

**USDA-ARS/  
U.S. Wheat and Barley Scab Initiative  
FY16 Final Performance Report  
Due date: July 28, 2017**

**Cover Page**

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| <b>Fiscal Year:</b>                                    | 2016  |
| <b>USDA-ARS Agreement ID:</b>                          | 59-0200-3-002   |
| <b>USDA-ARS Agreement Title:</b>                       | Management and Resistance Sources for Control of FHB in Barley.   |
| <b>FY16 USDA-ARS Award Amount:</b>                     | \$ 32,608   |
| <b>Recipient Organization:</b>                         | North Dakota State University<br>Office of Grant & Contract Accounting<br>NDSU Dept 3130, PO Box 6050<br>Fargo, ND 58108-0650 |
| <b>DUNS Number:</b>                                    | 80-388-2299   |
| <b>EIN:</b>  | 45-6002439  |
| <b>Recipient Identifying Number or Account Number:</b> | FAR0020590  |
| <b>Project/Grant Reporting Period:</b>                 | 5/8/16 - 5/7/17   |
| <b>Reporting Period End Date:</b>                      | 05/07/17  |

**USWBSI Individual Project(s)**

| <b>USWBSI Research Category*</b> | <b>Project Title</b>  | <b>ARS Award Amount</b> |
|----------------------------------|---|-------------------------|
| BAR-CP                           | Coordination of the NABSEN and Screening Western US Barley Germplasm.             | \$ 14,686               |
| BAR-CP                           | QTL Analysis of FHB and DON Accumulation Resistance in the Turkish Line CGN00483. | \$ 17,922               |
|                                  | <b>FY16 Total ARS Award Amount</b>  | <b>\$ 32,608</b>        |


07-28-2017  
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 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:** *Coordination of the NABSEN and Screening Western US Barley Germplasm.*

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

**Research Goals proposed for 2016**

1. Coordinate the 2016 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 2016 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 solar powered 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 Dec 2, 2016 to be uploaded to the USWBSI website. The data has since been uploaded to “The Triticeae Toolbox” (T3; <https://triticeaetoolbox.org/barley/>).

*2) specific objectives*

*Accomplishments outlined by the specific objectives are as follows;*

**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 2016, 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 2016 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 NABSEN report.

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

The inoculated and solar powered mist irrigated nurseries were established in Langdon, and Osnabrock, ND. Over a thousand pounds of *Fusarium graminearum* corn spawn inoculum

was produced in the lab during the spring of 2016. 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 was 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 MillerCoors 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 Miller Coors. The seed from each program was included in two mist irrigated and inoculated FHB nurseries in Langdon and Fargo, ND. In 2016 we screened ??, ?? and ?? lines from the University of Montana, USDA Aberdeen, ID and Miller Coors programs respectively. The data was provided to the breeding programs once we received the DON analyses data from Dr. Schwarz's lab.

**3) significant results**

Disease severities were not taken at Casselton, Osnabrock or Crookston dryland nurseries. FHB disease severity levels were low at St. Paul moderate at Brandon and high at the Fargo and Langdon locations in 2016. DON levels were high at Fargo, Langdon, Crookston and Brandon, while DON levels were moderately high at Osnabrock and low at Casselton and St. Paul. The Canadian line HB552 had consistently and significantly lower DON levels in the misted and non-misted trials compared to the other lines and 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.

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**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 is also being uploaded to “The Triticeae Toolbox” (T3).

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**Project 2:** *QTL Analysis of FHB and DON Accumulation Resistance in the Turkish Line CGN00483.*

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

**Research Goals proposed for 2016**

- a) Identify new important QTL for DON accumulation resistance in barley.
- b) 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. The data was 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 began developing a 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 genomic selection strategies.

2) *specific objectives*

**Research Objectives:**

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

The CGN00483 X Harrington RIL population was advanced to the F<sub>7</sub> generation consisting 170 individuals. In 2016 the RIL population was tested for disease severity and DON accumulation in two irrigated and inoculated FHB nurseries located at Fargo and Langdon, ND. The disease severity and DON accumulation data was acquired and used to perform QTL analyses and we identified only a single QTL associated with DON accumulation resistance that was consistently identified on chromosome 5H (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.

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.

Now we have designed PCR-GBS markers to genotype QTL loci on 2H, 3H and 5H and have genotyped and identified BC<sub>3</sub> individuals containing all three loci and are



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## **Training of Next Generation Scientists**

**Instructions:** Please answer the following questions as it pertains to the FY16 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 FY16 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 FY16 award period?**  
Yes  
**If yes, how many?**  
One
  
3. **Have any post docs who worked for you during the FY16 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 FY16 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?**

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### 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 FY16 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<br>(S, MS, MR, R, where<br>R represents your most<br>resistant check) | FHB<br>Rating<br>(0-9) | Year<br>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



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## **Publications, Conference Papers, and Presentations**

**Instructions:** Refer to the FY16-FPR\_Instructions for detailed instructions for listing publications/presentations about your work that resulted from all of the projects included in the FY16 grant. Only include citations for publications submitted or presentations given during your award period (5/8/16 - 5/7/17). If you did not have any publications or presentations, state 'Nothing to Report' directly above the Journal publications section.

'Nothing to Report'

**Journal publications.**

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

**Other publications, conference papers and presentations.**