

# Report of the 2012 Uniform Regional Scab Nursery for Spring Wheat Parents

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The Uniform Regional Scab Nursery for Spring Wheat Parents (URSN) was grown for the 18th year in 2012. Four locations at Brookings, SD, St. Paul and Crookston, MN, and Glenlea, Manitoba, Canada were planted.

A total of 25 entries were included in the 2012 URSN, including the resistant checks 2375, BacUp, and ND2710, and the susceptible checks Wheaton and Oslo. The other entries were contributed by 5 university and government breeding programs.

A core set of traits evaluated provided from most locations included FHB incidence, FHB severity, disease index (incidence x severity), and visual scabby kernel ratings (VSK  $\cong$  tombstone  $\cong$  FDK). Additional trait data such as grain deoxynivalenol content, yield, and heading date, are presented in individual location summary tables where they were measured. Overall means for traits over locations are presented, as are relative rankings for incidence, severity, disease index, VSK and DON. Correlation coefficients are provided between incidence, severity, disease index, and VSK. Molecular marker genotypes for a set of FHB resistance QTLs and other traits are provided for entries. Adult plant leaf and stem rust reactions are also presented.

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**Table 1. Entries for the Uniform Regional Scab Nursery for Spring Wheat Parents, 2012.**

<b>Entry No.</b>	<b>Name</b>	<b>Pedigree</b>	<b>Year First Entered</b>	<b>Source</b>
1	2375	CHECK		
2	Wheaton	CHECK		
3	Bacup	CHECK		
4	Oslo	CHECK		
5	ND2710	CHECK		
6	SD4361	SD3943-21/SD3851	2012	SDSU
7	SD4366	SD3948/SD4018	2012	SDSU
8	SD4388	SD4011/SD3942	2012	SDSU
9	SD4394	SD4018/SD3868	2012	SDSU
10	SD4397	SD3879/SD3851	2012	SDSU
11	N10-0176	RB07/SD3461	2012	Limagrain
12	MN08166	MN00232-2-2-2-3/MN03111-3	2012	UMN
13	MN08173	MN01261-8-1/MN03111-3	2012	UMN
14	MN09027	MN00209-3-1/2*MN03308-4	2012	UMN
15	MN09071	MN02092-1/2*MN03119	2012	UMN
16	MN09121	Sabin//Tom/Faller	2012	UMN
17	11EXP13-43	Banton/Faller	2012	NDSU
18	11EXP13-65	Faller/Alsen	2012	NDSU
19	11EXP13-78	Guadalupe/Glenn//Alsen/3/ND751	2012	NDSU
20	11EXP13-105	ND744'S/ND752	2012	NDSU
21	11EXP13-107	Goldfield/2*Alsen//Steele-ND	2012	NDSU
22	BW928	BW799/ND721//Alsen	2011	AAFC-SPARC
23	BW429	McKenzie/Alsen	2011	AAFC-CRC
24	BW464	BW342/98B25-AS3C02	2012	AAFC-CRC
25	BW484	BW342/98B25-AS3C02	2012	AAFC-CRC

**Table 2. 2012 Uniform Regional Scab Nursery for Spring Wheat Parents, Brookings, SD.**

<b>Line</b>	<b>Incidence %</b>	<b>Severity %</b>	<b>Disease Index</b>	<b>Tombstone %</b>
2375	50.0	7.5	3.8	1.3
Wheaton	56.7	9.7	5.6	3.3
Bacup	75.0	18.3	14.7	1.0
Oslo	73.3	17.0	12.5	2.3
ND2710	55.0	12.3	8.8	1.3
SD4361	76.7	18.0	14.3	1.3
SD4366	53.3	8.2	4.7	1.0
SD4388	78.3	16.7	13.3	2.0
SD4394	80.0	20.7	16.9	1.0
SD4397	81.7	20.8	17.0	1.0
N10-0176	86.7	22.0	19.9	3.3
MN08166	76.7	18.2	15.0	1.7
MN08173	56.7	10.0	6.4	1.7
MN09027	61.7	12.7	7.8	1.0
MN09071	85.0	20.5	17.5	1.0
MN09121	53.3	10.0	6.8	2.0
11EXP13-43	48.3	10.2	5.7	1.3
11EXP13-65	83.3	21.2	18.2	5.3
11EXP13-78	80.0	17.2	14.0	1.0
11EXP13-105	73.3	13.7	10.3	1.7
11EXP13-107	86.7	21.5	19.5	1.3
BW928	70.0	13.7	10.9	1.7
BW429*				
BW464*				
BW484*				
Brick	58.3	11.2	7.5	1.0
Brick	70.0	15.2	10.8	1.0
Brick	78.3	18.8	14.7	1.0
Mean	69.9	15.4	11.9	1.7
LSD	22.8	9.4	9.8	1.1
CV	17.9	30.0	41.6	60.8

\* Seed not received for planting.

Note: Brick added as filler plots in place of Canadian entries.

Note from Karl: It was a pretty tough year to test FHB resistance, so the data seems a bit unreliable. We tested 20 replicated checks for DON and none were above the detectible limit. Therefore, there is no DON data from SD for 2012 URSN.

**Table 3. 2012 Uniform Regional Scab Nursery for Spring Wheat Parents, Crookston, MN.**

Line	Incidence %	Severity %	Disease Index	VSK %	DON ppm	Heading d from 6-1	30 SSW <sup>1</sup> g	micro TWT <sup>2</sup> g
2375	100.0	39.6	39.6	46.7	4.7	31	6.3	-
Wheaton	96.7	72.6	71.3	78.3	9.9	33	1.7	-
BacUp	72.5	16.6	12.8	21.0	4.4	26	8.9	-
Oslo	96.7	65.8	64.7	55.0	7.1	30	3.0	-
ND2710	53.3	9.3	6.0	21.3	1.7	31	19.2	10.4
SD4361	81.7	17.6	14.7	14.0	2.7	25	12.4	10.5
SD4366	95.0	30.8	29.6	16.3	4.8	27	9.7	10.2
SD4388	81.7	31.1	28.0	19.0	5.0	28	11.5	10.2
SD4394	65.0	14.0	8.8	11.0	1.9	27	14.8	10.1
SD4397	73.3	10.8	7.9	11.5	2.3	27	13.1	10.9
N10-0176	53.3	11.1	5.5	65.0	2.7	28	9.5	9.5
MN08166	61.7	11.8	7.3	19.0	1.4	32	16.4	10.9
MN08173	86.7	25.2	21.8	11.7	4.5	35	13.9	11.6
MN09027	33.3	10.0	3.3	13.3	1.8	31	15.2	10.4
MN09071	88.3	30.0	27.4	17.3	5.7	31	8.3	9.9
MN09121	88.3	17.7	15.6	16.3	4.5	32	11.6	10.5
11EXP13-43	85.0	22.6	19.2	14.7	5.5	30	9.6	10.4
11EXP13-65	95.0	38.5	37.4	19.0	6.3	28	7.3	-
11EXP13-78	81.7	17.0	13.8	17.3	5.4	29	10.6	9.6
11EXP13-105	85.0	15.1	12.8	21.7	5.5	30	12.5	10.1
11EXP13-107	73.3	30.1	25.2	10.0	2.5	34	10.9	11.0
BW928	90.0	21.2	18.8	19.0	5.8	31	7.5	-
BW429*								
BW464*								
BW484*								
Alsen (MR check)	96.7	22.6	21.9	12.0	3.0	31	8.6	-
Roblin (S check)	100.0	90.3	90.3	86.7	3.7	27	5.9	-
MN00269 (S check)	96.7	74.9	73.1	40.0	4.4	36	0.6	-
Mean	81.2	29.8	27.1	27.1	4.3	30.0	10.0	10.4
LSD	17.9	18.0	18.5	9.8	-	1.4	3.2	0.4
CV	13.5	37.0	41.7	22.2	-	2.8	19.5	2.5

\* Seed not received for planting.

<sup>1</sup> 30 SSW = 30 spike seed weight. This is the sample used to determine VSK.

<sup>2</sup> Weight of the VSK sample that fits in a 15.7 mL copper vessel measuring 20 mm in diameter and 50 mm in height

**Table 4. 2012 Uniform Regional Scab Nursery for Spring Wheat Parents, St. Paul, MN.**

Line	Incidence %	Severity %	Disease Index	VSK %	DON ppm	Heading d from 6-1	30 SSW <sup>1</sup> g	micro TWT <sup>2</sup> g
2375	60.0	23.4	13.7	8.7	3.5	29	22.3	11.1
Wheaton	97.5	50.7	50.2	35.8	6.6	32	13.2	9.6
Bacup	71.7	22.5	17.1	6.3	2.7	27	16.1	11.3
Oslo	91.7	42.7	39.6	19.0	3.3	28	13.2	10.0
ND2710	30.0	10.9	4.1	3.3	0.6	28	24.6	11.4
SD4361	73.3	29.5	21.7	6.7	1.6	27	16.9	11.1
SD4366	81.7	17.5	14.2	6.0	1.2	27	16.8	11.4
SD4388	65.0	24.0	16.5	5.3	1.4	27	17.7	11.0
SD4394	80.0	23.5	18.5	6.0	1.5	27	19.2	10.9
SD4397	45.0	16.5	8.0	5.3	1.9	27	19.0	8.1
N10-0176	65.0	23.6	17.1	9.3	2.0	27	15.7	10.9
MN08166	41.7	18.3	7.4	4.7	1.3	28	19.4	11.5
MN08173	90.0	24.2	21.7	6.0	1.5	34	20.2	11.7
MN09027	56.7	17.9	12.4	5.3	1.2	32	20.1	11.2
MN09071	70.0	26.9	19.6	5.3	4.1	28	18.9	11.3
MN09121	76.7	15.9	12.2	7.3	1.4	32	16.4	10.9
11EXP13-43	70.0	21.8	15.4	8.7	2.6	27	18.0	11.2
11EXP13-65	73.3	21.8	16.9	14.7	5.3	29	20.5	10.8
11EXP13-78	68.3	14.4	10.3	6.7	1.6	27	18.0	11.3
11EXP13-105	71.7	16.4	11.9	9.3	2.9	27	16.8	10.8
11EXP13-107	85.0	18.6	15.8	5.3	2.4	32	16.1	11.6
BW928	71.7	20.9	14.7	10.3	2.5	31	12.5	10.7
BW429*								
BW464*								
BW484*								
Alsen (MR check)	88.3	20.8	18.6	7.3	3.8	28	14.3	11.5
Roblin (S check)	100.0	68.7	68.7	31.7	7.5	27	11.4	9.7
MN00269 (S check)	100.0	81.7	81.7	26.7	8.9	35	9.5	9.6
Mean	73.0	26.9	21.9	10.4	2.9	28.9	17.1	10.8
LSD	25.7	13.8	14.9	7.2	–	1.3	4.2	2.0
CV	21.3	30.7	39.9	39.4	–	2.8	15.2	11.4

\*Seed not received for planting.

<sup>1</sup> 30 SSW = 30 spike seed weight. This is the sample used to determine VSK.

<sup>2</sup> Weight of the VSK sample that fits in a 15.7 mL copper vessel measuring 20 mm in diameter and 50 mm in height

**Table 5. 2012 Uniform Regional Scab Nursery for Spring Wheat Parents, Glenlea, MB.**

Line	Incidence %	Severity %	Disease Index	FDK %	DON %	ISD*
2375	2.9	4.3	13.5	4.9	7.6	18.4
Wheaton	3.9	5.3	18.1	14.5	12.6	32.0
Bacup	2.6	2.5	6.6	2.1	3.7	11.5
Oslo	3.0	6.5	20.0	10.6	12.4	31.0
ND2710	2.1	3.6	7.5	2.4	4.5	11.9
SD4361						
SD4366						
SD4388						
SD4394						
SD4397						
N10-0176	1.5	3.3	3.8	3.6	3.5	10.8
MN08166	1.6	1.5	2.6	2.3	2.1	7.1
MN08173	3.0	1.5	4.3	3.9	3.2	10.9
MN09027	1.1	1.3	1.6	2.4	1.8	5.8
MN09071	2.8	1.8	4.0	2.5	2.8	10.1
MN09121	1.6	1.4	2.0	4.1	2.5	6.8
11EXP13-43	3.9	2.8	10.1	4.3	5.7	15.6
11EXP13-65	4.9	4.5	22.8	7.9	11.7	23.8
11EXP13-78	3.4	1.9	6.1	2.3	3.4	11.7
11EXP13-105	3.5	1.1	3.9	2.5	2.5	10.0
11EXP13-107	3.5	1.3	3.3	1.9	2.1	10.8
BW928	3.3	1.5	5.0	3.2	3.2	11.5
BW429	3.1	2.4	5.6	3.4	3.8	12.0
BW464	3.5	2.4	6.5	2.0	3.6	13.1
BW484	3.0	3.3	9.4	4.5	5.7	16.1
Mean	2.9	2.7	7.8	4.3	4.7	14.0
CV	51.7	56.7	68.3	37.7	60.8	32.9
LSD	3.9	4.0	14.1	4.2	7.6	12.1

\*ISD (%Incidence, %Severity, DON) is calculated by:  $(0.2 \cdot \text{AVG}\% \text{Inc}) + (0.2 \cdot \text{AVG}\% \text{Sev}) + (0.6 \cdot \text{AVG}\text{-DON})$   
for a given entry.

Note: SDSU entries were not planted.

**Table 6. 2012 Uniform Regional Scab Nursery for Spring Wheat Parents - Summary of Means.**

Line	Incidence %	Incidence Rank	Severity %	Severity Rank	Disease Index	Disease Index Rank	VSK %	VSK Rank	DON ppm	DON Rank
No. of Locations	4		4		4		4		3	
2375	53.2	6	18.7	14	17.7	18	15.4	19	5.3	19
Wheaton	63.7	15	34.6	22	36.3	22	33.0	22	9.7	22
Bacup	55.4	8	15.0	9	12.8	11	7.6	13	3.6	14
Oslo	66.2	17	33.0	21	34.2	21	21.7	21	7.6	20
ND2710	35.1	1	9.0	1	6.6	2	7.1	9	2.3	6
SD4361*	77.2	22	21.7	19	16.9	16	7.3	11	2.2	5
SD4366 *	76.7	21	18.8	15	16.2	15	7.8	14	3.0	10
SD4388 *	75.0	19	23.9	20	19.3	19	8.8	16	3.2	12
SD4394 *	75.0	19	19.4	16	14.8	13	6.0	5	1.7	3
SD4397 *	66.7	18	16.1	12	11.0	6	5.9	4	2.1	4
N10-0176	51.6	4	15.0	9	11.6	8	20.3	20	2.7	8
MN08166	45.4	3	12.4	5	8.1	3	6.9	8	1.6	1
MN08173	59.1	12	15.2	11	13.6	12	5.8	3	3.1	11
MN09027	38.2	2	10.4	2	6.3	1	5.5	2	1.6	1
MN09071	61.5	13	19.8	17	17.1	17	6.5	6	4.2	17
MN09121	55.0	7	11.2	3	9.1	4	7.4	12	2.8	9
11EXP13-43	51.8	5	14.3	7	12.6	10	7.2	10	4.6	18
11EXP13-65	64.1	16	21.5	18	23.8	20	11.7	18	7.8	21
11EXP13-78	58.3	9	12.6	6	11.1	7	6.8	7	3.5	13
11EXP13-105	58.4	10	11.6	4	9.7	5	8.8	16	3.6	14
11EXP13-107	62.1	14	17.9	13	15.9	14	4.6	1	2.3	6
BW928	58.7	11	14.3	7	12.4	9	8.6	15	3.8	16
Mean	59.5		17.6		15.3		10.0		3.7	

\* Mean of 3 locations for Incidence, Severity, Disease Index and VSK. DON: 2 locations.

Note: AAFC-CRC entries are not included since they were only grown at one location.

**Table 7. Correlation coefficients among traits, per-location basis.**

<b>Correlation Between</b>	<b>Brookings</b>	<b>Crookston</b>	<b>St. Paul</b>	<b>Glenlea</b>
Incidence & Severity	0.96	0.66	0.62	0.30
Incidence & Disease Index	0.96	0.70	0.74	0.61
Incidence & Tombstone/VSK/FDK	0.16	0.20	0.54	0.38
Incidence & DON		0.77	0.46	0.53
Severity & Disease Index	0.99	1.00	0.97	0.90
Severity & Tombstone/VSK/FDK	0.17	0.63	0.83	0.80
Severity & DON		0.80	0.67	0.93
Disease Index & Tombstone/VSK/FDK	0.19	0.62	0.86	0.81
Disease Index & DON		0.81	0.67	0.98
Tombstone/VSK/FDK & DON		0.51	0.80	0.91

**Table 8. Correlation coefficients among traits, using means across locations.**

	Incidence %	Severity %	Disease Index	VSK %
Severity %	0.60			
Disease Index	0.50	0.97		
VSK %*	0.07	0.71	0.76	
DON ppm	0.16	0.73	0.86	0.78

\*For calculation, VSK, FDK and tombstone considered to be equivalent.

**Table 9. Leaf and stem rust reactions in inoculated field nurseries,  
2012 Uniform Regional Scab Nursery for Spring Wheat Parents,  
St. Paul, MN (data from J. Kolmer and Y. Jin, USDA-ARS CDL).**

Line	Leaf Rust 7/9/2012	Stem Rust*	
		7/11/2012	7/22/2012
2375	too dry	TR	
Wheaton	10RMR	0	
Bacup	too dry	TR	
Oslo	too dry	10MR	
ND2710	30MS	TR	
SD4361	5R	10MR	
SD4366	20MRMS	20MR	
SD4388	30MS	30MS	
SD4394	10MRMS	20MR	
SD4397	30MS	40MRMS	
N10-0176	10MRMS	10MR	BIN**
MN08166	20MRMS	0	BIN**
MN08173	TR	0	
MN09027	20MRMS	30MRMS	
MN09071	TR	TR	
MN09121	20MR	TR	
11EXP13-43	10MS	TR	
11EXP13-65	50MS	5R	
11EXP13-78	30S	5R	
11EXP13-105	30MRMS	TMR	
11EXP13-107	20S	0	
BW928	too dry	TR	
BW429	too dry		
BW464	too dry		
BW484	too dry		
LMPG-6 (check)		70S	

\*Bulk inoculum: QFCSC, QTHJC, MCCFC, RKQQC, TPMKC

\*\*BIN = black internode, indicating the presence of Sr2

Table 10. Allele Sizes of Molecular Markers Associated with Selected Traits/Genes (From S. Chao, USDA-ARS, Fargo, ND)

Trait / Gene	HMW Glutenins / Glu-1A	HMW Glutenins / Glu-1Dx	HMW Glutenins / Glu-1Dy	Leaf Rust / Lr34	Stem Rust / Sr25			Leaf Rust / Lr21	Scab / Fhb_5A	Scab / Fhb1	Grain Protein Content / GPC	Tan Spot / tsn1	Photoperiod / Ppd-D1a (insen)	Photoperiod / Ppd-D1b (sen)	Height / Rht-B1a (wild type)	Height / Rht-B1b (dwarf)	Height / Rht-D1a (wild type)	Height / Rht-D1b (dwarf)	Stem Rust / Sr2
Marker	umn19	umn25	umn26	csLV34	Sr25			Lr21	barc180	umn10	uhw89	fcp397	Ppd-D1a	Ppd-D1b	Rht-B1a	Rht-B1b	Rht-D1a	Rht-D1b	gwm533
Chromosome	1A	1D	1D	7D	7D			1D	5A	3B	6B	5B	2D	2D	4B	4B	4D	4D	3B
2375	<b>341</b>	<b>278</b>	<b>391</b>	<b>156</b>	183	204	210	304	194	238	125	253	284		+	+	+	-	<b>116</b>
Wheaton	<b>341</b>	<b>278</b>	<b>391</b>	<b>156</b>	183	204	210	304	200	238	125	<b>226</b>	284		+	-	+	-	<b>116</b>
Bacup	359	<b>278</b>	<b>391</b>	237	183	<b>200</b>	204	304	197	238	125	253	284		-	+	+	-	<b>116</b>
Oslo	359	295	408	237	183	204	210	304	190	238	125	229	284		-	+	+	-	<b>116</b>
ND2710	359	<b>278</b>	<b>391</b>	<b>156</b>	183	204	210	304	<b>203</b>	<b>241</b>	125	253		414	+	+	+	-	143
SD4361	<b>341</b>	<b>278</b>	<b>391</b>	<b>156</b>	183	204	210	286	190	238	125	253	284		+	+	+	+	<b>116</b>
SD4366	<b>341</b>	<b>278</b>	<b>391</b>	<b>156</b>	183	204	210	286	190		125	253		414	+	-	+	-	<b>116</b>
SD4388	<b>341</b>	<b>278</b>	<b>391</b>	<b>156</b>	183	204	210					253		414	+	+	+		<b>116</b>
SD4394	<b>341</b>	<b>278</b>	<b>391</b>	<b>156</b>	183	204	210	286	190	238	125	253		414	+	+	+	-	<b>116</b>
SD4397	<b>341</b>	<b>278</b>	<b>391</b>	<b>156</b>	183	204	210	304	190	238	125	229	284		+	+	+	-	<b>116</b>
N10-0176	<b>341</b>	<b>278</b>	<b>391</b>	237	183	204	210	<b>196</b>	190	238	125	253		414	-	+	+	+	<b>116</b>
MN08166	<b>341</b>	<b>278</b>	<b>391</b>	<b>156</b>	204	210	232	286/304	<b>203</b>	238	125	253	284		+	+	+	+	<b>116</b>
MN08173	<b>341</b>	<b>278</b>	<b>391</b>	237	183	204	210	304	<b>203</b>	<b>241</b>	125	253		414	+	-	+	-	143
MN09027	<b>341</b>	<b>278</b>	<b>391</b>	237	183	204	210	304	<b>203</b>	<b>241</b>	125	229		414	+	+	+	-	143
MN09071	<b>341</b>	295	408	237	183	204	210	304	190	<b>241</b>	125	229		414	-	+	+	-	143
MN09121	359	<b>278</b>	<b>391</b>	<b>156</b>	183	<b>200</b>	204	304		<b>241</b>	125	253	284		+	+	+	+	143
11EXP13-43	<b>341</b>	<b>278</b>	<b>391</b>	237	183	204	210	<b>196</b>	<b>203</b>	<b>241</b>	125	253			-	+	+	+	143
11EXP13-65	<b>341</b>	<b>278</b>	<b>391</b>	237	183	204	210	<b>196</b>	190	<b>241</b>	125	253		414	-	+	+	-	<b>116</b>
11EXP13-78	<b>341</b>	<b>278</b>	<b>391</b>	237	183	204	210	<b>196</b>	<b>203</b>	<b>241</b>	125	253		414	-	+	+	-	143
11EXP13-105	<b>341</b>	<b>278</b>	<b>391</b>	237	183	204	210	<b>196</b>	<b>203</b>	<b>241</b>	125	253		414	-	+	+	-	
11EXP13-107	<b>341</b>	<b>278</b>	<b>391</b>	<b>156</b>	183	204	210	<b>196</b>	<b>203</b>	<b>241</b>	125	253		414	-	+	+	-	143
BW928	<b>341</b>	<b>278</b>	<b>391</b>	<b>156</b>	183	204	210	304	200	<b>241</b>	125	253		414	+	+	+	-	143
BW429	<b>341</b>	<b>278</b>	<b>391</b>	237	183	204	210	<b>196</b>	<b>203</b>	<b>241</b>	125	253		414	-	+	+	-	143
BW464	<b>341</b>	<b>278</b>	<b>391</b>	237	183	204	210	<b>196</b>	190	238	125	253		414	+	+	+	-	<b>116</b>
BW484	<b>341</b>	<b>278</b>	<b>391</b>	237	183	204	210	<b>196</b>	190	238	125	253		414	+	+	+	+	<b>116</b>

Numbers in bold are associated with gene/QTL. Please see next page for more details on marker allele/gene associations.

**Table 10 continued.**

<b>Trait</b>	<b>Marker</b>	<b>Gene</b>	<b>Chromosome</b>	<b>Size (base)</b>
scab	umn10	Fhb1	3B	Resistance=242
scab	barc180	Fhb_5A	5A	Resistance=203
Tan Spot	fcp394	tsn1	5B	Resistance=224
grain protein content	uhw89	GPC	6B	H=121, L=125
HMW Glutenins	umn19	Glu	1A	Ax2*=341, Ax1=359
HMW Glutenins	umn25	Glu-1Dx	1D	Dx5=278, Dx2=295
HMW Glutenins	umn26	Glu-1Dy	1D	Dy10=391, Dy12=408
Leaf rust	Lr21	Lr21	1D	Resistance=196
Leaf rust	csLV34	Lr34	7D	Resistance=156
Stem rust	Sr25	Sr25	7D	Resistance = 200
Stem rust	gwm533	Sr2	3B	Resistance = 116*
photoperiod	Ppd-D1a	Ppd-D1a (insensitive)	2D	284
photoperiod	Ppd-D1b	Ppd-D1b (sensitive)	2D	414
plant height	Rht-B1a	Rht-B1a (wild type)	4B	360 = +
plant height	Rht-B1b	Rht-B1b (dwarf)	4B	366 = +
plant height	Rht-D1a	Rht-D1a (wild type)	4D	250 = +
plant height	Rht-D1b	Rht-D1b (Dwarf)	4D	252 = +

\*This marker may not be diagnostic, for reference only.