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

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Fiscal Year:	FY14
USDA-ARS Agreement ID:	59-0206-4-033
USDA-ARS Agreement Title:	Development of Scab Resistant Soft Wheats adapted to the Southeast.
FY14 USDA-ARS Award Amount:	$ 48,400

USWBSI Individual Project(s)

USWBSI Research Category*	Project Title	ARS Award Amount
VDHR-SWW	Enhancement of Scab Resistant Wheat Varieties Adapted to the Southeast.	$ 42,067
VDHR-SWW	Developing Doubled Haploids to Expedite Variety Development in SRWW.	$ 6,333
	FY14 Total ARS Award Amount	**$ 48,400**

Jerry W Johnson 7/10/15

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: *Enhancement of Scab Resistant Wheat Varieties Adapted to the Southeast.*

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

   During 3 consecutive years (2013-2015) in Georgia and Southeast, scab epidemics have resulted in significant loss revenue due to low grain production and unacceptable toxin levels (DON). Resistant varieties that are adapted to the Southeast with the level of FHB resistance from native resistance (Truman/Bess) or *Fhb1*- derived lines are needed. Populations with broadly adaptive cultivars or their derivatives with (Fhb1) and native resistant sources are being evaluated to developed FHB resistant varieties. Phenotyping, marker assisted selection (MAS), and Double Haploid (DH) are all being employed to identify and incorporate resistant germplasm that combine improved FHB resistance with leaf and stripe rust, wheat soil-borne mosaic virus and Hessian fly resistance. Marker Assisted Selection accelerates the development of adapted FHB resistant cultivars by the selections within populations containing *Fhb1*, 2DL, 5AS, 3BSc, and 3BL$_{Massey}$, 2B$_{Ernie}$ in the UGA molecular lab and in cooperation with Gina Brown-Guedira, USDA Genotyping Center. Data and DON samples from the Uniform Southern FHB nursery grown in Georgia are being submitted. This project is a collaborative effort with cooperators from University of Arkansas, Louisiana State University, North Carolina State University, Virginia Tech, and the USDA-ARS Genotyping Center, Raleigh, NC.

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: Breeding program: Two hundred sixteen (single, three-and four-way) crosses were made involving one or more source of native and exotic FHB resistance (Truman/Bess, Neuse, Jamestown, GA051173-S11 (derived from Truman), IL07-4415, MD08-27-E9-26, KY03C-1237-32, MO 080104) with elite Georgia lines that have moderate FHB resistance. These populations were grown in a mist-irrigated inoculated FHB nursery. Thirty-three elite lines were evaluated at two locations for yield and disease resistance. Eight elite lines that were identified in the field with FHB resistance were entered in the Uniform Southern FHB nursery of which two lines had a high level of resistance from two different sources (Jamestown and IN0411) and four lines were entered in the Uniform Southern Wheat Nursery.

   Impact: These elite lines and populations from a diverse set of sources to FHB offer potential improvement for future varietal releases in the Southeast. These elite lines and populations are available to other breeders in the region. These lines will provide additional moderate FHB resistant as parent with high yield and potentially as new varieties for Georgia's producers.

   Accomplishment: Collaborative efforts between University of Georgia and cooperators from North Carolina State University, Virginia Tech and the USDA-ARS Genotyping

Center, Raleigh, NC has increase among USWBI sponsored breeding programs through the phenotyping of germplasm sources as a potential lines with resistance, the exchange of resistance germplasm, and evaluation and selection of double haploid lines.

Impact: Derived lines with FHB resistance from diverse sources are being evaluated for agronomic and FHB resistance. These derived lines will provide new varieties for producers in the region with an improved level of FHB resistance.

Accomplishment: Marker Assisted Selection is being employed to accelerate the development of adapted FHB resistant cultivars. Selection within FHB populations are being conducted for several FHB QTL such as *Fhb 1,* 2DL, 5AS, 3BL$_{Massey}$, in the UGA molecular lab and in cooperation with Gina Brown-Guedira, USDA Genotyping Center. Over thousand lines with different combination of QTL have been identified. Recently varietal releases have been backcross (BC2, selected for Fhb1 with MAS and advanced in greenhouse for three generations to accelerated enhancement. Several diverse sources of Fhb1, Baldwin (Fhb1), NC09-20986 (Fhb1), PIO26R32 (Fhb1), and KY 97C-02-32 (Fhb1) were used for backcross with recently released GA varieties. Numerous populations and backcross population have also been developed with combination of several QTL from Truman/Bess, Jamestown, and Neuse.

Impact:
MAS selection will assist in the acceleration of new FHB resistant varieties adapted to the Southeast with improved disease and insect resistance. Marker assisted selection for the one to three QTL combination of *Fhb1*, 2DL, 5AS, and 1B$_{Jamestown}$ will enhances the potential of elite germplasm from diverse background with FHB resistance.

Project 2: *Developing Doubled Haploids to Expedite Variety Development in SRWW.*

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

   Doubled haploids (DH) allow quick introgression of resistance genes and can significantly shorten variety development time. Six breeding programs from the Southern Winter Wheat region collaborated through DH production of selected FHB resistant crosses and one mapping population. Seed of each DH line will be increased and distributed to cooperators. This project was developed through the cooperation of the six breeding programs in the Southern region and will be a source of outstanding breeding SRWW lines selected for FHB resistance that will be available and freely shared with other wheat breeders and has great potential to deliver high–impact FHB resistant varieties in a short period of time.

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 DH population, (MD08-26-H2-7-12-9 / GA031257-10E34), was generated by the Heartland, Plant Innovations Facility with over 200 DH plants obtained. MD08-26-H2-7-12-9 has three QTL (Fhb 1, 2DL, and 5AS). The DH lines will be sent to the Genotyping Lab for marker assisted selection. The DH lines will be increased and seed will be distributed to cooperators. Another five DH populations are presently being developed. Over 600 DH lines were evaluated in the field.

   Impact: Double Haploid technique has great potential to deliver high–impact FHB resistant varieties in a short period of time.

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.*

Two elite lines, GA051477-13ES4 and GA051207-13ES18 were identified as having moderate FHB resistance and produced higher yield and test weight than the check AGS2035. These two lines will be increased for possible release.

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.

Jerry Johnson, Zhenbang Chen and James Buck. 2014. FHB Resistance in Soft Red Winter Wheat. Proceeding of the 2014 National Fusarium Head Blight Forum, 83, St. Louis, MO

E. Wright, C. Griffey, S. Malla, D. Van Sanford, S. Harrison, J.P. Murphy, J. Costa, E. Milus, J. Johnson, A. McKendry, D. Schmale III, A. Clark, N. McMaster, S. Chao and G. Brown-Guedira. 2014. Identification of New QTL for Native Resistance to FHB in SRW Wheat. Proceeding of the 2014 National Fusarium Head Blight Forum, 101, St. Louis, MO