USDA-ARS
U.S. Wheat and Barley Scab Initiative
FY20 Annual Performance Progress Report
Due date: July 29, 2021

Cover Page

Principle Investigator (PI):	Jason Cook
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Fiscal Year:	2020
USDA-ARS Agreement ID:	59-0206-0-129
USDA-ARS Agreement Title:	Development of Montana Adapted FHB Resistant Winter Wheat Varieties
FY20 USDA-ARS Award Amount:	$ 36,880
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:	4W8546
Project/Grant Reporting Period:	5/6/20 - 5/5/21
Reporting Period End Date:	5/5/2021

USWBSI Individual Project(s)

USWBSI Research Category*	Project Title	ARS Award Amount
HWW-CP	Development of Montana Adapted FHB Resistant Winter Wheat Varieties	$ 36,880
	FY20 Total ARS Award Amount	**$ 36,880**

7/9/2021

Principal Investigator Date

* MGMT – FHB Management
FST – Food Safety & Toxicology
R- Research
S – Service (DON Testing Labs)
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 research project?**

1.) Integrate FHB resistance genes from FHB resistant winter and spring wheat germplasm into MSU's winter wheat breeding program using both conventional breeding and marker assisted backcrossing (MAB) to increase FHB resistant allele frequencies in the Montana winter wheat breeding program.

2.) Phenotype Montana adapted winter wheat experimental lines for FHB resistance during the 2020 field seasons. Experimental lines found to have FHB resistance will be considered for public release.

3.) Deployment of FHB resistant winter wheat varieties adapted to Montana will help protect Montana's winter wheat grain producers and end-users from FHB infections and unacceptable deoxynivalenol (DON) levels that would prevent the sale of FHB infected winter wheat.

2. **What was accomplished under these goals or objectives?** *(For each major goal/objective, address these three items below.)*

a) What were the major activities?

Major activities included 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 conventional breeding. Lastly, experimental lines were phenotyped in FHB screening nurseries for FHB resistance.

b) What were the significant results?

Fifteen MT experimental lines were submitted to the 2020 FHB hard red winter wheat uniform screening nursery. Infection levels at all uniform screening nurseries were very good for differentiating FHB susceptible versus moderately resistant lines. I haven't received DON data from these trials and suspect it is due to COVID-19 delays.

We also had excellent disease incidence at our mist irrigated FHB screening nursery located at the Southern Ag Research Center (SARC). The nursery contained 45 experimental lines and four check varieties. Data collected from the experimental lines showed FHB Severity was 47.2% (19.8 - 64.8), FHB Incidence was 100 for all lines and the FHB Index was the same as the severity ratings. Mean DON levels were 29.0 ppm and ranged from 3.5 ppm to 72.8 ppm. Emerson, our resistant check variety, had a severity rating of 19.8% and a DON level of 19.5 ppm. Our susceptible check variety,

Yellowstone, had a severity rating of 55% and a 72.8 ppm DON level. Experimental lines that stood out as having moderate resistance in the regional and SARC FHB screening nurseries were MT19116 and MT19122.

Marker assisted breeding is being used to incorporate *Fhb1* and *Fhb5A* into Montana adapted winter wheat lines with an emphasis on developing varieties resistant to both FHB and wheat stem sawfly. A total of 420 lines were planted in the field for evaluation and seed increase during the 2020 growing season and several lines were advanced for further testing in 2021. We are also using MAB to incorporate an *Fhb1* + *Sr2* positive allele linkage group into our germplasm with the goal of maintaining both positive alleles in the winter wheat breeding program.

Lastly, our longtime winter wheat breeder, Dr. Phil Bruckner, retired in March 2021. We are currently in the process of hiring a new breeder, and we will inform the USWBSI when that is finalized.

c) List key outcomes or other achievements.

Key outcomes from our breeding efforts include acquiring FHB resistance information on Montana adapted experimental lines that carry *Fhb1* and native resistance from Emerson. Based on multiple years of data the *Fhb1* gene did not negatively impact yield and agronomic performance relative to the recurrent parents. Experimental lines with moderate FHB resistance were advanced in the breeding pipeline for additional testing in the 2021 yield trials. An additional set of 36 lines derived from FHB resistance sources are being evaluated in yield trials located in Huntley, MT, and Bozeman, MT during the 2021 growing season. Lines developed using MAB that carry *Fhb1* and *Fhb5A* have been planted for field evaluation in 2021.

3. Was this research impacted by the COVID-19 pandemic (i.e. university shutdowns and/or restrictions, reduced or lack of support personnel, etc.)? If yes, please explain how this research was impacted or is continuing to be impacted.

COVID-19 did not impact our operations.

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

None

5. 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 FY20 award period (5/6/20 - 5/5/21). 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 FY20 award period?**
   ☐Yes ☒No
   If yes, how many? Click to enter number here.

2. **Did any graduate students in your research program supported by funding from your USWBSI grant earn their Ph.D. degree during the FY20 award period?**
   ☐Yes ☒No
   If yes, how many? Click to enter number here.

3. **Have any post docs who worked for you during the FY20 award period and were supported by funding from your USWBSI grant taken faculty positions with universities?**
   ☐Yes ☒No
   If yes, how many? Click to enter number here.

4. **Have any post docs who worked for you during the FY20 award period and were supported by funding from your USWBSI grant gone on to take positions with private ag-related companies or federal agencies?**
   ☐Yes ☒No
   If yes, how many? Click to enter number here.

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 FY20 award period (5/6/20 - 5/5/21). 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	FHB Rating (0-9)	Year Released
No varieties were released.	Select Grain Class	Select what represents your most resistant check	Enter as text 0-9 rating	Select Year
Click here to enter text.	Select Grain Class	Select what represents your most resistant check	Enter as text 0-9 rating	Select Year
Click here to enter text.	Select Grain Class	Select what represents your most resistant check	Enter as text 0-9 rating	Select Year
Click here to enter text.	Select Grain Class	Select what represents your most resistant check	Enter as text 0-9 rating	Select Year
Click here to enter text.	Select Grain Class	Select what represents your most resistant check	Enter as text 0-9 rating	Select Year
Click here to enter text.	Select Grain Class	Select what represents your most resistant check	Enter as text 0-9 rating	Select Year
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Click here to enter text.	Select Grain Class	Select what represents your most resistant check	Enter as text 0-9 rating	Select Year
Click here to enter text.	Select Grain Class	Select what represents your most resistant check	Enter as text 0-9 rating	Select Year
Click here to enter text.	Select Grain Class	Select what represents your most resistant check	Enter as text 0-9 rating	Select Year
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Click here to enter text.	Select Grain Class	Select what represents your most resistant check	Enter as text 0-9 rating	Select Year
Click here to enter text.	Select Grain Class	Select what represents your most resistant check	Enter as text 0-9 rating	Select Year
Click here to enter text.	Select Grain Class	Select what represents your most resistant check	Enter as text 0-9 rating	Select Year

NOTE: List the associated release notice or publication under the appropriate sub-section in the 'Publications' section of the FPR.

Publications, Conference Papers, and Presentations

Instructions: Refer to the PR_Instructions for detailed more instructions for listing publications/presentations about your work that resulted from all of the projects included in the FY20 grant award. Only citations for publications published (submitted or accepted) or presentations presented during the **award period (5/6/20 - 5/5/21**) should be included. If you did not publish/submit or present anything, state 'Nothing to Report' directly above the Journal publications section.

NOTE: Directly below each citation, you **must** indicate the Status (i.e. published, submitted, etc.) and whether acknowledgement of Federal support was indicated in the publication/ presentation. See example below for a poster presentation with an abstract:

Z.J. Winn, R. Acharya, J. Lyerly, G. Brown-Guedira, C. Cowger, C. Griffey, J. Fitzgerald, R.E. Mason and J.P. Murphy. 2020. "Mapping of Fusarium Head Blight Resistance in NC13-20076 Soft Red Winter Wheat." In: S. Canty, A. Hoffstetter, and R. Dill-Macky (Eds.), *Proceedings of the 2020 National Fusarium Head Blight Forum (*p. 12.), Virtual; December 7-11. Online: https://scabusa.org/pdfs/NFHBF20_Proceedings.pdf.
Status: Abstract Published and Poster Presented
Acknowledgement of Federal Support: YES (Abstract and Poster)

Journal publications.

No publications.

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

No publications.

Other publications, conference papers and presentations.

No publications.