**USDA-ARS**
**U.S. Wheat and Barley Scab Initiative**
**FY18 Performance Report**
**Due date:** July 12, 2019

## Cover Page

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|---|---|
| **Principle Investigator (PI):** | Sunish Sehgal |
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| **E-mail:** | Sunish.Sehgal@sdstate.edu |
| **Phone:** | 605-688-5709 |
| **Fiscal Year:** | 2018 |
| **USDA-ARS Agreement ID:** | 59-0206-8-194 |
| **USDA-ARS Agreement Title:** | Winter Wheat Breeding for Scab Resistance in South Dakota |
| **FY18 USDA-ARS Award Amount:** | $ 67,690 |
| **Recipient Organization:** | South Dakota State University<br>SAD 133, Box 2201<br>Brookings, SD 57007 |
| **DUNS Number:** | 929929743 |
| **EIN:** | 46-6000364 |
| **Recipient Identifying Number or Account Number:** | 3F4627 |
| **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 | Developing Winter Wheat Varieties with Enhanced Resistance to FHB and Low DON. | $ 67,690 |
| | **FY18 Total ARS Award Amount** | $ 67,690 |

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

FY18 Performance Report
PI: Sehgal, Sunish
USDA-ARS Agreement #: 59-0206-8-194
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**Project 1:** *Developing Winter Wheat Varieties with Enhanced Resistance to FHB and Low DON.*

**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 specific objectives of this proposal are **(1)** Develop FHB resistant winter wheat varieties for South Dakota and surrounding regions. **(2)** Evaluate hard winter wheat germplasm, experimental breeding lines, and released cultivars in a mist-irrigated FHB inoculated field nursery to identify sources of FHB resistance. **(3)** Marker-assisted introgression and pyramiding multiple sources of resistance in advanced South Dakota breeding lines.

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

1. Major activities:

1: Evaluate Hard Winter Wheat (HWW) cultivars from the region, advanced breeding lines, and germplasm in the mist-irrigated inoculated FHB nursery. Utilization of FHB resistant genotypes as parents in crosses and advance most resistant breeding lines with the lowest disease index, FDK, and DON content.
2: Participation in multi-location regional screening under the mist-irrigated inoculated FHB nursery (i.e., Northern Regional HWW FHB Nursery).
3: Genetic mapping and marker assisted selection to enhance FHB resistance in SD germplasm.

2. Specific objectives:

1: Develop FHB resistant winter wheat varieties for South Dakota and surrounding regions.
2: Evaluate hard winter wheat germplasm, experimental breeding lines, and released cultivars in a mist-irrigated FHB inoculated field nursery to identify sources of FHB resistance.
3: Marker-assisted introgression and pyramiding multiple sources of resistance in advanced South Dakota breeding lines.

3. Significant results:

1: Data was collected on 35 Advanced and 125 Preliminary Yield Trial entries. In addition, 32 DH lines were also evaluated. Further, 600 F3:5 lines from several crosses were also screened in the mist-irrigated nursery. Two advanced breeding lines SD14113-3 and SD14115-5 performed well in the state trials and ranked among top five in Northern Regional Performance Nursery (NRPN) in 2018. Both these have good yield potential and good quality and moderate to intermediate resistance to rust and FHB. SD14113-3 has above average FHB tolerance and SD14115-5 has average FHB tolerance, better than Wesley and Ideal. SD14113-3 and SD14115-5 are likely to be considered for release in fall of 2019. Another advanced line SD13062-2 has shown very good FHB resistance similar to

Lyman in 2018 with higher yield potential and better resistance to stripe rust, leaf rust, and BLS. A small-scale seed increase has been initiated for SD13062-2.

2: 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.

3: More than 150 crosses were made specifically for FHB resistance and about 40 crosses and 20 backcrosses were made to incorporate *Fhb1* into the South Dakota germplasm and combine with native FHB resistance. Year 1 phenotyping evaluation on Lyman x Emerson RIL population has been completed.

4.Key outcomes:

1: Redfield released in 2013 (moderately resistant to FHB) 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. Recent releases, Oahe and Thompson should start picking up some acres from 2020. Two promising lines (SD14113-3 and SD14115-5) could potentially be released in 2019. Breeding materials with better scab resistance and superior yield will be moved to the next breeding cycle and parents for new crosses identified.

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

3: Selections were made from backcross populations using new *Fhb1* markers. This will help increase the frequency of *Fhb1* in 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. 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 4 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 FY18 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 FY18 award period?**

   **If yes, how many?**
   No

2. **Did any graduate students in your research program supported by funding from your USWBSI grant earn their Ph.D. degree during the FY18 award period?**

   **If yes, how many?**
   No

3. **Have any post docs who worked for you during the FY18 award period and were supported by funding from your USWBSI grant taken faculty positions with universities?**

   **If yes, how many?**
   No

4. **Have any post docs who worked for you during the FY18 award period and were supported by funding from your USWBSI grant gone on to take positions with private ag-related companies or federal agencies?**

   **If yes, how many?**
   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 FY18 award 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** |
|---|---|---|---|---|
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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 FY18-FPR_Instructions for detailed instructions for listing publications/presentations about your work that resulted from all of the projects included in the FY18 grant. 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 acknowledgment of Federal support was indicated in publication/ presentation. See example below for a poster presentation with an abstract:

> 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.**

Halder J, Zhang J, Ali S, Sidhu JS, Gill HS, Talukdar SK, Kleinjan J, Turnipseed B, Sehgal SK, (2019) Mining and genomic characterization of resistance to Tan spot, Stagonospora nodorum blotch (SNB), and Fusarium head blight in Watkins core collection of wheat landraces.
Status: Under review
Acknowledgment of Federal Support: YES

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

**Other publications, conference papers and presentations**.

Halder J, Ali S, Zhang J, Sehgal SK, (2018) Mining Watkins collection for resistance to Fusarium head blight, Tan spot, and Stagonospora nodorum blotch (SNB). In: Proceedings of 2018 FHB forum, December 2-4, 2019, St Louis, MO.
Status: *Poster presentation*
Acknowledgment of Federal Support: YES (poster), YES (abstract)