

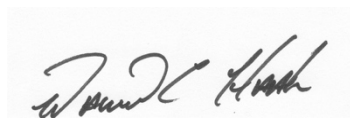
USDA-ARS
U.S. Wheat and Barley Scab Initiative
FY20 Annual Performance Progress Report
Due date: July 29, 2021

Cover Page

Principle Investigator (PI):	David Haak
Institution:	Virginia Tech.
E-mail:	dhaak@vt.edu
Phone:	540-231-1186
Fiscal Year:	2020
USDA-ARS Agreement ID:	59-0206-0-187
USDA-ARS Agreement Title:	Microbial Interactions with Wheat and Barley Pathogens.
FY20 USDA-ARS Award Amount:	\$ 36,251
Recipient Organization:	Virginia Polytechnic Institute and State University 1880 Pratt Drive, Suite 2006 Blacksburg, VA 24060
DUNS Number:	003137015
EIN:	54-6001805
Recipient Identifying Number or Account Number:	423546
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
PBG	Managing the Phytomicrobiome for Increased Disease Resistance	\$ 36,251
FY20 Total ARS Award Amount		\$ 36,251



Principal Investigator

3-AUG-2021

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: *Managing the Phytomicrobiome for Increased Disease Resistance*

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

This work is addressing two goals described under the Pathogen Biology Group (PBG) heading.

Goal 1. *Characterize plant-fungal interactions to identify important genes, proteins or small molecules that may be used to develop FHB resistance or to reduce DON contamination in barley and wheat.*

Under this goal we are growing several varieties from each class of FHB genetic resistance (sensitive, moderate resistance, resistance) and collecting quantitative pathogen, microbial community and mycotoxin levels. Together these data will provide insights on how interactions between the host and microbial communities influence pathogen abundance and mycotoxin production.

Goal 2. *Discover epiphytic or endophytic microbes or microbial communities and viruses that may be useful for development of effective biological control practices for FHB.*

Under this goal we are collecting metagenomic information from epiphytic and endophytic microbial and virus communities across several varieties that vary in genetic FHB resistance level (S, MR, R) across two locations. Coupled with data on quantitative abundance of the pathogen, these data allow us to describe the communities of microbes and, importantly, the pool of microbial genes that interact with the pathogen in mature grain heads across two locations.

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?

The primary impact of this project is aimed at informing our fundamental understanding of host-pathogen-microbiome interactions and how they result in disease. We have made significant progress toward our goals over the past year. We have collected field samples, extracted DNA, enriched these samples and prepared them for sequencing. We have sequenced a subset of these samples using Pacific Biosciences Long read sequencing and initiated analyses on these data. In addition to this work we are developing a bioinformatic pipeline for integrating long-read microbial community data with field level data on disease and quantitative estimates of pathogen abundance.

b) What were the significant results?

Preliminary analyses from our experiment are revealing the importance of bacteria in this system where 85% (11/13) of the most abundant taxa are bacteria and the non-bacterial taxa include pathogenic taxa *Fusarium* spp. and *Cercospora* spp.. Among these dominant bacteria are several genera that have previously been associated with suppression of FHB (*Sphingomonas* and *Methylobacterium*) and we are currently working on leveraging the power of long-read metagenomic data to identify these important players to the strain level. Finally, our data are confirming that, while the most abundant, *Fusarium graminearum* is only 1 of 8 *Fusarium* species interacting in this system. Further, in our data we see that upon infection *F. graminearum* shifts in relative abundance range from 54% to 90% and this is correlated with infection score. We are investigating how the additional species interact directly with *F. graminearum* or indirectly through the microbiome to impact FHB.

c) List key outcomes or other achievements.

To date this work has already uncovered some important interactions among the microbial community members in the wheat grain head microbiome. In addition, results supported by this work have been used as preliminary data in a large federal proposal. Finally, the bioinformatic workflows that are being built for these data will be used in a new graduate student course being taught by the PI in the Fall 2021 semester.

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.

This work was impacted by COVID-19 related restrictions on lab activities at Virginia Tech and restrictions on our sequencing provider Duke University. In fall 2020 the number of personnel and length of their time in the lab was limited which prolonged the processing of samples and DNA extraction. Our preferred sequencing provider experienced limits on personnel hours as well as re-tasking to prioritize sequencing of COVID related projects. Fortunately, we are no longer under these restrictions.

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

This project supported the training of an undergraduate and graduate student, as well as one postdoctoral research associate. In addition, the postdoctoral scholar attended a conference (National Fusarium Head Blight Forum 2020). Finally, the results from this work will be used to support training via a graduate level course in bioinformatics.

FY20 Annual Performance Progress Report

PI: Haak, David

USDA-ARS Agreement #: 59-0206-0-187

Reporting Period: 5/15/20 - 5/14/21

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

These results are being prepared for a presentation at the National Fusarium Head Blight Forum 2021. In addition, ancillary work investigating endophytes in the mature kernels, led by an undergraduate student, is being prepared for publication.

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? [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? 1

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.](#)

FY20 Annual Performance Progress Report

PI: Haak, David

USDA-ARS Agreement #: 59-0206-0-187

Reporting Period: 5/15/20 - 5/14/21

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/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.

Nothing to report.

Other publications, conference papers and presentations.

Abdelrazek, S., Gonzales, A., Diaz, and Haak, D.C. (2020, Dec 7-11). Characterizing Bacterial Community Differences Among Wheat Lines that Differ in FHB Resistance (p. 81). In: Canty, S., Hoffstetter, A., and Dill-Macky, R. (Eds.), *Proceedings of the 2020 National Fusarium Head Blight Forum*. https://scabusa.org/pdfs/NFHBF20_Proceedings.pdf.

Status: Abstract Published and Poster Presented

Acknowledgement of Federal Support: Yes (Abstract and Poster)