Report of the 2009 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 15th year in 2009. Five mist-irrigated locations at Brookings, SD, St. Paul and Crookston, MN, Langdon, ND, and Glenlea, Manitoba, Canada were planted.

A total of 33 entries were included in the 2009 URSN, including the resistant checks 2375, BacUp, and ND2710, and the susceptible checks Wheaton and Oslo. The other entries were contributed by 7 university, and industry 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 ≅ tombstone ≅ FDK). Additional trait data such as grain deoxynivalenol content, plot yield, and heading date, are presented in individual location summary tables. 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. Further, molecular marker genotypes for a set of FHB resistance QTLs and 13 other traits are provided for entries.

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Table 1. Entries for the Uniform Regional Scab Nursery for Spring Wheat Parents, 2009.

Entry No.	Name	Pedigree	Year First Entered	Source
1	2375	CHECK		
2	Wheaton	CHECK		
3	Bacup	CHECK		
4	Oslo	CHECK		
5	ND2710	CHECK		
6	MN05152-1-1	MN99163-7/MN97369-98	2009	UMN
7	MN06049-1-3	MN99017-6/MN99192-10	2009	UMN
8	MN06202-3-1	MN99192-10/N97-0100//Alsen	2009	UMN
9	MN06213-6-2-4	MN99112-10/FA900-720//Alsen	2009	UMN
10	MN06219-2-2	MN99112-10/FA900-720//Alsen	2009	UMN
11	SD3948	SD3367/FN1500-118	2009	SDSU
12	SD3997	FN1700-155/FN1500-074//SD3348	2009	SDSU
13	SD4011	SD3367/SD3618	2009	SDSU
14	SD4027	SD3641/SD3722	2009	SDSU
15	ND09/URSN-1	ND2902/Reeder//ND716-21	2009	NDSU
16	ND09/URSN-2	Frontana/W9207//Alsen/3/Glenn/4/ND752	2009	NDSU
17	ND09/URSN-3	ND2831//Parshall/ND706/3/ND752	2009	NDSU
18	ND09/URSN-4	Alsen/Walworth//ND744	2009	NDSU
19	ND09/URSN-5	ND721//SD8070/ND674/3/Alsen	2009	NDSU
20	NDSW0714	PI 634196/Alsen//*2Alsen	2007	NDSU
21	NDSW0715	PI 634196/Alsen//*2Alsen	2007	NDSU
22	BD76A*J0199	98B25-DF2B04/ND744//00H04*J3	2009	AAFC-CRC
23	3X1-134*FA0067	HC736/98B69-R28//2*Prodigy/3/HC374/3*98B69-L47	2009	AAFC-CRC
24	BW871	Alsen/AC Elsa//AC Barrie	2009	SPARC-AAFC
25	01S0094-65	Freyr/N98-0336	2009	AgriPro
26	02S0091-9	98S0031-02/98S0018-06	2009	AgriPro
27	03S0119-12	99S0350-8/N98-0286	2009	AgriPro
28	03S0352-22	00S0315-11/Knudson	2009	AgriPro
29	CA908-801	Glenn/Trooper	2009	WestBred
30	CA908-802	Glenn/Polaris	2009	WestBred
31	CA908-869	Kelby/Samson	2009	WestBred
32	CA908-870	Kelby/Rush	2009	WestBred
33	CA908-874	Polaris/Alsen	2009	WestBred

Table 2. 2009 Uniform Regional Scab Nursery for Spring Wheat Parents, Brookings, SD.

Line	Incidence %	Severity %	Disease Index	Tombstone %	DON ppm
2375	100.0	47.3	47.3	31.7	10.0
Wheaton	100.0	50.7	50.7	60.0	17.8
Bacup	100.0	31.7	31.7	20.0	6.0
Oslo	100.0	56.3	56.3	55.0	16.3
ND2710	100.0	28.5	28.5	16.7	5.4
MN05152-1-1	100.0	34.7	34.7	21.7	4.0
MN06049-1-3	100.0	28.3	28.3	23.3	3.6
MN06202-3-1	100.0	40.0	40.0	31.7	6.3
MN06213-6-2-4	100.0	33.8	33.8	13.3	5.2
MN06219-2-2	100.0	46.8	46.8	26.7	5.2
SD3948	100.0	30.8	30.8	25.0	10.9
SD3997	100.0	42.8	42.8	33.3	7.2
SD4011	100.0	30.3	30.3	28.3	9.0
SD4027	100.0	35.2	35.2	43.3	11.1
ND09/URSN-1	100.0	44.8	44.8	25.0	9.0
ND09/URSN-2	100.0	38.2	38.2	25.0	7.8
ND09/URSN-3	100.0	37.8	37.8	23.3	5.2
ND09/URSN-4	100.0	35.8	35.8	21.7	5.5
ND09/URSN-5	100.0	50.7	50.7	43.3	15.2
NDSW0714	100.0	38.0	38.0	31.7	8.7
NDSW0715	100.0	38.5	38.5	21.7	6.8
BD76A*J0199	100.0	36.3	36.3	30.0	7.1
3X1-134*FA0067	100.0	45.7	45.7	38.3	9.9
BW871	100.0	38.8	38.8	28.3	7.8
01S0094-65	100.0	46.7	46.7	48.3	8.9
02S0091-9	100.0	39.8	39.8	36.7	7.4
03S0119-12	100.0	44.7	44.7	33.3	6.8
03S0352-22	100.0	45.0	45.0	30.0	7.6
CA908-801	100.0	46.2	46.2	28.3	10.7
CA908-802	100.0	32.2	32.2	28.3	11.7
CA908-869	100.0	45.0	45.0	28.3	8.9
CA908-870	100.0	47.7	47.7	36.7	11.0
CA908-874	100.0	34.7	34.7	31.7	6.4
Mean	100.0	40.1	40.1	30.9	8.5
LSD		9.0	9.0	9.4	
CV		17.7	17.7	33.0	

Table 3. 2009 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 g
2375	100.0	16.7	16.7	22.3	13.8	38	18.8	9.2
Wheaton	100.0	67.8	67.8	76.7	19.8	41	10.4	7.8
Bacup	88.3	9.7	8.6	16.3	7.5	35	13.7	9.0
Oslo	100.0	38.6	38.6	53.3	14.3	38	12.9	8.4
ND2710	70.0	7.2	5.0	9.3	7.0	38	24.5	10.4
MN05152-1-1	78.3	9.9	8.0	5.3	3.6	39	23.9	10.8
MN06049-1-3	61.7	7.6	5.0	7.3	5.0	37	19.8	10.8
MN06202-3-1	86.7	8.6	7.5	11.7	9.6	38	17.4	10.6
MN06213-6-2-4	95.0	12.0	11.6	8.0	4.5	39	16.5	9.9
MN06219-2-2	95.0	13.8	13.4	10.0	7.4	39	15.9	9.7
SD3948	73.3	8.0	5.9	10.7	6.1	34	18.2	9.6
SD3997	66.7	7.6	5.2	8.0	5.2	37	18.7	9.7
SD4011	91.7	9.8	9.0	11.3	11.7	37	20.6	9.9
SD4027	95.0	22.3	21.4	25.7	12.8	34	16.5	9.3
ND09/URSN-1	98.3	12.9	12.7	11.0	10.7	39	13.0	10.2
ND09/URSN-2	88.3	9.6	8.5	8.7	12.2	38	16.8	10.3
ND09/URSN-3	96.7	16.4	16.1	12.3	14.9	39	16.7	9.7
ND09/URSN-4	95.0	21.1	20.2	10.0	15.9	41	13.1	10.4
ND09/URSN-5	86.7	10.8	9.5	13.7	22.7	38	18.4	10.1
NDSW0714	98.3	15.7	15.4	11.3	20.5	40	13.7	9.7
NDSW0715	93.3	10.3	9.6	9.3	17.5	43	12.6	10.0
BD76A*J0199	80.0	7.5	6.0	9.3	9.8	41	20.1	10.0
3X1-134*FA0067	86.7	11.8	10.3	13.0	18.8	41	16.1	10.0
BW871	81.7	12.8	11.3	11.7	12.5	40	16.5	9.9
01S0094-65	96.7	10.3	9.9	14.7	15.8	41	14.6	9.5
02S0091-9	100.0	22.3	22.3	30.0	30.4	40	13.7	8.8
03S0119-12	100.0	47.9	47.9	26.7	18.1	40	9.1	8.9
03S0352-22	95.0	10.9	10.5	15.0	15.3	41	15.2	9.7
CA908-801	100.0	22.0	22.0	16.7	25.3	38	9.9	9.0
CA908-802	95.0	15.5	15.2	11.3	20.4	40	17.2	10.4
CA908-869	100.0	18.7	18.7	28.3	29.0	39	14.5	9.3
CA908-870	100.0	45.5	45.5	35.0	26.7	40	11.8	8.6
CA908-874	100.0	38.7	38.7	41.7	14.0	39	7.7	8.0
Mean	90.7	18.2	17.4	18.4	14.5	38.8	15.7	9.6
LSD	16.7	12.9	13.0	12.0	–	1.4	3.6	0.8
CV	11.1	36.1	37.7	33.5	–	2.2	15.0	5.2

[1]30 SSW = 30 spike seed weight. This is the sample used to determine VSK.

Table 4. 2009 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 g
2375	93.3	25.8	25.0	23.3	16.6	20	19.7	10.0
Wheaton	100.0	84.2	84.2	65.0	40.1	22	5.6	-
Bacup	91.7	13.7	12.6	9.3	7.4	19	16.0	10.8
Oslo	100.0	35.0	35.0	38.3	18.9	20	13.1	9.0
ND2710	75.0	12.2	10.3	9.3	7.0	21	28.0	11.2
MN05152-1-1	71.7	10.0	7.3	2.7	1.9	20	25.2	11.4
MN06049-1-3	61.7	9.2	6.5	7.3	4.3	19	27.0	11.3
MN06202-3-1	90.0	11.4	10.4	10.0	7.9	19	22.3	11.1
MN06213-6-2-4	100.0	19.1	19.1	4.7	4.3	22	21.1	11.3
MN06219-2-2	95.0	23.0	22.2	7.3	6.3	22	14.8	10.9
SD3948	98.3	16.1	15.9	13.0	12.2	17	19.8	10.9
SD3997	61.7	8.3	5.2	8.7	3.6	19	21.9	10.8
SD4011	70.0	8.8	6.7	8.7	3.8	20	27.6	10.8
SD4027	91.7	13.7	12.7	11.0	9.5	17	24.3	10.8
ND09/URSN-1	93.3	21.7	21.0	9.3	7.7	22	16.3	11.2
ND09/URSN-2	78.3	8.7	7.0	9.3	5.6	19	21.7	11.4
ND09/URSN-3	91.7	15.0	14.1	8.7	10.0	20	25.1	11.3
ND09/URSN-4	100.0	33.7	33.7	9.3	12.0	22	13.5	11.1
ND09/URSN-5	86.7	9.6	8.3	8.7	6.9	19	23.2	11.2
NDSW0714	100.0	28.1	28.1	11.3	12.9	22	12.4	10.7
NDSW0715	88.3	22.2	19.6	10.0	8.0	22	14.1	10.9
BD76A*J0199	91.7	20.0	18.3	6.0	4.1	22	20.4	11.5
3X1-134*FA0067	100.0	34.2	34.2	11.7	8.1	22	11.6	10.6
BW871	95.0	26.5	25.7	15.3	8.6	22	18.0	10.8
01S0094-65	98.3	26.6	26.3	22.3	12.0	22	18.0	10.7
02S0091-9	100.0	29.7	29.7	19.7	15.9	22	13.6	10.6
03S0119-12	100.0	45.1	45.1	11.3	13.5	22	11.8	13.5
03S0352-22	81.7	15.7	13.4	14.0	5.9	21	19.0	10.6
CA908-801	100.0	21.6	21.6	12.3	15.0	20	13.6	10.8
CA908-802	98.3	25.1	24.8	17.3	11.5	22	15.4	10.4
CA908-869	100.0	28.3	28.3	23.0	23.6	22	15.1	10.3
CA908-870	100.0	36.7	36.7	17.3	12.1	22	14.7	10.5
CA908-874	96.7	22.5	22.1	18.0	8.0	20	13.2	10.0
Mean	90.9	23.1	22.1	14.4	10.5	20.7	18.1	10.9
LSD (0.05)	15.0	14.1	14.5	7.7	–	1.4	6.1	0.9
CV	10.0	31.5	33.6	28.0	–	4.3	21.7	5.1

[1]30 SSW = 30 spike seed weight. This is the sample used to determine VSK.

Table 5. 2009 Uniform Regional Scab Nursery for Spring Wheat Parents, Langdon, ND.

Line	Incidence %	Severity %	Disease Index	FDK %	DON ppm	Heading d from 6-1	1000 KWT g
2375	67.5	9.6	6.4	4.2	3.4	42	29.3
Wheaton	87.5	8.8	7.9	8.9	10.6	45	20.0
Bacup	22.5	7.1	1.6	3.3	4.1	38	25.9
Oslo	85.0	12.7	11.3	6.2	7.2	41	19.5
ND2710	52.5	8.9	4.8	3.2	2.2	41	29.9
MN05152-1-1	37.5	7.5	2.9	2.4	2.9	43	28.9
MN06049-1-3	27.5	5.9	2.1	1.9	1.1	40	27.6
MN06202-3-1	90.0	8.3	7.5	5.0	3.7	41	24.4
MN06213-6-2-4	77.5	9.8	8.2	6.2	4.0	44	24.4
MN06219-2-2	35.0	12.2	4.5	4.8	6.0	44	22.2
SD3948	40.0	8.1	3.4	3.2	2.4	38	23.1
SD3997	20.0	5.9	1.4	1.4	1.2	41	28.9
SD4011	35.0	7.6	2.7	2.8	1.5	43	19.5
SD4027	70.0	9.7	6.8	2.3	2.8	39	24.8
ND09/URSN-1	70.0	8.4	5.9	3.4	3.7	45	21.5
ND09/URSN-2	82.5	11.3	10.0	3.1	2.7	42	22.2
ND09/URSN-3	9.5	12.1	11.4	5.4	2.3	43	24.8
ND09/URSN-4	70.0	7.7	5.5	2.6	1.8	43	26.0
ND09/URSN-5	100.0	11.3	11.3	4.8	4.0	44	22.8
NDSW0714	75.0	10.4	7.0	6.1	4.2	44	22.6
NDSW0715	82.5	8.3	7.0	5.0	4.5	44	24.9
BD76A*J0199	95.0	9.7	9.3	4.4	4.0	45	21.6
3X1-134*FA0067	82.5	16.9	15.2	6.0	2.6	44	20.7
BW871	40.0	7.5	3.0	1.8	1.4	43	25.6
01S0094-65	82.5	10.8	9.5	3.8	3.3	46	20.7
02S0091-9	80.0	7.8	6.2	3.6	5.3	47	21.1
03S0119-12	95.0	9.1	8.8	4.1	5.1	45	26.5
03S0352-22	32.5	10.4	3.2	2.5	1.6	44	22.8
CA908-801	62.5	8.4	5.7	4.2	7.1	46	22.0
CA908-802	62.5	10.5	7.0	3.0	1.9	43	27.7
CA908-869	77.5	11.9	9.1	5.0	2.1	43	20.9
CA908-870	55.0	7.7	4.5	2.9	2.8	44	19.7
CA908-874	67.5	11.1	8.8	3.1	3.0	46	17.4
Mean	62.7	9.5	6.7	4.0	3.5	42.9	23.6
LSD	34.7	NS	6.0	2.3	2.1	2.7	2.5
CV	37.8	38.2	64.0	42.3	42.2		7.4

Table 6. 2009 Uniform Regional Scab Nursery for Spring Wheat Parents, Glenlea, MB.

Line	Incidence %[§]	Severity %[§]	Disease Index[§]
2375	38.8	41.3	15.3
Wheaton	55.0	65.0	35.4
Bacup	56.3	32.5	18.9
Oslo	72.5	67.5	49.1
ND2710	25.0	30.0	7.2
MN05152-1-1	35.0	28.8	10.1
MN06049-1-3	46.3	22.5	11.6
MN06202-3-1	46.3	30.0	14.1
MN06213-6-2-4	52.5	23.8	12.0
MN06219-2-2	36.3	21.3	7.9
SD3948	45.0	38.8	18.0
SD3997	48.8	30.0	15.9
SD4011	51.3	26.3	13.5
SD4027	57.5	26.3	15.1
ND09/URSN-1	52.5	35.0	18.5
ND09/URSN-2	51.3	31.3	15.9
ND09/URSN-3	56.3	31.3	18.4
ND09/URSN-4	51.3	28.8	15.2
ND09/URSN-5	72.5	50.0	36.3
NDSW0714	61.3	42.5	26.6
NDSW0715	48.8	25.0	11.6
BD76A*J0199	42.5	20.0	8.8
3X1-134*FA0067	37.5	26.3	9.9
BW871	31.3	30.0	10.5
01S0094-65	56.3	47.5	26.6
02S0091-9	67.5	38.8	27.2
03S0119-12	72.5	36.3	25.0
03S0352-22	56.3	40.0	22.6
CA908-801	66.3	46.3	30.8
CA908-802	40.0	23.8	9.4
CA908-869	58.8	50.0	31.5
CA908-870	62.5	33.8	21.2
CA908-874	71.3	32.5	23.6
Mean	52.2	34.9	19.2
LSD	-	-	20.5
CV	-	-	61.1

[§]Means of 4 replicates.

Table 7. 2009 Uniform Regional Scab Nursery for Spring Wheat Parents.
Means and Ranks Over Locations.

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**	**5**	**5**	**5**	**4**	**4**	**4**	**4**
2375	79.9	13	28.1	26	22.1	20	20.4	25	11.0	24
Wheaton	88.5	29	55.3	33	49.2	33	52.6	33	22.1	33
Bacup	71.8	9	18.9	6	14.7	6	12.2	8	6.3	7
Oslo	91.5	32	42.0	32	38.1	32	38.2	32	14.2	29
ND2710	64.5	3	17.4	3	11.2	2	9.6	3	5.4	5
MN05152-1-1	64.5	3	18.2	4	12.6	4	8.0	1	3.1	1
MN06049-1-3	59.4	1	14.7	1	10.7	1	10.0	4	3.5	2
MN06202-3-1	82.6	17	19.7	8	15.9	9	14.6	17	6.9	10
MN06213-6-2-4	85.0	23	19.7	8	17.0	11	8.0	1	4.5	4
MN06219-2-2	72.3	10	23.4	17	19.0	17	12.2	8	6.2	6
SD3948	71.3	8	20.4	11	14.8	7	13.0	15	7.9	15
SD3997	59.4	1	18.9	6	14.1	5	12.8	13	4.3	3
SD4011	69.6	5	16.6	2	12.4	3	12.8	13	6.5	9
SD4027	82.8	19	21.4	13	18.2	15	20.6	26	9.1	19
ND09/URSN-1	82.8	19	24.6	19	20.6	19	12.2	8	7.8	14
ND09/URSN-2	80.1	14	19.8	10	15.9	9	11.5	6	7.1	11
ND09/URSN-3	70.8	7	22.5	15	19.6	18	12.4	11	8.1	17
ND09/URSN-4	83.3	21	25.4	20	22.1	20	10.9	5	8.8	18
ND09/URSN-5	89.2	30	26.5	21	23.2	24	17.6	23	12.2	27
NDSW0714	86.9	26	26.9	22	23.0	22	15.1	19	11.6	26
NDSW0715	82.6	17	20.9	12	17.3	12	11.5	6	9.2	20
BD76A*J0199	81.8	16	18.7	5	15.7	8	12.4	11	6.3	7
3X1-134*FA0067	81.3	15	27.0	23	23.0	22	17.2	22	9.9	21
BW871	69.6	5	23.1	16	17.9	14	14.3	16	7.6	12
01S0094-65	86.8	25	28.4	27	23.8	25	22.3	28	10.0	22
02S0091-9	89.5	31	27.7	24	25.0	26	22.5	29	14.8	31
03S0119-12	93.5	33	36.6	31	34.3	31	18.9	24	10.9	23
03S0352-22	73.1	11	24.4	18	18.9	16	15.4	20	7.6	12
CA908-801	85.8	24	28.9	28	25.2	27	15.4	20	14.5	30
CA908-802	79.2	12	21.4	13	17.7	13	15.0	18	11.4	25
CA908-869	87.3	28	30.8	29	26.5	29	21.2	27	15.9	32
CA908-870	83.5	22	34.3	30	31.1	30	23.0	30	13.2	28
CA908-874	87.1	27	27.9	25	25.6	28	23.6	31	7.9	15
Mean	79.3		25.2		21.1		16.9		9.2	

Table 8. Correlation coefficients between traits, by location.

Correlation Between	Brookings	Crookston	St. Paul	Langdon	Glenlea
Incidence & Severity	N/A	0.54	0.59	0.35	0.54
Incidence & Disease Index	N/A	0.58	0.63	0.67	0.80
Incidence & Tombstone/FDK/VSK	N/A	0.49	0.37	0.50	
Incidence & DON	N/A	0.63	0.54	0.44	
Severity & Disease Index	1.00	1.00	1.00	0.82	0.92
Severity & Tombstone/FDK/VSK	0.69	0.90	0.81	0.51	
Severity & DON	0.60	0.44	0.84	0.13	
Disease Index & Tombstone/FDK/VSK	0.62	0.90	0.80	0.62	
Disease Index & DON	0.27	0.46	0.85	0.27	
Tombstone/FDK/VSK & DON	0.79	0.42	0.90	0.73	

N/A - Not available due to Incidence values all being 100%

Table 9. Correlation coefficients between traits, using means over locations.

	Incidence %	Severity %	Disease Index	VSK %
Severity %	0.64			
Disease Index	0.71	0.99		
VSK %	0.53	0.91	0.89	
DON ppm	0.69	0.86	0.86	0.81

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

Trait / Gene	Scab / Fhb1	Scab / Fhb_5A	Tan Spot / tsn1	Grain Protein Content / GPC	HMW Glutenins/Glu	HMW Glutenins/Glu-1Dx	HMW Glutenins /Glu-1Dy	Leaf Rust / Lr21	Leaf Rust / Lr34	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)
Marker	umn10	barc180	fcp394	uhw89	umn19	umn25	umn26	Lr21	csLV34	Ppd-D1a	Ppd-D1b	Rht-B1a	Rht-B1b	Rht-D1a	Rht-D1b
Chromosome	3B	5A	5B	6B	1A	1D	1D	1D	7D	2D	2D	4B	4B	4D	4D
2375	238	194	328	125	***341***	***278***	***391***	209	***156***	284		+	+	-	-
Wheaton	238	190	***377***	125	***341***	***278***	***391***	209	***156***	284		+	+	-	-
Bacup	238	197	328	125	359	***278***	***391***	209	237	-	-	-	+	-	-
Oslo	238	190	***377***	125	359	295	408	209	237	284		-	+	-	-
ND2710	***241***	***203***	328	125	359	***278***	***391***	209	***156***	284	414	+	+	-	-
MN05152-1-1	***241***	190	328	125	359	***278***	***391***	209	***156***	284	414	+	+	-	-
MN06049-1-3	***241***	***203***	***377***	125	***341***	***278***	***391***	209	***156***	284		+	+	-	-
MN06202-3-1	***241***	***203***	***377***	125	359	***278***	***391***	209	***156***		414	-	+	-	-
MN06213-6-2-4	***241***	***203***	328	125	***341***	***278***	***391***	209	***156***	284	414	-	+	-	-
MN06219-2-2	***241***	***203***	328	125	***341***	***278***	***391***	209	***156***	284	414	-	+	-	-
SD3948	***241***	190	328	125	***341***	***278***	***391***	209	***156***	284		-	+	-	-
SD3997	238	200	328	125	***341***	***278***	***391***	209	***156***	284		+	+	-	-
SD4011	238	190	328	125	***341***	***278***	***391***	209	***156***	284	414	+	+	-	-
SD4027	238	190	328	125	-	-	-	209	***156***		414	+	+	-	-
ND09/URSN-1	***241***	***203***	***377***	125	***341***	***278***	***391***	209	***156***		414	-	+	-	-
ND09/URSN-2	***241***	190	328	125	***341***	***278***	***391***	***196***	237		414	+	+	-	-
ND09/URSN-3	***241***	***203***	328	125	***341***	***278***	***391***	***196***	237	284	414	-	+	-	-
ND09/URSN-4	***241***	200	328	125	***341***	***278***	***391***	***196***	237		414	-	+	-	-
ND09/URSN-5	238	190	328	125	***341***	***278***	***391***	***196***	237		414	-	+	-	-
NDSW0714	***241***	***203***	328	125	***341***	***278***	***391***	209	***156***		414	-	+	-	-
NDSW0715	***241***	***203***	328	125	***341***	***278***	***391***	209	***156***		414	-	+	-	-
BD76A*J0199	***241***	190	***377***	125	***341***	***278***	***391***	***196***	237	284	414	+	+	-	-
3X1-134*FA0067	***241***	197	328	125	***341***	***278***	***391***	209	***156***		414	+	+	-	-
BW871	***241***	197	328	125	***341***	***278***	***391***	***196***	***156***		414	+	+	+	-
01S0094-65	***241***	***203***	***377***	125	***341***	***278***	***391***	209	***156***		414	+	+	-	-
02S0091-9	238	***203***	***377***	125	***341***	***278***	***391***	***196***	***156***	284		-	+	-	-
03S0119-12	***241***	***203***	***377***	125	***341***	***278***	***391***	209	***156***	284		+	+	-	-
03S0352-22	238	***203***	328	125	***341***	***278***	***391***	209	***156***		414	+	-	-	-

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

Westbred entries excluded on request.

Table 10 continued.

Trait	Marker	Gene	Chromosome	Size (base)
scab	umn10	Fhb1	3B	Resistance=241
scab	barc180	Fhb_5A	5A	Resistance=203
Tan Spot	fcp394	tsn1	5B	Resistance=377
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
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	237 = +
plant height	Rht-B1b	Rht-B1b (dwarf)	4B	235 = +
plant height	Rht-D1a	Rht-D1a (wild type)	4D	261 = +
plant height	Rht-D1b	Rht-D1b (Dwarf)	4D	252 = +