

A close-up photograph of wheat stems. The stems are green but show significant signs of rust infection, with numerous brown, fuzzy patches of rust covering parts of the stems and leaves. The background is blurred, focusing attention on the infected plant parts.

Ug99 Spring Wheat Breeding Efforts & DRRW Progress

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Current Varieties

- Almost all current Upper Midwest spring wheat varieties are susceptible to Ug99 and/or its derivatives
- 10-20% of advanced experimental lines have *Sr2*, *Sr24* or “Thatcher type” APR

Variety	Release Year	% 2010 MN Acreage
Faller	2007	30.0
RB07	2007	23.5
Samson	2007	5.8
Glenn	2005	5.4
Briggs	2002	3.3
Oklee	2003	2.9
Knudson	2001	2.6
Ada	2006	1.9
Jenna	2009	1.8
Vantage	2007	1.8
Breaker	2008	1.7
Granite	2002	1.7
Kelby	2006	1.7
Kuntz	2007	1.6
Howard	2006	1.6
Traverse	2006	1.5
Brennan	2009	1.4
Freyr	2004	1.4
Tom	2008	1.1
Alsen	2000	0.8
Steele-ND	2004	0.3
Granger	2004	0.3
Oxen	1996	0.2
Banton	2004	0.2
Walworth	2001	0.1
Others	various	5.6



Disease Reactions (local races)

Variety		Leaf Rust	Stem Rust ^b	Other	Scab
				Leaf Diseases ^c	
Brick	2009 NDSU	3	3	7	3
Glenn	2005 NDSU	2	1	4	3
Albany	2009 Limagrain	3	3	5 ^e	4
Barlow	2009 NDSU	2	1	4	4
Blade	2007 WestBred	2	2	3 ^f	4
Breaker	2008 WestBred	3	2	3	4
Cromwell	2007 Thunder Seed	4	1	4 ^f	4
Faller	2007 NDSU	2	1	3	4
Freyr	2004 AgriPro	4	4	4	4
Hat Trick	2006 Limagrain	5	4	5 ^{d,e}	4
Sabin	2009 MN	3	1	6	4
Select	2011 SDSU	2	4	7 ^e	4
Tom	2008 MN	4	1	5	4
Briggs	2002 SDSU	1	2	5	5
Kelby	2006 AgriPro	2	1	4 ^e	5
Oklee	2003 MN	4	1	5	5
RB07	2007 MN	2	2	5 ^e	5
Vantage	2007 WestBred	5	3	6 ^e	5
Ada	2006 MN	5	2	5 ^d	6
Brogan	2009 Westbred	3	2	6 ^e	6
Howard	2006 NDSU	2	1	4 ^f	6
Jenna	2009 AgriPro	4	2	4	6
Knudson	2001 AgriPro	2	3	3 ^f	6
Kuntz	2007 AgriPro	3	1	4	6
Brennan	2009 AgriPro	2	2	5	7
Marshall	1982 MN	8	1	7	7
Samson	2007 WestBred	5	1	6 ^e	7



Regional Ug99 Breeding Efforts

- **Sending Advanced Lines to Kenya and Priority Crossing with R/MR sources:**
 - MN, SDSU, AgriPro, Westbred, Trigen
- **Targeted Introgression – MN**

Crossing Block	No. R/MR Sources	Genes
Spring 2005	4	Thatcher (Th) type, Sr24
Fall 2005	2	Th
Spring 2006	6	Th, Sr24
Fall 2006	11	Th, 1A/1R, Sr2, Sr24, Sr25, Sr26, Sr36
Spring 2007	4	Th, Sr24, Sr26
Fall 2007	2	Th, Sr24
Spring 2008	3	Th, Sr24
Fall 2008	2	Th, Sr24
Fall 2010	2	Sr28, SrGabo 56



Backcrossing Ug99-Effective Genes

- Funded by MN AES Rapid Response Project

Gene	RB07	Sabin	MN03196
Sr22	BC2*	BC2	BC2*
Sr24	BC2	BC2	BC2
Sr25	BC2*	BC2*	BC2
Sr26	BC2	BC2	BC2
Sr32	BC2	BC2	BC2
Sr35	BC2	BC2	BC2
Sr36	BC1	BC1	BC1
Sr42	BC2*	BC2	BC2
Sr40/22	BC2	BC2	BC2
Sr2/25/26	BC1*	BC1	BC1*



Durable Rust Resistance in Wheat

Objective 6: Developing and Optimizing Markers for Rust Resistance

- **6.1 Optimize markers for previously characterized genes**
- **6.2 Haplotype uncharacterized genes to infer novelty and i.d. mapping targets**
- **6.3 Pyramid resistance genes**
- **6.4 Map novel sources of resistance**



DRRW Obj. 6 Participants

- **Jim Anderson, Minnesota**
- **Mike Baum, ICARDA**
- **Jorge Dubcovsky, CA-Davis**
- **Evans Lagudah, CSIRO, Australia**
- **Ravi Singh, CIMMYT**
- **Mark Sorrells, Cornell**
- **(Shiaoman Chao, ARS-Fargo)**
- **(Gina Brown-Guidera, ARS-Raleigh)**
- **(Mike Pumphrey, Washington St.)**
- **(Matt Rouse, Yue Jin, ARS-St. Paul)**



6.1 & 6.2 Optimize Markers and Haplotype

- 1A.1R *Secale cereale*
 - **Sr2** *Triticum turgidum* <http://maswheat.ucdavis.edu/protocols/Sr2/>
 - Sr13 *T. turgidum*
 - **Sr22** *T. monococcum*
 - **Sr24** *Thinopyrum elongatum*
 - **Sr25** *Th. elongatum*
 - **Sr26** *Th. elongatum*
 - Sr32 *T. speltoides*
 - Sr35 *T. monococcum*
 - **Sr36** *T. timopheevi*
 - **Sr40** *T. araraticum*
- Theor. Appl. Genet. (2010) 120:691–697

6.3 Pyramid Resistance Genes

- ***Sr2*, *Sr25*, & *Sr26* pyramided into 4 CIMMYT lines (Anderson)**
- **Combinations of *Sr2*, *Sr22*, *Sr24*, *Sr25*, *Sr26*, *Sr32*, *Sr36*, *Sr39*, & *Sr40* into winter wheat (Sorrells/Brown-Guidera/Pumphrey)**
- ***Sr2*, *Sr13*, & *Sr25* into durum (Dubcovsky)**



6.4 Map Novel Sources of Resistance

- **Race-specific resistance:**
 - *Sr28* (Rouse)
 - *Sr42* (Anderson/Yue Jin)
 - *I-39* (Anderson/Yue Jin)
 - *Tmp* (Rouse)
 - many others not funded by DRRW
- **Adult Plant Resistance:**
 - CIMMYT (~15 pops developed, 4 being mapped)
 - MN (10 pops. in development)

