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:	59-0200-3-006
USDA-ARS Agreement Title:	Transfer of FHB Resistance to NDSU Hard Red Winter Wheat Breeding Material.
FY15 USDA-ARS Award Amount:	$ 21,283
Recipient Organization:	North Dakota State University Office of Grant & Contract Accouting NDSU Dept 3130, PO Box 6050 Fargo, ND 58108-0650
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Reporting Period End Date:	06/30/16

USWBSI Individual Project(s)

USWBSI Research Category*	Project Title	ARS Award Amount
HWW-CP	Transfer of FHB Resistance to NDSU Hard Red Winter Wheat Breeding Material.	$ 21,283
	FY15 Total ARS Award Amount	**$ 21,283**

6/23/2016

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: *Transfer of FHB Resistance to NDSU Hard Red Winter Wheat Breeding Material.*

Major goal
The overall goal of the NDSU HRWW breeding program is to develop a productive breeding program with adequate variation to breed successfully for improved cold-hardiness, regional adaptation, yield, disease resistance and processing quality. The specific goal of this project was to speedily incorporate useful and diverse FHB resistance genes (primarily from spring wheat) into winter-hardy winter wheat backgrounds and to broadly disperse it through the breeding population.

Material available at the onset of this project
A previous project (2012-13 funding cycle) focused on the introgression of FHB resistance QTL: *Fhb1* and *Ofhs.ifa-5A* ex CM82036; *QTL3A* ex Frontana; and *QTL5AS* and *QTL5AL* ex PI277012 from spring wheat. Bridging genotypes were developed by crossing the resistance with winter-hardy wheats adapted to North Dakota and using the F_1 to initiate doubled haploid (DH) production and single seed descent (SSD) inbreeding. Winter habit lines with varying winter-hardiness were identified and some prescreening (markers) for the presence of *Fhb1* and *Qfhs.ifa-5A* (where appropriate) was done.

Objectives
1. To thoroughly evaluate the 805 new DH and SSD inbred lines from the previous funding cycle for FHB resistance, winter survival and plant phenotype and to identify the better lineages for continued testing.
2. To use the very best selections extensively in new breeding program crosses of January 2015 and 2016.
3. To initiate pyramiding of FHB and rust resistance genes.

Accomplishment: Project goal
A small but adequate number of winter habit lines with moderate to good winter-hardiness plus one (mostly *Fhb1*) or two FHB resistance QTL were identified and incorporated into the breeding pool.

Accomplishment: Project objective 1
2014 Season: 805 DH and SSD inbred lines were evaluated for FHB resistance in a hill-plot field trial with two replications planted at Fargo and an un-replicated trial planted at Casselton. The trial in Fargo was artificially inoculated with FHB whereas heavy, natural FHB infection occurred at Casselton. All rows were evaluated and an average impression of the resistance phenotype was gained.
2015 Season: 106 Lines with the lowest incidence of FHB were included in replicated Senior trials (53 lines) and an un-replicated Junior trial (53 lines) in 2015. The cross: CM82036 (*Fhb1*, *Qfhs.ifa-5A*)/Jerry contributed the most entries (54); cross RWG10 (*Fhb1*)/Jerry contributed 21 entries; cross RWG21 (*QTL5AS*, *QTL5AL*)/Jerry contributed 16 entries; while 11 entries resulted from crosses involving Norstar or Peregrine and an *Fhb1* source. Only one entry derived from a Frontana (*QTL3A*)/Peregrine cross. Severe winter conditions occurred and allowed for winter-survival ratings. Respectively, three and 21 Senior trial entries had good (similar to Emerson,

Flourish) and average survival ratings (similar to, or better than Ideal). Thirteen and 15 Junior trial entries had good or average ratings, respectively. The majority of lines exhibited markedly better FHB resistance than the ten current commercial varieties that were used as controls. Four lines (each having *Fhb1* singly) were included in a 2016 regional (Elite) trial and were planted at six locations in ND. Five lines were retained in the 2016 preliminary trials.
Regional FHB Nurseries: Fourteen of the lines that were selected in 2014 were included in the 2015 FHB Evaluation Nursery that was evaluated by NDSU, SDSU, UNL and KSU. The NDSU and SDSU trials of 2015 failed due to winter kill, however, the KSU and UNL trials were successful. Comparison among entries was complicated by the fact that the ND and SD lines were generally later maturing than entries from Kansas and Nebraska. Despite this, the results showed that the resistance in the NDSU material compared favorably with that from the other programs. Seven lines were also included among 15 NDSU entries that are being evaluated in the 2016 Regional FHB Evaluation Nursery.

Accomplishment: Project objective 2
January 2015: 746 new crosses were made among 96 parents. Nine lines with FHB resistance genes *Fhb1* and *Ofhs.ifa-5A* from the cross CM82036 (CIMMYT spring wheat)/Jerry; seven lines from the cross RWG10 (spring wheat with *Fhb1*)/Jerry and four lines from the cross RWG21 (spring wheat with novel FHB QTL on 5AS and 5AL)/Jerry were used in 415 crosses. Another 21 F_1, heterozygous for *Fhb1*, were used in 142 additional crosses. Thus 557 crosses (75%) involved a parent with at least one FHB QTL, mostly *Fhb1*. The F_2 from these crosses have been planted in the field and are being selected. F_1 of eight crosses were used to initiate 400 double haploids for field planting the fall of 2017.
January 2016: This crossing block involved 69 parents, 22 of which were among the best selections (FHB resistance) from the 2015 field trials. Another 21 parents were F_1 combinations from the 2015 crosses that involved at least one FHB resistant parent. The remaining parents included 14 varieties/pure lines plus five F_1 from crosses not having an FHB resistant parent but contributing diverse leaf, stem and stripe rust resistance genes. 698 crosses were made, all of which involved at least one FHB resistant parent.

Accomplishment: Project objective 3
Using molecular markers, five Norstar (very winter-hardy) near-isogenic lines that are believed to be respectively homozygous for *Fhb1*, *Sr2, Lr68*; *Fhb1, Sr39, Lr34, Lr46, Lr68*; *Fhb1, Sr26, Lr68*; *Fhb1, Sr50, Lr68*; and *Fhb1, Lr53, Lr68* have been derived. Some of these have been used in the 2016 crossing block and all will again be used in the 2017 crossing block. HRWW backcross derivatives with novel leaf and stem resistance genes (*Lr19*, *Lr50, Lr51, Lr52, Lr53, Lr56, Lr59, Lr62, Sr22* and *Sr35*) were used extensively in crosses with FHB resistant lines (2015 crossing block).

Opportunities provided for training and professional development.
Nothing to report

Dissemination of results to communities of interest
Nothing to report

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

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

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

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

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**

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

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.

Nothing to report

Journal publications.

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

Other publications, conference papers and presentations.