

Report of the 2024 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 30th year in 2024. Six locations (St. Paul, MN, Crookston, MN, Brookings, SD, Prosper, ND, Fargo, ND, and Langdon, ND) reported results.

A total of 30 entries were included in the 2024 URSN, in addition to the resistant checks ND2710, BacUp, and Rollag, the susceptible checks Wheaton, Oslo, Norm, and N10, a Norm near-isoline containing *Fhbl*. The entries were contributed by four university wheat breeding programs and the Agriculture and Agri-Food Canada.

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 QTL and other traits are provided for entries.

The data of genotype means for locations (Tables 2-7) will be available online on the Triticeae Toolbox under T3/Wheat.

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Previous URSN Entries Released as New Cultivars

Unlike the Hard Red Spring Wheat Uniform Regional Nursery (HRSWURN) Annual Report, the URSN Annual Report has not included records of experimental lines becoming released varieties. Including this information is valuable to the wheat community for tracking experimental lines that were tested in this nursery under FHB-inoculated conditions and their status of becoming a released variety. Some of these varieties were also tested in the HRSWURN, and information on their phenotype data can be found in that Annual Report posted to the GrainGenes website: <https://wheat.pw.usda.gov/GG3/>

When the spring wheat breeders release a new variety tested in the HRSWURN, the released variety name, experimental name, PI number, brief description, and years entered in the HRSWURN or URSN will be included below. No newly released varieties were named for the 2024 season.

Figure 1. Map of Uniform Regional Scab Nursery Locations, 2024



Table 1. Entries for the 2024 Uniform Regional Scab Nursery Parents.

Entry	Line	Pedigree	1st Year in URSN	Submitter	Organization
1	Bacup	CHECK			
2	ND2710	CHECK			
3	Rollag	CHECK			
4	Oslo	CHECK			
5	Wheaton	CHECK			
6	Norm	CHECK			
7	N10	CHECK (Norm Fhb1 NIL)			
8	MN19342-1	MN13356-6/MN13398-2	2024	J. Anderson	UMN
9	MN20080-3	Linkert-gpcB1/Lang-MN	2024	J. Anderson	UMN
10	MN20081-2	Linkert-gpcB1/MN11452-3//MN13288-1-32	2024	J. Anderson	UMN
11	MN20171-1	MN15482-4/SY-Valda	2024	J. Anderson	UMN
12	MN20172-2	MN15482-4/MN13479-8	2024	J. Anderson	UMN
13	SD5050	SY-VALDA/FOCUS	2024	K Glover	SDSU
14	SD5153	SD4871/SURPASS	2024	K Glover	SDSU
15	SD5158	FOCUS/SD4710	2024	K Glover	SDSU
16	SD5193	SD4944/SD4873	2024	K Glover	SDSU
17	SD5195	SD4951/SD4843	2024	K Glover	SDSU
18	SD5203	FHBDH-44004/DRIVER	2024	K Glover	SDSU
19	SD5223	SD4843/SD4873	2024	K Glover	SDSU
20	NDHRS18-0069-B077	NDHRS16-12-52/SYVALDA	2024	A. Green	NDSU
21	NDHRS18-0105-B080	ND834/LANG-MN//SYROWYN	2024	A. Green	NDSU
22	NDHRS18-0178-B057	MSCHEVELLE/GLENN//NDVITPRO	2024	A. Green	NDSU
23	NDHRS18-0180-B101	MSCHEVELLE/FALLER//NDVITPRO	2024	A. Green	NDSU
24	NDHRS18-0261-B234	NDFROHBERG/ALSEN	2024	A. Green	NDSU
25	NDHRS19RIL-0121-212-1	LANNING/BARLOW//ALSEN+TSN1	2024	A. Green	NDSU
26	MT21220	DAGMAR/MT 1716	2023	J. Cook	MSU
27	MT21224	DAGMAR/CAP 197-3	2024	J. Cook	MSU
28	MT22071	DAGMAR//MT1338/SD3997	2024	J. Cook	MSU
29	MT22345	DAGMAR/MN14105-7	2024	J. Cook	MSU
30	MT22361	MT 1867//Patwin515/MN-11394-6	2024	J. Cook	MSU
31	MT23004	DAGMAR/MT SIDNEY	2024	J. Cook	MSU
32	MT23297	DAGMAR/NDHRS16-14-41	2024	J. Cook	MSU
33	AAC Westking	BW5090	2024		AAFC
34	BW5095	BW5095	2024		AAFC
35	HY2136	HY2136	2024		AAFC
36	AAC Spike	PT4002	2024		AAFC
37	AAC Hodge	BW1069	2024		AAFC

Table 2. 2024 Uniform Regional Scab Nursery for Spring Wheat Parents, St. Paul, MN.

Entry	Line	Incidence %	Severity %	Disease Index	VSK %	DON ppm	Heading d from 6-1	micro TWT ¹ g
1	Bacup	92.9	23.2	22.0	10.0	3.4	31.0	11.4
2	ND2710	66.6	31.4	20.8	17.0	7.4	35.0	10.9
3	Rollag	97.6	48.6	47.7	20.0	3.1	35.0	10.2
4	Oslo	100.0	73.9	73.9	50.0	8.9	35.0	8.7
5	Wheaton	100.0	87.6	87.6	90.0	10.2	39.0	-
6	Norm	100.0	83.1	83.1	77.5	9.7	35.0	8.5
7	N10	100.0	66.3	66.3	62.5	5.8	35.0	8.8
8	MN19342-1	90.5	47.6	43.5	30.0	6.3	36.3	10.2
9	MN20080-3	90.5	20.9	19.0	6.0	4.5	39.0	11.5
10	MN20081-2	97.6	30.4	29.9	9.0	3.1	35.0	10.2
11	MN20171-1	97.6	29.9	29.5	9.0	3.6	35.0	10.7
12	MN20172-2	97.6	42.8	41.7	7.0	4.4	39.0	10.7
13	SD5050	100.0	47.7	47.7	15.0	4.2	31.0	11.1
14	SD5153	73.8	25.5	20.0	9.0	3.9	39.0	11.1
15	SD5158	85.7	41.7	38.0	9.0	2.2	31.0	11.6
16	SD5193	97.6	43.6	43.1	13.5	4.5	35.0	9.8
17	SD5195	100.0	40.0	40.0	24.0	5.2	33.7	10.6
18	SD5203	85.7	26.0	21.5	10.0	3.1	39.0	10.9
19	SD5223	85.7	27.9	23.5	15.0	4.8	35.0	10.8
20	NDHRS18-0069-B077	97.6	28.3	27.8	10.0	4.6	32.3	11.4
21	NDHRS18-0105-B080	42.9	17.1	7.0	9.0	1.6	35.0	11.5
22	NDHRS18-0178-B057	100.0	43.4	43.4	21.0	5.3	32.3	11.0
23	NDHRS18-0180-B101	95.2	37.5	36.5	23.5	4.6	31.0	11.0
24	NDHRS18-0261-B234	85.7	28.3	25.1	16.5	6.0	32.3	11.0
25	NDHRS19RIL-0121-212-1	88.1	19.3	16.7	11.5	5.1	31.0	11.1
26	MT21220	100.0	45.4	45.4	11.0	4.3	35.0	10.1
27	MT21224	100.0	59.9	59.9	25.0	7.2	35.0	10.2
28	MT22071	100.0	73.6	73.6	37.5	9.1	35.0	9.5
29	MT22345	100.0	65.8	65.8	22.5	6.9	36.3	10.0
30	MT22361	100.0	62.1	62.1	20.0	7.4	35.0	10.0
31	MT23004	100.0	51.7	51.7	22.5	5.4	32.3	10.9
32	MT23297	100.0	54.3	54.3	17.0	7.2	36.3	9.8
33	AAC Westking	95.3	28.5	27.6	11.0	4.2	35.0	10.5
34	BW5095	100.0	47.0	47.0	12.5	3.7	35.0	10.7
35	HY2136	97.6	59.8	59.0	17.5	8.8	39.0	9.7
36	AAC Spike	95.2	22.7	21.8	20.0	4.2	31.0	10.4
37	AAC Hodge	95.2	37.6	36.7	17.5	3.6	32.3	10.5
*	Alsen	97.6	29.2	28.7	8.0	5.7	35.0	10.9
*	MN00269	100.0	71.5	71.5	32.5	5.9	39.0	8.6
*	Roblin	100.0	81.2	81.2	67.5	6.9	31.0	9.3
Mean		93.8	45.1	43.5	22.9	5.4	34.7	10.4
LSD		14.8	29.8	30.3	13.1	-	2.2	1.0
CV		7.7	32.3	33.9	34.9	-	3.1	4.5

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

Planting date: May 10, 2024. Harvest date: August 13, 2024. Inoculation dates: 7/1, 7/5, 7/9, and 7/12

VSK CV is high at this location due to Linkert and Wheaton each having one low and one high value

Table 3. 2024 Uniform Regional Scab Nursery for Spring Wheat Parents, Crookston, MN.

Entry	Line	Incidence %	Severity %	Disease Index	VSK %	DON ppm	Heading d from 6-1	micro TWT ¹ g
1	Bacup	100.0	58.9	58.9	40.0	8.0	40.7	10.5
2	ND2710	86.7	21.3	19.6	14.0	11.5	42.0	11.2
3	Rollag	100.0	32.5	32.5	21.0	14.4	43.3	10.8
4	Oslo	100.0	71.6	71.6	67.5	11.6	42.3	9.0
5	Wheaton	100.0	71.4	71.4	72.5	18.5	45.0	8.4
6	Norm	100.0	63.1	63.1	75.0	13.9	44.7	9.4
7	N10	100.0	68.7	68.7	37.5	25.5	43.7	9.7
8	MN19342-1	100.0	32.4	32.4	14.5	24.2	44.7	11.4
9	MN20080-3	93.3	37.5	35.5	10.0	12.9	46.0	11.9
10	MN20081-2	83.3	30.6	26.7	10.0	10.9	44.0	11.2
11	MN20171-1	100.0	24.2	24.2	10.0	10.7	44.7	11.1
12	MN20172-2	100.0	28.1	28.1	9.0	10.3	48.7	11.1
13	SD5050	100.0	65.4	65.4	21.0	13.8	40.7	10.8
14	SD5153	93.3	24.9	23.8	8.0	19.1	45.7	11.9
15	SD5158	100.0	44.4	44.4	17.5	15.3	38.0	11.4
16	SD5193	93.3	19.6	18.7	12.5	20.7	45.3	11.5
17	SD5195	100.0	34.1	34.1	12.0	23.9	42.0	11.5
18	SD5203	100.0	19.7	19.7	8.0	19.5	46.7	11.4
19	SD5223	96.7	30.2	29.4	13.5	19.2	44.0	11.3
20	NDHRS18-0069-B077	100.0	26.5	26.5	20.0	18.1	42.7	10.6
21	NDHRS18-0105-B080	100.0	30.4	30.4	8.0	16.3	43.0	12.0
22	NDHRS18-0178-B057	96.7	53.9	52.6	20.0	10.8	42.3	11.4
23	NDHRS18-0180-B101	100.0	53.8	53.8	11.0	11.9	41.7	11.8
24	NDHRS18-0261-B234	100.0	45.4	45.4	30.0	6.3	42.0	10.4
25	NDHRS19RIL-0121-212-1	100.0	56.5	56.5	30.0	15.6	40.7	10.0
26	MT21220	100.0	45.4	45.4	23.5	8.0	45.0	10.1
27	MT21224	100.0	65.4	65.4	45.0	17.6	42.7	9.8
28	MT22071	100.0	74.1	74.1	42.5	15.4	45.0	9.7
29	MT22345	100.0	62.9	62.9	35.0	18.7	43.7	9.6
30	MT22361	100.0	62.6	62.6	30.0	15.6	45.0	10.6
31	MT23004	100.0	72.2	72.2	55.0	16.8	41.0	10.1
32	MT23297	100.0	48.0	48.0	18.5	11.0	46.0	10.2
33	AAC Westking	100.0	27.4	27.4	14.5	13.5	44.0	11.0
34	BW5095	100.0	23.1	23.1	12.0	10.1	44.0	11.1
35	HY2136	100.0	41.6	41.6	25.0	11.5	45.7	10.1
36	AAC Spike	100.0	55.1	55.1	50.0	7.6	42.3	9.7
37	AAC Hodge	100.0	45.5	45.5	11.0	8.8	42.3	11.3
*	Alsen	100.0	31.9	31.9	10.0	9.9	43.3	11.2
*	MN00269	100.0	54.0	54.0	32.5	22.7	48.3	9.7
*	Roblin	100.0	88.2	88.2	67.5	22.7	41.3	9.4
Mean		98.6	46.1	45.8	26.6	14.8	43.6	10.6
LSD		9.7	29.8	30.4	11.3	—	1.4	0.7
CV		4.8	31.5	32.4	25.9	—	1.5	3.3

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

Planting date: May 26, 2024. Harvest date: August 27, 2024. Inoculation method: corn spawn

Table 4. 2024 Uniform Regional Scab Nursery for Spring Wheat Parents, Brookings, SD.

Entry	Line	Incidence %	Severity %	Disease Index	VSK %	Inoculation d from 6-1
1	Bacup	98.3	39.3	38.8	33.3	30.7
2	ND2710	96.7	22.3	21.6	31.7	32.7
3	Rollag	100.0	38.2	38.2	28.3	32.7
4	Oslo	100.0	54.7	54.7	56.7	32.7
5	Wheaton	100.0	58.2	58.2	61.7	37
6	Norm	100.0	43.5	43.5	53.3	37.7
7	N10	100.0	39.0	39.0	48.3	34.0
8	MN19342-1	100.0	33.5	33.5	31.7	34.0
9	MN20080-3	100.0	30.3	30.3	26.7	36.0
10	MN20081-2	100.0	30.8	30.8	26.7	36.0
11	MN20171-1	100.0	26.5	26.5	28.3	34.0
12	MN20172-2	100.0	37.5	37.5	20.0	37.0
13	SD5050	100.0	32.8	32.8	35.0	30.0
14	SD5153	100.0	29.0	29.0	13.3	37.0
15	SD5158	98.3	18.5	18.2	25.0	29.3
16	SD5193	100.0	31.7	31.7	23.3	37.0
17	SD5195	98.3	24.5	24.1	30.0	32.0
18	SD5203	98.3	24.5	24.1	21.7	37.0
19	SD5223	100.0	23.3	23.3	25.0	34.0
20	NDHRS18-0069-B077	100.0	25.0	25.0	26.7	32.0
21	NDHRS18-0105-B080	96.7	17.8	17.4	20.0	32.0
22	NDHRS18-0178-B057	100.0	33.0	33.0	26.7	32.0
23	NDHRS18-0180-B101	96.7	23.2	22.4	23.3	30.7
24	NDHRS18-0261-B234	96.7	27.5	26.9	35.0	32.0
25	NDHRS19RIL-0121-212-1	95.0	21.5	20.4	30.0	29.0
26	MT21220	100.0	43.7	43.7	38.3	36.0
27	MT21224	100.0	46.5	46.5	50.0	32.7
28	MT22071	100.0	38.5	38.5	56.7	35.0
29	MT22345	100.0	56.0	56.0	58.3	34.3
30	MT22361	100.0	44.3	44.3	48.3	35.0
31	MT23004	100.0	43.30	43.3	63.3	30.7
32	MT23297	100.0	43.3	43.3	40.0	36.7
33	AAC Westking	100.0	30.3	30.3	33.3	34.0
34	BW5095	100.0	40.2	40.2	26.7	35.0
35	HY2136	100.0	42.3	42.3	31.7	37.7
36	AAC Spike	100.0	29.8	29.8	38.3	32.0
37	AAC Hodge	100.0	28.7	28.7	35.0	33.3
Mean		99.3	34.4	34.3	35.2	33.8
LSD		2.9	11.3	11.4	12.6	2.2
CV		1.8	20.2	20.5	22.0	4.0

Planting date: May 14. Inoculation dates: 28 Jun and 1, 3, 5, 8, & 10 Jul. Inoculation method: Early application of corn spawn and conidial suspension near flowering. Environmental notes: Pretty good trial. In addition to the mist-irrigation, there was no shortage of rainy or humid conditions. FHB symptoms on uninoculated yield trial plots near this nursery were almost as diseased as the misted/inoculated rows.

Table 5. 2024 Uniform Regional Scab Nursery for Spring Wheat Parents, Prosper, ND.

Entry	Line	FHB	VIBE FDK ¹	DON
		1-9	%	ppm
1	Bacup	5.7	29.0	15.2
2	ND2710	3.0	31.7	8.2
3	Rollag	7.0	20.5	20.2
4	Oslo	6.7	19.6	8.0
5	Wheaton	6.5	48.1	25.8
6	Norm	7.0	48.9	32.7
7	N10	7.0	32.3	27.7
8	MN19342-1	5.7	35.1	17.1
9	MN20080-3	5.0	18.6	9.8
10	MN20081-2	3.0	27.8	5.3
11	MN20171-1	3.3	12.5	8.2
12	MN20172-2	4.5	14.8	10.3
13	SD5050	5.0	13.4	5.7
14	SD5153	3.5	15.9	8.0
15	SD5158	5.5	16.6	4.4
16	SD5193	4.3	25.3	18.0
17	SD5195	5.3	17.2	12.6
18	SD5203	4.7	14.5	9.5
19	SD5223	3.3	24.7	11.6
20	NDHRS18-0069-B077	4.7	35.5	12.3
21	NDHRS18-0105-B080	3.0	19.1	4.8
22	NDHRS18-0178-B057	6.0	17.7	8.8
23	NDHRS18-0180-B101	4.7	10.2	12.3
24	NDHRS18-0261-B234	5.3	22.5	16.2
25	NDHRS19RIL-0121-212-1	4.5	26.6	5.8
26	MT21220	7.0	40.2	13.4
27	MT21224	7.3	30.7	22.0
28	MT22071	7.0	53.2	21.5
29	MT22345	7.7	24.4	11.8
30	MT22361	8.0	51.3	33.4
31	MT23004	8.3	54.5	14.3
32	MT23297	7.3	30.9	19.9
33	AAC Westking	7.3	16.9	11.4
34	BW5095	6.0	13.2	9.2
35	HY2136	5.5	43.0	23.7
36	AAC Spike	5.7	33.7	19.5
37	AAC Hodge	6.3	30.1	11.2
Mean		5.6	27.6	14.3

¹ Fusarium Damaged Kernels calculated from RGB image of plot grain sample using algorithm from VIBE seed analyzer.

Table 6. 2024 Uniform Regional Scab Nursery for Spring Wheat Parents, Fargo, ND.

Entry	Line	FHB 1-9	VIBE FDK ¹ %	DON ppm
1	Bacup	4.6	20.2	2.5
2	ND2710	4.7	10.4	0.6
3	Rollag	5.7	11.5	2.5
4	Oslo	5.9	14.0	5.1
5	Wheaton	5.3	25.9	1.8
6	Norm	7.0	56.4	12.8
7	N10	7.6	43.8	7.1
8	MN19342-1	3.7	19.4	0.8
9	MN20080-3	4.7	17.7	1.7
10	MN20081-2	4.7	25.0	2.8
11	MN20171-1	2.7	10.9	1.3
12	MN20172-2	4.5	15.1	4.7
13	SD5050	5.7	15.0	1.7
14	SD5153	4.4	8.9	0.6
15	SD5158	2.8	8.4	0.8
16	SD5193	6.0	19.2	1.9
17	SD5195	3.9	13.3	3.8
18	SD5203	4.1	13.8	2.4
19	SD5223	2.3	17.1	4.0
20	NDHRS18-0069-B077	3.5	14.7	1.4
21	NDHRS18-0105-B080	3.7	9.1	0.8
22	NDHRS18-0178-B057	5.7	14.2	1.4
23	NDHRS18-0180-B101	4.7	9.9	1.5
24	NDHRS18-0261-B234	4.1	13.4	1.2
25	NDHRS19RIL-0121-212-1	3.6	19.5	0.6
26	MT21220	4.8	32.4	6.7
27	MT21224	6.7	35.2	6.9
28	MT22071	6.0	47.7	12.0
29	MT22345	7.0	48.0	11.7
30	MT22361	5.9	50.9	24.1
31	MT23004	6.3	48.1	9.3
32	MT23297	5.9	15.1	11.6
33	AAC Westking	4.7	15.8	4.9
34	BW5095	4.9	12.7	2.8
35	HY2136	5.4	35.8	11.8
36	AAC Spike	5.8	24.4	3.9
37	AAC Hodge	3.8	16.8	0.5
Mean		4.9	22.4	4.6

¹ Fusarium Damaged Kernels calculated from RGB image of plot grain sample using algorithm from VIBE seed analyzer.

Table 7. 2024 Uniform Regional Scab Nursery for Spring Wheat Parents, Langdon, ND.

Entry	Line	FHB	VIBE FDK ¹	DON
		1-9	%	ppm
1	Bacup	6.2	59.0	12.9
2	ND2710	4.6	81.1	14.2
3	Rollag	7.1	60.6	6.7
4	Oslo	6.8	65.9	8.2
5	Wheaton	7.8	-	-
6	Norm	9.6	87.4	22.9
7	N10	6.5	75.7	18.4
8	MN19342-1	5.1	72.5	11.9
9	MN20080-3	4.7	58.3	8.2
10	MN20081-2	4.3	45.6	8.4
11	MN20171-1	3.9	29.9	10.6
12	MN20172-2	5.3	37.3	13.2
13	SD5050	6.4	45.7	10.8
14	SD5153	4.8	80.6	7.4
15	SD5158	5.7	27.6	4.8
16	SD5193	4.5	59.1	7.8
17	SD5195	4.9	53.4	5.8
18	SD5203	2.9	-	-
19	SD5223	5.0	75.1	6.3
20	NDHRS18-0069-B077	5.5	55.4	12.2
21	NDHRS18-0105-B080	5.2	62.2	6.5
22	NDHRS18-0178-B057	5.5	48.4	8.3
23	NDHRS18-0180-B101	6.0	41.5	5.7
24	NDHRS18-0261-B234	5.1	70.3	7.6
25	NDHRS19RIL-0121-212-1	5.1	93.5	10.8
26	MT21220	6.8	77.1	10.6
27	MT21224	9.1	60.6	14.8
28	MT22071	9.2	77.6	14.2
29	MT22345	7.1	60.6	20.3
30	MT22361	7.7	-	-
31	MT23004	9.9	-	-
32	MT23297	7.8	54.3	14.1
33	AAC Westking	4.5	35.4	9.7
34	BW5095	5.2	24.1	7.9
35	HY2136	8.2	68.3	27.6
36	AAC Spike	7.5	48.8	9.4
37	AAC Hodge	5.1	48.6	9.0
Mean		6.1	58.8	11.1

¹ Fusarium Damaged Kernels calculated from RGB image of plot grain sample using algorithm from VIBE seed analyzer.

Table 8. 2024 Uniform Regional Scab Nursery for Spring Wheat Parents - Summary of Means.

Line	Incidence ¹		Severity ¹		Disease		VSK ²		FHB ³		DON ⁴	
	%	Rank	%	Rank	Index ¹	Rank	%	Rank	1-9	Rank	ppm	Rank
	No. of Locations > 3		3		3		6		3		5	
Bacup	97.1	13	40.5	23	39.9	23	31.9	23	5.5	21	8.4	16
ND2710	83.3	2	25.0	3	20.7	2	31.0	21	4.1	6	8.4	15
Rollag	99.2	19	39.7	22	39.5	22	27.0	17	6.6	29	9.4	23
Oslo	100.0	25	66.7	36	66.7	36	45.6	32	6.4	27	8.4	14
Wheaton	100.0	25	72.4	37	72.4	37	59.6	36	6.5	28	14.1	32
Norm	100.0	25	63.2	35	63.2	35	66.4	37	7.9	36	18.4	36
N10	100.0	25	58.0	32	58.0	32	50.0	34	7.0	31	16.9	35
MN19342-1	96.8	11	37.8	20	36.4	18	33.9	24	4.8	14	12.1	28
MN20080-3	94.6	8	29.6	9	28.3	8	22.9	10	4.8	13	7.4	10
MN20081-2	93.7	4	30.6	10	29.1	10	24.0	11	4.0	4	6.1	3
MN20171-1	99.2	19	26.9	6	26.7	7	16.8	2	3.3	1	6.9	6
MN20172-2	99.2	19	36.1	17	35.8	17	17.2	4	4.8	12	8.6	17
SD5050	100.0	25	48.7	28	48.7	28	24.2	12	5.7	22	7.2	9
SD5153	89.0	3	26.5	4	24.3	4	22.6	9	4.2	7	7.8	13
SD5158	94.7	9	34.8	15	33.5	15	17.3	5	4.7	10	5.5	1
SD5193	97.0	12	31.6	11	31.2	11	25.5	15	5.0	16	10.6	26
SD5195	99.4	24	32.9	13	32.7	14	25.0	14	4.7	11	10.3	25
SD5203	94.7	9	23.4	2	21.8	3	13.6	1	3.9	3	8.6	19
SD5223	94.1	5	27.1	7	25.4	5	28.4	19	3.5	2	9.2	22
NDHRS18-0069-B077	99.2	19	26.6	5	26.4	6	27.0	18	4.5	9	9.7	24
NDHRS18-0105-B080	79.9	1	21.8	1	18.3	1	21.2	8	4.0	5	6.0	2
NDHRS18-0178-B057	98.9	18	43.4	24	43.0	24	24.7	13	5.7	23	6.9	7
NDHRS18-0180-B101	97.3	14	38.2	21	37.6	21	19.9	6	5.1	18	7.2	8
NDHRS18-0261-B234	94.1	6	33.7	14	32.5	13	31.3	22	4.8	15	7.5	11
NDHRS19RIL-0121-212-1	94.4	7	32.4	12	31.2	12	35.2	25	4.4	8	7.6	12
MT21220	100.0	25	44.8	25	44.8	25	37.1	28	6.2	24	8.6	18
MT21224	100.0	25	57.3	31	57.3	31	41.1	30	7.7	35	13.7	30
MT22071	100.0	25	62.1	34	62.1	34	52.5	35	7.4	34	14.4	33
MT22345	100.0	25	61.6	33	61.6	33	41.5	31	7.3	33	13.9	31
MT22361	100.0	25	56.3	30	56.3	30	40.1	29	7.2	32	20.1	37
MT23004	100.0	25	55.7	29	55.7	29	48.7	33	8.2	37	11.5	27
MT23297	100.0	25	48.5	27	48.5	27	29.3	20	7.0	30	12.8	29
AAC Westking	98.4	17	28.7	8	28.4	9	21.2	7	5.5	20	8.7	20
BW5095	100.0	25	36.8	18	36.8	19	16.9	3	5.4	19	6.7	5
HY2136	99.2	19	47.9	26	47.6	26	36.9	27	6.4	26	16.7	34
AAC Spike	98.4	15	35.9	16	35.6	16	35.9	26	6.3	25	8.9	21
AAC Hodge	98.4	15	37.3	19	37.0	20	26.5	16	5.1	17	6.62	4

¹ Includes the locations of St. Paul, Crookston, and Brookings

² Includes all locations

³ Includes the locations of Prosper, Fargo, and Langdon

⁴ Includes the locations of St. Paul, Crookston, Prosper, Fargo, and Langdon

Table 9. Correlation Coefficients Between Traits, by Location.

Correlation Between	St. Paul	Crookston	Brookings	Prosper	Fargo	Langdon
Incidence & Severity	0.532	0.386	0.552			
Incidence & Disease Index	0.618	0.422	0.570			
Incidence & Tombstone/VSK/FDK	0.291	0.308	0.290			
Incidence & DON	0.351	0.056				
Severity & Disease Index	0.994	0.999	1.000			
Severity & Tombstone/VSK/FDK	0.789	0.790	0.762			
Severity & DON	0.783	-0.021 *				
Disease Index & Tombstone/VSK/FDK	0.768	0.791	0.759			
Disease Index & DON	0.761	-0.016 *				
Tombstone/VSK/FDK & DON	0.716	-0.012 *		0.696	0.797	0.361

* Correlation was negative due to high levels of DON at this location across all entries

Table 10. Correlation coefficients among traits, using means across locations.

	Incidence	Severity	Disease Index
Severity	0.336		
Disease Index	0.420	0.995	
Tombstone/VSK/FDK	0.313	0.627	0.636

Calculated using 3 locations: St. Paul, Crookston, and Brookings

Table 11. 2024 Uniform Regional Scab Nursery for Spring Wheat Parents, St. Paul, MN.
Seedling stem rust reactions (Y. Jin, USDA-ARS).

		Domestic races					Field stem rust response	Bin	Pbc
Entry	Line	QFCSC 95MN1080	QTHJC 69MN399	RKRQC 99KS76A-1	TPMKC 74MN1409	TTTTF 01MN84A-1- 2	St. Paul		
1	Bacup	0;	2-	2-	;1-	3	0		
2	ND2710	0;	2-	2-	2-	;1	0		
3	Rollag	0;	2-	2-	2-	11+	0		
4	Oslo	;2-	2-	2-;	2-	3	0		
5	Wheaton	0;	2-	2-;	2-	11+;	0		
6	Norm	0;	2-	;1-	2-	;1	0		
7	N10	0;	2-	;1-	2-	1;	0		
8	MN19342-1	0;	2-	2-	.	11+;	0		
9	MN20080-3	0;	2-	2-	.	1;	0		
10	MN20081-2	;2-	2-	2-	2-	1;	0		
11	MN20171-1	0;	2-	;1-	2-	;1	0		
12	MN20172-2	;	2-	2-	2-	;	0		
13	SD5050	;	2-	2-	1-	1+1	5MR		
14	SD5153	;	2	2	.	1	0		
15	SD5158	0;	2-	22-	2-	;1	0		
16	SD5193	;2-N	2-C	2	2-	11+	0		
17	SD5195	;	2-C	2-	2-	;1	0		
18	SD5203	;2-N	2-C	2-	2-	1;	0		
19	SD5223	;2-N	2-C	2-2	2-	11+	0		
20	NDHRS18-0069-B077	;	2-	2-	;1-	1	0		
21	NDHRS18-0105-B080	;	2-	2-	2-	0;1	5MR		
22	NDHRS18-0178-B057	0;	2-	;2-	2-	1	0		
23	NDHRS18-0180-B101	0;	2-	2-	2-	1	0		
24	NDHRS18-0261-B234	0;	2-	;2-	2-	;1	0		
25	NDHRS19RIL-0121-212-1	0;	2-	2-	2-	;1	0		
26	MT21220	0;	2-	2	2-	3+	0		
27	MT21224	0;;	2-	2	2-	1+	0		
28	MT22071	0;	2-	2-	2-	3	0		
29	MT22345	0;	2- LIF	2-	.	;1	0		
30	MT22361	2-	2-	2-	2-	1;	0		
31	MT23004	0;	2-	2-	;1-	11+	0		
32	MT23297	;2-N	2-	2-	2-	;1	0		
33	AAC Westking	;	2-	2-	2-	;1	0		
34	BW5095	0;	2-	;1-	2-	;1	0		
35	HY2136	0;	2-	2-	2	;1	0		
36	AAC Spike	0;	2	;2-	2	;1	0		
37	AAC Hodge	0;	12-	;2-	2-	;1	0		
*	Line E	3+	3+	3+	3+	3+	100S		
*	LMPG-6	2+3	2+2	3	3	3+	90S		
*	NA101/MqSr7a	21	3	11+;	3+	1+1	50MRMS		

* Checks

Explanatory notes on next page

A. Races used in seedling evaluations:

Race	Origin	Virulence on differentia
QFCSC	MN, USA	5 8a 9a 9d 9g 10 17 21 McN
QTHJC	MN, USA	5 6 8a 9b 9d 9g 10 11 17 21 McN
RKRQC	MN, USA	5 6 7b 8a, 9a 9b 9d 9g 17 21 36 McN
TPMKC	MN, USA	5 7b 8a 9d 9e 9g 10 11 17 21 36 Tmp McN
TTTTF	MN, USA	5 6 7b 8a 9a 9b 9d 9e 9g 10 11 17 21 30 36 38 Tmp McN

B. Seedling rating scale:

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

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

LIF = low infection frequency (fewer number of pustules)

C = extensive chlorosis

N = extensive necrosis

C. Field stem rust nursery evaluations:

The stem rust nursery (X-13) was planted in 1-m row plots.

Nurseries were inoculated by spray inoculations with a single race QFCSC.

F. Field ratings:

Stem rust terminal severity (%) and infection responses (R, MR, MS, S or combination thereof)

were rated when entries were at the soft dough stage

BIN-Black internode, a likely indication of the presence of Sr2. This trait is considered to be more

consistent than pseudo black chaff (PBC) in the St. Paul nursery.

Sr2 also could be seen at the seedling stage in some cases, labeled as Sr2M (=Sr2 induced mosaic)

Table 12. 2024 Uniform Regional Scab Nursery for Spring Wheat Parents, St. Paul, MN.

Adult rust reactions in the field. Data from inoculated trials using a mixture of races. (J. Anderson)

Entry	Line	Leaf Rust	Stem Rust
1	Bacup	100S	0
2	ND2710	30MS	0
3	Rollag	100S	0
4	Oslo	60MR	0
5	Wheaton	40MS	0
6	Norm	50MR	0
7	N10	90S	0
8	MN19342-1	5MR	0
9	MN20080-3	5MR	0
10	MN20081-2	20MS	0
11	MN20171-1	10MR	0
12	MN20172-2	5MR	0
13	SD5050	30MS	0
14	SD5153	40MR	0
15	SD5158	5MR	0
16	SD5193	40MS	0
17	SD5195	5MR	0
18	SD5203	1MR	0
19	SD5223	10MR	0
20	NDHRS18-0069-B077	1R	0
21	NDHRS18-0105-B080	5MR	0
22	NDHRS18-0178-B057	20MR	0
23	NDHRS18-0180-B101	40S	0
24	NDHRS18-0261-B234	5MS	0
25	NDHRS19RIL-0121-212-1	30MS	0
26	MT21220	80MS	0
27	MT21224	20MS	0
28	MT22071	50MS	0
29	MT22345	5R	0
30	MT22361	5MR	0
31	MT23004	90S	0
32	MT23297	10MR	0
33	AAC Westking	40MS	0
34	BW5095	5MR	0
35	HY2136	20MR	0
36	AAC Spike	30MR	0
37	AAC Hodge	20MS	0

Table 13. Markers Associated With Selected Traits/Genes (R. Nandety and J. Fiedler, USDA-ARS).

Entry Line	Trait														Marker													
	StemRust 3B	StemRust 6A	StemRust 3B	Stem Rust 7D	LeafRust 2B	LeafRust 2B	LeafRust 1D	LeafRust 2B	LeafRust 7D	YellowRust 2B	TanSpot 5B	Fhb 3B	Fhb 3B	Fhb 5A	Fhb 5A	Fhb 6B	GrainProt. 6B	Glutenins 1D	Glutenin 1A	Dwarfing 4B	Dwarfing 4D	Dwarfing 6A	Photoper. 2B	Photoper. 2D	Kernel Color	Kernel Color	Kernel Color	
	Sr2	Sr8	Sr12	Sr25	Lr13	Lr16	Lr21	Lr23	Lr34	Yr7D	Tsn1	Fhb1	Fhb1-TaHRC	barc180	barc186	gwm644	GPC	Glud1	umr19	RhtB1	RhtD1	Rht24	PpdB1	PpdD1	Tamyb10-A1	Tamyb10-B1	Tamyb10-D1	
1 Bacup	S	S	R		R	S	S	S	R	S	S	S	S	R	R		N	G	1	Wt	Wt	D	I	I	R	W	R	
2 ND2710	--	H	R		S	H		H	R	S	S	R	R	S	S		N	U	2	Wt	U	Wt	S	H	R	W	R	
3 Rollag	S	S	R		R	R	S	R	R	S	S	R	R	S	S		N	G	2	Wt	D	D	S	S	R	W	W	
4 Oslo	S	R	R		R	S	S	U	S	R	R	S	S	S	S		N	P	1	D	Wt	D	S	I	W	R	W	
5 Wheaton	S	S	R		R	R	S	R	R	R	R	S	S	S	S		N	G	2	Wt	D	Wt	S	I	W	R	R	
6 Norm	S	S	R		R	R	S	R	R	R	R	S	S	S	S		N	G	2	Wt	D	Wt	S	S	W	R	R	
7 N10	S	S	R		R	R	S	R	R	R	R	R	R	S	S		N	P	2	Wt	D	Wt	S	S	W	W	R	
8 MN19342-1	--	S	R		R	S	R	R	R	R	S	R	R	S	S		N	G	2	Wt	Wt	D	S	I	R	R	R	
9 MN20080-3	--	S	R		R	S	R	R	R	R	R	R	R	S	S		N	G	2	Wt	Wt	D	S	I	R	R	R	
10 MN20081-2	--	S	S		R	S	S	S	R	R	R	R	R	S	S		N	G	2	Wt	D	D	I	S	R	R	R	
11 MN20171-1	--	S	R		R	R	S	S	R	R	R	R	R	R	R		N	G	2	Wt	D	Wt	S	S	R	R	R	
12 MN20172-2	--	S	S		S	R	S	S	R	R	S	R	R	S	S		N	G	2	D	Wt	D	S	S	R	R	R	
13 SD5050	--	S	S		R	R	S	R	R	R	R	R	R	S	S		N	G	2	Wt	D	Wt	S	I	R	W	R	
14 SD5153	--	S	S		R	S	S	R	R	R	R	R	R	S	S		N	G	2	Wt	Wt	D	S	S	R	W	R	
15 SD5158	--	S	R		R	S	S	R	R	R	R	S	R	S	S		N	G	2	Wt	Wt	D	S	I	R	R	W	
16 SD5193	S	S	R		R	R	S	R	R	S	R	R	R	S	S		N	G	2	D	Wt	Wt	S	S	R	W	R	
17 SD5195	--	S	R		S-a	R	R	R	R	R	S	S	S	S	S		N	G	2	Wt	Wt	D	S	S	R	R	R	
18 SD5203	S	S	R		S	R	S	R	R	S	R	R	R	R	R		N	G	2	D	Wt	Wt	S	S	R	R	R	
19 SD5223	--	S	S		R	R	S	R	R	R	R	S	R	S	S		N	G	2	Wt	Wt	D	S	S	R	R	R	
20 NDHRS18-0069-B077	--	S	S		R	R	R	S	R	R	R	S	S	S	S		N	G	2	D	Wt	Wt	S	S	R	R	R	
21 NDHRS18-0105-B080	--	R	S		S-a	S	R	S	R	R	S	R	R	R	R		N	G	2	Wt	Wt	Wt	S	I	R	R	W	
22 NDHRS18-0178-B057	--	S	R		R	R	R	R	R	S	S	S	S	S	S		N	G	1	D	Wt	Wt	S	S	R	R	R	
23 NDHRS18-0180-B101	S	S	R		R	S	R	S	R	S	S	S	S	S	S		N	G	2	D	Wt	Wt	S	S	R	R	R	
24 NDHRS18-0261-B234	--	S	R		R	R	S	R	R	S	S	R	R	R	R		N	G	2	D	Wt	Wt	S	S	R	R	R	
25 NDHRS19RIL-0121-212-1	--	S	R		R	S	R	S	R	S	U	S	R	S	S		N	G	2	D	Wt	Wt	S	S	R	R	R	
26 MT21220	--	S	R		R	R	S	R	S	R	S	S	S	S	S		N	G	2	D	Wt	Wt	S	S	W	R	R	
27 MT21224	--	S	R		S	R	S	S	R	R	S	S	S	S	S		N	G	2	D	Wt	Wt	S	S	R	R	R	
28 MT22071	--	R	R		R	R	S	R	R	R	S	S	S	S	S		N	G	2	D	Wt	Wt	I	S	R	R	R	
29 MT22345	--	S	R		R	R	S	R	R	R	S	S	S	S	S		N	G	2	D	Wt	U	I	I	R	R	R	
30 MT22361	S	S	S		S-a	S	S	S	S	R	U	S	S	S	R		N	G	2	D	Wt	Wt	S	S	R	R	R	
31 MT23004	--	S	R		S	R	S	S	R	R	U	S	S	S	S		N	G	2	D	Wt	Wt	S	S	R	R	R	
32 MT23297	--	S	S		S	R	S	S	R	R	S	S	S	S	S		N	G	2	D	Wt	Wt	S	S	R	R	R	
33 AAC Westking	--	S	R		S-a	S	R	S	R	R	S	R	R	S	S		N	G	1	D	Wt	Wt	S	S	R	R	R	
34 BW5095	--	S	R		S	R	S	S	R	R	S	R	R	S	S		N	G	2	D	Wt	Wt	S	S	R	R	R	
35 HY2136	S	S	R		S	S	S	R	R	R	R	R	R	S	S		N	G	1	Wt	D	Wt	S	S	W	R	R	
36 AAC Spike	--	R	R		R	R	S	R	R	R	R	S	S	S	S		N	G	2	D	Wt	Wt	I	S	R	R	R	
37 AAC Hodge	--	S	R		R	R	S	R	R	R	R	R	R	R	R		N	G	2	D	Wt	Wt	I	S	R	R	R	

Information about markers on next page

Allele Code	Description
R = Resistant (Hope allele)	S = Susceptible
R = Resistant (Harvest allele)	S = Susceptible
R = Resistant	S = Susceptible
R = Resistant (200 bp present)	S = Susceptible (no 200 bp)
R = Ne2/Lr13, Lr13, Lr13 resistant and hybrid necrosis (Ne2 allele)	S = Ne2/Lr13, Lr13, Lr13 susceptible, hybrid necrosis
R = Resistant	S = Susceptible
R = Resistant	S = Susceptible
R = Resistant	S = Susceptible
R = Resistant (Thatcher allele)	S = Susceptible
R = Resistant	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 (6+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
D = Dwarfing	Wt = Wild Type
I = Insensitive	S = Sensitive
I = Insensitive	S = Sensitive
R = Red	W = White
R = Red	W = White
R = Red	W = White

U = No Call or Unknown = Indeterminant designation

Het = Heterozygous call

Table 13 continued, Marker information

Name	Chromosome	Alternate Name	Comment	Manuscript
Sr2	3B		Null allele	https://doi.org/10.1007/s00122-010-1482-7
Sr8	6A	kwh53		https://doi.org/10.1094/PHYTO-05-16-0186-R
Sr12	3B	NBLRR3		https://doi.org/10.1371/journal.pone.0157029
Sr25	7D		SSR	Chao, unpublished
Lr13	2B			Anderson lab
Lr16	2B	kwm849		https://doi.org/10.1186/s12870-017-0993-7
Lr21	1D			https://doi.org/10.1007/s11032-012-9773-0
Lr23	2B	sunKASP_16 FJ436983-		https://doi.org/10.1007/s11032-017-0628-6
Lr34	7D	T67957A		https://doi.org/10.1126/science.1166453
Yr7	2B	Yr7D		https://doi.org/10.1038/s41477-018-0236-4
Tsn	5B	Tsn1-1Ka	SNP flanking deletion	Faris Lab unpublished
Fhb1	3B	FM227		https://doi.org/10.1007/s00122-016-2727-x
TaHRC	3B			https://doi.org/10.1007/s00122-018-3159-6
barc180	5A	GENE-3371_56	equivalent to SSR	https://doi.org/10.1007/s00122-011-1573-0
barc186	5A	IWA6412	equivalent to SSR	Chao, unpublished
gwm644	6B		SSR	https://doi.org/10.1093/genetics/149.4.2007
GPC	6B	GPC-B1_DUP		https://doi.org/10.1111/j.1469-8137.2005.01627.x
GluD1	1D			https://doi.org/10.1270/jsbbs.57.243
umn19	1A		SSR	https://doi.org/10.1007/s00122-008-0886-0
RhtB1	4B			https://doi.org/10.1007/s00122-002-1048-4
RhtD1	4D			https://doi.org/10.1007/s00122-002-1048-4
Rht24	6A	Rht24-TaAP2.1		Anderson lab
PpdB1	2B			https://doi.org/10.1371/journal.pone.0079459
PpdD1	2D			https://doi.org/10.1007/s11032-012-9765-0
Tamyb10-A1	3A			https://doi.org/10.1007/s00122-011-1555-2
Tamyb10-B1	3B			https://doi.org/10.1007/s00122-011-1555-2
Tamyb10-D1	3D			https://doi.org/10.1007/s00122-011-1555-2