

USDA-ARS
U.S. Wheat and Barley Scab Initiative
FY19 Performance Report
Due date: July 24, 2020

Cover Page

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Fiscal Year:	2019
USDA-ARS Agreement ID:	N/A
USDA-ARS Agreement Title:	Response of Transgenic Wheat Altered in Defense Metabolites to Head Scab
FY19 USDA-ARS Award Amount:	\$ 35,000

USWBSI Individual Project(s)

USWBSI Research Category*	Project Title	ARS Award Amount
GDER	Response of Wheat Constitutively Expressing Lignin Genes to Fusarium Head Blight	\$ 35,000
	FY19 Total ARS Award Amount	\$ 35,000

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Principal Investigator

Date

* MGMT – FHB Management
 FST – Food Safety & Toxicology
 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: Response of Wheat Constitutively Expressing Lignin Genes to Fusarium Head Blight

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

The **project objectives** are:

- 1) Screen transgenic lines constitutively expressing genes (*SbMyb60*, *SbCCoAOMT*, *Sb4CL* and *SbC3H*) in the monolignol biosynthesis pathway for resistance following artificial inoculations under field conditions.
- 2) Determine FHB resistance in lines with two stacked transgenes in the CB037 background, or with a single transgene in a highly susceptible or moderately-resistant background, and constitutively expressing monolignol biosynthesis genes.

2. What was accomplished under these goals or objectives? (For each major goal/objective, address items a-b) below.)

Obj. 1

a) What were the major activities?

- Assess lines in field trials for disease indices (incidence and severity), *Fusarium* damaged kernels (FDK) and deoxynivalenol (DON).

b) What were the significant results?

Lines constitutively expressing coumaroyl shikimate 3-hydroxylase (*SbC3H*) (2 lines), caffeoyl coenzyme A 3-O-methyl transferase (*SbCCoAOMT*) (1 line) and a Myb transcription factor (1 line) had disease indices not significantly different from that of the moderately resistant line Sumai 3. There were no significant differences in proportion of FDK among all the lines for the 2019 growing season; a different Myb line had the lowest level of all lines. For 2019, DON levels of most lines were not significantly different from that of Sumai 3, except for one line constitutively expressing 4-coumarate-Coenzyme A ligase (*Sb4CL*), which had significantly higher levels.

c) List key outcomes or other achievements.

- Two sets of transgenic lines (*SbCCoAOMT* and *SbC3H*) constitutively expressing genes for enzymes in the monolignol biosynthesis pathway, that could increase antimicrobial phenylpropanoids in plant cell walls, were shown to have modest increases in resistance as compared with susceptible lines. Another set, constitutively expressing one of the Myb transcription factors that controls expression of genes in monolignol biosynthesis, also exhibited increased resistance in field studies.

Obj. 2

a) What were the major activities?

- Completion of crosses combining two stacked transgenes with the best increased resistance, *SbC3H* and *SbCCoAOMT*, and crossing the transgene *SbC3H* in the moderately-resistant backgrounds, Alsen and Sumai 3.

b) What were the significant results?

- Crosses that have stacked *SbCCoAOMT* and *SbC3H* in the CB037 background, and incorporation of the *SbC3H* transgene in the Alsen and Sumai 3 backgrounds were completed. The F2 progeny have not yet been screened. This is due to the loss of the

technologist who was performing our FHB greenhouse assays and the inability to replace this individual or to obtain a graduate student to complete this work.

c) List key outcomes or other achievements.

- Dr. Funnell-Harris was invited to give a seminar on her work with pathogens of small grains (wheat and sorghum) at University of Southern Queensland, Toowoomba, Australia.

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

- Yes.
- My USDA-ARS lab is in University facilities. The University shut-down in March and only essential activities (i.e. keeping plants alive, checking on freezers) was allowed. Around June 1st, essential research (i.e. field plantings and grant-funded research) was allowed with restrictions to maintain social distancing, etc.
- I was unable to replace my technologist (May 2019), owing to the uncertainty of obtaining funding beyond September 30, 2019. Therefore, I rewrote the grant in the form of a proposal appropriate for a graduate student project. At that time I was not aware that additional limitations were to be placed on foreign students, and visiting foreign nationals, especially in federal laboratories. I am currently seeking a graduate student who is a U. S. citizen to begin hopefully in Jan. 2021.

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

-We have trained three undergraduate students in basic microbiology, agronomy and plant pathology skills. These include wheat harvesting and threshing techniques, procedures for grinding biomass samples, and scoring wheat seed for Fusarium Head Blight. One student has also been trained in inoculum preparation while another has been trained in wheat emasculations.

-Beyond funding for biological science technologist provided by this grant, we additionally trained a second biological science technologist in all steps of wheat culturing, and FHB inoculations, disease scoring and preparation of materials for further analyses.

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

-This work was reported at the Fusarium Head Blight Forum, December 2019, in two poster presentations.

-This work was also reported as part of an invited seminar on fungal diseases of small grains, University of Southern Queensland, Toowoomba, Australia, July 2019.

Training of Next Generation Scientists

Instructions: Please answer the following questions as it pertains to the FY19 award period (N/A). 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 FY19 award period?**

No

If yes, how many?

- 2. Did any graduate students in your research program supported by funding from your USWBSI grant earn their Ph.D. degree during the FY19 award period?**

No

If yes, how many?

- 3. Have any post docs who worked for you during the FY19 award period and were supported by funding from your USWBSI grant taken faculty positions with universities?**

No

If yes, how many?

- 4. Have any post docs who worked for you during the FY19 award period and were supported by funding from your USWBSI grant gone on to take positions with private ag-related companies or federal agencies?**

N/A

If yes, how many?

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 FY19 award period. 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 (S, MS, MR, R, where R represents your most resistant check)	FHB Rating (0-9)	Year Released

Add rows if needed.

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

Abbreviations for Grain Classes

- Barley - BAR
- Durum - DUR
- Hard Red Winter - HRW
- Hard White Winter - HWW
- Hard Red Spring - HRS
- Soft Red Winter - SRW
- Soft White Winter - SWW

Publications, Conference Papers, and Presentations

Instructions: Refer to the FY19-FPR_Instructions for detailed more instructions for listing publications/presentations about your work that resulted from all of the projects included in the FY19 grant award. Only citations for publications published (submitted or accepted) or presentations presented during the **award period (N/A)** 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:

De Wolf, E., D. Shah, P. Paul, L. Madden, S. Crawford, D. Hane, S. Canty, R. Dill-Macky, D. Van Sanford, K. Imhoff and D. Miller. 2019. “Impact of Prediction Tools for Fusarium Head Blight in the US, 2009-2019.” In: S. Canty, A. Hoffstetter, H. Campbell and R. Dill-Macky (Eds.), *Proceedings of the 2019 National Fusarium Head Blight Forum*, Milwaukee, WI; December 8-10. University of Kentucky, Lexington, KY. p. 12.

Status: Abstract Published and Poster Presented

Acknowledgement of Federal Support: YES (Abstract and Poster)

Journal publications.

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

Other publications, conference papers and presentations.

Funnell-Harris, D. L., Sattler, S. E., Khasin, M., and Wegulo, S. N. 2019. Responses of sorghum and wheat modified in phenylpropanoid metabolism to fungal pathogens. Abstract presented at Centre for Crop Health Seminar Series, University of Southern Queensland, Toowoomba, Australia, July 12, 2019 (invited seminar).

Status: Abstract Published and Seminar Presented

Acknowledgement of Federal Support: YES (Seminar)

Dill-Macky, R., Curland, R. D., Beheshteh, Z., Muehlbauer, G. J., Bethke, G., Funnell-Harris, D. Shah, J., McLaughlin, J. and Tumer, N. 2019. Testing transgenic spring wheat and barley lines for reaction to Fusarium head blight: 2019 field nursery report. In: Canty, S., A. Hoffstetter, H. Campbell and R. Dill-Macky (Eds.), *Proceedings of the 2019 National Fusarium Head Blight Forum* (p. 46). East Lansing, MI/Lexington, KY: U.S. Wheat & Barley Scab Initiative.

Status: Abstract Published and Poster Presented

Acknowledgement of Federal Support: YES (Abstract and Poster)

FY19 Performance Report
PI: Funnell-Harris, Deanna

Funnell-Harris, D., Duray, Z., Sattler, S., Wegulo, S., Dill-Macky, R. and Tatineni, S. 2019.
Response of wheat constitutively expressing monolignol biosynthesis genes to Fusarium
head blight. In: Canty, S., A. Hoffstetter, H. Campbell and R. Dill-Macky (Eds.),
Proceedings of the 2019 National Fusarium Head Blight Forum (p. 48). East Lansing,
MI/Lexington, KY: U.S. Wheat & Barley Scab Initiative.

Status: Abstract Published and Poster Presented

Acknowledgement of Federal Support: YES (Abstract and Poster)