USDA-ARS/
U.S. Wheat and Barley Scab Initiative
FY16 Final Performance Report
Due date: July 28, 2017

Cover Page

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Fiscal Year:	2016
USDA-ARS Agreement ID:	59-0206-4-027
USDA-ARS Agreement Title:	Development of FHB Resistant Wheat Genotypes Adapted to the Gulf Coast and use of DHs to Expedite.
FY16 USDA-ARS Award Amount:	$ 59,923
Recipient Organization:	Louisiana State University Office of Accounting Services Baton Rouge, LA 70603
DUNS Number:	763201633
EIN:	72-6000848
Recipient Identifying Number or Account Number:	940-14-5116, 963-57-5116, 965-61 -5116
Project/Grant Reporting Period:	6/1/16 - 5/31/17
Reporting Period End Date:	05/31/17

USWBSI Individual Project(s)

USWBSI Research Category*	Project Title	ARS Award Amount
VDHR-SWW	Development of FHB Resistant Wheat Varieties for the Gulf Coast.	$ 50,000
VDHR-SWW	Developing Double Haploids to Expedite Variety Development in SRWW.	$ 9,923
	FY16 Total ARS Award Amount	**$ 59,923**

Stephen A Harrison 7-26-2017

Principal Investigator Date

* MGMT – FHB Management
FST – Food Safety & Toxicology
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
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

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Project 1: *Development of FHB Resistant Wheat Varieties for the Gulf Coast.*

1. **What are the major goals and objectives of the project?**

Fusarium Head Blight (FHB) has been a major limiting factor of wheat production in Louisiana and adjacent Gulf Coast states for the past three years, which has significantly contributed to declining wheat acreage. Losses to FHB in the Gulf Coast are attributable to patterns of heavy rainfall during anthesis, increased production of corn, and a lack of adapted varieties with FHB resistance.

The goal of the LSU program is to diminish economic damage caused by FHB in the region and to export markets so that growers can reliably produce a quality wheat crop. Objectives of the program are: 1) to develop and release disease and abiotic stress resistant, high-yielding wheat varieties adapted to the Gulf Coast region that are FHB resistant and contribute to reduced grower loss and lower DON in export grain; 2) to increase efficiency of coordinated breeding programs across the region through development of marker populations, collaborative phenotyping of populations for marker development, introgression of useful genes, and development and utilization of genomic selection, and 3) to evaluate varieties and advanced breeding lines in the USSN, statewide variety trials, and other regional nurseries to determine FHB reaction and provide that information to growers and breeders.

2. **What was accomplished under these goals?** *Address items 1-4) below for each goal or objective.*

1) major activities

Obj 1) Approximately 500 crosses were made and many of these had DHB resistance in their background. Molecular markers were used in cross selection and advancement decisions. FHB was rated as part of field selection in headrows and yield plots. 1,888 wheat genotypes evaluated in yield trials were rated for FHB. Obj 2) A DH population was screened for FHB reaction in inoculated nurseries in AR and LA. Genomic selection for FHB resistance was implemented in collaboration with the USDA Eastern Wheat Genotyping Lab and Sungrains breeders. Obj 3) Headrow nurseries for FHB at three locations across Louisiana screened about 5,000 rows in collaboration with pathologists.

2) specific objectives

Obj 1, 3) Breeding lines in the SunWheat, Gulf-Atlantic Wheat Nursery, Uniform Southern Fusarium Headblight Nursery, Uniform Southern Soft Red Winter Wheat, Wheat Variety Trials, and several LSU prelims were screened for FHB and FDK. Grain samples from 1200 rows were submitted for DON analysis. Obj 1, 2) Genomic selection was carried out in a collaborative Sungrains project on GAWN and Sunwheat regional nurseries, and on a 580 entry first-year preliminary yield. GEBVs were generated for yield, rust reaction, FHB traits including FHB index and DON. Advancement decisions for the nursery were based on field data and GEBV's. A number of lines with high GEBV but only moderate phenotypic values were advanced to permit evaluation of the relative value / predictability of GEBV versus phenotypic value in predicting future performance. Obj 2) Significant differences in field reaction were observed in the AGS2060 DH population. DNA samples have been submitted for evaluation of QTL to determine if that resistance is unique. F1 seed of topcrosses to pyramid FHB1 with other FHB QTL was sent to the Heartland Institute for DH.

3) Significant results
Obj 1) About 500 crosses were made and most of these included parents with FHB resistance. Molecular markers were utilized in choosing parental combinations. These crosses combined various combinations of Fhb1, Fhb3 (TA5608), M3BL, 2DL, Fhb5A, and Fhb genes from LA06146, Coker 9511 (NC11-22289) and other sources. Obj 1, 2) A group of these crosses are in the DH channel, including three that combine Fhb1 with other Fhb QTL and good agronomic traits. 1) LA08008C-31-1, which had the highest yield in the Sunwheat regional nursery and below average FHB scores, contains three FHB QTL, and will be increased for release. Obj 3) The FHB data of varieties and breeding lines in statewide performance trials was included in data tables and posted online for seedsmen, extension agents, consultants and growers. http://wheat.lsu.edu/data.shtml Obj 1, 2, 3) The FHB data for Sungrains nurseries was compiled across states and distributed to collaborating breeders for use in advancement decisions and to facilitate crossing decisions. http://sungrains.lsu.edu/data.shtml . The PopVar procedure was used to predict cross performance of parents within the Sunwheat and GAWN for FHB reaction and agronomic performance.

4) key outcomes or other achievements
1) The breeding program made the most wheat crosses on record in 2017 with most of these having a FHB resistant parent and with parents chosen based on marker data as well as field performance. 1,888 breeding lines were evaluated in yield trials and rated for FHB 2) Genomic selection and Popvar cross predictions were used for the first time to augment phenotypic data for decision making and should result in greater efficiency of crossing and line advancement. Summer offseason nurseries were utilized to advance and increase seed of DH lines. 3) Excellent data was collected on breeding lines in regional and LSU nurseries, with over 1200 DON samples submitted after rating for FDK.

3) What opportunities for training and professional development has the project provided?

Four graduate students were involved in setting up mist systems, inoculating nurseries, and rating field symptoms for FHB. They also rated FDK in the lab. This provided them with experience and some degree of comfort in screening for scab resistance in wheat lines. A visiting scientist from EMBRAPA in Brazil also participated in all activities of the FHB project.

4) How have the results been disseminated to communities of interest?

The LSU wheat breeding programs maintains two websites for dissemination of data generated as part of this project. The first website (http://www.wheat.lsu.edu/index.shtml), the 'Wheat Breeding Data Site' is used as a repository for trial data tables and variety trial information to facilitate timely release of that information to growers, consultants, seedsmen, and extension agents. The second website (shttp://sungrains.lsu.edu/index.shtml) serves the Sungrains breeding group as a public and breeder-only repository of data from Sungrains breeding programs. Completed variety trial reports are posted on the LSU AgCenter variety trial website. Data on FHB severity, FDK, and DON for the regional nurseries are published in the official reports for those nurseries.

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

1. What are the major goals and objectives of the project?

The goal of the collaborative FHB project is accelerate the development of FHB resistant varieties containing complementary FHB resistance genes in the region through utilization of MAS for population enrichment of three-way F1s followed by development of doubled haploids from selected F1 plants. The use of doubled haploids in winter wheat decreases variety development time by approximately four years which brings resistant varieties to the grower sooner. Use of DH's also effectively turns the region into a large recurrent selection program that rapidly recombines superior FHB resistant germplasm across programs.

2. What was accomplished under these goals? *Address items 1-4) below for each goal or objective.*

1) major activities
The Virginia Tech program initiated a collaborative DH project to pyramid Fhb1 with other important QTL in adapted backgrounds with high potential to produce commercially viable varieties. The topcross F1 plants were evaluated with markers by the USDA-ARS Eastern Wheat Genotyping Lab and selected plants were sent to the Heartland Institute for production of DH's. A large number of DH lines were screened in the field during 2016-17 for agronomic performance and disease resistance with emphasis on FHB. Those lines with parentage that includes major FHB QTL were also screened in misted, inoculated nurseries. Two additional crosses sent to the Heartland Institute were increased in an off-season summer nursery and will be evaluated in field plots and misted nurseries this season. Two preliminary yield trials were evaluated for performance and FHB reaction across Louisiana.

2) specific objectives
The LSU program should receive 300 lines back in September that came from 15 individual plants from several crosses that contain desired QTL combinations. Seed form two other DH population will be harvested in the offseason nursery in September.

3) significant results
The 300 DH lines from the VaTech collaborative effort will be space-planted in the field and each DH line will again be evaluated for desired markers as part of the selection process. Selected DH lines will be harvested and entered into yield trials and screening nurseries the following year. A number of DH lines from the 2013 cross LA13076 (LA754 / MD08-26-H2-7-12-21) performed very well in preliminary trials and have been advanced to regional yield trials for 2018, about three years earlier than possible without DHs. This cross combines the highest-yielding variety in Louisiana with a very well adapted lines that contains Fhb1 plus three other QTL.

3) key outcomes or other achievements
The LSU wheat breeding program is has completely integrated the use of DH's with marker-assisted selection and offseason nurseries to move quickly from initial cross

through DH production to field yield trial evaluation of DH's containing desired FHB QTL.

3. What opportunities for training and professional development has the project provided?

Four graduate students and a visiting scholar received exposure to the concepts of population enrichment using Marker Assisted Selection and doubled haploids.

4. How have the results been disseminated to communities of interest?

Not applicable – see project 1

Training of Next Generation Scientists

Instructions: Please answer the following questions as it pertains to the FY16 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 FY16 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 FY16 award period?**
   NO

   If yes, how many?

3. **Have any post docs who worked for you during the FY16 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 FY16 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?

Release of Germplasm/Cultivars

Instructions: In the table below, list all germplasm and/or cultivars released with full or partial support through the USWBSI during the FY16 award period. All columns must be completed for each listed germplasm/cultivar. Use the key below the table for Grain Class abbreviations. *Leave blank if you have nothing to report or if your grant did NOT include any VDHR-related projects.*

Name of Germplasm/Cultivar	**Grain Class**	**FHB Resistance** (S, MS, MR, R, where R represents your most resistant check)	**FHB Rating** (0-9)	**Year Released**

Add rows if needed.

NOTE: List the associated release notice or publication under the appropriate sub-section in the 'Publications' section of the FPR.

Abbreviations for Grain Classes

Barley - BAR
Durum - DUR
Hard Red Winter - HRW
Hard White Winter - HWW
Hard Red Spring - HRS
Soft Red Winter - SRW
Soft White Winter - SWW

Publications, Conference Papers, and Presentations

Instructions: Refer to the FY16-FPR_Instructions for detailed instructions for listing publications/presentations about your work that resulted from all of the projects included in the FY16 grant. Only include citations for publications submitted or presentations given during your award period (6/1/16 - 5/31/17). If you did not have any publications or presentations, state 'Nothing to Report' directly above the Journal publications section.

Journal publications.

NONE

Books or other non-periodical, one-time publications.

NONE

Other publications, conference papers and presentations.

Price, Trey, Myra Purvis, Boyd Padgett, Steve Harrison, Erick Larson, Jenny Bibb, James Buck and John Youmans. 2016. Effect of Cleaning and Fungicide Seed Treatment on Stand Establishment in Scabby Seed Lots in the Southern U.S. In S. Canty, A. Clark, K. Wolfe and D. Van Sanford (Eds.), Proc. 2016 National Fusarium Head Blight Forum. East Lansing, MI/Lexington, KY: U.S. Wheat and Barley Scab Research Initiative. Page 33.
Status: Published
Acknowledgement of Federal Support: YES (poster), NO (abstract)