USDA-ARS/
U.S. Wheat and Barley Scab Initiative
FY10 Final Performance Report
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Cover Page

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Fiscal Year:	FY10
USDA-ARS Agreement ID:	59-0206-9-085
USDA-ARS Agreement Title:	Enhancement of Scab Resistant Wheat Cultivars Adapted to the Southeast.
FY10 USDA-ARS Award Amount:	$ 40,000

USWBSI Individual Project(s)

USWBSI Research Category*	**Project Title**	**ARS Award Amount**
VDHR-SWW	Enhancement of Scab Resistant Wheat Cultivars Adapted to the Southeast.	$ 40,000
	Total ARS Award Amount	**$ 40,000**

Principal Investigator Date

* MGMT – FHB Management
FSTU – Food Safety, Toxicology, & Utilization of Mycotoxin-contaminated Grain
GDER – Gene Discovery & Engineering Resistance
PBG – Pathogen Biology & Genetics
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: *Enhancement of Scab Resistant Wheat Cultivars 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?

Recent scab epidemics in Georgia have resulted in significant economic losses due to decreased in grain yield and unacceptable toxin levels for milling quality. A lack of varieties exists in the Southeast region with improved FHB resistance and end-use quality. Extensive phenotyping of breeding germplasm with *Fhb1* and native sources of resistance and use of Marker assisted selection (MAS) are required to identify and incorporate resistant germplasm. We are developing and releasing adapted soft red winter wheat varieties and germplasm with improved FHB resistance combined with other disease (leaf rust, stripe rust resistance and wheat soil-borne mosaic virus) and insect resistance. We are also using misted nurseries and MAS to identify FHB resistant germplasm within our breeding nurseries and in the regional Unifrom Southern Scab nursery and Uniform Southern Soft Winter Wheat nursery. In 2010, FHB infections were severe in the wheat breeding nurseries.

Marker Assisted Selection was employed to accelerate the development of adapted FHB resistant cultivars by the selections within populations containing *Fhb1*, 2DL, 5AS, 3BSc, and $5A_{Ernie}$ in the UGA molecular lab and in cooperation with Gina Brown-Guedira, USDA Genotyping Center. In other cooperation with the Regional Genotyping Center and with breeders within the southern region, backcross populations (BC_2F_3) from NC and MD and Double haploid populations were evaluated for both scab resistance and good agronomic traits. Several other backcross populations were developed with Truman, Langdon (3A dic), and Jamestown as source of FHB resistance. F_2 enrichment for several FHB resistant QTL was used on several *Fhb1* populations. Data and DON samples from the Uniform Southern FHB nursery grown in Georgia were submitted **.**

2. List the most important accomplishment and its impact (i.e. how is it being used) to minimize the threat of Fusarium head blight or to reduce mycotoxins. Complete both sections (repeat sections for each major accomplishment):

<u>Accomplishment:</u>

GA 001138-8E36 was developed and released in 2010 that is moderately resistant to scab. Three lines in the Uniform Southern Wheat Scab Nursery had very low FHB index (GA051173W-Truman/AGS 2010). Breeding lines with Truman source of resistance had similar FDK, Index, and DON ratings as Ernie. The development of high yielding SRWW cultivars with improved FHB resistance and end-use quality has been accelerated with the introgression of both native resistance from Jamestown, Truman, Neuse, Langdon, and IL 82228 and from *e*xotic resistance (*Fhb1*, 2DL, 5AS, 3BSc, $5A_{Ernie}$) in adapted variety with leaf and stripe rust resistant lines by three and four-way crosses (about 100/yr). 100 breeding populations and about 6000 headrows were also evaluated. Advanced lines, the Southern Uniform Scab nurseries, the Uniform Southern Wheat Nursery, and the GA state variety performance trial were collaborative grown and phenotyped in the misted and

inoculated (using corn inoculum applied twice) in field nursery at Griffin, GA. About 200 samples from the nurseries will be tested for DON concentration. Collaboration between breeding programs in Southern SRW region resulted in the first data on the Jamestown mapping populations for FHB index. Additional, the 175 RILs from the Jamestown mapping population were harvested and threshed for FDK and DON. Another Jamestown mapping population from SSD was generation advanced to F2:5 this summer. Double haploid populations with FHB resistance (about 400 lines) from NC were grown, evaluated and selected in the field.

Marker Assisted Backcrossing (MABC): QTL (3BS, 5AS, 2DL, 3BSc, and $5A_{Ernie}$) and Truman, Jamestown, and Neuse into SRWW background were performed using high yielding and moderately resistant FHB lines as recurrent parents. Pyramiding QTL will greatly facilitate development of cultivars that have effective FHB resistance. Exotic sources of FHB resistance from derivatives of Sumai 3, (INW 0411 (P97397E1-11)), INW 0412, VA02W-713, VA01W-461, VA 04W-433 and derived lines from W14 were crossed with our best yielding lines and were backcrossed to recurrent parents. The widely adapted, high yielding cultivar, AGS 2000 and several AGS 2000 derived lines were used as recurrent parents to develop populations of BC_1F_2 and BC_1F_3 plants with improved FHB resistance. These lines were screened for 3BS, 5AS, and 2DL. Selected lines with two QTL were crossed and backcrossed to our best elite breeding lines with leaf and stripe rust resistance. Populations and backcross populations along with selected pure lines with Jamestown, Truman, and IL82228 were made for selection with future markers. Breeding lines have been identified with moderate scab resistance with Fhb1 and Truman as source of resistance. In cooperation with other scientists and the USDA Eastern Wheat Genotyping Laboratory, populations derived from Truman (Truman / 2*AGS 2000 sib) and (Truman*2/SS8641), Neuse / AGS 2000), and Frontana (Neuse/3/Frontana/2* NC9913022)) and Jamestown (Jamestown/*2 AGS 2000) were evaluated to identify lines with FHB resistance and good agronomic performance. In collaboration with the USDA Eastern Wheat Genotyping Laboratory, selected lines with Type II resistance from a BC_3F_5 population (SS8641 // *2 Neuse) were evaluated in the field for agronomic and disease resistance (leaf and stripe rust).

Impact:

Data was collected on collaborative nurseries such as the Uniform Southern Wheat and the State Variety Performance Trial that will assist growers in their decision making on varietal selection. Wheat varieties and breeding lines from both native and exotic sources with moderate FHB resistance were identified which are adapted to the Southeast. Both native and exotic sources of scab resistance were incorporated into adapted lines with good agronomic performance. Several breeding lines with moderate scab resistance from the UGA program will be advanced to enter regional nurseries. The variety Baldwin has moderate Type II FHB resistance and is being marketed in GA.

Include below a list of all germplasm or cultivars released with full or partial support of the USWBSI. List the release notice or publication. Briefly describe the level of FHB resistance.

GA 001138-8E36 was developed and released in 2010 that is moderately resistant to scab. Three lines (GA051173W-(Truman/AGS 2010)) in the Uniform Southern Wheat Scab Nursery had very low FHB index. USG 3120 was developed and released in 2009 that is moderately susceptible to scab.

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 grant. Please reference each item using an accepted journal format. If you need more space, continue the list on the next page.

Johnson J, Bland D, Hao Y, Chen Z. 2010. Enhancement of fusarium head blight resistance in of red winter wheat using marker assisted selection. Proceedings of the 2010 National Fusarium Head Blight Forum Poster , Milwaukee, Wisconsin, pp: 146.

J. Shoots, M. Guttieri, F. Kolb, J. Lewis, A. McKendry, H. Ohm, C. Sneller, M.E. Sorrells,E. Souza, D. Van Sanford, J. Costa, C. Griffey, S. Harrison, J. Johnson and P. Murphy. 2010. Development and Distribution of Male-Sterile Facilitated Recurrent Selection Populations. Proceeding of the National FHB Forum, Milwaukee, WI.

Chen Z, Hao Y, Bland D, Brown-Guedira G, Johnson J. 2011. An integrated genetic map of soft red winter wheat using DArT and SSR markers. Plant & Animal Genome XIX Conference, San Diego, California, USA.