

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

Cover Page

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Fiscal Year:	FY14
USDA-ARS Agreement ID:	59-0206-4-039
USDA-ARS Agreement Title:	Improving FHB resistance in Hard Winter Wheat by Molecular Breeding/Manipulation.
FY14 USDA-ARS Award Amount:	\$ 19,926

USWBSI Individual Project(s)

USWBSI Research Category*	Project Title	ARS Award Amount
HWW-CP	Improving FHB resistance in Hard Winter Wheat by Molecular Breeding/Manipulation.	\$ 19,926
	FY14 Total ARS Award Amount	\$ 19,926



Principal Investigator

July 1, 2015

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: Improving FHB resistance in Hard Winter Wheat by Molecular Breeding/Manipulation.**1. What major problem or issue is being resolved relevant to Fusarium head blight (scab) and how are you resolving it?**

This project addressed the HWW-CP milestone “Compare regulation of *Fhb1* for between resistant and susceptible genotypes. Identify genetic cofactors responsible for regulation of *Fhb1*, and develop improved markers associated with the regulation of *Fhb1*. We are trying to identify improved marker for *Fhb1* and to develop better understanding of how *Fhb1* is regulated, which will lead to clone this important gene eventually.

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 are well on our mark to fulfill what we proposed to do in the first year. We previously identified *WFhb1-1* as a genic component of *Fhb1* and developed gene-specific PCR marker *XFhb1-1* for its diagnosis on the basis of its polymorphism between Sumai 3, Ning 7840 and Y1193-6 as well as between the *Fhb1*-near isogenic pair 260-2/260-4. This marker has been tested in spring wheat and it has been found performing better than *Xumn10* for *Fhb1* diagnosis (Fig. 1). Since we received FY14 funding in June, we have investigated the existence of this marker in 11 winter wheat *Fhb1* introgression line and their parents, and four other winter wheat lines that have native FHB resistance (Table 1).

Table 1. Results of marker screening using *Xumn10* and *XFhb1-1*.

Wheat lines	FHB phenotype*	<i>Xumn10</i> haplotype	<i>XFhb1-1</i> haplotype
Sumai 3	R	+	+
Y1193-6	S	-	-
260-02	R	+	+
260-04	S	-	-
Ning 7840	R	+	+
Wesley	S	-	-
Wesley FHB-095-103	R	+	-
Wesley FHB-095-104	R	+	-
Wesley FHB-095-105	R	+	-
Trego	S	-	+
Trego FHB-095-98	R	+	-
Trego FHB-095-100	MS	+	+

Wheat lines	FHB phenotype*	<i>Xumn10</i> haplotype	<i>XFhb1-1</i> haplotype
Ning/Clark NIL23	R	+	+
Ning/Clark NIL75	R	+	+
Ning/Clark NIL98	S	+	+
Harding	S	-	+
Harding-095-107	S	+	+
Harding-095-108	S	+	+
Harding-095-109	S	+	-
T154	R	-	-
Ernie	R	-	-
Freedom	R	-	-
Roane	R	-	-

R: resistant; S: susceptible; MS: median susceptible; +: resistance type; -: susceptibility type

*: based on Zhuang et al. (2013) and Jin et al. (2013), respectively.

Our investigation indicates that the sequence polymorphisms either *Xumn10* or *XFhb1* addresses are not universal in all wheat lines. More universal marker needs to be developed.

We've also investigated expression of *WFhb1-1* in these winter wheat lines at four time points after the pathogen infection with RT-qPCR assay. We have completed two runs of assay. One more biological repeats will be conducted before any conclusion can be made.

Our study of the regulatory elements of *WFhb1-1* gene (and thus *Qfhb1*) in the near isogenic pairs differing *Qfhb1* found that methylation of the elements is associated with FHB resistance (Fig. 1). More research is needed to explore the methylation patterns in more wheat lines to see if this is a universal phenomenon.

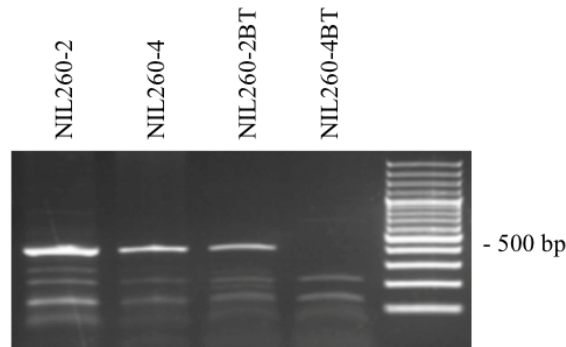


Figure 1. Results of methylation assay of the near-isogenic pairs NIL260-2 (*Qfhb1*⁺) and NIL260-4 (*Qfhb1*⁻). DNA samples were from FHB-inoculated spikelets at 48 hours after inoculation. BT: bisulfate transformed DNA samples (meC stable but C to U).

Impact:

Markers Xunn10 and XFhb1-1 are the best markers that are currently employed in marker-aided selection of *Qfhb1* for breeding wheat with improved FHB resistance in almost all breeding programs in the States. Our results indicate that both markers can introduce false positive results that may mislead the selection of *Qfhb1*, therefore should be used cautiously.

The methylation research could lead to a breakthrough in our strategy to control FHB.

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? Yes**

If yes, how many? One.

- 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.

Zhuang Y, Galla A, Qiu Y, Yen Y. “Susceptibility to Fusarium Head Blight by wheat is regulated by silencing RNAs of pathogen origin” at Plant and Animal Genome XXIII Conference, Jan 10, 2015, San Diego, CA, USA. (Invited speech)

Galla A, Zhuang Y, Qiu Y, Ali S, Yen Y. “Silencing RNA *fg-siR34* plays a key role in pathogenicity of *Fusarium graminearum*” at Edgar S. McFadden Symposium, September 23-24, 2014, Brookings, SD, USA. (Invited speech)