

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

Cover Page

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Fiscal Year:	2020
USDA-ARS Agreement ID:	59-0206-0-174
USDA-ARS Agreement Title:	DON Accumulation and Fusarium Head Blight Resistance in Winter Barley
FY20 USDA-ARS Award Amount:	\$ 61,501
Recipient Organization:	The Ohio State University Research Foundation Accounting Dept. 1960 Kenny Road, 4th Floor Columbus, OH 43210
DUNS Number:	07-165-0709
EIN:	31-6401599
Recipient Identifying Number or Account Number:	GRT00060260
Project/Grant Reporting Period:	5/15/20 - 5/14/21
Reporting Period End Date:	5/14/2021

USWBSI Individual Project(s)

USWBSI Research Category*	Project Title	ARS Award Amount
BAR-CP	Establishing a Winter Barley Fusarium Head Blight Screening Nursery in Ohio	\$ 61,501
FY20 Total ARS Award Amount		\$ 61,501

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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

Project 1: *Establishing a Winter Barley Fusarium Head Blight Screening Nursery in Ohio*

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

The overall project goal is to:

Identify winter barley lines possessing resistance to *Fusarium graminearum* toxin accumulation and incorporate that genetic resistance into modern elite two-row winter malting barley cultivars.

The specific objectives for this project are to:

- 1) Establish a uniform winter barley scab nursery consisting of a core set of 20–30 lines, and test this set for resistances to Fusarium Head Blight (FHB) and fungal toxin accumulation.
- 2) Assess a mapping population derived from a FHB-resistant parent for resistances to FHB and fungal toxin accumulation.
- 3) Assess lines in the Ohio Winter Malting Barley Breeding Program for resistances to FHB and fungal toxin accumulation.

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?

We planted the winter barley first scab nursery in Ohio autumn 2020. Included was a population of ~170 highly diverse two row winter barley lines associated with the Ohio breeding program. Each line was planted in three reps. We also planted a population of 82 recombinant lines from the 95SR316A × Charles cross, a population we refer to as the “Bregitzer population” in recognition of its developer, who had preliminary data indicating it is segregating for FHB resistance. Combined, we tested ~260 different barley lines. Also included were a set of six lines obtained from the Virginia Tech University breeding program that served as checks because they were previously determined to exhibit a range of visual and DON level resistance level differences (moderately resistant to moderately susceptible).

An overhead mist irrigation system was put in place prior to heading. During canopy development the nursery was inoculated with multiple race isolates of *F. graminearum* using corn cob "spawn" placed in nursery rows. Heading date of each line was recorded. At the first sign of head emergence (Zadoks 51-53) and prior to pollen dehiscence, heads were spray-inoculated using a backpack sprayer at two-day intervals with asexual spores, also derived from multiple Ohio pathogenic races. The field was overhead mist-irrigated intermittently for 2 min every 10 min between 5:00 AM and 9:00 AM, and again between 8:00 PM and 10:00 PM throughout anthesis, and for three days following the latest line completing anthesis.

Subsequently, each rep of every line was independently rated by two individuals for visual symptoms using a 1-10 scale. At maturity the reps were hand-harvested and bulked to create a composite. The composite was then threshed in a stationary lab thresher to obtain clean seed. This material will next be ground using coffee grinders and then submitted for DON analyses.

A subset of the lines have been genotyped using the Barley 50k iSelect SNP Array. A subset of the Bregitzer recombinants exhibiting moderate resistance were crossed to Ohio adapted germplasm.

b) What were the significant results?

The visual disease phenotypes exhibited by the individual check lines was as previously assigned (moderately resistant to moderately susceptible). FHB indexes of the ~170 highly diverse set and 82 Bregitzer recombinants also exhibited phenotypes in the categories defined by the checks. Preliminary findings suggest there might be an association between resistance levels and heading date but without additional replicated trials we cannot draw a definitive conclusion at this time.

c) List key outcomes or other achievements.

The 170 highly diverse lines were specifically chosen because they are highly diverse and thus could potentially serve as a novel source of resistance. However a preponderance of these lines also presented challenges, primarily high susceptibility to lodging and low grain yield. The high lodging necessitated eliminating one of the three reps at hand-harvest. In lines also having low yield the quantity of harvested material was less than the ideal minimum 50 g required for robust DON level determinations. We will circumvent these two challenges in the future by increasing the number of lodging resistant lines, reducing the number of lodging susceptible lines, modifying our headrow planting format, or a combination of these.

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.

My entire research program was severely negatively impacted by Covid-19 and the restrictions put in place by my institution.

In March 2020, The OSU shut down.

A hiring freeze was instituted. My program could hire no temporary employees until November 2020.

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Internal OSU funding was eliminated for all non-covid-19 related projects.

Administration discussed destroying all biological material, including plant populations in the greenhouses. Faculty were required to justify the importance of biological material to avoid its permanent loss.

Salvage and maintenance of all living biological material became the burden of a subset of individual faculty (me). That included harvesting, threshing, and packaging all of my research material and maintaining the biological material for other research programs.

Greenhouse time was limited to a maximum of one-to-two-hour time frame per day.

A moratorium was placed on planting anything in the greenhouse or field, which continued through August 2020.

All crossing in greenhouses had to be terminated.

Data collection for my graduate student's research project was severely curtailed.

All hand-harvesting of field headrows was carried out by me.

Research plots were left behind in the field as a result of insufficient personnel to combine-harvest and process it. This included >50% of my own research material and that of colleagues (Kevin Smith's Winter Malting Barley Trial and Pat Hayes's Oregon Malting Elite Trial).

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

Nothing to Report.

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

Nothing to Report (all field day events were cancelled as a result of Covid-19.)

Training of Next Generation Scientists

Instructions: Please answer the following questions as it pertains to the FY20 award period (5/15/20 - 5/14/21). 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? 1

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? [Click to enter number here.](#)

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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 (5/15/20 - 5/14/21)** 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:

Winn, Z.J., Acharya, R., Lyerly, J., Brown-Guedira, G., Cowger, C., Griffey, C., Fitzgerald, J., Mason R.E., and Murphy, J.P. (2020, Dec 7-11). Mapping of Fusarium Head Blight Resistance in NC13-20076 Soft Red Winter Wheat (p. 12). In: Canty, S., Hoffstetter, A. and Dill-Macky, R. (Eds.), *Proceedings of the 2020 National Fusarium Head Blight Forum*.

https://scabusa.org/pdfs/NFHB20_Proceedings.pdf.

Status: Abstract Published and Poster Presented

Acknowledgement of Federal Support: YES (Abstract and Poster)

Journal publications.

Muñoz-Amatriaín, M., Hernandez, F., Herb, D., Baenziger, P.S., Bochard, A., Capettini, F., Casas, A., Cuesta-Marcos, A., Einfeldt, C., Fisk, S. Genty, A., Helgerson, L., Herz, M., Hu, G., Igartua, E., Karsai, I., Nakamura, T., Sato, K., Smith, K., **Stockinger, E.**, Thomas, W., and Hayes, P. (2020). Perspectives on low temperature tolerance and vernalization sensitivity in barley: prospects for facultative growth habit. *Frontiers in Plant Science*. 11(1625).

<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7814503/>

Status: Published.

Federal support Acknowledged: No

Kost, M.A., Perales, H.R., Wijeratne, S., Wijeratne, A.J., **Stockinger, E.**, Grotewold, E., Mercer, K.L. (2020) Transcriptional differentiation of UV-B protectant genes in maize landraces spanning an elevational gradient in Chiapas, Mexico. *Evolutionary Applications*. 13(8): 1949-1967. <https://www.ncbi.nlm.nih.gov/pubmed/32908597>

Status: Published.

Federal support Acknowledged: No

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

Nothing to report.

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Other publications, conference papers and presentations.

Nothing to report.