

**USDA-ARS/
U.S. Wheat and Barley Scab Initiative
FY07 Final Performance Report (approx. May 07 – April 08)
July 15, 2008**

Cover Page

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| Fiscal Year: | 2007 |
| USDA-ARS Agreement ID: | 59-0790-4-100 |
| USDA-ARS Agreement Title: | Mapping and Pyramiding Resistance Genes and Developing Hard Red Spring Wheats Resistant to FHB. |
| FY07 ARS Award Amount: | \$ 117,631 |

USWBSI Individual Project(s)

| USWBSI Research Area* | Project Title | ARS Adjusted Award Amount |
|------------------------------|--|----------------------------------|
| VDUN | Development of Hard Red Spring Wheat Cultivars Resistant Scab Disease. | \$117,631 |
| | Total Award Amount | \$ 117,631 |

Principal Investigator

06/17/2008

Date

* CBCC – Chemical, Biological & Cultural Control
EEDF – Etiology, Epidemiology & Disease Forecasting
FSTU – Food Safety, Toxicology, & Utilization of Mycotoxin-contaminated Grain
GET – Genetic Engineering & Transformation
HGR – Host Genetics Resources
HGG – Host Genetics & Genomics
IIR – Integrated/Interdisciplinary Research
PGG – Pathogen Genetics & Genomics
VDUN – Variety Development & Uniform Nurseries

Project 1: *Development of Hard Red Spring Wheat Cultivars Resistant Scab Disease.*

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

Scab or Fusarium head bight (FHB) remains a major threat to wheat production and industry in the Northern Central Plains of the US. It is a complex disease that reduces significantly the grain yield and impacts negatively the wheat quality. In ND, the disease had tremendous implications, particularly on HRSW producers; users; and export market. This problem is being addressed by the NDSU HRSW wheat breeding program. Our goal is to resolve this problem by the development of elite and adapted genotypes/ lines/cultivars and breeding populations that incorporate diverse genetic resistance to the disease with desired agronomic and quality traits. Our strategy is based on pyramiding several types of genetic resistance to FHB from diverse sources into adapted cultivars using classical breeding methods and appropriate novel technologies such as selected molecular markers. We believe that genetic resistance provides a strategic long-term, economically, and environmentally sound solution to the problem. During the 2007-08 growing cycle, our efforts have continued to develop elite HRSW germplasm and cultivars that are adapted to ND in particular, and spring wheat region, in general.

**2. List the most important accomplishment and its impact (how is it being used?).
Complete all three sections (repeat sections for each major accomplishment):**

Accomplishment:

Our main accomplishments are illustrated in the release of many HRSW cultivars and germplasm that are hallmark of wheat production in the spring wheat region in particular and in the US as a whole. These varieties are grown on large acreages in ND and neighboring states generating millions of dollars of benefits for the growers, the industry and export market. These cultivars are the following:

- * The most recent release by our HRSW program (2007) is **'Faller'**. Before its release, Faller was tested under **ND 805** experimental line for many years in different nurseries in our breeding program and in the regional nurseries, including URN and URSN. Faller is a derivative cultivar of Sumai3. Hence it has medium resistance to FHB, similar to Alsen, a very popular HRSW cultivar in the spring region. However, Faller has very high yield and very good leaf disease package compared to Alsen. Faller is recommended for high rainfall and FHB prone spring wheat regions.
- * Prior to the release of Faller, **'Howard'** (**ND 800**) HRSW wheat variety was released in 2006 with good FHB resistance level comparable to Steele-ND. Both Howard and Steele-ND have FHB resistance different from Alsen (Sumai3). Howard has wide adaptation and recommended mainly, for the regions where Reeder and Alsen are grown because of its high yield level and good leaf diseases resistances package. Howard main attributes are FHB resistance, high yield and quality, and excellent leaf disease package compared to Alsen and Reeder.
- * **Glenn** (ND747) released in 2005 is now **The LEADING** HRSW cultivar in the spring wheat region replacing Alsen that dominated the wheat production for the last 5 years. Glenn with parentages involving both Sumai-3 and Steele-ND has higher FHB resistance

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level (better than Alsen variety). In addition Glenn has excellent quality attributes allowing it to be the quality standard by the Wheat Quality Council and the industry in the USA. Based on the US-Wheat Associates survey (OVA), Glenn is now the most preferred cultivar by the wheat importers worldwide. Glenn is expected to dominate the wheat production for some years.

- * The 2004 HRSW release, **Steele-ND (ND 741)** has good FHB resistance level and wide adaptation is now a major grown cultivar in the spring wheat region. Steele-ND has been grown on more than 9% of ND acreages in the past two years. It is recommended mainly, for the regions where Reeder and Alsen are grown because of many attributes including high yield level. It expected that Steele-ND will replace significant acreages of Alsen and Reeder across all the State and probably other cultivars in the region.
- * In 2007, we have released **ND 756** as a germplasm with FHB resistance (see publications). Prior to that, we have released several key sources of FHB resistance wheat germplasm including, ND 2710, ND 744, and ND 751 (See Crop Sciences).

Impact:

- * In the past 5 years, more than 50% (3.5-4 million acres) of ND spring wheat have been grown to NDSU cultivars. Among these common grown NDSU cultivars, **Alsen, Steele-ND and Glenn HRSW cultivars have resistance to FHB** and excellent agronomic/quality traits contribute. These three (3) cultivars have occupied more than 45.1% (2.85 million acres) of wheat grown in ND. These figures show that **the impact** on wheat business (growers, industry and export market) of the FHB resistant HRSW cultivars developed by this program using partly, the USWBSI initiative funds **is phenomenal.**
- * In addition, the NDSU HRSW cultivars are also grown in neighboring states (MN, SD, and MT) where spring wheat is a major crop and FHB is a threat. This is an important impact that should be factored in as well. For example, Reeder, the 1999 NDSU release is the leading wheat cultivar in MT 26%.
- * Releasing superior and very high quality HRSW cultivars with improved **FHB resistance** has allowed ND growers to be competitive in the wheat market at the national and international levels.
- * The HRSW germplasm with FHB resistance that we have released is well known and extensively used in the breeding program nationally and worldwide. Our HRSW breeding program is now a '**Center of excellence**' for wheat germplasm with high quality and **good sources of FHB** resistance.

As a result of that accomplishment, what does your particular clientele, the scientific community, and agriculture as a whole have now that they didn't have before?:

The above accomplishments/results (scab resistance HRSW cultivars and germplasm) by the NDSU HRSW breeding program has allowed the US wheat growers in the spring region to grow once again, on a large scale (3-4 million acres), wheat in scab prone regions. This obviously, has been generating for the growers, hundreds of millions of dollars annually. Similarly, the wheat industry is having better wheat quality for their products, particularly

during the scabby years. In addition, as more than 50% of total HRSW is exported worldwide for its superior quality, the NDSU HRSW cultivars with high quality and scab resistance has allowed our export market to be more competitive at the international level. Hence, substantial financial impact on wheat industry and export market due to NDSU HRSW cultivars has been generated. Finally, NDSU germplasm with FHB resistance and high quality is being used nationally and internationally in the research improvement program as a hallmark sources for these traits.

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 the grant. Please reference each item using an accepted journal format. If you need more space, continue the list on the next page.

- 1. Mergoum, M., R. C. Froberg, and R. W. Stack. 2008.** Registration of spring wheat germplasm ND 756 combining resistances to Fusarium head blight, leaf spotting, and rusts diseases. **Journal of Plant Registration Vol. 2, No.1:61-64.**
- 2. Zhang, G., and M. Mergoum. 2007.** Molecular mapping of kernel shattering and its association with Fusarium head blight resistance in a Sumai3 derived population. **Theoretical and Applied Genetics 115:757-766**
- 3. Zhang, G., and M. Mergoum. 2007.** Developing evaluation methods for kernel shattering in spring wheat. **Crop Science 47: 1841-1850**
- 4. Mergoum, M., R. C. Froberg, and R. W. Stack. 2007.** Registration of spring wheat germplasm ND 751 resistant to Fusarium head blight leaf and stem rusts. **Crop Science 47:455-457.**