

*Rhizoctonia:*  
From Planting to Storage

Carol E. Windels & Jason R. Brantner  
University of Minnesota  
Northwest Research & Outreach Center

# Today's Topics

- Potential new & registered products
  - Seed treatment
  - Band applications (RCRR)
  - Roundup Ready vs. conventional
- Decision factors in disease control
- Storage of diseased roots

# Seed treatment fungicides registered for sugarbeet

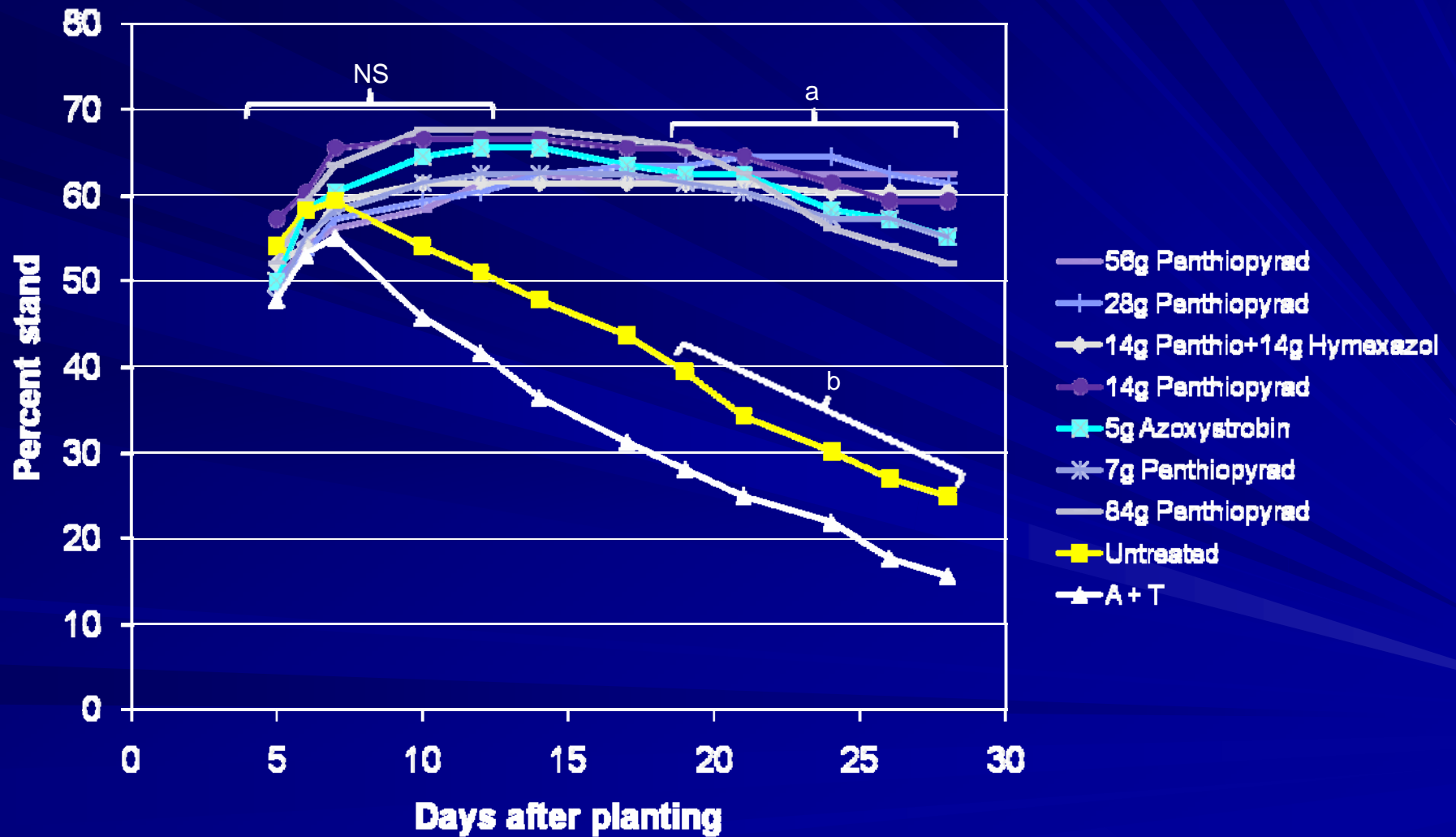
Active ingredient	Pathogens controlled		
	<i>Pythium</i>	<i>Rhizoctonia</i>	<i>Aphanomyces</i>
Metalaxyl (Apron, Allegiance)	+++	-	-
Thiram	+	+	-
Fludioxonil (Maxim)	-	++	-
Hymexazol (Tachigaren)	++	-	+++

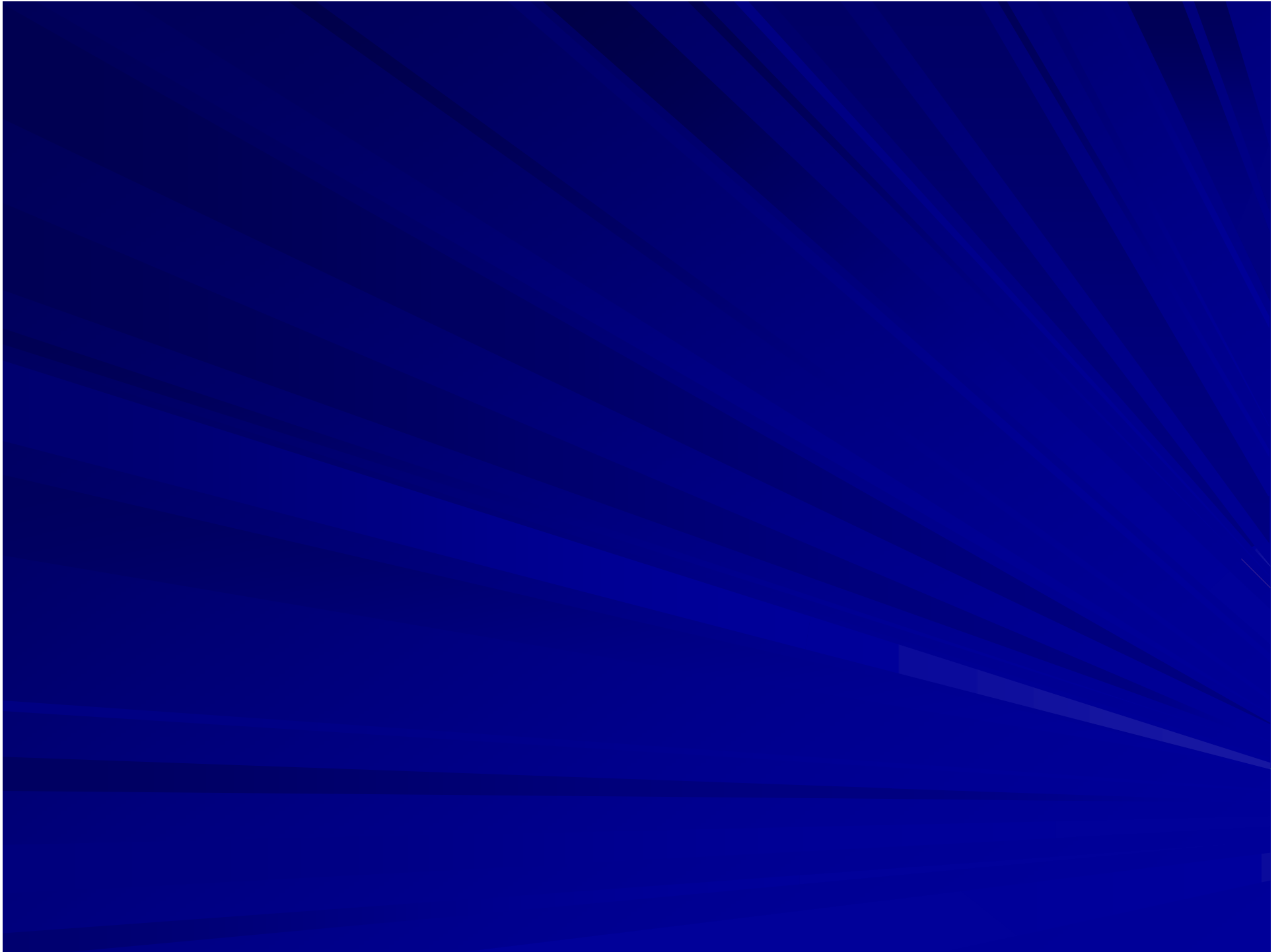
- = no control, + = fair, ++ = good, +++ = excellent

# Penthiopyrad seed treatment

- Controlled environment chamber
- Five rates of penthiopyrad (7, 14, 28, 56, & 84g)
- Penthiopyrad + hymexazol (14 + 14g)
- Three controls
  1. Untreated
  2. Apron + Thiram
  3. Apron + Thiram + azoxystrobin
- Planted into natural field soil inoculated with *R. solani* AG 2-2 IIIB, AG 2-2 IV and AG 4

## Percent stand in *R. solani*-infested soil







# RCRR starts at crown/near soil line



# Typical vs. Atypical root symptoms





# Background

- *R. solani* AG 2-2 from sugarbeet with RCRR
- Intraspecific Groups: IV and IIIB (964 cultures)
  - Identified by growth at 95 °F
  - AG 2-2 IIIB wider host range
- RRV (460 cultures)
  - 2-2 IV (66%), 2-2 IIIB (27%)
- Southern Minnesota (504 cultures)
  - 2-2 IV (23%), 2-2 IIIB (56%)

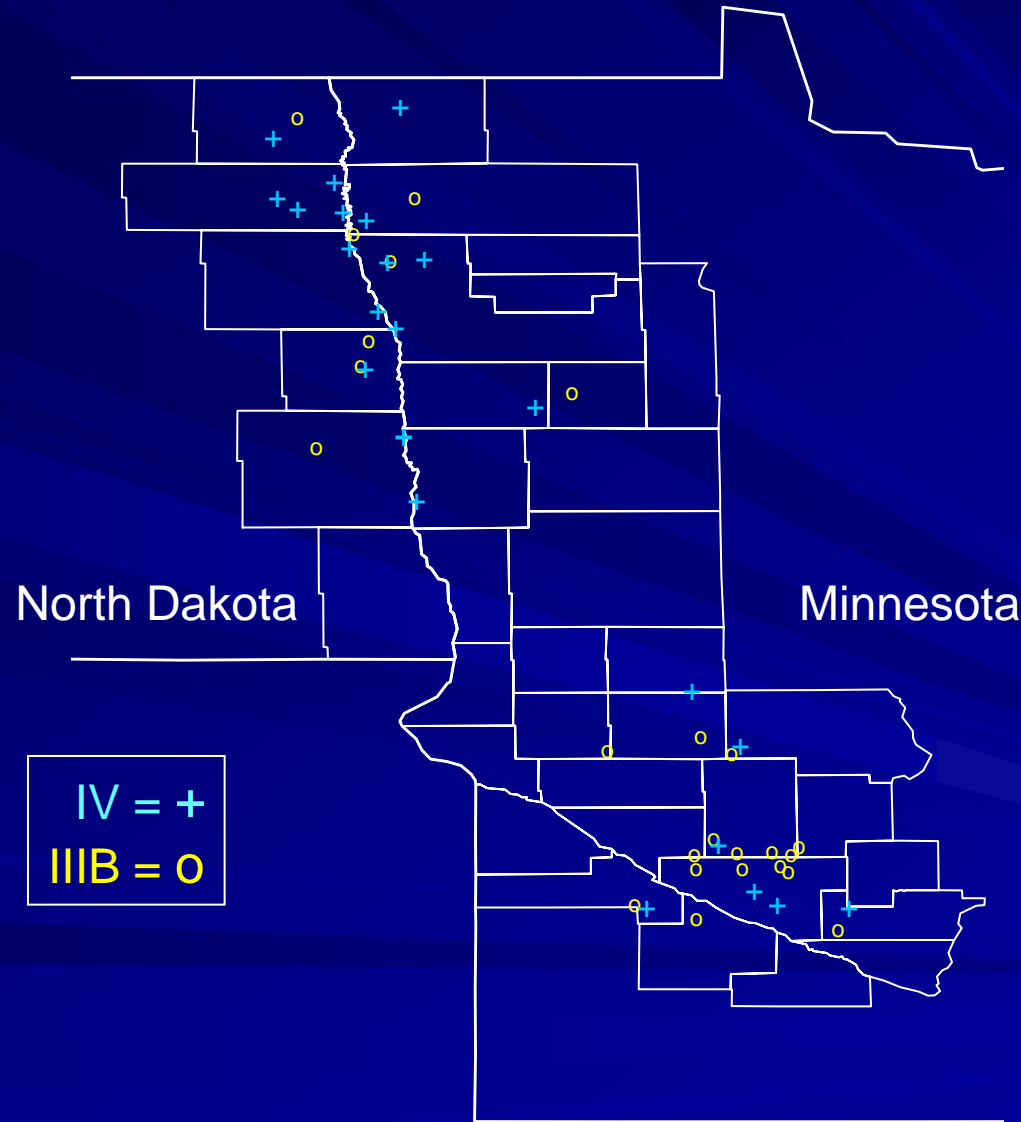
# Importance of ISGs on sugarbeet

- Pathogenicity of *R. solani* AG 2-2 ISGs on:
  - Seedlings
  - Adult roots

# Selection of cultures

- Total of 48 selected (24 each ISG)
- Criteria for selection of each ISG
  - Geographic origin: RRV and southern MN
  - Previous cropping history:  
corn, sweet corn, edible bean, potato, soybean, wheat
  - Sugarbeet variety: susceptible, partial resistance
  - Location of rot: crown, tap root

# Source of *R. solani* AG 2-2



# Pathogenicity Tests

## ■ Treatments

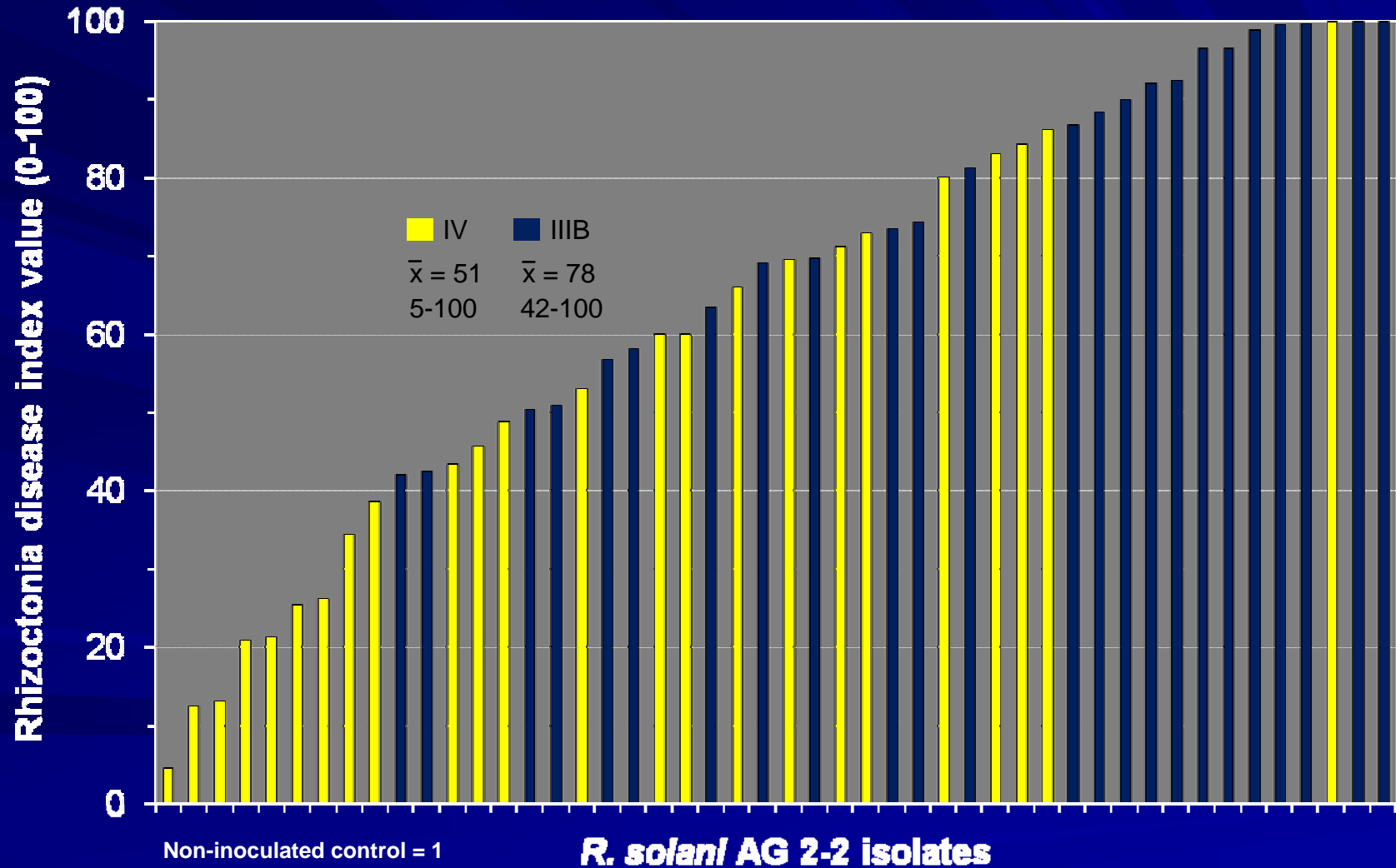
- 48 isolates
- Non-inoculated control

## ■ Seedling trials: sugarbeet

- Soil inoculated with *R. solani* before planting
- Evaluated stand loss & root rot 4 WAP



# Sugarbeet seedlings



# Pathogenicity Tests

- Adult sugarbeet roots
  - Roots inoculated 8 weeks after planting
  - Roots & crowns evaluated for RCRR 12 DAI



# Summary

- AG 2-2 IIB usually more pathogenic than AG 2-2 IV on sugarbeet seedlings
- Both ISGs are equally pathogenic in causing RCRR

# Band-applied fungicides: Compare potential products to Quadris

- Susceptible variety (rating = 4.3)
- Fungicides applied at 4-6 or 8-10 leaf stages  
(7-inch band)
- Inoculated with *Rhizoctonia*
- Cultivated after inoculation
- Stand data for 4-6 leaf stage treatments
- Yield and quality data on all treatments



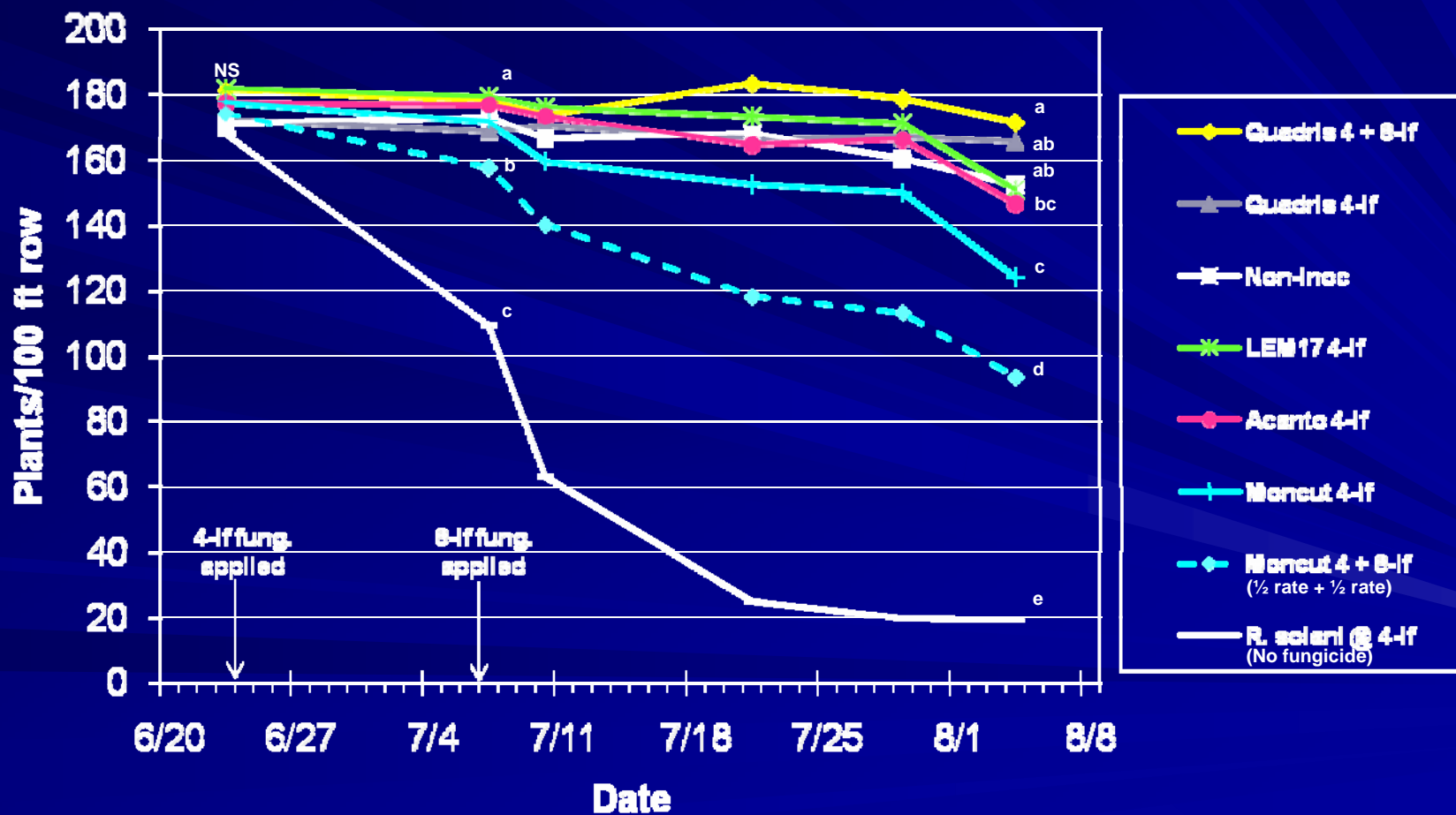
# 4-6 leaf stage treatments

4-6 leaf stage (June 24)	8-10 leaf stage (July 8)	First Cercospora (Aug 14)
Non-inoculated (no fungicide)	-	Eminent @ 13 oz/A
<i>R. solani</i> -inoculated:		
No fungicide	-	Eminent @ 13 oz/A
Quadris @ 14.25 oz/A	-	Eminent @ 13 oz/A
Quadris @ 14.25 oz/A	Quadris @ 14.25 oz/A	Eminent @ 13 oz/A
Quadris @ 14.25 oz/A	-	Proline @ 5.7 oz/A + Induce
Acanto @ 1.3 oz/A	-	Eminent @ 13 oz/A
LEM17 @ 1.6 oz/A	-	Eminent @ 13 oz/A
Moncut @ 1.1 lb/A	-	Eminent @ 13 oz/A
Moncut @ 0.55 lb/A	Moncut @ 0.55 lb/A	Eminent @ 13 oz/A

Fungicides applied in a 7-inch band

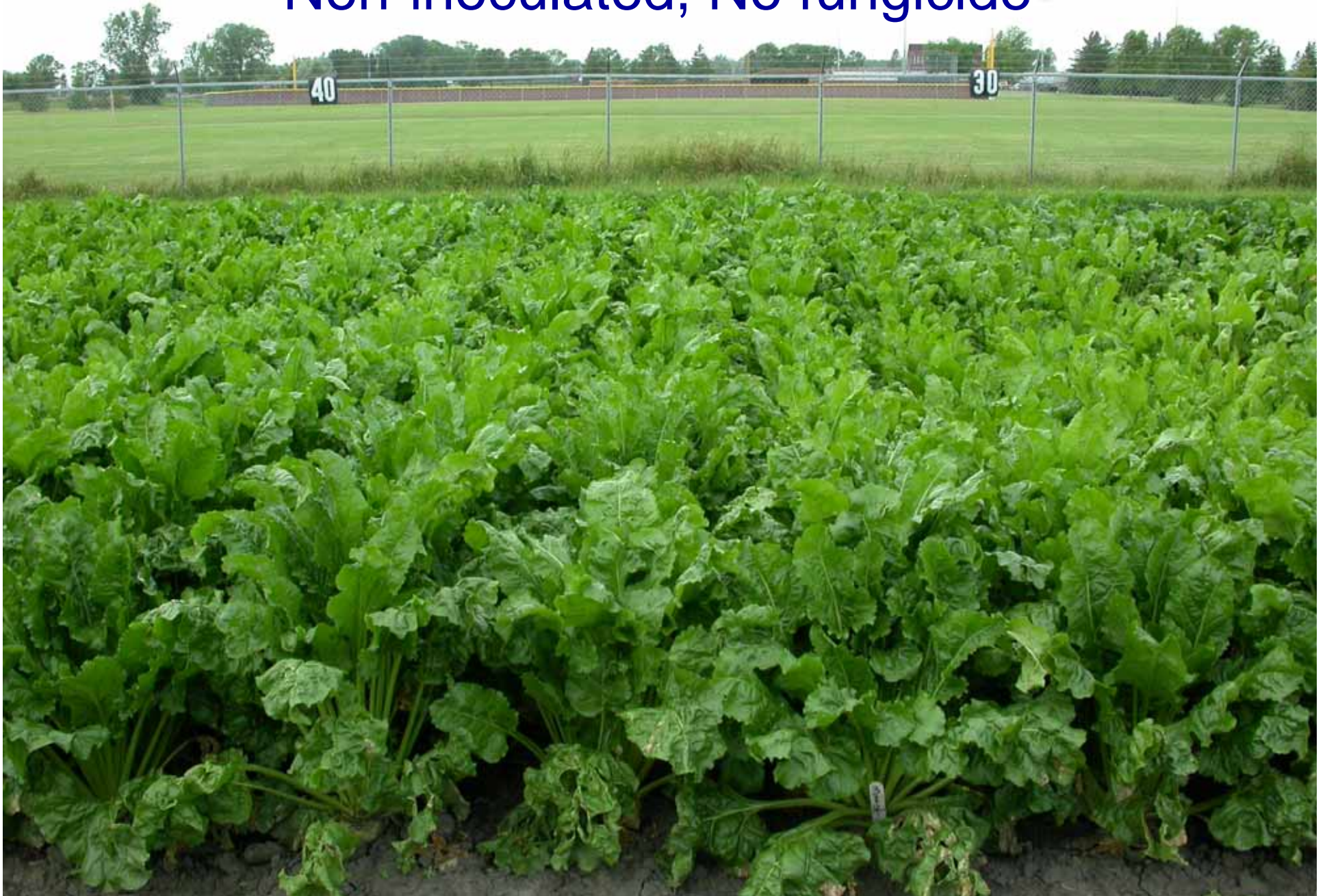
Quadris = azoxystrobin, Acanto = picoxystrobin, LEM 17 = penthiopyrad, Moncut = flutolanil

# Stand when fungicides applied @ 4-6 leaf stage





Non-inoculated, No fungicide





# Inoculated, No fungicide



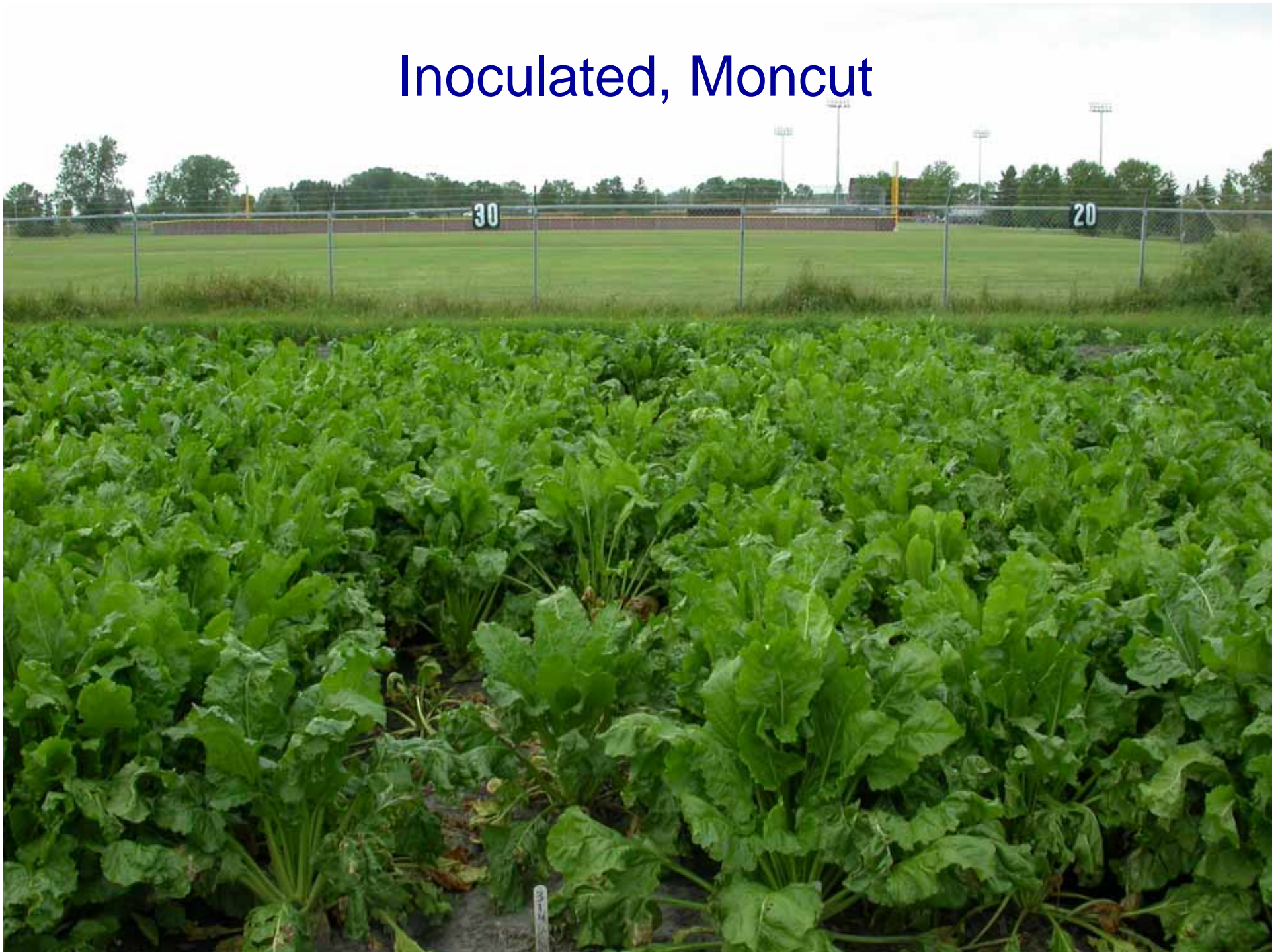


# Inoculated, Quadris





# Inoculated, Moncut



# Harvest results, 4-6 leaf

Treatment	Rating (0-7)	Yield (T/A)	Sucrose (lb recov/A)
Non-inoculated	1.6		
<i>R. solani</i> -inoculated:			
No fungicide	6.5		
Quadris	1.7		
Quadris 2x	1.6		
Quadris/Proline	1.7		
Acanto	4.2		
Lem17	4.1		
Moncut	5.7		
Moncut 2x (1/2 rate)	5.6		
LSD ( $P = 0.05$ )	0.8		

# Harvest results, 4-6 leaf

Treatment	Rating (0-7)	Yield (T/A)	Sucrose (lb recov/A)
Non-inoculated	1.6	32.4	8496
<i>R. solani</i> -inoculated:			
No fungicide	6.5	9.4	1922
Quadris	1.7	34.1	9508
Quadris 2x	1.6	34.7	9044
Quadris/Proline	1.7	33.9	8583
Acanto	4.2	23.2	5784
Lem17	4.1	26.7	6323
Moncut	5.7	18.6	4272
Moncut 2x (1/2 rate)	5.6	19.4	4595
LSD ( $P = 0.05$ )	0.8	6.0	1656

# 8-10 leaf stage treatments

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8-10 leaf stage (July 8)	First Cercospora (Aug 14)
Non-inoculated (no fungicide)	Eminent @ 13 oz/A
<i>R. solani</i> -inoculated:	
No fungicide	Eminent @ 13 oz/A
Quadris @ 14.25 oz/A	Eminent @ 13 oz/A
Moncut @ 1.1 lb/A	Eminent @ 13 oz/A
Carumba @ 14 oz/A	Eminent @ 13 oz/A

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Fungicides applied in a 7-inch band

Quadris = azoxystrobin, Moncut = flutolanil, Carumba = metconazole



# Harvest results, 8-10 leaf

Treatment	Rating (0-7)	Yield (T/A)	Sucrose (lb recov/A)
Non-inoculated	1.6		
<i>R. solani</i> -inoculated:			
No fungicide	5.8		
Quadris	2.4		
Moncut	4.3		
Carumba	5.0		
LSD ( $P = 0.05$ )	0.8		



# Harvest results, 8-10 leaf

Treatment	Rating (0-7)	Yield (T/A)	Sucrose (lb recov/A)
Non-inoculated	1.6	32.4	8496
<i>R. solani</i> -inoculated:			
No fungicide	5.8	20.7	4533
Quadris	2.4	34.8	9113
Moncut	4.3	28.1	6434
Carumba	5.0	23.9	5712
LSD ( $P = 0.05$ )	0.8	6.0	1656

# Fungicide x Herbicide

- Will registered fungicides control *Rhizoctonia* under conventional and Roundup Ready herbicide systems?
- RR vs. conventional variety (2.7 vs. 2.5)
  - RR var. + glyphosate
  - Conventional var. + microrates
- Fungicides (Quadris and Proline + Induce)
  - Applied @ 8-10 leaf stage (7-inch band)
- Inoculated with *Rhizoctonia* within 24 hr
- Cultivated immediately after inoculation
- Root rot ratings and yield data (% of non-inoculated)

# Harvest results

Treatment	<u>Rating (0-7)</u>		<u>Yield (% NI)</u>		<u>Recov. sucrose (% NI)</u>	
	Conv.	RR	Conv.	RR	Conv.	RR
Non-inoculated	2.3	2.2				
<i>R. solani</i> -inoculated:						
No fungicide	4.3	4.4				
Quadris	2.0	2.0				
Proline + Induce	2.6	2.4				
LSD ( $P = 0.05$ )	0.8	0.6				

# Harvest results

Treatment	<u>Rating (0-7)</u>		<u>Yield (% NI)</u>		<u>Recov. sucrose (% NI)</u>	
	Conv.	RR	Conv.	RR	Conv.	RR
Non-inoculated	2.3	2.2	100	100		
<i>R. solani</i> -inoculated:						
No fungicide	4.3	4.4	70	80		
Quadris	2.0	2.0	97	107		
Proline + Induce	2.6	2.4	96	104		
LSD ( $P = 0.05$ )	0.8	0.6	10	18		



# Harvest results

Treatment	<u>Rating (0-7)</u>		<u>Yield (% NI)</u>		<u>Recov. sucrose (% NI)</u>	
	Conv.	RR	Conv.	RR	Conv.	RR
Non-inoculated	2.3	2.2	100	100	100	100
<i>R. solani</i> -inoculated:						
No fungicide	4.3	4.4	70	80	65	75
Quadris	2.0	2.0	97	107	94	102
Proline + Induce	2.6	2.4	96	104	96	100
LSD ( $P = 0.05$ )	0.8	0.6	10	18	12	16

# Summary

- Penthiopyrad has potential as sugarbeet seed treatment
- Quadris provides excellent control of RCRR
  - Other nonregistered chemistries not as good
- Quadris & Proline provide excellent control of RCRR in both conventional and Roundup Ready systems

# Considering fungicides??

- History of *Rhizoctonia* (fields, locally)
  - Higher soil population, earlier disease begins
- Sugarbeet following susceptible crop
  - Esp., Soybean, edible beans
  - Back-to-back susceptible crops
- Weather conditions
  - Rhizoctonia infection related to soil conditions
  - Soil temp: range 55-95+ °F (ideal 70-85 °F)
  - Soil moisture: moist to wet (ideal wet)

# Soil temperature: An aid to timing fungicide applications?

- 2009: American Crystal pilot study

- Kathy Wang, Greg Richards, Al Cattanach

- A-C Ag Staff

- Soil temp. @ 4-inch from NDAWN stations

- <http://ndawn.ndsu.nodak.edu/>

- 2010: Available American Crystal website

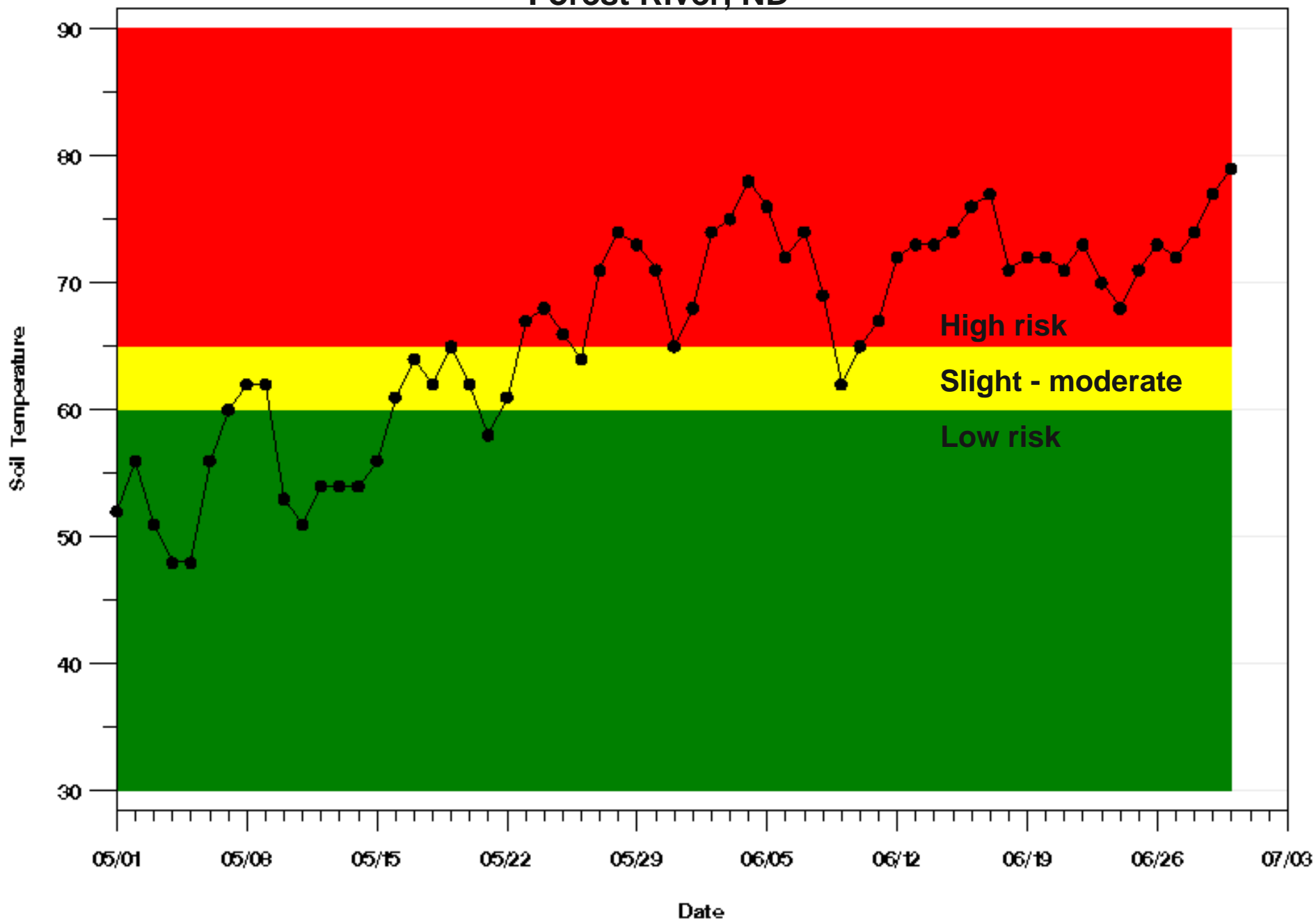
- <http://www.crystalsugar.com>



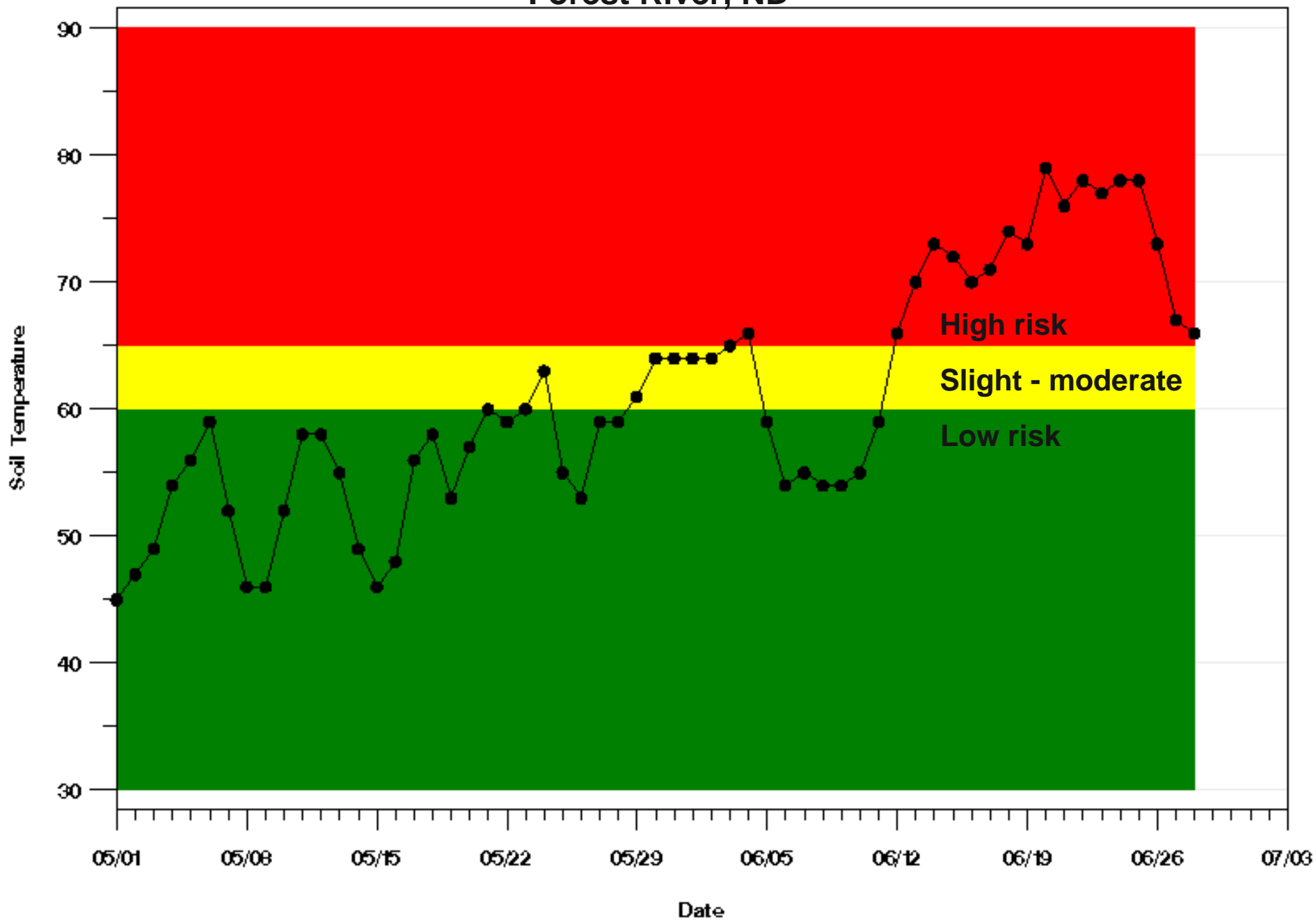
# Assumptions:

- Beet growth stage alone may not be best indicator of timing applications
- Rhizoctonia infection is related to soil temperature (moist to wet also necessary)
- Infection occurs as soil temps near 70 °F
  - Low risk (< 60 °F)
  - Slight – mod. risk (60-65 °F)
  - High risk ( $\geq 70$  °F)
- Fungicides are effective only when applied before infections occur

# 2006 Crop Daily Soil Temperature Forest River, ND



# 2009 Crop Daily Soil Temperature Forest River, ND



# Fungicides + Other Options

- Increase length of rotation
- Rotate non-host crops

cereals > corn/potatoes > soybean/edible bean





Sugarbeet 2007, Soybean 2008





Sugarbeet 2007, Soybean 2008



# Fungicides + Other Options

- Increase length of rotation
- Rotate non-host crops
  - Cereals>corn/potatoes>soybean/edible bean
- Select tolerant/PR variety (rating  $\leq 3.8$ )
  - Low risk RCRR: PR variety and no fungicide
  - High risk RCRR: PR variety + fungicide
- Plant early
- Avoid throwing soil in crowns, tillage?
- Improve soil drainage
- Control weeds

# What happens when roots with RCRR are stored in piles??

- Maximize root storability
- Cooperative research

Drs. Larry Campbell & Karen Fugate

USDA-ARS

Northern Crops Science Lab, Fargo, ND

# Disease categories for storage trial



1

2

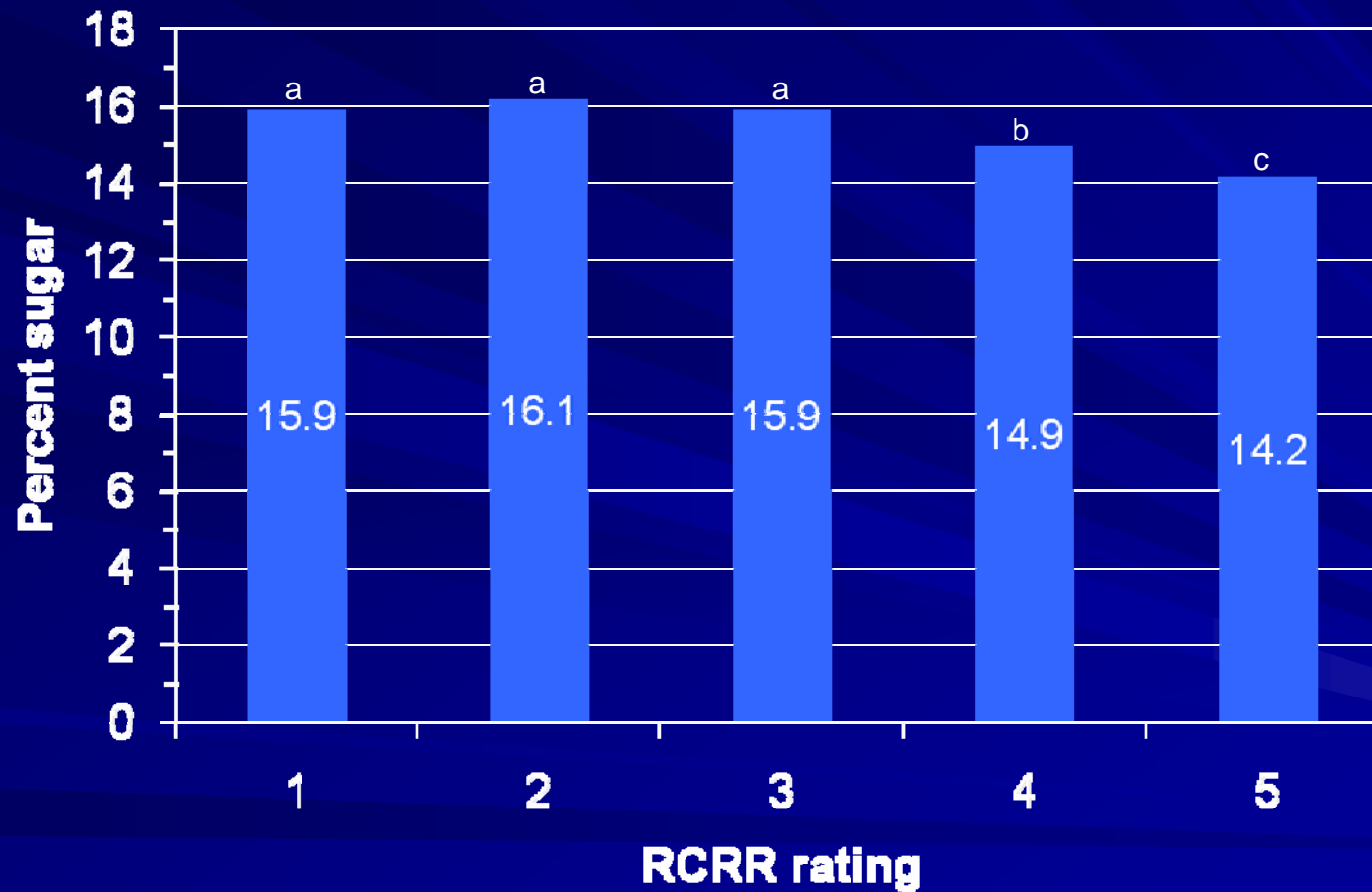
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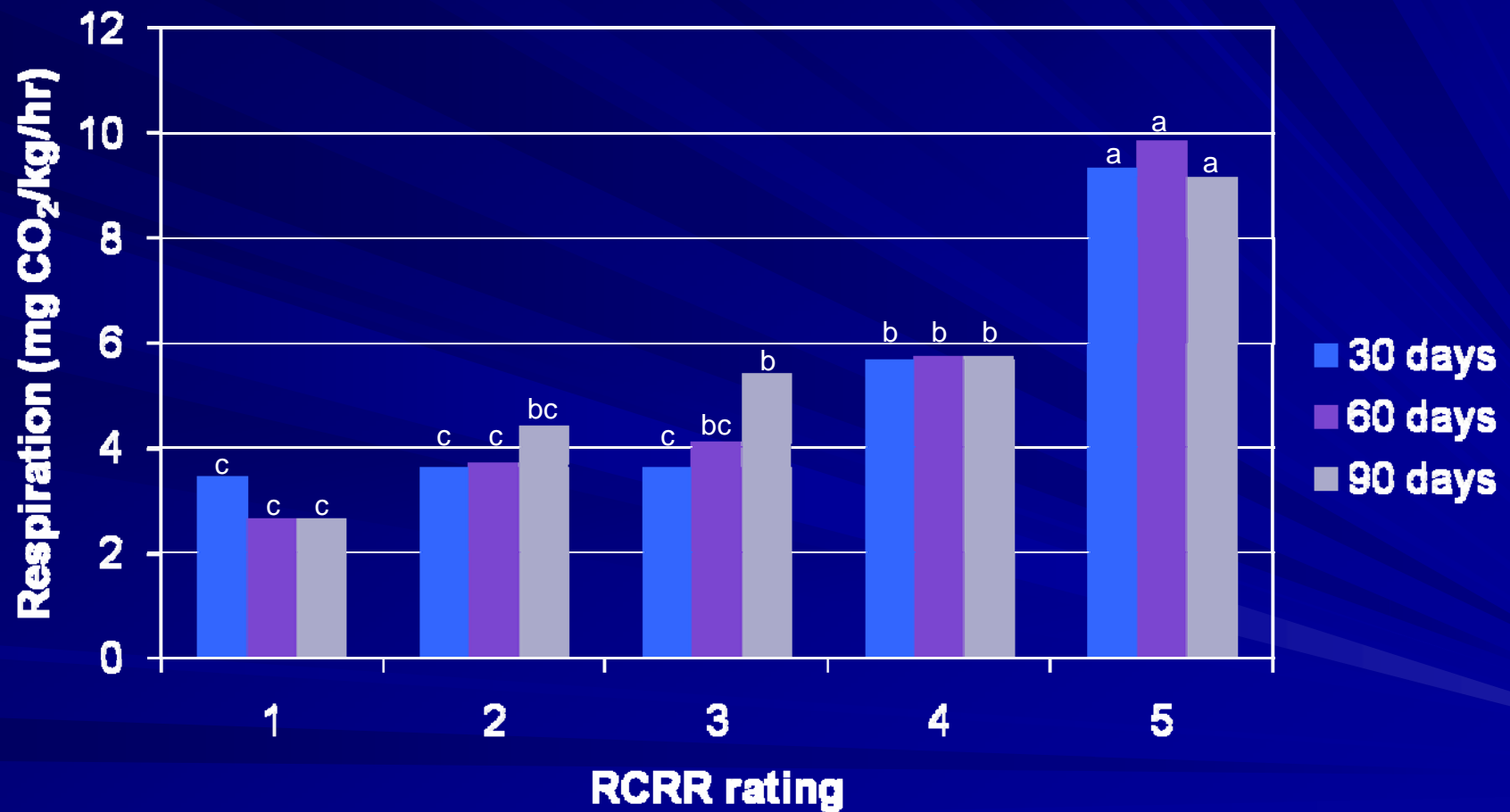
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# Effect of RCRR on sugar at harvest



# Effect of RCRR on respiration



# Acknowledgements

- Sugarbeet Research & Education Board of MN & ND
- American Crystal Sugar Co. staff
- Minn-Dak Farmers Coop. & So. MN Beet Sugar Coop.
- NDSU faculty & staff
- USDA-ARS personnel, Northern Crops Science Lab
- Mitsui, BASF, Bayer CropScience, DuPont, Gowan, Syngenta
- Betaseed, Crystal, Hilleshög
- University of Minnesota staff & students
  - Jeff Nielsen
  - Todd Cymbaluk
  - Mary Johnshoy
  - Chloe Danielson, Jackie Reitmeier, Katie Baird, Chelsie Solheim, Fiyori Gebrihiwot, Nathan Whalen, Jessie Erickson