USDA-ARS/
U.S. Wheat and Barley Scab Initiative
FY13 Final Performance Report
July 15, 2014

Cover Page

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Fiscal Year:	FY13
USDA-ARS Agreement ID:	59-0206-1-119
USDA-ARS Agreement Title:	Mapping Loci Conferring Resistance to FHB and DON Accumulation in Barley.
FY13 USDA-ARS Award Amount:	$ 38,160

USWBSI Individual Project(s)

USWBSI Research Category*	Project Title	ARS Award Amount
BAR-CP	Mapping Loci Conferring Resistance to FHB and DON Accumulation in Barley.	$ 38,160
	FY13 Total ARS Award Amount	**$ 38,160**

July 15, 2014
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: *Mapping Loci Conferring Resistance to FHB and DON Accumulation in 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 economic losses caused by FHB in barley, including quality discounts due to deoxynivalenol (DON) contamination. This can be best achieved by developing barley cultivars with the highest level of resistance possible. We identified about 20 promising accessions with partial FHB resistance through multiple years of field screening. Four of these accessions (Kutahya, a two-rowed cultivar from the Netherlands; W-365, a wild barley accession from Iraq; VIR26022, a two-rowed accession from Denmark; and PI350725, a two-rowed landrace from Tirol, Austria) were backcrossed to the partially resistant six-rowed cultivar 'Quest' to develop BC_2F_5 populations for mapping and characterizing quantitative trait loci (QTL) conferring FHB resistance and low DON accumulation. The specific objective for this proposal is to determine the number, effect, and chromosomal position of FHB resistance loci in these select barley accessions using the advanced backcross-QTL method. The information and germplasm generated from this study will lead to the development of malting barley cultivars with FHB resistance and low DON accumulation, thereby minimizing this disease threat for producers, processors, and consumers.

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:

We have developed or are in the process of developing three to four advanced backcross populations in the genetic background of the moderately resistant cultivar Quest. The Kutahya/Quest (361 lines) and W-365/Quest (378) populations were advanced to the $BC_2F_{5:6}$ generation in 2013 and phenotyped for FHB severity and DON concentration at three or four locations: Nanjing, China; Crookston MN; St. Paul, MN; and Brandon, Canada (Kutahya/Quest population only). Both populations are being phenotyped again for FHB severity at two sites (Crookston and St. Paul) in Minnesota in 2014. Seed of all progeny will be harvested and assayed for DON concentration by December. Both populations have been genotyped with the 9K SNP chip (Illumina Infinium assay). Map construction and quantitative trail loci (QTL) analyses will be completed in early 2015. Two additional populations are being developed from the partially resistant accessions VIR26022 and PI 350725. These populations are currently at the BC_1 generation and will be available for phenotyping during the 2016 field season.

Impact:

We have developed and advanced two backcross populations (Kutahya/Quest and W-365/Quest) in the genetic background of Quest--the first cultivar released from the Midwest that possesses moderate resistance to FHB. Preliminary evaluations from the 2013 nurseries identified several agronomically advanced two- and six-rowed progeny with a level of resistance greater than either of the parents. These resistant progeny lines will be given to breeders for use as parents in their FHB-resistance breeding programs. The pyramiding of new FHB resistance loci in malting barley cultivars will minimize this disease threat for producers, processors, and consumers. Comprehensive molecular maps will soon be constructed for the Kutahya/Quest and W-365/Quest populations and will allow us to determine the number, effect, and chromosomal position of loci conferring resistance to FHB and the accumulation of mycotoxins. Molecular markers linked with the resistance loci can be used for marker assisted and genomic selection in breeding programs.

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.

Huang, Y., Millet, B. P., Beaubien, K. A., Dahl, S. K., Steffenson, B. J., Smith, K. P., and Muehlbauer, G. J. 2013. Haplotype diversity and population structure in cultivated and wild barley evaluated for Fusarium head blight responses. Theor. Appl. Genet. 126:619-636. DOI 10.1007/s00122-012-2006-4.

Smith, K. P. Budde, A., Dill-Macky, R., Rasmusson, D. C., Schiefelbein, E., Steffenson, B., Wiersma, J. J., Wiersma J. V., and Zhang, B. 2013. Registration of 'Quest' spring malting barley with improved resistance to Fusarium head blight. J. Plant Reg. 7:125–129. doi:10.3198/jpr2012.03.0200crc.

Smith, K. P., Vikram, V., Sallam, A., Lorenz, A., Jannink, J.-L., Endleman, J., Horsley, R., Chao, S., and Steffenson, B. 2013. "Using genomic selection in barley to improve disease resistance." In: Proceedings of the Borlaug Global Rust Initiative 2013 Technical Workshop, New Delhi, India. August 19-22, 2013. P. 22.