USDA-ARS/
U.S. Wheat and Barley Scab Initiative
FY10 Final Performance Report
July 15, 2011

Cover Page

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Fiscal Year:	FY10
USDA-ARS Agreement ID:	59-0206-9-072
USDA-ARS Agreement Title:	Breeding and Genetics of Fusarium Head Blight Resistance in Barley.
FY10 USDA-ARS Award Amount:	$ 134,969

USWBSI Individual Project(s)

USWBSI Research Category*	Project Title	ARS Award Amount
BAR-CP	Genomic Selection for FHB Resistance in Midwest Six-row Barley.	$ 49,760
BAR-CP	Developing Six-rowed Malting Barley Varieties with FHB Resistance and Low DON.	$ 85,209
	Total ARS Award Amount	**$ 134,969**

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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 Soft Winter Wheat Region
SWW – Southern Soft Red Winter Wheat Region

Project 1: *Genomic Selection for FHB Resistance in Midwest Six-row Barley.*

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

   Selecting for FHB resistance in the field is laborious, expensive, and inherently imprecise. Despite these challenges, we have made slow progress enhancing FHB resistance in barley. We have also used traditional marker assisted selection (MAS) to manipulate two large effect QTLs. However, there are currently no other MAS targets that have been consistently mapped and also have large effects. Thus, further progress must be made by exploiting genetic variation controlled by multiple genes with small effects. To complement our phenotypic selection and MAS for targeted QTL, we have initiated a genomic selection (GS) approach in our breeding program using large marker and trait data sets to predict breeding values for FHB resistance in early generations, dramatically reducing the breeding cycle time and potentially accelerating gain from selection. In the past funding cycle, we developed a GS model using a marker and trait training data set, used that model to predict the phenotype of ~2,000 F3 barley lines, and selected individuals for advancement in the breeding program and to be used as parents in the next cycle of selection. To test the accuracy of GS, we have set up experiments to empirically measure FHB resistance, yield and other agronomic traits on a randomly selected set of lines. Accuracy will be determined by calculating the correlation between the GS predicted values and the observed values for these breeding lines. Thus, our goal is to both implement GS and evaluate its effectiveness for FHB resistance in barley.

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: We developed a GS model that predicts FHB, DON, yield and other traits in barley. Based on cross-validation, the model accuracy is 0.50 to 0.74. This level of accuracy, coupled with a breeding cycle time that is reduced from four years to one year, is expected to substantially increase the rate of genetic gain.

   Impact: The first breeding lines resulting from GS are in first year yield trials this year. We expect to have direct measurements of genetic gain during this current funding cycle to assess the impact.

Project 2: *Developing Six-rowed Malting Barley Varieties with FHB Resistance and Low DON.*

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

   None of the currently grown six-rowed malting barley varieties are more resistant than the variety Robust which has dominated the barley acreage in the Midwest since 1986. We are conducting a comprehensive field-based breeding effort along with implementation of marker assisted selection (MAS) to develop new barley varieties with enhanced FHB resistance. In order for these new varieties to be adopted by growers they must also be agronomically competitive with current varieties and meet the quality standards of the malting and brewing industries. We conduct extensive field evaluation of FHB resistance in inoculated and mist-irrigated nurseries in three locations in Minnesota. Last year we evaluated over 13,000 plots for FHB resistance and submitted over 3,000 grain samples for DON analysis. We are currently only entering lines with enhanced FHB resistance and lower DON levels to the industry malting and brewing tests.

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: We released the variety Quest in January 2010 and it was available for commercial production in 2011. Quest accumulates about half the level of DON compared to the dominant varieties Tradition and Lacey and this information has been posted on the ScabSmart website.

   Impact: We will assess the impact of Quest by evaluating barley variety survey data in the region and determining the acreage planted to Quest. That information is not yet available for the 2011 growing season.

Include below a list of 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.

The variety Quest which was released in January 2010, was added to the American Malting Barley Association (AMBA) list of recommended varieties in Dec 2010.

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.

Presentations

Smith, K. P. 2010. "Quest" for Scab Resistance in Barley. Crookston Field Day. July 14, 2010.

Smith, K. P. 2010. Barley Breeding: Past Present and Future genetics. WCROC Centennial Sumner Center Day 1910 - 2010. July 16, 2010.

Smith, K. P. 2011. Keeping barley competitive through research: Genomics and breeding. Research Panel. Barley Improvement Conference. Old Town San Diego, CA, Jan 12-13, 2011.

Smith, K. P. 2010. Understanding and exploiting resistance to Fusarium head blight in barley. Invited talk at the Dept. of Plant Pathology, University of Minnesota. Oct. 11, 2010.

Non-Peer Reviewed Articles

AMBA Approves UM Scab-Resistant Malting Barley Variety 'Quest'. Fusarium Focus, Vol. 11 (1) Winter 2011, p. 6.

Smith, K. P., J. Wiersma, R. Dill-Macky, J. Wiersma, B. Steffenson, and E. Schiefelbein 2010 Barley Variety Performance in Minnesota. Prairie Grains Issue 102.

Minnesota Varietal Trials Results. Barley. P. 16. Minnesota Agricultural Experiment Station.