

Report of the 2014 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 19th year in 2014. Five locations (Brookings, SD, St. Paul and Crookston, MN, and Prosper and Langdon, ND) were planted.

A total of 24 entries was included in the 2014 URSN, in addition to the resistant checks 2375, BacUp, and ND2710, and the susceptible checks Wheaton and Oslo. The entries were contributed by three university and two industry breeding programs.

A core set of traits evaluated at the nursery locations included Fusarium head blight (FHB) incidence, FHB severity, and disease index (incidence x severity). In addition, visual scabby kernel ratings (VSK \cong tombstone) and grain deoxynivalenol content were provided from two or more locations. Additional agronomic trait data are presented in individual location summary tables for locations where they were measured. 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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St. Paul, MN
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Cooperators for the 2014 Uniform Regional Scab Nursery for Spring Wheat Parents

South Dakota State University (Brookings):

Karl Glover

University of Minnesota (St. Paul, Crookston):

Jim Anderson and Ruth Dill-Macky

North Dakota State University (Prosper, Langdon):

Mohamed Mergoum

USDA-ARS, Cereal Crops Research Unit (Fargo, ND):

Shiaoman Chao

USDA-ARS, Cereal Disease Laboratory (St. Paul, MN):

Jim Kolmer, Yue Jin

Table 1. Entries for the Uniform Regional Scab Nursery for Spring Wheat Parents, 2014.

| Entry No. | Name | Pedigree | Year First Entered | | Source |
|-----------|----------------------|---|--------------------|-------------|-----------|
| 1 | 2375 | CHECK | | | |
| 2 | Wheaton | CHECK | | | |
| 3 | Bacup | CHECK | | | |
| 4 | Oslo | CHECK | | | |
| 5 | ND2710 | CHECK | | | |
| 6 | MN10021 | MN00187-3-1/Sabin | 2014 | J. Anderson | UMN |
| 7 | MN10388 | RB07/Glenn | 2014 | J. Anderson | UMN |
| 8 | MN11074 | MN05233/Rollag | 2014 | J. Anderson | UMN |
| 9 | MN11397-1 | Sabin//Prairie Red/Tom | 2014 | J. Anderson | UMN |
| 10 | MN11405 | MN00209-3-1/MN05209 | 2014 | J. Anderson | UMN |
| 11 | SD4504 | GLENN/SD4072 | 2014 | K. Glover | SDSU |
| 12 | SD4508 | KELBY/SD3997 | 2014 | K. Glover | SDSU |
| 13 | SD4510 | KELBY/SD3997 | 2014 | K. Glover | SDSU |
| 14 | SD4514 | SD3997/SD4072 | 2014 | K. Glover | SDSU |
| 15 | SD4546 | CA907-816W/SD4178 | 2014 | K. Glover | SDSU |
| 16 | 12-14-81 | PI157593/Parshall//Alsen | 2013 | M. Mergoum | NDSU |
| 17 | 12-14-97 | Frontana/W9207//2*Alsen/3/2*ND752 | 2013 | M. Mergoum | NDSU |
| 18 | 12-14-147 | Velva/Bigg Red | 2013 | M. Mergoum | NDSU |
| 19 | 12-14-158 | Arsenal//Kormorran/Rohau72-839/3/Parshall/4/ND706 | 2013 | M. Mergoum | NDSU |
| 20 | 12-14-172 | Tokai66/Parshall//Alsen | 2013 | M. Mergoum | NDSU |
| 21 | 07S0208-27 | 02S0066-13/Brennan | 2014 | J. Smith | Syngenta |
| 22 | 07S0211-23 | 02S0066-6/02S0214-15 | 2014 | J. Smith | Syngenta |
| 23 | 07S0274-2 | ARG 31/RB07 | 2014 | J. Smith | Syngenta |
| 24 | 08S0036-19 | Freyr/98S0167-09//02S0237-33 | 2014 | J. Smith | Syngenta |
| 25 | 08S0094-9 | 00S0221-9W//ALSEN/SY Soren 'S' | 2014 | J. Smith | Syngenta |
| 26 | LNR10-0176 | RB07/SD3641 | 2013 | D.B. Cooper | Limagrain |
| 27 | LNR10-0177 | RB07/SD3641 | 2013 | D.B. Cooper | Limagrain |
| 28 | LNR10-0177 RS6 | RB07/SD3641 | 2014 | D.B. Cooper | Limagrain |
| 29 | BIO-08228 = ALVORADA | VAQ/ABA | 2014 | D.B. Cooper | Limagrain |

Table 2. 2014 Uniform Regional Scab Nursery for Spring Wheat Parents, Brookings, SD.

| Line | Incidence % | Severity % | Disease Index | Tombstone % |
|----------------------|------------------------|-----------------------|--------------------------|------------------------|
| 2375 | 95.0 | 31.3 | 29.8 | 30.0 |
| Wheaton | 93.3 | 22.7 | 21.3 | 50.0 |
| Bacup | 98.3 | 31.0 | 30.5 | 41.7 |
| Oslo | 100.0 | 34.5 | 34.5 | 68.3 |
| ND2710 | 80.0 | 15.3 | 12.2 | 13.3 |
| MN10021 | 88.3 | 23.0 | 20.5 | 13.3 |
| MN10388 | 96.7 | 27.3 | 26.5 | 10.0 |
| MN11074 | 93.3 | 21.2 | 19.7 | 13.3 |
| MN11397-1 | 96.7 | 34.7 | 33.3 | 35.0 |
| MN11405 | 88.3 | 17.8 | 15.8 | 16.7 |
| SD4504 | 91.7 | 19.2 | 17.8 | 31.7 |
| SD4508 | 91.7 | 24.7 | 22.5 | 21.7 |
| SD4510 | 93.3 | 25.2 | 23.8 | 21.7 |
| SD4514 | 95.0 | 22.8 | 21.9 | 26.7 |
| SD4546 | 88.3 | 16.8 | 15.2 | 16.7 |
| 12-14-81 | 91.7 | 25.3 | 23.2 | 15.0 |
| 12-14-97 | 91.7 | 27.3 | 25.1 | 21.7 |
| 12-14-147 | 95.0 | 31.0 | 29.6 | 18.3 |
| 12-14-158 | 98.3 | 30.7 | 30.2 | 16.7 |
| 12-14-172 | 98.3 | 27.0 | 26.6 | 30.0 |
| 07S0208-27 | 91.7 | 29.8 | 27.5 | 43.3 |
| 07S0211-23 | 91.7 | 21.0 | 19.4 | 30.0 |
| 07S0274-2 | 95.0 | 27.7 | 26.3 | 20.0 |
| 08S0036-19 | 96.7 | 27.2 | 26.3 | 31.7 |
| 08S0094-9 | 100.0 | 29.0 | 29.0 | 31.7 |
| LNR10-0176 | 98.3 | 27.7 | 27.2 | 25.0 |
| LNR10-0177 | 98.3 | 26.5 | 26.1 | 31.7 |
| LNR10-0177 RS6 | 93.3 | 25.2 | 23.6 | 25.0 |
| BIO-08228 = ALVORADA | 96.7 | 32.4 | 31.5 | 25.0 |
| Mean | 94.0 | 26.0 | 24.7 | 26.7 |
| LSD | 7.9 | 7.7 | 8.0 | 11.9 |
| CV | 4.6 | 19.4 | 22.3 | 47.1 |

Table 3. 2014 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 ² g |
|-------------------------|----------------|---------------|------------------|----------|------------|-----------------------|--------------------------|-----------------------------|
| 2375 | 100.0 | 39.4 | 39.4 | 17.0 | 24.8 | 42.3 | 24.2 | 10.9 |
| Wheaton | 100.0 | 59.6 | 59.6 | 46.3 | 28.0 | 47.0 | 7.7 | 8.9 |
| Bacup | 73.8 | 18.0 | 13.9 | 17.8 | 13.6 | 39.0 | 17.8 | 11.0 |
| Oslo | 97.5 | 48.0 | 47.3 | 27.5 | 18.1 | 42.3 | 16.7 | 10.3 |
| ND2710 | 72.5 | 12.7 | 9.3 | 8.0 | 13.2 | 43.0 | 27.7 | 11.3 |
| MN10021 | 35.0 | 6.5 | 2.4 | 2.0 | 3.3 | 45.3 | 25.9 | 12.1 |
| MN10388 | 52.5 | 9.5 | 4.9 | 8.0 | 8.7 | 42.7 | 17.1 | 11.6 |
| MN11074 | 85.0 | 19.9 | 16.9 | 10.0 | 7.2 | 44.0 | 18.7 | 11.6 |
| MN11397-1 | 80.0 | 15.9 | 13.2 | 7.0 | 12.1 | 45.0 | 21.1 | 11.3 |
| MN11405 | 80.0 | 11.7 | 9.3 | 6.0 | 7.3 | 44.0 | 27.8 | 11.5 |
| SD4504 | 82.5 | 14.9 | 12.3 | 9.0 | 10.0 | 42.7 | 20.4 | 11.8 |
| SD4508 | 87.5 | 15.2 | 13.4 | 8.0 | 7.2 | 42.3 | 26.9 | 11.7 |
| SD4510 | 85.0 | 15.7 | 13.5 | 10.0 | 7.5 | 42.3 | 24.9 | 11.3 |
| SD4514 | 70.0 | 16.6 | 12.0 | 12.5 | 9.1 | 43.3 | 23.8 | 11.3 |
| SD4546 | 62.5 | 18.4 | 12.4 | 7.0 | 7.3 | 38.7 | 22.6 | 11.5 |
| 12-14-81 | 92.5 | 21.6 | 20.5 | 8.0 | 13.9 | 46.0 | 24.2 | 11.6 |
| 12-14-97 | 82.5 | 18.4 | 15.5 | 11.0 | 11.7 | 43.3 | 16.3 | 11.3 |
| 12-14-147 | 82.5 | 14.8 | 12.4 | 12.5 | 10.0 | 44.7 | 26.8 | 11.3 |
| 12-14-158 | 87.5 | 18.4 | 16.1 | 12.5 | 14.9 | 43.7 | 20.5 | 11.6 |
| 12-14-172 | 70.0 | 30.1 | 24.3 | 12.5 | 7.7 | 40.0 | 17.6 | 11.4 |
| 07S0208-27 | 95.0 | 34.1 | 32.9 | 22.5 | 15.3 | 44.0 | 23.1 | 11.1 |
| 07S0211-23 | 90.0 | 15.3 | 13.8 | 11.0 | 11.2 | 43.3 | 19.1 | 11.6 |
| 07S0274-2 | 77.5 | 12.0 | 9.4 | 9.0 | 12.6 | 43.7 | 22.4 | 11.5 |
| 08S0036-19 | 82.5 | 19.0 | 15.3 | 10.0 | 7.7 | 42.0 | 18.8 | 11.6 |
| 08S0094-9 | 85.0 | 18.3 | 15.6 | 10.0 | 12.9 | 43.3 | 16.7 | 11.0 |
| LNR10-0176 | 60.0 | 12.6 | 7.6 | 12.5 | 10.3 | 41.3 | 17.3 | 10.9 |
| LNR10-0177 | 97.5 | 24.1 | 23.7 | 25.0 | 13.2 | 42.7 | 16.3 | 10.6 |
| LNR10-0177 RS6 | 90.0 | 19.0 | 17.0 | 12.5 | 10.6 | 42.7 | 13.6 | 11.0 |
| BIO-08228 = ALVORADA | 92.5 | 23.4 | 21.5 | 11.0 | 19.0 | 44.3 | 18.7 | 10.9 |
| Alsen (MR check) | 87.5 | 17.9 | 15.9 | 8.0 | 6.9 | 44.0 | 17.9 | 11.7 |
| Roblin (S check) | 100.0 | 83.3 | 83.3 | 50.0 | 16.6 | 40.3 | 13.7 | 9.9 |
| MN00269 (S check) | 100.0 | 57.9 | 57.9 | 37.5 | 17.7 | 50.0 | 7.8 | – |
| Mean | 82.4 | 23.8 | 21.3 | 14.7 | 12.2 | 43.2 | 19.8 | 11.2 |
| LSD | 21.0 | 14.1 | 14.3 | 9.5 | | 1.0 | 4.5 | 0.6 |
| CV | 15.2 | 34.3 | 38.6 | 36.2 | | 1.7 | 14.0 | 3.4 |

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 20 mm in diameter and 50 mm in height.

Table 4. 2014 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 | 50.0 | 25.8 | 13.8 | 8.0 | 3.6 | 37.0 | 29.4 | 11.6 |
| Wheaton | 72.5 | 54.2 | 39.9 | 20.5 | 3.0 | 40.7 | 15.9 | 10.3 |
| Bacup | 35.0 | 11.0 | 3.9 | 3.0 | 0.9 | 35.0 | 22.0 | 11.8 |
| Oslo | 90.0 | 39.8 | 36.2 | 35.0 | 11.7 | 37.0 | 15.6 | 9.8 |
| ND2710 | 41.7 | 11.2 | 4.8 | 4.0 | 1.3 | 37.0 | 31.3 | 11.9 |
| MN10021 | 21.7 | 14.3 | 3.2 | 4.0 | 0.3 | 41.3 | 25.1 | 11.6 |
| MN10388 | 21.7 | 13.1 | 2.8 | 3.0 | 1.1 | 37.0 | 19.3 | 12.0 |
| MN11074 | 20.0 | 16.8 | 3.5 | 2.0 | 0.5 | 38.0 | 21.6 | 12.1 |
| MN11397-1 | 31.7 | 10.5 | 3.4 | 2.0 | 0.7 | 40.0 | 26.3 | 11.8 |
| MN11405 | 31.7 | 10.7 | 3.7 | 3.0 | 1.8 | 37.0 | 29.7 | 11.7 |
| SD4504 | 38.3 | 11.6 | 4.6 | 7.0 | 3.3 | 37.0 | 23.6 | 11.7 |
| SD4508 | 46.7 | 17.4 | 8.5 | 8.0 | 3.9 | 37.0 | 23.2 | 11.4 |
| SD4510 | 35.0 | 13.4 | 4.7 | 7.0 | 2.3 | 37.0 | 22.6 | 11.4 |
| SD4514 | 28.3 | 23.0 | 6.9 | 4.0 | 1.1 | 37.0 | 24.5 | 11.2 |
| SD4546 | 51.7 | 16.6 | 9.1 | 6.0 | 1.4 | 33.0 | 26.0 | 11.8 |
| 12-14-81 | 48.3 | 22.1 | 11.7 | 3.0 | 1.0 | 41.3 | 28.5 | 12.3 |
| 12-14-97 | 56.7 | 20.9 | 12.7 | 9.0 | 4.8 | 37.0 | 15.8 | 11.0 |
| 12-14-147 | 50.0 | 19.1 | 10.5 | 7.0 | 2.7 | 37.0 | 30.5 | 11.9 |
| 12-14-158 | 85.0 | 19.8 | 16.8 | 7.0 | 3.9 | 37.0 | 25.2 | 11.6 |
| 12-14-172 | 40.0 | 13.8 | 5.7 | 7.0 | 2.3 | 37.0 | 22.4 | 11.6 |
| 07S0208-27 | 35.0 | 12.4 | 5.0 | 11.0 | 3.2 | 38.0 | 24.9 | 11.5 |
| 07S0211-23 | 36.7 | 12.6 | 4.8 | 6.0 | 2.1 | 38.0 | 19.9 | 11.6 |
| 07S0274-2 | 46.7 | 16.7 | 7.7 | 5.0 | 1.3 | 39.0 | 18.4 | 11.2 |
| 08S0036-19 | 28.3 | 12.2 | 3.8 | 6.0 | 0.8 | 37.0 | 19.5 | 11.5 |
| 08S0094-9 | 66.7 | 17.4 | 11.2 | 7.0 | 0.8 | 39.0 | 16.6 | 11.0 |
| LNR10-0176 | 26.7 | 11.8 | 3.3 | 10.0 | 1.3 | 35.7 | 18.8 | 11.1 |
| LNR10-0177 | 70.0 | 17.9 | 12.8 | 17.0 | 4.3 | 37.0 | 13.9 | 10.3 |
| LNR10-0177 RS6 | 38.3 | 9.3 | 3.6 | 6.0 | 1.1 | 35.7 | 20.4 | 11.7 |
| BIO-08228 = ALVORADA | 50.0 | 35.4 | 17.3 | 6.0 | 1.7 | 40.0 | 23.9 | 11.6 |
| Alsen (MR check) | 33.3 | 13.6 | 4.6 | 3.0 | 1.6 | 38.0 | 15.1 | 11.3 |
| Roblin (S check) | 93.3 | 35.4 | 33.5 | 14.5 | 5.5 | 33.0 | 17.1 | 10.5 |
| MN00269 (S check) | 58.3 | 47.8 | 27.3 | 23.5 | 4.3 | 42.7 | 18.0 | 10.0 |
| Mean | 46.2 | 19.6 | 10.7 | 8.3 | 2.5 | 37.6 | 22.0 | 11.4 |
| LSD | 24.1 | 13.8 | 12.0 | 6.8 | | 1.8 | 5.0 | 0.6 |
| CV | 30.8 | 40.4 | 63.5 | 47.9 | | 3.5 | 13.8 | 3.4 |

¹ 30 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 20 mm in diameter and 50 mm in height.

Table 5. 2014 Uniform Regional Scab Nursery for Spring Wheat Parents, Prosper, ND.

| Line | Incidence % | Severity % | Disease Index |
|----------------------|------------------------|-----------------------|--------------------------|
| 2375 | 94.6 | 31.4 | 29.7 |
| Wheaton | 100.0 | 56.3 | 56.3 |
| Bacup | 100.0 | 38.3 | 38.3 |
| Oslo | 100.0 | 33.3 | 33.3 |
| ND2710 | 48.9 | 16.3 | 8.0 |
| MN10021 | 41.3 | 15.2 | 6.3 |
| MN10388 | 68.5 | 15.0 | 10.3 |
| MN11074 | 95.8 | 21.3 | 20.4 |
| MN11397-1 | 85.6 | 18.7 | 16.0 |
| MN11405 | 70.5 | 14.9 | 10.5 |
| SD4504 | 45.0 | 16.7 | 7.5 |
| SD4508 | 58.6 | 18.7 | 11.0 |
| SD4510 | 85.0 | 17.4 | 14.8 |
| SD4514 | 58.8 | 17.5 | 10.3 |
| SD4546 | 67.6 | 21.0 | 14.2 |
| 12-14-81 | 71.5 | 16.2 | 11.6 |
| 12-14-97 | 73.8 | 20.2 | 14.9 |
| 12-14-147 | 66.8 | 19.9 | 13.3 |
| 12-14-158 | 91.1 | 24.3 | 22.1 |
| 12-14-172 | 85.0 | 26.6 | 22.6 |
| 07S0208-27 | 95.8 | 25.4 | 24.3 |
| 07S0211-23 | 100.0 | 30.2 | 30.2 |
| 07S0274-2 | 74.6 | 16.9 | 12.6 |
| 08S0036-19 | 80.2 | 20.0 | 16.0 |
| 08S0094-9 | 70.5 | 18.8 | 13.3 |
| LNR10-0176 | 65.6 | 26.5 | 17.4 |
| LNR10-0177 | 100.0 | 38.1 | 38.1 |
| LNR10-0177 RS6 | 96.1 | 26.5 | 25.5 |
| BIO-08228 = ALVORADA | 100.0 | 31.8 | 31.8 |
| Mean | 80.0 | 23.9 | 19.1 |
| LSD | | | |
| CV | 22.6 | 38.7 | 60.6 |

Table 6. 2014 Uniform Regional Scab Nursery for Spring Wheat Parents, Langdon, ND.

| Line | Incidence % | Severity % | Disease Index |
|----------------------|------------------------|-----------------------|--------------------------|
| 2375 | 82.8 | 52.5 | 43.5 |
| Wheaton | 100.0 | 80.9 | 80.9 |
| Bacup | 83.8 | 53.0 | 44.4 |
| Oslo | 100.0 | 64.5 | 64.5 |
| ND2710 | 29.5 | 23.9 | 7.1 |
| MN10021 | 17.9 | 15.0 | 2.7 |
| MN10388 | 48.4 | 28.0 | 13.5 |
| MN11074 | 74.9 | 36.8 | 27.6 |
| MN11397-1 | 52.3 | 25.4 | 13.3 |
| MN11405 | 67.2 | 23.8 | 16.0 |
| SD4504 | 83.9 | 35.8 | 30.0 |
| SD4508 | 63.7 | 34.7 | 22.1 |
| SD4510 | 60.3 | 30.2 | 18.2 |
| SD4514 | 26.2 | 27.8 | 7.3 |
| SD4546 | 82.1 | 39.9 | 32.7 |
| 12-14-81 | 90.1 | 34.8 | 31.4 |
| 12-14-97 | 76.7 | 40.2 | 30.8 |
| 12-14-147 | 52.3 | 37.7 | 19.7 |
| 12-14-158 | 54.4 | 39.8 | 21.7 |
| 12-14-172 | 70.3 | 33.3 | 23.4 |
| 07S0208-27 | 75.0 | 35.1 | 26.3 |
| 07S0211-23 | 75.7 | 34.2 | 25.9 |
| 07S0274-2 | 58.7 | 23.5 | 13.8 |
| 08S0036-19 | 77.6 | 36.6 | 28.4 |
| 08S0094-9 | 90.6 | 32.2 | 29.2 |
| LNR10-0176 | 70.5 | 44.1 | 31.1 |
| LNR10-0177 | 76.6 | 46.5 | 35.6 |
| LNR10-0177 RS6 | 66.6 | 38.7 | 25.8 |
| BIO-08228 = ALVORADA | 59.6 | 36.0 | 21.5 |
| Mean | 68.0 | 37.4 | 27.2 |
| LSD | | | |
| CV | 29.7 | 34.9 | 59.5 |

Table 7. 2014 Uniform Regional Scab Nursery for Spring Wheat Parents - Summary of Means.

| 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 | | 3 | | 2 | |
| MN10021 | 40.9 | 1 | 14.8 | 1 | 7.0 | 1 | 6.4 | 1 | 1.8 | 1 |
| ND2710 | 54.5 | 2 | 15.9 | 3 | 8.3 | 2 | 8.4 | 3 | 7.3 | 20 |
| SD4514 | 55.7 | 3 | 21.5 | 9 | 11.7 | 5 | 14.4 | 15 | 5.1 | 9 |
| MN10388 | 57.6 | 4 | 18.6 | 4 | 11.6 | 4 | 7.0 | 2 | 4.9 | 6 |
| LNR10-0176 | 64.2 | 5 | 24.5 | 19 | 17.3 | 13 | 15.8 | 19 | 5.8 | 11 |
| MN11405 | 67.5 | 6 | 15.8 | 2 | 11.0 | 3 | 8.6 | 5 | 4.6 | 5 |
| SD4504 | 68.3 | 7 | 19.6 | 6 | 14.5 | 7 | 15.9 | 20 | 6.7 | 16 |
| MN11397-1 | 69.2 | 8 | 21.0 | 8 | 15.8 | 10 | 14.7 | 17 | 6.4 | 14 |
| 12-14-147 | 69.3 | 9 | 24.5 | 18 | 17.1 | 12 | 12.6 | 11 | 6.4 | 13 |
| SD4508 | 69.6 | 10 | 22.1 | 10 | 15.5 | 9 | 12.6 | 10 | 5.6 | 10 |
| SD4546 | 70.4 | 11 | 22.5 | 11 | 16.7 | 11 | 9.9 | 7 | 4.4 | 4 |
| 07S0274-2 | 70.5 | 12 | 19.3 | 5 | 14.0 | 6 | 11.3 | 8 | 7.0 | 18 |
| SD4510 | 71.7 | 13 | 20.4 | 7 | 15.0 | 8 | 12.9 | 12 | 4.9 | 7 |
| 12-14-172 | 72.7 | 14 | 26.2 | 21 | 20.5 | 21 | 16.5 | 23 | 5.0 | 8 |
| 08S0036-19 | 73.1 | 15 | 23.0 | 13 | 18.0 | 15 | 15.9 | 21 | 4.3 | 3 |
| MN11074 | 73.8 | 16 | 23.2 | 15 | 17.6 | 14 | 8.4 | 4 | 3.8 | 2 |
| 12-14-97 | 76.3 | 17 | 25.4 | 20 | 19.8 | 20 | 13.9 | 13 | 8.3 | 22 |
| LNR10-0177 RS6 | 76.9 | 18 | 23.7 | 16 | 19.1 | 17 | 14.5 | 16 | 5.9 | 12 |
| Bacup | 78.2 | 19 | 30.3 | 24 | 26.2 | 25 | 20.8 | 25 | 7.2 | 19 |
| 07S0208-27 | 78.5 | 20 | 27.3 | 23 | 23.2 | 23 | 25.6 | 27 | 9.3 | 24 |
| 07S0211-23 | 78.8 | 21 | 22.6 | 12 | 18.8 | 16 | 15.7 | 18 | 6.7 | 15 |
| 12-14-81 | 78.8 | 22 | 24.0 | 17 | 19.7 | 19 | 8.7 | 6 | 7.5 | 21 |
| BIO-08228 = ALVORADA | 79.8 | 23 | 31.8 | 26 | 24.7 | 24 | 14.0 | 14 | 10.4 | 26 |
| 08S0094-9 | 82.5 | 24 | 23.1 | 14 | 19.6 | 18 | 16.2 | 22 | 6.8 | 17 |
| 12-14-158 | 83.3 | 25 | 26.6 | 22 | 21.4 | 22 | 12.1 | 9 | 9.4 | 25 |
| 2375 | 84.5 | 26 | 36.1 | 27 | 31.2 | 27 | 18.3 | 24 | 14.2 | 27 |
| LNR10-0177 | 88.5 | 27 | 30.6 | 25 | 27.2 | 26 | 24.6 | 26 | 8.8 | 23 |
| Wheaton | 93.2 | 28 | 54.7 | 29 | 51.6 | 29 | 38.9 | 29 | 15.5 | 29 |
| Oslo | 97.5 | 29 | 44.0 | 28 | 43.2 | 28 | 43.6 | 28 | 14.9 | 28 |
| Mean | 73.3 | | 25.3 | | 19.9 | | 15.8 | | 7.2 | |

Table 8. Correlation coefficients among traits, by location.

| Correlation Between | Brookings | Crookston | St. Paul | Prosper | Langdon |
|-------------------------------|------------------|------------------|-----------------|----------------|----------------|
| Incidence & Severity | 0.77 | 0.61 | 0.62 | 0.70 | 0.71 |
| Incidence & Disease Index | 0.83 | 0.67 | 0.81 | 0.82 | 0.83 |
| Incidence & Tombstone/VSK | 0.44 | 0.54 | 0.69 | | |
| Incidence & DON | | 0.64 | 0.69 | | |
| Severity & Disease Index | 0.99 | 0.99 | 0.94 | 0.98 | 0.96 |
| Severity & Tombstone/VSK | 0.44 | 0.88 | 0.65 | | |
| Severity & DON | | 0.79 | 0.48 | | |
| Disease Index & Tombstone/VSK | 0.46 | 0.88 | 0.80 | | |
| Disease Index & DON | | 0.81 | 0.66 | | |
| Tombstone/VSK & DON | | 0.75 | 0.87 | | |

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

| | Incidence % | Severity % | Disease Index | VSK % |
|---------------|-------------|------------|---------------|-------|
| Severity % | 0.78 | | | |
| Disease Index | 0.84 | 0.99 | | |
| VSK %* | - | - | - | |
| DON ppm | - | - | - | - |

Note: correlations not calculated for disease index and VSK due to unequal number of locations.

**Table 10. Leaf and stem rust reactions in inoculated field nurseries,
2014 Uniform Regional Scab Nursery for Spring Wheat Parents,
St. Paul, MN. (J. Kolmer and Y. Jin, USDA-ARS, St. Paul, MN)**

| Line | Leaf Rust | Stem Rust |
|----------------------|------------------|------------------|
| 2375 | 50S | 20MR |
| Wheaton | 50MS | 5R |
| Bacup | 70S | 10MR |
| Oslo | 50MRMS | 10MR |
| ND2710 | 60S | 10MR |
| MN10021 | 30MRMS | 10MRMS |
| MN10388 | 70S | 10MR |
| MN11074 | 50S | 20MR |
| MN11397-1 | 40MSS | 0 |
| MN11405 | 5R | TMSMS |
| SD4504 | 50S | 20MR |
| SD4508 | 40MRMS | 20MRMS |
| SD4510 | 40MRMS | 5MR |
| SD4514 | TR | 20MR |
| SD4546 | 20MRMS | 40MRMS |
| 07S0208-27 | 30R | 20MR |
| 07S0211-23 | 20MRMS | 70MSS |
| 12-14-172 | 30MSS | 10MR |
| 12-14-81 | 50MSS | 10MR |
| 12-14-97 | 70S | 50MRMS |
| 07S0274-2 | 70S | 5MR |
| 08S0036-19 | 50S | 20MR |
| 08S0094-9 | 30MR | 10MR |
| 12-14-147 | 70S | 10MR |
| 12-14-158 | 30MSS | 0/20MR |
| LNR10-0176 | 60S | 10MR |
| LNR10-0177 | MSS | TR |
| LNR10-0177 RS6 | 50MSS | 0 |
| BIO-08228 = ALVORADA | 20M | 40MR |

Note: data from inoculation with a mixture of races.

Table 11. Allele Sizes of Molecular Markers Associated with Selected Traits/Genes (S. Chao, USDA-ARS, Fargo, ND)

| Trait / Gene | HMW Glutenins / Glu-1A | HMW Glutenins / Glu-1D | Grain Protein Content / GPC | Leaf Rust / Lr34 | Leaf Rust / Lr21 | Tan Spot / tsn1 | Scab / Fhb1 | Scab / Fhb 5A | Stem Rust / Sr25 | | | Stem Rust / Sr2 | Photoperiod / Ppd-D1a (insen) | Photoperiod / Ppd-D1b (sen) | Height / Rht-B1 | Height / Rht-D1 |
|----------------|------------------------|------------------------|-----------------------------|------------------|------------------|-----------------|-------------|---------------|------------------|-----|-----|-----------------|-------------------------------|-----------------------------|-----------------|-----------------|
| Marker | umn19 | | Gpc-B1 | l4 | Lr21 | fcp397 | Fhb1 | barc186 | Sr25 | | | gwm533 | Ppd-D1a | Ppd-D1b | Rht-B1 | Rht-D1 |
| Chromosome | 1A | 1D | 6B | 7D | 1D | 5B | 3B | 5A | 7D | | | 3B | 2D | 2D | 4B | 4D |
| 2375 | 341 | C | A | T | 304 | 253 | C | 211 | 183 | 206 | 211 | 116 | 284 | | G | C |
| Wheaton | 341 | C | A | T | 304 | 226 | C | 201 | 183 | 206 | 211 | 116 | 284 | | G | A |
| Bacup | 359 | C | A | T | 304 | 253 | C | 211 | 183 | 200 | 206 | 116 | 284 | | G | C |
| Oslo | 359 | G | A | A | 304 | 229 | C | 201 | 183 | 206 | 211 | 116 | 284 | | A | C |
| ND2710 | 359 | C | A | T | 304 | 253 | T | 211 | 183 | 206 | 211 | 142 | | 414 | G | C |
| MN10021 | 359 | C | A | T | 286 | 226 | T | 201 | 183 | 200 | 206 | 142 | 284 | | G | C |
| MN10388 | 341 | C | A | A | 196 | 253 | C | 201 | 183 | 206 | 211 | 116 | | 414 | G | C |
| MN11074 | 341 | C | A | T | 304 | 229 | T | 211 | 183 | 200 | 206 | 142 | | 414 | G | A |
| MN11397-1 | 359 | C | A | T | 304 | 253 | T | 201 | 183 | 200 | 206 | 142 | 284 | | G | C |
| MN11405 | 359 | C | A | T | 304 | 253 | T | 211 | 183 | 206 | 211 | 142 | | 414 | G | A |
| SD4504 | 341 | C | A | A | 196 | 253 | C | 201 | 183 | 206 | 211 | 116 | | 414 | G | C |
| SD4508 | 341 | C | A | T | 304 | | T | 201 | 206 | 211 | 231 | 142 | 284 | | G | C |
| SD4510 | 341 | C | A | T | 304 | 253 | T | 201 | 206 | 211 | 231 | 142 | 284 | | G | C |
| SD4514 | 341 | C | A | T | 304 | 253 | C | 201 | 183 | 206 | 211 | 116 | | 414 | G | C |
| SD4546 | 341 | C | A | T | 304 | 253 | T | 201 | 183 | 206 | 211 | 142 | 284 | | G | C |
| 07S0208-27 | 341 | C | A | T | 286 | 226 | T | 201 | 200 | 206 | 231 | 142 | 284 | | G | A |
| 07S0211-23 | 341 | C | A | T | 304 | 226 | T | 201 | 183 | 206 | 211 | 116 | 284 | | G | A |
| 07S0274-2 | 341 | C | A | A | 196 | 226 | T | 201 | 183 | 206 | 211 | 116 | | 414 | A | C |
| 08S0036-19 | 341 | C | A | T | 286 | 253 | T | 201 | 183 | 206 | 211 | 116 | | 414 | G | A |
| 08S0094-9 | 341 | C | A | T | 304 | 253 | C | 201 | -- | -- | -- | 142 | 284 | | G | A |
| LNR10-0176 | 341 | C | A | A | 196 | 253 | C | 211 | 183 | 206 | 211 | 116 | | 414 | A | C |
| LNR10-0177 | 341 | C | A | A | 196 | 253 | C | 201 | 183 | 206 | 211 | 142 | | 414 | A | C |
| LNR10-0177 RS6 | 341 | C | A | A | 196 | 253 | C | 201 | 183 | 206 | 211 | 116 | | 414 | A | C |
| BIO-08228 | 341 | C | A | A | 304 | -- | C | 201 | 183 | 206 | 211 | 116 | | 414 | A | C |
| 12-14-81 | Not evaluated | | | | | | | | | | | | | | | |
| 12-14-97 | Not evaluated | | | | | | | | | | | | | | | |
| 12-14-147 | Not evaluated | | | | | | | | | | | | | | | |
| 12-14-158 | Not evaluated | | | | | | | | | | | | | | | |
| 12-14-172 | Not evaluated | | | | | | | | | | | | | | | |

Please see next page for more details on marker allele/gene associations.

Table 11 continued.

| Trait | Marker | Gene | Chromosome | Size (base) |
|-----------------------|---------------|-----------------------|-------------------|-----------------------------|
| HMW Glutenins | umn19 | Glu-1A | 1A | Ax2*=341, Ax1=359 |
| HMW Glutenins | | Glu-1D | 1D | C = 5+10, G = 2+12 |
| Grain protein content | Gpc-B1 | GPC | 6B | High=T, Norma=A |
| Leaf rust | l4 | Lr34 | 7D | Resistance=T, Susceptible=S |
| Leaf rust | Lr21 | Lr21 | 1D | Resistance=196 |
| Tan Spot | fcp397 | tsn1 | 5B | Resistance=226 |
| Scab | Fhb1 | Fhb1 | 3B | Resistance=T, Susceptible=C |
| Scab | barc186 | Fhb 5A | 5A | Resistance=211 |
| Stem rust | Sr25 | Sr25 | 7D | Resistance = 200 |
| Stem rust | gwm533 | Sr2 | 3B | R=116* |
| Photoperiod | Ppd-D1a | Ppd-D1a (insensitive) | 2D | 284 |
| Photoperiod | Ppd-D1b | Ppd-D1b (sensitive) | 2D | 414 |
| Plant height | Rht-B1 | Rht-B1 | 4B | wild type = G, dwarf = A |
| Plant height | Rht-D1 | Rht-D1 | 4D | wild type = C, dwarf = A |

* This marker may not be diagnostic, for reference only.