USDA-ARS/
U.S. Wheat and Barley Scab Initiative
FY15 Final Performance Report
Due date: July 15, 2016

Cover Page

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Fiscal Year:	2015
USDA-ARS Agreement ID:	59-0206-4-028
USDA-ARS Agreement Title:	Improvement of Soft Winter Wheat that is Resistant to FHB and Adapted to Eastern USA.
FY15 USDA-ARS Award Amount:	$ 75,763
Recipient Organization:	Purdue University AG Sponsored Program Services 615 W. State Street West Lafauette, IN 47907
DUNS Number:	07-205-1394
EIN:	35-6002041
Recipient Identifying Number or Account Number:	107128
Project/Grant Reporting Period:	06/08/15-06/07/16
Reporting Period End Date:	06/07/16

USWBSI Individual Project(s)

USWBSI Research Category*	Project Title	ARS Award Amount
VDHR-NWW	Genetics of, and breeding for, Fusarium Head Blight Diseases Resistance in Wheat	$73,063
VDHR-NWW	Male Sterile Facilitated Recurrent Selection for FHB Resistance (MPI-5).	$700
VDHR-NWW	Coordinated Phenotyping of Uniform Nurseries and Official Variety Trials.	$1,998
	FY15 Total ARS Award Amount	**$75,763**

July 15, 2016

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: Genetics of, and breeding for, Fusarium Head Blight Diseases Resistance in Wheat.

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

Fusarium head blight (FHB) is a major disease of soft red winter (SRW) wheat production in the Eastern US. It is utmost important to select for FHB resistance and adaptability to the wheat producing areas in Indiana. The objectives of this project are: (1) to building host resistance to Fusarium Head Blight (FHB) in well-adapted soft red winter wheat varieties, (2) to train highly qualified breeders and scientists, and (3) to increase the knowledge of genetic map and markers that are linked to resistance loci for FHB and other agronomic traits. Ultimately, the development of resistant cultivars for FHB and other diseases, adaptability to the condition of Indiana, and meet the required quality standard for soft red winter wheat is the goal we want to gear our effort to.

2. What was accomplished under these goals?

1) major Activities

We evaluated a total 2457 wheat genotypes for FHB resistance under misting system with either artificial inoculation or natural infection. These were 80 advanced breeding lines from Purdue breeding program, 92 lines from P+NUWWSN (collaborative phenotyping), and a recombinant inbred population from a cross between INW0412 and 992060G1-1-5. INW0412 is a resistant line to FHB and harbors moderate type I and type II resistance both derived from Huapei 57-2. Recently, type I QTL for FHB were mapped in RIL population developed from INW0412 by 992060G1-1-5 cross (Sun et al., 2016).The remaining 2085 accessions were kept under misting system, which is conducive for natural infection. These 2085 are comprised of breeding populations and five bi-parental mapping populations that were produced by Dr. Herb Ohm.

2) specific objectives

The first specific objective is to evaluate resistance for FHB in Purdue advanced breeding lines, collaborative germplasm (P+NUWWSN, 5ST trials, and UESRWWN). The second specific objective is to map QTL for FHB resistance using recombinant inbred line population. The third specific objective is to train highly qualified breeders and scientists.

3) significant results

Breeding results: After spray inoculation, out of the 1044 breeding lines, 82 (7.9%) were selected based on their FHB resistance and visual appearance in the field. These lines will be increased for yield evaluation in the next season and also will be used as parents in the crossing program. We will also test again for FHB resistance next season because the disease development in 2015-2016 crop season was not sufficient this season due to cold weather during 1st inoculation and extremely warm temperature during the 2nd inoculation. At the same time, we performed point inoculation in the field. The 80 advanced lines and 92 P+NUWWSN materials were tested for type II resistance. Of these, 60 of the advanced lines and 33 of the P+NUWWSN materials were found to be resistant/moderately resistant to FHB with type II disease score of less than 20%. Hence, the data on FHB will be integral part as decision making tool to advance the breeding lines to the next stage of testing.

Genetic mapping results: Of the six bi-parental populations, the majority of lines in four of the populations parented by INW0412, Huapei 52-2, Goldfield, or F201R as the resistant parent, were survived the winter. As speculated by the reviewers of the 2016 grant proposal, two of the populations were spring type and did not survive the winter. We focused to renew seed for the three of the populations and also recorded FHB resistance, plant height, and days to heading particularly on the population parented by INW0412. Type I resistance QTL study was already reported on this population (Sun et al., 2016). So, the data generated in the greenhouse and field by point inoculation will be used to map QTL for type II FHB resistance.

4) key outcomes or other achievements

Outcomes include (1) resistant germplasm can be used in crossing programs, (2) experimental line data from multiple environment, and (3) markers we will identify for type II resistance will help in marker assisted introgression of resistance from INW0412 to breeding populations.

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

As a new faculty, my program uses start-up to fund two graduate students. The SCAB initiative fund was used to hire a postdoctoral research associate and partial salary of a field technician to undertake all aspects of FHB field and greenhouse work. All graduate and undergraduate students of my lab participate in FHB program and all other field and greenhouse activities. So, not only did this project provide the professional development opportunity for the formal postdoc, it also provided a learning environment for graduate and undergraduate students.

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

Will be shared at FHB Forum this year.

Project 2: *Male Sterile Facilitated Recurrent Selection for FHB Resistance (MPI-5).*

1. **What are the major goals and objectives of the project?**
   This is a collaborative project coordinated by Dr. Kolb from University of Illinois in Urbana Champaign. The objective of this project is to facilitate transfer of resistance genes from multiple sources to a male sterile germplasm. After few cycles of gene transfer, breeding lines will be extracted. This actually meant to reduce the burden of crossing program and to deliver breeding populations composed of multiple FHB resistance QTL.

2. **What was accomplished under these goals?**
   1) **major activities**
      Planting the bulk of male sterile population, provided by Dr. Kolb, surrounded by Purdue's FHB resistant lines i.e., INW0412, 04620, 06497A1-7-3, and 0762A1-2-8.

   2) **specific objectives**
      Transfer of FHB resistance from multiple sources (INW0412, 04620, 06497A1-7-3, and 0762A1-2-8) to the bulk of male sterile population.

   3) **significant results**
      One cycle of male-sterile facilitated gene transfer completed.

   4) **key outcomes or other achievements**

3. **What opportunities for training and professional development has the project provided?**
   As a new faculty, my program uses start-up to fund two graduate students. The SCAB initiative fund was used to hire a postdoctoral research associate and partial salary of a field technician to undertake all aspects of FHB field and greenhouse work. All graduate and undergraduate students of my lab participate in FHB program and all other field and greenhouse activities. So, not only did this project provide the professional development opportunity for the formal postdoc, it also provided a learning environment for graduate and undergraduate students.

4. **How have the results been disseminated to communities of interest?**
   Will be shared at FHB Forum this year.

Project 3: *Coordinated Phenotyping of Uniform Nurseries and Official Variety Trials.*

1. **What are the major goals and objectives of the project?**
   The goal of coordinated trials is to provide breeders with multiple environment data across states and objectives include: (1) to preform phenotypic evaluation of breeding lines and observe the effectiveness QTL in multiple environments, (2) to give breeders a chance to compare and to cross-reference their newly developed breeding lines with other breeding programs, and (3) it can also help in the exchange of germplasm among the breeding programs.

2. **What was accomplished under these goals?**

   1) **major activities**
      We evaluated 172 breeding lines including 80 (30 entries in UESRWWN, 25 entries in 5ST-Preliminary, and 25 entries in 5ST-Advanced trials) from different breeding programs and 92 lines in P+NUWWSN FHB nursery using artificial inoculation and under misting system. We also evaluated advanced breeding lines for yield and yield-related traits and resistance to FHB and other diseases under standard yield plot experiments.

   2) **specific objectives**
      Providing multiple environment yield and FHB resistance data to other breeders.

   3) **Significant results**
      Three yield trials (UESRWWN and two 5-Sate Trials) were conducted in ACRE. Data for yield, yield components, and agronomic traits are being recorded. The data will be compiled and shared with the trial coordinators.

   4) **key outcomes or other achievements**
      Germplasm with specific and wide adaptation for yield and agronomic performance will be identified. These varieties can be released for growers or can be recycled in breeding processes.

3. **What opportunities for training and professional development has the project provided?**
   As a new faculty, my program uses start-up to fund two graduate students. The SCAB initiative fund was used to hire a postdoctoral research associate and partial salary of a field technician to undertake all aspects of FHB field and greenhouse work. All graduate and undergraduate students of my lab participate in FHB program and all other field and greenhouse activities. So, not only did this project provide the professional development opportunity for the formal postdoc, it also provided a learning environment for graduate and undergraduate students.

4. **How have the results been disseminated to communities of interest?**
   The raw data will be sent to the coordinating PIs and ultimately to each participating breeders. The data will also be discussed at the FHB Forum this year.

Training of Next Generation Scientists

Instructions: Please answer the following questions as it pertains to the FY15 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 FY15 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 FY15 award period?**
   No.
   If yes, how many?

3. **Have any post docs who worked for you during the FY15 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 FY15 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 FY15 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**
0762A1-2-8	SRW	MR (from 2012 and 2013)	4.0	2016

Due to change of PI in this breeding program, the release of this germplasm EX0762 is still on-going. The first increase by Ag Alumni Seed in 2013, the first sale was 2014. Seeds are still on request and market in a wide agricultural area.

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

Refer to the FY15-FPR_Instructions for listing publications/presentations about your work that resulted from all of the projects included in the FY15 grant. If you did not have any publications or presentations, state 'Nothing to Report' directly above the Journal publications section.

Journal publications.

Sun, J., H. W. Ohm, J. A. Poland, and Williams C. E. (2016). Mapping Four Quantitative Trait Loci Associated with type I Fusarium Head Blight Resistance in Winter Wheat 'INW0412'. Crop Science 56: 1163-1172.

Status: Published.

Acknowledgement of Federal Support: YES, but for a different agreement (see below)

"This project was funded by USDA National Institute of Food and Agriculture competitive grant number 10-85117-20607 and award number 58-3620-8-688"

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

NA.

Other publications, conference papers and presentations.

NA.