USDA-ARS | U.S. Wheat and Barley Scab Initiative

FY21 Performance Progress Report

Due date: July 26, 2022

Cover Page

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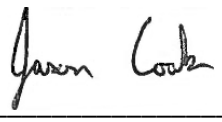
Fiscal Year:	2021
USDA-ARS Agreement ID:	59-0206-0-128
USDA-ARS Agreement Title:	Fusarium Head Blight Resistance for Montana Spring Wheat
FY20 USDA-ARS Award Amount:	$19,380
Recipient Organization:	Montana State University Plant Sciences & Plant Pathology PO Box 173150, 407 Leon Johnson Hall Bozeman, MT 59717
DUNS Number:	625447982
EIN:	816010045
Recipient Identifying Number or Account Number, if any:	RUW8545
Project/Grant Period:	5/6/21 - 5/5/23
Reporting Period End Date:	5/5/2022

USWBSI Individual Project(s)

USWBSI Research Category*	Project Title	ARS Award Amount
VDHR-SPR	Fusarium Head Blight Resistance for Montana Spring Wheat	$19,380
	FY21 Total ARS Award Amount	$19,380

I am submitting this report as an: ☒ Annual Report ☐ Final Report

I certify to the best of my knowledge and belief that this report is correct and complete for performance of activities for the purposes set forth in the award documents.



Principal Investigator Signature

7/25/2022
Date Report Submitted

* BAR-CP – Barley Coordinated Project
DUR-CP – Durum Coordinated Project
EC-HQ – Executive Committee-Headquarters
FST-R – Food Safety & Toxicology (Research)
FST-S – Food Safety & Toxicology (Service)
GDER – Gene Discovery & Engineering Resistance
HWW-CP – Hard Winter Wheat Coordinated Project
MGMT – FHB Management
MGMT-IM – FHB Management – Integrated Management Coordinated Project
PBG – Pathogen Biology & Genetics
TSCI – Transformational Science
VDHR – Variety Development & Uniform Nurseries
NWW –Northern Soft Winter Wheat Region
SPR – Spring Wheat Region
SWW – Southern Soft Red Winter Wheat Region

Project 1: Fusarium Head Blight Resistance for Montana Spring Wheat

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

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

2.) Phenotype Montana adapted spring wheat experimental lines for FHB resistance during the 2021 field season. Experimental lines found to have FHB resistance will be advance in breeding pipeline and used as parents in the crossing block.

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

There were two major activities. First, several experimental lines and varieties resistant to FHB have been incorporated into the hard red spring wheat crossing block. A single seed descent program was used to generate head rows at the F4 generation. Lines were selected with appropriate height, heading date, grain protein content, and stem solidness for two years prior to advancement to replicated yield trials. Advanced lines with an FHB-resistant parent were entered into FHB inoculated screening nursery located in Sidney, MT. The second activity was a marker assisted selection (MAS) program used to identify lines with major FHB resistance genes.

b) What were the significant results?

In 2021, severe drought struck the entire spring wheat growing region in the Northern Great Plains. The drought hindered our ability to get consistent infection in our FHB screening nursery. We increased the number of lines tested in our mist irrigated FHB screening nursery located at the Eastern Ag Research Center (EARC) in Sidney, MT to 66 lines. Fusarium head blight infection levels were variable across the nursery. The line means for FHB Severity was 12.3% (1.3 – 35.9), FHB Incidence was 48.7% (15.6-80.0) and FHB Index was 7.0% (0.3-28.4). The line mean for FDK was 2.1%(0.0-11.7) and DON was 0.6 ppm (0.1-1.6). Despite all traits being significantly different, the coefficient of variance (CV) for FDK and DON was >100, which cautions us to make any conclusions about how resistant the lines are to FHB in this trial.

We also entered six elite experimental lines into the Uniform Regional Scab Nursery for FHB resistance evaluation during the 2021 growing season. Once again, incidence of FHB was variable across all locations due to the drought making it difficult to draw any conclusion on how resistant our lines are to FHB.

Lastly, we sent 30 lines to Juliet Marshall, University of Idaho, for screening in their FHB nursery. Mean disease severity was 30.3 (17.7-47.0), incidence was 68.4 (45-88.4) and the disease index was 21.5 (8.3-38.2). Juliet's team does not collect grain samples for FDK or DON analysis from this site, but the information they do provide has value.

c) List key outcomes or other achievements.

Key outcome for 2021 is the expansion of experimental lines being tested in our FHB screening nursery. Despite the setbacks caused by the 2021 drought, our FHB screening nursery is working well to identify experimental lines with moderate FHB resistance, which are either advanced in the breeding pipeline or are used as parents in our crossing blocks. We are also expanding the number of parents with presumed FHB resistance in our crossing block. This increases the number of populations and experimental lines with FHB resistant parents in the breeding program and will improve our ability to identify lines with FHB resistance. In the future, we hope to continue expanding our screening nursery testing capacity to evaluate more lines for FHB resistance. To date, it appears native FHB resistance genes are providing moderate FHB resistance in our most advanced experimental lines. Experimental lines with known FHB resistance genes are dropping out of the breeding pipeline due to poor performance in first year statewide yield trials.

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

None

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

Fusarium head blight resistance ratings and our work with the USWBSI have been communicated to Montana wheat producers and stakeholders using periodicals, field days and social media. The topic of FHB is of special interest in eastern Montana. Dr. Frankie Crutcher, the plant pathologist at the Eastern Agricultural Research Center, has developed a screening nursery that serves as an excellent focal point for discussing this research. Our efforts to develop Montana adapted FHB resistant spring wheat varieties has received positive responses from the Montana wheat growing community.

Publications, Conference Papers, and Presentations

Please include a listing of all your publications/presentations about your FHB work that were a result of funding from your FY21 grant award. Only citations for publications published (submitted or accepted) or presentations presented during the **award period** should be included.

Did you publish/submit or present anything during this award period?

☐ Yes, I've included the citation reference in listing(s) below.

☒ No, I have nothing to report.

Journal publications as a result of FY21 grant award

List peer-reviewed articles or papers appearing in scientific, technical, or professional journals. Include any peer-reviewed publication in the periodically published proceedings of a scientific society, a conference, or the like.

Identify for each publication: Author(s); title; journal; volume: year; page numbers; status of publication (published [include DOI#]; accepted, awaiting publication; submitted, under review; other); acknowledgement of federal support (yes/no).

Books or other non-periodical, one-time publications as a result of FY21 grant award

Report any book, monograph, dissertation, abstract, or the like published as or in a separate publication, rather than a periodical or series. Include any significant publication in the proceedings of a one-time conference or in the report of a one-time study, commission, or the like.

Identify for each one-time publication: Author(s); title; editor; title of collection, if applicable; bibliographic information; year; type of publication (book, thesis or dissertation, other); status of publication (published; accepted, awaiting publication; submitted, under review; other); acknowledgement of federal support (yes/no).

Other publications, conference papers and presentations as a result of FY21 grant award

Identify any other publications, conference papers and/or presentations not reported above. Specify the status of the publication.