USDA-ARS/
U.S. Wheat and Barley Scab Initiative
FY13 Final Performance Report
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Cover Page

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Fiscal Year:	FY13
USDA-ARS Agreement ID:	59-0206-9-070
USDA-ARS Agreement Title:	Breeding and Development of DNA Markers for Fusarium Head Blight Resistance in Wheat.
FY13 USDA-ARS Award Amount:	$ 128,915

USWBSI Individual Project(s)

USWBSI Research Category*	Project Title	ARS Award Amount
VDHR-SPR	Fine Mapping and Validation of QTLs for FHB Resistance from PI 81791.	$ 13,881
VDHR-SPR	Breeding and Genetic Investigations of FHB Resistance in Spring Wheat.	$ 115,034
	FY13 Total ARS Award Amount	**$ 128,915**

Principal Investigator Date

* MGMT – FHB Management
FSTU – Food Safety, Toxicology, & Utilization of Mycotoxin-contaminated Grain
GDER – Gene Discovery & Engineering Resistance
PBG – Pathogen Biology & Genetics
BAR-CP – Barley Coordinated Project
DUR-CP – Durum Coordinated Project
HWW-CP – Hard Winter Wheat Coordinated Project
VDHR – Variety Development & Uniform Nurseries – Sub categories are below:
SPR – Spring Wheat Region
NWW – Northern Soft Winter Wheat Region
SWW – Southern Soft Red Winter Wheat Region

Project 1: *Fine Mapping and Validation of QTLs for FHB Resistance from PI 81791.*

1. What major problem or issue is being resolved relevant to Fusarium head blight (scab) and how are you resolving it?

PI 81791 (Sapporo Haru Komugi Jugo) was identified, via USWBSI funding, as a line with very high FHB resistance, including low visually scabby kernels. PI 81791 does not contain *Fhb1* and it is, therefore, a good target for a new QTL mapping effort. 150 RILs of a PI 81791/Wheaton population were developed and phenotypic data on FHB traits was collected from three field and two greenhouse inoculated nurseries and a skeleton map was produced in an earlier funding period. Given the relative ease and lower expense of mapping with new markers in wheat today versus only a few years ago, we used SNP markers to make a complete genetic map of this population and conduct a more thorough QTL mapping effort.

2. List the most important accomplishments and their impact (i.e. how are they being used) to minimize the threat of Fusarium Head Blight or to reduce mycotoxins. Complete both sections; repeat sections for each major accomplishment:

Accomplishment:

The most significant QTL, not confounded with heading date or plant height is located on chromosome 5A. Other QTL have been reported on this chromosome, but we think it is novel based on its chromosomal location and its affect on multiple FHB-related traits. A manuscript describing the QTL mapping in this population is in the revision stages and nearly ready for journal submission.

Impact: It is likely that at least one novel QTL on chromosome 5A has been identified. Because this QTL affects multiple traits, including Incidence, Severity, VSK, and DON, breeders are more likely to introgress this QTL into their germplasm and result in greater FHB resistance.

Project 2: *Breeding and Genetic Investigations of FHB Resistance in Spring Wheat.*

3. What major problem or issue is being resolved relevant to Fusarium head blight (scab) and how are you resolving it?

Although a dramatic increase in genetic resistance to FHB has been observed in the spring wheat region of the U.S. in the past five years and these varieties are being widely adopted, there are still susceptible varieties in production. Furthermore, even the moderately resistant varieties available today can suffer significant damage due to FHB and elevated DON in environments favorable for disease development. Therefore, the overall level of FHB resistance of regional varieties must be improved.

4. List the most important accomplishment and its impact (i.e. how is it being used) to minimize the threat of Fusarium head blight or to reduce mycotoxins. Complete both sections (repeat sections for each major accomplishment):

Accomplishment (1):
The experimental line MN07098-6 was released and made available for licensing. MN07098-6 (SD3696/Ulen sel) has been a consistent top yielder with good adaptation to Minnesota and Eastern ND and SD. Its grain yield is lower than Prosper, but MN07098-6 has marginally better straw strength, leaf rust resistance and FHB resistance (4 on 1-9 scale). End-use quality and pre-harvest sprouting reaction of MN07098-6 are acceptable, about average compared with other varieties. Due to its lack of significant advantages versus currently grown cultivars, we opted against public release of this line.

Impact:
MN07098-6 has a moderately resistant FHB rating of 4 (1-9 scale where 1 is immune, 9 is very susceptible). This rating group is the 2nd best among currently available varieties in the region. The current number of varieties in each rating group is as follows:

3 (3: Glenn, Rollag, Select)
4 (7)
5 (7)
6 (1)
7 (4)
8 (1)

I consider 6 and worse to be unacceptably susceptible, given the good selection of varieties that are rated as 5 or better. Therefore, MN07098-6 contributes to an overall improvement of FHB resistance in the region, especially if it can replace acreage of more susceptible varieties.

Accomplishment (2):
Five experimental lines were entered and evaluated in the 2013 Uniform Regional Scab Nursery. These lines were identified in previous testing as having improved levels of FHB resistance. Of the 23 entries and 5 checks in the trial, the 5 MN lines ranked 1-5 for lowest VSK and 1, 2, 3, 5, and 6 for lowest DON level (the MR check ND2710 ranked 4th).

Impact:
These lines combine FHB resistance from different sources and are candidates for future germplasm release. These lines are available and have been requested by and provided to other wheat breeders in the region for use as crossing parents.

Accomplishment (3):
Scab nurseries were established at two field sites in 2013. A total of 3,836 genotypes were evaluated in 8,117 total rows among the locations. The Crookston and St. Paul FHB screening nurseries were excellent, and provided highly discriminatory data. As a result of these nurseries and results from previous years, the FHB resistance of 27 spring wheat cultivars was assessed and reported to growers via print media and field day presentations.

Impact:
Good field screening nurseries are needed to maintain progress in breeding for FHB resistance. Our screening of more 2,000 F_5 lines for FHB reaction at two locations eliminates virtually all susceptible lines. Our FHB resistance ratings are an important part of growers' decision regarding which variety they will grow.

Accomplishment (4):
Marker-assisted selection was completed for 978 selected F_5 (pre-yield trial) lines, and 1,858 plants from 78 BC_1 and top-cross families segregating for FHB resistance QTL and other important genes. The F_5 lines were processed by the USDA-ARS Genotyping Center in Fargo and the BC_1 and top-cross samples were processed in-house. *Fhb1* and the 5AS FHB QTL were used to screen all 978 F_5 lines and selected in 45 and 12, respectively, of the 78 BC_1 and topcross populations subjected to MAS.

Impact:
The screening of BC_1 and top-cross lines enriches populations for FHB resistance QTL. Likewise, selecting F_5 lines containing the *Fhb1* and 5AS QTLs enhances the chances of advancing lines with high levels of FHB resistance.

Include below a list of all germplasm or cultivars released with full or partial support of the USWBSI during the FY13 award period. List the release notice or publication. Briefly describe the level of FHB resistance.

MN07098-6 spring wheat was released for the purpose of exclusively licensing in 2014. It has moderate resistance (4 on 1-9 scale) to FHB.

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 FY13 grant. Please reference each item using an accepted journal format. If you need more space, continue the list on the next page.

Anderson, J.A., J.J. Wiersma, S. Reynolds, and R. Caspers. 2013. Hard Red Spring Wheat. In Minnesota Varietal Trials Results, University of Minnesota Agricultural Experiment Station.

Eckard, J.T., J.L. Gonzalez-Hernandez, K.D. Glover, J. Anderson and M. Mergoum. 2013. Multiple Fusarium Head Blight Resistance QTL Pyramided onto Elite Spring Wheat Fhb1 Back-grounds using a Family-based Mapping Approach. *In*: S. Canty, A. Clark, Y. Salat and D. Van Sanford (Eds.), Proceedings of the 2013 National Fusarium Head Blight Forum (p. 16). East Lansing,MI/Lexington, KY: U.S. Wheat & Barley Scab Initiative.

ElDoliefy, A.E., James A. Anderson, Karl D. Glover, Ajay Kumar, Elias Elias, Shiaoman Chao, Mohammed S. Alamri and Mohamed Mergoum. 2013. Molecular Mapping of Fusarium Head Blight Resistance in Glenn, a High Quality and Adapted Hard Red Spring Wheat Cultivar. *In*: S. Canty, A. Clark, Y. Salat and D. Van Sanford (Eds.), Proceedings of the 2013 National Fusarium Head Blight Forum (p. 18). East Lansing,MI/Lexington, KY: U.S. Wheat & Barley Scab Initiative.

Ovando-Martinez, M., B. Ozsisli, J. Anderson, K. Whitney, J.Ohm, and S. Simsek. 2013. Analysis of deoxynivalenol and deoxynivalenol-3-glucoside in Hard Red Spring Wheat inoculated with *Fusarium graminearum*. Toxins 5:2522-2532.