USDA-ARS | U.S. Wheat and Barley Scab Initiative

FY21 FINAL Performance Progress Report

Due date: July 26, 2023

Cover Page

USDA-ARS Agreement ID:	59-0206-1-206
USDA-ARS Agreement Title:	Inhibition of F. graminearum Growth by Compounds in Wheat Bran
Principle Investigator (PI):	Senay Simsek
Institution:	Purdue University
Institution UEI:	YRXVL4JYCEF5
Fiscal Year:	2021
FY21 USDA-ARS Award Amount:	$33,550
PI Mailing Address:	Purdue University, Department of Food Science Nelson Hall of Food Science (NLSN), Room 2203 745 Agriculture Mall Dr. West Lafayette, IN 47907
PI E-mail:	ssimsek@purdue.edu
PI Phone:	765-494-8257
Period of Performance:	9/1/21 - 8/30/23
Reporting Period End Date:	8/30/2023

USWBSI Individual Project(s)

USWBSI Research Category*	Project Title	ARS Award Amount
PBG	Identification of Compounds in Wheat Bran that Inhibit the Growth of F. graminearum	$33,550
	FY21 Total ARS Award Amount	$33,550

I am submitting this report as a: ☒ FINAL Report

I certify to the best of my knowledge and belief that this report is correct and complete for performance of activities for the purposes set forth in the award documents.

Principal Investigator Signature

07/26/2023
Date Report Submitted

ǂ BAR-CP – Barley Coordinated Project
DUR-CP – Durum Coordinated Project
EC-HQ – Executive Committee-Headquarters
FST-R – Food Safety & Toxicology (Research)
FST-S – Food Safety & Toxicology (Service)
GDER – Gene Discovery & Engineering Resistance
HWW-CP – Hard Winter Wheat Coordinated Project
MGMT – FHB Management
MGMT-IM – FHB Management – Integrated Management Coordinated Project
PBG – Pathogen Biology & Genetics
TSCI – Transformational Science
VDHR – Variety Development & Uniform Nurseries
NWW –Northern Soft Winter Wheat Region
SPR – Spring Wheat Region
SWW – Southern Soft Red Winter Wheat Region

Project 1: Identification of Compounds in Wheat Bran that Inhibit the Growth of F. graminearum

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1. **What are the major goals and objectives of the research project?**
   The goal is to ultimately identify which compounds are responsible for inhibition. This information may lead to better understanding of the possible mechanisms involved in resistance, and the identification of possible control agents that could be used in the field or food processing.
   Objective 1: Extraction and characterization of methanolic extracts from wheat bran of low susceptible genotypes

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?**
   After extraction of methanol soluble compounds (MSC) from the wheat samples the extracted compounds were characterized by gas chromatography – mass spectroscopy. Further characterization of the compounds was done using ultra performance liquid chromatography with quadrapol time of flight (UPLC-QTOF). The UPLC-QTOF analysis was done to visualize unknown compounds by utilizing the accurate mass technology. The metabolomic profile determined by the UPLC-QTOF was used to conduct statistical analysis and grouping of the wheat samples. This will allow us to determine metabolic profiles of interest that are present in specific wheat varieties. Statistical analysis was done to create the interpretations of the data, conduct significance and fold change analysis, visualize the data through Venn diagrams, volcano plots, and principal component analysis (PCA) plots. This allowed us to utilize the ID browser in the QTOF software to search compound databases and identify some of the compounds found in the MSC. We will use this information to inform breeders and plant pathologist about wheat varieties with possible resistances to FHB.

   b) **What were the significant results?**
   The metabolomic profiling of the MSC extracts of the wheat samples resulted in the detection of more than two thousand unique compounds. The PCA plots showed clear separation between many of the varieties. The groupings were mostly consistent with their proposed susceptibility to FHB. Volcano plots were used to identify key compounds of interest that presented a significant ($p < .05$) difference with at least a two fold change among different varieties. Some of these compounds were identified though database searches. The current databases available allowed for the identification of lipid compounds.
   In order to take a close look at the compounds of interest two varieties were selected for further data analysis. The results showed that comparing a low susceptibility variety (Glenn) and a high susceptibility variety (Samson) resulted in the determination of more than 200 compounds that were unique to each variety. Also, Glenn contained 160 of 1013 compounds which were significantly ($p<0.05$) different by at least a 2 fold change as compared to Samson. Seventeen fatty acids were identified in the MSC from the different samples. Two fatty acids were found to be down regulated in Glenn as compared to Samson, while there were ten fatty acids up regulated in Glenn vs.

Samson. These ten fatty acids found in Glenn could be related to a unique metabolic profile that could have a possible link to the lower FHB susceptibility.

c) List key outcomes or other achievements.

This study provides evidence that could lead to possible mechanisms initiated within the wheat bran during fungal diseases (FHB). These mechanisms are associated with activating certain lipid-related enzymes like LOX that can lead to the breakdown of components in the wheat bran. These components break down into the formation of secondary products, potentially increasing inhibition activity against F. graminearum in wheat. Some of these secondary products were identified in various susceptibility wheat genotypes during this research. This research provides a basis for developing a laboratory-scale screening test for FHB susceptibility.

Metabolic profiling of HRS genotypes varying in FHB susceptibility has been performed. Initial analysis has shown differences in compounds between samples for all genotypes Significant variation was seen in the compounds detected between genotypes with varying FHB susceptibility

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

This research project provided training and professional development opportunities for a graduate student to learn laboratory techniques and research methods. In addition, the student had the opportunity to work with several researchers and develop professional skills to help them in their future career paths. This project also provided training on analytical techniques (LC-MS) for a post-doctoral researcher.

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

We are completing publications to disseminate these results to communities of interest. Additionally, we have had conversations and informal meetings with other wheat researchers (breeders, pathologists, etc.) and producers to discuss and communicate the results of this project.

Publications, Conference Papers, and Presentations

Please include a listing of all your publications/presentations about your FHB work that were a result of funding from your FY21 grant award. Only citations for publications published (submitted or accepted) or presentations presented during the **award period** should be included.

Did you publish/submit or present anything during this award period?

☐ Yes, I've included the citation reference in listing(s) below.
X No, I have nothing to report.

Journal publications as a result of FY21 award

List peer-reviewed articles or papers appearing in scientific, technical, or professional journals. Include any peer-reviewed publication in the periodically published proceedings of a scientific society, a conference, or the like.

Identify for each publication: Author(s); title; journal; volume: year; page numbers; status of publication (published [include DOI#]; accepted, awaiting publication; submitted, under review; other); acknowledgement of federal support (yes/no).

Books or other non-periodical, one-time publications as a result of FY21 award

Report any book, monograph, dissertation, abstract, or the like published as or in a separate publication, rather than a periodical or series. Include any significant publication in the proceedings of a one-time conference or in the report of a one-time study, commission, or the like.

Identify for each one-time publication: Author(s); title; editor; title of collection, if applicable; bibliographic information; year; type of publication (book, thesis, or dissertation, other); status of publication (published; accepted, awaiting publication; submitted, under review; other); acknowledgement of federal support (yes/no).

Other publications, conference papers and presentations as a result of FY21 award

Identify any other publications, conference papers and/or presentations not reported above. Specify the status of the publication.