USDA-ARS/
U.S. Wheat and Barley Scab Initiative
FY16 Final Performance Report
Due date: July 28, 2017

Cover Page

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Fiscal Year:	2016
USDA-ARS Agreement ID:	N/A
USDA-ARS Agreement Title:	Identification and Deployment of FHB Resistance QTL in US Hard Winter Wheat.
FY16 USDA-ARS Award Amount:	$ 75,000

USWBSI Individual Project(s)

USWBSI Research Category*	Project Title	ARS Award Amount
HWW-CP	Identification and Deployment of FHB Resistance QTL in US Hard Winter Wheat.	$ 75,000
	FY16 Total ARS Award Amount	**$** 75,000

Principal Investigator — 7/26/2017 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: *Identification and Deployment of FHB Resistance QTL in US Hard Winter Wheat.*

1. **What are the major goals and objectives of the project?**
   a). Map QTL from moderately resistant cultivar Lyman
   b). Pyramid QTLs on chromosome 5A from PI 277012 with Fhb1 in Overland and Everest backgrounds
   c). Genomic selection.

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

   1) major activities

   a). Phenotyped Lyman/CI13227 F7 population and Lyman/Overley RIL F6 population in both greenhouse and field experiments and genotyped both populations with GBS

   b). Continued backcrossing marker-selected Bc_1F_1 to Everest and Overland to obtain Bc_2F_1 seeds for QTL pyramiding project.

   c). Conducted GBS and analyzed known linked markers to FHB resistance QTLs for the materials from 2015 FHB nursery.

   2) specific objectives

   Identify QTLs in Lyman and SNP markers linked to these QTLs for marker-assisted selection and pyramid Fhb1 and other QTLs with both major and minor effects using marker-assisted selection.

   3). significant results

   (1). We collected two field and two greenhouse cycles of phenotypic data for Lyman/CI13227. GBS-SNP data were collected for map construction. However, this population headed very late in Manhattan fields, and inoculation period spread 5 weeks in the greenhouse experiments, which affected FHB evaluation accuracy.
   (2). For Lyman/Overley population, GBS data were generated and phenotyping was done for one field and one greenhouse experiment.
   (3). Two 5AS QTLs were successfully pyramided with *Fhb1* in Everest and Overland backgrounds by marker-assisted backcrossing.

   4) key outcomes or other achievements

   We developed two diagnostic markers for *Fhb1*. These markers (one gel based and one KASp marker) have been requested by many programs worldwide including genotyping centers for *Fhb1* selection. We also screened a worldwide core collection of wheat germplasm and the resistance allele is present only in the germplasm from Japan and China, not in germplasm from other areas, indicating the markers are highly diagnostic.

   Based on two years of field and greenhouse data, we identified some EverestFhb1 lines with both type I and type II resistance. These lines will be used as the source of type I resistance for QTL analysis and breeding.

For genomic selection, due to patent issue with GBS, we were told not to use GBS for breeding purpose. Now we are working on a new multiplex marker technology for this application.

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

Three graduate students (Ms. Yaoguang Li, Umara Rena, and Abdul Hashimi) have worked on these projects. They learnt FHB inoculation and disease note taking, GBS library construction and GBS data analysis. Visiting scientists Dr. Pingping Zhang and Chengjin Guo were also trained for FHB inoculation and disease note taking.

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

Fhb1 lines from all crosses project were distributed to breeding programs for further evaluation of FHB resistance and other traits in their breeding nurseries.

One *Fhb1* line in Overland background was tested in regional performance nursery this year by NE program.

Developed markers for *Fhb1* have been sent to other genotyping lab and more than 10 breeding programs worldwide.

Training of Next Generation Scientists

Instructions: Please answer the following questions as it pertains to the FY16 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 FY16 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 FY16 award period?**

   If yes, how many? Yes, three.

3. **Have any post docs who worked for you during the FY16 award period and were supported by funding from your USWBSI grant taken faculty positions with universities?**

   If yes, how many? Yes. Two.

4. **Have any post docs who worked for you during the FY16 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? 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 FY16 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 FY16-FPR_Instructions for detailed instructions for listing publications/presentations about your work that resulted from all of the projects included in the FY16 grant. Only include citations for publications submitted or presentations given during your award period. If you did not have any publications or presentations, state 'Nothing to Report' directly above the Journal publications section.

Journal publications.

J. Cai, S. Wang, T Li, G. Bai. 2016. Multiple minor QTLs are responsible for Fusarium head blight resistance in Chinese wheat landrace Haiyanzhong. PloS ONE DOI:10.1371/journal.pone.0163292
Status: Published
Acknowledgement of Federal Support: YES

Zhenqi Su, Amy Bernardo, Bin Tian, Shan Wang, Hongxiang Ma, Shibin Cai, Dongtao Liu, Dadong Zhang, Tao Li, Harold Trick, Paul St. Amand, Guihua Bai. A loss-of-function mutation in an HRC-like gene confers Fhb1 resistance to Fusarium head blight in wheat.
Status: submitted
Acknowledgement of Federal Support: Yes

T. Li, M. Luo, D. Zhang, D. Wu, L. Li, G. Bai. 2016. Effective marker alleles associated with type 2 resistance to Fusarium head blight infection in fields. Breed Sci. doi:10.1270/jsbbs.15124.
Status: Published
Acknowledgement of Federal Support: No

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

Other publications, conference papers and presentations.

Zhenqi Su and Guihua Bai. 2017 A sequence deletion in HRC-like gene confer Fhb1 resistance to Fusarium head blight in wheat. In: Proceedings of the XXIV International Plant & Animal Genome Conference, San Diego, CA.
Status: Abstract Published and Poster Presented
Acknowledgement of Federal Support: YES (poster), NO (abstract).

Z, Su, S. Jin, A. Bernardo, P. St. Amand, G. Bai. 2016. Development of high-throughput diagnostic markers for Fhb1, a major gene for FHB resistance in wheat. 2016 National Fusarium Head Blight Forum, St. Louis, MO, December 2016.
Status: Abstract Published and Poster Presented
Acknowledgement of Federal Support: YES.

Guihua Bai. 2017. Wheat resistance to Fusarium head blight. Invited symposium speaker, in Joint Annual General Meeting of the Canadian Phytopathological Society (CPS) and The Canadian Society of Agronomy (CSA), Winnipeg, Manitoba, Canada, June 18-21, 2017.
Status: Abstract Published and oral Presentation delivered
Acknowledgement of Federal Support: YES (presentation). No (abstract)

Zhenqi Su, Amy Bernardo, Bin Tian, Shan Wang, Hongxiang Ma, Shibin Cai, Dongtao Liu, Dadong Zhang, Tao Li, Harold Trick, Paul St. Amand, Jianming Yu, Zengyan Zhang, Guihua Bai. 2017. A Candidate gene regulates Fhb1 resistance to Fusarium head blight in wheat
Status: Abstract Published, Poster Presented and oral presentation delivered.
Acknowledgement of Federal Support: YES.