USDA-ARS/
U.S. Wheat and Barley Scab Initiative
FY14 Final Performance Report
July 15, 2015

Cover Page

PI:	Bikram Gill
Institution:	Kansas State University
Address:	Department of Plant Pathology 4024 Throckmorton Manhattan, KS 66506-5502
E-mail:	bsg@ksu.edu
Phone:	785-532-1391
Fax:	785-532-5692
Fiscal Year:	FY14
USDA-ARS Agreement ID:	59-0206-2-088
USDA-ARS Agreement Title:	Alien Chromosome Engineering and the Deployment of a Novel Source of Fusarium Head Blight Resistance in Wheat.
FY14 USDA-ARS Award Amount:	$ 63,230

USWBSI Individual Project(s)

USWBSI Research Category*	Project Title	ARS Award Amount
GDER	Cloning and Validation of the FHB1 QTL from Sumai3 for Resistance to Wheat Scab.	$ 63,230
	FY14 Total ARS Award Amount	**$ 63,230**

Principal Investigator — Date: 7/10/15

* 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: *Cloning and Validation of the FHB1 QTL from Sumai3 for Resistance to Wheat Scab.*

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

Fhb1 from Chinese Landrace Sumai 3 is a very important source of resistance to scab of wheat, and several groups have attempted its cloning in the past. Cloning of Fhb1 will enable wheat breeders to utilize it better by enabling us to avoid the associated linkage drag, and to combine it with native resistance. It can be even used transgenically to enhance the level of resistance in wheat and also in barley.

We have done map-based cloning of *Fhb1*. A BAC library with ~2X coverage previously developed from a USBWI funded grant to Akhunov, Anderson, Pumphrey and Gill and available in the Lab was used for sequencing the *Fhb1* region of Sumai 3. Six BACs spanning the *Fhb1* region were identified in this library using sequence information from Chinese Spring *Fhb1* region. The BACs were sequenced and annotated. The annotated genes that could be involved in disease resistance were further characterized for their candidacy. Expression patterns of the genes were studied in the spikes of a pair of resistant and susceptible near isogenic lines upon point inoculations with *Fusarium graminearum* macroconida. The candidates showing differential expression in R-NIL vs. S-NIL were selected for validation. An EMS induced TILLING population in Resistant NIL background characterized with a high mutation frequency of 1/40 kb was used for the validation of the candidate(s). Association mapping was done to see if alleles existed for the candidate gene validated. Full length sequence of the transcript of the validated gene was derived by 3' and 5' RACE. Intron-exon structure was derived and conserved domain analysis of the gene was done allowing us to predict/ hypothesize mode of action of the gene. The truncation mutants, intronic mutants and several mis-sense mutants showed loss of resistance phenotype (heavy bleaching of inoculated spikes) on account of mutation in the gene. Mutations in other genes in the *Fhb1* region was ruled out by sequencing all of them in all these mutants, establishing that the loss of resistance was due to mutations in our candidate gene only. The seeds of the inoculated mutants also had high DON content.

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: We have done map-based cloning of *Fhb1* the most important QTL.

Impact: The identification of *Fhb1* marks a new beginning for transgenically over-expressing this gene for providing strong resistance in hexaploid and durum wheat. The deployment of this gene can also be done in barley, where DON has been attributed for huge commercial losses to brewing industries. The greatest advantage of the gene is that it provides a broad spectrum durable resistance, and therefore its utilization will be economical to apply in crop improvement programs. Also, pyramiding *Fhb1* with other resistance QTL/

gene(s) should provide further enhanced and long lasting resistance in crops. Understanding the mode of action of the protein encoded by the gene will also be useful for its possible uses as a biological fungicide against *Fusarium* spp for other crops as well.

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?**
   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 FY14 award period?**
   No

   If yes, how many?

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.*

N/A

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.

Manuscript in preparation reporting cloning of the gene. Will be ready for submission by September, 2015.