

**USDA-ARS/
U.S. Wheat and Barley Scab Initiative
FY15 Final Performance Report
Due date: July 15, 2016**

Cover Page

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Phone:	701-239-1327
Fiscal Year:	2015
USDA-ARS Agreement ID:	N/A
USDA-ARS Agreement Title:	Introgression of Scab Resistance from Emmer and Timopheev Wheat into Durum Wheat.
FY15 USDA-ARS Award Amount:	\$ 52,520

USWBSI Individual Project(s)

USWBSI Research Category*	Project Title	ARS Award Amount
DUR-CP	Mapping and Introgression of Scab Resistance from Emmer wheat to Durum Wheat.	\$ 52,520
FY15 Total ARS Award Amount		\$ 52,520

July 15, 2016

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: Mapping and Introgression of Scab Resistance from Emmer wheat to Durum Wheat.

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

The major goals and objectives of the project are 1) to identify the FHB-resistant QTL in *Triticum dicoccum* PI 272527 and durum (*T. durum*) Divide and 2) to develop elite durum germplasm with improved FHB resistance and superior agronomic performance using previously developed populations and germplasm with FHB resistance.

2. What was accomplished under these goals?

Objective 1: Identify the FHB-resistant QTL in *T. dicoccum* PI 272527 and durum Divide

1) major activities

- A population (DP527) of 140 recombinant inbred lines (RILs) from the cross Divide × PI 272527 was developed and 129 of the RILs in F₇ generation with adequate seed were evaluated in two replicated experiments (single-spikelet inoculation and grain inoculum method) in the FHB nursery in Fargo, ND in the summer of 2015.
- Additional RILs from the cross Divide × PI 272527 were further developed in order to expand the population size. A population of 219 RILs in F₇ generations, including the original 129 RILs, was finally established. The 219 RILs were increased in greenhouse to produce adequate seeds for field and greenhouse evaluation experiments.
- The 219 RILs, their parents, and checks were evaluated in two greenhouse seasons in the winter of 2015 and the spring of 2016. They were also planted and are currently being evaluated in the field FHB nurseries at two locations (Fargo and Prosper, ND) in the summer of 2016. The evaluation in Fargo is performed in two experiments (single-spikelet inoculation and grain inoculum method).
- The population was genotyped using Infinium iSelect HD Custom Kit (90K SNP chips) and a high density linkage map covering all 14 chromosomes has been constructed with the polymorphic SNP markers. A preliminary QTL analysis was performed using the SNP marker data and the disease data collected from the evaluation experiments in the greenhouse and the FHB nursery in the summer of 2015.

2) specific objectives

- Identify the FHB-resistant QTL in *T. dicoccum* PI 272527 and durum cultivar Divide.

3) significant results

- A total of six QTL on chromosomes 1A, 1B, 2A, 3A, 5A, and 7B and linked SNP markers have been tentatively identified based on the preliminary QTL analysis.

4) key outcomes or other achievements

- Among the six QTL were identified, one (2A) and five were derived from Divide and PI 272527, respectively. These results further confirmed presence of minor QTL for FHB resistance in the ND durum cultivars recently developed and additive effort of five QTL is responsible for the high level of FHB resistance in PI 272527.

Objective 2: Develop elite durum germplasm with improved FHB resistance and superior agronomic performance

1) major activities

- A total of 31 BC₁F₄ and 229 BC₁F₅ durum lines derived from the 2nd round of introgression of FHB resistance derived from four *T. dicoccum* accessions (PI 41025, PI 254188, PI 254193, and PI 272527), two *T. carthlicum* accessions (PI 61102 and PI 94748), and common wheat lines PI 277012, ‘Sumai 3’, and TC67 (a derivative of *T. timopheevii* PI 343447) were evaluated for FHB resistance using replicated experiments in two FHB nurseries (Fargo and Prosper, ND) in the summer of 2015. All these lines were further grown and characterized in the greenhouse in the winter of 2015.
- A total of 258 lines in BC₁F₅ (4 lines), BC₁F₆ (62 lines), and BC₁F₇ (192 lines) generations are currently being evaluated using replicated experiments in two FHB nurseries (Fargo and Prosper, ND) in the summer of 2016.
- Ten elite durum lines, their parents and major ND durum cultivars are currently evaluated in the field FHB nursery in Fargo using single-spikelet inoculation. They are currently growing in a preliminary trial for evaluating agronomic performance, yield, and quality in two locations (Prosper and Langdon, ND).

2) specific objectives

- Develop elite durum germplasm with improved FHB resistance and superior agronomic performance

3) significant results

- Approximately 150 durum lines showed various levels of FHB resistance and 17 lines derived from the crosses for pyramiding FHB-resistance QTL from hexaploid wheat line PI 277012 and Sumai 3 exhibited a high level of FHB resistance, in the field and greenhouse evaluations. Four of the lines with the high level of FHB resistance also showed excellent agronomic traits.

4) key outcomes or other achievements

- The four durum lines with the high level of FHB resistance and excellent agronomic traits may represent the first success globally in developing adapted or elite durum germplasm with a high level of FHB resistance. They were included in the crossing block in the fall of 2015 in NDSU durum breeding program. Four lines developed in this project were also transferred to other three durum breeding programs through materials transfer agreements.

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

Nothing to Report.

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

Nothing to Report.

Training of Next Generation Scientists

Instructions: Please answer the following questions as it pertains to the FY15 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 FY15 award period?**

No.

- 2. Did any graduate students in your research program supported by funding from your USWBSI grant earn their Ph.D. degree during the FY15 award period?**

Yes, one.

- 3. Have any post docs who worked for you during the FY15 award period and were supported by funding from your USWBSI grant taken faculty positions with universities?**

Yes, one.

- 4. Have any post docs who worked for you during the FY15 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.

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 FY15 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

Refer to the FY15-FPR_Instructions for listing publications/presentations about your work that resulted from all of the projects included in the FY15 grant. If you did not have any publications or presentations, state 'Nothing to Report' directly above the Journal publications section.

Journal publications.

Nothing to Report.

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

Nothing to Report.

Other publications, conference papers and presentations.

Kianian, S.F., F. Ghavami, S.M. Pirseyedi, A. Kumar, J. Kumar, R. Dill-Macky, S. Xu and E.M. Elias. 2015. Enhancing FHB Resistance in Durum Wheat. In: S. Canty, A. Clark, S. Vukasovich and D. Van Sanford (Eds.), *Proceedings of the 2015 National Fusarium Head Blight Forum*. East Lansing, MI/Lexington, KY: U.S. Wheat & Barley Scab Initiative. p. 92.

Status: Abstract Published and poster presented

Acknowledgement of Federal Support: YES

Szabo-Hever, A., Q. Zhang, S. Zhong, T.L. Friesen, E.M. Elias, S.S. Xu and S. Chao. 2015. Characterization of new synthetic wheat germplasm for resistance to Fusarium head blight. In: S. Canty, A. Clark, S. Vukasovich and D. Van Sanford (Eds.), *Proceedings of the 2015 National Fusarium Head Blight Forum*. East Lansing, MI/Lexington, KY: U.S. Wheat & Barley Scab Initiative. p. 107-108.

Status: Abstract Published and poster presented

Acknowledgement of Federal Support: YES

Zhao, M., Y. Liu, Y. Leng, J. Li, R. Wang, Y. Long, S. Chao, S.S. Xu and S. Zhong. 2015. Development of user-friendly DNA markers for Fusarium head blight resistance QTL in PI 277012. In: S. Canty, A. Clark, S. Vukasovich and D. Van Sanford (Eds.), *Proceedings of the 2015 National Fusarium Head Blight Forum*. East Lansing, MI/Lexington, KY: U.S. Wheat & Barley Scab Initiative. p. 114-115.

Status: Abstract Published and poster presented

Acknowledgement of Federal Support: YES

Xu, S.S., S. Chao, J.D. Faris, T.L. Friesen, Z. Liu, Y. Jin, M.N. Rouse, and E.M. Elias. 2015. Development of genetic and genomic resources for target breeding in durum wheat. In: Invited Speakers & Oral presentations Abstracts, Durum Congress: From Seed to Pasta & Beyond, Bologna (31 May - 2 June 2015) and Milan (3 June 2015), Italy. http://www.fstp15.com/wp-content/uploads/2014/09/Invited_Oral.pdf.

Status: Abstract Published and invited talk presented

Acknowledgement of Federal Support: YES

(Form – FPR15)

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PI: Xu, Steven

USDA-ARS Agreement #: N/A

Xu, S., T. Friesen, S. Chao, J. Faris, S. Zhong, E. Elias, and X. Cai. 2015. Development of elite durum wheat germplasm with improved resistance to Fusarium head blight. Oral presentation at 2015 National Fusarium Head Blight Forum, St. Louis, Missouri, USA, December 6 - 8, 2015.

Status: Invited talk presented

Acknowledgement of Federal Support: YES