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

Cover Page

Principle Investigator (PI):	Jason Cook
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Fiscal Year:	2018
USDA-ARS Agreement ID:	59-0206-5-002
USDA-ARS Agreement Title:	Montana Winter Wheat Fusarium Head Blight Resistance.
FY18 USDA-ARS Award Amount:	$ 26,866
Recipient Organization:	Montana State University Office of Sponsored Programs Montana State University PO Box 172470 Bozeman, MT 59717-2470
DUNS Number:	625447982
EIN:	81-6010045
Recipient Identifying Number or Account Number:	W5478
Project/Grant Reporting Period:	5/6/18 - 5/5/19
Reporting Period End Date:	05/05/19

USWBSI Individual Project(s)

USWBSI Research Category*	Project Title	ARS Award Amount
HWW-CP	Development of Montana Adapted FHB Resistant Winter Wheat Varieties.	$ 26,866
	FY18 Total ARS Award Amount	$ 26,866

6/12/2019

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

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Project 1: *Development of Montana Adapted FHB Resistant Winter Wheat Varieties.*

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

a. Use marker assisted backcrossing (MAB) to incorporate *Fhb1* and *Fhb5A* into Montana adapted winter wheat germplasm, and make conventional breeding populations by crossing winter wheat lines with Fusarium head blight (FHB) resistance to Montana adapted winter wheat germplasm.
b. Phenotype publically released varieties and elite Montana adapted experimental lines for FHB resistance.

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

1) Major Activities:
Major activities funded by this grant include using MAB to integrate known FHB resistance genes into Montana adapted winter wheat germplasm. Secondly, crosses were made between FHB resistant winter wheat lines and susceptible Montana adapted winter wheat germplasm for double-haploid (DH) line development and conventional breeding. Lastly, lines developed from the breeding program were phenotyped in the field for FHB resistance.

2) Specific Objectives:
Advanced Montana winter wheat lines were evaluated during the 2018 growing season in a replicated FHB screening nursery in Minot, ND for FHB resistance. Additionally, 12 Montana adapted winter wheat lines were entered into the FHB hard red winter wheat uniform screening nursery for FHB screening. MAB was used to incorporate *Fhb1* and *Fhb5A* resistance genes from the Minnesota hard red spring wheat line MN-11394-6 into Montana adapted winter wheat lines. Conventional crosses were also made between FHB susceptible elite Montana adapted winter wheat varieties and FHB resistance winter wheat lines. Lastly, we planted our first winter wheat FHB screening nursery at Huntley, MT for FHB evaluation in 2019.

3) Significant Results:
Twelve elite MT experimental lines that include 5 DH lines developed by USWBSI that were derived from MAB *Fhb1* into Decade and Jerry were submitted to the 2018 FHB hard winter wheat uniform screening nursery. Informative FHB resistance information was obtained from the Manhattan, Kansas nursery. Experimental MT lines carrying the *Fhb1* gene had an FHB index (% killed spikelets) ranging from 9% to 17% in comparison to Flourish (FHB susceptible check) that had a FHB index of 58%. The experimental lines also had lower DON levels ranging between 13 ppm – 26 ppm compared to the susceptible checks Overley (41 ppm) and Flourish (41 ppm). No FHB was observed at the Minot, ND test location in 2018, however valuable agronomic performance data was obtained. Using the 2018 FHB resistance and agronomic data, two experimental lines, MT1793 (Decade – *Fhb1*) and MT1796 (Decade – *Fhb1*), were advanced for further testing in MT and ND.

Experimental lines MT1793 and MT1796 will be considered for public release to regional farmers after the 2019 growing season.

In 2018, F1 seed from crosses made between elite Montana winter wheat lines and winter wheat lines carrying *Fhb1* were sent to Heartland Plant Innovations for DH line production. In total, 109 DH lines were produced and are being evaluated during the 2019 growing season in Bozeman, MT for desirable agronomic attributes and seed increase. A set of 45 DH lines were selected from the 2018 observation nurseries for additional testing in Minot, ND, Huntley, MT and Bozeman, MT. Lastly, MAB is being used to incorporate *Fhb1* and *Fhb5A* into Montana adapted lines with an emphasis on developing varieties resistant to both FHB and wheat stem sawfly. The first set of 155+ MAB derived lines carrying *Fhb1* and *Fhb5A* will be evaluated for agronomics attributes and undergo seed increase during the 2020 growing season.

4) Key Outcomes or Other Achievements:

Key outcomes from this research project include acquiring FHB resistance information on Montana adapted elite lines that carry *Fhb1*. Overall, it appears the *Fhb1* gene reduces percent spikelets killed by FHB and DON levels in Montana adapted winter wheat backgrounds. Additionally, based on multiple years of data the *Fhb1* gene did not appear to negatively impact yield and agronomic performance relative to the recurrent parent. Two experimental lines that carry the *Fhb1* gene were advanced in the breeding pipeline to be tested in 2019 yield trials. An additional set of 45 DH lines derived from FHB resistance sources are being evaluated in yield trials located in Minot, ND, Huntley, MT, and Bozeman, MT during the 2019 growing season. The Huntley, MT site is located at the Southeast Agriculture Research Center, and is our first FHB winter wheat nursery in MT. Approximately 155 MAB lines carrying *Fhb1* and *Fhb5A* have been selected for field evaluation and seed increase in 2020. The Montana winter wheat breeding program now has breeding material potentially carrying resistance to FHB present in nearly every stage of the breeding pipeline.

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

None

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

We now have enough FHB data where we can provide FHB resistance ratings to Montana adapted varieties. Ratings and our work with the USWBSI have been communicated to Montana wheat producers and stakeholders through the use of periodicals, field days and social media. Our efforts to develop Montana adapted FHB resistant winter wheat varieties has received positive responses from the Montana wheat growing community.

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?** 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 FY18 award period?** No

   If yes, how many?

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?** No

   If yes, how many?

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?** 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 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**

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 (5/6/18 - 5/5/19). 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 acknowledgement 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
> Acknowledgement of Federal Support: YES (poster), NO (abstract)

Nothing to Report

Journal publications.

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

Other publications, conference papers and presentations.