USDA-ARS
U.S. Wheat and Barley Scab Initiative
FY20 Annual Performance Progress Report
Due date: July 29, 2021

Cover Page

Principle Investigator (PI):	Kathy Esvelt Klos
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Fiscal Year:	2020
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:	$ 38,735
Project/Grant Reporting Period:	5/1/20 - 4/30/21
Reporting Period End Date:	4/30/2021

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	$ 3,698
	FY20 Total ARS Award Amount	**$ 38,735**

07/28/2021

Principal Investigator Date

* MGMT – FHB Management
FST – Food Safety & Toxicology
R- Research
S – Service (DON Testing Labs)
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

FY20 Annual Performance Progress Report
PI: Klos, Kathy
USDA-ARS Agreement #: N/A
Reporting Period: 5/1/20 - 4/30/21

Project 1: *Identification, Characterization, & Development of Widely-adapted FHB-resistant Germplasm*

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

   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.

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?

   1) 1Resistant lines in elite winter germplasm: Approximately 200 elite winter malting lines were planted in FHB nurseries in Aberdeen and Kimberly Idaho, Mt. Holly Virginia and Ithaca New York. This will generate a second year of data for this set resulting in multi-year, multi-environment FHB response data.

   2) Crossing of resistant spring lines: Previously made crosses were advanced to the F5 generation. Seed increases were made of populations of RILs and DH lines.

   3) 3)Investigation of the utility of fungal biomass estimates: The spring GS training population is being evaluated in replicated controlled environment trials for fungal biomass and DON level after dip inoculation to achieve ~90% FHB severity.

   b) What were the significant results?

   1) Severity data from Kimberly 2019/2020 and 2020/2021 FHB trials of winter barley were similar to that of previous years. DON data is not yet in.

   2) Seed of 4 crosses (95SR316A/ND Genesis; 95SR316A/Conlon; 2Ab08-X5M10-82/ND Genesis; and 2Ab08-X5M10-82/Conlon) was transferred to cooperators in NDSU for field evaluation.

   c) List key outcomes or other achievements.

   Crosses between Aberdeen winter elite lines (06ARS798-39 and 10ARS523-3) and barley germplasm from outside of this program (Wintmalt, Lightning, and D130920) have been performed. These crosses will form the basis of mapping populations.

3. **Was this research impacted by the COVID-19 pandemic (i.e. university shutdowns and/or restrictions, reduced or lack of support personnel, etc.)? If yes, please explain how this research was impacted or is continuing to be impacted.**

   Reduced and lack of support personnel delayed processing of grain samples from 2019 and 2020 nurseries for DON and Biomass analyses. As a result, biomass data has not yet been taken on 2020 samples from nurseries outside of North Dakota.

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

   This project is providing training and professional development opportunities for 2 PIs, 2 technicians and 2 Post-Docs as we gain proficiency in the nuances of characterizing barley for FHB response in Idaho.

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

   Results have been relayed to producers at the UI Aberdeen Experiment Station Field Day of 2020, and via the UI Small Grains Extension Report.

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

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

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?

1) FHB resistance in the spring GS training population: The spring malting barley-training population was evaluated in FHB nurseries in Aberdeen and Kimberly Idaho and in Langdon and Fargo North Dakota. Don data was received from the 2020 nurseries.

2) Genomic Selection: Development and application of genomic selection within the spring malting barley awaits the multi-year multi-environment DON data from this field season.

b) What were the significant results?

1) Severity and DON data from 2020 FHB trials of the spring malting barley training population have been compiled. Mean DON levels for these lines averaged 1.38 ppm (range 1.5 to 23.5) in Fargo 2020, 34.39 ppm (range 7.6 to 58.9) in Langdon 2020, and 14.6 ppm (range 2.4 to 32.1) in Kimberly 2020. Three elite breeding lines were in the lowest 10% of DON levels in all three trials: 15ARS009-2, 2Ab09-X05M050-26, and 2Ab11-X08M234-13.

2) A genomic selection algorithm for agronomic traits was generated using genotype and phenotype data on the training population. This was applied to the selection of parents from 700 F3 lines using genotype data gathered and analyzed between seedling emergence and flowering. This demonstrates the feasibility of using GS for parent selection within the time frame of a normal winter crossing block.

c) List key outcomes or other achievements.

This year's work has demonstrated the feasibility of using GS for parent selection within the time frame of a normal winter crossing block. This will allow for the fastest possible selection cycles when selection for FHB resistance is implemented.

3. Was this research impacted by the COVID-19 pandemic (i.e. university shutdowns and/or restrictions, reduced or lack of support personnel, etc.)? If yes, please explain how this research was impacted or is continuing to be impacted.

The inability of personnel to access the malting quality lab in Madison, WI for much of this year has delayed evaluation of the spring GS training population for malting quality parameters. Incorporation of malting quality parameters into our FHB genomic selection algorithm is now uncertain.

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

This project is providing training and professional development opportunities for 2 PIs, 2 technicians and 2 Post-Docs as we gain proficiency in the nuances of characterizing barley for FHB response in Idaho.

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

Results have been relayed to producers at the UI Aberdeen Experiment Station Field Day of 2020.

Training of Next Generation Scientists

Instructions: Please answer the following questions as it pertains to the FY20 award period (5/1/20 - 4/30/21). 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 FY20 award period?**
   ☐Yes ☒No
   If yes, how many? Click to enter number here.

2. **Did any graduate students in your research program supported by funding from your USWBSI grant earn their Ph.D. degree during the FY20 award period?**
   ☐Yes ☒No
   If yes, how many? Click to enter number here.

3. **Have any post docs who worked for you during the FY20 award period and were supported by funding from your USWBSI grant taken faculty positions with universities?**
   ☐Yes ☒No
   If yes, how many? Click to enter number here.

4. **Have any post docs who worked for you during the FY20 award period and were supported by funding from your USWBSI grant gone on to take positions with private ag-related companies or federal agencies?**
   ☒Yes ☐No
   If yes, how many? 1

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 FY20 award period (5/1/20 - 4/30/21). All columns must be completed for each listed germplasm/cultivar. Use the key below the table for Grain Class abbreviations.

NOTE: 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	FHB Rating (0-9)	Year Released
Click here to enter text.	Select Grain Class	Select what represents your most resistant check	Enter as text 0-9 rating	Select Year
Click here to enter text.	Select Grain Class	Select what represents your most resistant check	Enter as text 0-9 rating	Select Year
Click here to enter text.	Select Grain Class	Select what represents your most resistant check	Enter as text 0-9 rating	Select Year
Click here to enter text.	Select Grain Class	Select what represents your most resistant check	Enter as text 0-9 rating	Select Year
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Click here to enter text.	Select Grain Class	Select what represents your most resistant check	Enter as text 0-9 rating	Select Year
Click here to enter text.	Select Grain Class	Select what represents your most resistant check	Enter as text 0-9 rating	Select Year

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

Publications, Conference Papers, and Presentations

Instructions: Refer to the PR_Instructions for detailed more instructions for listing publications/presentations about your work that resulted from all of the projects included in the FY20 grant award. Only citations for publications published (submitted or accepted) or presentations presented during the **award period (5/1/20 - 4/30/21**) should be included. If you did not publish/submit or present anything, state 'Nothing to Report' directly above the Journal publications section.

NOTE: Directly below each citation, you **must** indicate the Status (i.e. published, submitted, etc.) and whether acknowledgement of Federal support was indicated in the publication/ presentation. See example below for a poster presentation with an abstract:

Z.J. Winn, R. Acharya, J. Lyerly, G. Brown-Guedira, C. Cowger, C. Griffey, J. Fitzgerald, R.E. Mason and J.P. Murphy. 2020. "Mapping of Fusarium Head Blight Resistance in NC13-20076 Soft Red Winter Wheat." In: S. Canty, A. Hoffstetter, and R. Dill-Macky (Eds.), *Proceedings of the 2020 National Fusarium Head Blight Forum (*p. 12.), Virtual; December 7-11. Online: https://scabusa.org/pdfs/NFHBF20_Proceedings.pdf.
Status: Abstract Published and Poster Presented
Acknowledgement of Federal Support: YES (Abstract and Poster)

Journal publications.

Nothing to report.

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

None.

Other publications, conference papers and presentations.

None.