.71 bcd	17.5 cd	17.6	28.2 a	329	9309 a
AZteroid FC 3.3, 9.2 fl oz/A	Azoxystrobin (11)	20.8 cd	0.57 bcd	10.0 d	17.9	27.0 a	335	9052 a
Quadris SC 14.5 fl oz/A	Azoxystrobin (11)	14.5 d	0.37 cd	7.5 d	17.4	27.9 a	321	8947 a
Nontreated control	-	**52.8 a**	**4.36 a**	**72.5 a**	16.4	**14.6 c**	300	**4434 c**
LSD 0.05		11.5	1.22	14.75	-	3.74	-	1431
P- value		**<0.0001**	**<0.0001**	**<0.0001**	NS	<0.0001	NS	**<0.0001**

Postemergence treatments

Treatment and rate/A	Active Ingredient (FRAC Group)	% Plant Loss (%)	Root Rot Rating (1-10)	Root Rot Incidence (%)	Sugar (%)	Yield (tons/A)	RST (lbs/T)	RSA (lbs/A)
Excalia SC 0.64 fl oz/A	Inpyrfluxam (7)	13.3 d	0.18 d	12.5 d	17.7	29.5 a	330	9732 a
Quadris SC 14.5 fl oz/A Broadcast	Azoxystrobin (11)	18.1 cd	0.50 bcd	12.5 d	17.5	29.3 a	324	9499 a
Topguard EQ 7 fl oz/A	Flutriafol (3) + Azoxystrobin (11)	13.4 d	1.17 bcd	18.8 cd	17.1	29.4 a	319	9365 a
Quadris SC 10 fl oz/A	Azoxystrobin (11)	19.3 cd	0.71 bcd	17.5 cd	17.6	28.2 a	329	9309 a
AZteroid FC[3.3] 9.2 fl oz/A	Azoxystrobin (11)	20.8 cd	0.57 bcd	10.0 d	17.9	27.0 a	335	9052 a
Quadris SC 14.5 fl oz/A	Azoxystrobin (11)	14.5 d	0.37 cd	7.5 d	17.4	27.9 a	321	8947 a
Elatus WG 7.1 oz/A	Azoxystrobin (11) + Benzovindiflupyr (7)	14.0 d	0.53 bcd	13.8 cd	17.0	27.5 a	314	8618 a
Nontreated control	**-**	**52.8 a**	**4.36 a**	**72.5 a**	**16.4**	**14.6 c**	**300**	**4434 c**
LSD 0.05		11.5	1.22	14.75	-	3.74	-	1431
P- value		**<0.0001**	**<0.0001**	**<0.0001**	NS	<0.0001	NS	**<0.0001**

Postemergence treatments

Treatment and rate/A	Active Ingredient (FRAC Group)	% Plant Loss (%)	Root Rot Rating (1-10)	Root Rot Incidence (%)	Sugar (%)	Yield (tons/A)	RST (lbs/T)	RSA (lbs/A)
Priaxor SC 6.7 fl oz/A	Fluxapyroxad (7) + Pyraclostrobin (11)	17.8 cd	1.60 b	27.5 c	17.3	26.5 a	322	8542 a
Proline 480 SC 5.7 fl oz/A	Prothioconazole (3)	27.0 bc	1.53 bc	27.5 c	17.3	26.6 a	321	8528 a
Propulse SC 13.6 fl oz/A	Fluopyram (7) + Prothioconazole (3)	33.0 b	3.26 a	48.8 b	17.1	21.5 b	315	6794 b
Nontreated control	-	**52.8 a**	**4.36 a**	**72.5 a**	**16.4**	**14.6 c**	**300**	**4434 c**
LSD 0.05		11.5	1.22	14.75	-	3.74	-	1431
P- value		**<0.0001**	**<0.0001**	**<0.0001**	NS	<0.0001	NS	**<0.0001**

Fungicide Options for Rhizoctonia

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

SDHI | QoI | DMI | AH | Biological

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, or combinations etc.)
- 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

Fusarium Yellows

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

Austin Jeff

Thank You!

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