Report of the 2021 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 26th year in 2021. Five locations (Brookings, SD, St. Paul, MN, Crookston, MN, Prosper, ND, Langdon, ND) reported results.

A total of 21 entries was included in the 2021 URSN, in addition to the resistant checks 2710, BacUp, and Rollag, the susceptible checks Wheaton, Oslo, and Norm, and N10, a Norm near-isoline containing *Fhb1*. The entries were contributed by four university wheat breeding programs.

The core set of traits evaluated at the nursery locations varied, but most included Fusarium head blight (FHB) incidence, FHB severity, and disease index. In addition, visual scabby kernel ratings (VSK/tombstone/FDK) were provided for locations. Additional agronomic trait data are presented in individual location summary tables for locations where they were measured. Adult plant and seedling stem rust reactions are also presented. Molecular marker genotypes for a set of FHB resistance QTLs and other traits are provided for entries.

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Table 1. Entries for the 2021 Uniform Regional Scab Nursery Parents.

Entry	Line	Pedigree	1st Year in URSN	Submitter	Organization
1	Bacup	CHECK			
2	2710	CHECK			
3	Rollag	CHECK			
4	Oslo	CHECK			
5	Wheaton	CHECK			
6	Norm	CHECK			
7	N10	CHECK (Norm Fhb1 NIL)	2021	J. Anderson	UMN
8	MN17033-1	MN12069-1/Shelly	2021	J. Anderson	UMN
9	MN17038-5	MN10023-8/MN10204-6	2021	J. Anderson	UMN
10	MN17271-1	MN12069-1/MN11268-1	2021	J. Anderson	UMN
11	MN17332-2	MN12007/MN-Washburn sel//MN10281-1-39	2021	J. Anderson	UMN
12	SD4871	MN10261-1/SD4178	2021	K. Glover	SDSU
13	SD4933	SD4496/MN10261-1	2021	K. Glover	SDSU
14	SD4968	SD4416/SD4383	2021	K. Glover	SDSU
15	SD4976	BOOST/SD4624	2021	K. Glover	SDSU
16	SD4991	SURPASS/SD4587	2021	K. Glover	SDSU
17	SD5012	SD4383/SD4416	2021	K. Glover	SDSU
18	MT 1716	MT1274/RB07	2019	J. Cook	MSU
19	MT 1855	MT1053/MO8/3-4	2020	J. Cook	MSU
20	MT 2007	MT 1316/ND819	2021	J. Cook	MSU
21	MT 2013	MT 1542/ND819	2021	J. Cook	MSU
22	MT 2018	MT 1524/ND819	2021	J. Cook	MSU
23	MT 2022	MT 1401/ND 819	2021	J. Cook	MSU
24	NDHRS13-0177-0001	ND823/LANGMN	2021	A. Green	NDSU
25	NDHRS13-0156-C04	ALSEN/FOREFRONT	2021	A. Green	NDSU
26	NDHRS13-0309-B03	LANGMN/SYSOREN	2021	A. Green	NDSU
27	NDHRS17-0596-B28	ND834/LINKERT//SYROWYN	2021	A. Green	NDSU
28	NDHRS17DH-0467-056	ND834/ND826//NDVITPRO	2021	A. Green	NDSU

Table 2. 2021 Uniform Regional Scab Nursery for Spring Wheat Parents, St. Paul, MN.

Entry	Line	Incidence %	Severity %	Disease Index	VSK %	Heading d from 6-1	micro TWT [1] g
1	Bacup	65.0	12.1	7.9	7.0	22.0	11.5
2	2710	96.7	20.5	19.9	6.0	24.0	11.7
3	Rollag	96.7	27.8	26.8	10.0	24.0	11.7
4	Oslo	96.7	36.4	35.6	32.5	23.3	10.1
5	Wheaton	100.0	58.1	58.1	45.0	28.0	9.0
6	Norm	98.3	61.8	60.7	18.5	28.0	10.4
7	N10	100.0	40.6	40.6	15.0	28.0	10.4
8	MN17033-1	78.3	15.0	12.1	4.0	28.0	12.0
9	MN17038-5	88.3	29.3	25.5	9.0	28.0	11.4
10	MN17271-1	60.0	10.8	6.6	4.0	28.0	11.9
11	MN17332-2	93.3	19.1	18.0	6.0	28.0	11.8
12	SD4871	83.3	17.2	15.1	10.0	25.3	11.3
13	SD4933	85.0	19.7	17.0	3.0	26.7	11.7
14	SD4968	88.3	24.5	21.4	9.0	25.3	11.2
15	SD4976	70.0	12.8	10.6	17.0	22.7	10.9
16	SD4991	85.0	16.4	14.7	6.0	23.3	11.4
17	SD5012	98.3	30.6	30.2	23.5	24.0	10.6
18	MT 1716	93.3	38.2	35.9	10.0	25.3	11.2
19	MT 1855	96.7	30.2	29.0	7.0	28.0	10.6
20	MT 2007	91.7	33.9	31.2	17.5	24.0	10.6
21	MT 2013	100.0	56.4	56.4	45.0	24.0	10.2
22	MT 2018	93.3	42.2	40.2	37.5	23.3	10.1
23	MT 2022	90.0	13.4	12.2	35.0	22.0	10.4
24	NDHRS13-0177-0001	96.7	25.8	25.0	8.0	24.0	11.8
25	NDHRS13-0156-C04	73.3	20.0	16.2	8.0	22.7	11.1
26	NDHRS13-0309-B03	73.3	19.7	16.7	6.0	26.7	11.5
27	NDHRS17-0596-B28	93.3	30.4	28.5	10.0	25.3	11.5
28	NDHRS17DH-0467-056	96.7	28.0	27.1	10.0	24.0	11.7
	Alsen*	98.3	35.8	35.4	8.0	25.3	11.3
	Roblin*	96.7	47.1	45.8	80.0	24.0	9.0
	MN00269*	96.7	47.6	46.6	17.5	31.0	10.4
Mean		89.46	29.72	27.96	16.94	25.37	10.96
LSD		20.98	15.74	16.78	13.79	2.22	0.57
CV		14.36	32.43	36.75	39.91	5.35	2.53

[1] Weight of the VSK sample that fits in a 15.7 mL copper vessel measuring 20 mm in diameter and 50 mm in height

* Extra entries

DON ppm
5.3
8.7
11.3
9.6
19.0
20.8
13.7
4.6
11.4
4.6
8.1
10.8
4.5
7.8
14.4
4.8
12.5
6.0
6.8
15.4
12.9
14.8
14.0
9.5
4.4
5.3
7.5
20.5
10.0
17.3
8.0
10.46
–
–

Table 3. 2021 Uniform Regional Scab Nursery for Spring Wheat Parents, Crookston, MN.

Entry	Line	Incidence [1] %	Severity [1] %	Disease [1] Index	VSK %	Heading d from 6-1	micro TWT [2] g
1	Bacup	–	–	–	8.0	25.3	10.9
2	2710	–	–	–	6.0	29.7	10.8
3	Rollag	–	–	–	11.0	28.3	10.9
4	Oslo	–	–	–	65.0	28.7	9.0
5	Wheaton	–	–	–	75.0	31.0	8.2
6	Norm	–	–	–	65.0	32.0	8.7
7	N10	–	–	–	47.5	31.0	9.5
8	MN17033-1	–	–	–	5.0	33.3	10.8
9	MN17038-5	–	–	–	8.0	31.3	11.3
10	MN17271-1	–	–	–	3.0	31.3	11.7
11	MN17332-2	–	–	–	5.0	32.3	11.9
12	SD4871	–	–	–	8.0	29.7	11.3
13	SD4933	–	–	–	5.0	29.0	11.6
14	SD4968	–	–	–	8.0	28.0	10.4
15	SD4976	–	–	–	22.5	28.0	10.0
16	SD4991	–	–	–	7.0	27.7	11.5
17	SD5012	–	–	–	9.0	28.0	10.8
18	MT 1716	–	–	–	13.5	30.7	10.6
19	MT 1855	–	–	–	9.0	33.7	9.9
20	MT 2007	–	–	–	20.0	27.7	10.3
21	MT 2013	–	–	–	27.5	28.0	10.0
22	MT 2018	–	–	–	26.0	27.0	9.9
23	MT 2022	–	–	–	16.0	27.0	10.5
24	NDHRS13-0177-0001	–	–	–	8.0	29.7	11.1
25	NDHRS13-0156-C04	–	–	–	11.0	27.0	10.6
26	NDHRS13-0309-B03	–	–	–	8.0	30.3	11.1
27	NDHRS17-0596-B28	–	–	–	9.0	31.3	10.8
28	NDHRS17DH-0467-056	–	–	–	9.0	29.0	11.2
	Alsen*	–	–	–	11.0	31.0	10.3
	Roblin*	–	–	–	77.5	26.0	9.2
	MN00269*	–	–	–	52.5	34.7	8.7
Mean		–	–	–	21.16	29.60	10.41
LSD		–	–	–	13.25	1.63	0.76
CV		–	–	–	30.70	3.38	3.58

[1] Incidence, Severity, and Disease data were not recorded due to low disease levels at 3-4 weeks after heading

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

* Extra entries

DON ppm
3.1
2.0
4.4
8.1
15.4
21.5
12.1
3.4
6.7
1.8
4.6
4.7
3.3
4.0
5.3
1.7
4.0
6.1
4.0
6.6
7.0
5.2
4.4
4.9
3.5
3.7
4.3
4.5
4.6
5.9
21.4
6.20
–
–

Table 4. 2021 Uniform Regional Scab Nursery for Spring Wheat Parents, Brookings, SD.

Entry	Line	Incidence %	Severity %	Disease Index	Tombstone %
1	Bacup	94.0	19.9	18.7	28.3
2	2710	85.7	15.0	13.0	27.5
3	Rollag	96.7	23.3	22.8	26.7
4	Oslo	93.2	23.5	22.1	30.0
5	Wheaton	100.0	41.3	41.3	40.0
6	Norm	96.7	21.1	20.5	28.3
7	N10	93.7	19.8	18.5	27.5
8	MN17033-1	92.8	18.8	17.7	21.7
9	MN17038-5	98.7	24.2	23.9	23.3
10	MN17271-1	93.2	19.8	18.6	22.5
11	MN17332-2	93.2	20.5	19.3	21.7
12	SD4871	92.0	17.1	15.9	22.5
13	SD4933	91.2	18.6	17.0	18.3
14	SD4968	92.0	18.1	16.8	25.8
15	SD4976	95.8	21.6	20.7	29.2
16	SD4991	92.2	19.0	17.7	15.0
17	SD5012	89.5	15.9	14.3	24.2
18	MT 1716	98.0	23.3	22.8	25.0
19	MT 1855	100.0	29.8	29.8	25.0
20	MT 2007	96.5	23.5	22.7	27.5
21	MT 2013	95.0	27.0	25.8	37.5
22	MT 2018	99.2	25.2	25.1	29.2
23	MT 2022	98.0	21.2	20.8	27.5
24	NDHRS13-0177-0001	93.2	18.3	17.1	22.5
25	NDHRS13-0156-C04	97.2	23.1	22.5	31.7
26	NDHRS13-0309-B03	93.3	18.7	17.5	19.2
27	NDHRS17-0596-B28	91.3	16.6	15.3	20.8
28	NDHRS17DH-0467-056	96.3	25.6	24.7	24.2
Mean		94.59	21.78	20.82	25.81
LSD (0.05)		4.91	3.80	4.17	4.59
CV		4.53	15.33	17.53	15.61

Table 5. 2021 Uniform Regional Scab Nursery for Spring Wheat Parents, Prosper, ND.

Entry	Line	Severity %	FDK %	FHB (1-9)
1	Bacup	27.0	56.7	4.7
2	2710	31.0	56.7	4.7
3	Rollag	15.3	16.7	3.7
4	Oslo	39.3	16.7	4.3
5	Wheaton	18.3	16.7	4.0
6	Norm	23.4	21.7	4.0
7	N10	18.0	11.7	4.3
8	MN17033-1	38.3	30.0	5.0
9	MN17038-5	21.3	16.7	3.3
10	MN17271-1	32.0	21.7	3.7
11	MN17332-2	18.2	21.7	3.3
12	SD4871	34.7	11.7	4.0
13	SD4933	30.6	18.3	3.7
14	SD4968	17.9	13.3	3.3
15	SD4976	19.3	20.0	4.0
16	SD4991	15.8	16.7	2.7
17	SD5012	27.1	35.0	4.0
18	MT 1716	26.6	31.7	4.0
19	MT 1855	21.1	28.3	3.7
20	MT 2007	30.5	51.7	4.0
21	MT 2013	42.6	45.0	4.0
22	MT 2018	39.1	16.7	4.0
23	MT 2022	25.2	26.7	4.0
24	NDHRS13-0177-0001	24.2	20.0	4.3
25	NDHRS13-0156-C04	18.3	20.0	3.3
26	NDHRS13-0309-B03	20.5	31.7	4.3
27	NDHRS17-0596-B28	34.1	30.0	3.3
28	NDHRS17DH-0467-056	28.7	30.0	4.0
Mean		26.40	26.20	3.90
LSD		12.25	15.75	1.04
CV		28.37	36.73	16.19

Table 6. 2021 Uniform Regional Scab Nursery for Spring Wheat Parents, Langdon, ND.

Entry	Line	FDK %	FHB (1-9)
1	Bacup	40.0	4.7
2	2710	35.0	5.0
3	Rollag	38.3	5.0
4	Oslo	20.0	4.5
5	Wheaton	30.0	4.0
6	Norm	38.3	5.0
7	N10	33.3	4.3
8	MN17033-1	31.7	3.3
9	MN17038-5	26.7	6.0
10	MN17271-1	36.7	5.3
11	MN17332-2	35.0	4.0
12	SD4871	38.3	5.3
13	SD4933	25.0	3.7
14	SD4968	25.0	3.7
15	SD4976	38.3	5.7
16	SD4991	25.0	4.0
17	SD5012	41.7	5.7
18	MT 1716	38.3	5.7
19	MT 1855	45.0	4.3
20	MT 2007	40.0	4.0
21	MT 2013	50.0	6.0
22	MT 2018	38.3	6.0
23	MT 2022	35.0	3.3
24	NDHRS13-0177-0001	35.0	4.3
25	NDHRS13-0156-C04	38.3	4.3
26	NDHRS13-0309-B03	46.7	5.3
27	NDHRS17-0596-B28	31.7	4.0
28	NDHRS17DH-0467-056	36.7	5.0
Mean		35.50	4.70
LSD		14.39	1.58
CV		24.77	20.49

Table 7. 2021 Uniform Regional Scab Nursery for Spring Wheat Parents - Summary of Means.

	Incidence		Severity		Disease	
	%	Rank	%	Rank	Index	Rank
No. of Locations >	2		3		2	
Line						
Bacup	79.5	2	19.7	5	13.3	2
2710	91.2	11	22.2	11	16.5	7
Rollag	96.7	23	22.1	10	24.8	18
Oslo	94.9	18	33.1	24	28.9	21
Wheaton	100.0	28	39.2	27	49.7	28
Norm	97.5	26	35.4	25	40.6	26
N10	96.9	24	26.1	18	29.5	24
MN17033-1	85.6	6	24.0	15	14.9	3
MN17038-5	93.5	14	24.9	17	24.7	17
MN17271-1	76.6	1	20.8	9	12.6	1
MN17332-2	93.3	13	19.3	3	18.6	11
SD4871	87.7	7	23.0	14	15.5	4
SD4933	88.1	8	23.0	13	17.0	9
SD4968	90.2	10	20.2	7	19.1	12
SD4976	82.9	3	17.9	2	15.6	5
SD4991	88.6	9	17.1	1	16.2	6
SD5012	93.9	15	24.5	16	22.3	16
MT 1716	95.7	20	29.4	23	29.4	22
MT 1855	98.3	27	27.0	20	29.4	23
MT 2007	94.1	17	29.3	22	27.0	20
MT 2013	97.5	25	42.0	28	41.1	27
MT 2018	96.3	21	35.5	26	32.6	25
MT 2022	94.0	16	19.9	6	16.5	8
NDHRS13-0177-0001	94.9	18	22.8	12	21.0	14
NDHRS13-0156-C04	85.3	5	20.5	8	19.4	13
NDHRS13-0309-B03	83.3	4	19.6	4	17.1	10
NDHRS17-0596-B28	92.3	12	27.0	19	21.9	15
NDHRS17DH-0467-056	96.5	22	27.4	21	25.9	19

Table 8. Correlation Coefficients Between Traits, by Location.

Correlation Between	St. Paul	Crookston	Brookings	Prosper
Incidence & Severity	0.691		0.769	
Incidence & Disease Index	0.728		0.804	
Incidence & Tombstone/VSK/FDK	0.433		0.425	
Incidence & DON	0.529			
Severity & Disease Index	0.997		0.998	
Severity & Tombstone/VSK/FDK	0.638		0.658	0.336
Severity & DON	0.616			
Disease Index & Tombstone/VSK/FDK	0.650		0.647	
Disease Index & DON	0.632			
Tombstone/VSK/FDK & DON	0.599	0.867		

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

	Incidence	Severity	Disease Index
Severity	0.522		
Disease Index	0.582	0.996	
Tombstone/VSK/FDK	0.521	0.364*	0.423

Calculated using 2 locations unless noted

* 3 locations

Table 10. 2021 Uniform Regional Scab Nursery for Spring Wheat Parents, St. Paul, MN.
Seedling stem rust reactions (Y. Jin, USDA-ARS).

	Race									
Line	QFCSC 06ND76C	QTHJC 75ND717C	MCCFC 59KS19	RCRSC 77ND82A	RKRQC 99KS76A-1	TPMKC 74MN1409	TTTTF 01MN84A-1-2	GFMNC 12WA147-2	QCCSM 75WA165-2A	Adult plant stem rust [1]
Bacup	2-	2-/2	2-	2-	2	2	3/2/;1	;2-/2	2-;	5R
2710	0;	2-	;	;	;2-	2-	;1	;	;	5R-MR
Rollag	;1	2-LIF	;1-	;1-	2	2-	;2-	2-;	2-	5R-MR
Oslo	;	2	1-;	2-	;2-	2-	3-	;2-	;	10R
Wheaton	0;	2-	;	;	;2-/2-	2-	1;	0;	;	0
Norm	0;	2-	0;	0;	;1-	2-	-	0	0;	0
N10	-	2-	;	0;	2-	2-	1;	0;	;	5R
MN17033-1	0;	0;	0;	0;	;1-	2-	;	0	0;	5R-MR
MN17038-5	0;	2-	;	0;	;2-	2-	;1	;	;	5R-MR
MN17271-1	0	0	0;	0	0	;2-	0;	0;	0	5R-MR
MN17332-2	;	2-	;	;	2-	2-	;2-	;2-	;2-	20R-MR
SD4871	0;	2-/2	;	2-;	2-/2	2-	;1	0;	;2-	5MR
SD4933	0;	2-	;2-	;2-	2	2-	;1	;	;2-	5R-MR
SD4968	;	2-	;2-	;/;1-	2-	2-	;1	;	;	5R-MR
SD4976	;	2-	;1-	;2-	2-	2-	;1	;	;2-	10R-MR
SD4991	;	2	;1-	;1-	2	2-	;1	;2-	;2-	40MR-MS
SD5012	;	2-	;1-	;1-	2-	2-	;1	0;	;2-	5R
MT 1716	;1-	2	2-;	;1-	2-	2-	;1	;	;2-	10R-MR
MT 1855	;1	12-	2-;	2-/;2-	12	12-	21	;2-	2	30MS-S
MT 2007	0;	2-	;2-	;2-/;	2/;	2-	;1	;/2-	;	10MR
MT 2013	;	2-	2-	2-	2	2-	1;	0;	2-	5R-MR
MT 2018	;2-	2-	2-	2	2	2-	2+3	2-	2-	10MR
MT 2022	0;	2-	;2-	;2-	2	2-	;1	;	;2-	10MR
NDHRS13-0177-0001	;	2	2-;	2-	2	2-/2	12-/;1	;	2-;	5R
NDHRS13-0156-C04	0;	-	;	;	;	2-	0;1	0;	0;	10R-MR
NDHRS13-0309-B03	0;	2-	;2-	;2-	2	2-	11+;	0;	2-;	10R-MR
NDHRS17-0596-B28	;	2	;1-	;1-	2/3	2-	;11+	0;	;	50MS
NDHRS17DH-0467-056	0;	2-	0;	0;	0;	2-	0;	0;	0;	0
Line E*	4	3+	4	4	4	4	4	4	4	100S
LMPG-6*	3	3	23-	3	3	3-	3	3	3	80S
NA101/MqSr7a*	1;	1+3-	3	1+	1;	3	1;	1+1;	1;	50MS-S

[1] SR%IR

* checks

Explanatory notes on next page

Table 10 continued, Explanatory notes.

A. Races used in seedling evaluations:

Race	Origin	Virulence on differential genes
GFMNC	USA	8a 9a 9g 10 17 21 36 McN
QCCSM	USA	5 9a 9d 9g 10 17 21 24 McN
QFCSC	USA	5 8a 9a 9d 9g 10 17 21 McN
QTHJC	USA	5 6 8a 9b 9d 9g 10 11 17 21 McN
MCCFC	USA	5 7b 9g 10 17 Tmp McN
RCRSC	USA	5 7b 9a 9b 9d 9g 10 17 21 36 McN
RKRQC	USA	5 6 7b 8a 9a 9b 9d 9g 17 21 36 McN
TPMKC	USA	5 7b 8a 9d 9e 9g 10 11 17 21 36 Tmp McN
TTTTF	USA	5 6 7b 8a 9a 9b 9d 9e 9g 10 11 17 21 30 36 38 Tmp McN

* Red font represents unique and/or significant virulence or combination of virulences to resistance genes that are important in spring wheat

B. Seedling rating scale:

0 to 4 infection type scale of Stakmen et al., 3 or 4 are considered susceptible

"/" denotes hetergeneous, the predominant type given first.

"LIF" denotes low infection frequency, or fewer number of pustules.

"C" stands for excessive chlorosis

"N" stands for excessive necrosis

"Sr2M" referred to seedling chlorosis, similar to Sr2 expression in seedling under certain environments

C. Field Stem rust nursery

Test entries were planted in 1-meter row-plot in field X-14, St. Paul campus, MN.
Field stem rust nusery was inoculated with a bulk of 5 races: QFCSC (95MN1080), QTHJC (69MN399), RCRSC (00MN99C), RTQQC (04MN74-1), and TMPKC (74MN1409)
Stem rust disease severity (estimated % of stem tissue covered by rust pustules) and infection responses (R, MR, MS, and S) were noted at growth stages between milk and soft dough.

F. Please direct any questions to yue.jin@usda.gov and sam.gale@usda.gov

Table 11. Markers Associated With Selected Traits/Genes (J. Fiedler, USDA-ARS).

Entry	Line	Stem Rust 3B	Stem Rust 6A	Stem Rust 3B	Stem Rust 7D	Leaf Rust 2B	Leaf Rust 2B	Leaf Rust 1D	Leaf Rust 2B	Leaf Rust 7D	Yellow Rust 2B	Tan Spot 5B	Fhb 3B	Fhb 3B	Fhb 5A	Fhb 5A	Fhb 6B	Grain Protein 6B	Glutenins 1D	Glutenins 1A	Dwarfing 4B	Dwarfing 4D	Photoperiod 2B	Photoperiod 2D
	Marker	Sr2	Sr8	Sr12	Sr25 *	Lr13	Lr16	Lr21	Lr23	Lr34	Yr7	Tsn	Fhb1	TaHRC	barc180	barc186	gwm644 *	GPC	GluD1	umn19 *	RhtB1	RhtD1	PpdB1	PpdD1
1	Bacup	S	S	R		R	S	S	S	R	S	S	S	S	R	R		N	G		Wt	Wt	I	I
2	2710	S	S	R		R	S	S	R	R	R	S	R	R	R	R		N	G		Wt	Wt	S	S
3	Rollag	S	S	R		R	R	S	R	R	S	R	R	R	S	R		N	G		Wt	D	S	S
4	Oslo	S	R	R		S	S	S	S	S	R	R	S	S	S	S		N	P		D	Wt	S	I
5	Wheaton	S	S	R		R	S	S	R	R	R	R	S	S	S	S		N	G		Wt	D	S	I
6	Norm	S	S	R		R	R	S	R	R	R	R	S	S	S	S		N	G		Wt	D	S	S
7	N10	S	S	R		R	R	S	R	R	R	R	R	S	R	S		N	U		Wt	D	S	S
8	MN17033-1	S	S	R		S	S	S	R	R	S	R	R	R	S	S		N	G		Wt	D	S	S
9	MN17038-5	--	S	R		S	R	R	R	S	S	S	S	S	S	S		N	G		Wt	D	I	I
10	MN17271-1	S	S	R		S	R	R	R	S	S	S	S	S	S	S		N	G		Wt	D	I	I
11	MN17332-2	--	S	R		S	S	R	R	S	R	S	R	R	S	S		N	G		D	Wt	S	I
12	SD4871	S	S	R		R	S	R	R	R	R	S	R	R	S	S		N	G		Wt	Wt	S	I
13	SD4933	S	S	R		R	R	S	R	S	R	S	R	R	S	S		N	G		Wt	Wt	S	S
14	SD4968	S	R	S		S	R	R	S	R	R	S	S	S	S	S		N	G		Wt	Wt	S	S
15	SD4976	S	S	R		S	R	S	R	S	R	S	S	S	S	S		N	G		D	Wt	S	S
16	SD4991	S	R	S		S	R	S	S	R	R	S	R	R	S	S		N	G		Wt	Wt	S	S
17	SD5012	S	R	S		S	R	S	S	R	R	S	S	S	S	S		N	G		Wt	Wt	S	S
18	MT 1716	S	S	S		R	S	S	S	R	R	R	S	S	S	S		N	G		D	Wt	S	S
19	MT 1855	S	S	R		R	R	S	S	S	R	S	S	S	S	S		N	G		D	Wt	S	S
20	MT 2007	--	S	R		R	R	R	S	S	S	U	S	S	S	S		N	G		D	Wt	S	S
21	MT 2013	S	S	R		R	S	S	S	S	R	S	S	S	S	S		N	G		D	Wt	S	S
22	MT 2018	--	S	R		R	R	S	S	S	R	S	S	S	S	S		N	G		D	Wt	S	S
23	MT 2022	--	S	R		R	U	R	S	S	R	S	S	S	S	S		N	G		D	Wt	S	S
24	NDHRS13-0177-0001	--	S	S		R	S	R	R	S	R	S	R	R	S	S		N	G		Wt	Wt	S	I
25	NDHRS13-0156-C04	S	S	R		R	R	S	R	R	S	S	S	S	S	S		N	G		Wt	Wt	S	S
26	NDHRS13-0309-B03	--	S	R		R	S	S	R	R	R	S	R	R	S	S		N	G		Wt	Wt	S	S
27	NDHRS17-0596-B28	S	S	R		R	R	S	S	R	R	R	S	S	R	R		N	G		Wt	D	S	I
28	NDHRS17DH-0467-056	--	S	S		R	R	R	R	R	R	S	S	S	S	S		N	G		D	Wt	S	S

* SSR markers were not run in time for report

Information about markers on next page

Allele Code

R = Resistant (Hope allele)	S = Susceptible	S = Susceptible	S = Susceptible	S = Susceptible (no 200 bp	S = Susceptible	S = Susceptible	S = Susceptible	S = Susceptible	S = Susceptible	S = Susceptible	S = Susceptible	I = Insensitive	S = Susceptible	S = Susceptible	S = Susceptible	S = Susceptible	S = Susceptible (no 161 bp	N = Normal	P = Poor (2+12)	2 = 341bp = Ax2	wt = Wild Type = Rht-B1a	wt = Wild Type = Rht-D1a	S = Sensitive	S = Sensitive
R = Resistant (Harvest allele)				R = Resistant (200 bp present	R = Resistant	R = Resistant	R = Resistant	R = Resistant	R = Resistant	Resistant (Thatcher allele)	R = Resistant						S = Susceptible (161 bp present	I = Increased	G = Good (5+10)	1=359bp = Ax1 or Ax-null	D = Dwarfing = Rht-B1b	D = Dwarfing = Rht-D1b	I = Insensitive	I = Insensitive
R = Resistant (Thatcher allele																								

U = No Call or Unknown = Indeterminant designation

Het = Heterozygous call

Table 11 continued, Marker information

Marker Name	Alternate Name	Comment	Manuscript
Sr2		Null allele	https://doi.org/10.1007/s00122-010-1482-7
Sr8	kwh53		https://doi.org/10.1094/PHYTO-05-16-0186-R
Sr12	NBLRR3		https://doi.org/10.1371/journal.pone.0157029
Sr25		SSR	Chao, unpublished
Lr13	IWB1575		https://doi.org/10.1094/PHYTO-03-20-0074-R
Lr16	kwm849		https://doi.org/10.1186/s12870-017-0993-7
Lr21			https://doi.org/10.1007/s11032-012-9773-0
Lr23	sunKASP_16		https://doi.org/10.1007/s11032-017-0628-6
Lr34	FJ436983-T67957A		https://doi.org/10.1126/science.1166453
Yr7	Yr7D		https://doi.org/10.1038/s41477-018-0236-4
Tsn	Tsn1-1Ka	SNP flanking deletion	Faris Lab unpublished
Fhb1	FM227		https://doi.org/10.1007/s00122-016-2727-x
TaHRC			https://doi.org/10.1007/s00122-018-3159-6
barc180	GENE-3371_56	equivalent to SSR	https://doi.org/10.1007/s00122-011-1573-0
barc186	IWA6412	equivalent to SSR	Chao, unpublished
gwm644		SSR	https://doi.org/10.1093/genetics/149.4.2007
GPC	GPC-B1_DUP		https://doi.org/10.1111/j.1469-8137.2005.01627.x
GluD1			https://doi.org/10.1270/jsbbs.57.243
umn19		SSR	https://doi.org/10.1007/s00122-008-0886-0
RhtB1			https://doi.org/10.1007/s00122-002-1048-4
RhtD1			https://doi.org/10.1007/s00122-002-1048-4
PpdB1			https://doi.org/10.1371/journal.pone.0079459
PpdD1			https://doi.org/10.1007/s11032-012-9765-0