2005 Project Report

# *Winter Wheat Breeding and Genetics*

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## CROP REPORT

Winter Wheat production in South Dakota in 2005 was estimated at 63.4 million bushels from 1.44 million harvested acres (1.5 million planted acres), for an average of 44 bushels/acre.

In 2005, the winter wheat breeding program tested at eight sites throughout South Dakota. These environments included Aurora and Brookings (Brookings Co.), Platte (Douglas Co.), Highmore (Hyde Co.), Selby (Walworth Co.), Winner (Tripp Co.), Wall (Pennington Co.), the Northeast Research Farm near Watertown (Codington Co.), Kennebec (Lyman Co.), and both irrigated and dry land environments at the Dakota Lakes Research Farm east of Pierre (Hughes Co.). Crop performance testing also was conducted at five sites west of the Missouri River in cooperation with John Rickertsen and Bruce Swan (SDSU West River Agricultural Research and Extension Center, Rapid City).

The crop was planted September 11, 2004 at Selby and the Northeast Research Farm; September 17th at Dakota Lakes Research Farm and Highmore; September 20th at Winner, Wall and Platte; and October 4th at Brookings.

When fall stand counts were taken at all locations, the crop was at the four leaf stage, with very good crown development and as many as four tillers or more per plant. Above average temperatures in February and March led the South Dakota Field Office of USDA's National Agricultural Statistics Service to rate the winter wheat crop as 81 percent good to excellent the first week of April. A continuation of great growing conditions in May resulted in major disease development. Temperature and moisture conditions in late May resulted in the development of Powdery Mildew (a condition normally only seen in the greenhouse) at Dakota Lakes. Fusarium Head Blight (FHB) and tan spot were both severe in some parts of the state. The severity of disease occurrences (stripe rust, FHB, tan spot, stem rust, powdery mildew, take-all and wheat streak mosaic virus) allowed for data collection and evaluation in many sites in the breeding program.

The nursery at Selby was abandoned. The winter wheat seedlings were suppressed due to extreme pressure from volunteer spring wheat re-growth in that site. The spring wheat stubble nursery at Dakota Lakes was not harvested due to severe lodging and poor quality of seed samples.

## BREEDING PROGRAM

### Foundation Seed Increases

Foundation Seed of two lines (SD97W609 and SD98102) is being increased for potential release in 2006. SD97W609 was developed from the cross 'Abilene'/'Karl' and is a semi-dwarf, early-maturing (similar to 'Wendy') hard white winter wheat with good winter survival ability and excellent yield potential. It has excellent baking quality in predictive testing and in large-scale testing in the 2005 Wheat Quality Council. It has high test weight, intermediate levels of polyphenoloxidase enzyme, average protein, very short coleoptile, and good sprouting resistance. It is moderately resistant to stem rust and WSMV, and is moderately susceptible to leaf rust. SD98102 was developed from the cross 2076-W12-11/'Karl 92'//NE89526. It has very good yield performance, good milling, and average baking quality attributes. It is moderately resistant to stem rust and is moderately susceptible to leaf rust and WSMV.

A third line (SD97059-2) is being increased for Foundation Seed with potential release in 2007. SD97059-2 was developed from the cross ND8889/NE90574. It had very good yield performance over the last three years, excellent resistance to stem, leaf, and stripe rusts, good resistance to scab, strong straw, and good milling and baking quality. This line will be targeted as a replacement to Arapahoe wheat across South Dakota.

**Regional Nurseries**

The Northern Regional Performance Nursery (NRPN) was planted at Brookings, Winner, and the spring wheat stubble plots at Dakota Lakes (DLSWS). The NRPN consisted of four check varieties and 28 experimental lines from five public programs. Ten advanced experimental lines were included from the SDSU Winter Wheat Breeding Program. Average grain yield and other characteristics for 2005 NRPN are presented in Table 1. In addition to the NRPN, the Southern Regional Performance Nursery (SRPN) was planted at Brookings and at Dakota Lakes on pea stubble (DLP). While the SDSU breeding program does not typically enter lines into the SRPN, evaluation of this nursery in South Dakota is important both as a means of germplasm exchange and in determining the range of adaptation of elite material from southern plains and western programs.

In addition to the regional yield nurseries, the Regional Germplasm Observation Nursery (RGON) was planted at Watertown and at Brookings in the mist-irrigated *Fusarium* head blight disease nursery. This nursery consisted of 271 entries from nine different breeding programs and a periodic set of six checks, planted in double-row (3-foot long) plots with a single replication per entry. Thirty South Dakota advanced lines were entered in 2005 RGON.

**CPT Variety Trial**

The South Dakota Crops Performance Testing (CPT) Variety Trial, under the coordination of the SDSU Crops Performance Testing Program (Dr. Bob Hall, Manager), was planted at 14 sites across South Dakota. These environments included most of the sites where winter wheat breeding activities are ongoing and several other sites in western South Dakota that are coordinated by personnel at the West River Agricultural Research and Extension Center (John Rickertsen, SDSU). In 2005, the nursery included 30 entries, consisting of 17 released varieties, 11 advanced experimental lines from our program and two from the University of Nebraska.

Five of the 11 experimental lines from the breeding program evaluated in the 2005 CPT (Tables 2, 3, and 4) were retained for further testing in 2005:

| | |
|---|---|
| SD97059-2 | ND8889/NE90574 |
| SD97W609 | Abilene/Karl |
| SD98102 | 2076-W12-11/Karl92//NE89526 |
| SD01122 | Harding/KS84063-9-39-3-4W |
| SD01W064 | RussianPI592033/NE92458//Nekota |

## Table 1. Grain yield, Agronomic and Disease Data for the 2005 NRPN in South Dakota.

| Trait† | Grain Yield | | | | | TW | HT | HD | MAT | LD | ILAD | LS | TS | LR | YR | YR | FHB | WSMV |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | RANK | bushels per acre | | | | lbs/bu | inches | relative days | | scale of 1 to 9. 1 is best | | | | | | | | |
| Locations¥ | 1,5,8 | | 1 | 5 | 8 | 1,5,8 | 5,8 | 1,5,8 | 8 | 8 | 8 | 5 | 5 | 8 | 8 | 11 | 8 | 8 |
| Kharkof | 29 | 36 | 35 | 37 | 36 | 57 | 39 | 7 | 4 | 9 | 8 | 3 | 1 | 2 | 1 | 1 | 7 | 9 |
| Harding | 32 | 29 | 21 | 39 | 28 | 56 | 38 | 8 | 6 | 8 | 7 | 3 | 1 | 3 | 1 | 1 | 6 | 9 |
| Nuplains | 27 | 38 | 48 | 44 | 23 | 54 | 30 | 4 | 9 | 6 | 9 | 8 | 2 | 3 | 3 | 6 | 7 | 9 |
| Nekota | 30 | 33 | 36 | 37 | 25 | 52 | 31 | 0 | 0 | 5 | 9 | 7 | 2 | 4 | 2 | 7 | 6 | 5 |
| N02Y5075 | 25 | 40 | 49 | 37 | 32 | 55 | 32 | 2 | 10 | 4 | 6 | 4 | 3 | 2 | 1 | 2 | 5 | 7 |
| N02Y5078 | 17 | 43 | 50 | 39 | 39 | 57 | 32 | 2 | 7 | 2 | 5 | 5 | 3 | 1 | 2 | 1 | 6 | 4 |
| N02Y5106 | 6 | 46 | 58 | 50 | 31 | 55 | 30 | 2 | 3 | 5 | 9 | 4 | 4 | 2 | 1 | 5 | 5 | 9 |
| N02Y5117 | 15 | 43 | 52 | 45 | 32 | 53 | 31 | 1 | 5 | 5 | 8 | 4 | 3 | 2 | 1 | 1 | 7 | 9 |
| NP-02 | 31 | 32 | 37 | 39 | 20 | 53 | 29 | 4 | 5 | 7 | 9 | 9 | 2 | 3 | 3 | 6 | 7 | 9 |
| TX00V1117 | 5 | 48 | 60 | 50 | 34 | 55 | 30 | 3 | 9 | 2 | 6 | 4 | 1 | 1 | 2 | 3 | 5 | 4 |
| NE01604 | 14 | 43 | 42 | 46 | 41 | 55 | 31 | 0 | 5 | 4 | 3 | 4 | 2 | 1 | 1 | 3 | 4 | 4 |
| NE02513 | 24 | 40 | 52 | 42 | 27 | 54 | 28 | 0 | 6 | 4 | 7 | 6 | 2 | 3 | 1 | 1 | 6 | 9 |
| NE02528 | 8 | 46 | 57 | 46 | 35 | 56 | 31 | 0 | 4 | 4 | 8 | 6 | 3 | 6 | 1 | 1 | 5 | 5 |
| NE02584 | 9 | 45 | 52 | 48 | 35 | 56 | 29 | 1 | 7 | 2 | 7 | 5 | 3 | 3 | 1 | 3 | 5 | 7 |
| NE02592 | 1 | 52 | 54 | 52 | 50 | 56 | 35 | 1 | 4 | 4 | 6 | 2 | 1 | 1 | 1 | 2 | 5 | 2 |
| NI03427 | 7 | 45 | 48 | 50 | 39 | 55 | 31 | 3 | 7 | 4 | 7 | 3 | 2 | 3 | 3 | 1 | 5 | 7 |
| NE01643 | 3 | 49 | 50 | 48 | 49 | 56 | 33 | 3 | 10 | 2 | 3 | 4 | 2 | 1 | 1 | 3 | 6 | 2 |
| NH01036 | 16 | 43 | 47 | 40 | 41 | 55 | 33 | 3 | 6 | 6 | 8 | 5 | 5 | 4 | 2 | 5 | 4 | 5 |
| NH01048 | 20 | 42 | 51 | 46 | 28 | 51 | 33 | 4 | 7 | 6 | 9 | 5 | 4 | 6 | 2 | 2 | 6 | 5 |
| NI02425 | 18 | 42 | 53 | 36 | 37 | 55 | 29 | 2 | 7 | 2 | 7 | 4 | 2 | 2 | 1 | 1 | 6 | 7 |
| SD00032 | 23 | 40 | 37 | 43 | 41 | 56 | 35 | 1 | 8 | 3 | 4 | 3 | 1 | 3 | 1 | 2 | 5 | 7 |
| SD00258 | 2 | 50 | 53 | 43 | 54 | 56 | 34 | 4 | 8 | 4 | 2 | 6 | 8 | 1 | 1 | 2 | 6 | 5 |
| SD01054 | 12 | 43 | 49 | 51 | 30 | 53 | 32 | 5 | 9 | 5 | 7 | 3 | 1 | 3 | 2 | 6 | 6 | 7 |
| SD02024 | 19 | 42 | 47 | 50 | 30 | 51 | 31 | 4 | 10 | 5 | 7 | 9 | 2 | 3 | 2 | 4 | 7 | 4 |
| SD02039 | 10 | 44 | 46 | 49 | 37 | 58 | 37 | 3 | 6 | 5 | 8 | 7 | 1 | 3 | 2 | 6 | 5 | 9 |
| SD02480 | 11 | 44 | 44 | 46 | 41 | 57 | 33 | 3 | 7 | 4 | 7 | 3 | 1 | 2 | 1 | 1 | 5 | 9 |
| SD02771 | 13 | 44 | 39 | 49 | 43 | 57 | 34 | 6 | 9 | 5 | 7 | 3 | 1 | 1 | 2 | 7 | 6 | 4 |
| SD01W064 | 26 | 39 | 42 | 52 | 24 | 52 | 33 | 3 | 8 | 5 | 9 | 3 | 1 | 2 | 2 | 5 | 7 | 5 |
| SD02W129 | 28 | 38 | 40 | 47 | 27 | 53 | 32 | 4 | 6 | 9 | 8 | 9 | 2 | 2 | 1 | 3 | 6 | 9 |
| SD98W175-1 | 4 | 49 | 54 | 52 | 41 | 55 | 30 | 3 | 9 | 4 | 5 | 3 | 2 | 2 | 1 | 1 | 6 | 2 |
| BC97-ROM50W | 22 | 41 | 47 | 43 | 34 | 49 | 28 | 3 | 4 | 2 | 5 | 1 | 1 | 1 | 1 | 2 | 8 | 5 |
| 97x0850-16 | 21 | 42 | 54 | 47 | 24 | 49 | 30 | 1 | 5 | 3 | 9 | 4 | 1 | 1 | 2 | 6 | 7 | 4 |
| Mean | | 42 | 47 | 45 | 35 | 54 | 32 | 3 | 6 | 4 | 7 | 4 | 2 | 2 | 2 | 3 | 6 | 6 |
| CV % | | 13 | 13 | 14 | 11 | 3 | 3 | 1 | | | | | | | | | | |
| LSD (P<0.05) | | 10 | 10 | 10 | 6 | 2 | 2 | 1 | | | | | | | | | | |

¥ Dakota Lakes Pea Stubble, 5 Winner, 8 Brookings

† GY-Grain Yield , TW-Testweight, HT-Height, HD-Heading and MAT-Physiological Maturity (days relative to Nekota), LD Lodging
ILAD-Inverse of Leaf Area Duration ( retention of green appearance of flag leaf as affected by diseases and environment),
LS-Leaf Spotting Diseases, TS-Tanspot Severity, LR-Leaf Rust, YR-Yellow (Stripe) Rust incidence,
FHB-Fusarium Head Blight (scale based on Index = severity * incidence in inoculated,misted nursery, where incidence was uniformly 100
WSMV-Wheat Streak Mosaic Virus severity

**Table 2. Grain yield, Test weight and Protein Data for the 2005 Crops Performance Testing (CPT) Variety Trial.**

| | Grain Yield (bushels per acre) | | | | | | | | | | | | | | | TW¥ | PRO¥ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| LOCATION† | BRK | PLA | HIG | DLP | WIN | WINT | KEN | HAY | MAR | OEL | STU | WALL | State | Rank | 3-yr | State | State |
| ALLIANCE | 32 | 39 | 68 | 64 | 48 | 59 | 57 | 57 | 60 | 50 | 28 | 52 | 51 | 16 | 54 | 57.0 | 11.4 |
| ARAPAHOE | 47 | 36 | 71 | 66 | 48 | 59 | 52 | 61 | 57 | 46 | 29 | 45 | 51 | 12 | 53 | 58.1 | 12.9 |
| CRIMSON | 33 | 41 | 66 | 62 | 48 | 58 | 56 | 54 | 53 | 51 | 26 | 46 | 49 | 23 | 52 | 59.5 | 13.2 |
| EXPEDITION | 35 | 32 | 66 | 64 | 43 | 54 | 60 | 67 | 66 | 50 | 29 | 42 | 51 | 15 | 53 | 58.6 | 12.5 |
| HARDING | 43 | 37 | 66 | 62 | 52 | 52 | 52 | 56 | 55 | 49 | 25 | 46 | 49 | 22 | 54 | 59.3 | 12.8 |
| HARRY | 32 | 28 | 65 | 64 | 46 | 60 | 50 | 54 | 58 | 58 | 29 | 41 | 48 | 27 | . | 54.4 | 11.1 |
| HATCHER | 27 | 34 | 72 | 68 | 50 | 63 | 63 | 59 | 72 | 62 | 36 | 48 | 54 | 4 | . | 58.0 | 11.2 |
| JAGALENE | 20 | 42 | 62 | 74 | 52 | 59 | 64 | 61 | 72 | 48 | 28 | 47 | 52 | 10 | 56 | 58.9 | 11.8 |
| JERRY | 53 | 40 | 66 | 64 | 46 | 61 | 58 | 56 | 60 | 55 | 24 | 54 | 53 | 7 | 54 | 59.1 | 12.9 |
| MILLENNIUM | 54 | 47 | 71 | 68 | 49 | 63 | 65 | 65 | 65 | 48 | 33 | 56 | 57 | 2 | 58 | 60.1 | 12.1 |
| NE01643 | 53 | 45 | 70 | 75 | 51 | 69 | 70 | 69 | 67 | 49 | 27 | 51 | 58 | 1 | . | 59.9 | 12.3 |
| NE99533-4 | 24 | 36 | 62 | 69 | 48 | 63 | 59 | 51 | 61 | 42 | 33 | 46 | 49 | 24 | . | 58.5 | 12.8 |
| NEKOTA | 26 | 38 | 58 | 59 | 45 | 56 | 45 | 43 | 43 | 46 | 30 | 46 | 44 | 30 | 50 | 57.3 | 11.9 |
| OVERLEY | 32 | 30 | 60 | 67 | 43 | 56 | 68 | 79 | 67 | 41 | 29 | 40 | 51 | 13 | . | 59.6 | 13.1 |
| SD00032 | 43 | 39 | 51 | 55 | 48 | 54 | 56 | 66 | 62 | 44 | 26 | 42 | 48 | 26 | . | 59.2 | 13.3 |
| SD00W024 | 37 | 38 | 61 | 56 | 51 | 62 | 45 | 39 | 43 | 51 | 22 | 42 | 45 | 29 | . | 58.3 | 12.4 |
| SD01104 | 32 | 33 | 52 | 59 | 48 | 56 | 55 | 50 | 56 | 53 | 30 | 45 | 47 | 28 | . | 56.7 | 12.5 |
| SD01122 | 42 | 40 | 67 | 61 | 54 | 59 | 55 | 49 | 55 | 54 | 26 | 44 | 50 | 19 | . | 58.1 | 12.4 |
| SD01W064 | 26 | 42 | 62 | 65 | 60 | 68 | 57 | 56 | 63 | 53 | 29 | 64 | 53 | 9 | . | 59.7 | 11.2 |
| SD96240-3-1 | 40 | 36 | 68 | 63 | 54 | 69 | 69 | 66 | 71 | 61 | 31 | 48 | 56 | 3 | . | 58.4 | 12.3 |
| SD97059-2 | 49 | 38 | 73 | 74 | 57 | 59 | 57 | 52 | 59 | 52 | 28 | 51 | 54 | 5 | 57 | 57.6 | 12.4 |
| SD97380-2 | 48 | 37 | 69 | 56 | 52 | 68 | 57 | 61 | 58 | 52 | 30 | 54 | 53 | 8 | 55 | 57.8 | 12.5 |
| SD97538 | 39 | 35 | 66 | 67 | 48 | 56 | 55 | 52 | 59 | 52 | 31 | 53 | 51 | 14 | 57 | 58.2 | 12.3 |
| SD97W609 | 31 | 33 | 68 | 62 | 56 | 64 | 57 | 64 | 66 | 50 | 26 | 48 | 52 | 11 | 55 | 58.7 | 12.3 |
| SD98102 | 30 | 49 | 67 | 64 | 58 | 61 | 48 | 46 | 55 | 50 | 30 | 56 | 50 | 17 | 56 | 58.7 | 12.4 |
| TANDEM | 36 | 40 | 64 | 55 | 48 | 48 | 61 | 67 | 59 | 47 | 29 | 43 | 50 | 20 | 53 | 60.1 | 12.6 |
| TREGO | 20 | 32 | 63 | 66 | 52 | 53 | 55 | 57 | 59 | 50 | 31 | 50 | 49 | 25 | 53 | 58.2 | 12.1 |
| WAHOO | 43 | 41 | 72 | 64 | 49 | 53 | 58 | 60 | 64 | 50 | 29 | 54 | 53 | 6 | 57 | 56.1 | 12.4 |
| WENDY | 38 | 26 | 68 | 77 | 51 | 56 | 58 | 53 | 58 | 47 | 29 | 45 | 50 | 18 | 54 | 59.2 | 12.5 |
| WESLEY | 35 | 39 | 62 | 64 | 43 | 48 | 61 | 62 | 68 | 41 | 27 | 43 | 50 | 21 | 53 | 56.5 | 13.3 |
| Mean | 37 | 37 | 65 | 64 | 49 | 59 | 58 | 58 | 60 | 50 | 29 | 48 | 52 | | 54 | 58.5 | 12.4 |
| CV % | 11 | 12 | 6 | 11 | 11 | 11 | 11 | 9 | 8 | 10 | 10 | 15 | 11 | | 12 | 2.4 | 6.8 |
| LSD (P<0.05) | 6 | 6 | 5 | 10 | 8 | 10 | 9 | 8 | 7 | 7 | 5 | 10 | 2 | | 2 | 0.6 | 0.7 |

† Location abbreviations are for Brookings, Platte, Highmore, Dakota Lakes Pea Stubble, Winner,

Winner Intensive (cooperator's management system including fertility and fungicides),

Kennebec, Hayes, Martin, Oelrichs, Sturgis, Wall, Statewide average, Statewide Rank, Statewide 3-year averages

¥ Test weight in pounds per bushel, Protein in percent content of seed

**Table 3. Agronomic and Disease Data for the 2005 Crops Performance Testing (CPT) Variety Trial.**

| Trait† | HT | HD | MAT | SCR | LD | FHB | ILAD | LR | YR | TS | LS | WSMV | BYDV |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | inches | relative days | | scale of 1 to 9, 1 is best | | | | | | | | | |
| Locations¥ | 1,3,5,6,7,8,9, 16,17,18,19 | 1,3,5,6,7 ,8,9 | 8 | 1,8 | 1 | 8* | 8 | 8 | 8 | 5,9 | 9 | 3,7,8 | 1 |
| ALLIANCE | 31 | 1 | 7 | 5 | 5 | | 9 | 4 | 1 | 3 | 4 | 6 | 7 |
| ARAPAHOE | 33 | 2 | 9 | 4 | 5 | 4 | 5 | 1 | 2 | 4 | 7 | 6 | 8 |
| CRIMSON | 35 | 6 | 11 | 5 | 1 | 6 | 7 | 5 | 2 | 2 | 2 | 5 | 6 |
| EXPEDITION | 31 | 0 | 6 | 4 | 1 | 3 | 9 | 4 | 1 | 5 | 9 | 5 | 9 |
| HARDING | 36 | 6 | 10 | 4 | 1 | 4 | 5 | 1 | 2 | 4 | 5 | 5 | 5 |
| HARRY | 31 | 4 | 9 | 4 | 3 | 5 | 8 | 2 | 4 | 6 | 6 | 6 | 4 |
| HATCHER | 30 | 1 | 6 | 4 | 1 | 4 | 7 | 3 | 1 | 3 | 5 | 8 | 8 |
| JAGALENE | 31 | 1 | 4 | 5 | 1 | 6 | 9 | 5 | 1 | 2 | 4 | 5 | 6 |
| JERRY | 36 | 5 | 9 | 3 | 1 | 5 | 4 | 1 | 1 | 5 | 5 | 7 | 7 |
| MILLENNIUM | 33 | 4 | 8 | 3 | 1 | 5 | 2 | 1 | 1 | 7 | 6 | 5 | 3 |
| NE01643 | 33 | 2 | 8 | 4 | 3 | 5 | 3 | 1 | 1 | 3 | 5 | 3 | 4 |
| NE99533-4 | 29 | 1 | 2 | 5 | 5 | 5 | 9 | 9 | 4 | 4 | 4 | 5 | 7 |
| NEKOTA | 31 | 1 | 1 | 5 | 5 | 5 | 9 | 6 | 3 | 3 | 6 | 6 | 7 |
| OVERLEY | 31 | 0 | 6 | 5 | 3 | 6 | 1 | 1 | 1 | 1 | 3 | 2 | 5 |
| SD00032 | 36 | 3 | 10 | 4 | 1 | 6 | 4 | 2 | 1 | 4 | 4 | 6 | 9 |
| SD00W024 | 33 | 6 | 12 | 5 | 1 | 4 | 6 | 3 | 2 | 3 | 3 | 5 | 6 |
| SD01104 | 34 | 6 | 12 | 7 | 3 | 5 | 6 | 1 | 2 | 4 | 5 | 5 | 3 |
| SD01122 | 34 | 5 | 10 | 4 | 1 | 4 | 6 | 3 | 1 | 3 | 6 | 5 | 6 |
| SD01W064 | 34 | 4 | 10 | 2 | 1 | 7 | 7 | 3 | 2 | 2 | 2 | 5 | 8 |
| SD96240-3-1 | 31 | 5 | 7 | 6 | 5 | 5 | 6 | 4 | 1 | 4 | 6 | 5 | 7 |
| SD97059-2 | 35 | 5 | 11 | 3 | 1 | 5 | 5 | 1 | 1 | 4 | 5 | 5 | 6 |
| SD97380-2 | 33 | 3 | 9 | 5 | 7 | 4 | 5 | 1 | 1 | 5 | 6 | 4 | 4 |
| SD97538 | 32 | 3 | 9 | 5 | 3 | 6 | 6 | 1 | 2 | 5 | 5 | 5 | 5 |
| SD97W609 | 29 | 0 | 2 | 4 | 1 | 3 | 8 | 2 | 1 | 3 | 4 | 6 | 7 |
| SD98102 | 33 | 4 | 9 | 3 | 3 | 4 | 6 | 4 | 1 | 2 | 2 | 5 | 7 |
| TANDEM | 34 | 2 | 8 | 6 | 7 | | 8 | 5 | 1 | 2 | 6 | 7 | 7 |
| TREGO | 30 | 1 | 4 | 5 | 7 | 5 | 9 | 3 | 2 | 5 | 4 | 4 | 6 |
| WAHOO | 32 | 3 | 9 | 4 | 7 | 3 | 5 | 2 | 1 | 4 | 8 | 4 | 4 |
| WENDY | 28 | 0 | 2 | 4 | 1 | 3 | 8 | 3 | 1 | 3 | 5 | 5 | 6 |
| WESLEY | 30 | 2 | 7 | 3 | 3 | 5 | 6 | 3 | 2 | 3 | 4 | 6 | 8 |
| Mean | 32 | 3 | 7 | 4 | 4 | 5 | 6 | 3 | 2 | 3 | 5 | 5 | 6 |
| CV % | 4 | 1 | 20 | 16 | | 2 | 23 | 35 | 43 | 25 | 25 | 32 | |
| LSD (P<0.05) | 1 | 1 | 2 | 1 | | 1 | 1 | 2 | 1 | 1 | 2 | 2 | |

**¥** 1 = Dakota Lakes Pea Stubble, 3 = Highmore, 5 = Winner, 6 = Wall, 7 = Northeast Farm, 8 = Brookings, 9 = Platte,

16 = Hayes, 17 = Martin, 18 = Sturgis, 19 = Oehlrichs

* Misted, inoculated nursery. Alliance and Tandem were replaced with resistant Alsen (DI=26%) and susceptible Wheaton (DI=54%) checks.

**†** HT = plant height, HD = relative days to heading, MAT = relative days to physiological maturity,

SCR = general appearance score of plants at harvest time, LD = lodging,

FHB = Fusarium Head Blight (scale is based on disease index = severity * incidence, all plots having 100% incidence)

ILAD = effect of all disease and other environmental factors on loss of green appearance of flag leaf (inverse of Leaf Area Duration)

LR = Leaf Rust Symptoms, YR = Yellow (Stripe) Rust symptoms, TS = TanSpot symptoms, LS = general leaf spot symptoms

WSMV = Wheat Streak Mosaic Virus symptoms, BYDV = Barley Yellow Dwarf Virus Symptoms

**Table 4. Combined Quality Data for Winner, Wall and Dakota Lakes Samples from the 2005 Crops Performance Testing (CPT), 2005 Advanced Yield (AYT) Trials and 2005 Preliminary Yield Trials (PYT) for Lines Advanced to 2006 Nurseries.**

| ID | Color | Seedß Protein (%) | Coleoptile (cms) | PPOπ (5 is best) | SproutingΩ (% germ) | MillingÂ (% flour) | Flour Water AbsorptionΣ (%) | Mixing TolerancœΔ (5 is best) | Water AbsorptionΔ (5 is best) | Subjective MIXOΔ (5 is best) | Mixing Peak TimeΔ (minutes) | Baking Score¥ (% of optimum) | Protein Quality† (% from mean) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ALLIANCE | RED | 11.3 | 7.0 | 2.3 | 19 | 65 | 64 | 2.0 | 2.2 | 3.2 | 6.1 | 49 | -16 |
| ARAPAHOE | RED | 11.5 | 7.3 | 1.0 | 10 | 65 | 64 | 2.8 | 2.4 | 2.9 | 6.3 | 55 | -9 |
| CRIMSON | RED | 11.7 | 10.8 | 1.5 | 3 | 61 | 64 | 3.7 | 2.1 | 4.4 | 6.7 | 68 | 7 |
| EXPEDITION | RED | 11.0 | 8.1 | 1.0 | 17 | 65 | 65 | 4.7 | 3.5 | 4.2 | 10.1 | 73 | 32 |
| HARDING | RED | 12.4 | 9.4 | 2.4 | 24 | 61 | 64 | 3.0 | 2.2 | 3.2 | 5.5 | 56 | -13 |
| HARRY | RED | 10.1 | 7.1 | 1.0 | 33 | 62 | 64 | 4.0 | 2.4 | 3.6 | 6.2 | 67 | 19 |
| HATCHER | RED | 9.6 | 8.0 | 1.5 | 19 | 64 | 63 | 2.3 | 1.7 | 3.1 | 5.6 | 48 | -6 |
| JAGALENE | RED | 9.9 | 7.8 | 1.5 | 4 | 64 | 64 | 2.8 | 2.2 | 2.6 | 6.7 | 50 | -4 |
| JERRY | RED | 12.4 | 8.4 | 2.0 | 27 | 64 | 64 | 3.7 | 2.3 | 4.5 | 4.5 | 70 | 4 |
| MILLENNIUM | RED | 11.7 | 7.8 | 3.0 | 35 | 64 | 64 | 2.8 | 2.2 | 2.7 | 6.0 | 51 | -14 |
| NE01643 | RED | 12.0 | 8.0 | 3.4 | 11 | 64 | 63 | 2.0 | 1.5 | 2.7 | 4.4 | 42 | -28 |
| NEKOTA | RED | 11.1 | 8.0 | 2.0 | 6 | 65 | 63 | 2.0 | 1.6 | 3.2 | 4.4 | 45 | -19 |
| OVERLEY | RED | 12.4 | 8.0 | 1.5 | 5 | 65 | 65 | 2.7 | 3.1 | 4.4 | 7.7 | 66 | 1 |
| SD00111-9 | RED | 10.9 | 9.1 | 3.2 |  | 63 | 63 | 2.5 | 1.8 | 3.9 | 5.1 | 55 | -5 |
| SD00151-6 | RED | 10.6 | 7.7 | 2.5 |  | 64 | 63 | 2.8 | 1.8 | 3.7 | 5.8 | 56 | -2 |
| SD00151-7 | RED | 11.4 | 7.4 | 1.5 |  | 63 | 63 | 3.2 | 2.1 | 3.7 | 6.2 | 59 | -2 |
| SD00151-8 | RED | 11.6 | 7.2 | 1.5 |  | 62 | 64 | 3.5 | 2.3 | 4.0 | 6.2 | 65 | 4 |
| SD00258-1 | RED | 11.5 | 8.2 | 1.0 |  | 63 | 64 | 2.8 | 2.3 | 3.6 | 5.8 | 59 | -4 |
| SD00265-3 | RED | 11.1 | 11.1 | 3.5 |  | 64 | 63 | 2.8 | 2.0 | 3.4 | 4.9 | 55 | -6 |
| SD01058 | RED | 11.3 | 7.3 | 2.0 | 9 | 60 | 64 | 3.7 | 2.3 | 4.0 | 6.2 | 67 | 8 |
| SD01122 | RED | 11.6 | 7.4 | 1.5 | 28 | 63 | 65 | 4.3 | 2.9 | 3.8 | 8.0 | 71 | 14 |
| SD01273 | RED | 11.0 | 8.8 | 2.4 | 15 | 61 | 64 | 3.5 | 2.1 | 4.4 | 5.9 | 67 | 11 |
| SD02091 | RED | 11.5 | 7.7 | 2.5 | 19 | 64 | 65 | 3.8 | 3.3 | 3.9 | 6.9 | 73 | 15 |
| SD02279 | RED | 12.2 | 9.8 | 3.1 | 38 | 61 | 64 | 3.7 | 2.8 | 4.2 | 6.5 | 72 | 8 |
| SD02286 | RED | 12.2 | 8.4 | 2.5 | 65 | 64 | 64 | 2.8 | 2.3 | 3.9 | 5.9 | 60 | -6 |
| SD02480 | RED | 12.8 | 10.6 | 2.0 | 19 | 63 | 65 | 3.2 | 3.2 | 3.7 | 6.7 | 67 | -2 |
| SD02771 | RED | 11.9 | 10.2 | 2.5 | 10 | 62 | 64 | 3.3 | 2.5 | 3.4 | 6.1 | 62 | -3 |
| SD03018 | RED | 11.4 | 9.4 | 2.4 |  | 63 | 64 | 2.7 | 2.2 | 3.8 | 4.7 | 58 | -5 |
| SD03077 | RED | 12.0 | 9.2 | 3.0 |  | 64 | 63 | 2.7 | 2.1 | 3.8 | 5.5 | 57 | -10 |
| SD03113 | RED | 12.0 | 10.3 | 1.5 |  | 66 | 64 | 4.0 | 2.8 | 4.7 | 7.3 | 76 | 15 |
| SD03144 | RED | 11.2 | 9.7 | 3.0 |  | 64 | 67 | 4.7 | 4.9 | 4.6 | 11.5 | 80 | 46 |
| SD03171 | RED | 11.2 | 9.1 | 1.0 |  | 64 | 63 | 3.2 | 2.1 | 3.7 | 6.0 | 59 | -1 |
| SD03177 | RED | 10.5 | 8.8 | 1.0 |  | 63 | 63 | 2.5 | 1.5 | 4.0 | 6.1 | 53 | -5 |
| SD03178 | RED | 11.1 | 8.8 | 1.0 |  | 63 | 64 | 2.7 | 2.3 | 3.8 | 6.4 | 58 | -2 |
| SD03184 | RED | 10.8 | 8.4 | 2.0 |  | 62 | 65 | 3.3 | 3.2 | 3.8 | 9.2 | 62 | 15 |
| SD03188 | RED | 10.8 | 7.9 | 1.0 |  | 65 | 63 | 2.7 | 1.9 | 3.5 | 5.4 | 54 | -6 |
| SD96240-3-1 | RED | 11.2 | 7.8 | 2.0 | 7 | 62 | 63 | 1.8 | 1.7 | 2.8 | 4.2 | 42 | -24 |
| SD97059-2 | RED | 11.7 | 7.7 | 1.5 | 18 | 62 | 64 | 4.3 | 2.8 | 4.3 | 6.9 | 76 | 17 |
| SD98102 | RED | 12.0 | 8.1 | 1.5 | 8 | 63 | 64 | 3.3 | 2.9 | 3.9 | 6.9 | 67 | 4 |
| SD98113-2-1 | RED | 11.5 | 9.7 | 2.4 |  | 65 | 64 | 3.0 | 2.6 | 4.5 | 7.2 | 67 | 7 |
| TANDEM | RED | 11.6 | 10.1 | 2.8 | 12 | 65 | 64 | 3.5 | 2.4 | 4.2 | 6.6 | 67 | 6 |
| WAHOO | RED | 12.0 | 7.8 | 1.5 | 31 | 64 | 64 | 3.0 | 2.4 | 4.2 | 5.8 | 64 | -1 |
| WESLEY | RED | 12.7 | 7.4 | 1.8 | 11 | 64 | 66 | 4.8 | 3.7 | 4.8 | 9.5 | 81 | 25 |
| SD01W064 | WHITE | 9.6 | 7.7 | 2.2 | 21 | 62 | 63 | 2.8 | 2.1 | 3.1 | 6.9 | 54 | 4 |
| SD01W064-1 | WHITE | 9.0 | 7.7 | 2.4 | 25 | 62 | 63 | 2.2 | 2.0 | 2.2 | 6.5 | 42 | -10 |
| SD01W064-6 | WHITE | 9.0 | 7.8 | 2.4 | 29 | 62 | 63 | 2.8 | 1.9 | 3.0 | 6.7 | 51 | 5 |
| SD01W070-3 | WHITE | 11.1 | 8.5 | 2.9 | 23 | 61 | 63 | 3.0 | 1.9 | 3.5 | 5.4 | 56 | -5 |
| SD03W017 | WHITE | 10.5 | 8.5 | 2.4 | 73 | 67 | 64 | 3.3 | 2.8 | 3.3 | 7.6 | 61 | 9 |
| SD03W018 | WHITE | 10.7 | 8.8 | 4.0 | 33 | 63 | 65 | 5.0 | 3.3 | 4.3 | 9.4 | 77 | 37 |
| SD03W063 | WHITE | 10.4 | 7.6 | 3.0 | 34 | 64 | 63 | 2.3 | 1.7 | 3.7 | 5.4 | 52 | -6 |
| SD03W078 | WHITE | 12.5 | 10.7 | 3.4 | 12 | 61 | 67 | 4.7 | 5.0 | 5.0 | 12.6 | 81 | 37 |
| SD03W104 | WHITE | 10.9 | 10.7 | 5.0 | 31 | 61 | 63 | 3.2 | 2.0 | 3.9 | 6.0 | 61 | 3 |
| SD03W164 | WHITE | 10.7 | 9.8 | 3.0 | 26 | 62 | 63 | 2.7 | 2.1 | 4.1 | 5.9 | 59 | 2 |
| SD97W609 | WHITE | 11.7 | 7.1 | 2.8 | 3 | 64 | 64 | 2.8 | 2.5 | 3.8 | 6.6 | 61 | -2 |
| SD97WBlend | WHITE | 11.0 | 7.4 |  | 7 | 63 | 63 | 2.0 | 2.0 | 3.0 | 5.3 | 46 | -18 |
| SD98W175-1 | WHITE | 10.5 | 7.8 | 2.0 | 18 | 62 | 63 | 2.0 | 1.5 | 3.1 | 5.2 | 44 | -17 |
| SD98W175-1-13 | WHITE | 10.5 | 7.6 | 3.0 | 26 | 63 | 63 | 0.8 | 1.6 | 2.7 | 4.6 | 34 | -32 |
| SD98W175-1-14 | WHITE | 10.5 | 7.3 | 3.0 | 21 | 63 | 63 | 1.3 | 1.6 | 2.9 | 4.5 | 39 | -25 |
| TREGO | WHITE | 10.6 | 7.5 | 1.8 | 28 | 64 | 63 | 2.0 | 1.9 | 3.2 | 5.6 | 47 | -14 |
| Wendy | WHITE | 11.1 | 6.6 | 1.8 | 51 | 63 | 63 | 0.7 | 1.6 | 1.5 | 3.7 | 25 | -46 |

**ß** Near infrared spectrophotometer seed protein is corrected to 12 % moisture basis.

**Â** Milling was performed on a Brabender Quadrumat Junior Mill, after tempering to 15% moisture. Bran was removed by sifting for 3 minutes.

**π** Visual 5-seed polyphenoloxidase protocol uses 1 ml of 10 mM L-DOPA in 50 mM MOPS solution. (adopted from Anderson and Morris, 2001, Crop Sci. 41:1697-1705).

**Ω** Sprouting tests were conducted on seeds threshed from heads collected at physiological maturity and stored in a freezer until germination tests could be performed.

**Σ** Flour Water Absorption was obtained from computer output after running a preliminary mixograph (formula provided by J.B. OHM, USDA/ARS).

**Δ** Mixograph scores are based on output for a 10-minute mixing time and 10 grams of flour with optimum water addition.
The optimum amount of water was derived from the absorption score and was added to flour for a second, defining mixograph.
Mixing Tolerance is the average of subjective and formula-derived scores based on bandwith and slope after peak mixing time.
Subjective Mixo score takes into account peak height and bandwidth and slope before and after peak mixing time.
Mixing Peak Time is an adjustment of time to peak mixing based on a formula that correlates mixograph with baking data (formula provided by J.B.Ohm, USDA/ARS)

**¥** Baking Score = 100 * average(Mixing tolerance score, water absorption score, subjective mixograph score) - 3 * (mixing peak time - 7, if(MPT > 7).

**†** Protein Quality = average(Mixing tolerance score, water absorption score, subjective mixograph score) / seed protein content, in terms of percent from the mean for all entries

# Table 5. Grain yield, Testweight and Agronomic Data for the 2005 Advanced Yield Trial (AYT).

| Trait† | Grain Yield | | | | | | | TW | HT | HD | MAT | LD | SCR | ILAD | LS | TS | LR | YR | FHB | WSMV |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | RANK | bushels per acre | | | | | | lbs/bu | inches | relative days | | scale of 1 to 9. 1 is best | | | | | | | | |
| Locations¥ | 1,3,5,6,8 | | 1 | 3 | 5 | 6 | 8 | 1,3,5,6,8 | | | 8 | 1,8 | 1,8 | 8 | 5 | 5 | 8 | 8 | 8 | 3,8 |
| ALLIANCE | 8 | 54 | 55 | 74 | 50 | 52 | 38 | 57 | 31 | 0 | 2 | 7 | 6 | 9 | 7 | 3 | 3 | 1 | | 5 |
| ARAPAHOE | 13 | 52 | 59 | 70 | 47 | 43 | 43 | 58 | 98 | 2 | 5 | 7 | 6 | 6 | 7 | 2 | 1 | 2 | 4 | 3 |
| CRIMSON | 25 | 49 | 61 | 62 | 48 | 45 | 30 | 59 | 35 | 5 | 6 | 3 | 4 | 8 | 3 | 1 | 4 | 2 | 7 | 6 |
| EXPEDITION | 11 | 53 | 67 | 68 | 46 | 42 | 33 | 58 | 29 | 0 | 4 | 6 | 3 | 9 | 9 | 1 | 3 | 1 | 4 | 5 |
| HARDING | 24 | 49 | 64 | 67 | 47 | 45 | 41 | 59 | 34 | 6 | 8 | 4 | 5 | 6 | 6 | 1 | 2 | 3 | 6 | 4 |
| JAGALENE | 29 | 49 | 65 | 61 | 47 | 34 | 40 | 56 | 31 | 1 | 5 | 5 | 5 | 9 | 4 | 1 | 4 | 1 | 7 | 4 |
| NE01643 | 2 | 59 | 64 | 65 | 49 | 42 | 23 | 58 | 33 | 3 | 7 | 3 | 3 | 3 | 4 | 3 | 1 | 1 | 6 | 2 |
| SD01054 | 20 | 51 | 55 | 68 | 43 | 36 | 33 | 57 | 33 | 5 | 8 | 3 | 3 | 7 | 7 | 1 | 4 | 2 | 7 | 7 |
| SD01058 | 6 | 55 | 59 | 70 | 40 | 42 | 52 | 58 | 33 | 2 | 8 | 2 | 5 | 6 | 7 | 1 | 2 | 2 | 4 | 6 |
| SD01099 | 18 | 51 | 53 | 70 | 40 | 39 | 28 | 59 | 39 | 8 | 9 | 5 | 2 | 5 | 2 | 2 | 2 | 1 | 7 | 5 |
| SD01104 | 31 | 48 | 58 | 66 | 44 | 42 | 35 | 55 | 34 | 5 | 12 | 2 | 4 | 7 | 7 | 1 | 1 | 2 | 7 | 5 |
| SD01122 | 7 | 54 | 58 | 74 | 46 | 46 | 46 | 57 | 34 | 5 | 8 | 4 | 4 | 6 | 3 | 2 | 1 | 2 | 5 | 5 |
| SD01181 | 32 | 48 | 64 | 70 | 43 | 39 | 33 | 55 | 36 | 5 | 10 | 5 | 6 | 8 | 4 | 2 | 1 | 4 | 7 | 4 |
| SD01273 | 19 | 51 | 68 | 72 | 57 | 42 | 53 | 59 | 33 | 1 | 4 | 5 | 5 | 5 | 4 | 1 | 1 | 2 | 5 | 3 |
| SD01474 | 45 | 43 | 72 | 77 | 53 | 41 | 45 | 52 | 31 | 5 | 6 | 2 | 5 | 6 | 3 | 1 | 4 | 2 | 7 | 6 |
| SD01W009 | 44 | 44 | 58 | 66 | 52 | 35 | 39 | 58 | 29 | 2 | 4 | 5 | 3 | 9 | 3 | 2 | 4 | 2 | 6 | 7 |
| SD01W062 | 37 | 46 | 63 | 59 | 60 | 40 | 21 | 58 | 33 | 4 | 5 | 5 | 5 | 8 | 6 | 1 | 5 | 1 | 7 | 4 |
| SD01W064 | 14 | 52 | 57 | 65 | 43 | 45 | 35 | 58 | 33 | 4 | 9 | 4 | 2 | 8 | 3 | 1 | 4 | 2 | 8 | 5 |
| SD02018 | 12 | 53 | 58 | 58 | 39 | 49 | 22 | 58 | 34 | 4 | 10 | 2 | 3 | 3 | 9 | 5 | 1 | 1 | 7 | 5 |
| SD02024 | 38 | 46 | 60 | 69 | 45 | 39 | 41 | 54 | 31 | 5 | 8 | 5 | 5 | 8 | 9 | 3 | 2 | 2 | 8 | 8 |
| SD02039 | 26 | 49 | 70 | 69 | 42 | 34 | 32 | 59 | 36 | 4 | 7 | 4 | 5 | 8 | 6 | 3 | 2 | 1 | 6 | 5 |
| SD02068 | 9 | 54 | 63 | 66 | 43 | 48 | 37 | 57 | 33 | 2 | 5 | 6 | 4 | 6 | 6 | 3 | 1 | 2 | 4 | 2 |
| SD02091 | 22 | 50 | 78 | 77 | 38 | 46 | 54 | 58 | 32 | 3 | 8 | 4 | 4 | 4 | 3 | 1 | 1 | 1 | 7 | 5 |
| SD02279 | 3 | 58 | 55 | 70 | 51 | 48 | 30 | 58 | 36 | 6 | 11 | 4 | 4 | 3 | 5 | 2 | 1 | 1 | 6 | 5 |
| SD02286 | 21 | 50 | 70 | 71 | 45 | 54 | 36 | 57 | 39 | 6 | 9 | 4 | 3 | 3 | 4 | 2 | 1 | 1 | 7 | 5 |
| SD02466 | 28 | 49 | 56 | 62 | 47 | 42 | 46 | 53 | 32 | 5 | 6 | 4 | 5 | 9 | 8 | 2 | 5 | 2 | 7 | 5 |
| SD02480 | 4 | 57 | 56 | 56 | 50 | 48 | 29 | 59 | 34 | 4 | 9 | 4 | 4 | 7 | 4 | 2 | 2 | 1 | 5 | 5 |
| SD02501 | 27 | 49 | 62 | 73 | 49 | 43 | 43 | 59 | 34 | 3 | 5 | 5 | 5 | 9 | 6 | 2 | 4 | 1 | 6 | 5 |
| SD02752 | 43 | 45 | 55 | 63 | 45 | 49 | 25 | 56 | 32 | 4 | 9 | 5 | 6 | 9 | 9 | 4 | 4 | 2 | 7 | 4 |
| SD02771 | 17 | 51 | 52 | 67 | 50 | 51 | 34 | 59 | 37 | 6 | 8 | 6 | 5 | 7 | 4 | 2 | 1 | 2 | 6 | 5 |
| SD02819 | 23 | 50 | 48 | 51 | 55 | 42 | 21 | 58 | 32 | 2 | 5 | 5 | 5 | 9 | 4 | 2 | 4 | 1 | 6 | 7 |
| SD02W070 | 33 | 47 | 72 | 76 | 61 | 52 | 37 | 60 | 32 | 3 | 11 | 3 | 4 | 8 | 4 | 1 | 2 | 2 | 7 | 6 |
| SD02W124 | 40 | 45 | 55 | 64 | 48 | 36 | 24 | 58 | 31 | 2 | 4 | 7 | 6 | 8 | 7 | 2 | 2 | 2 | 4 | 5 |
| SD02W125 | 30 | 48 | 71 | 70 | 42 | 48 | 38 | 56 | 31 | 5 | 6 | 6 | 5 | 8 | 6 | 2 | 3 | 2 | 7 | 4 |
| SD02W126 | 36 | 46 | 55 | 60 | 51 | 44 | 26 | 57 | 30 | 2 | 3 | 8 | 6 | 8 | 6 | 1 | 4 | 1 | 6 | 5 |
| SD02W129 | 39 | 45 | 61 | 64 | 35 | 41 | 27 | 56 | 30 | 4 | 8 | 6 | 5 | 8 | 8 | 1 | 4 | 2 | 6 | 5 |
| SD02W130 | 42 | 45 | 63 | 67 | 39 | 43 | 30 | 56 | 31 | 4 | 5 | 6 | 5 | 8 | 9 | 1 | 4 | 1 | 6 | 5 |
| SD02W132 | 34 | 47 | 52 | 65 | 40 | 48 | 27 | 55 | 32 | 4 | 8 | 5 | 5 | 8 | 7 | 2 | 4 | 1 | 7 | 5 |
| SD96240-3-1 | 1 | 60 | 59 | 63 | 41 | 42 | 23 | 57 | 31 | 4 | 4 | 5 | 5 | 7 | 3 | 2 | 4 | 1 | 7 | 3 |
| SD97WBlend | 16 | 51 | 57 | 63 | 37 | 38 | 30 | 58 | 30 | 0 | 1 | 5 | 5 | 9 | 8 | 3 | 2 | 1 | 5 | 3 |
| SD98W175-1 | 5 | 56 | 64 | 66 | 37 | 41 | 28 | 59 | 31 | 4 | 9 | 3 | 4 | 4 | 4 | 2 | 1 | 2 | 7 | 5 |
| TANDEM | 35 | 47 | 77 | 71 | 48 | 45 | 41 | 59 | 33 | 3 | 6 | 7 | 6 | 9 | 5 | 2 | 5 | 1 | | 7 |
| TREGO | 41 | 45 | 54 | 67 | 41 | 34 | 26 | 58 | 30 | 1 | 2 | 8 | 5 | 9 | 6 | 2 | 4 | 2 | 6 | 4 |
| WENDY | 10 | 54 | 57 | 61 | 46 | 43 | 23 | 59 | 29 | 0 | 0 | 4 | 4 | 9 | 9 | 3 | 2 | 1 | 4 | 3 |
| WESLEY | 15 | 51 | 67 | 72 | 52 | 45 | 24 | 55 | 28 | 1 | 6 | 3 | 3 | 7 | 3 | 1 | 3 | 1 | 6 | 5 |
| Mean | | 50 | 61 | 67 | 46 | 43 | 34 | 57 | 34 | 3 | 6 | 5 | 4 | 7 | 5 | 2 | 3 | 1 | 6 | 5 |
| CV % | | 11 | 10 | 5 | 14 | 15 | 14 | 2 | | 1 | 22 | 24 | 18 | 21 | 27 | 52 | | 34 | 14 | 32 |
| LSD (P<0.05) | | 4 | 10 | 5 | 10 | 10 | 7 | 1 | | 1 | 3 | 1 | 1 | 1 | 3 | 2 | | 1 | | 1 |

**¥** Dakota Lakes Pea Stubble, 3 Highmore, 5 Winner, 6 Wall, 8 Brookings

**†** GY-Grain Yield , TW-Testweight, HT-Height, HD-Heading and MAT-Physiological Maturity (days relative to Nekota), LD Lodging ILAD-Inverse of Leaf Area Duration ( retention of green appearance of flag leaf as affected by diseases and environment), SCR-General Appearance at Harvest, LS-Leaf Spotting Diseases, TS-Tanspot Severity, LR-Leaf Rust, YR-Yellow (Stripe) Rust incidence, FHB-Fusarium Head Blight (scale based on Index = severity * incidence in inoculated,misted nursery. Incidence was uniformly 100%), WSMV-Wheat Streak Mosaic Virus severity

**South Dakota Advanced Yield Trial (AYT)**

The 2005 Advanced Yield Trial (AYT) was grown at seven sites in South Dakota. The AYT included 45 entries, consisting of 37 advanced experimental lines from our program and one line from Nebraska and eight checks. Twelve of the 37 experimental lines were whites.

The screening tests performed on entries in the AYT included wheat streak mosaic virus field adult plant screening (Dr. Marie Langham, SDSU), multiple-race seedling stem rust screening, field FHB screening, and field leaf and stem rust screening. The SDSU program also evaluated pre-harvest sprouting tolerance, PPO enzyme activity, coleoptile length, protein levels, and mixograph performance (Table 4). Based on field performance data and screening results (Table 5), four lines were advanced to statewide yield trials (CPT) in 2006:

| | |
|---|---|
| SD01058 | XH1877/NE967430 |
| SD02279 | SD93528/Culver |
| SD02480 | Tandem/Cougar |
| SD98W175-1 | KS84273BB-10/KSSB110-9//KS831374-141B/YE1110/3/KS82W418/SPN |

**Preliminary Yield Trial (PYT)**

Separate Preliminary Yield Trial (PYT) nurseries were planted for hard red and hard white winter wheat in 2005. The nurseries were planted on dry land pea stubble at Dakota Lakes, on spring wheat stubble at Selby, on spring wheat stubble at Winner, on fallow at Wall, and on millet stubble at Brookings.

2005 PYT RED SELECTIONS FOR 2006 AYT

One notable line in the 2005 PYT Red nursery, SD03077 (TX95V4339/SD97287) had no observed deficiencies and ranked 14 of 75 for yield. A pair of re-selections from SD00151 (KS94U328/KS84063-9-39-3-1W//SD93522) were also notable, both ranking in the top 10% for grain yield. One re-selection was deficient for FHB tolerance and testweight and excelled for overall appearance, protein content and predicted baking quality, while the opposite was true for its sibling (Tables 4 and 6).

All but two lines in the top 20% for grain yield were selected for advancement from PYT Red nursery. Most of these lines had only a single deficiency, either for FHB tolerance or spotting disease (tan spot and *Septoria nodorum*) tolerance. No lines with stem or stripe rust susceptibility or poor leaf area duration were advanced.

2005 PYT WHITE SELECTIONS FOR 2006 AYT

Only one-third of the top 20% for grain yield were selected for advancement, primarily due to deficiencies in leaf spotting tolerance, leaf area duration, straw strength or testweight. Most PYT White lines were found to be susceptible to FHB, but were not penalized for this deficiency, since

## Table 6. Grain yield, Testweight, Agronomic and Disease Data for the 2005 Preliminary Yield Trial Red (PYTR).

| Trait† | Grain Yield | | TW | HT | HD | MAT | LD | SCR | ILAD | LS | TS | LR | YR | FHB | WSMV | BYDV |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Rank | bu/acre | lbs/bu | inches | relative days | | scale of 1 to 9, 1 is best | | | | | | | | | |
| Locations¥ | 1.5.6.8 | | | | | 8 | 1,8 | 1,8 | 8 | 5 | 5 | 8 | 8 | 8 | 8 | 1 |
| ARAPAHOE | 24 | 53 | 56 | 34 | 3 | 8 | 4 | 5 | 5 | 4 | 1 | 1 | 2 | 4 | 4 | 7 |
| EXPEDITION | 19 | 54 | 57 | 31 | 0 | 5 | 2 | 3 | 8 | 7 | 2 | 3 | 1 | 5 | 5 | 7 |
| HARDING | 28 | 52 | 58 | 36 | 5 | 9 | 1 | 4 | 6 | 3 | 1 | 1 | 4 | 6 | 3 | 5 |
| JAGALENE | 52 | 49 | 55 | 31 | 1 | 1 | 3 | 5 | 9 | 4 | 1 | 5 | 1 | 6 | 3 | 5 |
| JERRY | 17 | 54 | 57 | 36 | 6 | 8 | 1 | 4 | 3 | 8 | 1 | 1 | 1 | 6 | 3 | 9 |
| MILLENNIUM | 5 | 59 | 58 | 34 | 4 | 8 | 1 | 3 | 2 | 4 | 6 | 1 | 1 | 5 | 1 | 3 |
| SD00111-9 | 4 | 60 | 60 | 32 | 2 | 5 | 5 | 7 | 2 | 7 | 3 | 1 | 1 | 4 | 1 | 7 |
| SD00123-2 | 58 | 48 | 55 | 36 | 4 | 6 | 3 | 5 | 3 | 3 | 1 | 1 | 3 | 7 | 2 | 7 |
| SD00151-6 | 7 | 58 | 57 | 34 | 2 | 7 | 2 | 2 | 2 | 5 | 1 | 1 | 1 | 7 | 3 | 7 |
| SD00151-7 | 6 | 58 | 56 | 36 | 2 | 6 | 4 | 4 | 3 | 3 | 1 | 1 | 1 | 7 | 1 | 5 |
| SD00151-8 | 1 | 61 | 56 | 35 | 3 | 7 | 3 | 5 | 2 | 2 | 1 | 1 | 1 | 7 | 5 | 7 |
| SD00257-2 | 33 | 51 | 56 | 36 | 4 | 9 | 2 | 3 | 5 | 9 | 1 | 1 | 2 | 6 | 1 | 7 |
| SD00258-1 | 3 | 61 | 59 | 36 | 6 | 10 | 1 | 4 | 2 | 5 | 6 | 1 | 1 | 6 | 1 | 1 |
| SD00265-1 | 39 | 50 | 59 | 39 | 5 | 7 | 6 | 5 | 4 | 9 | 1 | 1 | 1 | 6 | 4 | 3 |
| SD00265-3 | 9 | 56 | 59 | 39 | 5 | 8 | 2 | 4 | 5 | 5 | 1 | 1 | 1 | 6 | 1 | 5 |
| SD01014-5 | 21 | 53 | 56 | 35 | 6 | 9 | 2 | 5 | 7 | 3 | 1 | 1 | 2 | 6 | 2 | 5 |
| SD01066-1 | 75 | 38 | 56 | 38 | 9 | 6 | 5 | 6 | 5 | 9 | 1 | 1 | 2 | 7 | 2 | 3 |
| SD01069-1 | 66 | 46 | 55 | 35 | 7 | 10 | 2 | 5 | 3 | 3 | 1 | 2 | 1 | 6 | 3 | 9 |
| SD01108-3 | 60 | 47 | 57 | 36 | 7 | 10 | 2 | 3 | 7 | 9 | 1 | 1 | 2 | 6 | 2 | 3 |
| SD01124-1 | 62 | 47 | 56 | 35 | 9 | 11 | 2 | 5 | 5 | 1 | 1 | 1 | 5 | 7 | 2 | 5 |
| SD01124-2 | 50 | 49 | 57 | 33 | 7 | 11 | 3 | 5 | 6 | 3 | 1 | 5 | 1 | 6 | 3 | 7 |
| SD01195-3 | 54 | 48 | 54 | 35 | 6 | 8 | 2 | 5 | 6 | 5 | 1 | 1 | 4 | 7 | 2 | 7 |
| SD01195-4 | 49 | 49 | 56 | 37 | 6 | 9 | 3 | 5 | 7 | 5 | 2 | 1 | 4 | 7 | 4 | 3 |
| SD01198-9 | 46 | 49 | 56 | 34 | 7 | 9 | 2 | 4 | 2 | 5 | 1 | 1 | 1 | 7 | 2 | 3 |
| SD01234-3 | 74 | 39 | 53 | 35 | 7 | 9 | 1 | 5 | 9 | 9 | 3 | 1 | 2 | 6 | 5 | 5 |
| SD01298-4 | 71 | 42 | 53 | 36 | 6 | 8 | 2 | 5 | 9 | 8 | 1 | 5 | 2 | 6 | 1 | 7 |
| SD01392-3 | 22 | 53 | 58 | 34 | 6 | 8 | 5 | 5 | 4 | 9 | 1 | 1 | 1 | 6 | 4 | 7 |
| SD01392-8 | 48 | 49 | 59 | 35 | 6 | 7 | 3 | 4 | 4 | 9 | 1 | 1 | 1 | 6 | 3 | 7 |
| SD03001 | 35 | 51 | 56 | 36 | 6 | 10 | 1 | 4 | 3 | 8 | 1 | 1 | 2 | 6 | 3 | 9 |
| SD03004 | 30 | 52 | 56 | 35 | 6 | 7 | 3 | 2 | 6 | 2 | 1 | 3 | 1 | 6 | 1 | |
| SD03012 | 47 | 49 | 57 | 34 | 1 | 7 | 3 | 5 | 7 | 3 | 1 | 4 | 2 | 6 | 1 | 3 |
| SD03014 | 69 | 44 | 54 | 31 | 1 | 6 | 1 | 5 | 8 | 9 | 9 | 1 | 2 | 7 | 5 | 3 |
| SD03016 | 61 | 47 | 56 | 36 | 4 | 8 | 2 | 5 | 6 | 3 | 8 | 2 | 2 | 6 | 5 | 9 |
| SD03018 | 23 | 53 | 60 | 34 | 2 | 7 | 5 | 5 | 4 | 3 | 1 | 1 | 1 | 5 | 4 | 9 |
| SD03020 | 72 | 41 | 53 | 33 | 3 | 5 | 6 | 5 | 9 | 9 | 9 | 4 | 3 | 7 | 5 | 9 |
| SD03021 | 64 | 46 | 55 | 36 | 5 | 8 | 3 | 5 | 6 | 2 | 1 | 2 | 2 | 6 | 3 | 5 |
| SD03022 | 70 | 43 | 54 | 37 | 4 | 6 | 4 | 5 | 6 | 9 | 8 | 1 | 2 | 6 | 4 | 9 |
| SD03026 | 34 | 51 | 58 | 32 | 2 | 6 | 6 | 7 | 2 | 8 | 2 | 2 | 1 | 5 | 1 | 5 |
| SD03027 | 18 | 54 | 55 | 32 | 2 | 6 | 2 | 2 | 6 | 8 | 2 | 2 | 2 | 7 | 1 | 9 |
| SD03032 | 55 | 48 | 56 | 36 | 6 | 9 | 5 | 5 | 4 | 2 | 1 | 1 | 4 | 7 | 1 | 3 |
| SD03036 | 59 | 47 | 59 | 39 | 7 | 8 | 3 | 5 | 7 | 4 | 1 | 2 | 1 | 7 | 4 | 7 |
| SD03050 | 41 | 50 | 60 | 37 | 4 | 6 | 2 | 4 | 9 | 4 | 1 | 1 | 2 | 7 | 5 | 9 |
| SD03051 | 26 | 53 | 60 | 35 | 5 | 6 | 2 | 5 | 9 | 4 | 1 | 1 | 1 | 6 | 5 | 9 |
| SD03052 | 29 | 52 | 56 | 32 | 3 | 9 | 5 | 6 | 6 | 8 | 1 | 1 | 4 | 5 | 5 | 3 |
| SD03055 | 40 | 50 | 57 | 36 | 4 | 8 | 3 | 5 | 7 | 3 | 1 | 1 | 3 | 6 | 3 | 3 |
| SD03061 | 56 | 48 | 58 | 36 | 8 | 10 | 2 | 4 | 2 | 6 | 1 | 1 | 1 | 6 | 1 | 3 |
| SD03076 | 51 | 49 | 57 | 36 | 3 | 8 | 4 | 5 | 2 | 7 | 1 | 1 | 1 | 7 | 4 | 7 |
| SD03077 | 14 | 55 | 59 | 38 | 4 | 9 | 4 | 5 | 3 | 3 | 1 | 1 | 1 | 6 | 4 | 7 |
| SD03088 | 31 | 52 | 57 | 34 | 4 | 8 | 1 | 5 | 3 | 7 | 2 | 1 | 1 | 6 | 5 | 9 |
| SD03111 | 36 | 51 | 59 | 39 | 6 | 10 | 1 | 4 | 2 | 3 | 1 | 1 | 1 | 6 | 5 | 9 |
| SD03113 | 42 | 50 | 59 | 44 | 8 | 10 | 1 | 5 | 2 | 2 | 1 | 1 | 1 | 7 | 1 | 3 |
| SD03115 | 43 | 50 | 57 | 40 | 5 | 10 | 3 | 5 | 2 | 3 | 2 | 2 | 2 | 7 | 1 | 9 |
| SD03118 | 44 | 50 | 58 | 41 | 7 | 10 | 2 | 5 | 2 | 1 | 1 | 1 | 2 | 7 | 1 | 1 |
| SD03122 | 57 | 48 | 55 | 33 | 7 | 9 | 7 | 6 | 3 | 4 | 1 | 1 | 1 | 5 | 3 | 3 |
| SD03144 | 27 | 52 | 61 | 36 | 0 | 5 | 2 | 5 | 4 | 9 | 1 | 2 | 2 | 4 | 1 | 3 |
| SD03162 | 13 | 55 | 57 | 31 | 1 | 5 | 3 | 4 | 6 | 6 | 2 | 1 | 6 | 4 | 1 | 1 |
| SD03164 | 15 | 54 | 59 | 32 | 2 | 7 | 4 | 5 | 4 | 7 | 2 | 1 | 3 | 3 | 1 | 3 |
| SD03166 | 16 | 54 | 56 | 31 | 2 | 4 | 5 | 5 | 8 | 7 | 1 | 2 | 1 | 3 | 1 | 3 |
| SD03171 | 12 | 56 | 57 | 30 | 3 | 4 | 2 | 4 | 7 | 6 | 1 | 2 | 1 | 6 | 1 | 7 |
| SD03177 | 2 | 61 | 57 | 35 | 4 | 7 | 2 | 4 | 5 | 9 | 1 | 2 | 2 | 6 | 1 | 3 |
| SD03178 | 11 | 56 | 57 | 36 | 2 | 6 | 4 | 5 | 3 | 9 | 1 | 1 | 1 | 3 | 4 | 3 |
| SD03184 | 8 | 57 | 57 | 33 | 3 | 7 | 5 | 4 | 4 | 9 | 1 | 2 | 1 | 4 | 4 | 7 |
| SD03188 | 10 | 56 | 55 | 35 | 4 | 11 | 3 | 5 | 3 | 3 | 1 | 2 | 2 | 5 | 1 | 5 |
| SD03189 | 67 | 46 | 56 | 34 | 5 | 10 | 3 | 4 | 3 | 9 | 3 | 1 | 1 | 6 | 4 | 7 |
| SD03197 | 38 | 50 | 54 | 35 | 6 | 9 | 3 | 5 | 2 | 7 | 4 | 1 | 2 | 7 | 3 | 3 |
| SD03203 | 32 | 52 | 57 | 34 | 4 | 8 | 1 | 3 | 3 | 7 | 2 | 1 | 2 | 6 | 2 | 3 |
| SD03209 | 37 | 50 | 54 | 35 | 4 | 10 | 2 | 4 | 8 | 9 | 5 | 7 | 1 | 6 | 4 | 5 |
| SD03229 | 68 | 46 | 60 | 34 | 2 | 5 | 4 | 5 | 3 | 8 | 1 | 1 | 1 | 4 | 1 | 5 |
| SD03237 | 25 | 53 | 56 | 37 | 6 | 10 | 1 | 4 | 3 | 4 | 1 | 1 | 3 | 6 | 2 | 7 |
| SD98113-2-1 | 45 | 50 | 58 | 38 | 3 | 8 | 1 | 5 | 3 | 5 | 1 | 1 | 1 | 6 | 2 | 7 |
| TANDEM | 53 | 49 | 58 | 35 | 2 | 7 | 4 | 5 | 8 | 4 | 1 | 3 | 1 | | 5 | 9 |
| TREGO | 63 | 47 | 55 | 30 | 1 | 4 | 2 | 4 | 9 | 8 | 1 | 3 | 2 | 6 | 3 | 7 |
| WENDY | 20 | 53 | 58 | 28 | 0 | 0 | 1 | 4 | 9 | 9 | 1 | 4 | 2 | 7 | 1 | 3 |
| WESLEY | 65 | 46 | 57 | 27 | 1 | 6 | 1 | 4 | 3 | 2 | 5 | 2 | 1 | 6 | 3 | 7 |
| X011485 | 73 | 40 | 54 | 35 | 7 | 7 | 4 | 7 | 9 | 9 | 9 | 4 | 7 | 5 | 4 | 5 |
| Mean | | 51 | 57 | 35 | 4 | 7 | 3 | 4 | 5 | 6 | 2 | 2 | 2 | 6 | 3 | 6 |
| CV % | | 11 | 2 | 5 | 1 | 14 | 43 | 18 | 16 | | | | | 13 | | |
| LSD (P<0.05) | | 2 | 1 | 3 | 1 | 2 | 3 | 2 | 2 | | | | | | | |

¥ Dakota Lakes Pea Stubble, 3 Highmore, 5 Winner, 6 Wall, 8 Brookings

† GY-Grain Yield , TW-Testweight, HT-Height, HD-Heading and MAT-Physiological Maturity (days relative to Nekota), LD Lodging ILAD-Inverse of Leaf Area Duration ( retention of green appearance of flag leaf as affected by diseases and environment), SCR-General Appearance at Harvest, LS-Leaf Spotting Diseases, TS-Tanspot Severity, LR-Leaf Rust, YR-Yellow (Stripe) Rust incidence, FHB-Fusarium Head Blight (scale based on Index = severity * incidence in inoculated,misted nursery. Incidence was uniformly 100%), WSMV-Wheat Streak Mosaic Virus severity, BYDV-Barley Yellow Dwarf Virus severity

## Table 7. Grain yield, Testweight, Agronomic and Disease Data for the 2005 Preliminary Yield Trial White (PYTW).

| Trait† | Grain Yield | | TW | HT | HD | MAT | LD | SCR | ILAD | LS | TS | LR | YR | FHB | WSMV | BYDV | SPROUT |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | rank | bu/acre | lbs/bu | inches | relative | days | scale of 1 to 9, 1 is best | | | | | | | | | | |
| Locations¥ | 1.5.6.8 | | | | | 8 | 1,8 | 1,8 | 8 | 5 | 5 | 8 | 8 | 8 | 8 | 1 | 8 |
| ARAPAHOE | 5 | 52 | 58 | 33 | 2 | 5 | 3 | 4 | 6 | 1 | 6 | 1 | 2 | 5 | 3 | 5 | 3 |
| EXPEDITION | 7 | 51 | 59 | 32 | 1 | 1 | 3 | 3 | 9 | 1 | 6 | 2 | 1 | 3 | 3 | 3 | 1 |
| HARDING | 11 | 50 | 59 | 33 | 5 | 7 | 4 | 4 | 7 | 1 | 3 | 1 | 3 | 7 | 3 | 5 | 1 |
| JAGALENE | 21 | 46 | 57 | 30 | 2 | 1 | 3 | 5 | 9 | 1 | 3 | 6 | 1 | 6 | 3 | 5 | 1 |
| SD00W083-4 | 16 | 47 | 60 | 37 | 8 | 7 | 5 | 5 | 7 | 1 | 1 | 5 | 1 | 6 | 3 | 5 | 3 |
| SD01W061-2 | 45 | 39 | 53 | 30 | 5 | 7 | 5 | 5 | 8 | 1 | 4 | 5 | 2 | 6 | 3 | 5 | 2 |
| SD01W061-7 | 27 | 44 | 56 | 32 | 5 | 7 | 4 | 4 | 8 | 1 | 2 | 5 | 1 | 7 | 3 | 1 | 3 |
| SD01W062-3 | 20 | 46 | 58 | 32 | 5 | 6 | 5 | 5 | 7 | 1 | 2 | 6 | 1 | 7 | 4 | 5 | 5 |
| SD01W062-4 | 34 | 43 | 59 | 34 | 5 | 5 | 6 | 4 | 7 | 1 | 3 | 6 | 1 | 8 | 4 | 7 | 5 |
| SD01W064-1 | 4 | 52 | 58 | 32 | 4 | 8 | 5 | 1 | 7 | 1 | 3 | 2 | 1 | 8 | 2 | 7 | 3 |
| SD01W064-2 | 6 | 51 | 58 | 33 | 4 | 7 | 7 | 3 | 8 | 1 | 2 | 2 | 1 | 7 | 3 | 5 | |
| SD01W064-6 | 12 | 49 | 58 | 33 | 4 | 8 | 3 | 2 | 7 | 1 | 2 | 2 | 1 | 7 | 3 | 7 | 3 |
| SD01W070-1 | 28 | 44 | 58 | 33 | 7 | 8 | 5 | 3 | 6 | 1 | 1 | 2 | 1 | 6 | 4 | 3 | 4 |
| SD01W070-15 | 37 | 42 | 58 | 34 | 7 | 8 | 5 | 2 | 7 | 1 | 1 | 2 | 1 | 6 | 3 | 1 | 4 |
| SD01W070-16 | 40 | 40 | 57 | 34 | 7 | 8 | 4 | 2 | 5 | 1 | 2 | 2 | 1 | 6 | 3 | 5 | |
| SD01W070-17 | 26 | 44 | 58 | 33 | 7 | 8 | 6 | 3 | 6 | 1 | 1 | 2 | 1 | 7 | 3 | 5 | 4 |
| SD01W070-3 | 30 | 43 | 58 | 34 | 8 | 8 | 5 | 3 | 6 | 1 | 1 | 2 | 1 | 6 | 4 | 3 | 2 |
| SD03W005 | 24 | 45 | 58 | 31 | 4 | 6 | 4 | 3 | 5 | 1 | 9 | 2 | 1 | 5 | 1 | 3 | 7 |
| SD03W009 | 13 | 49 | 59 | 30 | 3 | 8 | 2 | 3 | 4 | 2 | 9 | 1 | 1 | 5 | 2 | 5 | 6 |
| SD03W017 | 8 | 51 | 57 | 33 | 5 | 9 | 4 | 3 | 4 | 1 | 3 | 1 | 1 | 7 | 2 | 3 | 8 |
| SD03W018 | 10 | 50 | 57 | 35 | 7 | 10 | 4 | 4 | 3 | 1 | 2 | 1 | 1 | 8 | 3 | 5 | 4 |
| SD03W029 | 3 | 53 | 56 | 32 | 4 | 7 | 2 | 3 | 8 | 2 | 9 | 1 | 1 | 7 | 2 | 9 | 5 |
| SD03W036 | 19 | 46 | 56 | 30 | 4 | 7 | 5 | 2 | 6 | 1 | 8 | 1 | 2 | 7 | 2 | 7 | 3 |
| SD03W040 | 17 | 46 | 54 | 31 | 2 | 4 | 3 | 3 | 7 | 2 | 5 | 1 | 2 | 8 | 3 | 5 | |
| SD03W042 | 15 | 47 | 55 | 35 | 7 | 7 | 6 | 4 | 6 | 1 | 1 | 1 | 2 | 7 | 3 | 5 | 7 |
| SD03W043 | 39 | 41 | 56 | 39 | 6 | 8 | 5 | 4 | 5 | 1 | 1 | 1 | 2 | 7 | 3 | 5 | 4 |
| SD03W054 | 14 | 48 | 56 | 31 | 2 | 1 | 3 | 3 | 8 | 1 | 8 | 5 | 1 | 6 | 3 | 7 | 3 |
| SD03W061 | 18 | 46 | 57 | 33 | 5 | 7 | 2 | 5 | 8 | 1 | 9 | 1 | 4 | 7 | 3 | 5 | 1 |
| SD03W063 | 32 | 43 | 57 | 31 | 6 | 7 | 3 | 3 | 7 | 2 | 3 | 3 | 2 | 7 | 3 | 9 | 3 |
| SD03W066 | 44 | 40 | 55 | 29 | 4 | 4 | 4 | 5 | 9 | 1 | 9 | 3 | 3 | 7 | 3 | 9 | 2 |
| SD03W078 | 36 | 42 | 57 | 34 | 3 | 7 | 3 | 4 | 7 | 4 | 5 | 1 | 2 | 7 | 3 | 9 | |
| SD03W079 | 42 | 40 | 56 | 34 | 2 | 7 | 5 | 5 | 6 | 3 | 9 | 1 | 2 | 7 | 4 | 9 | 3 |
| SD03W081 | 43 | 40 | 56 | 33 | 3 | 6 | 5 | 6 | 6 | 8 | 9 | 1 | 2 | 7 | 5 | 9 | 2 |
| SD03W104 | 25 | 45 | 59 | 34 | 1 | 7 | 1 | 5 | 6 | 1 | 1 | 3 | 2 | 5 | 4 | 9 | 2 |
| SD03W140 | 38 | 42 | 58 | 34 | 3 | 6 | 6 | 6 | 6 | 2 | 3 | 2 | 1 | 5 | 3 | 9 | 3 |
| SD03W148 | 29 | 44 | 58 | 35 | 4 | 9 | 2 | 7 | 4 | 8 | 9 | 1 | 1 | 7 | 3 | 3 | 3 |
| SD03W157 | 41 | 40 | 57 | 27 | 3 | 8 | 2 | 5 | 7 | 3 | 8 | 1 | 1 | 6 | 3 | 7 | 5 |
| SD03W164 | 22 | 45 | 59 | 38 | 3 | 7 | 1 | 4 | 5 | 1 | 2 | 2 | 2 | 6 | 3 | 5 | 3 |
| SD03W186 | 35 | 42 | 59 | 32 | 0 | 4 | 7 | 6 | 6 | 1 | 4 | 2 | 1 | 6 | 4 | 7 | 2 |
| SD03W198 | 31 | 43 | 60 | 33 | 3 | 5 | 3 | 5 | 4 | 2 | 8 | 3 | 2 | 6 | 4 | 9 | 4 |
| SD98W175-1-13 | 2 | 55 | 60 | 29 | 4 | 7 | 3 | 2 | 2 | 1 | 4 | 1 | 1 | 7 | 3 | 3 | 2 |
| SD98W175-1-14 | 1 | 56 | 60 | 28 | 4 | 7 | 2 | 2 | 3 | 1 | 3 | 1 | 1 | 6 | 3 | 5 | 2 |
| TREGO | 33 | 43 | 57 | 29 | 1 | 1 | 3 | 4 | 9 | 1 | 6 | 4 | 6 | | 3 | 3 | 4 |
| WENDY | 9 | 51 | 59 | 29 | 0 | 0 | 3 | 2 | 9 | 1 | 9 | 3 | 2 | 6 | 3 | 3 | 2 |
| WESLEY | 23 | 45 | 56 | 28 | 2 | 6 | 3 | 3 | 7 | 1 | 2 | 3 | 1 | | 3 | 3 | |
| Mean | | 46 | 57 | 32 | 4 | 6 | 4 | | 6 | 2 | 4 | 2 | 2 | 6 | 3 | 5 | 3 |
| CV % | | 10 | 2 | 6 | 1 | 12 | 24 | | 18 | | | | | | | | |
| LSD (P<0.05) | | 4 | 1 | 3 | 1 | 2 | 2 | | 1 | | | | | | | | |

**¥** Dakota Lakes Pea Stubble, 3 Highmore, 5 Winner, 6 Wall, 8 Brookings

**†** GY-Grain Yield , TW-Testweight, HT-Height, HD-Heading and MAT-Physiological Maturity (days relative to Nekota), LD Lodging ILAD-Inverse of Leaf Area Duration ( retention of green appearance of flag leaf as affected by diseases and environment), SCR-General Appearance at Harvest, LS-Leaf Spotting Diseases, TS-Tanspot Severity, LR-Leaf Rust, YR-Yellow (Stripe) Rust incidence, FHB-Fusarium Head Blight (scale based on Index = severity * incidence in inoculated,misted nursery. Incidence was uniformly 100%), WSMV-Wheat Streak Mosaic Virus severity, BYDV-Barley Yellow Dwarf Virus severity, SPROUT-tolerance to preharvest sprouting

the target area for the release of white varieties is in the semi-arid portions of South Dakota (Table 7).

Only six (13%) of 45 experimental lines in the 2005 PYT White nursery compared to 40% of PYT Red lines yielded above 50 bushels per acre. Top yielding lines were more likely to be deficient for protein and/or baking quality for the PYT White nursery than for the PYT Red nursery.

In selecting for both noodle and bread quality, it is desirable to have excellent gluten quality with moderate to moderately low protein content, as well as low PPO activity and resistance to pre-harvest sprouting. Two selected lines surpassed other lines for these criteria and also lacked other deficiencies other than FHB tolerance: SD03W018 (N97S195/SD97W641) had high grain yield but exhibited only moderate tolerance to pre-harvest sprouting; SD03W078 (KS93U139/ N97S084/// Seward/Tandem// NW98S095) had relatively poor grain yield and only moderate PPO activity, but also had a very long coleoptile. One line, SD03W104 [SD98153 (= EG NE89534/NE91629// SD89204) / SD98W209 (= KS82W422/SWM754308// KS831182/KS82W422/3/KS82W418/SPN], excelled for many attributes except for grain and milling yield and had moderate susceptibility to stem rust and WSMV. This line excelled for testweight, pre-harvest sprouting, mixograph performance, had extremely low PPO, moderate protein level, heavy kernels, FHB tolerance, resistance to leaf and tan spot, and long coleoptile.

**Early Yield Trial (EYT)**

2005 EYT RED SELECTIONS FOR 2006 PYT RED

All selections were from among the top 50% for grain yield. Half of the top 10% and one-quarter of the next 10% for grain yield were selected for advancement.

Only lines with resistance or moderate resistance to stem, leaf, and stripe rusts were selected for advancement. All lines with severe reaction to WSMV and leaf spotting diseases or with poor green leaf duration due to disease severity were also discarded.

Among the top 20% for grain yield, disease symptoms accounted for 64% of discard decisions (spotting diseases –42%, rust responses – 12%, Scab or WSMV—10%), low test weight and poor leaf area duration accounted for 15%, low protein content or poor gluten quality accounted for 17% and the remaining 4% headed or matured later than desired.

2005 EYT WHITE SELECTIONS FOR 2006 PYT WHITE

All selections were from among the top 50% for grain yield. One-third of the top 10% and one-third of the next 10% for grain yield were selected for advancement. Only 3.5% of lines in the EYT White nursery yielded above 50 bushels per acre across locations compared to 7.2% of lines in the EYT Red nursery.

Eight (one-third) of the 23 selected lines had no deficiencies for observed traits (listed above for EYTR) or for pre-harvest sprouting. Several were deficient for gluten quality, but were retained for a combination of low PPO activity and tolerance to pre-harvest sprouting. The other selected lines were deficient only in test weight or had moderate values for other traits. Several other lines had few deficiencies, but were not selected because they were already represented by siblings with better performance or by head-row re-selections.

Among the top 20% for grain yield, late heading date, rust indices and spotting disease severity scores each accounted for about 20% of discard decisions. Pre-harvest sprouting susceptibility

accounted for 16%, protein content or quality accounted for 5%, and low testweight or poor leaf area duration accounted for 7%. Field FHB ratings contributed to decisions among siblings, but were not used as primary criteria. Lines had been screened for PPO before the nursery was planted; most lines had favorable PPO activity. Very few lines were deficient for straw strength or resistance to WSMV, perhaps as a consequence of using Kansas germplasm as parents in our crossing program

**Head -row Nursery**

The 2005 head-row nursery consisted of periodic check rows in addition to 17,796 head-rows originating from 308 different cross combinations, and 64 $F_4$ FHB-screening populations. Of the 249 white populations and the 149 red populations, 16 white entries and 30 red entries were re-selections from the 2004 EYT nursery. Fifty heads were picked from each EYT plot for each entry. The other entries were obtained by picking 100 heads from each selected $F_3$ plot. A large number of white entries (134) originated from special screening for PPO of single-seed descent material, resulting in 1268 rows (75 populations) from sorted whites and 558 rows (59 populations) from individual heads.

2005 HEAD-ROW SELECTIONS FOR 2006 EYT

Selections were based on relative date to maturity, pedigree and visual observation of plants prior to and at maturity. Conditions in the head-row nursery were suitable for selecting against FHB, BYDV, Tanspot and WSMV susceptibility. Heads of progeny of red/white crosses were threshed individually and evaluated for seed color before placing in the appropriate EYT nursery. White lines were screened for PPO before advancing to the EYT White nursery.

**Early Generation Bulk Populations**

*a) $F_3$ Bulk Generation*

The 2005 $F_3$ nursery of bulk populations was planted at Brookings and Dakota Lakes from seed of 360 $F_2$ bulk populations. The $F_3$ plots consisted of 141 red, 75 white, and 144 red/white bulk populations from crosses made in 2002. Of the white populations, 35 were from single crosses and 40 were from 3-way crosses. Of the red populations, 81 were from single crosses, 49 were from three-way crosses of winter wheat parents, and 14 were from 3-way crosses with one spring wheat parent. Of the red/white populations, 85 were from single crosses, 57 were from 3-way crosses, and 2 were from 3-way crosses with one spring wheat parent. The crosses with a spring wheat parent (Sumai3, Alsen or ND2710) plus 24 other crosses in the 2005 F3 nursery were specifically made to incorporate FHB resistance.

2005 $F_3$ HEAD SELECTIONS FOR 2006 HEAD-ROWS

The Dakota Lakes nursery had a problem with severe lodging and poor quality samples in 2005. Therefore all observations and head collections were performed at Brookings. Notes on overall appearance and relative maturation date were used, along with pedigree information, for selecting 189 of the 360 $F_3$ plots from which heads were picked for the 2006 Head-row nursery. For most plots, 100 heads were picked, with an attempt to obtain a diversity of plant types while avoiding scabby heads. An additional 150 heads were picked in 19 plots for FHB research.

2005 $F_2$ BULKS RETAINED FOR 2006 $F_3$ NURSERY

Nineteen bulk populations developed for FHB resistance were recycled to the 2006 $F_3$ nursery from seed that was harvested after heads were picked.

*b) $F_2$ Generation*

The 2005 $F_2$ nurseries of bulk populations consisted of 516 entries from spring 2004 and fall 2003 greenhouse crossing cycles, including 14 entries remaining from the spring 2003 greenhouse cycle. Entries were assigned to one of three nurseries at Aurora, depending on seed quantity and cross-type. Entries with greater than 25 grams were planted in two nurseries in 7-row plots. Entries with 4 to 24 grams were either planted in 4-row plots or combined with entries having fewer than 4 grams, for inclusion in one of the $F_2$ nurseries. The $F_2$ plots consisted of 275 red and 83 white bulk populations and 158 populations from red/white crosses. Most of the populations were single crosses, 39 were backcrosses and 122 were 3-way crosses. Nine populations were crosses between adapted winter wheat and FHB-tolerant spring wheat (Briggs or ND2710). Forty-six of these populations were mixtures from crosses with $F_1$ yields of less than 25 grams. Crosses were allocated to the mixtures based on common parentage.

2005 $F_2$ BULK ADVANCEMENT TO 2006 $F_3$

All except 5 $F_2$ populations were advanced to the 2006 $F_3$ nursery.

**Greenhouse Crossing and Increase Program**

The basic strategy of the greenhouse crossing program is to make adapted/adapted and adapted/un-adapted//adapted crosses (three-way crosses) with adapted winter wheat from our program and neighboring programs and un-adapted (e.g., spring wheat or other exotic germplasm) material with special desirable traits. Unique germplasm with resistance to FHB, WSMV, aphids, stem and leaf rusts, and hard white grain characteristics continue to be used in the crossing program. During 2005, 616 successful crosses were made during two greenhouse cycles (365 in the spring and 251 in the fall).

**Germplasm Development**

In anticipation of broadening germplasm development efforts, a program was envisioned for developing 12 germplasm pools targeted to six geographic adaptation areas in South Dakota. Each pool would be enriched with genes for 3 traits that fit a particular adaptation area. The two pools targeted for each adaptation area would have one trait in common and two traits not in common. For example, the Central Pools would have low PPO as a common trait. For Central Pool 1, crosses would be made for the purpose of combining low PPO with WSMV tolerance and long coleoptile. For Central Pool 2, crosses would be made for the purpose of combining low PPO with leaf spotting disease and sprouting tolerance. In the crossing program, after genes are enriched within pools, crosses will be made among pools to gradually combine as many desired traits as possible.

A list of adapted parents from among experimental lines in the AYT and PYT nurseries was compiled that would contribute best to these pools. For this list, correlation analysis revealed that the following desired combinations of traits are rare among our advanced lines: tan spot resistance combined with FHB resistance; leaf rust resistance with FHB resistance; short plant height with high protein content; low PPO with long coleoptile; WSMV resistance with high protein content;

and leaf rust resistance with protein quality. Winter hardiness, root rot, drought tolerance and forage adaptation were not included in the correlation analysis for lack of data.

## RESEARCH SUPPORT PROJECTS

Basic research support projects included: end-use quality enhancements and inheritance studies on resistance to *Fusarium* head blight (FHB), stem rust, and freeze survival.

### *Fusarium* Head Blight

Eight hundred and forty lines have been screened in our mist-irrigated nursery in 2005 including the Northern Regional Performance Nursery (NRPN), Regional Germplasm Observation Nursery (RGON), Southern Regional Performance Nursery (SRPN), in addition to South Dakota Crop Performance Trials (CPT), Advanced Yield Trial (AYT), Preliminary Yield Trials (PYT), and Early Yield Trial (EYT). Expedition hard red winter wheat, released by our program in 2002 showed better resistance to FHB than Wesley and Jagalene in producers' fields in eastern and central South Dakota in 2005. Two experimental lines, SD98102 and SD97059-2, have been increased with intention to release in 2006 and 2007, respectively. Both lines have good FHB resistance in addition to excellent leaf and stem rust resistance. They also had good performance and stability in the NRPN which is essential for adaptation in the northern Great Plains. Seven lines with promising FHB resistance were included in the 2006 AYT, 16 in the 2006 PYT, and 58 in the 2006 EYT. Our program relied on indigenous local resistance in the past. However, with the spread of FHB epidemics in winter wheat in South Dakota, use of highly resistant sources became paramount. In the 2005 – 2006 season, we planted 151 out of 535 $F_3$'s and 134 out of 593 $F_2$'s with promising FHB resistance. Sixty-six of the $F_3$'s and 8 of the $F_2$'s included resistance sources from Sumai3, Ning7840 and their derivatives. About 7,000 head-rows with Sumai3 type sources were planted in 2005. Best lines out of the head-row nursery will be included in the EYT in 2006. FHB-resistant advanced lines from these populations will be entered into regional nurseries to facilitate development of varieties with broad adaptation to the northern Great Plains.

A six parent diallel showed highly significant ($P<0.01$) general combining ability in both greenhouse and field environments, but significant specific combining ability ($P<0.05$) only in an $F_2$ greenhouse environment for resistance to FHB. The ratio of combining ability variance components ranged from 0.66 to 0.89 indicating the importance of additive gene effects.

### Stem rust

We have transferred several novel/under-utilized broad-spectrum stem rust resistance genes into selected adapted lines. Line derivation from these populations will begin in July of 2006. Research studies in coming years will focus on assessment of positive or negative effects of these genes with regard to yield, quality, or other agronomic traits. We also built several populations for mapping markers associated with resistance of these sources in collaboration with Dr. Yang Yen, SDSU Molecular Biologist and Dr. Jeff Stein, SDSU Small Grains Pathologist. Our objectives are to: 1) to conduct a preliminary screen for the few existing markers linked with stem rust resistance genes, to assess the potential for using these markers in selection for the respective resistance genes, and 2) to search for molecular markers linked to the novel and under-utilized genes mentioned above. Resistance in most of these unique sources is believed to be conferred by a single major gene. The $F_2$ generation of resistant-by-susceptible line has been increased in the spring 2005 greenhouse at

SDSU. Ebrahiem Babiker, MS student with our program is mapping markers associated with Sr35 and Sr25 which have universal resistance to races of stem rust. We look at marker assisted selection as a complementary tool and not a replacement to more traditional methods, and we believe that it offers unique opportunities for enhancing the efficiency of variety development.

**Root rot**

Common root rot, caused by *Cochliobolus sativus* crown/foot rot caused by *Fusarium* species (*F. graminearum, F. culmorum, and F. avenacaem*) are problems in the Great Plains in general and in South Dakota in particular, especially during dry seasons. The root rot disease complex caused by these fungi results mainly from inoculum in the soil. Increased incidence of root rot in South Dakota is attributed to increase in the adoption of no-till practices. Complex root rot is occurring in winter wheat producers' fields in western South Dakota and many times it is not diagnosed. Significant crown root rot was reported in some counties west of the Missouri river in South Dakota in 2005. In collaboration with Dr. Jeff Stein, we will focus on the development of field screening techniques and understanding the interaction between the disease and tillage systems. A set of 10 lines from the CPT trial was planted in 2005 in Aurora farm following inoculation with root rot. This space in Aurora will be continuously planted to wheat to increase inoculum in the soil to test all lines of the CPT and AYT for the root rot complex.

**Hard white wheat as a main component of Baladi bread**

There has been an ever-increasing demand for wheat products such as bread in Africa. To cut down the production cost and to make bread available at affordable price, up to 20 percent sorghum or millet flour is blended into the wheat flour in a few African countries. Products made with composite flour have been well accepted in Kenya, Nigeria, Senegal, and the Sudan. It has been found that blending up to 20 percent sorghum with 80 percent wheat produced flat Baladi bread comparable to that made of 100 percent wheat. HW wheat is highly desirable in this blend. A South Dakota experimental HW wheat 'SD97W609' was found to possess excellent bread baking quality and is expected to be an excellent choice for flour blends used for producing this kind of bread. The objective of this project is to analyze breads made with composite flour of the Sudanese white sorghum variety 'Tabat' and South Dakota HW wheat line SD97W609 and to gain an understanding of the unique quality of this bread. This project has been done in collaboration with Dr. [0]Padmanaban Krishnan, Professor at the Nutrition, Food Science and Hospitality Department at SDSU and Dr. Abdelmoneim I. Mustafa, Professor of Food Science at the University of Khartoum in the Sudan. A major part of the research has already been conducted at SDSU by a Sudanese M.S. student, Ranya F. Abdelghafor. Pan and flat Baladi breads were made with composite flour of white sorghum and white hard wheat. A wide range of chemical, rheological and baking analyses were performed on the samples. Emphasis was placed on dough mixing properties, physical characteristics of the bread in addition to sensory evaluation. The data is being analyzed for the time being.

**Near Infrared Reflectance (NIR) analyzer**

The winter and spring wheat breeding programs recently obtained FOSS 6500 Near Infrared Reflectance (NIR) analyzer, along with a computer and software that are required to operate the machine. The FOSS 6500 is the most widely used system of its kind in the USA. Several universities as well as some USDA wheat quality labs currently use FOSS 6500's where it is appropriate. It has a very broad wavelength range spectrum of 400 to 2500 nanometers, (nm) which

covers both the near-infrared (1100 to 2500 nm) and the visible ranges of light (400 to 1100 nm). This allows an extensive array of materials, such as flour or whole grain, to be subjected to analysis. FOSS NIR Systems has developed a software package (winISI III) that is used to calibrate and operate their machines. Calibration takes place by first using standard analysis methods (i.e., wet lab, physical or chemical analysis, etc.) to obtain a dataset used for training purposes. Then grain or flour, as examples, are analyzed and the calibration software is used to build a model that will approximate the dataset used for training purposes. After a satisfactory model has been developed for any particular characteristic, samples can be analyzed with the NIR machine and data that are produced will mimic, or be highly correlated with, results from standard analysis procedures.

The FOSS 6500 will hopefully improve selection strategies within our breeding programs through the rapid and non-destructive analysis of milling and baking quality in thousands of early generation breeding lines. Program efficiency will thereby be increased through discarding materials with little potential. We are entirely cognizant that before we may predict milling and baking quality, etc. calibration models must be formulated. Fortunately, the software allows for calibrations to be shared from one unit to another. This may allow us to use calibrations derived by other programs.

**Clearfield Wheat**

South Dakota Agricultural Experiment Station has signed a Material Transfer Agreement (MTA) with BASF Corporation to develop hard winter wheat with tolerance to the Beyond® herbicide. To accelerate progress in this area we will select among advanced germplasm at the University of Nebraska. In the meanwhile the two events that control resistance to the Beyond herbicide will be incorporated into selected white and red genotypes using adapted germplasm from Nebraska to produce segregating populations containing the herbicide-tolerant events. These populations will be tested for herbicide tolerance by treating with the Beyond® herbicide in the greenhouse and field until resistance is confirmed. Marker assisted selection using sequences provided by BASF will be utilized. Selection for yield, stability, quality, disease and abiotic stress tolerance will also be practiced prior to line increase and release. We expect the release of such genotypes to have an impact in certain production areas in Southwestern South Dakota where jointed goat grass, a close wheat relative, is problematic in wheat-fallow rotations.

**Winterhardiness**

Multi-year replicated field testing forms the basis for maintenance and improvement of winterhardiness in new winter wheat cultivars. Physiological and molecular markers of freeze resistant genotypes also will be required to complement field-testing especially during milder years. We have established collaboration with Dr. Fedora Sutton, SDSU Plant Molecular Physiologist to conduct studies geared towards understanding the physiological basis and identifying genes and proteins necessary for freeze survival. Our goal is to combine agricultural genomics with conventional breeding approaches to provide our program with tools to select varieties that combine winter survival ability and drought tolerance with disease resistance, superior quality, and high yielding ability.

Our research program consists of 1. understanding the physiological basis and identifying genes and proteins necessary for freeze survival, and 2. studying the allelism and gene action of freeze resistance. We proposed that increased water loss during cold acclimation can be an indicator for the selection of freeze-resistant (FR) genotypes. To test this hypothesis, we will test water loss and other physiological markers between FR (CDC Falcon, Harding, Jerry, Norstar, $SDm_{16029}$) and freeze susceptible (FS) (Arlin, Heyne, Jagger, Overley, $SDm_{16169}$ and TAM-W101) lines. The lines were grown in two locations (Brookings and Watertown, SD) and will be tested in a cold chamber as well. Testing will be repeated again in the 2006 – 2007 season. Generation means analysis will also be performed using six generations. An FR line from Canada 'Norstar' and an FS line from Texas 'TAM W-101' have been crossed in the greenhouse and the $F_1$ generation was increased in spring 2005 greenhouse cycle. The $F_2$ and backcross ($BC_1$1 and $BC_1$2) generations were produced in the fall cycle of 2005. Field plots will be planted in September and harvested in late July. Two greenhouse cycles will be conducted including $P_1$ (50 plants), $P_2$ (50 plants), $F_1$ (40 plants), $F_2$ (200 plants) $Bc_1$ (50 plants) and $Bc_2$ (50 plants).