

# Report of the 2014 Uniform Regional Scab Nursery for Spring Wheat Parents

**Coordinator:** David F. Garvin  
USDA-ARS, Plant Science Research Unit  
411 Borlaug Hall, University of Minnesota  
1991 Upper Buford Circle, St. Paul, MN 55108

**Report prepared by:** David F. Garvin and Zachary Blankenheim

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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**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.**

| <b>Line</b>          | <b>Incidence<br/>%</b> | <b>Severity<br/>%</b> | <b>Disease<br/>Index</b> | <b>Tombstone<br/>%</b> |
|----------------------|------------------------|-----------------------|--------------------------|------------------------|
| 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<br>% | Severity<br>% | Disease<br>Index | VSK<br>% | DON<br>ppm | Heading<br>d from 6-1 | 30 SSW <sup>1</sup><br>g | micro TWT <sup>2</sup><br>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 =<br>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                         |

<sup>1</sup>30 SSW = 30 spike seed weight. This is the sample used to determine VSK.

<sup>2</sup> 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<br>% | Severity<br>% | Disease<br>Index | VSK<br>% | DON<br>ppm | Heading<br>d from 6-1 | 30 SSW <sup>1</sup><br>g | micro TWT <sup>2</sup><br>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 =<br>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                         |

<sup>1</sup>30 SSW = 30 spike seed weight. This is the sample used to determine VSK.

<sup>2</sup> 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.**

| <b>Line</b>          | <b>Incidence<br/>%</b> | <b>Severity<br/>%</b> | <b>Disease<br/>Index</b> |
|----------------------|------------------------|-----------------------|--------------------------|
| 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.**

| <b>Line</b>          | <b>Incidence<br/>%</b> | <b>Severity<br/>%</b> | <b>Disease<br/>Index</b> |
|----------------------|------------------------|-----------------------|--------------------------|
| 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 =<br>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.**

| <b>Correlation Between</b>    | <b>Brookings</b> | <b>Crookston</b> | <b>St. Paul</b> | <b>Prosper</b> | <b>Langdon</b> |
|-------------------------------|------------------|------------------|-----------------|----------------|----------------|
| 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)**

| <b>Line</b>          | <b>Leaf Rust</b> | <b>Stem Rust</b> |
|----------------------|------------------|------------------|
| 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.**

| <b>Trait</b>          | <b>Marker</b> | <b>Gene</b>           | <b>Chromosome</b> | <b>Size (base)</b>          |
|-----------------------|---------------|-----------------------|-------------------|-----------------------------|
| 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.