

USDA-ARS
U.S. Wheat and Barley Scab Initiative
FY17 Preliminary Final Performance Report
Due date: July 31, 2018

Cover Page

Principle Investigator (PI):	Steve Harrison
Institution:	Louisiana State University Agricultural Center
E-mail:	sharrison@agctr.lsu.edu
Phone:	225-578-2110
Fiscal Year:	2017
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.
FY17 USDA-ARS Award Amount:	\$ 59,807
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DUNS Number:	763201633
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Project/Grant Reporting Period:	6/1/17 - 5/31/18
Reporting Period End Date:	5/31/2018

USWBSI Individual Project(s)

USWBSI Research Category*	Project Title	ARS Award Amount
VDHR-SWW	Development of FHB Resistant Wheat Varieties for the Gulf Coast.	\$ 49,903
VDHR-SWW	Developing Double Haploids to Expedite Variety Development in SRWW.	\$ 9,904
	FY17 Total ARS Award Amount	\$ 59,807



7-31-2018

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

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) is a major limiting factor of wheat production in Louisiana and adjacent Gulf Coast states. 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. Our goal is to develop FHB-resistant wheat varieties adapted to this unique environment. Objectives of the LSU AgCenter wheat breeding project are to: 1) develop and release high-yielding FHB resistant varieties; 2) increase efficiency of coordinated breeding programs through sharing of DH populations, marker development and introgression of useful genes using MAS-population enrichment; and 3) to screen varieties and advanced breeding lines for FHB reaction to help growers make wise variety choices.

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

- 1) Major Activities: (Obj1) The breeding program added 477 wheat crosses to the program in the spring of 2018. Most contained a FHB resistant parent in the immediate pedigree and 211 included Fhb1. There were 31,798 wheat headrows in F3:4 to F7:8 and DH generations evaluated across two locations. Seven preliminary yield trials included 1079 breeding lines evaluated at two locations. (Obj1,2) FHB GEBV values were determined for 570 entries in a wheat genomic selection yield trial. (Obj2) A DH population was screened, and SNPs evaluated to determine presence of uncharacterized QTL for FHB resistance. (Obj1,2,3) Inoculated nurseries grown at three locations contained 5,200 headrows comprised of about 3,000 breeding lines, and statewide variety trials, regional and SunGrains yield trials, and two marker development panels.
- 2) Specific Objectives: (Obj1) Crosses were made to combine effective Fhb genes in adapted backgrounds. Fhb1 was in the pedigree of 44% of crosses made in 2017. Other Fhb lineages used frequently were the Jamestown QTLs (Fhb1BJT, Fhb1ANeuse, Fhb6AJT), the Fhb resistance from NC11-2289 (Coker 9511 source) and NC13-20076. Molecular marker information and Genomic Estimated Breeding Values for FHB were utilized in planning crosses to facilitate combining of Fhb QTL. (Obj1,2) Wheat Prelim-F (Fusarium prelim) was included in misted nurseries at two locations in Louisiana and one in Arkansas (Esten Mason). (Obj1,3) FHB, DON, and FDK were determined for all entries in statewide performance trials from misted nurseries at three locations. (Obj1,2) Sungrains nurseries included 395 advanced breeding lines evaluated across six states and in misted screening nurseries. A collaborative genomic selection program led by NC State and the Eastern Wheat Genotyping Lab developed FHB prediction models for all Sungrains nurseries as well as preliminary breeding lines for individual programs. The genomic data was used to predict (PopVar) superior crosses among advanced lines to improve FHB resistance and yield. (Obj2) A DH mapping population was evaluated in three misted screening sites in AR and LA. (Obj2) A summer nursery of 4,222 SunGrains

DH lines in Washington generated seed for FHB and yield trials. A summer nursery in Idaho advanced SunGrains F1 seed from crosses made in the spring.

- 3) Significant Results: (Obj1,2,3) Excellent yield and FHB data was obtained on all breeding trials during the 2017-18 season. FDK and DON data was analyzed for 2,000 misted nursery samples that includes all of the advanced generation breeding lines. (Obj1,2) A set of 85 F4:5 headrows with striking differences in FHB field reaction was to be grown in a small study to evaluate the impact of combinations of Fhb1, Fhb2D, and Fhb5AS on FHB development. Each row was rated for FHB, FDK, and DON. The lines will be genotyped to determine gene combinations and grown in replicated screening trials next year. (Obj1) A total of 945 headrows were harvested for inclusion in preliminary yield trials. (Obj2) The DH population evaluated over three locations, (AGS2035/AGS2060) showed wide variation in FHB and FDK, with DON results pending. Neither parent contains a known QTL although AGS2060 occurs in the pedigree of several resistant varieties. SNP markers have been run using the Illumina chip and will be used to evaluate presence of significant QTL.
- 4) Key outcomes or other achievements: (Obj1) The majority of germplasm flowing through the program contains pedigrees with known FHB QTL. Advanced breeding lines are evaluated in inoculated, misted nurseries to determine resistance to FHB, FDK, and DON as a major determinant of line advance. (Obj2) Collaborative activities to develop FHB resistant varieties included two offseason nurseries (F1 and DH) as well as mapping populations and sharing of testing sites, regional nurseries, and germplasm. These activities contribute tremendously to efficient development of FHB resistant varieties.

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 (<https://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 accelerating the development of FHB resistant varieties containing complementary FHB resistance genes in the region. This project will utilize 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 several years and 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.

Specific objectives are:

1. Crossing parents which contain favorable loci for FHB resistance
2. Development of double haploid lines from these crosses
3. Evaluation for FHB resistance in the DH lines, including genotyping for known resistance loci, and phenotyping for grain yield and other important traits
4. Cooperative distribution of these lines to other regional programs

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

1) major activities: (Obj1,2) 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 from 2016 crosses 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. (Obj3) 200 DH lines from this project were screened in the field during 2017-18 for agronomic performance and disease resistance with emphasis on FHB. (Obj2) Four additional crosses were sent to the North Carolina State University DH Lab for the next cycle. (Obj3) Two preliminary yield trials of DH lines were evaluated for performance and FHB reaction in misted nurseries and yield trials.

2) specific objectives

(Obj2,3,4) The LSU program received 200 DH lines in September 2017 that came from 15 individual plants from several crosses that contain desired QTL combinations as part of the collaborative DH program. Selected headrows were advanced and will be included in FHB nurseries and yield trials for 2018-19. (Obj3,4) Seed of lines from the DH population LA15099 was evaluated in Wheat Prelim-F(usarium) and in misted nurseries in Arkansas and Louisiana. LA15099 is a cross between NC11-22289 (Coker 9511 FHB resistance) and LA06146 (Jamestown QTL). (Obj 3) About 200 DH lines from the cross LA15203 (Hilliard/AGS3000) were evaluated in a preliminary yield trial at two locations in Louisiana.

3) significant results

(Obj3) Selected lines from the 200 DH lines from the VaTech collaborative effort will be evaluated in preliminary yield trials next season and each DH line will again be evaluated for desired markers as part of the selection process. (Obj3,4) A number of DH lines from the 2015 cross LA15203 performed very well in preliminary trials. These were advanced to regional yield trials for 2018-19, about three years earlier than possible without DHs. Three additional DH populations were developed from 2016 crosses and will be evaluated in the field in 2018-19. Two of the 2016 crosses contain Fhb1 plus other effective QTL, while the third combines the Jamestown QTL with those from the NC11-22289 parent. (Obj 2) Six crosses from 2018 containing Fhb1 plus additional QTL in a high-yielding background were submitted for development of new DH populations.

4) key outcomes or other achievements

The LSU wheat breeding program has a large number of DH's with FHB parentage in yield trials. These have been screened in misted nurseries and evaluated for FHB QTL. This effort leads to much quicker development of FHB resistant breeding lines and permits effective pyramiding of FHB genes.

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

Four graduate students and a visiting student intern received exposure to the concepts of population enrichment using Marker Assisted Selection and doubled haploids for rapid generations advancement.

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

Not applicable – see project 1

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Training of Next Generation Scientists

Instructions: Please answer the following questions as it pertains to the FY17 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 FY17 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 FY17 award period?**
NO
If yes, how many?

3. **Have any post docs who worked for you during the FY17 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 FY17 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?

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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 FY17 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
none				

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

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Publications, Conference Papers, and Presentations

Instructions: Refer to the FY17-FPR_Instructions for detailed instructions for listing publications/presentations about your work that resulted from all of the projects included in the FY17 grant. Only include citations for publications submitted or presentations given during your award period (6/1/17 - 5/31/18). If you did not have any publications or presentations, state 'Nothing to Report' directly above the Journal publications section.

NOTE: Directly below each reference/citation, you must indicate the Status (i.e. published, submitted, etc.) and whether acknowledgement of Federal support was indicated in publication/presentation.

Journal publications.

Price, P., Purvis, M. A., Pruitt, H., G. B. Padgett, and S. Harrison. 2017. Effect of commercial fungicides on stripe rust and Fusarium head blight (scab) in Louisiana, 2016. Plant Dis. Manag. Rep. 11:CF002.

Status: Published

Acknowledgement of Federal support: No

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

Other publications, conference papers and presentations.

Harrison, S.A. et. al. 2017. Small Grain Performance Trials. LAES Research Summary 212.

pStatus: Published

Acknowledgement of Federal support: Not applicable for this report.