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

FY22 Performance Progress Report

Due date: July 26, 2023

Cover Page

USDA-ARS Agreement ID:	59-0206-2-103
USDA-ARS Agreement Title:	Fusarium Head Blight (FHB) Resistance for Montana Barley
Principle Investigator (PI):	Frankie Crutcher
Institution:	Montana State University
Institution UEI:	EJ3UF7TK8RT5
Fiscal Year:	2022
FY22 USDA-ARS Award Amount:	$42,188
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Period of Performance:	May 1, 2022 – April 30, 2026
Reporting Period End Date:	April 30, 2023

USWBSI Individual Project(s)

USWBSI Research Category*	Project Title	ARS Award Amount
BAR-CP	Fusarium Head Blight Resistance for Montana Barley	$42,188
	FY22 Total ARS Award Amount	$42,188

I am submitting this report as an: ☒ Annual 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.

Frankie Crutcher

Principal Investigator Signature

7/22/2023

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 Barley

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1. **What are the major goals and objectives of the research project?**
   Objective 1: Continue crossing resistant material into Montana lines; field screen resulting progeny in three different environments.

   Objective 2: Continue to pyramid resistant lines and screen for resistance in the field for future genotype mapping.

   Objective 3: Collect and identify Fusarium isolates from FHB infected barley

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?**
   Objective 1: We grew lines that have shown promise in previous screenings in four locations: Sidney, Langdon, and Fargo in 2022. We have sent out seed for the same screening in 2023. In Sidney, these lines have been planted and inoculated. Heading occurred approximately 2 weeks ago so we will begin rating for disease soon.

   Objective 2: We screened over 1000 lines in 2022 produced from pyramiding different sources of resistance subset of the 2-row nested association mapping (NAM) panel in small hill plots in our nursery in 2022. We sent in seed for DON analysis for many of these lines. In 2023, we are retesting the NAM lines and have planted an additional set of pyramiding lines. In total, we are screening 645 hill plots in 2023.

   We have sent lines from the 2-row population to the National Agricultural Genotyping Center to be genotyped this summer and fall. Once we receive this data, we will use it and the disease data from our hill plots to map areas of resistance.

   Objective 3: We have identified 350 isolates collected in 2019 from two regions in Montana and have completed the chemotype analysis for the *F. graminearum* isolates. We also collected isolates in 2022 and have identified and are in the process of chemotyping the *F. graminearum* isolates. We also evaluated *F. sporotrichioides* isolates collected from two malt barley fields in south central Montana for virulence on barley in the greenhouse in spring 2023. We inoculated over 800 individual barley heads with 21 *F. sporotrichioides* isolates along with a water and *F. graminearum* control. Both a resistant (Bearpaw) and susceptible (Hocket) variety was used. Six plants were inoculated in each of three reps. Currently, we are threshing seed from individual heads. This seed will be counted, weighed, and plated on potato dextrose agar for FDK over the winter.

   b) **What were the significant results?**
   Objective 1: In 2022, there were significant differences in disease severity in Langdon and Fargo, however there was no difference in DON measurements. In Sidney, there

were significant differences in both disease severity and DON. We improved on our ability to get disease within the nursery on barley and had a decent amount of DON produced overall. Our disease control – Stander – had both high DON and high severity. In all three locations, our lines bred for FHB resistance (begins with 2017, 2019, or 2020) performed better than lines from the MSU barley breeding program bred for other characteristics (MT lines). Results are shown below.

Line	DON (ppm)	Disease Index
MT18M06012	18.7 A	12.9 B
Stander	16.8 AB	44.6 A
MT18F00908	14.9 A-C	7.4 B-D
MT19_M057_03	12.1 A-D	10.1 B-D
MT19_M045_11	11.7 A-D	11.8 B-D
MT17M05416	11.3 A-D	9.1 B-D
MT17M04801	11.0 A-D	5.6 B-D
MT18M06009	10.6 A-D	10.6 B-D
MT19_M028_10	10.2 A-D	9.8 B-D
MT16F02401	10.0 A-D	10.9 B-D
MT19_M070_09	10.0 A-D	12.0 BC
Pinnacle	9.7 A-D	8.7 B-D
MT17M01908	9.6 A-D	10.0 B-D
MT19_M069_10	9.4 A-D	10.4 B-D
MT18M09301	9.3 A-D	12.1 BC
MT18M06011	9.3 A-D	9.1 B-D
MT19_M055_03	9.0 A-D	8.2 B-D
MT19_M071_21	8.9 A-D	7.7 B-D
MT19_M097_08	8.8 A-D	5.5 B-D
MT17M01906	8.6 A-D	8.7 B-D
MT19_M060_06	8.5 A-D	5.2 B-D
MT17M05808	8.4 A-D	3.2 B-D
MT19_M080_13	8.4 A-D	7.4 B-D
MT19_M095_04	8.3 A-D	5.7 B-D
MT16F01601	8.3 A-D	7.9 B-D
MT19_M022_10	8.2 A-D	5.9 B-D
2017-42-6	7.8 A-D	2.2 B-D
MT19_M067_02	7.7 A-D	8.8 B-D
2019-28-36	7.7 A-D	6.5 B-D
2020-45-8	7.6 A-D	4.9 B-D
MT18M10106	7.6 A-D	8.5 B-D
MT19_M051_03	7.6 A-D	10.4 B-D
2017-39-13	7.5 A-D	9.4 B-D
MT16M09602	7.4 A-D	9.1 B-D
MT19_F01_01	7.3 A-D	7.4 B-D
MT18M06008	7.3 A-D	5.2 B-D
2021-26-11	7.2 A-D	7.6 B-D
2017-40-10	7.1 A-D	7.9 B-D
MT19_M061_16	7.1 A-D	3.4 B-D
MT19_M046_16	7.0 A-D	6.1 B-D
MT18M10207	6.9 A-D	7.0 B-D
2021-101-13	6.9 A-D	4.1 B-D
MT19_M045_08	6.8 B-D	9.3 B-D
MT19_M044_08	6.7 B-D	3.6 B-D
MT19_H11_17	6.7 B-D	3.0 B-D
2017-40-17	6.6 B-D	4.9 B-D
MT18F00503	6.6 B-D	6.7 B-D

MT19_M098_17	6.6 B-D	7.8 B-D
MT16M02101	6.6 B-D	5.6 B-D
MT19_M064_19	6.5 B-D	8.5 B-D
MT18M11006	6.4 B-D	6.1 B-D
MT19_M034_16	6.4 B-D	5.9 B-D
2017-59-2	6.4 B-D	6.5 B-D
2017-42-12	6.3 B-D	2.5 B-D
MT18M11002	6.3 B-D	8.2 B-D
2017-42-3	6.2 B-D	1.8 CD
2019-24-8	6.2 B-D	5.9 B-D
MT19_M066_18	6.2 B-D	8.8 B-D
MT19_M047_05	6.0 B-D	7.8 B-D
MT18M11101	6.0 B-D	7.7 B-D
MT18M11004	5.9 B-D	9.3 B-D
2019-27-46	5.9 B-D	4.0 B-D
MT18H02702	5.8 B-D	6.6 B-D
Buzz	5.7 B-D	6.3 B-D
2017-41-6	5.7 B-D	1.9 B-D
2019-25-101	5.7 B-D	2.8 B-D
2019-26-97	5.6 B-D	3.5 B-D
2017-45-16	5.5 B-D	4.9 B-D
2019-25-74	5.4 B-D	4.5 B-D
2017-43-11	5.4 B-D	4.0 B-D
MT19_M094_04	5.4 B-D	6.7 B-D
MT19_M038_16	5.4 B-D	7.7 B-D
2017-44-21	5.3 B-D	5.0 B-D
Lavina	5.2 B-D	8.1 B-D
2019-21-12	5.1 B-D	4.2 B-D
2017-45-12	5.0 B-D	5.0 B-D
2019-21-27	5.0 B-D	6.5 B-D
2021-106-18	5.0 CD	3.8 B-D
2019-24-14	4.9 CD	4.1 B-D
2019-26-48	4.9 CD	2.2 B-D
2019-26-73	4.7 CD	4.4 B-D
MT18M11106	4.6 CD	4.2 B-D
MT19_M061_19	4.5 CD	4.3 B-D
Hockett	4.5 CD	2.3 B-D
2019-25-17	4.5 CD	9.4 B-D
2019-27-43	4.4 CD	1.6 CD
MT19_M041_01	4.3 CD	7.6 B-D
2017-39-7	4.3 CD	2.0 B-D
2019-24-49	4.3 CD	3.4 B-D
2021-99-14	4.3 CD	2.4 B-D
MT19_H09_09	4.3 CD	0.9 D
2017-60-6	4.2 CD	7.2 B-D
2017-47-6	4.2 CD	1.5 CD
2019-25-29	4.1 CD	5.9 B-D
2019-24-7	4.1 CD	6.1 B-D
MT18F00812	4.1 CD	7.2 B-D
MT18F00714	4.1 CD	5.8 B-D
2020-26-9	4.0 CD	2.9 B-D
2019-21-43	4.0 CD	8.0 B-D
2017-43-8	3.9 CD	5.9 B-D
2019-27-48	3.8 CD	3.4 B-D
2019-28-48	3.8 CD	2.0 B-D
MT19_M064_04	3.7 CD	4.2 B-D

2019-27-71	3.7 CD	2.1 B-D
MT19_M031_18	3.5 CD	5.3 B-D
2020-27-1	3.5 CD	2.2 B-D
MT18F00803	3.5 CD	3.9 B-D
2017-43-22	3.4 CD	2.1 B-D
2019-25-55	3.4 CD	5.5 B-D
2017-46-10	3.3 CD	1.1 CD
MT19_M075_23	3.2 CD	3.5 B-D
2021-45-7	3.1 CD	6.7 B-D
2017-46-19	3.0 D	1.4 CD
Bearpaw	3.0 D	1.7 CD
MT19_M065_05	3.0 D	5.3 B-D
2017-43-18	2.9 D	1.9 B-D
MT19-H14-11	2.7 D	5.6 B-D
MT18M11103	2.6 D	3.6 B-D
2019-23-26	2.6 D	5.3 B-D
2021-45-11	2.5 D	1.5 CD
2017-42-18	2.5 D	2.4 B-D
2017-43-20	2.1 D	2.0 B-D
MT19_H11_03	2.1 D	5.6 B-D
2019-23-22	2.0 D	7.8 B-D
MT18F00607	1.9 D	5.7 B-D

Objective 2: For the hill plots we were able to get a fair amount of disease and DON production overall – similar to the full plots. We were also able to measure differences within our 2-row NAM population. This allowed us to select lines for genotyping and to deploy them in larger plots in 2023.

Objective 3: We are still collecting and evaluating the large amount of data from our greenhouse experiment with the *F. sporotrichioides* isolates.

c) List key outcomes or other achievements.

Objective 1: We have identified potential candidates for the breeding program that we will continue to evaluate.
Objective 2: We have been moving potential lines forward and are still performing crosses in the greenhouse. We have gotten one year of good data for the 2-row NAM lines.
Objective 3: We have identified the F. graminearum 3-ADON chemotype for the first time in Montana. We will be using these isolates for varietal development.

3. What opportunities for training and professional development has the project provided?
An M.S. student was trained during the process of this project. She is currently writing her thesis and preparing to defend.

4. How have the results been disseminated to communities of interest?
Results of the screening have been presented at field days and included in the regional MonDak research report that reaches approximately 2500 people in Montana and North Dakota annually.

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 FY22 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 May 1, 2022 – April 30, 2023?

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

X No, I have nothing to report.

Journal publications as a result of FY22 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 FY22 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 FY22 award

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