

USDA-ARS / USWBSI
FY03 Final Performance Report (approx. May 03 – April 04)
July 15, 2004

Cover Page

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Year:	FY2003 (approx. May 03 – April 04)
FY03 ARS Agreement ID:	59-0790-9-079
FY03 ARS Agreement Title:	Winter wheat breeding for scab resistance in South Dakota.
FY03 ARS Award Amount:	\$ 56,488

USWBSI Individual Project(s)

USWBSI Research Area *	Project Title	ARS Adjusted Award Amount
VDUN	Winter wheat breeding for scab resistance in South Dakota.	\$ 56,488
	Total Amount Recommended	\$ 56,488

Principal Investigator

Date

 * BIO – Biotechnology
 CBC – Chemical & Biological Control
 EDM – Epidemiology & Disease Management
 FSTU – Food Safety, Toxicology, & Utilization
 GIE – Germplasm Introduction & Enhancement
 VDUN – Variety Development & Uniform Nurseries

Project 1: *Winter wheat breeding for scab resistance in South Dakota.*

1. What major problem or issue is being resolved and how are you resolving it?

Resistant varieties will be the main component of an integrated strategy to control scab. The development and implementation of resistant varieties is the most economical, sustainable, and long lasting means of control. We will continue to simultaneously select for resistance and desirable agronomic characteristics. The objective is to use traditional breeding techniques, assisted by molecular marker selection, to develop scab resistant hard winter wheat cultivars. Breeding efforts for improved head scab resistance in winter wheat focus on:

- i) Characterization of scab resistance or tolerance among commercially grown cultivars and elite and preliminary lines from SDSU and regional breeding programs in addition to Asian, European, and Latin American resistance sources.
- ii) Identification of winter wheat germplasm sources that show a high level of scab resistance.
- iii) Development of populations segregating for scab resistance and desirable agronomic traits, and
- iv) Selection of advanced lines that combine good scab resistance with superior agronomic adaptation.

We use mist-irrigated field screening nurseries to evaluate the material. Winter wheat would be vernalized in the early spring and then transplanted into the field in April. The program has successfully tested dormant seeding as an alternative to transplanting. All scab material is planted into 5 foot rows in the mist irrigated nursery while a transplanted nursery is used as a backup.

2. What were the most significant accomplishments?

The following nurseries were screened for scab resistance in 2003:

- a. Northern Regional Performance Nursery
- b. Regional Germplasm Performance Nursery
- c. Southern Regional Performance Nursery
- d. South Dakota Crop Performance Trials (commercial varieties)
- e. SDSU Advanced Hard Red and Hard White Yield Trials
- f. SDSU Preliminary Hard Red and Hard White Yield Trials
- g. SDSU Early Hard Red and Hard White Yield Trials
- h. Nebraska Interstate Nursery

Our program continues to advance segregating lines, resulting from crossing with scab-resistant sources, through a modified bulk breeding method. The F_2 and F_3 populations are grown as bulks under normal winter wheat production practices. Individual F_3 plants are evaluated for scab reaction by millet inoculation. $F_{3:4}$ progeny rows are planted under normal winter wheat production practices and selected for agronomic performance. Individual heads and the bulks are harvested. $F_{3:5}$ yield trials (1 rep, 2 locations) are grown and corresponding $F_{4:5}$ progeny rows are grown in the scab nursery. Entries with good yield and scab reaction data are advanced to the $F_{4:6}$ yield trials (1 rep, 2 locations), in the scab nursery, and are also screened in the greenhouse for Type II scab resistance. Most promising lines are advanced to multi-location yield trials the following year.

Approximately 6000 plants were evaluated for scab resistance during the 1999 season. 1500 of the plants were kept and were planted into the field in 2000 (as $F_{3:4}$ progeny rows). Forty-four lines were selected out of 1500 based on agronomic performance and were planted in 2001 – 2002 season in the early yield trial nursery (as $F_{3:5}$ lines). These lines were also planted in the greenhouse to confirm resistance. Heads were also picked from the best promising $F_{3:4}$ progeny rows and planted in the mist-irrigated nursery to get scab reaction data prior to line entry in the preliminary yield trials the following year. In the 2001 – 2002 growing season, we planted 3631 progeny rows, with resistant sources, under normal winter wheat production practices in Dakota Lakes, SD. These progeny rows were planted in spring wheat stubble with supplementary irrigation. The best 291 lines were advanced to the $F_{3:5}$ yield trials and observation rows of these were evaluated in the mist-irrigated nurseries in the field and greenhouse in 2003. We have used marker assisted selection, as a complementary tool to our traditional breeding methods, to confirm resistance in our promising segregating populations.

We investigated planting schemes between 2001 and 2003 to determine if direct seeded row materials are affected differently than transplanted hill plots when they are inoculated with FHB. Preliminary results suggested that there were indeed significant correlations between the two methods. We also started using point inoculation to evaluate winter wheat lines and varieties for scab tolerance under greenhouse conditions in 2002 and continued that in 2003. An M.S. graduate student joined our program in the fall of 2002 and he is part of the proposed research. This student is assisting with the breeding program and conducting independent research regarding the genetics of scab resistance in hard winter wheat germplasm.

Include below a list of the publications, presentations, peer-reviewed articles, and non-peer reviewed articles written about your work that resulted from all of the projects included in your grant. Please reference each item using an accepted journal format. If you need more space, continue the list on the next page.

1. Ibrahim, A.M.H., S.D. Haley, Y. Jin, M.A.C. Langham, C. Stymiest, J. Rickertsen, S. Kalsbeck, R. Little, O.K. Chung, B.W. Seabourn, and D.V. McVey. 2004. Registration of 'Expedition' wheat. *Crop Sci.* 44:1470.
2. Liu, D., Y. Yen and A.M. Ibrahim. 2003. Screening elite South Dakota winter wheat for SSR markers linked to Fusarium head blight resistance. *Proc. SD Acad. Sci.* 82:19-25.
3. Ibrahim, A.M.H., and D. Gustafson. 2003. Fusarium head blight research at South Dakota State University. *In* W.J. Raupp (ed.) *Annual Wheat Newsletter*. Vol. 49. Kan. State Univ. Manhattan, KS.
4. Ibrahim, A., S. Malla, R. Little, and S. Kalsbeck. 2003. Comparison of FHB development on hard winter wheat using different planting schemes. p. 256. *In* 2002 National Fusarium Head Blight Forum. Bloomington, MN.