

Control of Rhizoctonia from Planting to Harvest

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Today's topics

- About *Rhizoctonia*
- Fungicides
 - Experiments, experiences, & other factors
- Plant resistance
- Crop susceptibility to *Rhizoctonia*
- Tillage
- Others disease management options

About *Rhizoctonia*

- *Rhizoctonia solani* AG 2-2
- Seed rot, damping-off of seedlings



About *Rhizoctonia*

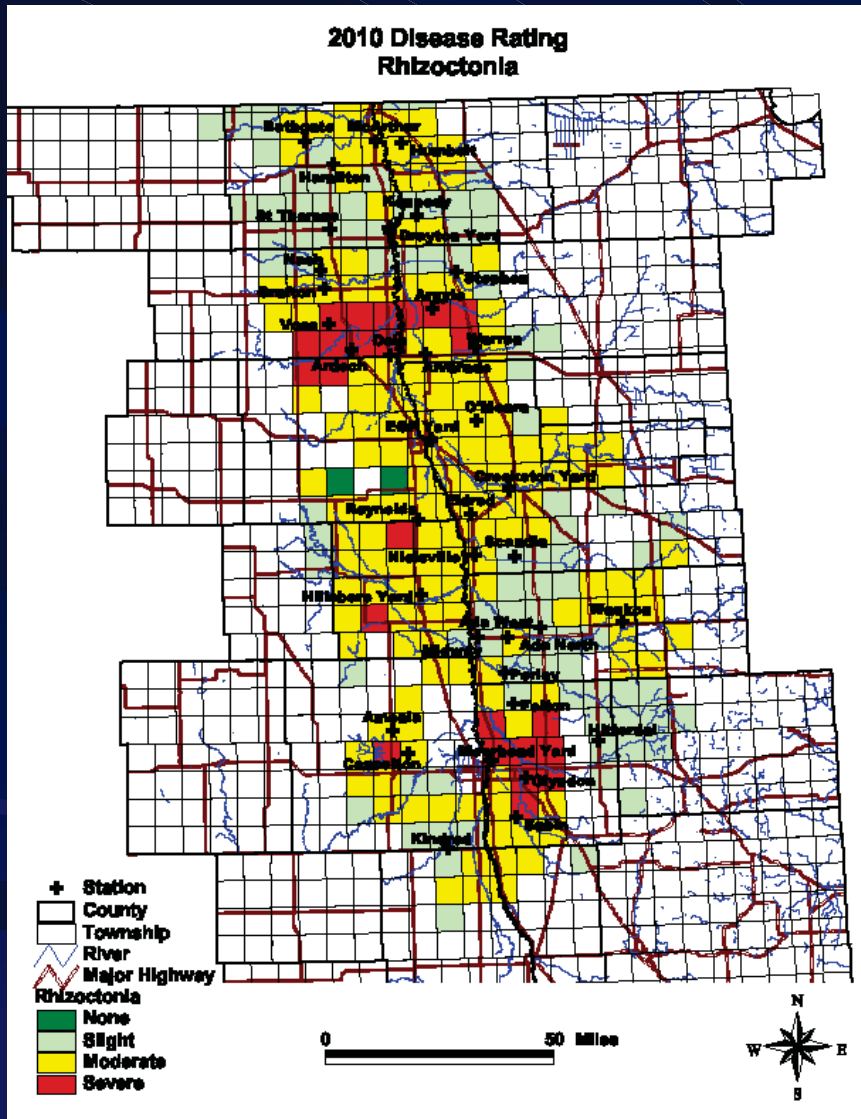
- *Rhizoctonia solani* AG 2-2
- Seed rot, damping-off of seedlings
- *Rhizoctonia* crown and root rot



About *Rhizoctonia*

- AG 2-2 has intraspecific groups (ISGs)
 - AG 2-2 IV and AG 2-2 IIIB
 - Cause Rhizoctonia crown & root rot
- Both occur in MN/ND
 - RRV: AG 2-2 IV most common (66%)
 - So. MN: AG 2-2 IIIB most common (56%)
- Both ISG's cause same symptoms on sugarbeet

Rhizoctonia: 2010 Disease Rating (ACSC)



Rating	Yield Loss %	% Acres
None	0	2
Slight	0-5	32
Moderate	5-15	57
Severe	15-30	10
	(Abandonment)	

Source: ASCS

Factors affecting Rhizoctonia diseases

- Density of fungus in soil
 - High populations: disease begins early in season even if weather not ideal
 - Low populations: onset of disease is later in season, esp. if weather ideal
- Susceptibility of variety
- Environment
 - Temperature: 50 to 95+ °F (68 to 85 °F)
 - Soil moisture: dry to wet @ 25 – 100% MHC

Fungicides: Seed treatment

- Current fungicides: fair to good control
 - Thiram, Maxim (combined with Apron or Allegiance)
- Dynasty (Syngenta)
 - Registered for sugarbeet – azoxystrobin
 - 2011: Test in region @ many sites
 - 2012: Available to seed companies
 - Cruiser + Apron XL + Maxim + Dynasty (minipellet)
- Other fungicides in pipeline:
 - Sedaxene (pyrazole)

2010 Field trial fungicides: In-furrow

- Plots inoculated with *R. solani* AG 2-2 IIB on whole barley (31 lb/acre)
 - Broadcast and worked into top 4 inches of soil
 - Randomized complete block - 4 reps
 - Two controls
 - ◆ Non-inoculated, no fungicide
 - ◆ Inoculated, no fungicide
- Fungicides applied in 4-inch band right behind disk opener (6 row plots)



In-furrow nozzle

Drip tube
No starter fertilizer

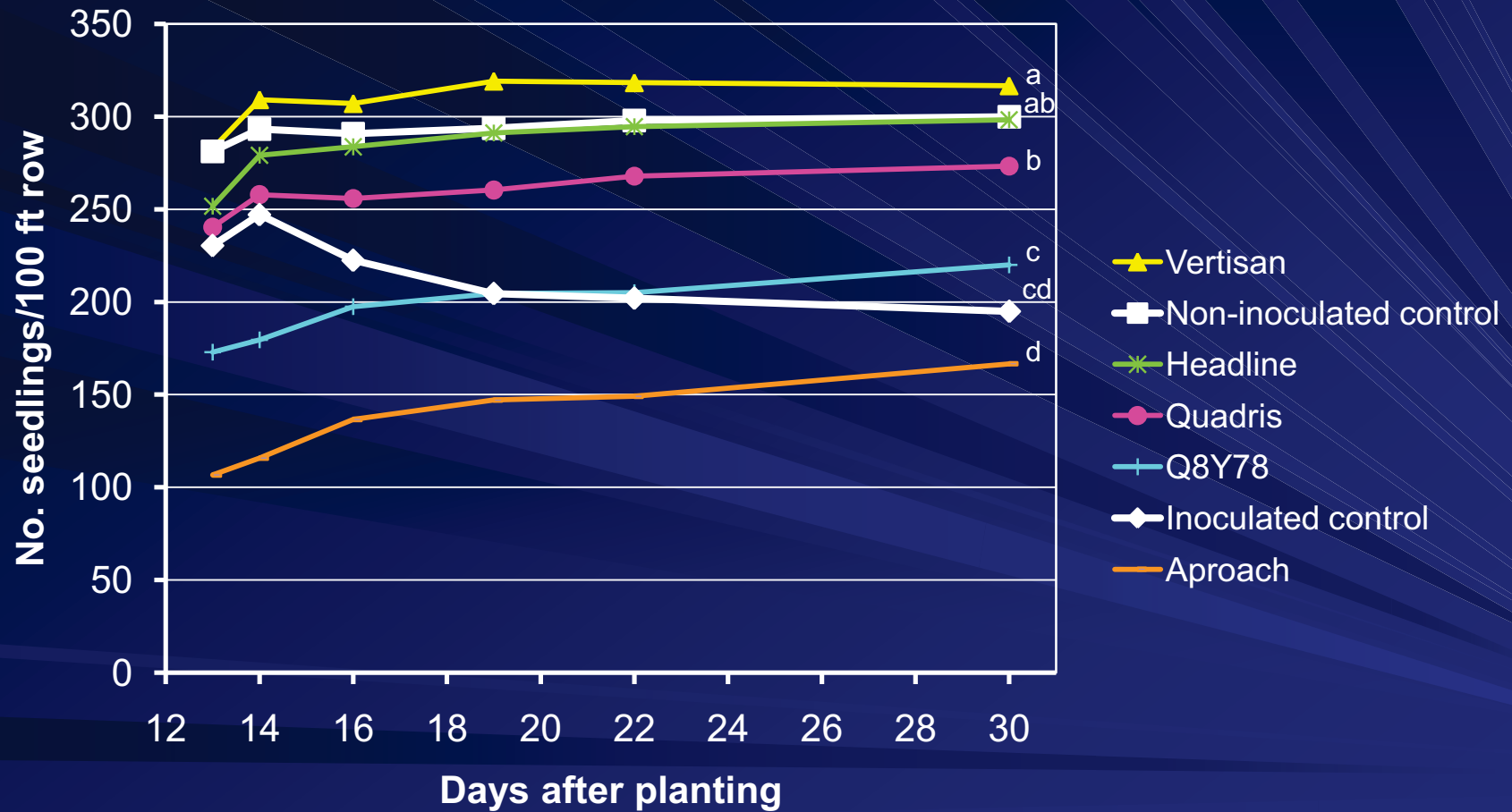
In-furrow fungicide trial

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 - Broadcast and worked into top 4 inches of soil
 - Randomized complete block - 4 reps
- Fungicides applied in 4-inch band right behind disk opener (6 row plots)
- Planted susceptible variety (rating = 5.8)
 - May 19 at 2.4-inch spacing
- Thinned June 23
- Stand, root rot ratings, yield and quality data

In-furrow fungicides

Fungicide	Active ingredient	Product rate	
		fl oz/1000 ft row	fl oz/acre
Aproach	Picoxystrobin	1.3	31
Headline	Pyraclostrobin	0.5	12
Q8Y78 (Aproach + Vertisan)	2:1 premix of penthio + picoxystrobin	1.6	38
Quadris	Azoxystrobin	0.6	14.3
Vertisan	Penthiopyrad	1.6	38

In-furrow trial stand establishment



Non-inoculated Control



Inoculated Control



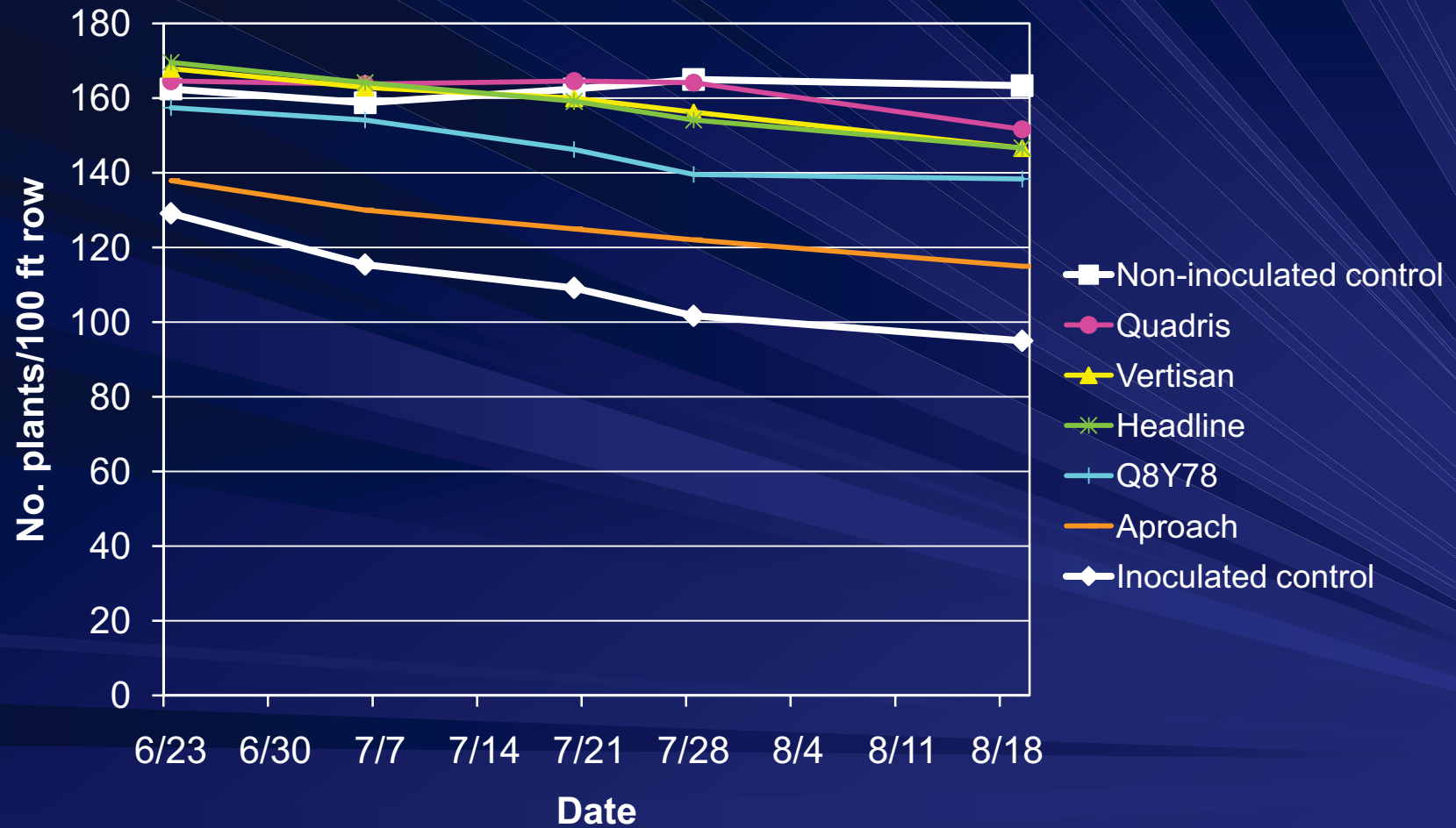
Vertisan in-furrow



Approach in-furrow



In-furrow trial post-thinning stand data



In-furrow trial yield data

Treatment	Rating (0-7)	Yield (T/A)	Sucrose (lb recov/A)
Non-inoculated	1.8	27.2	8635
<i>R. solani</i> -inoculated:			
No fungicide	3.8	17.7	5540
.....			
LSD ($P = 0.05$)	0.77	4.4	1395

In-furrow trial yield data

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Non-inoculated	1.8	27.2	8635
<i>R. solani</i> -inoculated:			
No fungicide	3.8	17.7	5540
Quadris	2.2	23.9	7614
Headline	2.3	24.3	7599
Vertisan	3.0	22.7	7043
Q8Y78	2.7	21.3	6769
Approach	2.6	20.1	6318
LSD ($P = 0.05$)	0.77	4.4	1395

Conclusions: In-furrow trial

- Headline, Quadris, and Vertisan resulted in good emergence compared to Aproach and Q8Y78, which were phytotoxic
- Quadris protected stands for 10 weeks
- Headline and Vertisan protected stands for about for about 4-5 weeks
- Quadris and Headline under high disease pressure resulted in yields comparable to non-inoculated control

When is an in-furrow fungicide needed?

- History of early-season Rhizoctonia diseases
 - Post-emergence seedling stand loss, root rot
- History of severe Rhizoctonia crown and root rot
- And if beans grown the previous season
- Severe infestation (10% acres):
 - In-furrow fungicide
 - In-furrow + post-emergence application (MI)



Source: Steve Poindexter Michigan State Extension: Saginaw

In-Furrow Applications of Quadris

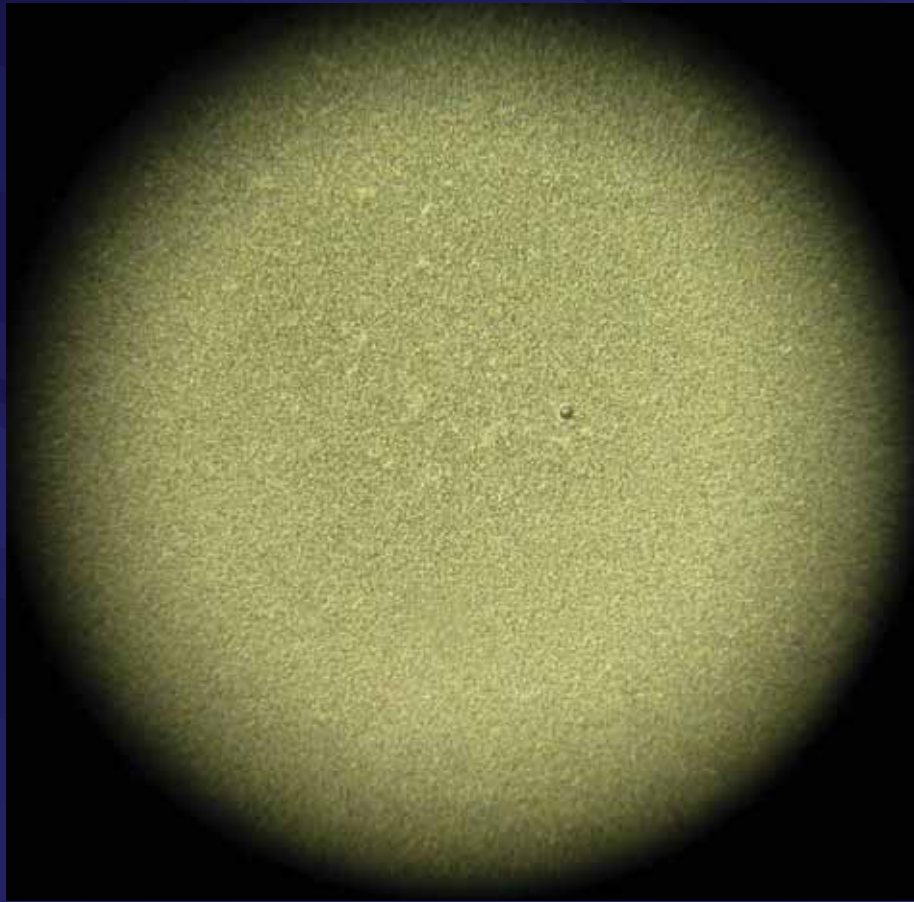
(Michigan, ACSC, U of M, NDSU, USDA, BASF, Syngenta, WC Chem)

- **Quadris: phytotoxicity issues:**
- In-furrow Quadris dribbled on seed in-furrow can reduce emergence
- Reduce phytotoxicity:
 - Quadris more effective applied as a T-band than dribbled in-furrow (3.5- to 4-inch vs. 7-inch)
- Monitor spray nozzles for continuous flow

In-Furrow Applications of Quadris

(Michigan, ACSC, U of M, NDSU, USDA, BASF, Syngenta, WC Chem)

- **Quadris + liquid fertilizers:
Phytotoxicity and incompatibility issues**
- *Reduce phytotoxicity: Apply T-band*
- Quadris does not mix well directly with in-furrow liquid fertilizers
- *Improve compatibility: Quadris premixed with ½ to 1 gal water for each gal of starter, then add to liquid fertilizer*



Quadris premixed with water,
then added to 10-34-0

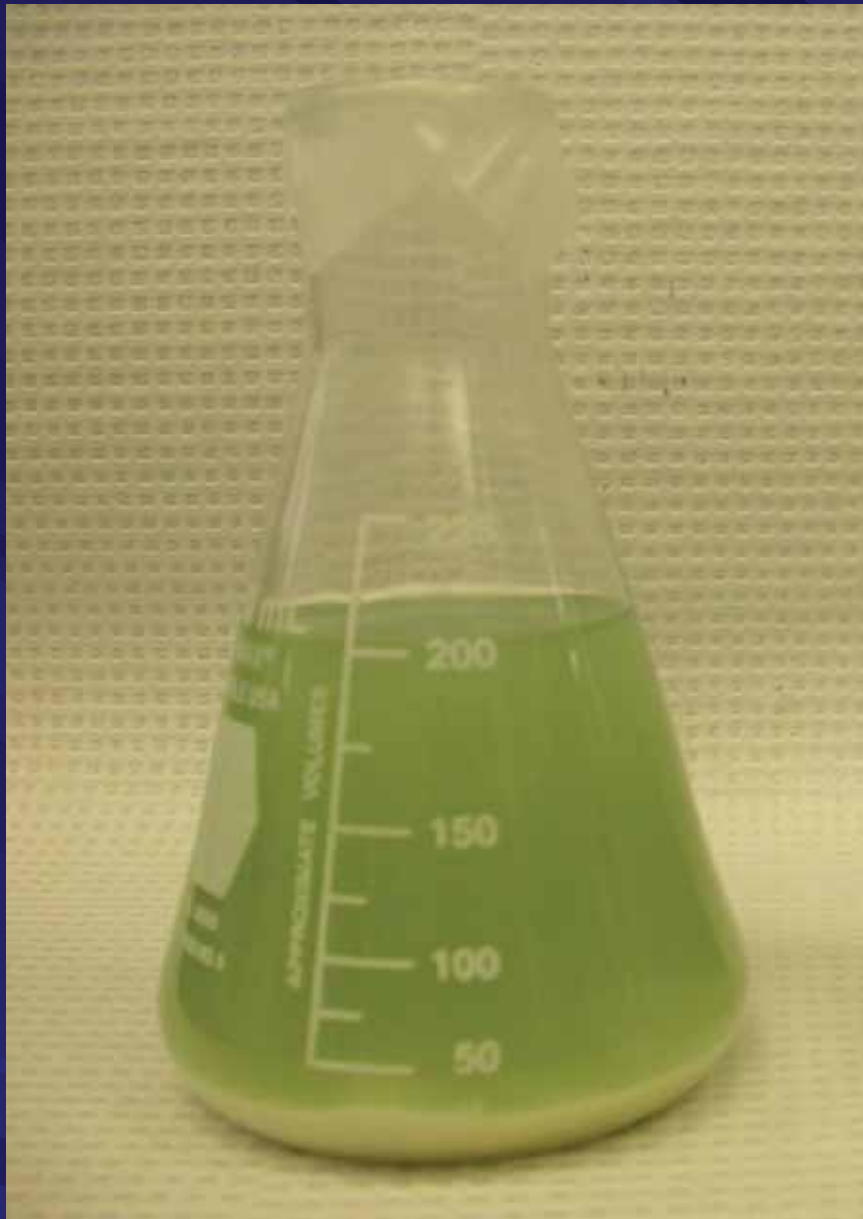


Quadris mixed directly with
10-34-0

In-Furrow Applications of Quadris

(Michigan, ACSC, U of M, NDSU, USDA, BASF, Syngenta, WC Chem)

- Constant agitation required to avoid separation and precipitation
- Best to apply within 4 hours
- Do not let sit overnight without very thorough agitation before application



18 hours later:
Quadris premixed in water before
adding to starter fertilizer

In-Furrow Applications of Headline

(Michigan, ACSC, U of M, NDSU, USDA, BASF, Syngenta, WCCChem)

- Do not discontinue starter fertilizer
- Headline causes less risk of phytotoxicity than Quadris
- BASF recommends mixing Headline with at least 1 gal water before adding to liquid fertilizer
- Addition of compatibility agents does not improve stability of Headline + liquid fertilizer solutions
- Agitation eliminates layering of Headline on top of liquid fertilizer



Headline premixed with
water before adding to
starter fertilizer

Headline added directly to
starter fertilizer premixed
with water

In-Furrow Applications of Headline

(Michigan, ACSC, U of M, NDSU, USDA, BASF, Syngenta, WC Chem)

- Best to apply with constant agitation within 4 hours after mixing
- Avoid solutions settling overnight – requires very thorough agitation before application
- Compatibility & nozzle plugging also affected by:
 - Temperature of water, starter fertilizer, air
 - Nozzle/orifice size, sprayer screen size



Source: Tyler Grove, ACSC

In-Furrow Applications of Fungicides

(Michigan, ACSC, U of M, NDSU, USDA, BASF, Syngenta, WC Chem)

- To avoid compatibility problems, use injection system equipment to inject fungicide into starter fertilizer solution
- Plugging should stop – but does not guarantee no phytotoxicity

2010 Field trial fungicides: Banded

- Susceptible variety (rating = 5.8)
- Fungicides applied and June 24
 - 7-inch band @ 6- to 8-leaf stage
 - 4-inch soil temperature max = 75 °F
 - Randomized complete block - 4 reps
- Plots inoculated (uniform disease) within 4 hr
- Cultivated immediately after inoculation
- Root rot ratings, yield and quality data

Fungicide application on 6-leaf beets



Inoculum application



Band-applied fungicides

Fungicide	Active ingredient	Product rate	
		fl oz/1000 ft row	fl oz/acre
Aproach	Picoxystrobin	1.3	31
Headline*	Pyraclostrobin	0.5	12
Proline*	Prothioconazole	0.24	5.7
Q8Y78 (Aproach + Vertisan)	2:1 premix of penthio + picoxystrobin	1.6	38
Quadris	Azoxystrobin	0.6	14.3
Vertisan	Penthiopyrad	1.6	38

* + induce @ 0.125%

Band trial yield data

Treatment	Rating (0-7)	Yield (T/A)	Sucrose (lb recov/A)
Non-inoculated	2.8	23.8	7537
<i>R. solani</i> -inoculated:			
No fungicide	5.7	9.5	2780
<hr/>			
LSD ($P = 0.05$)	1.1	5.3	1693

Band trial yield data

Treatment	Rating (0-7)	Yield (T/A)	Sucrose (lb recov/A)
Non-inoculated	2.8	23.8	7537
<i>R. solani</i> -inoculated:			
No fungicide	5.7	9.5	2780
Aproach	2.0	25.5	8429
Quadris	1.5	24.5	8295
Vertisan	2.1	25.3	8196
Proline	1.6	24.7	8064
Q8Y78	2.0	24.0	7863
Headline	2.6	23.7	7228
LSD ($P = 0.05$)	1.1	5.3	1693

Summary

- All six band-applied fungicides were effective against *Rhizoctonia* crown and root rot initiated at the crown (applied before infections occurred)
- Quadris and Proline most effective in reducing RCRR

2010 Fungicide field trial: Quadris application method/rate (ACSC-Sponsored)

- Susceptible variety (rating = 5.8)
- Inoculated site
 - Fungicides applied and plots inoculated June 16
 - 6-leaf stage; 4-inch soil temperature max = 72 °F
 - Cultivated immediately after inoculation
- **Non-inoculated site**
 - Fungicides applied June 7
 - 4-leaf stage; 4-inch soil temperature max = 60 °F
- Root rot ratings, yield and quality data

Quadris treatments

- Application methods
 - 5-inch band
 - 7-inch band
 - Broadcast
- Application rates (fl oz product/acre)
 - 5.0, 7.5, 10.0, 14.5
- Non-inoculated control (no fungicide)

Non-inoculated trial Fungicide application on 4-leaf beets



Non-inoculated trial: Quadris trial yield data

Treatment	Rating (0-7)	Yield (T/A)	Sucrose (lb recov/A)
Control (no fungicide)	2.4	24.0	8270
Application method			
5-inch band	2.1	25.3	8379
7-inch band	1.8	26.6	8903
Broadcast	1.5	27.7	9181
Broadcast vs. band	**	*	NS
5-inch vs. 7-inch band	NS	NS	NS
Application rate			
5.0 fl oz product/A			
7.5 fl oz product/A			
10.0 fl oz product/A			
14.5 fl oz product/A			
Rate linear			
Rate quadratic			
Method x rate interaction			

Non-inoculated trial: Quadris trial yield data

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Broadcast	1.5	27.7	9181
Broadcast vs. band	**	*	NS
5-inch vs. 7-inch band	NS	NS	NS
Application rate			
5.0 fl oz product/A	1.8	25.5	8413
7.5 fl oz product/A	1.8	25.9	8587
10.0 fl oz product/A	1.8	27.0	9062
14.5 fl oz product/A	1.7	27.6	9223
Rate linear	NS	NS	NS
Rate quadratic	NS	NS	NS
Method x rate interaction	NS	NS	NS

Non-inoculated trial: Quadris trial revenue data

Treatment	Revenue (\$/A)	Product cost (\$/A)	Benefit over no fung. (\$/A)
Control (no fungicide)	1401	-	-
Application rate			
5.0 fl oz product/A	1368	12.50	-46
7.5 fl oz product/A	1403	18.75	-17
10.0 fl oz product/A	1496	25.00	70
14.5 fl oz product/A	1520	36.25	83

Inoculated Trial: Quadris revenue data

Treatment	Revenue (\$/A)	Product cost (\$/A)	Benefit over no fung. (\$/A)
Non-inoculated control	1614	-	-
Inoculated, no fungicide	124	-	-
.....			
Application rate			
5.0 fl oz product/A	1605	12.50	1469
7.5 fl oz product/A	1677	18.75	1534
10.0 fl oz product/A	1706	25.00	1557
14.5 fl oz product/A	1712	36.25	1552

Conclusions

- Low Rhizoctonia disease pressure
Based on one year's data, trial will be repeated in 2011
- There was a trend for higher yields and recoverable sucrose with increasing rates of Quadris
- Economic benefits occurred with highest rates of Quadris (10 and 14.5 fl oz/A)

POST-planting Applications of Quadris

(Michigan, ACSC, U of M, NDSU, USDA, BASF, Syngenta, WC Chem)

- Application preemergence over the row is not very effective
- Application in cotyledon stage less effective than at later leaf stages
- Wait until at least 2- to 4-leaf stage
- Best to wait until 4- to 6-leaf stage, if possible
- Benefits occur if applied 21 days before infection

POST-planting Applications of Quadris

(Michigan, ACSC, U of M, NDSU, USDA, BASF, Syngenta, WC Chem)

- Quadris + Mustang Max causes significant nozzle plugging if not applied immediately after mixing
- Quadris + liquid Lorsban is a problem because of phytotoxicity to seedlings
- Quadris + any EC formulation is risky and may cause significant crop injury
- Avoid mixing Quadris with surfactants
- Conduct jar tests for compatibility before mixing in tank

POST-planting Applications of Quadris

(Michigan, ACSC, U of M, NDSU, USDA, BASF, Syngenta, WC Chem)

- Quadris should never be mixed with microrate herbicides
- Apply Quadris as near to the exact mid-point between two successive microrate applications as possible
- Quadris can be mixed with POST-glyphosate applications, but Monsanto does NOT recommend this practice or stand behind weed control efficacy

Experiences of ACSC AG Staff

- In 2010, ACSC growers applied Quadris (postemergence) on ~ 50,000 acres
- Quadris performed well for 75-80% of fields
- What happened to the other 20-25%?
 - No negative or positive effect
 - Misdiagnosis of problem

Root diseases are confusing to diagnose



Rhizoctonia



Aphanomyces

What disease(s) is this???



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Quadris applied at 6-leaf stage



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 - Infections occurred on root (not crown)
 - Applied after crowns/roots infected & no symptoms
 - ◆ Time between infection & symptoms can be 1-3 weeks

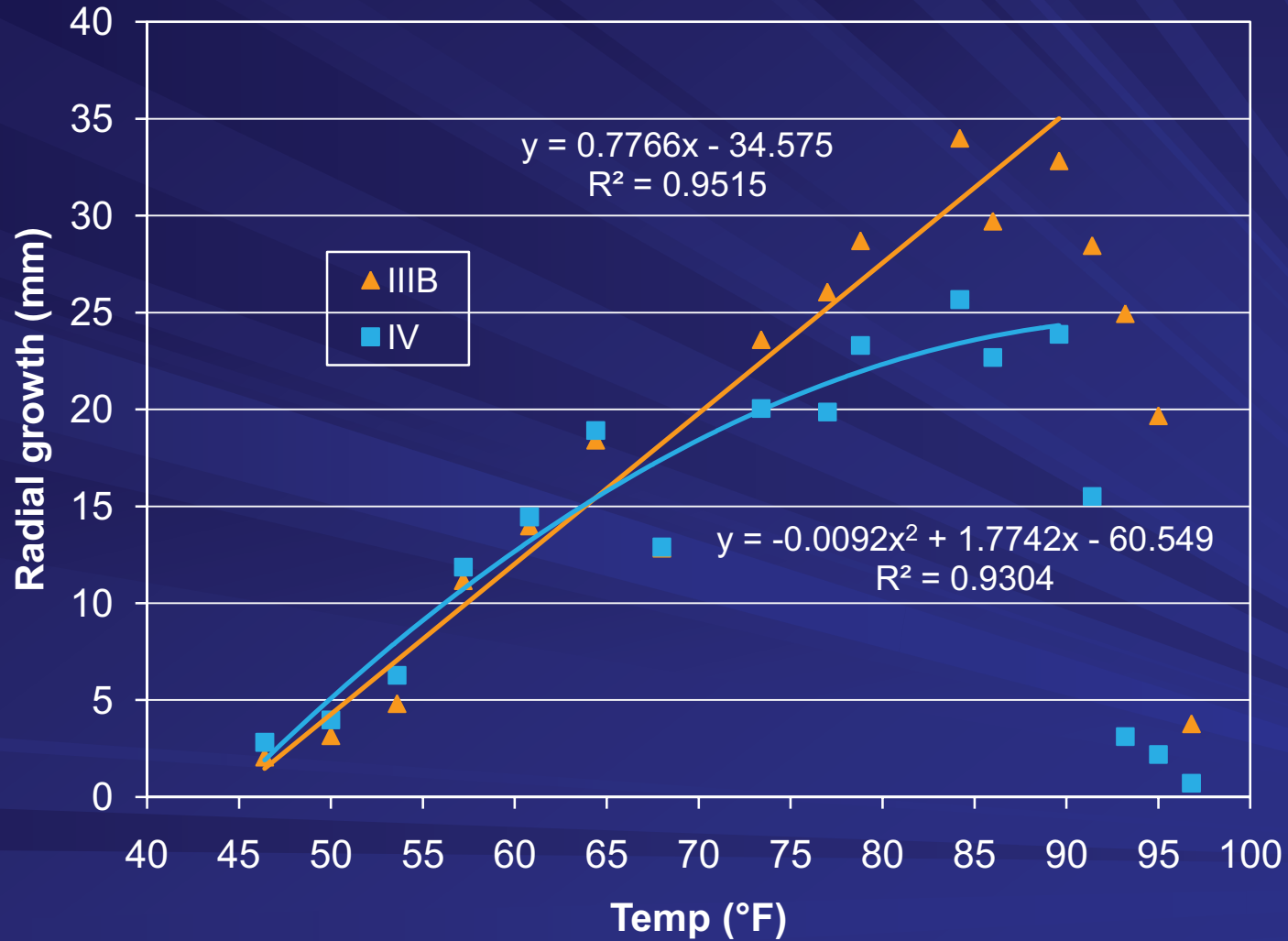
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 - No negative or positive effect
 - Misdiagnosis of problem
 - Infections occurred on root (not crown)
 - Applied after crowns/roots infected & no symptoms
 - Applied too late (after symptoms develop) to “catch up”

Fungicide Timing?

- Fungicides effective when applied before *Rhizoctonia* infects sugarbeet
- Still under investigation
- Growing Degree Days
- Soil temperature (60-65 °F)

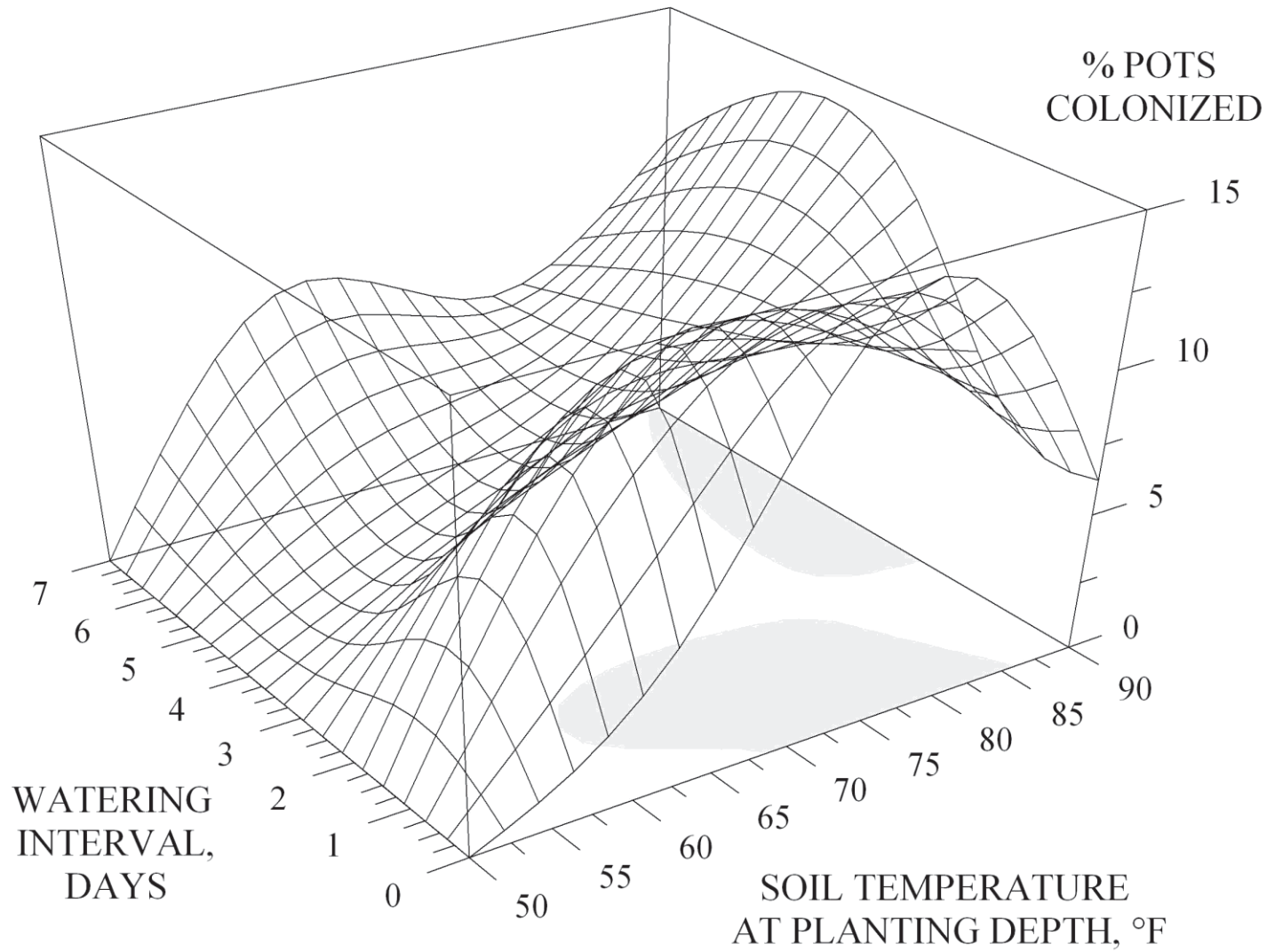
Temperature Effect on Growth of *Rhizoctonia solani* AG 2-2 IV and AG 2-2 IIIB



Fungicide Timing?

- Fungicides effective when applied before *Rhizoctonia* infects sugarbeet
- Still under investigation
- Growing Degree Days
- Soil temperature (60-65 °F)
- Soil moisture: dry to wet
- Soil temperature & moisture interaction

RHIZOCTONIA spp.



Source: Paul Meyer & Jim Kurle, Dept. Plant Pathology, University of Minnesota, St. Paul

Fungicide Timing?

- Still under investigation
- Growing Degree Days
- Soil temperature (60-65 °F)
- Soil moisture (dry to wet)
- Soil temperature & moisture
- Plant growth stage (4- to 8-leaf)
- In general, most fields do not have Rhizoctonia pressure to justify cost of >1 application

Plant resistance

- Severe disease severity:
 - Select varieties with disease rating < 3.82
- Slight to Moderate disease severity:
 - Select varieties with disease rating < 5.0
- Lower Rhizoctonia ratings means improved partial resistance/tolerance
 - Does not mean immunity
- Resistance not fully expressed until 6-8 leaf stage

Give your fungicides a better chance



Susceptible
(5.76)

Moderate
(4.14)

Resistant
(2.35)

RCRR: 5.4

4.4

3.5

RSA: 4382

6606

7201

Sugarbeet variety & Fungicides

- Slight Rhizoctonia pressure
 - Partially Resistant variety – no fungicide
 - Susceptible variety – apply fungicide
- Moderate Rhizoctonia pressure
 - Partially Resistant variety + fungicide
- Severe Rhizoctonia pressure
 - Partially Resistant variety + fungicide (2)

Crop Susceptibility to *Rhizoctonia*

- *R. solani* AG 2-2 IV vs. AG 2-2 IIIB
- Differ in host range?
- Differ in aggressiveness?
- Effect on rotation crops

Adult Plants: Aggressiveness of *R. solani* AG2-2

Crop (Disease scale)	Avg. disease ratings (min – max)		
	Control	AG 2-2 IV	AG 2-2 IIIB
Sugarbeet (0-7 scale)	0.3	5.0 a (3.3-5.6)	4.9 a (3.8-5.9)
Pinto bean (1-5 scale)			
Soybean (1-5 scale)			
Wheat (0-3 scale)			
Corn (1-5 scale)			

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Pinto bean (1-5 scale)	1.0	2.9 a (2.5-3.4)	3.1 b (2.3-3.8)
Soybean (1-5 scale)			
Wheat (0-3 scale)			
Corn (1-5 scale)			

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Soybean (1-5 scale)	1.0	3.5 a (3.0-4.3)	3.5 a (2.3-4.1)
Wheat (0-3 scale)			
Corn (1-5 scale)			

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Soybean (1-5 scale)	1.0	3.5 a (3.0-4.3)	3.5 a (2.3-4.1)
Wheat (0-3 scale)	0.0	0.1 a (0.0-0.7)	0.3 b (0.1-0.7)
Corn (1-5 scale)	-	-	-

Average Disease Rating

Sugarbeet

(0-7)

~5



Pinto bean

(1-5)

~3



Soybean

(1-5)

~3.5



Wheat

(0-3)

~0.2



Conclusions

- Planting back-to-back crops susceptible to *R. solani* AG 2-2 is ill-advised and should be avoided
- Use long crop rotations
- Consider two small grain crops between and/or before sugarbeet
- Plant Rhizoctonia resistant/tolerant soybean and bean crops, if available

Tillage and *Rhizoctonia*

- *Rhizoctonia* survives in residue of infected plants/debris
- Tillage that hastens decomposition residue
- 2011 Trial (U of M and NSDU)
 - No-till
 - Strip tillage
 - Conventional tillage
 - Moldboard Plow
 - Deep-ripping

More Rhizoctonia Control Options

- Plant early
- Avoid throwing soil in crowns during cultivation
- Control weeds
- Control soybean cyst nematode
- Control soil insects
- Use good field drainage practices

REAL LIFE ADVENTURES

CONGRATULATIONS. THAT WAS THE MOST OBSCURE, RAMBLING, BORING PRESENTATION I'VE EVER SEEN.

THANKS. I USE POWERPOINTLESS.

9-28

WISE/
ALDRICH

