

Rhizoctonia Forum:
***R. solani* AG 2-2 Intraspecific**
Groups (ISG) IV and IIIB

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

Thank You for Sharing Information!

Dr. Melvin Bolton, USDA-ARS, Fargo, ND

Dr. Gary Franc, University of Wyoming, Laramie

Dr. Linda Hanson, USDA-ARS, Univ. Michigan, East Lansing

Dr. Bob Harveson, University of Nebraska, Scottsbluff

Dr. Barry Jacobsen, Montana State University, Bozeman

Dr. Frank Martin, USDA-ARS, Salinas, CA

Dr. Lee Panella, USDA-ARS, Fort Collins, CO

Dr. Carl Strausbaugh, USDA-ARS, Kimberly, ID

The Fungus: *Rhizoctonia solani*

- *R. solani* is composed of genetically isolated strains
 - Anastomosis Groups (AGs)
 - Based on ability of hyphae to fuse when they are in contact



The Fungus: *Rhizoctonia solani*

- *R. solani* is composed of genetically isolated strains
 - Anastomosis Groups (AGs)
 - Based on ability of hyphae to fuse when they are in contact
- Primary cause of Rhizoctonia crown & root rot is AG 2-2
- Further divided into intraspecific groups (ISG)
 - AG 2-2 IV (sugar beet pathogen); does not grow @ 95 °F
 - AG 2-2 IIIB (blight of mat rush and rice); grows @ 95 °F
- Both ISG's (IV and IIIB) of *R. solani* AG 2-2 cause RCRR

Occurrence of *R. solani* Causing RCRR

Location	Presence (+), Absence (-), % Occurrence			
	AG 2-2 IV	AG 2-2 IIIB	“Intermediates”	AG-4
Idaho/Oregon	1%	47% (west)	?	44% (east)
Michigan/Ontario	40-45%	50-60%	5-10%	
Red River Valley	66%	27%	7%	
Southern Minnesota	23%	60%	17%	
Montana	+	+	+	
Colorado	+	+	+	
Nebraska	?	?	?	
Wyoming	?	?	?	

Crops in Rotation with Sugar Beet

Primary/Major Rotation crop*	State or Region									
	ID			CO	WY			RRV	So	
	(w)	(Cn)	(e)		(se)	NE	MT		MN	MI
Corn	X	X		X	X	X	X	X	X	X
Barley		X	X				X			
Wheat		X	X		X		X	X		X

* Typically, 3 to 4 year rotation with sugarbeet

Crops in Rotation with Sugar Beet

Primary/Major Rotation crop*	State or Region									
	ID			CO	WY			RRV	So	
	(w)	(Cn)	(e)		(se)	NE	MT		MN	MI
Corn	X	X		X	X	X	X	X	X	X
Barley		X	X				X			
Wheat		X	X		X		X	X		X
Dry beans		X		X	X	X	X	X		X
Soybeans								X	X	X
Alfalfa		X					X			
Cucumbers										X
Onions				X						
Potatoes		X	X							

* Typically, 3 to 4 year rotation with sugarbeet

Rhizoctonia solani AG 2-2 ISGs known to attack crops grown in MN & ND

Crop	<i>R. solani</i>	<i>R. solani</i>
	AG 2-2 IV	AG 2-2 IIIB
Sugar beet	++/+++	+++
Soybean	++/+++	+++
Dry beans	++/+++	+++

- = nonhost
+ = slightly aggressive

++ = moderately aggressive
+++ = severely aggressive

Rhizoctonia solani AG 2-2 ISGs known to attack crops grown in MN & ND

Crop	<i>R. solani</i>	<i>R. solani</i>
	AG 2-2 IV	AG 2-2 IIIB
Sugar beet	++/+++	+++
Soybean	++/+++	+++
Dry beans	++/+++	+++
Corn	-/+	+ / +++
Barley/Wheat	-	-

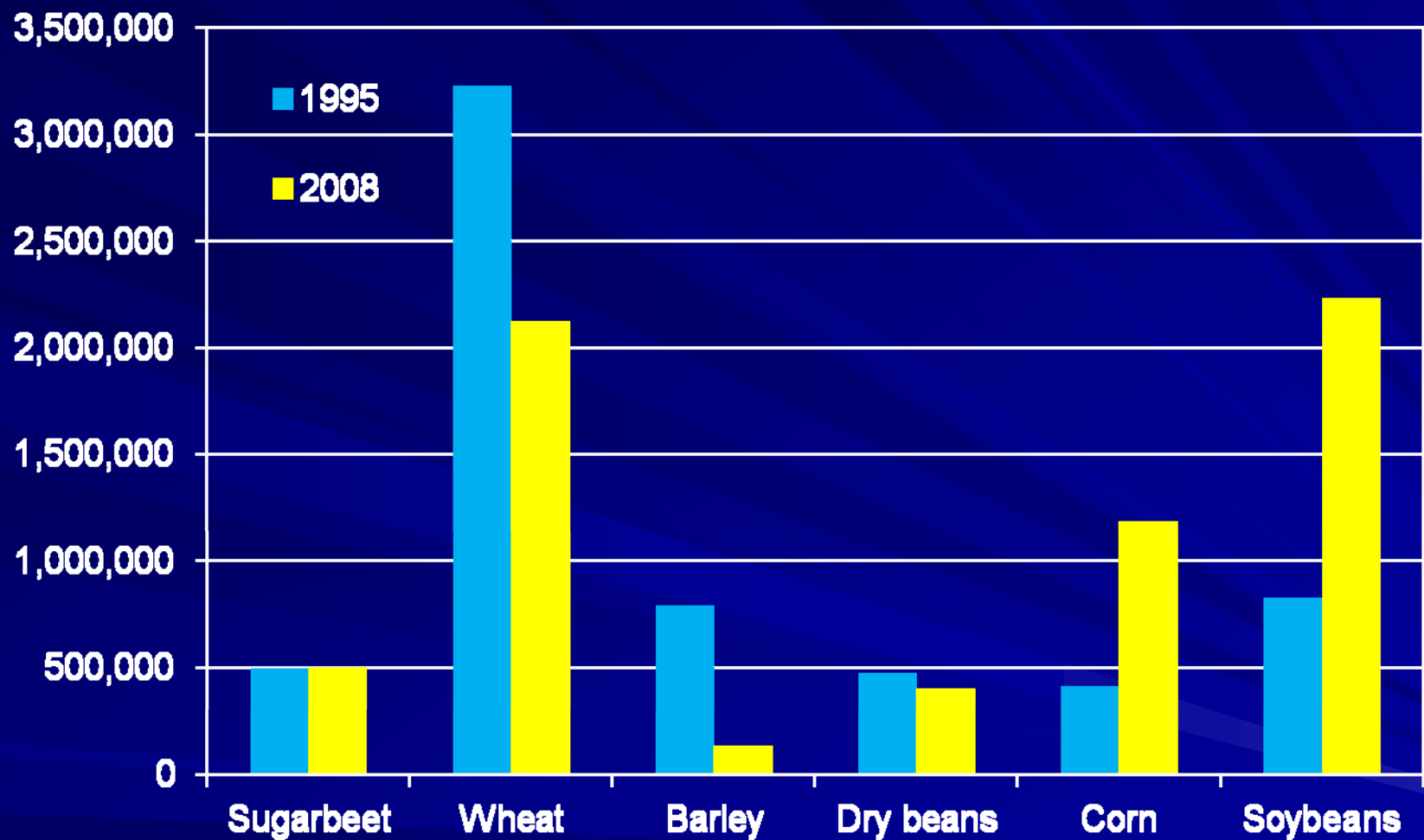
- = nonhost
+ = slightly aggressive

++ = moderately aggressive
+++ = severely aggressive

Have ISG'S Causing RCRR Changed?

- Suspected “shifts” in ISG’s in CO, MI
- Montana: Isolations in earlier years were *R. solani* AG 2-2 IV
- Idaho: *Rhizoctonia* followed by bacterial root rot
Leuconostoc
- Red River Valley of Minnesota and North Dakota
 - 1985-1990: *R. solani* AG 2-2 IV
Temperature, fatty acid, isozyme, restriction analysis rDNA
 - 2005-2009: *R. solani* AG 2-2 IV and AG 2-2 IIIB

Red River Valley Acres Sown: 1995 to 2008



FROM: USDA Agricultural Statistics Service

Methods for Identifying ISG's

- Temperature: Growth on PDA at 95 °F (35 °C)
- Advantages:
 - Easy to set up temperature tests
- Disadvantages:
 - Some isolates do not give a clear result & It is difficult to interpret amount of growth (“intermediates”)

Molecular characterization

- PCR with primers specific for 2-2 IV and 2-2 IIIB
 - Carling et al., 2002. *Phytopathology*
 - Salazar et al., 1999. *Mycologia*
- Advantages:
 - Distinguished author's culture collection
- Disadvantages:
 - Unreliable discrimination between ISGs for other culture collections
 - Amplification of several isolates with both the IV and IIIB primers
 - Small number of isolates do not amplify with either primer set (but amplify with AG 2-2 primers)

Molecular characterization

- Sequencing the ITS-5.8S rDNA region

Strausbaugh, Panella, Hanson, others

- Advantages:

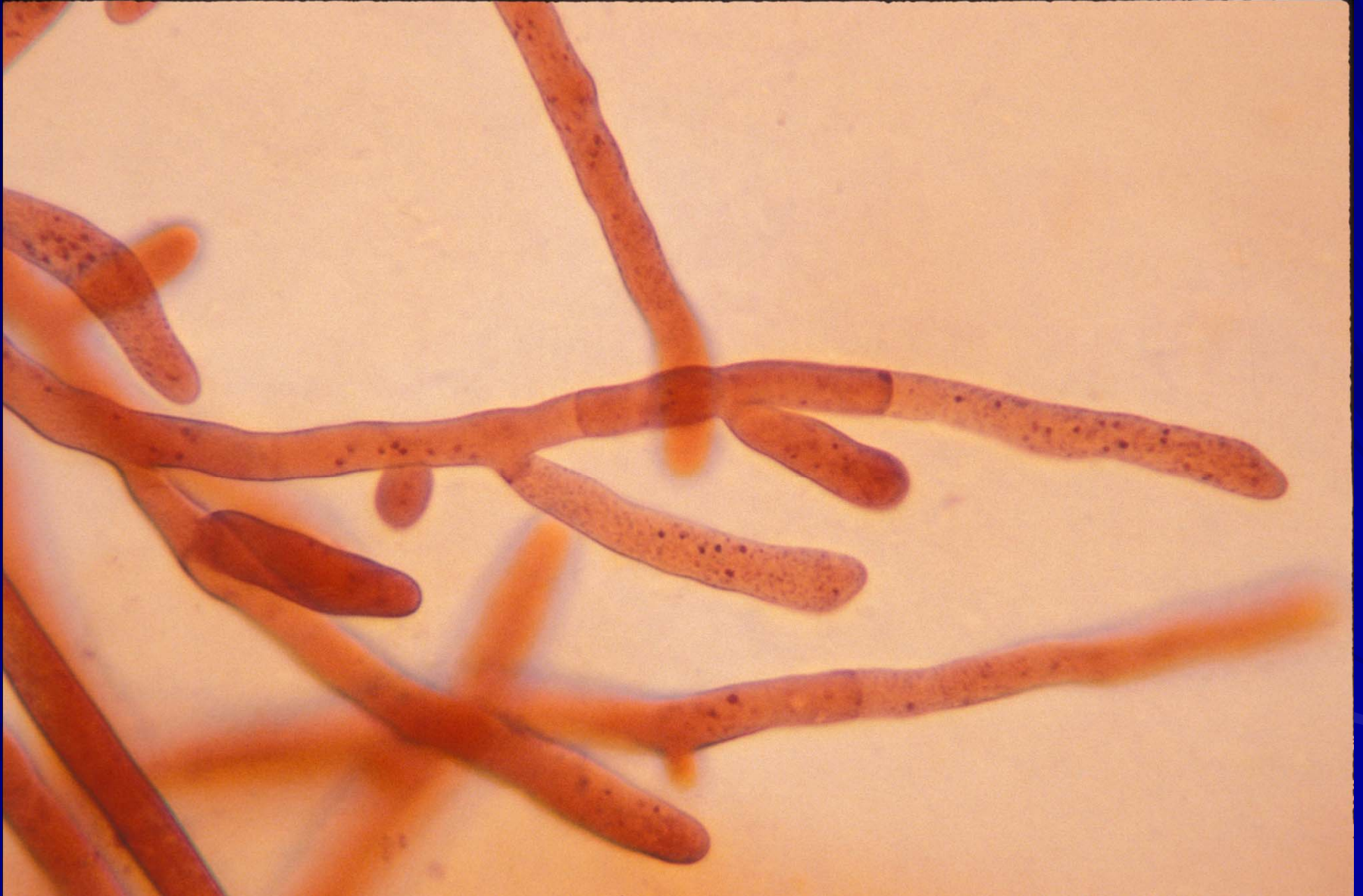
- Ease of comparison with isolates from other studies
- Provides an easily accessible historical database if placed in GenBank

- Disadvantages:

- Some isolates require cloning to get homogeneous sequence
 - ◆ 70% of AG 2-2 IIB isolates required cloning
 - ◆ Only 5% of AG-4 isolates required cloning

Molecular characterization

- Identify population structure *R. solani* AG 2-2 IV & AG 2-2 IIIB from sugarbeet with RCRR (MI, MN, ND)
 - Dr. Frank Martin, USDA-ARS, Salinas, CA
 - *Phytophthora* molecular diagnostics
- Development of molecular markers to analyze population structure of culture collection
 - Simple Sequence Repeats (SSR, microsatellite markers) 14 primer pairs (Ferrucho et al., 2009)
 - Inter Simple Sequence Repeats (ISSR)
- Determine relationship between population structure & aggressiveness on sugarbeet & crops



Questions for Thought & Discussion

- How similar/different are populations of AG 2-2 IV and AG 2-2 IIIB in different geographic regions?
- Does fusion occur between *R. solani* AG 2-2 IV and 2-2 IIIB in nature?
- Is a heterokaryon formed between AG 2-2 IV and AG 2-2 IIIB and what characteristics are displayed?
- Are there subpopulations within each ISG that differ in host preference, variation in pathogenicity?
- Do AG 2-2 IV and AG 2-2 IIIB respond similarly to fungicides?
- Do AG 2-2 IV and AG 2-2 IIIB respond similarly to plant resistance/tolerance to RCRR?



Temperature Growth Range for *R. solani* AG 2-2 IIIB and IV

