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

Cover Page

Principle Investigator (PI):	Frances Trail
Institution:	Michigan State University
E-mail:	trail@msu.edu
Phone:	517-432-2939
Fiscal Year:	2020
USDA-ARS Agreement ID:	59-0206-0-152
USDA-ARS Agreement Title:	Elucidating Fungal Processes that Evade Host Resistance and Chemical Control
FY20 USDA-ARS Award Amount:	$ 57,611
Recipient Organization:	Michigan State University Contract & Grant Administration Hannah Administration Building, Room 2 East Lansing, MI 48824-1046
DUNS Number:	193247145
EIN:	38-6005984
Recipient Identifying Number or Account Number:	RC111337
Project/Grant Reporting Period:	5/15/20 - 5/14/21
Reporting Period End Date:	5/14/2021

USWBSI Individual Project(s)

USWBSI Research Category[1*]	Project Title	ARS Award Amount
BAR-CP	Elucidating Modes of Infection that Evade Host Resistance and Chemical Control	$ 57,611
	FY20 Total ARS Award Amount	**$ 57,611**

Principal Investigator Date 8/9/21

[1*] 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: *Elucidating Modes of Infection that Evade Host Resistance and Chemical Control*

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

1) Document the *in planta* and *in vitro* developmental stages of biofilms using microscopy.
2) Determine if the biofilms are more resistant to external pressures, such as fungicides and ROS. Determine if *F. graminearum* can adapt to fungicides and ROS by increasing biofilm formation *in planta*.
3) Identify processes and genes important to biofilm formation using transcriptional profiling of biofilm development, including on the plant and in culture, using wild type, artificially selected strains, and mutant strains in the presence of fungicides and ROS. Identify genes whose regulation is affected by these different conditions. Generate and phenotype gene knockouts to demonstrate gene function in biofilm formation, stress resistance and pathogenicity.

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) *In vitro* biofilm development has been fully mapped over time, providing the knowledge to move into plants. We have shown the structures and stages of biofilm formation, and are using this knowledge to look into plants for the same structures.
(2) This objective has not been addressed yet. However, we know that ROS impact cell morphology, and this is being looked for in plants along with objective 1.
(3) Transcriptional profiling is ongoing, and will be completed soon with a list of candidate genes for knockout being determined. Gene knockouts of candidate genes that are orthologs to other fungal biofilm genes in other species are being generated. We are also repeating the artificial selection of a strain that increases adhesion, where adhesion has been successfully increased a second time and a third is ongoing. These artificially selected strains will all be phenotyped independently. We also plan to do transcriptome analysis on the selected strains to determine what genes were impacted from the selection.

Work was presented at the meeting of the NCCC307 Virtual Workshop in October 2020, the Fusarium Head Blight Forum in December, 2020, Botany 2021 in July 2021, and the American Phytopathological Society Plant Health 2021 meeting in August, 2021.

b) What were the significant results?

(1) We have determined the most detailed biofilm development from a filamentous fungal plant pathogen. We have also identified the components of the matrix

surrounding biofilm formations, which have not been well-studied in filamentous fungi. We now know that the matrix surrounding and protecting biofilm cells is composed of extracellular nucleic acids, proteins, and polysaccharides. We also know that fully developed biofilm cells are lipid-rich, much like overwintered cells on crop debris. Biofilm formations are temporary cell structures, which form and dissolve in 48 hours total.

(2) This objective has not been addressed yet

(3) Artificial selection for adhesion has been repeatable, which provides us a better sampling for genetic analysis. We now know that selection for additional ability to adhere to a surface is possible, and that the increased adhesion increases the ability of the fungus to infect barley florets.

c) List key outcomes or other achievements.

Should the presentations go here instead? I only listed on down at the bottom page for presentations because the Botany and APS abstracts haven't been published yet, to my knowledge.

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.

Yes, the university was shut down for approximately two months, and at 50% capacity for the following year. This restricted lab time and space, delaying data collection for most of 2020.

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

Graduate student has given presentations annually at national meetings. She has also trained an undergraduate to knockout genes in Fusarium graminearum. That undergraduate has been participating in the project.

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

Shay et al, 2021. Biofilm formation and structure in the filamentous fungus *Fusarium graminearum,* a plant pathogen. Manuscript to be submitted Aug. 2021; there's a note about community outreach on the instructions for this part. I did a fungal foray in the fall, which is vaguely directly related, but that's it.

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? 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.

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 (5/15/20 - 5/14/21). 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
N/A	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
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
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
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 (5/15/20 - 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:

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.

Nothing to report.

Other publications, conference papers and presentations.

R. Shay, F. Trail. 2020. "Biofilm Formation in *Fusarium graminearum" Proceedings of the 2020 National Fusarium Head Blight Forum (*p. 11.), Virtual; December 7-11. Online: https://scabusa.org/pdfs/NFHBF20_Proceedings.pdf.
Status: Abstract Published and Poster Presented
Acknowledgement of Federal Support: Yes

R. Shay, F. Trail. 2021. "Biofilm Formation in *Fusarium graminearum" Proceedings of the 2021 Mycological Association Annual meeting.* Virtual; August.
Status: Abstract Published and Poster Presented
Acknowledgement of Federal Support: YES (Abstract and Poster)