

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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| Phone: | 701-231-8159 |
| Fiscal Year: | 2017 |
| USDA-ARS Agreement ID: | 59-0206-4-010 |
| USDA-ARS Agreement Title: | Identify and Develop Durum Wheat Resistant to Fusarium Head Blight. |
| FY17 USDA-ARS Award Amount: | \$ 129,068 |
| 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: | FAR0022040 |
| 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 |
|----------------------------------|--|-------------------------|
| DUR-CP | Develop Durum Wheat Resistant to Fusarium Head Blight. | \$ 102,905 |
| DUR-CP | Identify Sources of Resistance to Fusarium Head Blight in Durum Wheat. | \$ 26,163 |
| | FY17 Total ARS Award Amount | \$ 129,068 |

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: *Develop Durum Wheat Resistant to Fusarium Head Blight.*

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

The relevance of the project's objectives to the goals and research priorities of the USWBSI are as follows:

- a) Breeding FHB-resistant durum wheat (Action VDHR goals 1-3 and CP priority 3-4);
- b) Screen durum populations/experimental lines for FHB resistance in greenhouses and irrigated field nurseries (Action VDHR goal 2 and CP priority 1);
- c) Evaluate experimental lines for DON (Action VDHR goal 2 and CP priority 4);
- d) Use marker assisted selection at the USDA-ARS Genotyping Center in Fargo, ND for selection of valuable loci (Action VDHR goal 2-3 and CP priority 2);
- e) Evaluate identified FHB resistant lines for quality (Action VDHR goal 2 and CP priority 3-4); and
- f) Develop new populations by crossing adapted germplasm to newly identified sources of resistance (Action VDHR goal 1-3 and CP priority 3-4).

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

1) major activities

- 3 lines were evaluated in the Uniform Regional Durum Nursery
- 10 lines were evaluated in the Elite Advanced Yield Trial
- 49 lines were evaluated in the Advanced Yield Trials
- 360 lines were evaluated in the Preliminary Yield Trials
- 73 populations were screened in the field and greenhouses
- 14 new populations were developed
- 2,451 lines were tested for DON
- 7,500 lines were evaluated in the FHB nursery in Prosper, ND
- 742 lines were evaluated in the FHB nursery in Fargo, ND
- 2,100 lines were evaluated in the FHB nurseries at Langdon, ND
- 965 lines were genotyped at the USDA-ARS Genotyping Center in Fargo, ND

2) specific objectives

The specific objective of this project is to develop germplasm that is resistant to FHB with good agronomic and quality traits that can be used by producers, millers, and the pasta industry. We will continue developing resistant germplasm using native resistance, resistant wild relatives, and world collection accessions. We will evaluate the developed resistant germplasm for agronomic and quality traits. Combine FHB resistance with low cadmium uptake in the newly developed germplasm.

3) significant results

- All material listed in major activities above was successfully screened in FHB field irrigated nurseries and the greenhouse.
- Several lines were successfully genotyped at the USDA-ARS Genotyping Center in Fargo, ND.
- All experimental lines in yield trials were evaluated for agronomic and quality traits.
- Several experimental lines from yield trials were evaluated for low cadmium uptake.
- Several experimental lines with moderate resistance that is combined with low cadmium uptake were selected and advanced to be evaluated in 2018.

4) key outcomes or other achievements

Divide, Carpio, and Joppa the moderately FHB resistant cultivars, continue to rank the top three in durum planted acreage. Collectively they are planted on 49.7% of the acreage in North Dakota. In 2017, we released a new moderately resistant cultivar ND Riveland. ND Riveland has the lowest disease severity when compared to all cultivars grown in ND. It also has lower DON than all the cultivars with the exception of Joppa. Based on FHB resistance, yield advantage, and the current grown acreage, the four cultivars will generate millions of dollars into the economy.

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

Three students rated scab nurseries.

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

Gave presentations at Field Days hosted by NDSU Research Centers and to trade teams through ND Wheat Commissions.

Project 2: *Identify Sources of Resistance to Fusarium Head Blight in Durum Wheat.*

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

The relevance of the project's objectives to the goals and research priorities of the USWBSI are as follow:

- 1) Screen diverse durum accessions from ICARDA for reaction to FHB in an FHB screening nursery located at the Jiangsu Academy of Agricultural Sciences in Nanjing, China (Action VDHR goals 1-3 and CP priority 1);
- 2) Re-evaluate the accessions exhibiting high levels of resistance in the preliminary screening test in the greenhouse and field screening nurseries in North Dakota (Action VDHR goals 1-3 and CP priority 1) ;
- 3) Determine whether the new sources of resistance carry novel resistant loci by marker haplotyping using the existing markers associated with known resistant QTL (Action VDHR goals 3 and CP priority 2);
- 4) Make crosses using the resistant lines and distribute them to durum wheat breeders (Action VDHR goals 1-3 and CP priority 3).

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

- 1) major activities
 - 6,053 accessions from ICARDA have been evaluated to date. After several evaluations in the field and greenhouses three accessions maintained disease severity less than 30%. Fifteen populations were developed from crossing the three accessions with adapted germplasm.
 - 1,000 new lines were sent to China for evaluation.
 - 246 selected ICARDA accessions from 2016 were reevaluated in the fall 2017 greenhouse.
 - 81 lines were tested and advanced from crossing adapted germplasm with Tunisian 7.
 - 2 F5 populations were advanced in New Zealand winter nursery from crossing adapted germplasm with Tunisian 7.
 - 1 F5 population was advanced in New Zealand winter nursery from crossing adapted germplasm with *Triticum dicoccum*.
 - 15 F5 populations were advanced in New Zealand winter nursery from crossing adapted germplasm with ICARDA accessions.
 - 5 F5 populations were evaluated in yield trials from crosses of adapted lines to *T. Carthilicum*.
 - 4,000 F2 plants were genotyped from crosses of adapted lines with wild relatives.
 - 38 F4 populations were advanced from crossing adapted lines to various sources of unadapted moderately resistant accessions.
 - 14 F3 populations were advanced from crossing adapted lines to various sources of unadapted moderately resistant accessions.

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2) specific objectives

The major goal of the project is to identify new sources of tetraploid FHB resistant germplasm. A more specific objective is to screen the ICARDA material in order to identify resistant durum wheat and ultimately introgress the resistant genes into the cultivated durum wheat cultivars to reduce the threat of the FHB disease.

3) significant results

- ICARDA accessions were successfully screened in FHB field irrigated nurseries in China.
- Selected ICARDA accessions were successfully screened for FHB in greenhouses.
- Several experimental lines with FHB resistance from wild relative and Tunisian sources of resistance were evaluated in yield trials for agronomic and quality traits.

4) key outcomes or other achievements

Using wild relatives and unadapted germplasm normally is associated with linkage drag. However, from crossing adapted lines to various sources of unadapted moderately resistant accessions, several experimental lines with lower linkage drag were selected and evaluated in yield trials.

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

Three students rated scab nurseries.

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

Gave presentations at Field Days hosted by NDSU Research Centers and to trade teams through ND Wheat Commissions.

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?

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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 |
|----------------------------|-------------|--|------------------------|------------------|
| ND Riveland | DUR | MR | 4 | 2017 |
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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.

Journal publications.

Nothing to report

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

Nothing to report

Other publications, conference papers and presentations.

Jitendra Kumar, Farhad Ghavami, Seyed M. Pirseyedi, Ajay Kumar, Steven Xu, Elias M. Elias, Ruth Dill-Macky, and Shahryar Kianian (2017). Epigenetic control of fhb in durum wheat. In: S. Canty, K. Wolfe, and D. Van Sanford (Eds.), Proceedings of the 2017 National Fusarium Head Blight Forum. East Lansing, MI/Lexington, KY: U.S. Wheat & Barley Scab Initiative. p. 82.

Status: Abstract Published and poster presented

Acknowledgement of Federal Support: YES

A. Szabo-Hever, Q. Zhang, S. Zhong, T.L. Friesen, E.M. Elias, S.S. Xu and S. Chao (2017). Association mapping for Fusarium head blight resistance in synthetic hexaploid wheat. In: S. Canty, K. Wolfe, and D. Van Sanford (Eds.), Proceedings of the 2017 National Fusarium Head Blight Forum. East Lansing, MI/Lexington, KY: U.S. Wheat & Barley Scab Initiative. p. 97.

Status: Abstract Published and poster presented

Acknowledgement of Federal Support: YES