USDA-ARS
U.S. Wheat and Barley Scab Initiative
FY17 Final Performance Report – NCE for FY18
Due date: July 12, 2019

Cover Page

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Fiscal Year:	2017 (NCE for FY18)
USDA-ARS Agreement ID:	59-0206-4-004
USDA-ARS Agreement Title:	Breeding Winter Wheat for FHB Resistance in South Dakota.
FY17 USDA-ARS Award Amount:	$ 50,000
Recipient Organization:	South Dakota State University SAD 133, Box 2201 Brookings, SD 57007
DUNS Number:	929929743
EIN:	46-6000364
Recipient Identifying Number or Account Number:	SA1400627
Project/Grant Reporting Period:	4/6/18 - 4/5/19
Reporting Period End Date:	04/05/19

USWBSI Individual Project(s)

USWBSI Research Category*	Project Title	ARS Award Amount
HWW-CP	Winter Wheat Breeding for Scab Resistance in South Dakota.	$ 50,000
	FY17 Total ARS Award Amount	$ 50,000

Sunish Sehgal

7/10/2019

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: *Winter Wheat Breeding for Scab Resistance in South Dakota.*

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

The major goal of this project was to successfully address USWBSI – HWW-CP priorities, which are to develop high yielding and high-quality hard winter wheat varieties with improved resistance to FHB and lower DON content. The major objectives of the project are to 1) evaluate hard winter wheat germplasm, experimental breeding lines, and released cultivars in a mist-irrigated FHB inoculated field nursery. 2) to utilize several native sources of resistance like Overland, Lyman, Everest, Emerson and combine them with *Fhb1* to develop new genotypes with improved FHB resistance. 3) Develop crosses based on the FHB screening data and advance the most resistant lines with the lowest disease index, FDK, and DON content in the breeding program. Finally we share FHB disease data from the inoculated nursery with other breeding programs and level of FHB resistance of released and currently grown cultivars with producers of the state and the region.

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

1) Major activities:
   1: Participation in multi-location regional screening under the mist-irrigated inoculated FHB nursery (i.e., Northern Regional HWW FHB Nursery).
   2: Develop crosses to combine minor (native resistance) with major (*Fhb1*) genes for FHB resistance.
   3: Evaluate Hard Winter Wheat (HWW) cultivars from the region, advanced breeding lines, and germplasm in the mist-irrigated inoculated FHB nursery and utilize FHB resistant genotypes as parents in crosses, and advance most resistant breeding lines with the lowest disease index, FDK, and DON content.

2) Specific objectives:
   1: Screening of regional germplasm to accumulate disease resistance phenotypic data including Northern Hard Winter Wheat FHB Public and Private Nurseries, Regional Performance Nursery.
   2: Utilize FHB resistance ratings, DON content, and molecular marker information on germplasm, cultivars, and breeding material to develop hybridizations and select desirable genotypes in early generations to combine major and minor FHB resistance genes.
   3: Obtain FHB disease ratings, and DON concentration data from advanced breeding lines. This along with agronomic performance, end-use quality, and other traits facilitates in a potential cultivar release and use as parents within the breeding program.

3) Significant results:

1: The FHB disease ratings on regional germplasm in the Northern Hard Winter Wheat FHB Public and Private Nurseries and South Dakota CPT is made available to South Dakota producers, and colleagues at other participating institutions and private industries.

2: Two mapping populations were developed to map and combine FHB resistance from AC Emerson and Lyman.

3: Data was collected on 35 Advanced and 105 Preliminary Yield Trial entries. In addition, 64 DH lines from Bai and Gonzalez projects were also evaluated. Further, 600 F3:4 lines from several crosses were also screened in the mist-irrigated nursery. A new hard red winter wheat variety 'Thompson' (SD9227) was released in fall 2017 for certified seed growers. Thompson has good yield potential and an excellent disease resistance package. Thompson has better FHB resistance as compared to Wesley and Ideal, and similar to Overland in most trials.

In addition, one advanced line showing better FHB resistance SD14113-3 ranked 13th overall in Crop Performance Trials (CPT) and 23rd overall in NRPN trials. More than 25 DH lines from Guihua Bai and Gonzalez projects were selected for winter hardiness, stripe rust, and other agronomic traits in 2016-17 and are being evaluated in EYT 2017-18 at two locations.

4) Key outcomes:

1: FHB disease ratings were utilized within the breeding program, shared with colleagues, and data pertaining to released cultivars were made available to regional producers.

2: More than 150 new crosses were developed with FHB resistant lines and selections were made from within segregating populations with the highest levels of resistance, which will increase the frequency and resistance levels of SD breeding material against FHB. Ultimately, these efforts are expected to lead to the release of FHB resistant winter hardy cultivars and result in reducing grower losses due to FHB epidemics across the region.

3: 'Thompson' a new HRW wheat cultivar was released during this period. Redfield released in 2013 is moderately resistant to FHB and has picked up 16% winter wheat acreage in the state based on a recent variety survey conducted by South Dakota Wheat Commission and is second most popular variety in the state. Lyman, another cultivar developed from the program is grown on 4-5% winter wheat acreage in SD. Breeding materials with better scab resistance and superior yield will be moved to the next breeding cycle and parents for new crosses identified.

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

One graduate student (partially supported by the project) and several undergraduate students got hands-on training/experience in day-to-day operations of the breeding program and FHB screening nursery during this period. Additionally, students assisted with collecting *Fusarium* damaged kernel (FDK) scores and helped in the preparation of samples for DON analysis.

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

FHB resistance ratings collected on released cultivars are made available to growers as a part of the annual South Dakota Crop Performance Testing Hard Winter Wheat report. Additionally, data collected from Northern Hard Winter Wheat FHB Public and Private Nurseries is shared back with the colleagues from both public and private breeding programs. The results from this project were shared at 6 farmer field days last year and through articles in appropriate popular press sources, word of mouth, brochures, and Extension press releases from the Agricultural Experiment Station.

Training of Next Generation Scientists

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

3. **Have any post docs who worked for you during the FY17-NCE 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-NCE 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 FY17-NCE period. All columns must be completed for each listed germplasm/cultivar. Use the key below the table for Grain Class abbreviations.

NOTE: 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**
THOMPSON	HRW	MR-MS	6	2017

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 FY17-NCE_FPR-Instructions for detailed instructions for listing publications/presentations about your work that resulted from all of the projects included in the FY17-NCE grant period. Only include citations for publications submitted or presentations given during your award period (4/6/18 - 4/5/19). 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 an acknowledgement of Federal support was indicated in publication/ presentation. See example below for a poster presented at the FHB Forum:

> Conley, E.J., and J.A. Anderson. 2018. Accuracy of Genome-Wide Prediction for Fusarium Head Blight Associated Traits in a Spring Wheat Breeding Program. In: Proceedings of the XXIV International Plant & Animal Genome Conference, San Diego, CA.
> Status: Abstract Published and Poster Presented
> Acknowledgment of Federal Support: YES (poster), NO (abstract)

Journal publications.

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

Other publications, conference papers and presentations.

Release notice for Thompson, SD Agricultural Experiment Station. Notification Emailed to AES on 11/13/2017, South Dakota State University, and Brookings, SD. (PVP application number 201800429).
Status: Published
Acknowledgment of Federal Support: YES