USDA-ARS/
U.S. Wheat and Barley Scab Initiative
FY08 Final Performance Report (approx. May 08 – April 09)
July 15, 2009

Cover Page

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Fiscal Year:	2008
USDA-ARS Agreement ID:	59-0790-6-073
USDA-ARS Agreement Title:	Evaluation of Hordeum Germplasm for Resistance to Fusarium Head Blight
FY08 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
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 a set of promising sources of resistance through multiple years and locations of field screening. We are characterizing this core set of sources with DArT markers and SSR markers to identify those that are genetically distinct from previously identified resistance sources. Our 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. At the same time, this research will lead to the development of advanced breeding lines with major 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 'Ramusson' as the recurrent parent. BC_2 seeds were increased in January 2009 and single seeds are being advanced again in summer 2009. Approximately 60 BC_2F_3 progeny will be genotyped with Diversity Arrays Technology (DArT) markers to identify a subset having complete genome coverage of the introgressed wild barley chromosomes in a '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 family. This scheme is patterned after the advanced backcross QTL method.

   Impact:

   The full impact of this project will be realized when the first FHB phenotyping evaluations are completed on the introgression lines. These evaluations will be done on the advanced backcross lines at two locations in Minnesota during the summer of 2010. 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 introgression lines for use in their crossing block; information on the introgressed wild barley segments contributing the highest level FHB resistance and lowest DON accumulation; and molecular markers useful for marker assisted selection of wild barley derived FHB resistance QTLs.

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?

FHB threatens the existence of the barley industry in the Upper Midwest. 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 foreign genebanks.

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 Upper Midwest and also off-season nurseries in China. The screening of the entire six-rowed spring and winter barley collection from the USDA National Small Grains Collection (NSGC) is complete. 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. 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; the Station federale de recherches en production vegetale de Changins (SFRSPP) in Nyon, Switzerland; the Nordic Gene Bank (NGB) in Alnarp, Sweden; the Institute for Cereal Crops Improvement (ICCI) in Tel Aviv, Israel; Plant Genetic Resources of Canada (PGRC) in Saskatoon, Canada; and International Center for Agriculture in the Dry Areas (ICARDA) in Aleppo, Syria.

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 last two years, we have procured over 16,000 additional 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-one of these accessions came from the NSGC, 43 from the VIR, 8 from the SFRSPP, 8 from the NGB, 3 from the ICCI, 109 from the PGRC, and 0 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.

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.

Beaubien, K. A., Dill-Macky, R., Dong, Y., Roy, J. K., Steffenson, B. J., and Smith, K. P. 2008. Investigating host variation for DON accumulation in wild barley. Pages 137-141 in: Canty, S. M., Walton, E., Clark, A., Ellis, D., Mundell, J., and Van Sanford, D. A. (Eds.), Proceedings of the National Fusarium Head Blight Forum; 2008 Dec. 2-4; Indianapolis, IN. Lexington, KY, University of Kentucky.

Beaubien, K. A., Dill-Macky, R., Dong, Y., Steffenson, B. J., and Smith, K. P. 2008. Characterizing barley near-isogenic lines for a DON QTL on chromosome 3H. Pages 134-136 in: Canty, S. M., Walton, E., Clark, A., Ellis, D., Mundell, J., and Van Sanford, D. A. (Eds.), Proceedings of the National Fusarium Head Blight Forum; 2008 Dec. 2-4; Indianapolis, IN. Lexington, KY, University of Kentucky.

Steffenson, B. J., and Dahl, S. K. 2008. Into the wild: FHB resistance identified in *Hordeum vulgare* subsp. *spontaneum*. Page 214 in: Canty, S. M., Walton, E., Clark, A., Ellis, D., Mundell, J., and Van Sanford, D. A. (Eds.), Proceedings of the National Fusarium Head Blight Forum; 2008 Dec. 2-4; Indianapolis, IN. Lexington, KY, University of Kentucky.

If your FY08 USDA-ARS Grant contained a VDHR-related project, 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. If this is not applicable (i.e. no VDHR-related project) to your FY08 grant, please insert 'Not Applicable' below.

No germplasm lines have been released yet from my program. In 2011, we anticipate releasing several germplasm lines from the advanced backcross populations involving PI466423.