

**Minnesota Wheat Research and Promotion Council
CROP YEAR 2013 RESEARCH REPORTING FORM
Form Due November 15, 2013**

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| 1. PROJECT TITLE <p style="text-align: center;">Accelerated Breeding for Resistance to Fusarium Head Blight</p> | |
| 2. PRINCIPAL INVESTITAGATOR (S) A. PI# 1 Name: Karl D. Glover | 3. PI #1 Business Address Karl D. Glover Plant Science Dept. NBP 244D, Box 2140C South Dakota State University Brookings, SD 57007 |
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| 4. REPORT DATE | 5. REPORTING PERIOD January 1, 2013 – December 31, 2012 |
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9: EXECUTIVE SUMMARY

Research Question:

Complete resistance to Fusarium Head Blight (FHB) is unknown, yet genetic variability for resistance is well documented. Steady progress toward increasing resistance levels has been demonstrated by breeding programs through the implementation of largely repeatable FHB screening procedures. Breeding programs must sustain efforts to simultaneously select resistant materials with desirable agronomic characteristics. The objective of this program is to use traditional plant breeding and selection techniques to develop hard spring wheat germplasm and cultivars that possess agronomic characteristics worthy of release in addition to acceptable levels of FHB resistance.

Results:

Entries retained in the advanced yield trial (AYT) are thought to be at least moderately resistant to FHB. Those that do not perform adequately are generally discarded after the first year of AYT observation. 2013 AYT results are presented in the appendix. Thirty-seven experimental breeding lines were tested during the 2013 growing season. Nineteen experimental lines had FHB disease index (DIS) values that were less than the test average. Fourteen of these 19 entries also had Fusarium damaged kernel (FDK) values that were below average. Among these 14, seven produced more grain than average and the test weight of four was also heavier than average. Two of these four (SD4178 and SD4362) are presently under consideration for release as cultivars. Specifically, SD4178 will likely be released this fall and be made available to Certified seed producers in spring 2014. SD4362 is presently in its second season of seed increase in California and may be released in fall 2014.

Application/Use:

With the progression of time, increases in FHB resistance levels should help to prevent devastating losses to growers caused by severe FHB outbreaks.

Materials and Methods:

Focused efforts to increase resistance began within this program after the 1993 FHB epidemic in the spring wheat production region. Both mist-irrigated greenhouse and field screening nurseries were established and disease evaluation methods were developed. Breeding materials are evaluated for FHB resistance using three generations per year: two in the greenhouse and one in the field. We have the capacity to screen 4,500 individual hills in the greenhouse. We also have 4 acres in the field under mist-irrigation. Both the field and greenhouse nurseries are inoculated with grain spawn (corn that is infested with the causal fungus) and spore suspensions. Mist-irrigation is used to provide a favorable environment for infection. Approximately 25 percent of the experimental populations possess *Fhb1* as a source of resistance. Most of what remains are crosses with various "field resistant" advanced breeding lines. Experimental materials are advanced through the program in the following fashion;

| | | |
|--------|--------------------|---|
| Year 1 | Field | Space planted F ₂ populations |
| Year 1 | Fall greenhouse | F _{2:3} hills |
| Year 1 | Spring greenhouse | F _{3:4} hills |
| Year 2 | Field | F _{4:5} progeny rows |
| Year 2 | Off-season Nursery | F _{5:6} progeny rows |
| Year 3 | Field | F _{5:7} Yield Trials (1 replication, 2 locations) |
| Year 4 | Field | F _{5:8} Yield Trials (2 replications, 5 locations) |
| Year 5 | Field | Advanced Yield Trials (3 reps, 8 locations) |

F₂ populations are planted in the field and individual plants are selected. These are advanced to the fall greenhouse where seed from each plant is sown as individual F_{2:3} hills and evaluated for FHB resistance. Four plants from each of the top 25% of the hills are advanced to the spring greenhouse. They are sown as individual F_{3:4} hills and evaluated for FHB resistance. Those with FHB resistance nearly equal to or better than 'Brick' are advanced to the mist-irrigated field nursery as F_{4:5} progeny rows. They are evaluated again for resistance and general agronomic performance. Plants are selected within the

superior rows and sent to New Zealand as F_{5:6} progeny rows for seed increase. A portion of seed from each selected plant is also grown in the fall greenhouse to confirm its resistance. If the FHB resistance of an F_{5:6} line is confirmed, then the respective progeny row is harvested in New Zealand. In the following South Dakota field season, the selected lines are tested in a two replication, multi-location yield trial. Those that have agronomic performance and yield similar to current cultivars are included in more advanced, multi-location, replicated yield trials the following year. In year 5, lines advanced through this portion of the program are included in the AYT along with entries from the traditional portion of the program. Performance data with respect to DIS and FDK, along with agronomic potential from the 2013 AYT are presented in Table 1 of the appendix.

Economic Benefit to a Typical 500 Acre Wheat Enterprise:

The presence of FHB inoculum within fields and favorable weather conditions are just two factors that heavily influence whether this disease will become problematic. Immediate economic benefits are therefore difficult to assess. When conditions become favorable for disease presence, however, cultivars with elevated FHB resistance levels can help to reduce potentially serious losses for growers.

12: APPENDIX

Table 1. South Dakota State University advanced yield trial spring wheat entries ranked according to FHB disease index values (lowest to highest – collected at Brookings) presented along with agronomic data obtained from three replication tests conducted at eight test environments in 2013.

| ENTRY | FHB DIS INDEX | TOMB- STONE (%) | GRAIN YIELD (BU/AC) | TEST WEIGHT (LB/BU) | GRAIN PROTEIN (%) | HEAD DATE (D > 6/1) | PLANT HEIGHT (INCHES) |
|------------|---------------------|-----------------------|---------------------------|---------------------------|-------------------------|---------------------------|-----------------------------|
| SD4313 | 8.59 | 11.67 | 39.16 | 62.17 | 15.87 | 27.89 | 35.04 |
| SD4472 | 9.48 | 30.00 | 43.40 | 61.31 | 14.88 | 28.56 | 32.40 |
| FOREFRONT | 9.93 | 25.00 | 44.41 | 61.59 | 14.90 | 28.28 | 36.09 |
| SD4330 | 10.35 | 18.33 | 41.99 | 62.70 | 15.23 | 29.17 | 34.65 |
| SD4366 | 10.85 | 26.67 | 43.24 | 61.40 | 14.88 | 28.39 | 33.91 |
| SD4416 | 10.85 | 26.67 | 44.10 | 61.29 | 14.88 | 29.33 | 33.03 |
| SD4450 | 11.80 | 33.33 | 44.23 | 61.85 | 15.12 | 28.00 | 33.95 |
| BRICK | 11.93 | 20.00 | 42.61 | 62.06 | 14.52 | 26.11 | 33.95 |
| SD4479 | 12.23 | 16.67 | 43.42 | 61.05 | 15.52 | 28.56 | 34.41 |
| SD4362 | 12.27 | 18.33 | 44.64 | 62.06 | 14.85 | 26.67 | 34.74 |
| SD4321 | 12.35 | 25.00 | 41.02 | 60.68 | 16.21 | 27.61 | 34.23 |
| SD4178 | 12.61 | 26.67 | 46.23 | 61.35 | 14.17 | 30.11 | 32.29 |
| SD4403 | 12.65 | 20.00 | 44.99 | 61.07 | 15.08 | 31.33 | 33.86 |
| SD4393 | 12.70 | 26.67 | 44.89 | 61.71 | 15.12 | 29.56 | 31.05 |
| SD4418 | 12.74 | 20.00 | 43.40 | 61.74 | 14.41 | 28.06 | 34.02 |
| STEELE-ND | 13.10 | 23.33 | 43.38 | 61.48 | 15.12 | 30.06 | 34.04 |
| SD4477 | 13.21 | 36.67 | 45.68 | 60.72 | 14.82 | 29.78 | 31.35 |
| SD4470 | 13.81 | 21.67 | 41.08 | 61.07 | 15.30 | 29.06 | 32.77 |
| SD4460 | 13.97 | 33.33 | 48.40 | 60.33 | 13.49 | 30.61 | 33.01 |
| SD4400 | 14.14 | 31.67 | 44.60 | 60.94 | 14.78 | 30.94 | 34.56 |
| GRANGER | 14.36 | 46.67 | 43.13 | 61.12 | 14.99 | 29.94 | 35.04 |
| BRIGGS | 14.38 | 36.67 | 42.73 | 60.98 | 15.02 | 28.00 | 32.34 |
| SD4383 | 14.40 | 18.33 | 45.10 | 60.62 | 14.63 | 29.00 | 32.53 |
| SD4471 | 14.51 | 21.67 | 43.95 | 61.10 | 14.58 | 28.89 | 33.54 |
| SD4439 | 14.89 | 18.33 | 44.41 | 62.06 | 14.56 | 27.78 | 33.43 |
| SD4299 | 14.98 | 26.67 | 47.20 | 60.66 | 14.88 | 32.50 | 33.19 |
| SD4474 | 15.13 | 30.00 | 44.46 | 62.52 | 15.00 | 28.33 | 31.44 |
| SD4215 | 15.33 | 25.00 | 42.25 | 60.63 | 14.60 | 28.94 | 31.42 |
| SD4218 | 15.48 | 28.33 | 43.59 | 61.48 | 14.13 | 28.94 | 33.86 |
| SD4465 | 15.51 | 38.33 | 45.95 | 61.76 | 14.33 | 28.50 | 32.84 |
| ADVANCE | 15.79 | 36.67 | 46.74 | 61.61 | 14.04 | 29.89 | 31.13 |
| SD4189 | 15.91 | 36.67 | 42.35 | 60.73 | 14.59 | 29.11 | 34.30 |
| TRAVERSE | 15.97 | 30.00 | 46.06 | 58.85 | 14.10 | 28.83 | 34.28 |
| SD4389 | 16.03 | 28.33 | 46.74 | 61.75 | 14.70 | 29.39 | 33.43 |
| SD4398 | 16.08 | 35.00 | 43.19 | 61.94 | 14.25 | 27.89 | 33.34 |
| SD4469 | 16.43 | 15.00 | 42.77 | 61.27 | 14.90 | 28.89 | 34.80 |
| SD4451 | 16.86 | 35.00 | 44.90 | 62.06 | 14.79 | 28.44 | 33.47 |
| SD4454 | 17.02 | 35.00 | 42.96 | 61.27 | 14.54 | 28.28 | 31.07 |
| FALLER | 17.61 | 26.67 | 50.35 | 60.73 | 13.90 | 31.17 | 33.89 |
| SD4441 | 17.83 | 30.00 | 40.91 | 60.77 | 14.86 | 30.50 | 33.97 |
| SD4427 | 18.28 | 38.33 | 42.96 | 61.26 | 15.24 | 29.56 | 31.70 |
| SD4436 | 18.44 | 45.00 | 43.03 | 60.65 | 14.56 | 28.17 | 31.64 |
| OXEN | 19.30 | 40.00 | 38.79 | 59.42 | 14.65 | 30.72 | 32.38 |
| SD4434 | 19.76 | 43.33 | 42.80 | 60.68 | 15.27 | 28.00 | 31.77 |
| KNUDSON | 20.26 | 31.67 | 42.74 | 60.82 | 14.58 | 31.00 | 32.86 |
| SD4352 | 20.75 | 50.00 | 37.94 | 60.74 | 15.64 | 27.33 | 33.30 |
| SELECT | 21.35 | 36.67 | 44.94 | 61.33 | 14.45 | 26.44 | 33.56 |
| SD4432 | 21.82 | 40.00 | 42.17 | 60.86 | 14.63 | 28.39 | 31.35 |
| MEAN | 14.88 | 29.48 | 43.75 | 61.21 | 14.78 | 28.98 | 33.23 |
| LSD (0.05) | 6.84 | 12.94 | 2.12 | 0.36 | 0.20 | 0.54 | 0.90 |
| CV% | 21.23 | 29.87 | 5.23 | 1.15 | 3.35 | 4.51 | 3.71 |

