

Report of the 2011 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 17th year in 2011. Five locations at Brookings, SD, St. Paul and Crookston, MN, Langdon, ND, and Glenlea, Manitoba, Canada were planted.

A total of 24 entries were included in the 2011 URSN, including the resistant checks 2375, BacUp, and ND2710, and the susceptible checks Wheaton and Oslo. The other entries were contributed by 5 university and government 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 \cong tombstone \cong 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. 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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| Table 1. Entries for the Uniform Regional Scab Nursery for Spring Wheat Parents, 2011. | | | | |
|---|---------------|---|---------------------------|---------------|
| Entry No. | Name | Pedigree | Year First Entered | Source |
| 1 | 2375 | CHECK | | |
| 2 | Wheaton | CHECK | | |
| 3 | Bacup | CHECK | | |
| 4 | Oslo | CHECK | | |
| 5 | ND2710 | CHECK | | |
| 6 | MN07057-6-4 | MN99322-5(Fuijan 5114-1/MN2538(BacUp'S')) /84-5-5-1-2(Parshall/MN97589) | 2011 | UMN |
| 7 | MN07167W-2-1 | MN01280W/8019-R1-1//MN01281 | 2011 | UMN |
| 8 | MN09023 | MN01261-8-1(Ada/Parshall)/2*Sabin | 2011 | UMN |
| 9 | MN09092 | Sabin//Tom/Faller | 2011 | UMN |
| 10 | X00009-16 | Wheaton/Excelcier | 2011 | UMN |
| 11 | SD4313 | STEELE-ND/SD3974 | 2011 | SDSU |
| 12 | SD4331 | GLENN/SD3997 | 2011 | SDSU |
| 13 | SD4337 | SD3948/SD3997 | 2011 | SDSU |
| 14 | SD4338 | SD3618/ND739 | 2011 | SDSU |
| 15 | SD4343 | SD3623/SD3744 | 2011 | SDSU |
| 16 | 10EXP13-16 | ND735/Steele-ND | 2011 | NDSU |
| 17 | 10EXP13-24 | Keene/3/Grandin*2//Coteau/LNW(Tt-2)/4/ND708/5/ND711/6/ND756 | 2011 | NDSU |
| 18 | 10EXP13-44 | Walworth/ND721 | 2011 | NDSU |
| 19 | 10EXP13-87 | Frontana/W9207//Alsen/3/ND740'S' | 2011 | NDSU |
| 20 | 10 EXPSW13-9 | NDSW0849 | 2011 | NDSU |
| 21 | 10 EXPSW13-19 | NDSW0925 | 2011 | NDSU |
| 22 | 10 EXPSW13-28 | NDSW0948 | 2011 | NDSU |
| 23 | BW 928 | BW799/ND721//Alsen | 2010 | SPARC, AAFC |
| 24 | BW429 | McKenzie/Alsen | 2011 | CRC, AAFC |

Table 2. 2011 Uniform Regional Scab Nursery for Spring Wheat Parents, Brookings, SD.

| Line | Incidence % | Severity % | Disease Index | Tombstone % | DON ppm |
|---------------|------------------------|-----------------------|--------------------------|------------------------|--------------------|
| 2375 | 100.0 | 53.7 | 53.7 | 15.0 | 4.9 |
| Wheaton | 100.0 | 61.8 | 61.8 | 21.7 | 7.6 |
| Bacup | 98.3 | 38.3 | 38.0 | 5.0 | 2.6 |
| Oslo | 100.0 | 64.2 | 64.2 | 10.0 | 2.8 |
| ND2710 | 100.0 | 39.5 | 39.5 | 5.0 | 1.8 |
| MN07057-6-4 | 98.3 | 46.0 | 45.2 | 5.0 | 4.6 |
| MN07167W-2-1 | 100.0 | 50.5 | 50.5 | 5.0 | 6.1 |
| MN09023 | 96.7 | 51.3 | 50.1 | 5.0 | 4.1 |
| MN09092 | 100.0 | 49.0 | 49.0 | 5.0 | 3.7 |
| X00009-16 | 100.0 | 43.0 | 43.0 | 6.7 | 2.6 |
| SD4313 | 96.7 | 27.7 | 26.8 | 5.0 | 1.8 |
| SD4331 | 98.3 | 37.7 | 37.2 | 8.3 | 5.1 |
| SD4337 | 100.0 | 52.5 | 52.5 | 6.7 | 5.1 |
| SD4338 | 100.0 | 53.5 | 53.5 | 5.0 | 2.5 |
| SD4343 | 100.0 | 39.2 | 39.2 | 5.0 | 1.5 |
| 10EXP13-16 | 100.0 | 52.3 | 52.3 | 11.7 | 5.4 |
| 10EXP13-24 | 100.0 | 49.3 | 49.3 | 5.0 | 2.3 |
| 10EXP13-44 | 98.3 | 33.8 | 33.2 | 5.0 | 1.6 |
| 10EXP13-87 | 100.0 | 57.7 | 57.7 | 5.0 | 2.2 |
| 10 EXPSW13-9 | 100.0 | 54.8 | 54.8 | 8.3 | 6.7 |
| 10 EXPSW13-19 | 100.0 | 56.2 | 56.2 | 6.7 | 6.2 |
| 10 EXPSW13-28 | 96.7 | 30.3 | 29.3 | 3.3 | 2.2 |
| BW 928 | 100.0 | 48.3 | 48.3 | 5.0 | 3.3 |
| Brick | 93.3 | 25.8 | 24.8 | 5.0 | 1.6 |
| Mean | 99.0 | 46.5 | 46.2 | 7.0 | 3.7 |
| LSD | NS | 18.8 | 19.2 | 5.0 | 2.8 |
| CV | 1.7 | 22.5 | 23.3 | 58.2 | 50.0 |

Table 3. 2011 Uniform Regional Scab Nursery for Spring Wheat Parents, Crookston, MN.

| Line | VSK % | DON ppm | Heading d from 6-1 | micro TWT ¹ g |
|-------------------|----------|------------|-----------------------|-----------------------------|
| 2375 | 17 | 9.8 | 37 | 9.8 |
| Wheaton | 60 | 12.5 | 41 | – |
| Bacup | 24 | 11.2 | 33 | 9.9 |
| Oslo | 25 | 8.2 | 35 | – |
| ND2710 | 14 | 14.9 | 38 | 10.2 |
| MN07057-6-4 | 8 | 4.4 | 41 | 9.6 |
| MN07167W-2-1 | 9 | 14.1 | 37 | 10.0 |
| MN09023 | 5 | 6.6 | 41 | 10.9 |
| MN09092 | 8 | 6.8 | 39 | 9.8 |
| X00009–16 | 17 | 12.2 | 38 | 9.9 |
| SD4313 | 19 | 6.6 | 33 | 9.5 |
| SD4331 | 30 | 10.2 | 34 | 9.7 |
| SD4337 | 14 | 6.1 | 35 | 9.9 |
| SD4338 | 12 | 7.8 | 33 | 10.7 |
| SD4343 | 8 | 5.0 | 36 | 11.1 |
| 10EXP13-16 | 14 | 9.1 | 37 | 10.6 |
| 10EXP13-24 | 9 | 8.5 | 35 | 10.4 |
| 10EXP13-44 | 16 | 7.3 | 34 | 10.1 |
| 10EXP13-87 | 10 | 10.4 | 37 | 10.7 |
| 10 EXPSW13-9 | 16 | 18.3 | 36 | 9.4 |
| 10 EXPSW13-19 | 13 | 7.4 | 41 | – |
| 10 EXPSW13-28 | 30 | 4.6 | 33 | 9.0 |
| BW 928 | 8 | 10.0 | 38 | 10.7 |
| BW429 | – | – | – | – |
| Alsen (MR check) | 6 | 5.9 | 37 | 11.2 |
| Roblin (S check) | 62 | 9.3 | 33 | 8.3 |
| MN00269 (S check) | 28 | 7.1 | 42 | 9.9 |
| Mean | 17.6 | 9.0 | 36.7 | 10.1 |
| LSD | 8.6 | | 1.4 | 0.7 |
| CV | 29.8 | | 2.4 | 4.4 |

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
No data collected on incidence or severity at this location

Table 4. 2011 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 | 100.0 | 28.8 | 28.8 | 11.0 | 3.5 | 30 | 17.9 | 10.1 |
| Wheaton | 100.0 | 78.5 | 78.5 | 86.7 | 5.8 | 30 | 4.2 | 8.7 |
| Bacup | 95.0 | 34.6 | 33.1 | 9.3 | 3.6 | 28 | 13.3 | 10.7 |
| Oslo | 100.0 | 77.9 | 77.9 | 20.0 | 4.7 | 30 | 7.4 | 8.9 |
| ND2710 | 86.7 | 13.3 | 11.6 | 9.3 | 2.5 | 30 | 18.1 | 10.3 |
| MN07057-6-4 | 95.0 | 36.8 | 35.3 | 15.0 | 6.0 | 35 | 10.3 | 10.4 |
| MN07167W-2-1 | 100.0 | 27.9 | 27.9 | 9.3 | 8.7 | 30 | 11.3 | 10.0 |
| MN09023 | 96.7 | 30.8 | 29.8 | 8.0 | 5.3 | 35 | 11.1 | 10.6 |
| MN09092 | 100.0 | 12.0 | 12.0 | 9.7 | 4.5 | 30 | 12.3 | 9.6 |
| X00009-16 | 98.3 | 23.3 | 22.9 | 8.0 | 3.1 | 30 | 17.4 | 10.5 |
| SD4313 | 95.0 | 22.0 | 20.7 | 15.7 | 3.2 | 27 | 10.1 | 10.2 |
| SD4331 | 91.7 | 27.2 | 25.3 | 17.7 | 5.5 | 27 | 14.2 | 10.0 |
| SD4337 | 76.7 | 29.2 | 22.3 | 7.3 | 2.6 | 28 | 14.7 | 9.3 |
| SD4338 | 93.3 | 19.8 | 18.7 | 8.0 | 3.1 | 27 | 16.0 | 10.6 |
| SD4343 | 80.0 | 7.9 | 6.3 | 4.7 | 2.0 | 30 | 15.2 | 10.8 |
| 10EXP13-16 | 100.0 | 29.3 | 29.3 | 12.0 | 4.8 | 30 | 14.4 | 10.9 |
| 10EXP13-24 | 98.3 | 16.2 | 15.9 | 7.3 | 3.6 | 30 | 13.8 | 11.0 |
| 10EXP13-44 | 98.3 | 32.3 | 31.9 | 16.7 | 3.1 | 30 | 16.0 | 10.5 |
| 10EXP13-87 | 98.3 | 18.5 | 18.3 | 15.7 | 5.0 | 30 | 13.5 | 10.1 |
| 10 EXPSW13-9 | 100.0 | 40.4 | 40.4 | 10.0 | 8.3 | 30 | 12.6 | 9.5 |
| 10 EXPSW13-19 | 100.0 | 51.6 | 51.6 | 19.7 | 3.3 | 35 | 18.2 | 8.9 |
| 10 EXPSW13-28 | 96.7 | 33.5 | 32.5 | 13.0 | 4.1 | 30 | 7.2 | 10.4 |
| BW 928 | 100.0 | 12.0 | 12.0 | 14.0 | 3.8 | 30 | 10.7 | 9.2 |
| BW429 | – | – | – | – | – | – | – | – |
| Alsen (MR check) | 98.3 | 15.2 | 15.0 | 6.7 | 3.7 | 30 | 9.3 | 10.0 |
| Roblin (S check) | 100.0 | 79.6 | 79.6 | 68.3 | 4.8 | 27 | 9.7 | 9.0 |
| MN00269 (S check) | 100.0 | 86.7 | 86.7 | 48.3 | 7.6 | 35 | 3.1 | 10.7 |
| Mean | 94.0 | 35.7 | 34.9 | 20.3 | 4.5 | 30.0 | 12.1 | 10.1 |
| LSD | 9.7 | 11.4 | 12.1 | 10.4 | | 1.6 | 5.1 | 1.0 |
| CV | 6.3 | 19.4 | 21.1 | 31.1 | | 3.3 | 20.7 | 6.3 |

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 measuring 20 mm in diameter and 50 mm in height

Table 5. 2011 Uniform Regional Scab Nursery for Spring Wheat Parents, Langdon, ND.

| Line | Incidence % | Severity % | Disease Index | DON ppm | Heading d from 6-1 |
|---------------|------------------------|-----------------------|--------------------------|--------------------|-------------------------------|
| 2375 | 100 | 59.5 | 59.5 | 1.5 | 14 |
| Wheaton | 100 | 86.8 | 86.8 | 1.0 | 17 |
| Bacup | 100 | 72.7 | 72.7 | 0.9 | 14 |
| Oslo | 100 | 90.4 | 90.4 | 1.3 | 11 |
| ND2710 | 100 | 32.5 | 32.5 | 0.7 | 15 |
| MN07057-6-4 | 100 | 68.1 | 68.1 | 0.2 | 21 |
| MN07167W-2-1 | 100 | 70.0 | 70.0 | 0.9 | 20 |
| MN09023 | 100 | 49.3 | 49.3 | 0.3 | 19 |
| MN09092 | 100 | 54.7 | 54.7 | 0.3 | 18 |
| X00009-16 | 100 | 56.6 | 56.6 | 0.9 | 14 |
| SD4313 | 100 | 49.6 | 49.6 | 0.5 | 15 |
| SD4331 | 100 | 52.2 | 52.2 | 1.2 | 11 |
| SD4337 | 100 | 43.1 | 43.1 | 1.2 | 12 |
| SD4338 | 100 | 25.8 | 25.8 | 0.8 | 12 |
| SD4343 | 100 | 20.8 | 20.8 | 0.4 | 17 |
| 10EXP13-16 | 100 | 41.5 | 41.5 | 0.6 | 16 |
| 10EXP13-24 | 100 | 43.7 | 43.7 | 0.5 | 13 |
| 10EXP13-44 | 100 | 38.5 | 38.5 | 0.3 | 12 |
| 10EXP13-87 | 100 | 44.1 | 44.1 | 0.4 | 18 |
| 10 EXPSW13-9 | 100 | 80.3 | 80.3 | 1.1 | 19 |
| 10 EXPSW13-19 | 100 | 63.7 | 63.7 | 0.8 | 19 |
| 10 EXPSW13-28 | 100 | 56.6 | 56.6 | 0.5 | 15 |
| BW 928 | 100 | 53.4 | 53.4 | 1.3 | 16 |
| BW429 | 100 | 69.0 | 69.0 | 0.7 | 18 |
| Mean | 100 | 55.1 | 55.1 | 0.8 | 15.6 |
| LSD | | 19.5 | 19.5 | 0.8 | 4.1 |
| CV | | 25.1 | 25.1 | 70.4 | 18.6 |

Table 6. 2011 Uniform Regional Scab Nursery for Spring Wheat Parents, Glenlea, MB.

| Line | Incidence % | Severity % | Disease Index | | FDK % | DON % | DISK* | ISD** | |
|--------------|----------------|---------------|------------------|----|----------|----------|-------|-------|----|
| 2375 | 2.8 | 2.0 | 5.3 | MR | 1.8 | 2.6 | 2.3 | 2.5 | MR |
| Wheaton | 3.6 | 5.3 | 17.6 | MS | 7.1 | 7.7 | 6.2 | 5.8 | MS |
| Bacup | 2.9 | 1.4 | 4.3 | R | 0.9 | 1.9 | 1.7 | 2.0 | MR |
| Oslo | 3.0 | 2.4 | 7.6 | MR | 4.4 | 6.7 | 4.4 | 4.3 | I |
| MN07057-6-4 | 1.6 | 0.5 | 1.2 | R | 1.0 | 0.4 | 0.9 | 0.8 | R |
| MN07167W-2-1 | 2.6 | 1.4 | 3.4 | R | 1.3 | 3.8 | 2.3 | 2.7 | MR |
| MN09023 | 3.4 | 1.4 | 4.4 | R | 0.7 | 0.7 | 1.4 | 1.7 | MR |
| MN09092 | 2.8 | 0.6 | 1.6 | R | 0.8 | 1.1 | 1.2 | 1.4 | R |
| X00009-16 | 1.9 | 1.1 | 2.1 | R | 0.8 | 1.3 | 1.2 | 1.4 | R |
| BW928 | 2.9 | 1.1 | 3.1 | R | 2.0 | 3.3 | 2.4 | 2.5 | MR |
| Mean | 2.7 | 1.7 | 5.1 | | 2.1 | 3.0 | 2.4 | 2.5 | |
| LSD | 4.0 | 2.5 | 7.6 | | 2.7 | 4.6 | 2.4 | 2.4 | |
| CV | 60.6 | 60.5 | 61.9 | | 53.0 | 64.0 | 40.9 | 39.1 | |

*DISK = (DON, % Incidence, % Severity, Kernel (FDK))

is calculated by: $((0.2 \cdot \text{AVG}\%I) + (0.2 \cdot \text{AVG}\%S) + (0.3 \cdot \text{AVG-FDK}) + (0.3 \cdot \text{AVG-DON}))$ for a given entry

**ISD (%Incidence, %Severity, DON) is calculated by: $(0.3 \cdot \text{AVG}\%Inc) + (0.3 \cdot \text{AVG}\%Sev) + (0.4 \cdot \text{AVG-DON})$ for a given entry.

Entries from NDSU, SDSU and a few others were not planted

Table 7. Correlation coefficients among traits on a per-location basis.

| Correlation Between | Brookings | Crookston | St. Paul | Langdon |
|-------------------------------|------------------|------------------|-----------------|----------------|
| Incidence & Severity | 0.64 | | 0.33 | |
| Incidence & Disease Index | 0.67 | | 0.39 | |
| Incidence & Tombstone/VSK | 0.32 | | 0.25 | |
| Incidence & DON | 0.88 | | 0.48 | |
| Severity & Disease Index | 1.00 | | 1.00 | 1.00 |
| Severity & Tombstone/VSK | 0.51 | | 0.68 | |
| Severity & DON | 0.55 | | 0.33 | 0.39 |
| Disease Index & Tombstone/VSK | 0.51 | | 0.69 | |
| Disease Index & DON | 0.55 | | 0.35 | 0.39 |
| Tombstone/VSK & DON | 0.62 | 0.19 | 0.21 | |

Table 8. 2011 Uniform Regional Scab Nursery for Spring Wheat Parents - Cross-Location Means and Ranks.

| Line | Incidence % | Incidence Rank | Severity % | Severity Rank | Disease Index | Disease Index Rank | VSK % | VSK Rank | DON ppm | DON Rank |
|------------------|-------------|----------------|------------|---------------|---------------|--------------------|-------|----------|---------|----------|
| No. of Locations | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 4 | 4 |
| 2375 | 100 | 15 | 47.3 | 16 | 47.3 | 16 | 14.4 | 19 | 4.9 | 18 |
| Wheaton | 100 | 15 | 75.7 | 23 | 75.7 | 23 | 56.1 | 23 | 6.7 | 22 |
| Bacup | 97.8 | 5 | 48.6 | 17 | 47.9 | 17 | 12.8 | 16 | 4.6 | 15 |
| Oslo | 100 | 15 | 77.5 | 24 | 77.5 | 24 | 18.3 | 21 | 4.3 | 12 |
| ND2710 | 95.6 | 3 | 28.4 | 2 | 27.9 | 2 | 9.4 | 10 | 5.0 | 19 |
| MN07057-6-4 | 97.8 | 5 | 50.3 | 19 | 49.5 | 18 | 9.3 | 8 | 3.8 | 8 |
| MN07167W-2-1 | 100 | 15 | 49.5 | 18 | 49.5 | 18 | 7.7 | 5 | 7.5 | 23 |
| MN09023 | 97.8 | 5 | 43.8 | 15 | 43.1 | 15 | 6.1 | 2 | 4.1 | 11 |
| MN09092 | 100 | 15 | 38.6 | 8 | 38.6 | 9 | 7.6 | 4 | 3.8 | 8 |
| X00009-16 | 99.4 | 12 | 41.0 | 12 | 40.8 | 13 | 10.4 | 12 | 4.7 | 17 |
| SD4313 | 97.2 | 5 | 33.1 | 4 | 32.4 | 3 | 13.2 | 18 | 3.0 | 4 |
| SD4331 | 96.7 | 4 | 39.0 | 9 | 38.2 | 8 | 18.7 | 22 | 5.5 | 21 |
| SD4337 | 92.2 | 1 | 41.6 | 14 | 39.3 | 10 | 9.3 | 8 | 3.8 | 8 |
| SD4338 | 97.8 | 5 | 33.0 | 3 | 32.6 | 4 | 8.4 | 6 | 3.5 | 6 |
| SD4343 | 93.3 | 2 | 22.6 | 1 | 22.1 | 1 | 5.9 | 1 | 2.2 | 2 |
| 10EXP13-16 | 100 | 15 | 41.0 | 12 | 41.0 | 14 | 12.7 | 15 | 5.0 | 19 |
| 10EXP13-24 | 99.4 | 12 | 36.4 | 6 | 36.3 | 6 | 7.2 | 3 | 3.7 | 7 |
| 10EXP13-44 | 98.9 | 11 | 34.9 | 5 | 34.5 | 5 | 12.4 | 14 | 3.1 | 5 |
| 10EXP13-87 | 99.4 | 12 | 40.1 | 10 | 40.0 | 12 | 10.2 | 11 | 4.5 | 14 |
| 10 EXPSW13-9 | 100 | 15 | 58.5 | 21 | 58.5 | 21 | 11.3 | 13 | 8.6 | 24 |
| 10 EXPSW13-19 | 100 | 15 | 57.2 | 20 | 57.2 | 20 | 12.9 | 17 | 4.4 | 13 |
| 10 EXPSW13-28 | 97.8 | 5 | 40.2 | 11 | 39.5 | 11 | 15.4 | 20 | 2.9 | 3 |
| BW 928 | 100 | 15 | 37.9 | 7 | 37.9 | 7 | 9.0 | 7 | 4.6 | 15 |
| BW429* | 100 | 15 | 69.0 | 22 | 69.0 | 22 | | | 0.7 | 1 |
| Mean | 98.4 | | 45.2 | | 44.8 | | 13.0 | | 4.4 | |

* - Based on data from one location.

Table 9. Correlation coefficients among traits using cross-location means.

| | Incidence % | Severity % | Disease Index | VSK % | DON ppm |
|---------------|-------------|------------|---------------|-------|---------|
| Incidence % | | | | | |
| Severity % | 0.51 | | | | |
| Disease Index | 0.54 | 1.00 | | | |
| VSK % | 0.22 | 0.63 | 0.62 | | |
| DON ppm | 0.30 | 0.26 | 0.26 | 0.34 | |

Note: Correlation coefficients were calculated with means across locations.

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

| Trait / Gene | HMW Glutenins / Glu-1A | HMW Glutenins / Glu-1Dx | HMW Glutenins / Glu-1Dy | Leaf Rust / Lr34 | Stem Rust / Sr25 | | | Leaf Rust / Lr21 | Scab / Fhb_5A | Scab / Fhb1 | Grain Protein Content / GPC | Tan Spot / tsn1 | 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 | umn19 | umn25 | umn26 | csLV34 | Sr25 | | | Lr21 | barc180 | umn10 | uhw89 | fcp397 | Ppd-D1a | Ppd-D1b | Rht-B1a | Rht-B1b | Rht-D1a | Rht-D1b |
| Chromosome | 1A | 1D | 1D | 7D | 7D | | | 1D | 5A | 3B | 6B | 5B | 2D | 2D | 4B | 4B | 4D | 4D |
| 2375 | 341 | 278 | 391 | 156 | 183 | 204 | 210 | 304 | 194 | 239 | 125 | 251 | 284 | | + | + | + | - |
| Wheaton | 341 | 278 | 391 | 156 | 183 | 204 | 210 | 304 | 190 | 239 | 125 | 224 | 284 | | + | + | - | + |
| Bacup | 359 | 278 | 391 | 237 | 183 | 200 | 204 | 304 | 197 | 239 | 125 | 251 | 284 | | + | + | + | - |
| Oslo | 359 | 295 | 408 | 237 | 183 | 204 | 210 | 304 | 190 | 239 | 125 | 226 | 284 | | - | + | + | - |
| ND2710 | NS* | | | | | | | | | | | | | | | | | |
| MN07057-6-4 | 359 | 278 | 391 | 156 | 183 | 200 | 204 | 304/307 | 200 | 242 | 125 | 251 | | 414 | + | - | + | - |
| MN07167W-2-1 | 341 | 278 | 391 | 237 | 183 | 210 | 232 | 304 | 190 | 239 | 125 | 251 | 284 | | + | + | + | - |
| MN09023 | 359 | 278 | 391 | 156 | 183 | 204 | 210 | 304 | 200 | 242 | 125 | 251 | | 414 | + | - | + | - |
| MN09092 | 359 | 278 | 391 | 156 | 183 | 204 | | 304 | 200 | 242 | 125 | 251 | 284 | | + | - | + | - |
| X00009-16 | 359 | 278 | 391 | 237 | 183 | 204 | 210 | 304 | 190 | 239 | 125 | 224 | 284 | | + | + | + | - |
| SD4313 | 359 | 278 | 391 | 156 | 183 | 200 | 204 | 304 | 190 | 239 | 125 | 251 | 284 | | + | + | + | - |
| SD4331 | 359 | 278 | 391 | 237 | 183 | 204 | 210 | 304 | 190 | 239 | 125 | 251 | | 414 | + | - | + | - |
| SD4337 | 341 | 278 | 391 | 156 | 183 | 204 | 210 | 286 | 200 | 239 | 125 | 251 | | 414 | + | + | + | - |
| SD4338 | 341 | 278 | 391 | 237 | 183 | 204 | 210 | 304 | 190 | 242 | 125 | 251 | | 414 | + | + | + | - |
| SD4343 | 341 | 278 | 391 | 156 | 183 | 204 | 210 | 304 | 194 | 242 | 125 | 251 | | 414 | + | - | + | - |
| 10EXP13-16 | NS* | | | | | | | | | | | | | | | | | |
| 10EXP13-24 | NS* | | | | | | | | | | | | | | | | | |
| 10EXP13-44 | NS* | | | | | | | | | | | | | | | | | |
| 10EXP13-87 | NS* | | | | | | | | | | | | | | | | | |
| 10 EXPSW13-9 | NS* | | | | | | | | | | | | | | | | | |
| 10 EXPSW13-19 | NS* | | | | | | | | | | | | | | | | | |
| 10 EXPSW13-28 | NS* | | | | | | | | | | | | | | | | | |
| BW928 | 341 | 278 | 391 | 156 | 183 | 204 | | 304 | 197 | 242 | 125 | 251 | | 414 | - | + | + | - |
| BW429 | 341 | 278 | 391 | 237 | 183 | 204 | 210 | 196 | 203 | 242 | 125 | 251 | | 414 | - | + | + | - |

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

* Seed not provided

Table 10 continued.

| Trait | Marker | Gene | Chromosome | Size (base) |
|-----------------------|---------------|-----------------------|-------------------|--------------------|
| scab | umn10 | Fhb1 | 3B | Resistance=242 |
| scab | barc180 | Fhb_5A | 5A | Resistance=203 |
| Tan Spot | fcp394 | tsn1 | 5B | Resistance=224 |
| 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 |
| Stem rust | Sr25 | Sr25 | 7D | Resistance = 200 |
| 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 | 360 = + |
| plant height | Rht-B1b | Rht-B1b (dwarf) | 4B | 366 = + |
| plant height | Rht-D1a | Rht-D1a (wild type) | 4D | 250 = + |
| plant height | Rht-D1b | Rht-D1b (Dwarf) | 4D | 252 = + |

Table 11. Leaf and stem rust reactions in inoculated field nurseries of the 2011 Uniform Regional Scab Nursery for Spring Wheat Parents, St. Paul, MN (J. Kolmer and Y. Jin, USDA-ARS CDL)

| Line | Leaf rust | | Stem rust |
|---------------|-----------|-----------------------|-----------|
| | 19-Jul | 7/22 (0-TR not noted) | |
| 2375 | - | | |
| Wheaton | 10RMR | | |
| Bacup | - | | |
| Oslo | 30MS | | |
| ND2710 | 20MRMS | | |
| MN07057-6-4 | 20MR | | |
| MN07167W-2-1 | 10R | | |
| MN09023 | 10MR | | |
| MN09092 | TR | | |
| X00009-16 | 40MS | | 5MR |
| SD4313 | 5R | | 20MR-MS |
| SD4331 | 20MS | | |
| SD4337 | 10R | | 10MR |
| SD4338 | 10MR | | 10MR |
| SD4343 | 5T | | |
| 10EXP13-16 | 5M | | |
| 10EXP13-24 | TR | | |
| 10EXP13-44 | TR | | |
| 10EXP13-87 | TR | | |
| 10 EXPSW13-9 | TR | | |
| 10 EXPSW13-19 | 5R | | 5MS |
| 10 EXPSW13-28 | 10MRMS | | |
| BW 928 | 10MR | | |
| BW429 | - | | - |