

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

Cover Page

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Fiscal Year:	2017
USDA-ARS Agreement ID:	59-0206-4-013
USDA-ARS Agreement Title:	Development of Hard Spring Wheat Cultivars Resistant Scab Disease.
FY17 USDA-ARS Award Amount:	\$ 119,943
Recipient Organization:	North Dakota State University Office of Grant & Contract Accounting NDSU Dept 3130, PO Box 6050 Fargo, ND 58108-0650
DUNS Number:	80-388-2299
EIN:	45-6002439
Recipient Identifying Number or Account Number:	FAR0022046
Project/Grant Reporting Period:	5/5/17 - 5/4/18
Reporting Period End Date:	5/4/2018

USWBSI Individual Project(s)

USWBSI Research Category*	Project Title	ARS Award Amount
VDHR-SPR	Development of Hard Spring Wheat Cultivars Resistant to Scab Disease.	\$ 119,943
	FY17 Total ARS Award Amount	\$ 119,943

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: *Development of Hard Spring Wheat Cultivars Resistant to Scab Disease.*

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

- Continue to develop varieties adapted to the Northern Plains spring wheat region which are at least moderately resistant to Fusarium head blight.
- Screen breeding lines, varieties, and uniform nurseries in misted, inoculated nurseries, and test those entries for DON accumulation.
- Characterize non-Fhb1 resistance present in breeding program through marker-assisted selection and phenotyping.
- Introgress novel germplasm from pre-breeding into adapted spring wheat backgrounds with suitable end-use quality for breeding and cultivar development.
- Utilize marker assisted selection for FHB resistance in cooperation with the USDA-ARS genotyping facility.

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

a) major activities; b) specific objectives; c) significant results; d) key outcomes or other achievements

- Continue to develop varieties adapted to the Northern Plains spring wheat region which are at least moderately resistant to Fusarium head blight.
 - a) Lines advanced in our breeding program are all at least moderately resistant to FHB, relative to our local checks.
 - b) We screened for visual disease severity, test weight, and DON accumulation for all entries in the 2017 nurseries. We select for lines that are both visually free from disease in addition to producing sound grain that is free from excessive DON accumulation.
 - c) Our results in 2017 were good enough to make advancement decisions in the breeding program, and publicize the results from released varieties in the annual variety trial results and variety selection guide.
 - d) In 2017, fourth year breeding lines averaged 3.1 on a 1-9 scale for FHB visual severity, whereas the commercial checks (including long term resistant checks) averaged 3.4.
- Screen breeding lines, varieties, and uniform nurseries in misted, inoculated nurseries, and test those entries for DON accumulation.
 - a) We screened 3120 entries at two locations North Dakota, including all released varieties in the ND variety trial, and every experimental line in the breeding program. All data collected on uniform regional nurseries were made public to cooperators.
 - b) We are selecting for low DON accumulation and low Fusarium damaged kernels, in addition to low disease severity.
 - c) We identified lines that showed disease symptoms but did not have higher DON than the susceptible checks, as well as lines that appeared to have low severity but

still had high DON. Both are important in the breeding program, since the result to producers and end-users is affected grain and Type I and Type II errors are made by advancing breeding lines based on visual score alone.

- d) We secured 3000 data points for DON accumulation through USWBSI labs to assist with advancement decisions.
- Characterize non-Fhb1 resistance present in breeding program through marker-assisted selection and phenotyping.
 - a) Experimental lines which are consistently null for Fhb1 and Fhb5 but appear resistant in field screening were advanced for further study.
 - b) We are working with collaborators at NDSU to identify potential sources of this resistance, most of which is coming through Glenn, a known resistant line not containing Sumai-3 based resistance.
 - c) Because of its high end use quality and FHB resistance, Glenn based resistance is important for our program and it has been used extensively as a crossing parent.
 - d) Entries containing Glenn alleles in the fourth year yield test had an average severity of 3.1, while the commercial checks, had an average of 3.5.
 - Introgress novel germplasm from pre-breeding into adapted spring wheat backgrounds with suitable end-use quality for breeding and cultivar development.
 - a) 61 new F2 populations were screened under disease pressure in 2017. These populations were developed by Dr. Xiwen Cai, and our program made selections in the populations for FHB resistance, as well as agronomic suitability. We also tested 170 experimental lines containing potentially beneficial novel alleles developed by Dr. Cai's program. We will continue to screen these for use in our breeding program.
 - b) We are trying to identify novel sources of FHB resistance which can be utilized in our crossing program. The goal is to identify superior FHB resistance so that those genotypes can be evaluated in trials for yield and baking potential.
 - c) Around 75% of the populations tested in 2017 were advanced after screening in 2017, and a select number of experimental lines showing promise are being tested in 2018 trials.
 - d) F3 populations and second year experimental lines are being tested in 2018.
 - Utilize marker assisted selection for FHB resistance in cooperation with the USDA-ARS genotyping facility
 - a. Every experimental line in the breeding program was screened for Fhb1, and the data were used to augment disease nursery scores to make advancement decisions.
 - b. While we are striving to identify non-Fhb1 resistance in our program, known QTL conferring resistance are the highest value. By utilizing marker assisted selection, we are increasing the number of lines in our program containing desirable alleles.
 - c. Marker assisted selection for Fhb1 continues to be an important tool for early yield tests, where field based data is still limited.

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- d. 31% lines in the preliminary yield test were found to be homozygous for Fhb1, good considering the high percentage of Glenn based (non-Fhb1) resistance in our program.

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

We have worked to train 6 undergraduate students, most of whom were financially supported through the project. They assist with all aspects of data collection in the breeding program.

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

Results from our misted, inoculated nurseries are used to produce the FHB ratings in the annual variety trial results and variety selection guide. At approximately 6 field days each year, the PI discusses FHB resistance of relevant varieties using this data. One of the top priorities of our program is genetic resistance to important diseases, and we communicate this goal, along with the importance of FHB resistance every time there is an opportunity.

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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?**

If yes, how many? No.

- 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?**

If yes, how many? No.

- 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?**

If yes, how many? None.

- 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?**

If yes, how many? None.

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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

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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 (5/5/17 - 5/4/18). 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.