

**USDA-ARS/
U.S. Wheat and Barley Scab Initiative
FY16 Final Performance Report
Due date: July 28, 2017**

Cover Page

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Fiscal Year:	2016
USDA-ARS Agreement ID:	N/A
USDA-ARS Agreement Title:	Response of Transgenic Wheat Altered in Defense Metabolites to Head Scab.
FY16 USDA-ARS Award Amount:	\$ 32,950

USWBSI Individual Project(s)

USWBSI Research Category*	Project Title	ARS Award Amount
GDER	Response of Transgenic Wheat Altered in Defense Metabolites to Head Scab.	\$ 32,950
	FY16 Total ARS Award Amount	\$ 32,950

DEANNA FUNNELL-HARRIS

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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 Transgenic Wheat Altered in Defense Metabolites to Head Scab.*

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

The goal of this proposed research is to identify Fusarium head blight (FHB) resistance in transgenic wheat lines overexpressing genes involved in the monolignol biosynthetic pathway. Four genes, one a MYB transcription factor (*SbMyb60*) that acts as a positive regulator, and three for genes encoding enzymes in the pathway, caffeoyl CoA 3-O-methyltransferase (SbCCoAOMT), 4-coumarate-coenzyme A ligase, (Sb4CL), and p-coumarate 3-hydroxylase (SbC3H) were cloned into overexpression constructs and individually transformed into wheat using *Agrobacterium tumefaciens*-mediated transformation. The objectives of this proposal are to:

- 1) screen transgenic wheat overexpressing genes from the lignin biosynthesis pathway for Type I (to initial infection) and Type II (to spread after infection) resistance and reduced mycotoxin (deoxynivalenol or DON) production following infection with the FHB pathogen, *Fusarium graminearum*.
- 2) conduct metabolic profiling to identify changes in levels of metabolites that could contribute to disease resistance in transgenic wheat.

The hypotheses to be tested are:

- Obj. 1: Transgenic wheat lines will be resistant to FHB or have reduced DON production by the pathogen.
- Obj. 2: At least one metabolite contributes to increased resistance to FHB or reduced DON production by the pathogen.

2. What was accomplished under these goals? *Address items 1-4) below for each goal or objective.*

Objective 1: screen transgenic wheat overexpressing genes from the lignin biosynthesis pathway for Type I (to initial infection) and Type II (to spread after infection) resistance and reduced mycotoxin (deoxynivalenol or DON) production following infection with the FHB pathogen, *Fusarium graminearum*.

- 1) major activities-The inoculum preparation protocol using Nebraska isolates of *F. graminearum* was maximized. The first repetition of *F. graminearum* inoculations is completed, the second repetition has just been inoculated and a third repetition is planned.
- 2) specific objectives-Identify transgenic lines with increased resistance to *F. graminearum* as compared with susceptible controls, as determined by area under the disease progress curve (AUDPC), Fusarium damaged kernels (FDK) and DON levels.
- 3) significant results- For the first repetition, AUDPC indicated that two sets of transgenic lines, SbCCoAOMT and SbC3H, are promising to have potential resistance over susceptible checks. FDK and DON analyses are being completed to determine whether these results can be confirmed or the other lines (*SbMyb60* and Sb4CL) may have reductions in these measurements. FDK for repetition 1 is being conducted now. DON analysis has been delayed at the facility.
- 4) key outcomes or other achievements-The SbCCoAOMT and SbC3H overexpression lines along with the recipient line and checks, will be included in inoculated field trials during the 2018 growing season.

Objective 2: conduct metabolic profiling to identify changes in levels of metabolites that could contribute to disease resistance in transgenic wheat.

1) major activities-Collection of plant tissues (grain and leaves) from repetition 1 for phenolic metabolomics analysis. Initiation of metabolomics analyses.

2) specific objectives-Identify differences in phenolic metabolite profiles in transgenic lines, as compared with susceptible or resistant checks lines, that may be associated with increased resistance.

3) significant results-none to report at this time.

4) key outcomes or other achievements-none to report at this time.

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

Five undergraduate students have been trained in basic greenhouse and laboratory techniques, including plant culture, tissue sampling, harvesting of grain and biomass, identification of proper growth stage for inoculation, and preparation of materials for fungal inoculum.

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

Poster presentation at 2016 National Fusarium Head Blight Forum, St. Louis, Dec. 4 – 6, 2016:

Funnell-Harris, D. L., Graybosch, R. A., Sattler, S. E., Wegulo, S. N. and Clemente, T. E. 2016. “Transgenic wheat lines upregulated for genes in lignin biosynthesis as potential sources against Fusarium head blight.” In: S. Canty, A. Clark, K. Wolfe and D. Van Sanford (Eds.), *Proceedings of the 2016 National Fusarium Head Blight Forum* (p. 48). East Lansing, MI/Lexington, KY: U. S. Wheat & Barley Scab Initiative.

Training of Next Generation Scientists

Instructions: Please answer the following questions as it pertains to the FY16 award period. 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 FY16 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 FY16 award period? No.**

If yes, how many?

- 3. Have any post docs who worked for you during the FY16 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 FY16 award period and were supported by funding from your USWBSI grant gone on to take positions with private ag-related companies or federal agencies? No.**

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 FY16 award period. All columns must be completed for each listed germplasm/cultivar. Use the key below the table for Grain Class abbreviations. *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 FY16-FPR_Instructions for detailed instructions for listing publications/presentations about your work that resulted from all of the projects included in the FY16 grant. Only include citations for publications submitted or presentations given during your award period. If you did not have any publications or presentations, state ‘Nothing to Report’ directly above the Journal publications section.

Journal publications.

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

Other publications, conference papers and presentations.

Funnell-Harris, D. L., Graybosch, R. A., Sattler, S. E., Wegulo, S. N. and Clemente, T. E. 2016. “Transgenic wheat lines upregulated for genes in lignin biosynthesis as potential sources against Fusarium head blight.” In: S. Canty, A. Clark, K. Wolfe and D. Van Sanford (Eds.), *Proceedings of the 2016 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 (poster), YES (abstract)