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:	59-0206-4-028
USDA-ARS Agreement Title:	Improvement of Soft Winter Wheat that is Resistant to FHB and Adapted to Eastern USA.
FY16 USDA-ARS Award Amount:	$ 73,556
Recipient Organization:	Purdue University AG Spnsored Program Services 615 W. State Street West Lafauette, IN 47907
DUNS Number:	07-205-1394
EIN:	35-6002041
Recipient Identifying Number or Account Number:	107128
Project/Grant Reporting Period:	6/8/16 - 6/7/17
Reporting Period End Date:	06/07/17

USWBSI Individual Project(s)

USWBSI Research Category*	**Project Title**	**ARS Award Amount**
VDHR-NWW	Genetics of, and Breeding for, Fusarium Head Blight Disease Resistance in Wheat.	$ 70,936
VDHR-NWW	Male Sterile Facilitated Recurrent Selection for FHB Resistance.	$ 680
VDHR-NWW	Coordinated Phenotyping of Uniform Nurseries and Official Variety Trials.	$ 1,940
	FY16 Total ARS Award Amount	**$ 73,556**

M. Mohammadi — July 31, 2017

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: *Genetics of, and Breeding for, Fusarium Head Blight Disease Resistance in Wheat.*

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

The major goals of this project were to characterize agronomic traits and the response Fusarium head blight of Purdue germplasm, including, advanced yield (n = 30) and preliminary yield (n = 240) nurseries, 17 doubled haploid lines from INW0411 x INW0412 cross, and 198 recombinant inbred lines from INW0412 × 992060G1 cross. INW0412 has reportedly type I & II resistance against FHB disease. In 2015-16 season, we planted more bi-parental populations. Some were spring and exotic type. We did not repeat those in 2016-17 season.

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

1) major activities
Activities included set up FHB field after a previous corn crop, planting row plots for al nurseries mentioned above, producing sufficient inoculum, setting up misting system to provide sufficient humidity at the time of inoculation, and greenhouse inoculation of the RIL population.

2) specific objectives
- Obtaining FHB incidence and severity for the germplasm in the field condition.
- Obtaining FHB severity for the 198 RILs INW0412 × 992060G1 in the greenhouse by artificial injection.

3) significant results
We could evaluate the germplasm for phenology traits but for most part, the level of disease establishment was not sufficient to screen germplasm for disease resistance rating. In the greenhouse, however, we produced two cycles of data for type II FHB resistance for 198 RILs INW0412 × 992060G1.

4) key outcomes or other achievements
The greenhouse data, along with the genotypic data we are producing, will allow to map loci that control type II FHB resistance.

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

Postdoctoral training: Dr. Sintayehu Daba's postdoctoral employment is funded by the USWBSI funding. This project has provided an opportunity for Dr. Daba to improve field based plant breeding skills. In particular, this project has prepared him to run plant disease nurseries. In addition to these field scale training, Dr. Daba is also improving his skills in genomewide marker development and applications in plant breeding.

Graduate student training: Mr. Blake Russel, Mr. Rupesh Gaire, and Mr. Seth Tolley are three graduate students in my program that are not funded by USWBSI, but were heavily involved field-based implementation, plant inoculation, and disease scoring. This project is indeed an experiential learning project for graduate student seeking advanced degree and training in plant breeding.

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

Poster presentation at the 2016 National Fusarium Head Blight Forum

Project 2: *Male Sterile Facilitated Recurrent Selection for FHB Resistance.*

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

The goal of this project was to utilize male-sterility in wheat, which greatly facilitates hybridization without laborious manual emasculation and pollination, to pyramid resistance genes against FHB disease quickly. This project has one specific objective, which is to advance male-sterile facilitated recurrent selection populations surrounded by FHB moderately resistant lines that perform well under Indiana condition.

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

1) specific objectives
During FY16 one cycle of male sterile based hybridization was achieved, where the bulk of male sterile was fertilized by four local elite lines.

2) major activities
We planted each male sterile row in between two high yielding and relatively FHB resistant experimental accessions from Purdue. Each row was 4 meters. The field layout was: 0762A1-2-8 | MS | 0722A1-1-1-7 | 05247A1-7-7-3-1 | MS | 0762A1-2-8.

3) significant results
The significance is the production of a bulk population of male sterile germplasm that received pollen from four high yielding, adapted males that are relatively resistant to FHB at random.

4) key outcomes or other achievements
Work in progress. See "3) significant results" section. In the next season, we will plant the bulk population in field and will extract individual plants to be planted in head-to-row fashion. The lines extracted from the head-to-row procedure will be tested for FHB resistance and yield.

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

The postdoc that is being trained on the FHB phenotyping learned essentials of implementing this project.

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

Nothing published. Discussions are ongoing with the project coordinator (Dr. Fred Kolb) as how to utilize resources during the next cycles. The options are a) continuing male sterile hybridization, b) sharing bulks and start head-to-row line extraction or both.

Project 3: *Coordinated Phenotyping of Uniform Nurseries and Official Variety Trials.*

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

The success of breeding germplasm, for yield, adaptation, and disease resistance, is assessed in the local environment as well as diverse geographical locations. Yield and FHB resistance require accurate phenotyping for selection procedures. Coordinated Phenotyping of Uniform Nurseries and Official Variety Trials are tools of cross-talk among various breeding programs, which evaluates breeding germplasm in several environments. The ultimate goal of this project is to provide the VDHR research community with accurate phenotyping of soft red winter wheat breeding materials based on several locations. Three specific objectives are:

- Yield trial reporting of the UE coordinated phenotyping.
- Yield trial reporting of the 5STA, 5STP coordinated phenotyping.
- FHB phenotyping and reporting of the P+NUWWSN coordinated phenotyping nursery.

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

1) specific objectives

- *Yield trial reporting of the UE coordinated phenotyping.*
  A set of 36 entries of elite experimental lines was distributed to local test locations by coordinator Dr. Harold Bockelman of USDA in Aberdeen, ID. This UESRWWN2017 nursery was planted at Purdue and the result was communicated with the coordinator. The 36 elite lines exhibited a mean yield range of 68-106 bu/acre, averaging 85 bu/acre. The University of Kentucky elite line "KY06C-2067-16-7-1" and the KWS company elite line "KWS127" were the highest and the second highest yielding lines in this nursery.

- *Yield trial reporting of the 5STA, 5STP coordinated phenotyping.*
  Two sets of 25 entries each, i.e., 5STADV and 5STPRE, were distributed to local test locations by coordinator Dr. Clay Sneller. These nurseries were planted at Purdue University farm in four replicates. The data for the 5STAADvV and 5STPRE are being processed and will be communicated with the coordinator before mid-August.

- *FHB phenotyping and reporting of the P+NUWWSN coordinated phenotyping nursery.*
  One hundred and three entries from different programs, which include 60 entries tested under NUWWSN nursery and 43 entries tested under PNUWWSN nursery were received from coordinator Dr. Clay Sneller. They were evaluated for resistance against FHB disease under misting system and the results, in temrs of %incidence, was communicated with the coordinator. Although we set up misting system to increase humidity and apply sufficient inoculum, the temperature was not optimal for disease establishment. The data prepared for the coordinator was prepared by collecting heads from the infected areas of the plot and visual scoring post hand harvest.

2) major activities

- *Field evaluation for yield performance and reporting of the UESRWWN coordinated phenotyping.*
  The arriving seed packet was divided in four section and the experiment was planted in four replicates in the Agronomy Center for Research and Education (ACRE), West Lafayette. Each replicate was a plot of 4ft x 12ft, trimmed to 4ft x 10ft later. The trial was planted by a standard 7-row small grain yield planter. We measured days to heading (DH), days to maturity (DM), and plant height (PLH) before harvest. After harvest, burlap bags were dried in the outside installed drier for three days, undergraduate trainees processed the samples and measured yield (bu/acre), hectoliter weight (lb/bu), and 1000 kernel weight (g).

- *Field evaluation for yield performance and reporting of the 5STA, 5STP coordinated phenotyping.*
  The arriving seed packet was divided in four section and the experiments were planted each in four replicates in ACRE, West Lafayette. Each replicate was a plot of 4ft x 12ft, trimmed to 4ft x 10ft later. The trial was planted by a standard 7-row small grain yield planter. We measured days to heading (DH), days to maturity (DM), and plant height (PLH) before harvest. After harvest, burlap bags were dried in the outside installed drier and after three days, undergraduate trainees processed the samples and measured yield (bu/acre), hectoliter weight (lb/bu), and 1000 kernel weight (g).

- FHB phenotyping and reporting of the P+NUWWSN coordinated phenotyping nursery.
  The 60 NUWWSN and 43 PNUWWSN entries were planted in single replicate 4ft x 4ft plots in the FHB evaluation field at ACRE, West Lafayette. For inoculum, we prepared the conidia of *Fusarium graminearum* in mung bean extraction grown culture of local isolates (currently three local isolates 10FG 196, 09IN Decatur F151, and 10 IN SW S2-U1 are available, which were kindly provided by Dr. Kiersten Wise). The inoculum was sprayed during anthesis to only a quarter portion of each plot. FHB incidence (number of heads infected expressed in %) was measured from each plot. The result was communicated with the coordinator Dr. Clay Sneller.

3) Significant results

As stated in the goals, the aim of this project was to characterize the reaction of elite breeding germplasm to infection by *Fusarium graminearum* under diverse environments. The FHB disease requires warm and humid weather condition for successful establishment. From year to year, depending on the weather conditions around anthesis time of wheat plants, the intensity of infection varies. This particular year, i.e., 2017 season, we observed relatively lower infection levels compared to more disease epidemic years. This season was not the most ideal environment for breeders to select among elite germplasm. Nevertheless, a phenotyping results for year 2017 was achieved for P+NUWWSN that was clearly communicated with the coordinator.

4) key outcomes or other achievements
The outcome of this study is that breeders are now informed with the reaction of their elite lines to FHB pathogen in diverse environments. They are now well aware of the yield performance of their lines in diverse environments (because of 5STPRE, 5STADV, and UE trials). This information will help them for further selection and final release of their varieties. Varieties that are selected by this method are widely adapted and are less prone to FHB epidemics because they have passed several years and locations of FHB testing.

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

These field-based activities provided an opportunity for professional development of a postdoctoral trainee to improve field skills. This postdoctoral trainee is funded by this project. In addition, three wheat breeding PhD students, not funded by this project, participated in field based aspects of the project as group activity. Therefore, this project provided experiential learning environment for graduate students and increased the knowledge of postdoc and graduate students.

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

The results of coordinated trials were reported back to the coordinators and ultimately the results from all the locations will be reported to the participating breeders by the coordinator.

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 (6/8/16 - 6/7/17). 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.

Sintayehu Daba, Rupesh Gaire and Mohsen Mohammadi. 2016.Evaluation of Germplasm Resistance to Fusarium Head Blight Disease. Poster #37. Proceedings of the 2016 National Fusarium Head Blight Forum. St. Louis, Missouri, USA, December 4-6, 2016

Status: Abstract Published and Poster Presented

Acknowledgement of Federal Support: YES (poster), NO (abstract)