USDA-ARS
U.S. Wheat and Barley Scab Initiative
FY17 Final Performance Report
Due date: July 31, 2018

Cover Page

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Fiscal Year:	2017
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.
FY17 USDA-ARS Award Amount:	$ 73,415
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:	6/8/17 - 6/7/18
Reporting Period End Date:	6/7/2018

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.	$ 70,800
VDHR-NWW	Male Sterile Facilitated Recurrent Selection for FHB Resistance.	$ 678
VDHR-NWW	Coordinated Phenotyping of Uniform Nurseries and Official Variety Trials.	$ 1,937
	FY17 Total ARS Award Amount	$ 73,415

M. Mohammadi

Principal Investigator — July 31, 2018 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 Fusarium head blight response of the Purdue germplasm, including advanced yield (n = 30) and preliminary yield (n = 50) nurseries. Resistance of the entries measured using FHB incidence, severity, and disease index. A total of 110 entries composed of advanced breeding lines and cultivars from different breeding programs were also evaluated in two collaborative FHB nurseries (PNUSRWWN and NUSRWWN). Samples were harvested early July 2018 and are being evaluated for kernel damage percentage. Ultimately, we will send grain samples for DON measurement.

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

1) major activities

Activities included setting up FHB misting system after a previous corn crop, planting row plots (3 ft each) for all nurseries, producing sufficient inoculum, setting up misting system to provide sufficient humidity at the time of inoculation after a previous corn crop. We used a combination of 9 isolates of FHB in our disease evaluation in FHB nursery under misting system.

2) specific objectives

Obtaining FHB incidence and severity for the germplasm in the field condition. This will be used in the line selection and variety release selection process.

We also planned to evaluate the entries for FDK and DON accumulation.

3) significant results

A good year for breeders (establishing lots of disease in nurseries) is a bad year for growers. This year was a good year for Purdue breeding program. The disease establishment i.e., incidence and severity in the FHB nursery this year was very good. We measured the disease incidence and severity of all entries. We also evaluated the germplasm for phenology traits and yielding ability. The 93 Purdue breeding lines had disease incidence from a low of 25% to a high of 95%, with a mean of 66%. The disease severity for the same materials range from 7% to 40%, with mean of 21%. Promising breeding lines Along with their FHB responses are listed in Table 1. The data for PNUWWSN and NUWWSN was communicated to the trial coordinator.

Table 1. FHB responses of Purdue promising lines.

Name	Source	FHB-I	Severity	FHB Index
053A1-2-5-3-5-4	AYT_2017_Entry#5	35.0	6.5	2.3
08334A1-31	AYT_2017_Entry#10	40.0	14.4	5.8
05251A1-1-77-8	AYT_2017_Entry#13	40.0	12.3	4.9
0566A1-3-1-68	PYT1_Entry#35	35.0	20.0	7.0
05251A1-1-136-9-7-4	PYT2_Entry#50	40.0	14.7	5.9
05251A1-1-136-9-7-4	PYT3_Entry#50	40.0	7.1	2.8
0762A1-2-8	PYT1, PYT2, PYT3_Entry#80- Check	40.0	16.4	6.5
0527A1-9-14-4-3-3	5ST_PREL_2017_Entry#13	30.0	19.0	5.7

4) key outcomes or other achievements

Under the misting system, we evaluated FHB incidence and severity for the entire Purdue germplasm that we have purified and genotyped over the past three years. This is a set of N = 378 Purdue bred lines developed from 1980 to 2015. For this germplasm, we observed a range of 24% - 100% and average of 77% for disease incidence and a range of 3.2% - 100% and average of 44% for disease severity. This data will be used for genetic mapping and resistant germplasm selection for recycling as parents in breeding program.

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 addition, Dr. Daba is also improving his skills in genome-wide 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 are heavily involved in field-based implementation, plant inoculation, and disease scoring.

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

By attending Fusarium Head Blight Forum and the Eastern Wheat Worker conferences as well as journal publications.

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.

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

1) major activities

During FY16 one cycle of male sterile based hybridization was achieved, where the bulk of male sterile was fertilized by four local elite lines. Unfortunately, during the 2017-18 season, too much rain resulted in severe lodging and the heads were not distinguishable. We have contacted the coordinator to receive another batch of male sterile seed.

2) specific objectives

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

Before harvest, we lost this experiment and nearby plots to severer rain and lodging.

4) key outcomes or other achievements

Before harvest, we lost this experiment and nearby plots to severer rain and lodging.

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

We are in the process of learning and implementing this system.

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

Nothing published as we are in the process of learning and implementing this system. Discussions are ongoing with the project coordinator (Dr. Fred Kolb) as how to utilize resources during the next cycles.

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

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

Coordinated Phenotyping of Uniform Nurseries and Official Variety Trials are used to evaluate breeding germplasm across a wide range of environments. The ultimate goal of this project is to provide the VDHR research community with accurate phenotyping of soft red winter wheat advanced breeding lines in several locations. Three specific objectives are:

- Yield trial evaluation and reporting of the Uniform Eastern Trial, composed of 30 entries.
- Yield trial evaluation and reporting of the 5-state advanced and 5-state preliminary trials, each composed of 25 entries.
- FHB evaluation and reporting of 110 advanced lines in the PNUWWSN and NUWWSN coordinated nurseries.

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

1) major activities

For the Uniform Eastern and the 5-state trials:

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 trials were 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 workers processed the samples and measured grain yield (bu/acre), hectoliter weight (lb/bu), and 1000 kernel weight (g).

For PNUWWSN and NUWWSN trials:

The 55 NUWWSN and 55 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 from 9 isolates of *Fusarium graminearum* in mung bean extraction. 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 trial coordinator.

2) specific objectives

Specific objectives were evaluation and reporting of data to trail coordinators so ach breeder can make an informed decision for variety selection and release.

3) significant results

In Uniform Eastern trial, the average yield was 91.2 bu/acre with a minimum of 66 bu/acre. The maximum yield of 112 bu/acre was for M14R1140. The CV for this experiment was 12.2% and the LSD was 15.8 bu/acre.

In 5-state preliminary trial, the average yield was 101.2 bu/acre with a minimum of 85.4 bu/acre. The maximum yield of 114.2 bu/acre was for 05247A1-7-7-3-1. The CV for this experiment was 7.2% and the LSD was 10.3 bu/acre.

In 5-state advanced trial, the average yield was 97.4 bu/acre with a minimum of 76.9 bu/acre. The maximum yield of 114.8 bu/acre was for OH14216-47. The CV for this experiment was 10% and the LSD was 13.6 bu/acre.

One hundred and ten entries from different programs (55 in NUWWSN nursery and 55 in PNUWWSN nursery) were received. They were evaluated for resistance against FHB disease under misting system. In NUWWSN, the range observed for disease incidence was 30-100% and a mean of 70%. The disease severity range was 4-82% with a mean of 26%. In PNUWWSN, the range observed for disease incidence was 30-95% and a mean of 68.4%. The disease severity range was 7.2-36.5% with a mean of 16.5%.

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.

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 plots and disease resistance skills. 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. The 5-state breeders directly received the data.

Training of Next Generation Scientists

Instructions: Please answer the following questions as it pertains to the FY17 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 FY17 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 FY17 award period?** No

   If yes, how many?

3. **Have any post docs who worked for you during the FY17 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 FY17 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 FY17 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 FY17-FPR_Instructions for detailed instructions for listing publications/presentations about your work that resulted from all of the projects included in the FY17 grant. Only include citations for publications submitted or presentations given during your award period (6/8/17 - 6/7/18). If you did not have any publications or presentations, state 'Nothing to Report' directly above the Journal publications section.

NOTE: Directly below each reference/citation, you must indicate the Status (i.e. published, submitted, etc.) and whether acknowledgement of Federal support was indicated in publication/ presentation.

Nothing to Report.

Journal publications.

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

Other publications, conference papers and presentations.