USDA-ARS
U.S. Wheat and Barley Scab Initiative
FY17 Final Performance Report
Due date: July 31, 2018

Cover Page

Principle Investigator (PI):	Brian Steffenson
Institution:	University of Minnesota
E-mail:	bsteffen@umn.edu
Phone:	612-325-4735
Fiscal Year:	2017
USDA-ARS Agreement ID:	59-0206-6-006
USDA-ARS Agreement Title:	Mapping Loci Conferring Resistance to FHB and DON Accumulation in Barley.
FY17 USDA-ARS Award Amount:	$ 53,610
Recipient Organization:	Regents of the University of Minnesota Suite 450 Sponsored FIN RPT-P100100001 Minneapolis, MN 55455-2003
DUNS Number:	555917996
EIN:	41 -6007513
Recipient Identifying Number or Account Number:	CON000000060625
Project/Grant Reporting Period:	5/2/17 - 5/1/18
Reporting Period End Date:	05/01/18

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.	$ 53,610
	FY17 Total ARS Award Amount	$ 53,610

July 31, 2018
Principal Investigator Date

* MGMT – FHB Management
FST – Food Safety & Toxicology
GDER – Gene Discovery & Engineering Resistance
PBG – Pathogen Biology & Genetics
EC-HQ – Executive Committee-Headquarters
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 RegionSWW – Southern Soft Red Winter Wheat Region

FY17 Final Performance Report
PI: Steffenson, Brian
USDA-ARS Agreement #: 59-0206-6-006
Reporting Period: 5/2/17 - 5/1/18

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

1. What are the major goals and objectives of the project?

Our major goal is to reduce the economic losses caused by Fusarium head blight (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, in conjunction with various cultural and chemical control methods. Through extensive germplasm evaluations funded by the USWBSI over the past 16 years, we have identified 78 accessions that possess a level of resistance comparable to the six-rowed and two-rowed controls of Chevron and CIho 4196, respectively. One of the most resistant accessions identified in this group is PI 350725, a two-rowed accession from the Tirol in Austria. Six-rowed barleys have been the preferred type for malting in the Midwest region for more than 80 years. A resistant two-rowed barley was selected for this investigation because this is now the industry-preferred row type for Midwestern malting barley cultivars. Our specific objectives for this proposal are to: 1) determine the number, effect, and chromosomal position of FHB resistance loci in barley accession PI 350725 using the advanced backcross QTL method and 2) provide adapted FHB-resistant parental materials to barley improvement programs. This research addresses Barley-CP VDHR objective #2 (Mapping novel QTL for resistance to FHB in barley), but is also an important step in advancing objective #4 (Develop new barley varieties with enhanced resistance to FHB and lower DON). The outputs from this work will be advanced breeding lines with novel genes for FHB resistance. Use of this germplasm in breeding will help fulfill the USWBSI primary goal to develop as quickly as possible effective control measures that minimize the threat of FHB, including the reduction of mycotoxins, to the producers, processors, and consumers of barley.

2. What was accomplished under these goals? *Address items 1-4) below for each goal or objective.*

1) major activities

PI 350725 was crossed with cultivar 'Quest' (the first released Midwestern six-rowed cultivar with partial FHB resistance) in the fall greenhouse season. About 50 F_1 progeny were backcrossed with 'Quest' in the winter greenhouse season to obtain the BC_1 generation. At least 5 crossed seeds were obtained per backcross. About 90 BC_1 plants were backcrossed to 'Quest' to obtain the BC_2 generation in the second winter greenhouse season. Through timely supplemental support from the USWBSI, the BC_2 generation was made into doubled haploids (DHs) by Patrick Hayes' group at Oregon State University. This critical DH step shortened the time needed to obtain homozygous lines, allowing for earlier phenotyping in the field. From each BC_2 plant, 5 seeds were used for DH production. Due to the recalcitrant nature of this cross, only 170 doubled haploid progeny were obtained from Oregon State University. These DH progenies were increased in the fall/winter greenhouse season of 2015-2016 and were phenotyped at our late-planted FHB nursery in Crookston in 2016. Due to the lower than expected number of DH progeny, we also advanced remnant BC_2 seed by single seed descent, which will serve to expand the population for QTL mapping and validate the results found in the DH

population. The number of BC_2 Recombinant Inbred Lines (RILs) generated was 328. The DH and RIL populations were phenotyped at St. Paul and Crookston in 2017, but unfortunately the latter location had very low disease pressure. The same populations are now being evaluated at the same two locations in 2018 to provide sufficiently robust phenotype data for mapping quantitative trait loci (QTL) for resistance. The 50K iSelect single nucleotide polymorphism (SNP) array will be used for genotyping the populations. Thereafter, QTL analyses will be completed.

2) specific objectives

The specific objectives for this proposal are to: 1) determine the number, effect, and chromosomal position of FHB resistance loci in barley accession using the advanced backcross QTL method and and 2) provide adapted FHB-resistant parental materials to barley improvement programs.

3) significant results

DH and RIL progeny from the PI 350725/Quest cross differed markedly for their FHB severity in St. Paul (2017 and 2018) and in Crookston (2016 for the DH population only). This should allow for the successful mapping of resistance QTLs in both populations. However, agro-morphological traits such as heading date, height, and spike density can have a pronounced affect on FHB severity. Thus, these traits will also be scored to determine if they co-locate with QTLs for FHB reaction.

4) key outcomes or other achievements

None at this time. We hope to identify novel resistance alleles in the PI350725/Quest population once the data are analyzed. Additionally, we expect to identify progeny with relatively high levels of resistance that can be distributed to breeders for their resistance programs.

3. What opportunities for training and professional development has the project provided?

Our USWBSI-funded research has provided an excellent training opportunity for many scientists. The immediate past research comprised a portion of the Ph.D. dissertation of Dr. Matthew Haas, and the current research project is part of the M.S. thesis of my new graduate student Rae Page. Other participants in this research included post-doctoral research associates Ahmad Sallam, Oadi Matny, and Ali Mehrabi and Researcher II scientists Tamas Szinyei, Matthew Martin, and Ryan Johnson. There were also many undergraduate students who assisted on this project in various capacities. All of these individuals were trained in the methodology for working with FHB, including production and storage of inoculum; inoculation techniques; disease severity scoring; and DON analyses. Moreover, several

members of my senior research team gained valuable experience in SNP genotyping, molecular map construction and QTL analysis.

4. How have the results been disseminated to communities of interest?

The current research project is part of Rae Page's M.S. thesis. Her aim is to present her research at an upcoming USWBSI forum and then publish it in a refereed journal.

Training of Next Generation Scientists

Instructions: Please answer the following questions as it pertains to the FY17 award period. The term "support" below includes any level of benefit to the student, ranging from full stipend plus tuition to the situation where the student's stipend was paid from other funds, but who learned how to rate scab in a misted nursery paid for by the USWBSI, and anything in between.

1. **Did any graduate students in your research program supported by funding from your USWBSI grant earn their MS degree during the FY17 award period?** Yes

   If yes, how many? Two: Fazal Manan and Matthew Martin

2. **Did any graduate students in your research program supported by funding from your USWBSI grant earn their Ph.D. degree during the FY17 award period?** No

   If yes, how many?

3. **Have any post docs who worked for you during the FY17 award period and were supported by funding from your USWBSI grant taken faculty positions with universities?** No

   If yes, how many?

4. **Have any post docs who worked for you during the FY17 award period and were supported by funding from your USWBSI grant gone on to take positions with private ag-related companies or federal agencies?** No

   If yes, how many?

Release of Germplasm/Cultivars

Instructions: In the table below, list all germplasm and/or cultivars released with full or partial support through the USWBSI during the FY17 award period. All columns must be completed for each listed germplasm/cultivar. Use the key below the table for Grain Class abbreviations. *Leave blank if you have nothing to report or if your grant did NOT include any VDHR-related projects.*

Name of Germplasm/Cultivar	**Grain Class**	**FHB Resistance** (S, MS, MR, R, where R represents your most resistant check)	**FHB Rating** (0-9)	**Year Released**

Add rows if needed.

NOTE: List the associated release notice or publication under the appropriate sub-section in the 'Publications' section of the FPR.

Abbreviations for Grain Classes

Barley - BAR
Durum - DUR
Hard Red Winter - HRW
Hard White Winter - HWW
Hard Red Spring - HRS
Soft Red Winter - SRW
Soft White Winter - SWW

Publications, Conference Papers, and Presentations

Instructions: Refer to the FY17-FPR_Instructions for detailed instructions for listing publications/presentations about your work that resulted from all of the projects included in the FY17 grant. Only include citations for publications submitted or presentations given during your award period (5/2/17 - 5/1/18). If you did not have any publications or presentations, state 'Nothing to Report' directly above the Journal publications section.

NOTE: Directly below each reference/citation, you must indicate the Status (i.e. published, submitted, etc.) and whether acknowledgement of Federal support was indicated in publication/ presentation.

Journal publications.

Books or other non-periodical, one-time publications.

Other publications, conference papers and presentations.

Huang, Y., Heinen, S., Steffenson, B., Smith, K. P., and Muehlbauer, G. J. 2017. Mapping FHB quantitative trait loci in barley. In: Page 46 of Proceedings of the 2017 National Fusarium Head Blight Forum, Milwaukee, WI. December 3-5, 2017.
Status: Abstract Published and Poster Presented
Acknowledgement of Federal Support: YES (poster), NO (abstract)