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

Cover Page

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Fiscal Year:	2017
USDA-ARS Agreement ID:	59-0206-7-001
USDA-ARS Agreement Title:	FHB Management in Barley: QTL Deployment and Phenotyping.
FY17 USDA-ARS Award Amount:	$ 32,608
Recipient Organization:	North Dakota State University Office of Grant & Contract Accouting NDSU Dept 3130, PO Box 6050 Fargo, ND 58108-0650
DUNS Number:	80-388-2299
EIN:	45-6002439
Recipient Identifying Number or Account Number:	FAR0028113
Project/Grant Reporting Period:	7/12/17 - 7/11/18
Reporting Period End Date:	07/11/18

USWBSI Individual Project(s)

USWBSI Research Category*	Project Title	ARS Award Amount
BAR-CP	QTL Analysis of FHB and DON Accumulation Resistance in the Turkish Line CGN00483.	$ 17,923
BAR-CP	Coordination of the NABSEN and Screening Western US Barley Germplasm.	$ 14,685
	FY17 Total ARS Award Amount	$ 32,608

07-30-2018

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 Region
SWW – Southern Soft Red Winter Wheat Region

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Project 1: *QTL Analysis of FHB and DON Accumulation Resistance in the Turkish Line CGN00483.*

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

1. Identify new important QTL for DON accumulation resistance in barley.
2. Introgress these new resistances into elite malting background with the cv Conlon resistance QTL.

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

1) major activities

The CGN00483 X Harrington RIL population was genotyped and phenotyped for disease severity and DON accumulation in the 2017 both the Langdon and Fargo, ND irrigated and inoculated nurseries. The data from all sight years were used to perform QTL analyses and the associated markers flanking the consistent QTL on Ch. 5H are being used for MAS to introduce this CGN00483 DON accumulation QTL into the cultivar Conlon and ND-Genesis. We also continued advancing the CGN00483 x Conlon RIL population in order to identify DON accumulation QTL from both CGN00483 and Conlon to introduce into the cultivars Pinnacle and ND-Genesis via future marker assisted selection strategies.

2) specific objectives

1. Identify QTL and associated markers from the Turkish line CGN00483.

The CGN00483 X Harrington RIL population was advanced to the F_7 generation consisting of 170 individuals. In 2017 and 2018 the RIL population was tested for disease severity, DON accumulation, heading date and height in two irrigated and inoculated FHB nurseries located at Fargo and Langdon, ND. The disease severity, DON accumulation, heading date and height data generated in 2017 were used to perform QTL analyses and we identified only a single QTL associated with DON accumulation resistance that was consistently identified on chromosome 5H and contributed by CGN00483 (Fig 1). Markers specific to CGN00483 genotype at this locus are now being used in the MAS selection as well as markers for CGN00483 QTL that were identified on ch 2H and 3H. However, the later QTL have not been consistent. A QTL contributed by cv Harrington on chromosome 7H was also consistently detected, however was associated with a major height QTL suggesting that I was due to the plant morphology.

2. Integrate the CGN00483 QTL into the DON accumulation resistant 2-rowed varieties ND-Genesis and Conlon utilizing recurrent BC and marker assisted selection via PCR-GBS.

Polymerase chain reaction genotype by sequencing (PCR-GBS) SNP markers were designed to the QTL on 2H, 3H and 5H, and we have genotyped and advanced individuals containing all three loci and are backcrossing them with ND Genesis (BC_4) and Pinnacle (BC_2). Previously we had BC_3F_1 individual homozygous for the

chromosome 4H locus, which we were selecting for, but the new phenotyping data has shown this to be a very inconsistent QTL. These individuals were homozygous for ND Genesis at the chromosome 5H QTL, thus, we had to back track to the BC1 to identify individuals carrying the 2H, 3H and 5H QTL.

3) significant results

One QTL coming from CGN00483 has been identified that has consistent results, detected in 4 of 6 site years tested to date (Fig 1) and markers have been identified and are currently being used to screen for the QTL in MAS via PCR-GBS.

4) key outcomes or other achievements
Elite malting barley lines with CGN00483 DON accumulation QTL are being advanced and prebreeding lines will be available soon that contain the novel DON accumulation QTL on chromosome 5H.

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

The project has provided training in the lab and field for undergraduate and graduate students.

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

The data generated has not been reported as we were still in the process of generating QTL and selection data. After the DON data is recovered and QTL analysis performed for the 2018 nurseries we will have eight site years of data and will prepare and submit the manuscript to a peer reviewed journal.

Project 2: *Coordination of the NABSEN and Screening Western US Barley Germplasm.*

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

1. Coordinate the 2017 NABSEN by collecting and redistributing seed, establishing and collecting data for two nursery sites in ND and collating all data for the final report.
2. Establish, maintain and evaluate two irrigated and inoculated ND nurseries.
3. Solicit Western participants and establish and evaluate western US barley germplasm in two ND FHB nurseries during the 2017 growing season.

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

1) major activities

The germplasm of advanced barley lines with FHB resistance developed by the cooperating/collaborating barley breeders/pathologists were collected and redistributed for testing in the NABSEN. We established two mist-irrigated nurseries in Fargo and Langdon, ND. All NABSEN data generated was collected, collated and the final report generated and submitted to the USWBSI NFO on Jan 23, 2018 has been uploaded to the USWBSI website. The data has since been uploaded to "The Triticeae Toolbox" (T3; https://triticeaetoolbox.org/barley/.

2) specific objectives

Objective 1. Coordinate the exchange and distribution of advanced FHB resistant barley germplasm between NABSEN collaborators to expedite the development of resistant barley varieties.

The seed was requested from all collaborating scientist in the spring of 2017 and 2018, received and redistributed to the collaborators for establishment of the NABSEN at other locations. The FHB nurseries established by the other cooperators included Osnabrock, and Casselton, ND, St. Paul and Crookston, MN, and Brandon, Manitoba. In 2017 and 2018 the NABSEN included breeding lines with putative FHB resistance from the NDSU 2-rowed and 6-rowed breeding programs and lines from the Univ. of Minnesota, Busch Ag, and Agriculture and Agri-Food Canada. FHB parameters, DON, and agronomic factors were recorded, collated then submitted as the final 2017 NABSEN report and 2018 data was collected.

Objective 2. Establish and evaluate NABSEN nurseries at two North Dakota locations.

The inoculated and mist irrigated nurseries were established in Langdon, and Osnabrock, ND in 2017 and 2018. Over a thousand pounds of *Fusariun graminearum* corn spawn inoculum was produced in the lab during the spring of 2017. Four hundred pounds was provided to Dr. Rich Horsley's NDSU breeding program, from which the Osnabrock NABSEN location was inoculated. Two applications of inoculum were applied to the nurseries and approximately 300 pounds of corn inoculum was used to inoculate the

NABSEN and western breeding materials. The Langdon and Fargo nurseries were maintained (fertilized, weed control, and tied up to prevent lodging), harvested, threshed, bagged and delivered to Dr. Schwarz's lab (NDSU) for DON analysis.

Objective 3. Coordinate the screening of western US barley germplasm.

Advanced lines and cultivars from three western US barley breeding programs, Montana State University, USDA-ARS Aberdeen Idaho and Oregon State University were also evaluated in the NABSEN nurseries established in Fargo and Langdon ND. To accomplish this objective will solicited materials from five western breeding programs including University of Montana, University of Idaho, USDA Aberdeen, ID, Oregon State University, Washington State University, and Miller Coors. We received material for screening from three western US barley breeding programs; University of Montana, USDA Aberdeen, ID, and Oregon State University. The seed from each program was included in two mist irrigated and inoculated FHB nurseries in Langdon and Fargo, ND. The data was provided to the breeding programs once we received the DON analyses data from Dr. Schwarz's lab.

3) significant results
There was no disease severity taken at Casselton and Osnabrock dryland nurseries. FHB disease severity levels were moderate at St. Paul, Brandon MD and high at Fargo, Langdon and Crookston locations in 2017. DON levels were high at Fargo, Langdon and moderate at Brandon, MD and moderately low at Osnabruck and Casselton the two-dryland locations. HB632, TR15152, TR17640 and 2ND28065 had the lowest DON compared to checks.

4) key outcomes or other achievements
Progress is being made toward developing FHB tolerant and DON accumulation resistant barley cultivars through the USWBSI funding and these lines have been tested within the NABSEN. The cooperating breeders are able to use the relative performance data to make decisions about particular breeding lines. All North American barley breeders have access to the data collected in this project and breeders have: 1) tests of the resistance stability of their breeding lines across a range of environments and disease pressures; 2) a measure of the resistance in their advanced lines compared to those of the other barley breeders in North America; 3) access to unique germplasm with resistance to FHB and DON accumulation. The data is now being uploaded to "The Triticeae Toolbox" (T3) for better access and use.

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

The project has provided training in the lab and field for undergraduate and graduate students.

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

The data and results of the screening have been reported in the annual NABSEN report which is available on the USWBSI website and available to all interested. The data was also uploaded to "The Triticeae Toolbox" (T3).

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?** No

   If yes, how many?

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?** Yes

   If yes, how many? One

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? N/A

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?**

   If yes, how many? No

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 (7/12/17 - 7/11/18). 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.

Nothing to Report

Journal publications.

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

Other publications, conference papers and presentations.