

FY21 Performance Progress Report

Due date: July 26, 2022

Cover Page

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Fiscal Year:	2021
USDA-ARS Agreement ID:	59-0206-1-206
USDA-ARS Agreement Title:	Inhibition of F. graminearum Growth by Compounds in Wheat Bran
FY20 USDA-ARS Award Amount:	\$33,550
Recipient Organization:	Purdue University Department of Food Science Nelson Hall of Food Science (NLSN), Room 2203, 745 Agriculture Mall Dr. West Lafayette, IN 47907
DUNS Number:	07-205-1394
EIN:	35-6002041
Recipient Identifying Number or Account Number, if any:	
Project/Grant Period:	9/1/21 - 8/30/23
Reporting Period End Date:	8/30/2022

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 an: Annual Report 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.

Senay Simsek

Principal Investigator Signature

7/21/2022
Date Report Submitted

† 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*

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?

Our lab has acquired the samples and materials for this project. Complete methodologies have been assessed for completing the experiments. The wheat samples have been milled to separate the bran material that will be utilized for the extraction of metabolites. Methanol soluble compounds (MSC) have been extracted from the wheat bran samples. These MSC were used to produce an agar-based media for the growth of *Fusarium graminearum*. Plaque diameters and ergosterol levels were determined after four days of growth on agar plates containing MSC from 19 wheat varieties. Lipids and other bioactive compounds were extracted from the bran, and their contents of the MSC were evaluated to determine any possible connection with inhibition of *F. graminearum* growth.

F. graminearum growth in wheat bran/ agar plates was measured using nineteen wheat genotypes with various FHB susceptibilities: Plaque diameters were determined, ergosterol analysis was performed, and fatty acid profiles in bran samples were analyzed with GC-MS. A reconstitution study was conducted using one low and one high susceptibility wheat genotypes. Lipids were exchanged from high susceptibility genotypes with low susceptibility genotypes: Plaque diameters were determined, and ergosterol analysis was performed. A spiking study was conducted using one low and one high susceptibility wheat genotypes where bran slurries were enriched with linoleic acid: Plaque diameters were determined, ergosterol analysis was performed, and fatty acid profiles in bran samples were analyzed with GC-MS.

b) What were the significant results?

This in vitro microbiological study provided strong preliminary evidence that HRSW genotypes can be screened for susceptibility to fusarium head blight by measuring *F. graminearum* growth on agar plates incorporating bran from the corresponding genotypes. *F. graminearum* grew better in wheat bran/agar plates prepared from the bran of high susceptibility genotypes. The fungus had moderate growth in medium susceptibility genotypes. The third category, the low susceptibility genotypes, had the lowest growth of *F. graminearum*. This study led us to investigate the biochemical

composition in wheat bran that may be partially responsible for the level of FHB susceptibility in wheat.

Methanol soluble compounds (MSC) present in wheat bran inhibited the growth of *F. graminearum* to a certain extent in wheat bran/agar plates. We found that the hydroxy-fatty acids in the MSC were the critical class of compounds related to the inhibition of *F. graminearum* growth. The oxygenated fatty acids may result from the LOX enzyme acting on 18:2 (linoleic acid) and 18:3 (linolenic acid) fatty acids. Most of these hydroperoxides were formed in the presence of linoleic acid. Fragments from 9-hydroxy-10,12-octadecadienoic acid and fatty acid 12,13-dihydroxy-9-octadecenoic acid were identified and confirmed by GC-MS.

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.

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.

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

We are currently finalizing data and preparing 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.
 No, I have nothing to report.

Journal publications as a result of FY21 grant 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).

Nothing to report

Books or other non-periodical, one-time publications as a result of FY21 grant 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).

Nothing to report

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

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

Nothing to report