USDA-ARS/
U.S. Wheat and Barley Scab Initiative
FY09 Final Performance Report
July 15, 2010

Cover Page

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Fiscal Year:	2009
USDA-ARS Agreement ID:	59-0790-6-073
USDA-ARS Agreement Title:	Evaluation of Hordeum Germplasm for Resistance to Fusarium Head Blight.
FY09- USDA-ARS Award Amount:	$ 68,106

USWBSI Individual Project(s)

USWBSI Research Category*	Project Title	ARS Adjusted Award Amount
BAR-CP	Mapping Loci Conferring Resistance to FHB and DON Accumulation Barley.	$ 34,846
BAR-CP	Screening Hordeum Germplasm for Resistance to Fusarium Head Blight and DON Accumulation.	$ 33,260
	Total Award Amount	**$ 68,106**

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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 Winter Wheat Region
SWW – Southern Sinter Wheat Region

Project 1: *Mapping Loci Conferring Resistance to FHB and DON Accumulation Barley.*

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

Our primary and long-term goal is to reduce the losses caused by FHB, including quality discounts due to DON contamination. This can be best achieved by developing barley cultivars with the highest level of resistance possible. We have identified promising sources of resistance through multiple years and locations of field screening. Several diverse sources of resistance have been crossed with advanced breeding lines to map and characterize loci conferring FHB resistance. The specific objective for this proposal is to determine the number, effect, and chromosomal position of FHB resistance loci in PI466423 (a wild barley accession from Israel) using the advanced backcross quantitative trait locus (QTL) method. This research will lead to the development of advanced breeding lines with loci conferring resistance to FHB and the accumulation of DON. This information and germplasm will allow breeders to more rapidly develop FHB resistant barley cultivars for growers.

2. 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:

Backcross populations have been developed for PI466423 using the Minnesota cultivar 'Rasmusson' as the recurrent parent. BC_2 lines have been advanced three generations through single seed descent to achieve greater homozygosity. We now have 257 BC_2F_4 lines for phenotyping for FHB resistance and DON accumulation in the field. These lines will be genotyped with Diversity Arrays Technology (DArT) markers to identify the introgressed wild barley chromatin contributing to FHB resistance in the 'Rasmusson' background. Given that all of the DArT markers developed for cultivated and wild barley are positioned on the barley consensus map, we will have accurate information on the introgressions in each line.

Impact:

The complete impact of this project will be realized when the first FHB phenotyping evaluations are completed on the introgression lines. These evaluations are currently being done on the advanced backcross lines at two locations in Minnesota during summer 2010. Preliminary data from St. Paul indicate that we have recovered the FHB resistance of PI466423 in a cultivated barley background. Subsequent phenotyping tests will be made in China in spring 2011 and again at two locations in Minnesota in summer 2011. The deliverables from this project will be to provide breeders with agronomically advanced introgression lines for use in their crossing block; information on the introgressed wild barley segments contributing the highest FHB resistance and lowest DON accumulation; and molecular markers useful for marker-assisted selection of wild barley-derived FHB resistance QTL.

Project 2: *Screening Hordeum Germplasm for Resistance to Fusarium Head Blight and DON Accumulation.*

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

In the Upper Midwest, the series of FHB epidemics starting in the early 1990s has contributed to one of the greatest declines in barley acreage in the last century. Deployment of resistant cultivars is the most effective and environmentally sound means of managing this disease; however, barley accessions with high levels of resistance to *Fusarium graminearum* and its toxins are lacking. Thus, the primary objective of this research is to identify *Hordeum* germplasm with the highest level of FHB resistance possible. Our specific activities also involve the sourcing of unique *Hordeum* germplasm from genebanks outside the United States.

Our USWBSI research program is an ongoing effort to systematically evaluate unique *Hordeum* germplasm from USDA and foreign genebanks for resistance to FHB in the field. The screening of the entire six-rowed spring and six-rowed winter barley collection from the USDA National Small Grains Collection (NSGC) has been completed. Additionally, all of the wild barley (*Hordeum vulgare* subsp. *spontaneum*) accessions from the NSGC have been evaluated as well as most of the two-rowed spring and winter collection. The total number of NSGC accessions screened exceeds 20,000. We also have sourced unique *Hordeum* accessions from other genebanks around the world, including the N. I. Vavilov All-Russian Scientific Research Institute of Plant Industry (VIR) in St. Petersburg, Russia (2,369 accessions total); the Station federale de recherches en production vegetale de Changins (SFRSPP) in Nyon, Switzerland (74 accessions); the Nordic Gene Bank (NGB) in Alnarp, Sweden (1,044 accessions); the Institute for Cereal Crops Improvement (ICCI) in Tel Aviv, Israel (150 accessions); Plant Genetic Resources of Canada (PGRC) in Saskatoon, Canada (3,384 accessions); and International Center for Agriculture in the Dry Areas (ICARDA) in Aleppo, Syria (318 accessions).

2. 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:

Additional sources of resistance to FHB are needed in breeding programs. Over the past 10 years, we have procured 27,188 accessions from various genebanks and evaluated them in FHB nurseries in the Upper Midwest and/or China. From these evaluations, we have identified accessions with resistance levels comparable to the resistant six-rowed check Chevron. One hundred and fifty-three of these accessions came from the NSGC, 45 from the VIR, 8 from the SFRSPP, 8 from the NGB, 3 from the ICCI, 110 from the PGRC, and 2 from ICARDA.

Impact:

We have discovered new and diverse sources of FHB resistance in barley that are different from those already reported. This is based on genotyping assays conducted with Diversity Array Technology (DArT) markers. The identification of resistant germplasm is the first step in developing barley cultivars with enhanced resistance to FHB and the accumulation of toxins. Accessions identified as resistant in our initial screening nurseries are immediately distributed to barley breeders for crossing within their FHB resistance-breeding program. Additionally, several of these populations are subjected to genetic analysis to identify and map FHB resistance loci.

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

Several advanced breeding lines from North Dakota State University and University of Minnesota have enhanced resistance to FHB derived from sources we identified in previous USWBSI-funded research. These lines are in the pilot and plant scale testing and may be released as cultivars in the next several years if accepted by industry. At this time, no germplasm lines have been released directly from my program. In early 2012, we anticipate releasing several germplasm lines from the advanced backcross populations involving PI466423.

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.

Dahl, S. K., Bockelman, H. E., Kovaleva, O., Loskotov, I., Kleijer, G., Ottosson, F., Valkoun, J., Kessler, D., St. Pierre, R., Anikster, Y., and Steffenson, B. J. 2009. Evaluation of *Hordeum* accessions for resistance to Fusarium head blight. Proceedings of the 2009 National Fusarium Head Blight Forum. December 7-9, Orlando, Florida.

Beaubien, K. A., Szinyei, T., Smith, K. P., and Steffenson, B. J. 2009. Mapping QTL for FHB resistance and DON accumulation in barley population COMP351 x M98-102. Evaluation of *Hordeum* accessions for resistance to Fusarium head blight. Proceedings of the 2009 National Fusarium Head Blight Forum. December 7-9, Orlando, Florida.