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

FY21 Performance Progress Report

Due date: July 26, 2022

Cover Page

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Phone:	208-397-4162 ext. 123
Fiscal Year:	2021
USDA-ARS Agreement ID:	N/A
USDA-ARS Agreement Title:	Characterization of FHB Resistance in Widely-Adapted Barley Germplasm and Genomic Selection in Spring Malting Barley
FY20 USDA-ARS Award Amount:	$39,005
Recipient Organization:	USDA-ARS National Small Grains Germplasm Research Facility 1691 S. 2700 W. Aberdeen, ID 83210
DUNS Number:	N/A
EIN:	N/A
Project/Grant Period:	5/1/21 - 4/30/22
Reporting Period End Date:	4/30/2022

USWBSI Individual Project(s)

USWBSI Research Category*	Project Title	ARS Award Amount
BAR-CP	Identification, Characterization, & Development of Widely-adapted FHB-resistant Germplasm	$35,037
BAR-CP	Genomics Selection for FHB Resistance and Malting Quality in Spring Malting Barley	$3,968
	FY21 Total ARS Award Amount	$39,005

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.

Kathy Esvelt Klos

7/11/2022

Principal Investigator Signature | Date Report Submitted

* 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: 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?

Major project goals:

To broaden the adaptability of Aberdeen barley germplasm by producing elite spring and winter germplasm with broad spectrum disease resistance with an emphasis on Fusarium head blight resistance.

Project objectives:

1). Identify resistant lines in elite winter germplasm;

2). Cross resistant spring lines to a) create mapping populations and b) broaden the adaptability of Aberdeen FHB-resistant malting germplasm by introducing broad-spectrum disease resistance.

3). Investigate fungal biomass estimated qPCR as a screening tool for selection of low-DON lines.

What was accomplished under these goals or objectives?

a) What were the major activities?

1). 200 winter barley lines/varieties were planted and tested for FHB resistance in two locations, Aberdeen and Kimberley, ID.

2). Four spring barley populations including one doubled haploid (DH) and three recombinant inbred line (RIL) populations were planted in initial field trials and evaluated for FHB resistance in Fargo and Langdon, ND.

3). Leaf tissue of the training population in FHB nurseries was sampled for fungal biomass estimation. DNA was extracted and PCR assays will be performed to evaluate the ability of the fungal biomass assay to predict DON levels.

b) What were the significant results?

1). By combing our 2019-2020 and 2020-2021 FHB data, five winter barley lines showing lower deoxynivalenol (DON) concentration (< 4 ppm) were identified (Figure 1).

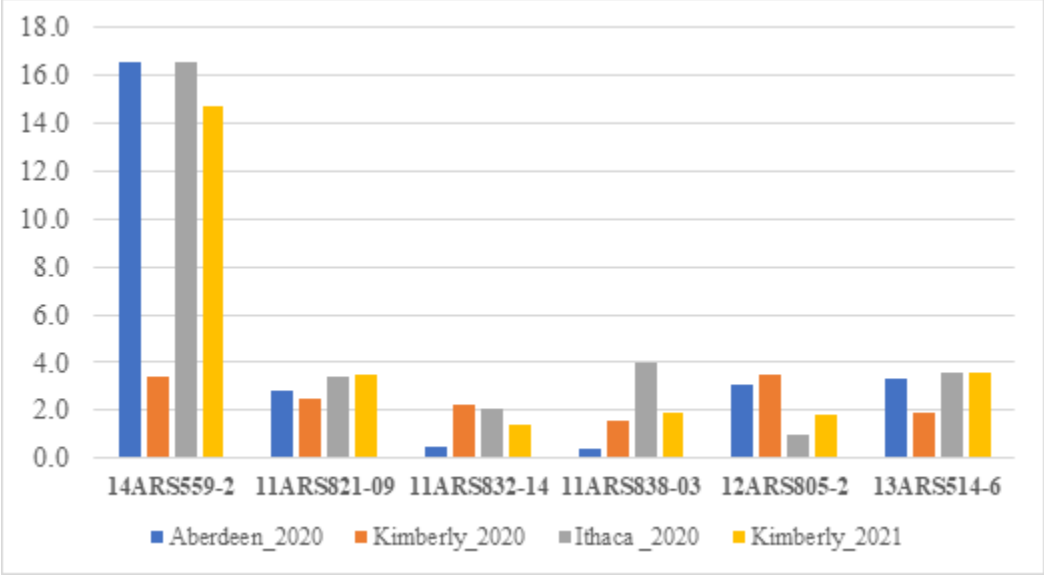

Figure 1. DON concentrations of six winter barley lines in four testing environments

2). Field evaluation of all four bi-parental populations were performed at Langdon, ND. Variation among lines within population was observed for disease severity Figure 2A) and DON concentration (Figure 2B), suggesting that these populations will provide data suitable for linkage mapping analysis.

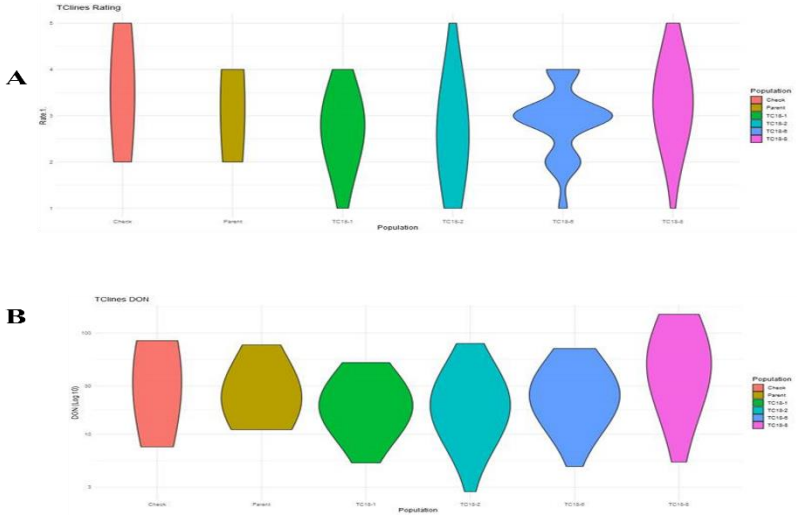

Figure 2. FHB disease rating (A) and DON concentrations (B) of (from left to right) checks, parent lines, and four bi-parental populations at Langdon, ND.

c) List key outcomes or other achievements.

1). The winter barley lines with lower DON contamination provide good resources/germplasms for develop FHB resistance/tolerance barley varieties.

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

This project provided a training opportunity for one newly hired scientist and one postdoc at ARS. Additionally, this project also trained one undergraduate student at Idaho State University and one local high school student.

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

The barley materials developed by our group have been shared with several barley scientists in US. The FHB testing results are being used to prepare scientific manuscripts or conference abstracts.

Project 2: Genomics Selection for FHB Resistance and Malting Quality in Spring Malting Barley

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What are the major goals and objectives of the research project?

Overall project goals: 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.

1. What was accomplished under these goals or objectives?

a) What were the major activities?

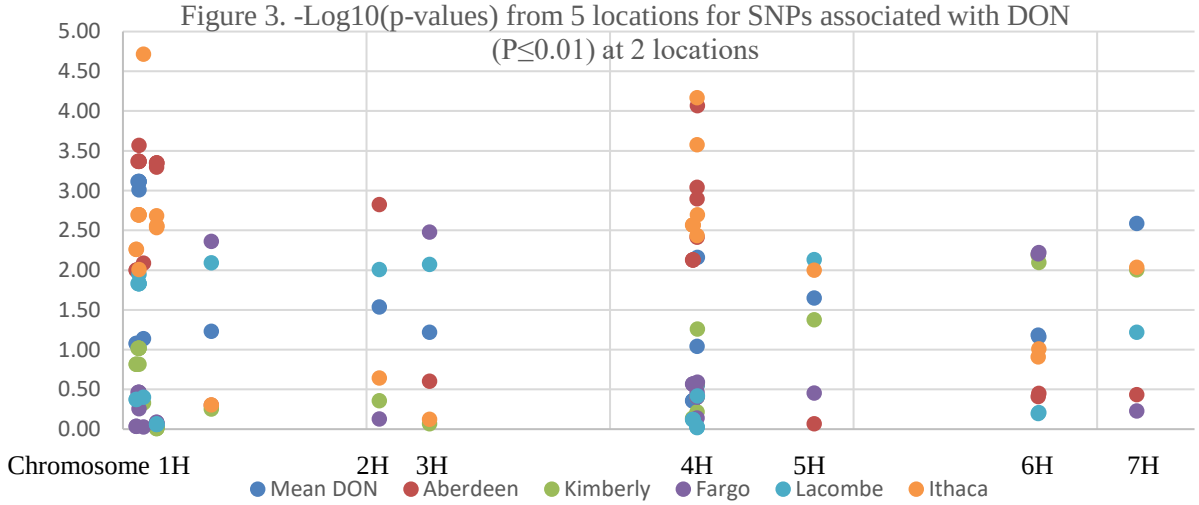
1). The training population was planted and tested for FHB resistance in Aberdeen and Kimberley, ID, at Fargo and Langdon, ND, and at Ithaca, NY.

2) Association analysis was performed to visualize the number, genomic locations and effect sizes of putative QTL.

b) What were the significant results?

Although the training population sample size is too small to provide the statistical power necessary to detection small to moderate effects of genotype on phenotype at a threshold of significance sufficient to correct for multiple testing, the GWAS provided a picture of the regions that will be under selection based on a genomic selection algorithm. Eight QTL were suggested based on nominally significant association (P≤0.01) with DON level at two locations (Figure 3). Although the SNPs representing these QTL were predictive of DON in at least 2 locations, they were also not predicitve in at least 2 locations.

Figure 3. -Log10(p-values) from 5 locations for SNPs associated with DON (P≤0.01) at 2 locations



c) List key outcomes or other achievements.

1) Spring barley parents have been selected for crossing based on predicted FHB breeding value.

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

This project provided the opportunity for training and career development for one postdoc at ARS.

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

The FHB data for the training population has been used by a student at NDSU for her thesis project.

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.