Update on wheat stem rust in Australia

North American Rust Workers Meeting

June 12th 2011

Robert Park and Haydar Karaoglu

THE UNIVERSITY OF SYDNEY

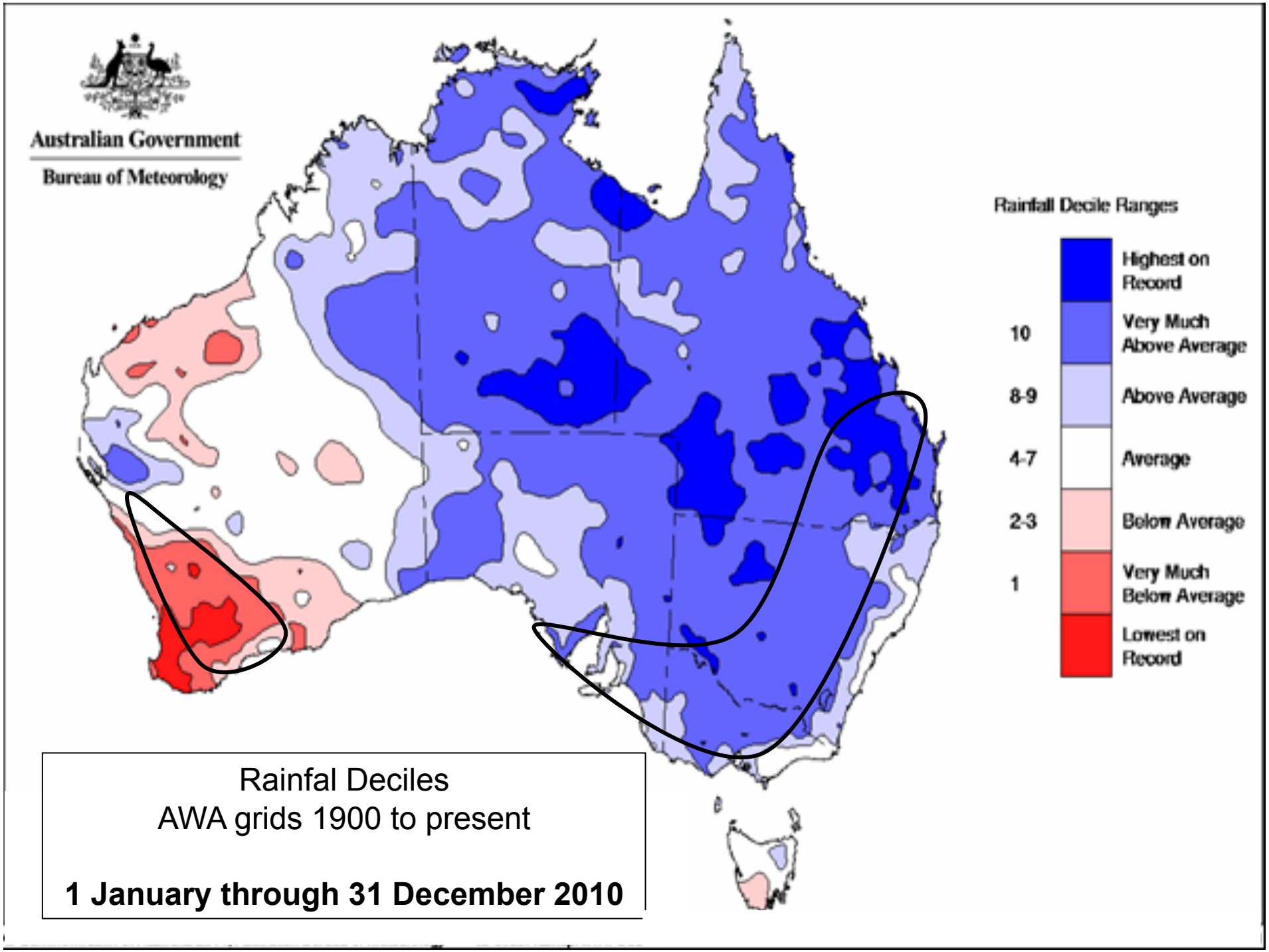
Australian Cereal Rust Control Program

GRDC Grains Research & Development Corporation

CSIRO

THE UNIVERSITY OF ADELAIDE AUSTRALIA

CIMMYT


Australian Government
Bureau of Meteorology
Rainfall Decile Ranges
10
8-9
4-7
2-3
1
Highest on Record
Very Much Above Average
Above Average
Average
Below Average
Very Much Below Average
Lowest on Record
Rainfal Deciles
AWA grids 1900 to present
1 January through 31 December 2010

Cereal rusts, 2010

Western Australia – rust incidence low (drought)

eastern Australia:

- wheat stripe rust widespread
- all other rusts increased in frequency:
  - wheat stem rust widespread in southern regions (Vic, SA)
  - leaf rust widespread
  - barley leaf rust common again, esp. in north (*Rph3* virulence)
  - crown rust of oats common, pathotypic diversity high

Pathogenicity surveys, 2005 - 2010

-number of samples received and processed

	Year					
Pathogen	2005	2006	2007	2008	2009	2010
WSR	51	125	21	18	11	60
WLR	122	40	13	23	19	100
WYR	393	167	350	830	552	650
BLR	27	31	13	65	62	123
BSR	10	10	4	5	18	5
OCR	46	34	24	49	17	165
OSR	41	17	13	42	20	?
Total	**690**	**424**	**438**	**1,032**	**705**	**1,103+**

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Stem rust pathogenicity surveys
-Australian differentials

"International":	
Reliance	*Sr5*
Marquis	*Sr7b*
Acme	*Sr9g,X*
Emmer	*Sr9e*
Einkorn	*Sr21*
Line S	*Sr13,17*

Australian:	
1. McMurachy	*Sr6*
2. Yalta	*Sr11*
3. W2402	*Sr7b,9b*
4. TD	*Sr36*
5. Renown	*Sr7b,17*
6. Mentana	*Sr8a*
7. Norka	*Sr15*
8. Festiguay	*Sr30*
9. TAF 2	*SrAgi*
10. ED Montijo	*SrEm*
11. Barletta	*Sr8b*
12. Coorong	*Sr27*
13. Satu	*SrSatu*

Additional:	
Kite	*Sr26*
Agent	*Sr24*
Norin 40	*SrN40*
Mildress	*Sr31*
W3534	*Sr22*
W3531	*Sr32*
M80.3990	*Sr35*
Trident	*Sr38*
Gatcher	*Sr2,5,6,8a,12*
Combination X	*Sr5,7b,9b*
Cook	*Sr5,6,8a,36*
Banks	*Sr5,8a,9b,12,30*
Mendos	*Sr11,17,36*

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Standard race 34

Australian:	
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2. Yalta	*Sr11*
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4. TD	*Sr36*
5. Renown	*Sr7b,17*
6. Mentana	*Sr8a*
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Standard race 34 -2,12,13

Pathotype 34-2,12,13

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-Australian differentials

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Cook	*Sr5,6,8a,36*
Banks	*Sr5,8a,9b,12,30*
Mendos	*Sr11,17,36*

Virulence not detected on: *Sr13, Sr22, Sr24, Sr26, Sr31, Sr32*

Stem rust pathogenicity surveys, 2005 - 2010
-12 pathotypes identified, virulence

Pathotype	Virulence*
21-0	*Sr7b, Sr9g*
34-2,7	*Sr5, Sr7b, Sr9g, Sr11, Sr15*
34-1,2,7	*Sr5, Sr6, Sr7b, Sr9g, Sr11, Sr15*
34-1,2,7 +Sr38	*Sr5, Sr6, Sr7b, Sr9g, Sr11, Sr15, Sr38*
11-1,2,7 +Sr38	*Sr5, Sr6, Sr7b, Sr9g, Sr11, Sr15, Sr21, Sr38*
34-1,2,7 +Sr38 +Norin 40	*Sr5, Sr6, Sr7b, Sr9g, Sr11, Sr15, Sr38, Sr42*
34-2,12,13	*Sr5, Sr7b, Sr9g, Sr11, Sr27, SrSatu*
11-2,12,13	*Sr5, Sr7b, Sr9g, Sr11, Sr21, Sr27, SrSatu*
98-1,2,3,5,6	*Sr5, Sr9g, Sr6, Sr11, Sr9b, Sr17, Sr8a*
98-1,2,3,5,6,7	*Sr5, Sr9g, Sr6, Sr11, Sr9b, Sr17, Sr8a, Sr15*
222-1,2,3,5,6,7	*Sr5, Sr7b, Sr9g, Sr6, Sr11, Sr9b, Sr15, Sr17, Sr8a*
343-1,2,3,5,6	*Sr5, Sr6, Sr11, Sr9b, Sr17, Sr8a*
TOTAL	

* tested on *Sr5, Sr6, Sr7b, Sr8a, Sr8b, Sr9b, S9e, Sr9g, Sr11, Sr13, Sr15, Sr17, Sr21, Sr22, Sr24, Sr26, Sr27, Sr30, Sr31, Sr32, Sr35, Sr36, Sr38, Sr42, SrEM, SrAgi*

Stem rust pathogenicity surveys, 2005 - 2010

-12 pathotypes identified, number of isolates

Pathotype	Number of isolates						
	2005	2006	2007	2008	2009	2010	**TOTAL**
21-0	-	1	-	-	-	-	**1**
34-2,7	1	1	-	-	1	-	**3**
34-1,2,7	-	2	-	-	-	-	**2**
34-1,2,7 +Sr38	26	103	7	33	6	51	**226**
11-1,2,7 +Sr38	-	3	-	-	-	-	**3**
34-1,2,7 +Sr38 +Norin 40	-	5	4	-	-	-	**9**
34-2,12,13	-	1	-	4	3	4	**12**
11-2,12,13	-	-	-	-	-	1	**1**
98-1,2,3,5,6	1	5	1	2	-	-	**9**
98-1,2,3,5,6,7	10	9	-	12	-	-	**31**
222-1,2,3,5,6,7	-	-	-	3	-	-	**3**
343-1,2,3,5,6	2	4	-	21	-	-	**27**
TOTAL	**39**	**134**	**12**	**75**	**10**	**56**	**326**

Pathogenicity surveys, 2010 – wheat stem rust

- Common in commercial wheat crops in south eastern Australia
- Found on Yitpi volunteers in the Mallee in late February 2010
- 60 samples received, 56 IDs, three pts identified:

  - 34-2,12,13 (northern NSW, 4 isolates)
  - 11-2,12,13 (northern NSW 1 isolate)
  - 34-1,2,7 +Sr38 (51 isolates)

Wheat stem rust samples received
- autumn thru winter 2000 to 2010

Year	Month					Total
	April	May	June	July	August	
2000	0	1	0	0	2	**3**
2001	0	0	0	0	0	**0**
2002	0	0	0	0	0	**0**
2003	1	0	0	0	0	**1**
2004	1	0	0	0	0	**1**
2005	1	0	0	0	0	**1**
2006	20	2	0	0	0	**22**
2007	0	0	0	0	0	**0**
2008	0	0	0	0	0	**0**
2009	0	0	0	0	1	**1**
2010	3	2	3	0	2	**11**

Wheat stem rust samples received
- autumn thru winter 2000 to 2010

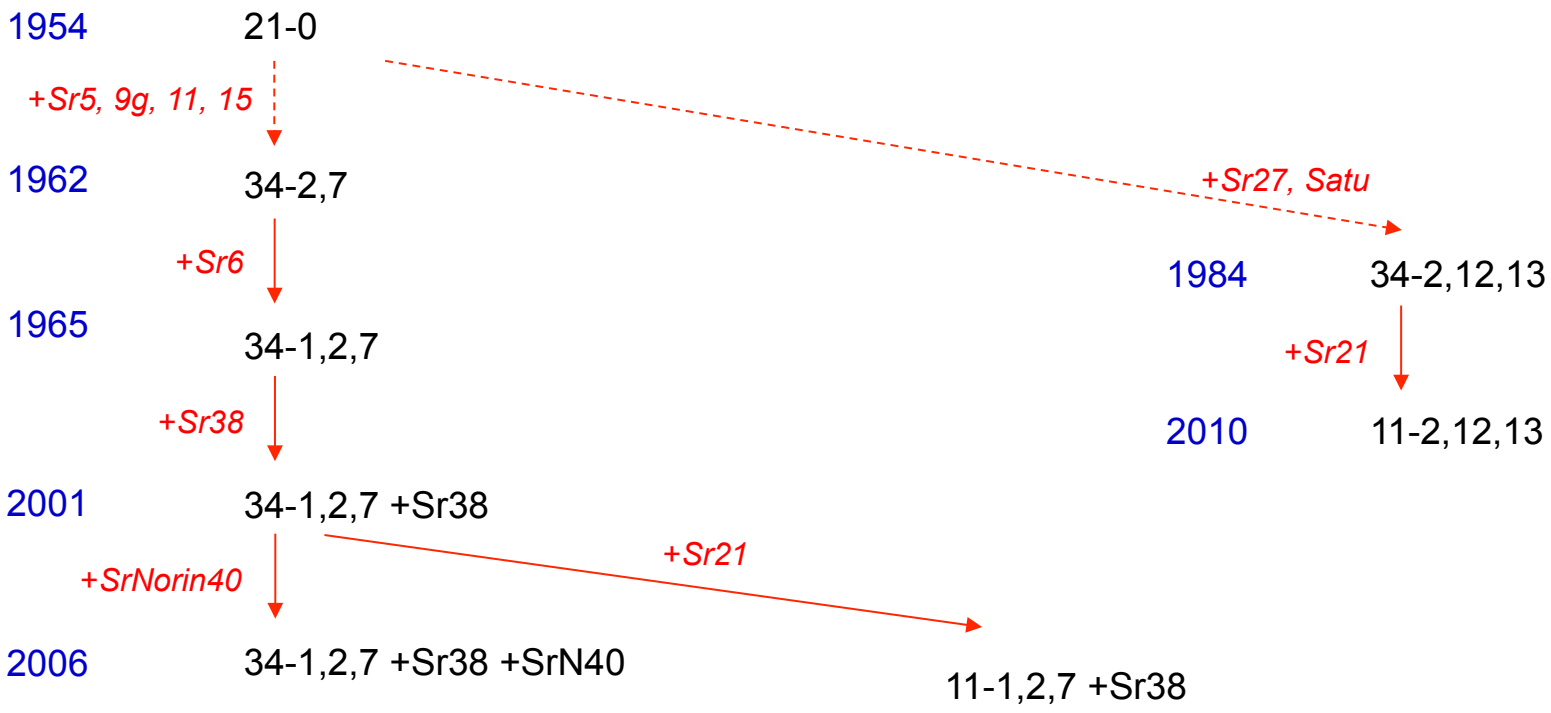
Stem rust pathogenicity surveys, 2005 - 2010
-pathotypes identified

Pathotype	Year						TOTAL
	2005	2006	2007	2008	2009	2010	
21-0	-	1	-	-	-	-	**1**
34-2,7	1	1	-	-	1	-	**3**
34-1,2,7	-	2	-	-	-	-	**2**
34-1,2,7 +Sr38	26	103	7	33	6	51	**226**
11-1,2,7 +Sr38	-	3	-	-	-	-	**3**
34-1,2,7 +Sr38 +Norin 40	-	5	4	-	-	-	**9**
34-2,12,13	-	1	-	4	3	4	**12**
11-2,12,13	-	-	-	-	-	1	**1**
98-1,2,3,5,6	1	5	1	2	-	-	**9**
98-1,2,3,5,6,7	10	9	-	12	-	-	**31**
222-1,2,3,5,6,7	-	-	-	3	-	-	**3**
343-1,2,3,5,6	2	4	-	21	-	-	**27**
TOTAL	**39**	**134**	**12**	**75**	**10**	**56**	**326**

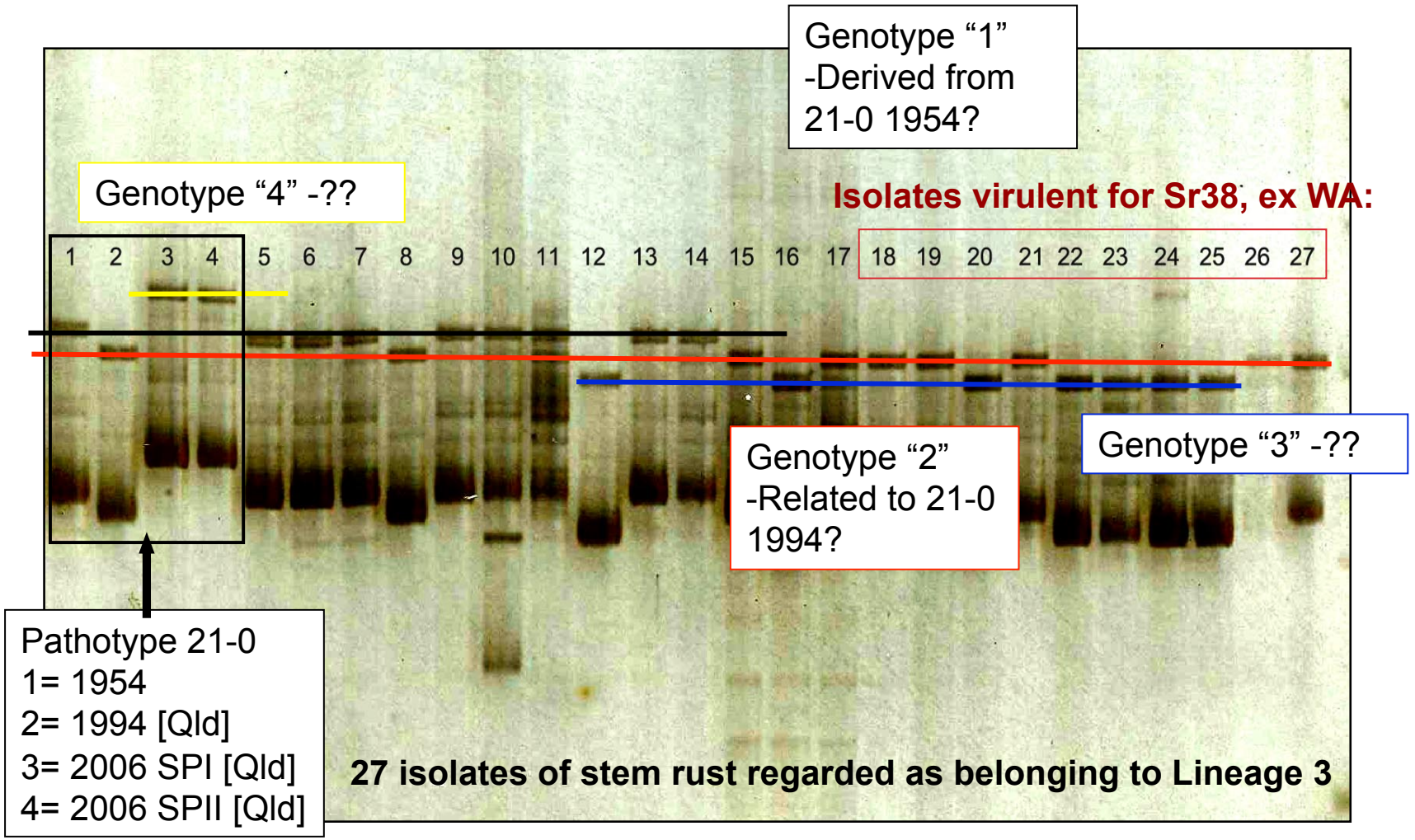
Single-step mutation in Lineage 3 (race 21)

- pathotypes detected from 2005-2010

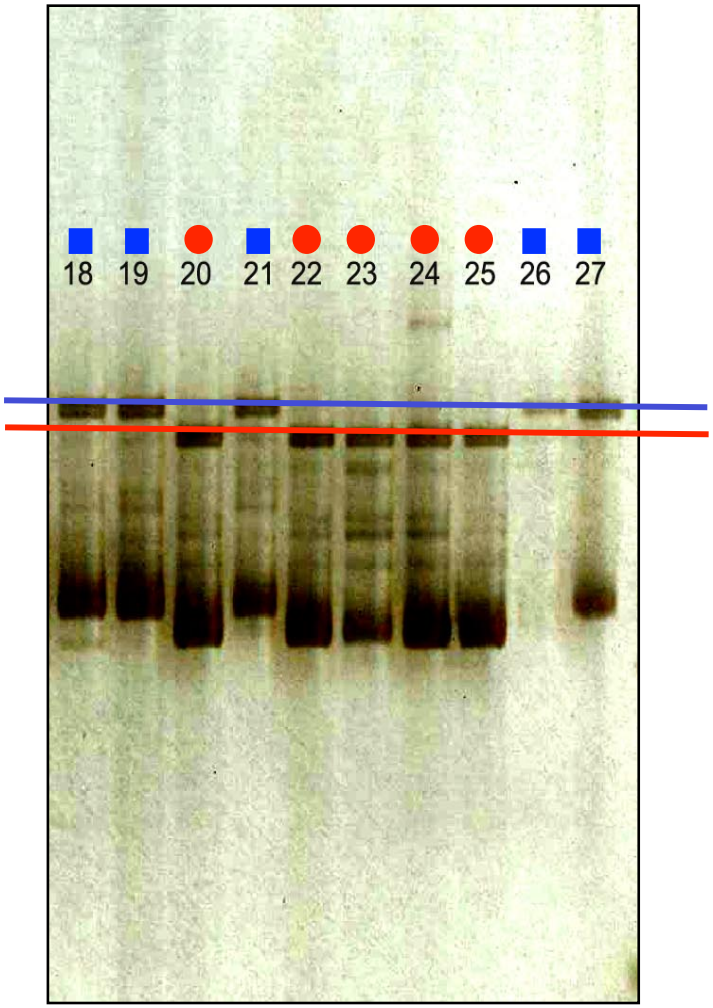
Year 1st detected



SSR variability in *P. graminis* f. sp. *tritici* –lineage 3



SSR variability in *P. graminis* f. sp. *tritici* –lineage 3
-isolates virulent for Sr38



Group 1:

- **18.** 34-1,2,7 +Sr38 [2001]
- **19.** 34-1,2,7 +Sr38 [2006]
- **21.** 34-1,2,7,10 +Sr38 [2003]
- **26.** 34-1,2,7 +Sr38 +Yalta low [2006]
- **27.** 34-1,2,7 +Sr38 +Yalta low [2006]

Group 2:

- **20.** 34-1,2,7 +Sr38 [2006]
- **22.** 34-1,2,7 +Sr38 +Norin 40 [2006]
- **23.** 34-1,2,7 +Sr38 +Norin 40 [2006]
- **24.** 11-1,2,7 +Sr38 [2006]
- **25.** 11-1,2,7 +Sr38 [2006]

2010 – wheat stem rust on cvs. Kite and Blade?

South Australia
October 2010
[courtesy Dr I. Dundas]

[courtesy Dr H. Wallwork]

2010 – wheat stem rust on cvs. Kite and Blade?

Rohit Mago's "Sr26-#43" primer set – Ian Dundas

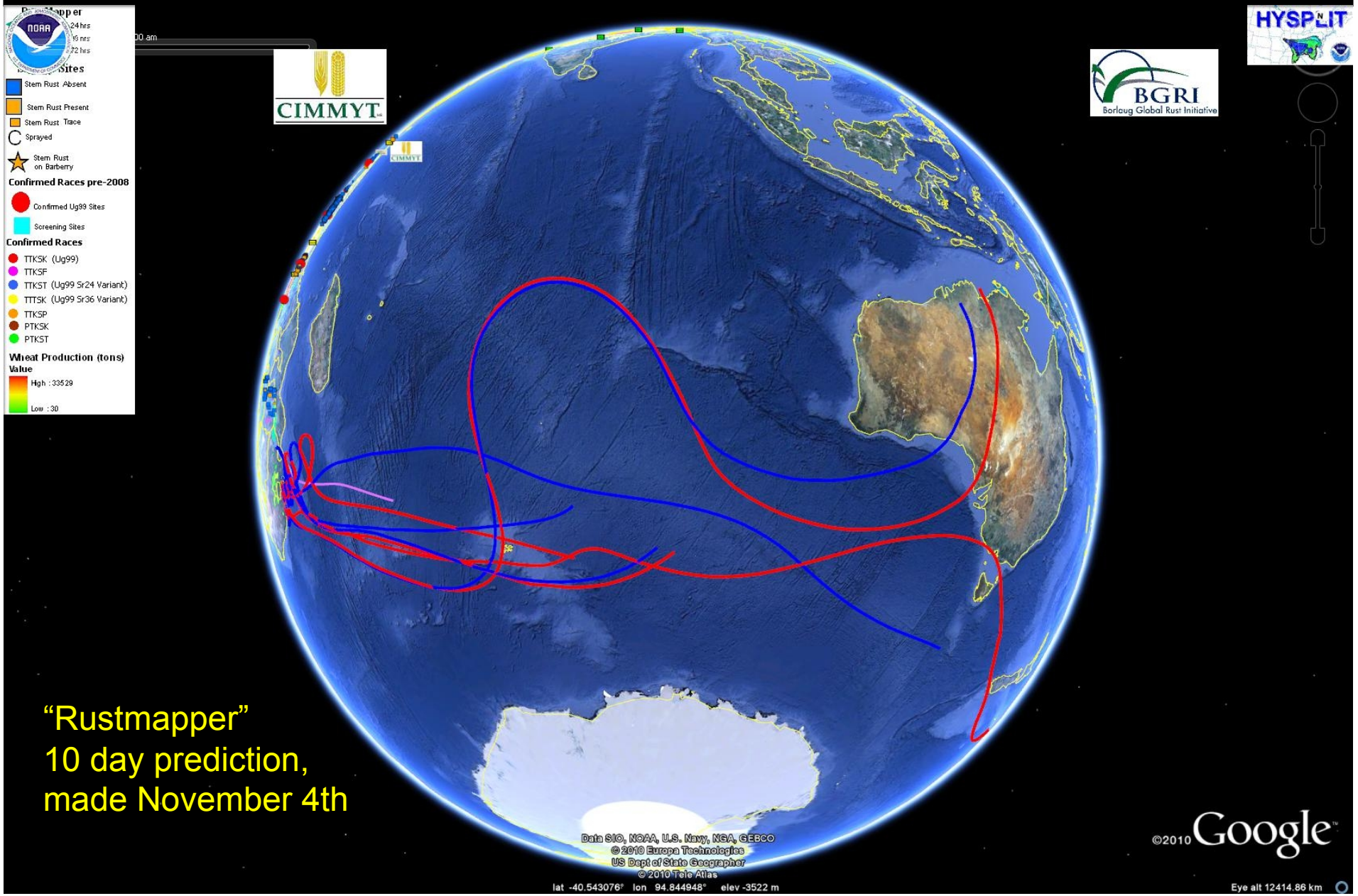
2011 – wheat stem rust in the green bridge

Victoria, April 7th 2011

	Rust Response				Rust Resistance Genotype		
Cultivar	Leaf Rust	Stem Rust	Stripe Rust WA pt	Stripe Rust Yr17-27 pt	Leaf Rust	Stem Rust	Stripe Rust
Axe	MR	MS	R-MR	R-MR		*Sr8b*	
Bolac	MR-MS	MR	R-MR	R-MR		*Sr30*	*Yr4*
Carinya	R	R-MR	R	MR-MS	*Lr24, Lr34, Lr37*	*Sr24, Sr38*	*Yr17, Yr18*
Catalina	R	R-MR	MS	MS	*Lr24, Lr34*	*Sr24*	*Yr18*
Chara	MR-MS	MR-MS	MS-S	MS-S	*Lr13, Lr34*	*Sr30*	*Yr18*
Correll	MS-S	MR	MR-MS	MR-MS		*Sr30*	
Crusader	R	R-MR	R	MR-MS	*Lr1, Lr13, Lr34, Lr37*	*Sr2, Sr30, Sr38*	*Yr17, Yr18, Yr30*
Derrimut	R	MR	R	MS-S	*Lr13, Lr37*	*Sr2, Sr30, Sr38*	*Yr17*
EGA Gregory	R-MR	MR	MR	MR	*Lr13, Lr23, Lr34*	*Sr30*	*Yr33, Yr18*
EGA Wedgetail	MS	MR-MS	MR-MS	MR-MS	*Lr34*	*Sr30*	*Yr18*
Espada	R	R-MR	R	MR-MS	*Lr24, Lr37*	*Sr24, Sr38*	*Yr17*
GBA Ruby	MR-MS	MS	R-MR	MS-S		*Sr30*	*Yr27*
Gladius	MS	MR	R	MR-MS	*Lr37*	*Sr38*	*Yr17*
Kellalac	MS	MS	MR-MS	MR-MS		*Sr30*	
Lincoln	R	MR	R-MR	R-MR		*Sr30*	*Yr4*
Livingston	R	MR-MS	R	-	*Lr1, Lr13, Lr37*	*Sr2, Sr38*	*Yr17, Yr27, Yr30*
Mace	R	MR	R	S-VS	*Lr13, Lr23, Lr37*	*Sr2, Sr38*	*Yr17, Yr30*
Peake	R	MR	MR-MS	MR-MS	*Lr13, Lr37, Lr34*	*Sr2, Sr30, Sr38*	*Yr17, Yr18, Yr30*
Sentinel	R	R-MR	R-MR	R-MR	*Lr26*	*Sr2, Sr31*	
Ventura	R	R-MR	R	MS	*Lr13, Lr37*	*Sr2, S38*	*Yr17*
Waagan	MR-MS	MS	R-MR	S			*Yr27*
Wyalkatchem	R	S	S	S	*Lr13, Lr23*	*Sr2, Sr8a, Sr15*	*Yr29*, Yr30*
Yitpi	MS	S	MS	MS	*Lr34*	*Sr30*	*Yr18*
Young	R	MS	R-MR	MS	*Lr37*	*Sr30, Sr36*, Sr38*	*Yr17*

Intercontinental tracking of rust pathogens

-modelling wind trajectories, Dr Dave Hodson FAO [UN]



"Rustmapper"
10 day prediction,
made November 4th

Adult plant rust resistant responses

Category	Description
R	highly resistant: occasional symptoms of infection including necrotic flecks; no sporulation
R-MR	resistant: symptoms evident and usually with necrosis and chlorosis, limited sporulation, and affected leaf area up to 15%
MR	moderately resistant: evidence of sporulating areas on the leaf surface with some chlorosis and necrosis, and affected leaf area up to 30%
MR-MS	intermediate: restricted sporulating areas with some chlorosis, and affected leaf area up to 50%
MS	moderately susceptible: freely sporulating lesions and affected leaf area up to 70%
MS-S	moderately susceptible to susceptible: freely sporulating lesions with leaf area affected up to 90%
S	susceptible: abundant sporulation across the whole leaf surface; leaf area affected up to 100%; some chlorosis and necrosis evident
S-VS	Susceptible to very susceptible: abundant sporulation across the leaf surface ; leaf area affected up to 100%; limited chlorosis
VS	highly susceptible: abundant sporulation across the whole leaf area with no evidence of chlorosis or necrosis; 100% leaf area affected