USDA-ARS/
U.S. Wheat and Barley Scab Initiative
FY19 Final Performance Progress Report
Due date: August 31 2021

Cover Page

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Fiscal Year:	2019
USDA-ARS Agreement ID:	59-0206-8-214
USDA-ARS Agreement Title:	Genetic Improvement of Grain Yield and Disease Resistance in Wheat
FY19 USDA-ARS Award Amount:	$ 83,213
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:	17000549
Project/Grant Reporting Period:	6/8/19 - 6/7/21
Reporting Period End Date:	6/7/2021

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	$ 80,114
VDHR-NWW	Male Sterile Facilitated Recurrent Selection for FHB Resistance	$ 1,163
VDHR-NWW	Coordinated Phenotyping of Uniform Nurseries and Official Variety Trials	$ 1,936
	FY19 Total ARS Award Amount	**$ 83,213**

M. Mohammadi 8/31/21

Principal Investigator Date

* MGMT – FHB Management
FST – Food Safety & Toxicology
R – Research
S – Service (DON Testing Lab)
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 research project?**

The goal of this project was to mitigate the adverse effect of FHB in soft red winter wheat region. In the recent years, we evaluated a set of 432 entries that were inherited from the previous breeding lead by using phenotypic assessments in the field and genome-wide molecular markers. One of the objectives of this project was to form preliminary and advanced yield trials based on the level of purity in the germplasm. After resuming the work in 2015, we were able to perform first breeding crosses. In FY15, we performed 46 crosses, which were then increased to ~100 crosses per year by using 35 parent germplasm. One of the objectives of this project was to increase the number of crosses to develop novel breeding germplasm. Based on the crosses we have performed in FY15, we planted 46 F4 populations during FY18. In summer (2019), we selected individual heads from each F4 family. One of the objective of this project was to evaluate the appearance and visual characteristics of these selections in head row nurseries. Therefore, the major goals were:

1- Creating novel genetic diversity by crossing high-yielding x high-yielding and high-yielding x FHB moderately resistant germplasm.
2- Planting of ~6,500 F5 heads row from the early crosses performed in Dr. Mohammadi' breeding program in 2015.
3- Structuring preliminary and advance testing of germplasm and further purification of the germplasm inherited from previous breeding lead.

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?

1- Creating novel genetic diversity by crossing high-yielding x high-yielding and high-yielding x FHB moderately resistant germplasm.

We used 93 parental lines from multiple breeding program and performed 241 crosses. The parents were chosen based on performance in earlier yield or P+NUWWSN nursery. The number of crosses we performed during FY19 (241) is drastically larger than the number of crosses in previous years (~100).

2- Planting of ~6,500 F5 heads row from the early crosses performed in my breeding program in 2015.

From ~6,500 F4 derived F5 head rows, we selected 508 head rows based on their appearance and foliar disease resistance. These were collected by sickles and were advanced to form the stage-1 testing of 2020-21. Y1 nurseries next year.

3- Structuring preliminary and advance testing of germplasm and further purification of the germplasm inherited from previous breeding lead.

We have structured the preliminary and advanced yield trials based on the purity observed in the germplasm inherited from the previous program. 160 entries were planted in three Y1 nurseries. 129 entries were planted in three Y2 nurseries. 96 entries were tested in two Y3 nurseries. All Y1, Y2, and Y3 nurseries were only tested in West Lafayette location. 30 entries were tested in one Y4 nursery and planted in two locations West Lafayette and Vincennes.

b) What were the significant results?

We are processing the grains that were harvested from Y1s, Y2s, Y3s, and Y4 nurseries. The crosses that we made in spring will be planted in fall 2020. The results from these tests were used to form Y4 and Y3 tests that were tested in 2020-21 in IN and OH. Based on the results observed in IN and OH, a common set from these germplasm will be tested again in IN and OH in 2021-22 for identification of high yielding lines.

c) List key outcomes or other achievements.

Selections from these lines will be tested in 2021-22 in IN and OH advanced tests.

3. Was this research impacted by the COVID-19 pandemic (i.e. university shutdowns and/or restrictions, reduced or lack of support personnel, etc.)? If yes, please explain how this research was impacted or is continuing to be impacted.

The experiments were planned and planted before the emergence and pandemics of SARS-Cov2. We hired one undergraduate worker who could not work after the shelter-in-place order. This situation created some difficulties for us during harvest. We completed the harvest with limited workers and using assistance from two postdocs (funded by other projects) as field assistance for few days. For the very same reason, the grain processing is continuing to be impacted and we are moving slower than normal.

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

Two postdocs funded by other projects were trained in different aspects of harvest in a wheat breeding program.

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

The breeding data was used to advance germplasm. One poster from the work of a graduate student not funded by USWBSI but working on scab resistance was presented in two conferences. See the publication section.

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

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

   My program opted out of this male sterile project in September 2019. We informed the VDHR-NWW collaborators, the NFO and USDA-ARS that we discontinue male sterile facelifted recurrent selection for FHB resistance project. Our FY2020 Award to this agreement was reduced to account for us dropping this project.

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?**
   See response to answer 1.

   b) **What were the significant results?**
   See response to answer 1.

   c) **List key outcomes or other achievements.**
   See response to answer 1.

3. **Was this research impacted by the COVID-19 pandemic (i.e. university shutdowns and/or restrictions, reduced or lack of support personnel, etc.)? If yes, please explain how this research was impacted or is continuing to be impacted.**

   NA

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

   See response to answer 1.

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

   See response to answer 1.

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

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

Strong FHB resistance must be combined with high-yield to impact the Eastern US wheat industry. Each year the multiple breeding programs generate breeding lines that are in the advanced stages of development. Due to low to moderate heritability of FHB resistance multi-location testing is needed to determine the FHB resistance of these lines, as well as their yield, quality, agronomic value, and resistance to other diseases. The collaborating breeders in this project use a series of coordinated nurseries to test germplasm for yield and FHB resistance in multiple location so to select and advance germplasm for variety release. Information from multiple locations helps to perform informed selection. Specific goals of my program were conducting:

1. Preliminary and Advanced Nurseries, and the coordinated P+NUWWSN FHB experiment
2. Five-State preliminary and advanced nurseries
3. Uniform Eastern and Southern Regional Winter Wheat Nurseries (UESRWWN)

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?

1. Preliminary and Advanced Nurseries, and the coordinated P+NUWWSN FHB experiment

A total of 37 PNUWWSN entries and 50 NUWWSN entries were planted in four replicates of randomized head rows in September 2019. FHB incidence and severity was measured on all four replicates. Head rows were collected by hand and are now being threshed. When the grains are ready, FDK will be measured and a decision will be made for sending grains to DON lab.

2. Five-State preliminary and advanced nurseries

We have planted 25 entries in three replicates under preliminary 5-state trials and 25 entries in three replicates under advanced 5-state trials in September 2019. Although after winter we experienced episodes of low temperature, the plants survived the cold. We reported the 5-state data back to all collaborators on July 20, 2020.

3. Uniform Eastern Regional Winter Wheat Nurseries (UERWWN)

   We have planted 30 entries in four replicates under Eastern Regional Winter Wheat Nurseries (UERWWN) in four replicates in September 2019. Despite episodes of low temperature in spring during pre-heading stages, the plants survived. We reported the UERWWN data back to all collaborators on July 20, 2020.

b) What were the significant results?

1. Preliminary and Advanced Nurseries, and the coordinated P+NUWWSN FHB experiment

   We are currently processing head rows. Then we will measure FDK and decide on sending samples to DON lab. See COVID-19 impact statement. Because we were unable to provide water and misted system, the incidence and severity were so low that with the coordinator we decided not to send the grains for DON measurements.

2. Five-State preliminary and advanced nurseries

   We reported the 5-state data back to all collaborators on July 20, 2020. Data included days to heading, test weight, and grain yield. We sent data both in average and standard error forms and as raw data by three replicates. The 5-state preliminary trial averaged 62 bu/acre with a range of 48-80 bu/acre. Hilliard, OH15-131-31, and OH09-207-68 were amongst the highest yielding lines in 5-state preliminary trials. The 5-state advanced trial averaged 65 bu/acre with a range of 47-84 bu/acre. LA01-425/08-33373, X11-0357-24-13-5, and OH15-191-52 were amongst the highest yielding lines in 5-state advanced trials.

3. Uniform Eastern Regional Winter Wheat Nurseries (UERWWN)

   We reported the UERWWN data back to all collaborators on July 20, 2020. The UERWWN trial averaged 68 bu/acre with a range of 47-89 bu/acre. Interestingly, we observed that two lines from KWS i.e., KWS280 89 bu/acre and KWS291 84 bu/acre were by far better than local check 0762A1-2-8 (63 bu/acre) and better than Pioneer Brand 25R46 (78 bu/acre).

c) List key outcomes or other achievements.

The P+NUWWSN data was sent to the coordinator. Data of 5-states were reported at plot level. The result of UERWWN was sent to the coordinator.

3. **Was this research impacted by the COVID-19 pandemic (i.e. university shutdowns and/or restrictions, reduced or lack of support personnel, etc.)? If yes, please explain how this research was impacted or is continuing to be impacted.**

   Yes. The experiments were planned and planted before the emergence and pandemics of SARS-Cov2. The PNUWWSN and NUWWSN nurseries were planted in a location in the field for which we planned to pipe for water. During the COVID-19, the field operated with very limited workers and the crew could not provide water for misting system. Because of this, we had low level of disease incidence and severity.

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

   The project covered operational cost of research for a Ph.D. student who earned his degree during FY19 and went on to become a postdoctoral scientist in academia. Recently, this individual has become a senior scientist in a wheat discovery program of private industry.

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

   All results were communicated with the coordinators.

Training of Next Generation Scientists

Instructions: Please answer the following questions as it pertains to the **FY19 award period (6/8/19 - 6/7/21)**. 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 FY19 award period?**
   ☐Yes ☒No ☐ Not Applicable
   If yes, how many? Click to enter number here.

2. **Did any graduate students in your research program supported by funding from your USWBSI grant earn their Ph.D. degree during the FY19 award period?**
   ☒Yes ☐No ☐ Not Applicable
   If yes, how many? One. The PhD student who finished his doctoral program on this project went on to take a postdoctoral position in academia and now became a senior scientist in a small grain breeding company in the US.

3. **Have any post docs who worked for you during the FY19 award period and were supported by funding from your USWBSI grant taken faculty positions with universities?**
   ☐Yes ☐No ☐ Not Applicable
   If yes, how many? Click to enter number here.

4. **Have any post docs who worked for you during the FY19 award period and were supported by funding from your USWBSI grant gone on to take positions with private ag-related companies or federal agencies?**
   ☐Yes ☒No ☐ Not Applicable
   If yes, how many? Click to enter number here.

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 **FY19 award period (6/8/19 - 6/7/21)**. All columns must be completed for each listed germplasm/cultivar. Use the key below the table for Grain Class abbreviations.

NOTE: 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	FHB Rating (0-9)	Year Released
Nothing to report.	Select Grain Class	Select what represents your most resistant check	Enter as text 0-9 rating	Select Year
Click here to enter text.	Select Grain Class	Select what represents your most resistant check	Enter as text 0-9 rating	Select Year
Click here to enter text.	Select Grain Class	Select what represents your most resistant check	Enter as text 0-9 rating	Select Year
Click here to enter text.	Select Grain Class	Select what represents your most resistant check	Enter as text 0-9 rating	Select Year
Click here to enter text.	Select Grain Class	Select what represents your most resistant check	Enter as text 0-9 rating	Select Year
Click here to enter text.	Select Grain Class	Select what represents your most resistant check	Enter as text 0-9 rating	Select Year
Click here to enter text.	Select Grain Class	Select what represents your most resistant check	Enter as text 0-9 rating	Select Year
Click here to enter text.	Select Grain Class	Select what represents your most resistant check	Enter as text 0-9 rating	Select Year
Click here to enter text.	Select Grain Class	Select what represents your most resistant check	Enter as text 0-9 rating	Select Year
Click here to enter text.	Select Grain Class	Select what represents your most resistant check	Enter as text 0-9 rating	Select Year
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Click here to enter text.	Select Grain Class	Select what represents your most resistant check	Enter as text 0-9 rating	Select Year
Click here to enter text.	Select Grain Class	Select what represents your most resistant check	Enter as text 0-9 rating	Select Year

NOTE: List the associated release notice or publication under the appropriate sub-section in the 'Publications' section of the FPR.

FY19 Final Performance Progress Report
PI: Mohammadi, Mohsen
USDA-ARS Agreement #: 59-0206-8-214
Reporting Period: 6/8/19 - 6/7/21

Publications, Conference Papers, and Presentations

Instructions: Refer to the FPR_Instructions for detailed more instructions for listing publications/presentations about your work that resulted from all of the projects included in the FY19 grant award. Only citations for publications published (submitted or accepted) or presentations presented during the **award period (6/8/19 - 6/7/21**) should be included. If you did not publish/submit or present anything, state 'Nothing to Report' directly above the Journal publications section.

NOTE: Directly below each citation, you **must** indicate the Status (i.e. published, submitted, etc.) and whether acknowledgement of Federal support was indicated in the publication/ presentation. See example below for a poster presentation with an abstract:

> Winn, Z.J., Acharya, R., Lyerly, J., Brown-Guedira, G., Cowger, C., Griffey, C., Fitzgerald, J., Mason R.E., and Murphy, J.P. (2020, Dec 7-11). Mapping of Fusarium Head Blight Resistance in NC13-20076 Soft Red Winter Wheat (p. 12). In: Canty, S., Hoffstetter, A. and Dill-Macky, R. (Eds.), *Proceedings of the 2020 National Fusarium Head Blight Forum*. https://scabusa.org/pdfs/NFHBF20_Proceedings.pdf.
> Status: Abstract Published and Poster Presented
> Acknowledgement of Federal Support: YES (Abstract and Poster)

Journal publications.

Gaire, R., Ohm, H., Brown-Guedira, G., and Mohammadi, M. 2020. Identification of Regions under Selection and Loci Controlling Agronomic Traits in a Soft Red Winter Wheat. The Plant Genome 13, e20031 doi.org/10.1002/tpg2.20031.
Status: Published
Acknowledgement of Federal Support: YES

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

None

Other publications, conference papers and presentations.

Gaire, Rupesh, Brown-Guedira, Gina, Ohm, Herb, and Mohammadi, Mohsen. 2019. Genome-wide Association Studies of Fusarium Head Blight Disease Resistance in Soft Red Winter Wheat Population *(p. 50).* In: S. Canty, A. Hoffstetter, H. Campbell and R. Dill-Macky (Eds.), *Proceedings of the 2019 National Fusarium Head Blight Forum*, Milwaukee, WI; December 8-10. University of Kentucky, Lexington, KY.
Status: Published
Acknowledgement of Federal Support: Yes (Abstract)

Gaire, Rupesh, Arrudo, Marcio P., Mohammadi, Mohsen, Kolb, Frederic K. and Rutkoski, Jessica. 2020. "Multivariate Genomic Prediction for Fusarium Head Blight Resistance in Soft Red Winter Wheat." In: S. Canty, A. Hoffstetter, and R. Dill-Macky (Eds.), *Proceedings of the 2020 National Fusarium Head Blight Forum (*p. 103.), Virtual; December 7-11. Online: https://scabusa.org/pdfs/NFHBF20_Proceedings.pdf.
Status: Published
Acknowledgement of Federal Support: Yes (Abstract and Poster)

Presentations

ASA-CSSA-SSSA International Annual Meeting. San Antonio, Texas, Nov. 10-13
Status: Presented
Acknowledgement of Federal Support: YES

National Association of Plant Breeders Annual Meeting. Callaway Gardens – Pine Mountain, Ga. August 25-29.
Status: Presented
Acknowledgement of Federal Support: YES