USDA-ARS/
U.S. Wheat and Barley Scab Initiative
FY14 Final Performance Report
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Cover Page

PI:	Guihua Bai
Institution:	USDA-ARS
Address:	Plant Science and Entomology Research Unit (PSERU) 4008Throckmorton Hall Manhattan, KS 66506
E-mail:	gbai@ksu.edu
Phone:	785-532-1124
Fax:	785-532-6167
Fiscal Year:	FY14
USDA-ARS Agreement ID:	NA
USDA-ARS Agreement Title:	Identification and Deployment of FHB Resistance QTL in US Hard Winter Wheat.
FY14 USDA-ARS Award Amount:	$ 107,108

USWBSI Individual Project(s)

USWBSI Research Category*	Project Title	ARS Award Amount
HWW-CP	Doubled Haploidy to Rapidly Develop FHB Tolerant, Low DON Wheat Cultivars.	$ 51,500
HWW-CP	Identification and Deployment of FHB Resistance QTL in US Hard Winter Wheat.	$ 55,608
	FY14 Total ARS Award Amount	**$ 107,108**

7/9/2015

Principal Investigator Date

* MGMT – FHB Management
FSTU – Food Safety, Toxicology, & Utilization of Mycotoxin-contaminated Grain
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
WES-CP – Western 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: *Doubled Haploidy to Rapidly Develop FHB Tolerant, Low DON Wheat Cultivars.*

1. **What major problem or issue is being resolved relevant to Fusarium head blight (scab) and how are you resolving it?**

   Fusarium head blight (FHB) has been more frequent and severe in hard winter wheat (HWW) region of the Great Plains. Transferring major QTL into adopted hard winter wheat will minimize losses caused by FHB epidemics. Marker-assisted backcross has been used to transfer *Fhb1* and other QTL into adapted US HWW. Because marker selection was done only for *FHB* resistance QTL, not for other traits, it takes several years of selection before the selected plants become homozygous for these traits. We use double haploid technique that can quickly fix these traits and generate homozygous plants in a year. This technique in couple with marker-assisted selection significantly speeds up the breeding process and shortens the breeding cycle.

2. **List the most important accomplishments and their impact (i.e. how are they being used) to minimize the threat of Fusarium Head Blight or to reduce mycotoxins. Complete both sections; repeat sections for each major accomplishment:**

   Accomplishment:

   About 500 DH lines were produced in HPI. First two batches were increased with additional 200 RILs from gene pyramiding experiments in Arizona and ~100 to 1000 g seeds are available for these lines. These lines are also being genotyped for *Fhb1* markers to confirm the presence of *Fhb1* gene. The third batch of DH was generated in this April and they are being increased in HPI this summer. All these lines will be ready for release this fall.

   Impact:

   The selected DH plants with target FHB resistance gene are homozygous for all agronomic traits. After increase, these seeds from all crosses will be distributed to five breeding programs for further evaluation of FHB resistance and other traits in their breeding nurseries. Selected lines can be used as adapted FHB resistant parents for breeding and may result in new cultivars after further yield testing, which will lead to quick improvement of FHB resistance in HWW.

Project 2: *Identification and Deployment of FHB Resistance QTL in US Hard Winter Wheat.*

1. **What major problem or issue is being resolved relevant to Fusarium head blight (scab) and how are you resolving it?**

   In the U.S. most of hard winter wheat are grown in the central and southern Great Plains. Currently used commercial HWW cultivars in the region are highly FHB susceptible, thus FHB is becoming one of the major breeding objectives in 5 out of 7 states in the Great Plains. A major FHB resistance QTL (*Fhb1*) from Ning7840 or Sumai3 has been mapped and proved to have stable and large effects on type II resistance. *Fhb1* significantly improves the resistance in diverse genetic backgrounds. However, it has not been deployed in HWW in the Great Plains. Because of poor adaptation of Ning7840 in the Great Plains, direct use of Sumai 3 as *Fhb1* donor has not been successful. We are using marker-assisted backcross to transfer major FHB resistance QTL *Fhb1* and other QTL from Asian sources into adapted hard winter wheat to quickly deploy these QTL in hard winter wheat germplasm and cultivars. This work will provide adapted HWW germplasm with *Fhb1* gene and some of the selected breeding lines may lead to release of new FHB resistant cultivars after further yield testing in the CP breeding programs.

2. **List the most important accomplishments and their impact (i.e. how are they being used) to minimize the threat of Fusarium Head Blight or to reduce mycotoxins. Complete both sections; repeat sections for each major accomplishment:**

   Accomplishment:

   a. In MAS project, *Fhb1* from WesleyFhb1 previously developed in my lab was transferred into 11 different elite breeding lines or newly released susceptible cultivars from 5 states. About 30 to 50 backcross lines from each backcross were screened for FHB resistance in greenhouse and field experiments this spring. These lines were increased in Arizona this spring and will be available to breeders this fall.
   b. Overland/Overley F6 was phenotyped for FHB resistance in both greenhouse and field this spring season and genotyped using GBS marker. A GBS map was constructed and will be used for QTL mapping.
   c. Lyman/Overley F5 seeds were obtained and ready for FHB evaluation next cycle.

   Impact:

   Developed germplasm using marker-assisted backcross will be important for breeding programs in OK, NE, SD, ND and KS to use them as FHB resistant parents or directly to select resistant cultivars. Because the recurrent parents were contributed by the 5 states, some selected lines will have *Fhb1* and minor QTL from local lines good, as well as local adaptation, and can be directly used as cultivars to quickly relieve FHB damage in HWW growing region where FHB resistant cultivar currently is not available. Also, these selected lines can be used as breeding parents to quickly move *Fhb1* to their elite breeding lines to

develop new cultivars. In addition, this work also demonstrates that marker-assistant backcross can be a powerful tool to quickly deploy FHB QTL when breeding programs closely collaborate with the USDA genotyping lab.

Overland is a moderately resistant cultivar developed from the Great Plains area and it contain resistance genes from a native source. Identification QTL from this cultivar will facilitate utilization of native QTL to improve FHB resistance.

Training of Next Generation Scientists

Instructions: Please answer the following questions as it pertains to the FY14 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 FY14 award period?** Yes

   If yes, how many? One.

2. **Did any graduate students in your research program supported by funding from your USWBSI grant earn their Ph.D. degree during the FY14 award period?** Yes

   If yes, how many? Two

3. **Have any post docs who worked for you during the FY14 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 FY14 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?

Include below a list of all germplasm or cultivars released with full or partial support of the USWBSI during the FY14 award period. List the release notice or publication. Briefly describe the level of FHB resistance. *If not applicable because your grant did NOT include any VDHR-related projects, enter N/A below.*

No

Include below a list of the publications, presentations, peer-reviewed articles, and non-peer reviewed articles written about your work that resulted from all of the projects included in the FY14 grant. Please reference each item using an accepted journal format. If you need more space, continue the list on the next page.

Proceeding Abstracts:

J. Cai, S. Wang, and G. Bai. 2014. Meta-analysis of Fusarium head blight resistance QTL in Chinese wheat landraces. 2014 National Fusarium Head Blight Forum, St. Louis, MO, December 2014

G. Bai, J Cai, Z Su, P. St. Amand, A Bernado W. Bockus, S. Beanziger, B. Carver, A. Fritz, W. Berzonsky and F. Marais. 2014. Using marker-assisted selection to improve hard winter wheat FHB resistance. 2014 National Fusarium Head Blight Forum, St. Louis, MO, December 2014

Z-Q Su, S-J Jin, A.N. Bernardo, S-M Chao and G-H Bai. 2014. Develop SNP markers for Fhb1 through fine mapping using wheat 90K SNP arrays. 2014 National Fusarium Head Blight Forum, St. Louis, MO, December 2014.