USDA-ARS | U.S. Wheat and Barley Scab Initiative

FY21 Performance Progress Report

Due date: July 26, 2022

Cover Page

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Fiscal Year:	2021
USDA-ARS Agreement ID:	59-0206-0-163
USDA-ARS Agreement Title:	FHB Management in Barley: QTL Deployment and Phenotyping
FY20 USDA-ARS Award Amount:	$23,715
Recipient Organization:	North Dakota State University Department of Plant Pathology PO Box 6050, Dept. 7660 Fargo, ND 58108-6050
DUNS Number:	80-388-2299
EIN:	45-6002439
Recipient Identifying Number or Account Number, if any:	FAR0031979
Project/Grant Period:	6/12/21 - 6/11/23
Reporting Period End Date:	6/11/2022

USWBSI Individual Project(s)

USWBSI Research Category*	Project Title	ARS Award Amount
BAR-CP	Coordination of NABSEN and Collaborative Screening of Western US Barley Germplasm.	$13,175
BAR-CP	Development of 2-rowed FHB Resistance Germplasm and Cultivars	$2,640
BAR-CP	Identification, Characterization, & Development of Widely-adapted FHB-resistant Germplasm	$2,444
BAR-CP	Genomics Selection for FHB Resistance and Malting Quality in Spring Malting Barley	$5,456
	FY21 Total ARS Award Amount	$23,715

I am submitting this report as an: ☒ Annual Report ☐ Final Report

I certify to the best of my knowledge and belief that this report is correct and complete for performance of activities for the purposes set forth in the award documents.

Principal Investigator Signature — Date Report Submitted: 7/26/2022

‡ BAR-CP – Barley Coordinated Project
DUR-CP – Durum Coordinated Project
EC-HQ – Executive Committee-Headquarters
FST-R – Food Safety & Toxicology (Research)
FST-S – Food Safety & Toxicology (Service)
GDER – Gene Discovery & Engineering Resistance
HWW-CP – Hard Winter Wheat Coordinated Project
MGMT – FHB Management
MGMT-IM – FHB Management – Integrated Management Coordinated Project
PBG – Pathogen Biology & Genetics
TSCI – Transformational Science
VDHR – Variety Development & Uniform Nurseries
NWW –Northern Soft Winter Wheat Region
SPR – Spring Wheat Region
SWW – Southern Soft Red Winter Wheat Region

Project 1: Coordination of NABSEN and Collaborative Screening of Western US Barley Germplasm.

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1. **What are the major goals and objectives of the research project?**
   This program addresses Action Plan I for variety development and host resistance (VDHR) by coordinating the NABSEN. The NABSEN nursery provides long term evaluation of *Hordeum* germplasm resistance to FHB. The nursery facilitates the identification of new sources of resistance, aids in mapping and validation of novel QTL for resistance, and helps breeders evaluate their breeding progress for enhanced resistance to FHB and lower mycotoxins. Coordination of the NABSEN effort provides breeders with robust FHB phenotyping, resistant germplasm, and the extensive genotyping data available on T3. Breeders are better able to move FHB resistant QTL into elite lines with the data NABSEN provided.

2. **What was accomplished under these goals or objectives?** *(For each major goal/objective, address these three items below.)*

   a) **What were the major activities?**
   This program coordinated, received and distributed advanced breeding lines seed form the University of Minnesota, Busch Ag, USDA-ARS, Canadian breeding Group and NDSU breeding programs in our FHB nurseries in Fargo, and Langdon, ND. These advanced lines were grown across five locations, Fargo, Casselton and Langdon, ND and Crookston and St. Paul, MN. Plant nurseries were grown to compare FHB severity and incidence, heading date and DON accumulation on misted and dryland plots.

   The overall project goal is to promote collaboration between North American barley breeding programs to advance and distribute elite barley germplasm with resistance to Fusarium head blight.

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

   b) **What were the significant results?**
   We grew, evaluated, and harvested a total of 45 advanced breeding lines planted in short rows and with 3 replications in 2021 in Fargo and Langdon misted nurseries. The misted nurseries were inoculated with infected FHB corn spawn to ensure good infection. Heading date, FHB incidence and severity notes were collected along with DON accumulation. Note that 2021 saw record drought across the country and this drought severely affected FHB in the Fargo nursery. However, the Langdon ND nursery had comparable or even higher disease ratings and DON levels as prior years.

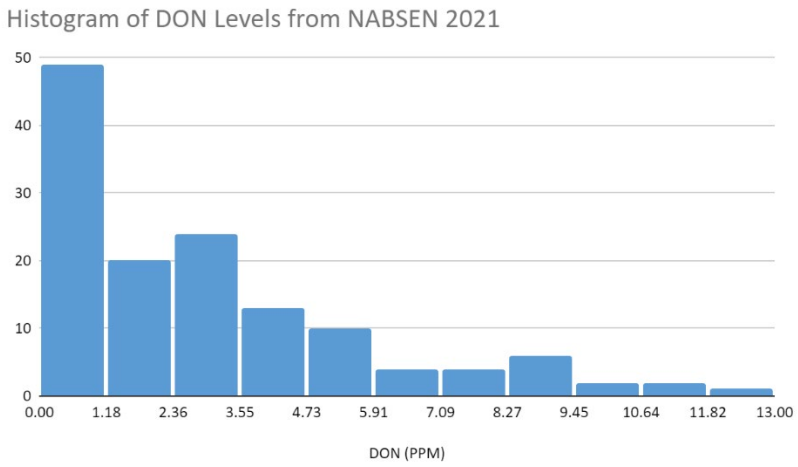

Figure 1: histogram of DON measurements from Fargo Misting Nursery in 2021

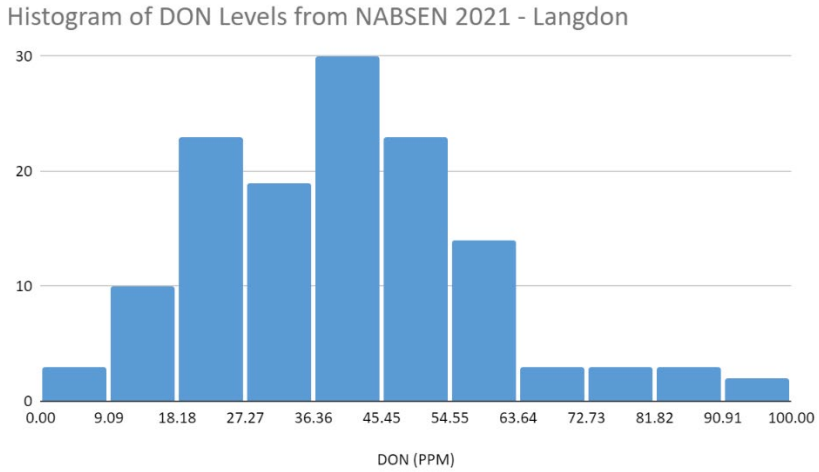

Figure 2: histogram of DON measurements from Langdon Misting Nursery in 2021

In 2022, 48 lines are currently being assessed in both Fargo and Langdon locations, along with the other locations in the NABSEN the coordinated project. Germplasm from USDA-ARS Aberdeen, including the foliar disease biparental mapping populations TC182&6, Dr. Gongshe Hu's breeding population and Montana State Universities breeding populations are being evaluated in both Fargo and Langdon. So far, high levels of FHB are being observed in both locations for 2022.

c) List key outcomes or other achievements.

On average, eleven of the 45 lines had lower DON levels than the new check AAC Synergy. These lines were from multiple programs (See NABSEN 2021 report for more details).

3. **What opportunities for training and professional development has the project provided?**
   The long running NABSEN program manager, Mr. Patrick Gross's final year was in 2021 and has retired. Recently, Mr. Abraham Hangamaisho has been hired as Mr. Gross's replacement. This year, the PI Dr. Thomas Baldwin and Mr. Gross has been training Mr. Hangamaisho to run the NABSEN and associated nurseries. Mr. Hangamaisho will be presenting results from the NABSEN nursery at this year's Scabforum 2022.

4. **How have the results been disseminated to communities of interest?**
   The results of NABSEN 2021 were published in the USWBSI website and data was uploaded to T3

Project 2: Development of 2-rowed FHB Resistance Germplasm and Cultivars

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1. **What are the major goals and objectives of the research project?**
   This project aims to conduct multiple-year/location evaluation of barley breeding lines from Idaho and introduced lines for FHB resistance. We hope to obtain enough data to conclude which lines are FHB resistant or produce low DON from Dr. Gongshe Hu's breeding program.

2. **What was accomplished under these goals or objectives?** *(For each major goal/objective, address these three items below.)*

   a) **What were the major activities?**
   100 Lines from Dr. Gongshe Hu's program were planted in 3 replicates in Fargo and Langdon misted nurseries. FHB scores were taken and lines were processed for DON analysis.

   b) **What were the significant results?**
   FHB scores and DON levels were reported to Dr. Hu.

   c) **List key outcomes or other achievements.**
   Significantly lower disease was noted in Fargo nurseries for 2021. However, the Langdon, ND nursery had significant disease

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

4. **How have the results been disseminated to communities of interest?**
   FHB scores and DON levels were reported to Dr. Hu.

Project 3: Identification, Characterization, & Development of Widely-adapted FHB-resistant Germplasm

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1. **What are the major goals and objectives of the research project?**
   This project will broaden the adaptability of Aberdeen, Idaho barley germplasm by producing elite spring and winter germplasm with broad spectrum disease resistance with an emphasis on Fusarium head blight resistance. To accomplish this, we will identify resistant lines in elite winter germplasm; cross FHB resistant spring lines to malting germplasm carrying broad-spectrum disease resistance.

2. **What was accomplished under these goals or objectives?** *(For each major goal/objective, address these three items below.)*

   a) **What were the major activities?**
   Four biparental populations were planted only in Langdon misted nursery in 2021 for direct comparison of the population of spring malt barley. One replication was planted for each line for an initial assessment of the breeding material (2,000 plots total).

   b) **What were the significant results?**
   Langdon misted nursery in 2021 had above average levels of FHB and DON.

   c) **List key outcomes or other achievements.**
   Key outcomes include successful screening of biparental mapping populations for FHB in Langdon, ND. This allowed for lines to be chosen for the testing the following year.

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

4. **How have the results been disseminated to communities of interest?**
   FHB scores and DON levels were reported to Dr. Kathy Klos for analysis

Project 4: Genomics Selection for FHB Resistance and Malting Quality in Spring Malting Barley

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1. **What are the major goals and objectives of the research project?**
   To increase the level of FHB resistance in Aberdeen malting barley germplasm while maintaining outstanding malt quality.

   Project Objectives:
   1) Evaluate FHB resistance and malt quality of lines in a training population selected to represent the Aberdeen, ID spring malting barley breeding program.

   2) Develop and apply a genomic selection prediction model for FHB resistance in the Aberdeen spring malting barley germplasm, accounting for the need to maintain acceptable malt quality.

2. **What was accomplished under these goals or objectives?** *(For each major goal/objective, address these three items below.)*

   a) **What were the major activities?**
   In 2021, the Aberdeen training population was planted in the Fargo misted FHB nursery. It was planted in two replicated blocks (total of 500 plots). Plots were rated for FHB severity, harvested and processed for DON analysis.

   b) **What were the significant results?**
   2021 Fargo nursery was significantly affected by the 2021 drought and produced little FHB disease and low DON measurements

   c) **List key outcomes or other achievements.**
   The Aberdeen, ID malt barley training population was evaluated in Fargo, ND in 2021. This nursery was greatly affected by the drought. As a result, FHB and DON score were significantly lower than in previous years.

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

4. **How have the results been disseminated to communities of interest?**
   FHB scores and DON levels were reported to Dr. Kathy Klos for analysis

Publications, Conference Papers, and Presentations

Please include a listing of all your publications/presentations about your FHB work that were a result of funding from your FY21 grant award. Only citations for publications published (submitted or accepted) or presentations presented during the **award period** should be included.

Did you publish/submit or present anything during this award period?

☐ Yes, I've included the citation reference in listing(s) below.
☒ No, I have nothing to report.

Journal publications as a result of FY21 grant award

List peer-reviewed articles or papers appearing in scientific, technical, or professional journals. Include any peer-reviewed publication in the periodically published proceedings of a scientific society, a conference, or the like.

Identify for each publication: Author(s); title; journal; volume: year; page numbers; status of publication (published [include DOI#]; accepted, awaiting publication; submitted, under review; other); acknowledgement of federal support (yes/no).

Books or other non-periodical, one-time publications as a result of FY21 grant award

Report any book, monograph, dissertation, abstract, or the like published as or in a separate publication, rather than a periodical or series. Include any significant publication in the proceedings of a one-time conference or in the report of a one-time study, commission, or the like.

Identify for each one-time publication: Author(s); title; editor; title of collection, if applicable; bibliographic information; year; type of publication (book, thesis or dissertation, other); status of publication (published; accepted, awaiting publication; submitted, under review; other); acknowledgement of federal support (yes/no).

Other publications, conference papers and presentations as a result of FY21 grant award

Identify any other publications, conference papers and/or presentations not reported above. Specify the status of the publication.