

Report of the 2014 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 19th year in 2014. Five locations (Brookings, SD, St. Paul and Crookston, MN, and Prosper and Langdon, ND) were planted.

A total of 24 entries was included in the 2014 URSN, in addition to the resistant checks 2375, BacUp, and ND2710, and the susceptible checks Wheaton and Oslo. The entries were contributed by three university and two industry breeding programs.

A core set of traits evaluated at the nursery locations included Fusarium head blight (FHB) incidence, FHB severity, and disease index (incidence x severity). In addition, visual scabby kernel ratings (VSK \cong tombstone) and grain deoxynivalenol content were provided from two or more locations. Additional agronomic trait data are presented in individual location summary tables for locations 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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St. Paul, MN
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Jim Kolmer, Yue Jin

Table 1. Entries for the Uniform Regional Scab Nursery for Spring Wheat Parents, 2014.

Entry No.	Name	Pedigree	Year Entered	First Entered	Source
1	2375	CHECK			
2	Wheaton	CHECK			
3	Bacup	CHECK			
4	Oslo	CHECK			
5	ND2710	CHECK			
6	MN10021	MN00187-3-1/Sabin	2014	J. Anderson	UMN
7	MN10388	RB07/Glenn	2014	J. Anderson	UMN
8	MN11074	MN05233/Rollag	2014	J. Anderson	UMN
9	MN11397-1	Sabin//Prairie Red/Tom	2014	J. Anderson	UMN
10	MN11405	MN00209-3-1/MN05209	2014	J. Anderson	UMN
11	SD4504	GLENN/SD4072	2014	K. Glover	SDSU
12	SD4508	KELBY/SD3997	2014	K. Glover	SDSU
13	SD4510	KELBY/SD3997	2014	K. Glover	SDSU
14	SD4514	SD3997/SD4072	2014	K. Glover	SDSU
15	SD4546	CA907-816W/SD4178	2014	K. Glover	SDSU
16	12-14-81	PI157593/Parshall//Alsen	2013	M. Mergoum	NDSU
17	12-14-97	Frontana/W9207//2*Alsen/3/2*ND752	2013	M. Mergoum	NDSU
18	12-14-147	Velva/Bigg Red	2013	M. Mergoum	NDSU
19	12-14-158	Arsenal//Kormorran/Rohau72-839/3/Parshall/4/ND706	2013	M. Mergoum	NDSU
20	12-14-172	Tokai66/Parshall//Alsen	2013	M. Mergoum	NDSU
21	07S0208-27	02S0066-13/Brennan	2014	J. Smith	Syngenta
22	07S0211-23	02S0066-6/02S0214-15	2014	J. Smith	Syngenta
23	07S0274-2	ARG 31/RB07	2014	J. Smith	Syngenta
24	08S0036-19	Freyr/98S0167-09//02S0237-33	2014	J. Smith	Syngenta
25	08S0094-9	00S0221-9W//ALSEN/SY Soren 'S'	2014	J. Smith	Syngenta
26	LNR10-0176	RB07/SD3641	2013	D.B. Cooper	Limagrain
27	LNR10-0177	RB07/SD3641	2013	D.B. Cooper	Limagrain
28	LNR10-0177 RS6	RB07/SD3641	2014	D.B. Cooper	Limagrain
29	BIO-08228 = ALVORADA	VAQ/ABA	2014	D.B. Cooper	Limagrain

Table 2. 2014 Uniform Regional Scab Nursery for Spring Wheat Parents, Brookings, SD.

Line	Incidence %	Severity %	Disease Index	Tombstone %
2375	95.0	31.3	29.8	30.0
Wheaton	93.3	22.7	21.3	50.0
Bacup	98.3	31.0	30.5	41.7
Oslo	100.0	34.5	34.5	68.3
ND2710	80.0	15.3	12.2	13.3
MN10021	88.3	23.0	20.5	13.3
MN10388	96.7	27.3	26.5	10.0
MN11074	93.3	21.2	19.7	13.3
MN11397-1	96.7	34.7	33.3	35.0
MN11405	88.3	17.8	15.8	16.7
SD4504	91.7	19.2	17.8	31.7
SD4508	91.7	24.7	22.5	21.7
SD4510	93.3	25.2	23.8	21.7
SD4514	95.0	22.8	21.9	26.7
SD4546	88.3	16.8	15.2	16.7
12-14-81	91.7	25.3	23.2	15.0
12-14-97	91.7	27.3	25.1	21.7
12-14-147	95.0	31.0	29.6	18.3
12-14-158	98.3	30.7	30.2	16.7
12-14-172	98.3	27.0	26.6	30.0
07S0208-27	91.7	29.8	27.5	43.3
07S0211-23	91.7	21.0	19.4	30.0
07S0274-2	95.0	27.7	26.3	20.0
08S0036-19	96.7	27.2	26.3	31.7
08S0094-9	100.0	29.0	29.0	31.7
LNR10-0176	98.3	27.7	27.2	25.0
LNR10-0177	98.3	26.5	26.1	31.7
LNR10-0177 RS6	93.3	25.2	23.6	25.0
BIO-08228 = ALVORADA	96.7	32.4	31.5	25.0
Mean	94.0	26.0	24.7	26.7
LSD	7.9	7.7	8.0	11.9
CV	4.6	19.4	22.3	47.1

Table 3. 2014 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 ¹ g	micro TWT ² g
2375	100.0	39.4	39.4	17.0	24.8	42.3	24.2	10.9
Wheaton	100.0	59.6	59.6	46.3	28.0	47.0	7.7	8.9
Bacup	73.8	18.0	13.9	17.8	13.6	39.0	17.8	11.0
Oslo	97.5	48.0	47.3	27.5	18.1	42.3	16.7	10.3
ND2710	72.5	12.7	9.3	8.0	13.2	43.0	27.7	11.3
MN10021	35.0	6.5	2.4	2.0	3.3	45.3	25.9	12.1
MN10388	52.5	9.5	4.9	8.0	8.7	42.7	17.1	11.6
MN11074	85.0	19.9	16.9	10.0	7.2	44.0	18.7	11.6
MN11397-1	80.0	15.9	13.2	7.0	12.1	45.0	21.1	11.3
MN11405	80.0	11.7	9.3	6.0	7.3	44.0	27.8	11.5
SD4504	82.5	14.9	12.3	9.0	10.0	42.7	20.4	11.8
SD4508	87.5	15.2	13.4	8.0	7.2	42.3	26.9	11.7
SD4510	85.0	15.7	13.5	10.0	7.5	42.3	24.9	11.3
SD4514	70.0	16.6	12.0	12.5	9.1	43.3	23.8	11.3
SD4546	62.5	18.4	12.4	7.0	7.3	38.7	22.6	11.5
12-14-81	92.5	21.6	20.5	8.0	13.9	46.0	24.2	11.6
12-14-97	82.5	18.4	15.5	11.0	11.7	43.3	16.3	11.3
12-14-147	82.5	14.8	12.4	12.5	10.0	44.7	26.8	11.3
12-14-158	87.5	18.4	16.1	12.5	14.9	43.7	20.5	11.6
12-14-172	70.0	30.1	24.3	12.5	7.7	40.0	17.6	11.4
07S0208-27	95.0	34.1	32.9	22.5	15.3	44.0	23.1	11.1
07S0211-23	90.0	15.3	13.8	11.0	11.2	43.3	19.1	11.6
07S0274-2	77.5	12.0	9.4	9.0	12.6	43.7	22.4	11.5
08S0036-19	82.5	19.0	15.3	10.0	7.7	42.0	18.8	11.6
08S0094-9	85.0	18.3	15.6	10.0	12.9	43.3	16.7	11.0
LNR10-0176	60.0	12.6	7.6	12.5	10.3	41.3	17.3	10.9
LNR10-0177	97.5	24.1	23.7	25.0	13.2	42.7	16.3	10.6
LNR10-0177 RS6	90.0	19.0	17.0	12.5	10.6	42.7	13.6	11.0
BIO-08228 = ALVORADA	92.5	23.4	21.5	11.0	19.0	44.3	18.7	10.9
Alsen (MR check)	87.5	17.9	15.9	8.0	6.9	44.0	17.9	11.7
Roblin (S check)	100.0	83.3	83.3	50.0	16.6	40.3	13.7	9.9
MN00269 (S check)	100.0	57.9	57.9	37.5	17.7	50.0	7.8	–
Mean	82.4	23.8	21.3	14.7	12.2	43.2	19.8	11.2
LSD	21.0	14.1	14.3	9.5		1.0	4.5	0.6
CV	15.2	34.3	38.6	36.2		1.7	14.0	3.4

¹30 SSW = 30 spike seed weight. This is the sample used to determine VSK.

² Weight of the VSK sample that fits in a 15.7 mL copper vessel 20 mm in diameter and 50 mm in height.

Table 4. 2014 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 ¹ g	micro TWT ² g
2375	50.0	25.8	13.8	8.0	3.6	37.0	29.4	11.6
Wheaton	72.5	54.2	39.9	20.5	3.0	40.7	15.9	10.3
Bacup	35.0	11.0	3.9	3.0	0.9	35.0	22.0	11.8
Oslo	90.0	39.8	36.2	35.0	11.7	37.0	15.6	9.8
ND2710	41.7	11.2	4.8	4.0	1.3	37.0	31.3	11.9
MN10021	21.7	14.3	3.2	4.0	0.3	41.3	25.1	11.6
MN10388	21.7	13.1	2.8	3.0	1.1	37.0	19.3	12.0
MN11074	20.0	16.8	3.5	2.0	0.5	38.0	21.6	12.1
MN11397-1	31.7	10.5	3.4	2.0	0.7	40.0	26.3	11.8
MN11405	31.7	10.7	3.7	3.0	1.8	37.0	29.7	11.7
SD4504	38.3	11.6	4.6	7.0	3.3	37.0	23.6	11.7
SD4508	46.7	17.4	8.5	8.0	3.9	37.0	23.2	11.4
SD4510	35.0	13.4	4.7	7.0	2.3	37.0	22.6	11.4
SD4514	28.3	23.0	6.9	4.0	1.1	37.0	24.5	11.2
SD4546	51.7	16.6	9.1	6.0	1.4	33.0	26.0	11.8
12-14-81	48.3	22.1	11.7	3.0	1.0	41.3	28.5	12.3
12-14-97	56.7	20.9	12.7	9.0	4.8	37.0	15.8	11.0
12-14-147	50.0	19.1	10.5	7.0	2.7	37.0	30.5	11.9
12-14-158	85.0	19.8	16.8	7.0	3.9	37.0	25.2	11.6
12-14-172	40.0	13.8	5.7	7.0	2.3	37.0	22.4	11.6
07S0208-27	35.0	12.4	5.0	11.0	3.2	38.0	24.9	11.5
07S0211-23	36.7	12.6	4.8	6.0	2.1	38.0	19.9	11.6
07S0274-2	46.7	16.7	7.7	5.0	1.3	39.0	18.4	11.2
08S0036-19	28.3	12.2	3.8	6.0	0.8	37.0	19.5	11.5
08S0094-9	66.7	17.4	11.2	7.0	0.8	39.0	16.6	11.0
LNR10-0176	26.7	11.8	3.3	10.0	1.3	35.7	18.8	11.1
LNR10-0177	70.0	17.9	12.8	17.0	4.3	37.0	13.9	10.3
LNR10-0177 RS6	38.3	9.3	3.6	6.0	1.1	35.7	20.4	11.7
BIO-08228 = ALVORADA	50.0	35.4	17.3	6.0	1.7	40.0	23.9	11.6
Alsen (MR check)	33.3	13.6	4.6	3.0	1.6	38.0	15.1	11.3
Roblin (S check)	93.3	35.4	33.5	14.5	5.5	33.0	17.1	10.5
MN00269 (S check)	58.3	47.8	27.3	23.5	4.3	42.7	18.0	10.0
Mean	46.2	19.6	10.7	8.3	2.5	37.6	22.0	11.4
LSD	24.1	13.8	12.0	6.8		1.8	5.0	0.6
CV	30.8	40.4	63.5	47.9		3.5	13.8	3.4

¹30 SSW = 30 spike seed weight. This is the sample used to determine VSK.

² Weight of the VSK sample that fits in a 15.7 mL copper vessel 20 mm in diameter and 50 mm in height.

Table 5. 2014 Uniform Regional Scab Nursery for Spring Wheat Parents, Prosper, ND.

Line	Incidence %	Severity %	Disease Index
2375	94.6	31.4	29.7
Wheaton	100.0	56.3	56.3
Bacup	100.0	38.3	38.3
Oslo	100.0	33.3	33.3
ND2710	48.9	16.3	8.0
MN10021	41.3	15.2	6.3
MN10388	68.5	15.0	10.3
MN11074	95.8	21.3	20.4
MN11397-1	85.6	18.7	16.0
MN11405	70.5	14.9	10.5
SD4504	45.0	16.7	7.5
SD4508	58.6	18.7	11.0
SD4510	85.0	17.4	14.8
SD4514	58.8	17.5	10.3
SD4546	67.6	21.0	14.2
12-14-81	71.5	16.2	11.6
12-14-97	73.8	20.2	14.9
12-14-147	66.8	19.9	13.3
12-14-158	91.1	24.3	22.1
12-14-172	85.0	26.6	22.6
07S0208-27	95.8	25.4	24.3
07S0211-23	100.0	30.2	30.2
07S0274-2	74.6	16.9	12.6
08S0036-19	80.2	20.0	16.0
08S0094-9	70.5	18.8	13.3
LNR10-0176	65.6	26.5	17.4
LNR10-0177	100.0	38.1	38.1
LNR10-0177 RS6	96.1	26.5	25.5
BIO-08228 = ALVORADA	100.0	31.8	31.8
Mean	80.0	23.9	19.1
LSD			
CV	22.6	38.7	60.6

Table 6. 2014 Uniform Regional Scab Nursery for Spring Wheat Parents, Langdon, ND.

Line	Incidence %	Severity %	Disease Index
2375	82.8	52.5	43.5
Wheaton	100.0	80.9	80.9
Bacup	83.8	53.0	44.4
Oslo	100.0	64.5	64.5
ND2710	29.5	23.9	7.1
MN10021	17.9	15.0	2.7
MN10388	48.4	28.0	13.5
MN11074	74.9	36.8	27.6
MN11397-1	52.3	25.4	13.3
MN11405	67.2	23.8	16.0
SD4504	83.9	35.8	30.0
SD4508	63.7	34.7	22.1
SD4510	60.3	30.2	18.2
SD4514	26.2	27.8	7.3
SD4546	82.1	39.9	32.7
12-14-81	90.1	34.8	31.4
12-14-97	76.7	40.2	30.8
12-14-147	52.3	37.7	19.7
12-14-158	54.4	39.8	21.7
12-14-172	70.3	33.3	23.4
07S0208-27	75.0	35.1	26.3
07S0211-23	75.7	34.2	25.9
07S0274-2	58.7	23.5	13.8
08S0036-19	77.6	36.6	28.4
08S0094-9	90.6	32.2	29.2
LNR10-0176	70.5	44.1	31.1
LNR10-0177	76.6	46.5	35.6
LNR10-0177 RS6	66.6	38.7	25.8
BIO-08228 = ALVORADA	59.6	36.0	21.5
Mean	68.0	37.4	27.2
LSD			
CV	29.7	34.9	59.5

Table 7. 2014 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	5		5		5		3		2	
MN10021	40.9	1	14.8	1	7.0	1	6.4	1	1.8	1
ND2710	54.5	2	15.9	3	8.3	2	8.4	3	7.3	20
SD4514	55.7	3	21.5	9	11.7	5	14.4	15	5.1	9
MN10388	57.6	4	18.6	4	11.6	4	7.0	2	4.9	6
LNR10-0176	64.2	5	24.5	19	17.3	13	15.8	19	5.8	11
MN11405	67.5	6	15.8	2	11.0	3	8.6	5	4.6	5
SD4504	68.3	7	19.6	6	14.5	7	15.9	20	6.7	16
MN11397-1	69.2	8	21.0	8	15.8	10	14.7	17	6.4	14
12-14-147	69.3	9	24.5	18	17.1	12	12.6	11	6.4	13
SD4508	69.6	10	22.1	10	15.5	9	12.6	10	5.6	10
SD4546	70.4	11	22.5	11	16.7	11	9.9	7	4.4	4
07S0274-2	70.5	12	19.3	5	14.0	6	11.3	8	7.0	18
SD4510	71.7	13	20.4	7	15.0	8	12.9	12	4.9	7
12-14-172	72.7	14	26.2	21	20.5	21	16.5	23	5.0	8
08S0036-19	73.1	15	23.0	13	18.0	15	15.9	21	4.3	3
MN11074	73.8	16	23.2	15	17.6	14	8.4	4	3.8	2
12-14-97	76.3	17	25.4	20	19.8	20	13.9	13	8.3	22
LNR10-0177 RS6	76.9	18	23.7	16	19.1	17	14.5	16	5.9	12
Bacup	78.2	19	30.3	24	26.2	25	20.8	25	7.2	19
07S0208-27	78.5	20	27.3	23	23.2	23	25.6	27	9.3	24
07S0211-23	78.8	21	22.6	12	18.8	16	15.7	18	6.7	15
12-14-81	78.8	22	24.0	17	19.7	19	8.7	6	7.5	21
BIO-08228 = ALVORADA	79.8	23	31.8	26	24.7	24	14.0	14	10.4	26
08S0094-9	82.5	24	23.1	14	19.6	18	16.2	22	6.8	17
12-14-158	83.3	25	26.6	22	21.4	22	12.1	9	9.4	25
2375	84.5	26	36.1	27	31.2	27	18.3	24	14.2	27
LNR10-0177	88.5	27	30.6	25	27.2	26	24.6	26	8.8	23
Wheaton	93.2	28	54.7	29	51.6	29	38.9	29	15.5	29
Oslo	97.5	29	44.0	28	43.2	28	43.6	28	14.9	28
Mean	73.3		25.3		19.9		15.8		7.2	

Table 8. Correlation coefficients among traits, by location.

Correlation Between	Brookings	Crookston	St. Paul	Prosper	Langdon
Incidence & Severity	0.77	0.61	0.62	0.70	0.71
Incidence & Disease Index	0.83	0.67	0.81	0.82	0.83
Incidence & Tombstone/VSK	0.44	0.54	0.69		
Incidence & DON		0.64	0.69		
Severity & Disease Index	0.99	0.99	0.94	0.98	0.96
Severity & Tombstone/VSK	0.44	0.88	0.65		
Severity & DON		0.79	0.48		
Disease Index & Tombstone/VSK	0.46	0.88	0.80		
Disease Index & DON		0.81	0.66		
Tombstone/VSK & DON		0.75	0.87		

Table 9. Correlation coefficients among traits, using means across locations.

	Incidence %	Severity %	Disease Index	VSK %
Severity %	0.78			
Disease Index	0.84	0.99		
VSK %*	-	-	-	
DON ppm	-	-	-	-

Note: correlations not calculated for disease index and VSK due to unequal number of locations.

**Table 10. Leaf and stem rust reactions in inoculated field nurseries,
2014 Uniform Regional Scab Nursery for Spring Wheat Parents,
St. Paul, MN. (J. Kolmer and Y. Jin, USDA-ARS, St. Paul, MN)**

Line	Leaf Rust	Stem Rust
2375	50S	20MR
Wheaton	50MS	5R
Bacup	70S	10MR
Oslo	50MRMS	10MR
ND2710	60S	10MR
MN10021	30MRMS	10MRMS
MN10388	70S	10MR
MN11074	50S	20MR
MN11397-1	40MSS	0
MN11405	5R	TMSMS
SD4504	50S	20MR
SD4508	40MRMS	20MRMS
SD4510	40MRMS	5MR
SD4514	TR	20MR
SD4546	20MRMS	40MRMS
07S0208-27	30R	20MR
07S0211-23	20MRMS	70MSS
12-14-172	30MSS	10MR
12-14-81	50MSS	10MR
12-14-97	70S	50MRMS
07S0274-2	70S	5MR
08S0036-19	50S	20MR
08S0094-9	30MR	10MR
12-14-147	70S	10MR
12-14-158	30MSS	0/20MR
LNR10-0176	60S	10MR
LNR10-0177	MSS	TR
LNR10-0177 RS6	50MSS	0
BIO-08228 = ALVORADA	20M	40MR

Note: data from inoculation with a mixture of races.

Table 11. Allele Sizes of Molecular Markers Associated with Selected Traits/Genes (S. Chao, USDA-ARS, Fargo, ND)

Trait / Gene	HMW Glutenins / Glu-1A	HMW Glutenins / Glu-1D	Grain Protein Content / GPC	Leaf Rust / Lr34	Leaf Rust / Lr21	Tan Spot / tsn1	Scab / Fhb1	Scab / Fhb 5A	Stem Rust / Sr25			Stem Rust / Sr2	Photoperiod / Ppd-D1a (insen)	Photoperiod / Ppd-D1b (sen)	Height / Rht-B1	Height / Rht-D1
Marker	umn19		Gpc-B1	l4	Lr21	fcp397	Fhb1	barc186	Sr25			gwm533	Ppd-D1a	Ppd-D1b	Rht-B1	Rht-D1
Chromosome	1A	1D	6B	7D	1D	5B	3B	5A	7D			3B	2D	2D	4B	4D
2375	341	C	A	T	304	253	C	211	183	206	211	116	284		G	C
Wheaton	341	C	A	T	304	226	C	201	183	206	211	116	284		G	A
Bacup	359	C	A	T	304	253	C	211	183	200	206	116	284		G	C
Oslo	359	G	A	A	304	229	C	201	183	206	211	116	284		A	C
ND2710	359	C	A	T	304	253	T	211	183	206	211	142		414	G	C
MN10021	359	C	A	T	286	226	T	201	183	200	206	142	284		G	C
MN10388	341	C	A	A	196	253	C	201	183	206	211	116		414	G	C
MN11074	341	C	A	T	304	229	T	211	183	200	206	142		414	G	A
MN11397-1	359	C	A	T	304	253	T	201	183	200	206	142	284		G	C
MN11405	359	C	A	T	304	253	T	211	183	206	211	142		414	G	A
SD4504	341	C	A	A	196	253	C	201	183	206	211	116		414	G	C
SD4508	341	C	A	T	304		T	201	206	211	231	142	284		G	C
SD4510	341	C	A	T	304	253	T	201	206	211	231	142	284		G	C
SD4514	341	C	A	T	304	253	C	201	183	206	211	116		414	G	C
SD4546	341	C	A	T	304	253	T	201	183	206	211	142	284		G	C
07S0208-27	341	C	A	T	286	226	T	201	200	206	231	142	284		G	A
07S0211-23	341	C	A	T	304	226	T	201	183	206	211	116	284		G	A
07S0274-2	341	C	A	A	196	226	T	201	183	206	211	116		414	A	C
08S0036-19	341	C	A	T	286	253	T	201	183	206	211	116		414	G	A
08S0094-9	341	C	A	T	304	253	C	201	--	--	--	142	284		G	A
LNR10-0176	341	C	A	A	196	253	C	211	183	206	211	116		414	A	C
LNR10-0177	341	C	A	A	196	253	C	201	183	206	211	142		414	A	C
LNR10-0177 RS6	341	C	A	A	196	253	C	201	183	206	211	116		414	A	C
BIO-08228	341	C	A	A	304	--	C	201	183	206	211	116		414	A	C
12-14-81	Not evaluated															
12-14-97	Not evaluated															
12-14-147	Not evaluated															
12-14-158	Not evaluated															
12-14-172	Not evaluated															

Please see next page for more details on marker allele/gene associations.

Table 11 continued.

Trait	Marker	Gene	Chromosome	Size (base)
HMW Glutenins	umn19	Glu-1A	1A	Ax2*=341, Ax1=359
HMW Glutenins		Glu-1D	1D	C = 5+10, G = 2+12
Grain protein content	Gpc-B1	GPC	6B	High=T, Norma=A
Leaf rust	l4	Lr34	7D	Resistance=T, Susceptible=S
Leaf rust	Lr21	Lr21	1D	Resistance=196
Tan Spot	fcp397	tsn1	5B	Resistance=226
Scab	Fhb1	Fhb1	3B	Resistance=T, Susceptible=C
Scab	barc186	Fhb 5A	5A	Resistance=211
Stem rust	Sr25	Sr25	7D	Resistance = 200
Stem rust	gwm533	Sr2	3B	R=116*
Photoperiod	Ppd-D1a	Ppd-D1a (insensitive)	2D	284
Photoperiod	Ppd-D1b	Ppd-D1b (sensitive)	2D	414
Plant height	Rht-B1	Rht-B1	4B	wild type = G, dwarf = A
Plant height	Rht-D1	Rht-D1	4D	wild type = C, dwarf = A

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