Report of the 2020 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 25th year in 2020. Six locations (Brookings, SD, St. Paul, MN, Crookston, MN, Prosper, ND, Langdon, ND, Fargo, ND) reported results.

A total of 23 entries was included in the 2020 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 leaf and stem rust reactions, as well as 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 2020 Uniform Regional Scab Nursery for Spring Wheat Parents (URSN).

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)			
8	MN16103-1	MN10349-4/MN10279-6	2020	J. Anderson	UMN
9	MN16277-3	MN10349-4/MN10204-6	2020	J. Anderson	UMN
10	MN16340-8	MN10349-4/MN10204-6//Linkert	2020	J. Anderson	UMN
11	MN16360-1	Prosper/MN10204-6//MN06075-4	2020	J. Anderson	UMN
12	MN16408-5	Prosper/MN-Washburn sel	2020	J. Anderson	UMN
13	SD4848	SD4495/MN10261-1	2020	K Glover	SDSU
14	SD4917	SD4383/SD4299	2020	K Glover	SDSU
15	SD4926	MN10201-4-A/SD4579	2020	K Glover	SDSU
16	SD4947	LCS-NITRO/FOREFRONT	2020	K Glover	SDSU
17	SD4950	ALVORADA/SD4496	2020	K Glover	SDSU
18	MT 1716	MT1274/RB07	2019	P. Bruckner	MSU
19	MT 1775	MT0801/09SR49//MT0928/MOTT	2020	P. Bruckner	MSU
20	MT 1809	VIDA/M0 09/3-4	2020	P. Bruckner	MSU
21	MT 1855	MT1053/MO8/3-4	2020	P. Bruckner	MSU
22	MT 1866	Vida*4/Conan	2020	P. Bruckner	MSU
23	MT 1871	MT1007/TRAVERSE	2020	P. Bruckner	MSU
24	MT 1872	MT1007/M0 09/3-4	2020	P. Bruckner	MSU
25	NDHRS16-14-126	ND804/FREYR	2019	A. Green	NDSU
26	NDHRS13-0318-0003	BROGAN/HOWARD//BARLOW	2020	A. Green	NDSU
27	NDHRS13-0170-0004	ND812/NORDEN	2019	A. Green	NDSU
28	NDHRS13-0215-C03	HOWARD/ADVANCE	2020	A. Green	NDSU
29	NDHRS13-0121-C05	BW932/NDVITPRO	2020	A. Green	NDSU
30	NDHRS13-0114-C06	ND815/PROSPER	2020	A. Green	NDSU

Table 2. 2020 Uniform Regional Scab Nursery for Spring Wheat Parents, St. Paul, MN.

Line	Incidence %	Severity %	Disease Index	VSK %	DON ppm	Heading d from 6-1	micro TWT[2] g
Bacup	88	19	17	8.0	4.0	19.0	11.6
2710	42	12	6	4.0	2.5	27.7	11.4
Rollag	97	32	31	11.0	5.7	23.0	11.0
Oslo	100	92	92	65.0	11.2	23.0	9.2
Wheaton	85	76	71	77.5	16.2	27.7	8.0
Norm	90	36	33	45.0	9.7	27.7	9.7
N10	90	57	53	32.5	10.5	26.3	9.4
MN16103-1	95	25	25	8.0	4.4	23.0	11.6
MN16277-3	83	16	14	10.0	5.1	24.0	11.1
MN16340-8	87	21	18	7.0	3.3	25.0	11.4
MN16360-1	92	31	28	6.0	3.5	29.0	11.8
MN16408-5	83	17	15	6.0	3.9	29.0	12.0
SD4848	90	28	25	6.0	1.8	25.3	11.5
SD4917	80	34	29	10.0	3.1	26.3	10.9
SD4926	97	30	29	8.0	3.6	31.0	10.7
SD4947	100	44	44	9.0	1.7	29.0	10.9
SD4950	90	39	37	8.0	4.1	31.3	11.5
MT 1716	100	41	41	12.5	6.8	23.0	10.7
MT 1775	85	53	49	37.5	12.5	27.7	9.4
MT 1809	100	36	36	13.5	7.2	22.0	10.2
MT 1855	98	75	74	22.5	5.6	29.0	9.0
MT 1866	100	40	40	13.5	6.8	25.3	10.3
MT 1871	93	65	61	30.0	13.1	25.0	9.4
MT 1872	100	68	68	52.5	11.6	22.0	9.3
NDHRS16-14-126	95	23	22	9.0	6.1	19.0	11.3
NDHRS13-0318-0003	97	38	36	20.0	7.6	21.0	10.9
NDHRS13-0170-0004	92	24	23	12.0	5.6	20.0	11.5
NDHRS13-0215-C03	95	21	20	13.5	6.3	20.0	11.0
NDHRS13-0121-C05	93	31	29	11.0	6.2	22.0	10.9
NDHRS13-0114-C06	92	24	22	11.5	6.2	22.0	11.2
Alsen*	98	23	23	8.0	5.9	23.0	11.0
Roblin*	100	75	75	67.5	20.2	19.0	9.2
MN00269*	98	66	64	25.0	6.5	29.0	9.6
Mean	91.7	39.7	37.8	20.6	6.9	24.7	10.5
LSD	23.8	24.9	28.1	11.4	–	2.7	0.6
CV	12.7	30.7	36.4	27.1	–	6.8	2.9

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

* extra entries

Table 3. 2020 Uniform Regional Scab Nursery for Spring Wheat Parents, Crookston, MN.

Line	Incidence %	Severity %	Disease Index	VSK %	DON ppm	Heading d from 6-1	micro TWT[2] g
Bacup	70	11	8	9.0	2.8	29.0	12.0
2710	65	12	8	9.0	2.0	32.3	11.7
Rollag	85	22	18	6.0	0.9	32.0	11.8
Oslo	98	44	43	20.0	2.7	31.0	10.0
Wheaton	93	50	48	80.0	8.8	34.3	8.6
Norm	98	51	50	55.0	5.6	33.7	10.4
N10	98	25	24	70.0	3.2	32.3	9.9
MN16103-1	80	16	12	8.0	3.7	32.7	11.4
MN16277-3	83	17	14	8.0	1.5	31.3	11.4
MN16340-8	93	21	19	8.0	3.3	33.0	11.5
MN16360-1	85	14	12	9.0	4.1	34.0	11.6
MN16408-5	83	13	11	6.0	3.4	35.7	12.1
SD4848	85	18	15	11.5	2.4	33.3	11.2
SD4917	85	23	20	6.0	2.2	33.3	11.7
SD4926	100	13	13	6.0	3.2	37.0	11.2
SD4947	65	14	9	11.5	3.1	34.7	11.4
SD4950	48	8	4	8.0	3.6	40.3	11.7
MT 1716	88	31	28	12.5	4.0	31.7	11.3
MT 1775	95	43	40	50.0	12.4	33.7	10.1
MT 1809	88	24	21	10.0	2.4	32.0	10.3
MT 1855	98	38	37	20.0	6.4	35.7	10.2
MT 1866	90	16	15	9.0	1.9	32.3	10.6
MT 1871	100	47	47	47.5	7.7	32.7	9.9
MT 1872	98	39	37	35.0	5.8	30.0	10.2
NDHRS16-14-126	93	31	28	11.0	1.3	30.3	11.4
NDHRS13-0318-000	90	20	18	12.0	1.9	30.7	10.9
NDHRS13-0170-000	83	19	16	7.0	1.1	30.7	11.4
NDHRS13-0215-C03	63	13	8	11.0	1.5	30.3	11.9
NDHRS13-0121-C05	88	30	26	8.0	2.0	31.7	11.9
NDHRS13-0114-C06	80	19	15	11.5	2.6	30.7	11.1
Alsen*	90	18	16	8.0	1.3	32.3	11.6
Roblin*	100	83	83	80.0	3.6	29.0	10.0
MN00269*	95	59	55	50.0	9.9	37.7	9.0
Mean	86.2	27.3	24.8	21.6	3.7	32.8	10.9
LSD	16.6	23.1	23.3	16.1	–	1.2	0.7
CV	9.5	41.4	46.1	36.4	–	2.2	3.3

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

* extra entries

Table 4. 2020 Uniform Regional Scab Nursery for Spring Wheat Parents, Brookings, SD.

Entry	Line	Incidence %	Severity %	Disease Index	Tombstone %
1	Bacup	98.3	23.4	23.1	37.5
2	2710	95	19.6	18.8	33.3
3	Rollag	97.5	21.7	21.3	36.7
4	Oslo	95	21.1	20.3	39.2
5	Wheaton	100	43.7	43.7	52.5
6	Norm	98.3	24.8	24.5	45.8
7	N10	96.7	28.8	28.3	41.7
8	MN16103-1	100	19.8	19.8	22.5
9	MN16277-3	99.2	21.6	21.4	25.8
10	MN16340-8	99.2	21.3	21.2	27.5
11	MN16360-1	98.3	26.7	26.3	25
12	MN16408-5	98.3	24.1	23.8	23.3
13	SD4848	96.7	25.7	24.9	27.5
14	SD4917	95.8	20.4	19.8	30
15	SD4926	93.3	20.2	19	20.8
16	SD4947	100	31.4	31.4	26.7
17	SD4950	100	30.8	30.8	20
18	MT 1716	99.2	21.9	21.8	33.3
19	MT 1775	100	27.8	27.8	41.7
20	MT 1809	97.5	21.5	21.1	34.2
21	MT 1855	100	37.1	37.1	39.2
22	MT 1866	100	29.8	29.8	33.3
23	MT 1871	99.2	32	31.9	41.7
24	MT 1872	97.5	23.6	23	42.5
25	NDHRS16-14-126	95.8	20	19.2	36.7
26	NDHRS13-0318-0003	96.7	19.3	18.8	28.3
27	NDHRS13-0170-0004	96.7	18.7	18.1	30
28	NDHRS13-0215-C03	96.7	20.3	19.7	34.2
29	NDHRS13-0121-C05	93.3	16.7	15.7	33.3
30	NDHRS13-0114-C06	95.8	19.5	18.9	41.7
MEAN		97.67	24.44	24.04	33.53
LSD (0.05)		4.06	5.94	6.22	6.14
CV %		2.05	24.69	25.99	23.72

Table 5. 2020 Uniform Regional Scab Nursery for Spring Wheat Parents, Langdon, ND.

Entry	Line	FHB Index (1-9 Scale)	FDK %
1	Bacup	4.0	38.3
2	2710	2.0	30.0
3	Rollag	4.0	46.7
4	Oslo	5.3	55.0
5	Wheaton	1.0	42.5
6	Norm	6.5	90.0
7	N10	4.0	81.7
8	MN16103-1	2.0	32.5
9	MN16277-3	4.3	26.7
10	MN16340-8	4.5	53.3
11	MN16360-1	2.5	46.7
12	MN16408-5	5.0	46.7
13	SD4848	2.0	38.3
14	SD4917	2.0	36.7
15	SD4926	4.0	48.3
16	SD4947	4.0	45.0
17	SD4950	0.3	25.0
18	MT 1716	7.0	68.3
19	MT 1775	8.3	81.7
20	MT 1809	4.0	65.0
21	MT 1855	4.7	65.0
22	MT 1866	5.0	70.0
23	MT 1871	7.7	80.0
24	MT 1872	6.5	70.0
25	NDHRS16-14-126	5.0	32.5
26	NDHRS13-0318-000	4.7	43.3
27	NDHRS13-0170-000	3.0	28.3
28	NDHRS13-0215-C03	1.5	33.3
29	NDHRS13-0121-C05	3.5	30.0
30	NDHRS13-0114-C06	3.0	53.3
Mean		4.0	50.1
CV		27.4	22.2
LSD 0.05		1.8	18.2

Table 6. 2020 Uniform Regional Scab Nursery for Spring Wheat Parents, Prosper, ND.

Entry	Line	FHB Index (1-9 Scale)	FDK %	Severity
1	Bacup	5.3	35.0	32.0
2	2710	4.0	18.3	14.4
3	Rollag	6.3	40.0	37.1
4	Oslo	5.7	63.3	30.7
5	Wheaton	4.7	40.0	29.9
6	Norm	6.3	83.3	47.0
7	N10	6.5	82.5	45.8
8	MN16103-1	4.3	31.7	26.2
9	MN16277-3	5.0	38.3	31.3
10	MN16340-8	4.7	31.7	24.0
11	MN16360-1	4.7	28.3	23.1
12	MN16408-5	4.0	28.3	21.4
13	SD4848	4.3	33.3	23.2
14	SD4917	4.0	15.0	27.6
15	SD4926	2.7	43.3	20.1
16	SD4947	5.7	43.3	26.2
17	SD4950	4.3	31.7	21.7
18	MT 1716	5.0	51.7	38.4
19	MT 1775	5.3	58.3	42.8
20	MT 1809	5.0	55.0	36.4
21	MT 1855	6.3	76.7	44.1
22	MT 1866	5.0	83.3	34.9
23	MT 1871	5.3	63.3	34.6
24	MT 1872	6.7	71.7	57.7
25	NDHRS16-14-126	6.0	36.7	37.4
26	NDHRS13-0318-000	5.5	22.5	33.9
27	NDHRS13-0170-000	4.7	35.0	34.6
28	NDHRS13-0215-C03	5.3	35.0	32.0
29	NDHRS13-0121-C05	5.3	21.7	34.5
30	NDHRS13-0114-C06	4.0	23.3	26.5
Mean		5.1	44.1	32.3
CV		16.3	27.7	25.4
LSD 0.05		1.4	19.9	13.4

Table 7. 2020 Uniform Regional Scab Nursery for Spring Wheat Parents, Fargo, ND.

Entry	Line	FHB (1-9 Scale)	FDK %	SEEDLING SR	SEEDLING LR
1	Bacup	8.0	43.3	MR	MR
2	2710	4.0	17.5	MR	MS
3	Rollag	6.0	46.7	MS	MS
4	Oslo	5.7	53.3	MR	MS
5	Wheaton	6.0	61.7	MR	MS
6	Norm	7.7	70.0	MR	MR
7	N10	7.3	65.0	MR	MS
8	MN16103-1	4.0	38.3	MR	MR
9	MN16277-3	7.0	33.3	MR	MR
10	MN16340-8	5.0	36.7	R	R
11	MN16360-1	5.7	30.0	MR	MR
12	MN16408-5	4.7	26.7	MR	MR
13	SD4848	5.3	31.7	MR	MR
14	SD4917	4.7	23.3	MR	MR
15	SD4926	3.0	30.0	MR	MR
16	SD4947	4.7	40.0	MS	MS
17	SD4950	4.7	25.0	MR	MR
18	MT 1716	6.0	45.0	MR	MS
19	MT 1775	6.3	71.7	MR	S
20	MT 1809	5.7	53.3	MR	S
21	MT 1855	6.3	53.3	S	MS
22	MT 1866	6.7	50.0	MR	MR
23	MT 1871	6.7	66.7	MR	MR
24	MT 1872	7.0	73.3	MR	MS
25	NDHRS16-14-126	6.3	46.7	MR	MS
26	NDHRS13-0318-000	6.0	35.0	MR	MR
27	NDHRS13-0170-000	6.3	30.0	MR	MS
28	NDHRS13-0215-C03	5.0	46.7	MR	S
29	NDHRS13-0121-C05	6.0	45.0	R	MS
30	NDHRS13-0114-C06	5.7	33.3	MR	MS
Mean		5.8	44.1		
CV		15.0	20.8		
LSD 0.05		1.4	15.0		

Table 8. 2020 Uniform Regional Scab Nursery, Correlation Coefficients Between Traits, by Location.

Between	St. Paul	Crookston	Brookings
Incidence & Severity	0.38	0.63	0.64
Incidence & Disease Index	0.44	0.67	0.67
Incidence & Tombstone/VSK/FDK	0.19	0.49	0.05
Incidence & DON	0.24	0.36	
Severity & Disease Index	1	1	1
Severity & Tombstone/VSK/FDK	0.83	0.81	0.37
Severity & DON	0.72	0.57	
Disease Index & Tombstone/VSK/FDK	0.81	0.81	0.37
Disease Index & DON	0.71	0.57	
Tombstone/VSK/FDK & DON	0.9	0.64	

Table 9. 2020 Uniform Regional Scab Nursery for Spring Wheat Parents, St. Paul, MN.
Rust data from inoculated trials using a mixture of races (J. Kolmer and Y. Jin, USDA-ARS

Line	Leaf Rust	Stem Rust
Bacup	60S	5R
2710	50M	10MR
Rollag	60S	10R
Oslo	60S	5R
Wheaton	60S	5R
Norm	60S	5R
N10	60MS	5R
MN16103-1	20MR	TR
MN16277-3	60MS	5R
MN16340-8	50MS	5R
MN16360-1	5R	5R
MN16408-5	TR	0
SD4848	TR	10MR
SD4917	30MRMS	40MR-MS
SD4926	5R	0
SD4947	60MRMS	30MR
SD4950	TR	5R
MT 1716	60MS	10R
MT 1775	60S	5R
MT 1809	50MS	5R
MT 1855	TR	10R
MT 1866	60MS	10MR
MT 1871	70S	20MR
MT 1872	50MS	5R
NDHRS16-14-126	60S	5R
NDHRS13-0318-0003	60S	5R
NDHRS13-0170-0004	60MS	10R-MR
NDHRS13-0215-C03	50S	5R
NDHRS13-0121-C05	30S	5R
NDHRS13-0114-C06	60S	20R-MR

Table 10. 2020 Uniform Regional Scab Nursery for Spring Wheat Parents, St. Paul, MN. Adult plant stem rust reactions from a different field (Y. Jin, USDA-ARS).

Entry	Line	Severity/Response	Other notes
1	Bacup	10MR	BIN
2	2710	0	
3	Rollag	0	
4	Oslo	10MR	BIN
5	Wheaton	0	
6	Norm	0	
7	N10	0	
8	MN16103-1	0	
9	MN16277-3	0	
10	MN16340-8	0	
11	MN16360-1	0	
12	MN16408-5	0	
13	SD4848	5R	
14	SD4917	30MRMS	
15	SD4926	0	
16	SD4947	20MR	
17	SD4950	0	BIN
18	MT 1716	0	
19	MT 1775	5MR	
20	MT 1809	0	
21	MT 1855	0	BIN, strong PBC
22	MT 1866	0	
23	MT 1871	0	BIN, PBC
24	MT 1872	0	
25	NDHRS16-14-126	0	
26	NDHRS13-0318-0003	0	
27	NDHRS13-0170-0004	0	
28	NDHRS13-0215-C03	0	
29	NDHRS13-0121-C05	0	
30	NDHRS13-0114-C06	0	
check	Line E	90S	
check	LMPG-6	90S	
check	NA101/MqSr7a	40MS	

Nursery inoculated with a bulk of 6 races: QFCSC, QTHJC, MCCFC, RCRSC, RKRQC, and TMPKC.

Stem rust disease severity and infection responses recorded at growth stages between milk and soft dough.

Black internade (BIN) and pseudo black chaff (PBC), a trait associated with Sr2, were noted when one or more plants in an entry expressed this trait.

Table 11. 2020 Uniform Regional Scab Nursery for Spring Wheat Parents, St. Paul, MN. Seedling stem rust reactions (Y. Jin, USDA-ARS).

	Race										
Line	QFCSC	QTHJC	MCCFC	RCRSC	RKRQC	TPMKC	TTTTF	GFMNC	QCCSM	TTKSK	TTKTT
Bacup	0;	2-	0	;2-	2-	0;2-/;2-	3-	0;	0;	3	3+
2710	0	2-	;	0;	2-	2-	;	0;	0;	2+3-	3
Rollag	0;	2-	0	;2-	2	2-	1;	0;	;2-	3	3
Oslo	;	2	2-	2-	0;	2-	3+	;2-	;	3+	3
Wheaton	0;	2-	0;	0;2-	;2-	-	;	0	0;	3	3
Norm	0	-	-	0;	;2-	-	-	-	-	3	-
N10	0	2-	0;	;	;2-	2-	1;	0	0	3	3
MN16103-1	0	0/2-	0;	0	0;1-	0;	;1	0	0	3	3
MN16277-3	0	2-	0	0;	;1-	;2-	0;	0	0	3+	3
MN16340-8	0;	2-	0;	0;	;1-	2-	1;	0	0;	3	3
MN16360-1*	0	2-	;2-	0;	2-	2-	;1	0;	0;	3-	3-
MN16408-5	0;	2-	;2-	2-;	2-	2-	1+;	;	;2-	3+	3+
SD4848	0;/;	22-	;	;2-	2-	2-	1;	0;	;2-	3	3
SD4917	0;	2+3-	1-;/0;	2-/0;	2	0;/2-	3+	0;	0;	3+	3+
SD4926	0	1	0;	0;	2-	0;	11+	0	;1-	3+	3+
SD4947	2	2	2-	2-	2-	2	3	2	2-	3	3+
SD4950	;2-	2-/2	;1-	2-	2-	2-	2-	0	;2-	2-	3
MT 1716	0;	2	0;	0;1-	2	;2-	3-	0;/;1-	;	3+	3+
MT 1775	2-	2	2-	0;2-/2-	2	2	11+	;2-	;2-	3+	3+
MT 1809	;	2-	;1-	1-	2-	2-	1	;2-	;	3	3+
MT 1855	1	2	2-	2	2	2+3-	3-C	2-	2	3+	3+
MT 1866	2-	2-	2-	;2-	2-	2-	1;	2-	2-	3	3+
MT 1871	;2-/2-	2	;2-	1	21	2	13-;	;2-	2-	3+	3+
MT 1872	0;	2-	;2-	;2-	2-	2-	13-;	0;	;2-	3	3+
NDHRS16-14-126	0	2-	0;/;	0	;	2-	1	0	0	3-	33+
NDHRS13-0318-0003	0;/;2-	2-2	;2-	0	;2-	2-	;1	0	0;/2-	3	3
NDHRS13-0170-0004	0;	-	0;/;	;1-	2-	2-	;1	;2-	0;	3+	3+
NDHRS13-0215-C03	0	2-	0;/;	0;	0;/2-	2-	3-	0	0	3+	3+
NDHRS13-0121-C05	0	0;1-	;1-	0;	2-	2-	;1	0	0;	3+	3+
NDHRS13-0114-C06	;	2-	2-	2-	2-	2-	3-1	;	2-	3+	3+
Line E	4	4	4	4	4	4	4	4	4	4	3+
LMPG-6	32	33+	3	3	3	3	3+	3	3	3+	3+
NA101/MqSr7a	1+3-;	3+	3	1;	1;	3+	11+;	11+;	1;	3+	3+

* Thatcher resistance

Note: Explanatory notes below

Notes and explanations for stem rust evaluation of breeding germplasm

A. Races used in seedling evaluations:

Race	Origin	Virulence on differential genes
MCCFC	USA	5 7b 9g 10 17 Tmp 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
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
TTKSK	Kenya	5 6 7b 8a 9a 9b 9d 9e 9g 10 11 17 21 30 **31 38** McN
TTKTT	Kenya	5 6 7b 8a 9a 9b 9d 9e 9g 10 11 17 21 **24** 30 **31 38 Tmp** McN

* **Red font** represents unique and/or significant virulence or combination of virulences

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

Table 12. Markers Associated With Selected Traits/Genes (J. Fiedler, USDA-ARS).

Trait	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/Gene	Sr2	Sr8	Sr12	Sr25	Lr13	Lr16	Lr21	Lr23	Lr34	Yr7D	Tsn	Fhb1	TaHRC	barc180	barc186	gwm644	GPC	GluD1	umn19	RhtB1	RhtD1	PpdB1	PpdD1
Line																							
Bacup	S	S	R	R	U	S	S	S	R	S	S	S	S	R	R	S	N	G	1	wt	wt	I	I
2710	S	S	R	S	U	S	S	R	R	R	S	R	R	R	R	R	N	G	1	wt	wt	S	S
Rollag	S	S	R	S	S	R	S	S	R	R	I	R	R	S	R	S	N	G	2	wt	D	S	S
Oslo	S	R	R	S	U	S	S	S	S	R	I	S	S	S	S	S	N	P	1	D	wt	S	I
Wheaton	S	S	R	S	R	S	S	R	R	R	I	S	S	S	S	S	N	G	2	wt	D	S	I
Norm	S	S	R	S	R	R	S	R	R	R	I	S	S	S	S	S	N	G	2	wt	D	S	S
N10	S	S	R	S	R	R	S	R	R	R	I	R	R	S	S	S	N	P	1	wt	D	S	S
MN16103-1	S	S	R	R	R	R	S	S	R	R	I	R	R	S	S	S	N	G	2	wt	wt	I	I
MN16277-3	S	S	R	S	S	R	S	R	R	S	I	R	R	S	S	S	N	G	2	D	wt	I	I
MN16340-8	S	S	R	S	S	Het	S	R	R	S	I	R	R	S	S	S	N	G	2	wt	wt	I	I
MN16360-1	--	S	R	S	S	S	S	R	S	S	I	R	R	R	R	S	N	G	2	D	wt	S	I
MN16408-5	S	S	R	S	S	S	R	R	S	R	S	R	R	S	S	S	N	G	2	D	wt	S	S
SD4848	S	S	R	S	S	R	R	S	R	R	S	R	R	U	S	S	N	G	2	wt	wt	S	S
SD4917	S	R	S	S	S	R	S	S	S	S	S	S	S	U	S	S	N	G	2	U	wt	S	S
SD4926	S	S	R	S	R	R	S	S	S	R	S	R	R	S	S	S	U	G	2	D	wt	I	S
SD4947	S	R	R	S	S	S	S	R	R	S	S	S	S	S	S	S	N	G	1	D	wt	S	S
SD4950	S	R	R	S	R	S	S	R	R	R	I	S	S	S	S	S	U	G	2	D	wt	S	I
MT 1716	--	S	R	S	R	S	S	R	S	R	I	S	S	S	S	S	N	G	2	D	wt	S	S
MT 1775	S	S	S	S	U	S	S	S	R	R	I	S	S	S	S	S	N	G	1	D	wt	S	S
MT 1809	S	S	R	S	R	S	R	S	S	R	I	S	S	S	S	S	N	G	1	D	wt	S	S
MT 1855	S	S	R	S	S	R	S	S	S	R	S	S	S	S	S	S	N	G	2	D	wt	S	S
MT 1866	--	S	R	S	U	S	S	S	S	R	I	S	S	S	R	S	N	G	1	D	wt	S	S
MT 1871	S	S	R	S	U	R	S	S	S	U	I	S	S	S	S	S	N	G	1	D	wt	S	S
MT 1872	S	S	R	S	R	R	R	S	S	R	S	S	S	S	S	S	N	G	1	D	wt	S	S
NDHRS16-14-126	--	S	R	S	U	R	R	R	S	S	S	R	R	S	S	R	N	G	2	D	wt	S	S
NDHRS13-0318-0003	--	S	S	S	S	S	S	R	R	R	I	R	R	S	S	S	N	G	1	D	U	S	S
NDHRS13-0170-0004	--	S	R	S	R	R	R	S	R	R	I	R	R	R	R	S	N	G	2	D	wt	S	S
NDHRS13-0215-C03	S	S	R	S	R	R	R	R	S	R	S	S	S	S	S	S	N	G	2	U	wt	S	S
NDHRS13-0121-C05	S	S	R	S	U	R	R	R	R	S	S	R	R	S	S	S	N	G	2	D	wt	S	S
NDHRS13-0114-C06	--	S	R	S	R	S	R	R	S	S	S	S	S	R	R	S	N	G	2	D	wt	S	S

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

U = No Call or Unknown = Indeterminant designation

Het = Heterozygous call