

**USDA-ARS/
U.S. Wheat and Barley Scab Initiative
FY05 Final Performance Report (approx. May 05 – April 06)
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Cover Page

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Fiscal Year:	2005
FY05 ARS Agreement ID:	59-0790-4-100
Agreement Title:	Mapping and Pyramiding Resistance Genes and Developing Hard Red Spring Wheats Resistant to FHB.
FY05 ARS Award Amount:	\$ 115,122

USWBSI Individual Project(s)

USWBSI Research Area*	Project Title	ARS Adjusted Award Amount
BIO	Molecular Mapping and Pyramiding of New Scab Resistance Genes.	\$ 23,317
VDUN	Development of Hard Red Spring Wheat Cultivars Resistant to Scab.	\$ 87,805
	Total Award Amount	\$ 115,122

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: *Molecular Mapping and Pyramiding of New Scab Resistance Genes.*

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

To date, most FHB resistant spring wheat lines trace back to the Chinese line ‘Sumai-3 or its derivatives’, most of which share the same QTL’s. One of the main goals in breeding for resistance to FHB is to explore resistance genes from other sources. This will enhance genetic diversity of the resistance and facilitate pyramiding of resistance genes from different sources with the ultimate objective of developing effective and durable FHB resistant varieties. Marker assisted selection for FHB resistance is an efficient tool that can accelerate selection, germplasm development and release of wheat varieties with durable resistance to FHB. Recently, released Hard Red Spring Wheat (HRSW) variety ‘Steele-ND’ from NDSU HRSW breeding program shows good resistance to FHB. Steele-ND is not a Sumai3 derivative. A RIL population comprising 212 F_{2:7} lines derived from a cross between Steele-ND and ND 735 experimental line were developed by the breeding program for the purpose to determine the FHB resistance genes in Steele-ND and to map these genes.

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:

Phenotypic Evaluation:

- Phenotypic data from field evaluation of the RIL population along with its parents and relevant checks was done in summer 2005.
- A greenhouse screening of the RIL population was also accomplished in spring 2005. The disease assessment was done following the protocols developed by Stack and McMullen (1998).

Molecular Work:

- DNA extraction and quantification of 138 among the 212 F_{2:7} RIL of the ND735/Steele-ND population, the parents involved in the cross (Parshall and ND706) along with other relevant checks including Sumai3, Alsen, Reeder, and Glenn; has been done.
- All these genotypes have been screened with 32 previously identified molecular markers linked to FHB resistance located on different chromosomes.
- Polymorphism among the parents was observed and presently the RIL population is being screened with the polymorphic markers in order to develop the skeletal map of ND735/Steele-ND population.

Impact:

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 results from this work will have significant impact on the following:

- Marker Assisted Selection (MAS): Beside looking for new markers we are using existing markers in addition to the information on wheat EST's being generated by the NSF funded wheat genomic project to identify and develop 'breeder friendly' markers to map the resistance of Steele-ND.
- Pyramiding FHB resistance genes: The information from this project is being used to develop markers linked to resistance QTL's from Steel-ND to fasten the process of selection for FHB resistance. Markers may represent the only mean by which pyramiding of resistance genes from different sources can be achieved in order to develop durable FHB resistant wheat varieties.
- Today, crosses between Steele-ND and other sources of resistance to FHB have been initiated and advanced generations of these crosses are being evaluated for FHB resistance in greenhouse and field FHB nurseries.

Project 2: *Development of Hard Red Spring Wheat Cultivars Resistant to Scab.*

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

Scab (FHB) reduces significantly the grain yield levels and affects negatively quality characteristics of HRSW in the spring wheat region. The disease had tremendous implications, particularly on HRSW producers in ND; users; and export market. This problem is being resolved by the development of elite parental genotypes and lines; and breeding populations to incorporate diverse genetic resistance to FHB with desired agronomic and quality traits into new HRSW cultivars adapted to ND. The combination of several types of genetic resistance to FHB from diverse germplasm sources into adapted cultivars using mainly, classical breeding methods and appropriate novel technologies such as selected molecular markers were used in 2005-06 to provide a strategic long-term solution to the control of FHB not only in ND but in the entire HRSW growing region. During the 2005-2006 growing cycles, our on-going efforts have focused on the development of elite HRSW germplasm and cultivars that are adapted to ND and surrounding regions.

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

1. Accomplishment:

- * *Release of ‘Howard’ (ND 800), a new HRSW wheat variety with good FHB resistance level comparable to Steele-ND released in 2004. Howard has wide adaptation and recommended mainly, for the regions where Reeder and Alsen are grown, particularly in the Western parts of ND because of its high yield level. Howard main attributes –in addition to FHB resistance- are high yield and quality, excellent leaf disease package (better than Alsen).*
- * *Glenn (ND747) with parentages involving Sumai-3 and Steele-ND with very good FHB resistance level (better than Alsen variety) that we released in 2005 is gaining substantial popularity while Alsen, the most grown FHB HRSW cultivar is losing acreages.*
- * *ND 803, a high yielding line is in the last testing year and seed is being increased. ND 803 is a candidate for release in 2007.*
- * *ND 805 is another pre-released line that is being increased is in its final testing stages. ND 805 is also a candidate for release for 2007.*
- * *ND 804 was pre-released this year.*
- * *Continuation of research studies (graduate student research programs) on grain shattering and its relationship with FHB in wheat*
- * *ND 744 was released as a germplasm with FHB resistance (see publications).*

Impact:

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?:

- * *Growing **Howard, Glenn, and Steele-ND, and other HRSW cultivars released by this program** with improved FHB resistance and agronomic/quality traits contributes substantially to the income of wheat growers and industry while meeting the export market requirements.*
- * *In the past 3 years HRSW cultivars released by this breeding program (Alsen, Parshall, and Reeder) occupied more than 50% of total HRSW acreages.*
- * *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.*
- * *Today, NDSU HRSW breeding program is well known **nationally and worldwide as a center of excellence** for wheat germplasm with **high quality and good sources of FHB resistance**.*

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.

Journal articles:

- Mergoum, M.,** R. C. Frohberg, T. Olson, T. L. Friesen, J. B. Rasmussen, and R. W. Stack. **2006.** Registration of 'Glenn' wheat. *Crop Sci.* 46:473-474.
- Mergoum, M.,** R. C. Frohberg, J. D. Miller, and R. W. Stack. **2005.** Registration of 'Steele-ND' wheat. *Crop Sci.* 45:1163-1164.
- Mergoum, M.,** R. C. Frohberg, J. D. Miller, J. B. Rasmussen, and R. W. Stack. **2005.** Registration of spring wheat germplasm ND 744 resistant to Fusarium head blight leaf and stem rusts. *Crop Sci.* 45:430-431.

Proceedings:

- Mergoum M.,** R. C. Frohberg, and R. W. Stack. 2005. Enhancing Fusarium head blight resistance in spring wheat: A glance in successes and challenges. p. 64-68. *In* S. M. Canty et al. (eds.) Proc. of the National Fusarium Head Blight Forum; 7-9 Dec. 2005; Milwaukee, WI. USA. Michigan State Univ., East Lansing, MI.
- Mergoum M.,** R. C. Frohberg, and R. W. Stack. 2005. "Glenn" hard red spring wheat cultivar: A new step in combating Fusarium head blight disease. p. 69-71. *In* S. M. Canty et al. (eds.) Proc. of the National Fusarium Head Blight Forum; 7-9 Dec. 2005; Milwaukee, WI. USA. Michigan State Univ., East Lansing, MI.

- Stack, R. W., **M. Mergoum**, R. C. Frohberg and J. M. Hammond 2005. Spring wheat line Tokai-66, a source of heritable kernel resistance to Fusarium head blight. p. 91. *In* S. M. Canty et al. (eds.) Proc. of the National Fusarium Head Blight Forum; 7-9 Dec. 2005; Milwaukee, WI. USA. Michigan State Univ., East Lansing, MI.
- Kadariya, M., L. Osborne, **M. Mergoum**, L. Peterson and K. Glover. 2005. Correlation of seed size and DON accumulation in spring wheat. p. 177. *In* S. M. Canty et al. (eds.) Proc. of the National Fusarium Head Blight Forum; 7-9 Dec. 2005; Milwaukee, WI. USA. Michigan State Univ., East Lansing, MI.
- Kadariya, M., L. Peterson, **M. Mergoum**, R. Stack and K. Glover. 2005. Progress from five years of selecting for resistance to Fusarium head blight in spring wheat. p. 50. *In* S. M. Canty et al. (eds.) Proc. of the National Fusarium Head Blight Forum; 7-9 Dec. 2005; Milwaukee, WI. USA. Michigan State Univ., East Lansing, MI.
- Mergoum M.**, R. C. Frohberg, and R. W. Stack. 2005. Breeding Hard Red Spring Wheat for Fusarium Head Blight (Scab) Resistance: Successes and Challenges. p.. *In* Proceedings of the 7th Int. Wheat Conf., Nov. 27- Dec. 2, 2005, Mar del Plata, Argentina .

Abstracts:

- Stack R. W., **M. Mergoum**, R. C. Frohberg, and J. Hammond. 2005. Spring Wheat Line Tokai-66, a Source of Heritable Kernel Resistance to Fusarium Head Blight. *In* ASA-CSSA-SSSA-CSSS Abstracts 2005 [CD-ROM], Madison, WI.
- Ransom J. K., and **M. Mergoum**. 2005. Traits Associated with High Yield Potential in Spring Wheat. *In* ASA-CSSA-SSSA-CSSS Abstracts 2005 [CD-ROM], Madison, WI.

Oral Presentations:

Invited Speaker: Breeding for Fusarium Head Blight Resistance: Achievements and Challenges. 2005 National Fusarium Head Blight, Forum, Milwaukee, WI, USA.

One oral presentation: Breeding Hard Red Spring Wheat for Fusarium Head Blight (Scab) Resistance: Successes and Challenges. 7th International Wheat Conference, Nov. 27- Dec. 2, 2005, Mar del Plat, Argentina.