

**USDA-ARS**  
**U.S. Wheat and Barley Scab Initiative**  
**FY18 Final Performance Report**  
*NCE for FY19*  
**Due date: July 24, 2020**

**Cover Page**

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|--|---|
| <b>Principle Investigator (PI):</b>                    | Frankie Crutcher  |
| <b>Institution:</b>                                    | Montana State University  |
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| <b>Fiscal Year:</b>                                    | 2018 ( <i>NCE for FY19</i> )  |
| <b>USDA-ARS Agreement ID:</b>                          | 59-0206-5-003   |
| <b>USDA-ARS Agreement Title:</b>                       | Fusarium Head Blight Resistance for Montana Barley.   |
| <b>FY18 USDA-ARS Award Amount:</b>                     | \$ 32,338   |
| <b>Recipient Organization:</b>                         | Montana State University<br>Office of Sponsored Programs<br>Montana State University<br>PO Box 172470<br>Bozeman, MT 59717-2470 |
| <b>DUNS Number:</b>                                    | 625447982   |
| <b>EIN:</b>  | 81-6010045  |
| <b>Recipient Identifying Number or Account Number:</b> | W5477   |
| <b>Project/Grant Reporting Period:</b>                 | 5/6/19 - 5/5/20   |
| <b>Reporting Period End Date:</b>                      | 5/5/2020  |

**USWBSI Individual Project(s)**

| <b>USWBSI Research Category*</b>   | <b>Project Title</b>                                | <b>ARS Award Amount</b> |
|------------------------------------|---|-------------------------|
| BAR-CP                             | Fusarium Head Blight Resistance for Montana Barley. | \$ 32,338               |
| <b>FY18 Total ARS Award Amount</b> |   | <b>\$ 32,338</b>        |



Principal Investigator

7/23/2020

Date

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\* 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

**Project 1:** *Fusarium Head Blight Resistance for Montana Barley.*

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

To continue the advancement of Montana adapted FHB resistant barley varieties, in this funding period we have continued to make crosses of barley varieties that have shown resistance with high performing Montana varieties (Objective 1). Progeny from new crosses along with progeny developed from 2015-2017, progeny developed from pyramiding different types of resistance, and the 2-row NAM population are being screened at the MSU Eastern Ag Research Center, which has sufficient field and greenhouse space to evaluate a large number of barley lines (Objective 2). This screening will involve the collection and use of *Fusarium graminearum* isolates from Montana barley fields (Objective 3).

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

a) What were the major activities?

Objective 1: From previous screening of Montana germplasm, NDSU found Bearpaw to be somewhat resistant. We have been crossing Bearpaw with other germplasm reported to be resistant by NDSU and UM. We will continue this as new material is identified and other breeders are willing to share. In fall of 2019, we crossed Bearpaw to lines from the world core collection with some resistance including PI094790, PI234846, PI357314, and PI361609.

Objective 2: In 2019, more than 800 progeny from earlier crosses performed by Dr. Sherman were screened at the EARC nursery in Sidney, MT in hill plots. These plots were assessed for disease severity (1-7 scale) and DON. Approximate heading dates were also noted so that lines with the later planting dates could be eliminated. Of these progeny, 19 lines showing promise were planted as 10 ft 2-row plots and 154 were repeated as hill plots in 2020. Additionally, 36 lines that have been screened since 2017 were planted in 2-row plots and the 2-row NAM population consisting of 352 lines were planted as hill plots. As of mid-July, some of the later lines have yet to flower, but once that occurs an application of *F. graminearum* conidia will be performed. Disease evaluations will begin in late July and harvest in mid-August.

Objective 3: In 2019, several incidences of FHB occurred both in the northeast and south central parts of Montana. We either traveled to these areas for plant collection or samples were sent by collaborators. Some of the sampled fields had DON accumulation as high as 22 ppm. We isolated 252 *Fusarium* spp. from these samples, single spored them for purity, and are currently identifying them both morphologically and by gene sequencing. Twenty-five lines from this collection were used to make cornspawn and conidial suspensions for the 2020 field season.

b) What were the significant results?

Objective 1: Dr. Sherman has performed several crosses that have resulted in progeny with different characteristics including maturity rate and morphology. DON measurements from 2019 also indicate that these crosses have resulted in progeny with similar DON accumulation and disease severity within the cross, indicating that we may be looking at a difference in genetics. We were able to eliminate any resistance that might be due to a later maturity rate.

Objective 2: We were able to greatly expand our screening capability in 2019 by planting early generation material in hill plots. This has allowed for an earlier evaluation that permits us to eliminate material without resistance or with resistance related to other factors such as maturity rate.

Objective 3: We have collected 252 *Fusarium* isolates from two different regions in Montana that have had the greatest impact from FHB: northeast and south central Montana. Northeast Montana grows primarily durum and spring wheat under dryland, no-till conditions in rotation with pulse crops and oilseeds. Corn is usually only grown in this part of the state when irrigation is available. In south central Montana, both barley, spring wheat, and winter wheat are grown, though all of our samples from this region came from barley. Cereals are typically grown under overhead irrigation in rotation with corn and sugar beets. Several of the fields we sampled contained barley planted in corn residue. This survey should give us a good idea of how both the spatial and agronomic factors will affect the *Fusarium* populations in these two regions.

c) List key outcomes or other achievements.

Objective 1: We have been able to perform a large number of crosses between different resistant lines in order to pyramid potential resistance genes.

Objective 2: We have been able to screen the large numbers of progeny from Objective 1 which has allowed us to better focus our breeding efforts. Using a hill plot system, in 2020 we have been able to screen both the earlier progeny and the 2-row NAM population.

Objective 3: The large number of isolates we were able to collect in 2019 from several fields in two different regions of the state should allow us to better understand how common agronomic practices effect head blight fungal populations and how this in particular effects barley production in Montana.

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

Our research was impacted by COVID-19 in that we were unable to get seed to the two nurseries in North Dakota for evaluation this year due to staff limitations. We were able to get the entire nursery planted in Sidney, but without the other locations, screening of the more advanced material may require an additional season.

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

N/A

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

Unfortunately, most of the farmer education events this year were cancelled due to COVID-19. For our field day this summer, we are having a virtual event that will have videos produced by different researchers made available on YouTube. Our program has produced a video outlining FHB research in our state, including the FHB nursery in Sidney. In this video, we go through the nature of the disease, best management practices, and how we perform varietal screening in our nursery. We did credit the initiative in our funding acknowledgements. When these are made available, a link will be forwarded to Amber Hoffstetter and Sue Canty as well as included in future performance reports.

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## **Training of Next Generation Scientists**

**Instructions:** Please answer the following questions as it pertains to the FY18 award period (5/6/19 - 5/5/20). 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?**

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### 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<br>(S, MS, MR, R, where<br>R represents your most<br>resistant check) | FHB<br>Rating<br>(0-9) | Year<br>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

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## **Publications, Conference Papers, and Presentations**

**Instructions:** Refer to the FY18-FPR\_Instructions for detailed more instructions for listing publications/presentations about your work that resulted from all of the projects included in the FY18 grant award. Only citations for publications published (submitted or accepted) or presentations presented during the **award period (5/6/19 - 5/5/20)** 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:

De Wolf, E., D. Shah, P. Paul, L. Madden, S. Crawford, D. Hane, S. Canty, R. Dill-Macky, D. Van Sanford, K. Imhoff and D. Miller. 2019. "Impact of Prediction Tools for Fusarium Head Blight in the US, 2009-2019." In: S. Canty, A. Hoffstetter, H. Campbell and R. Dill-Macky (Eds.), *Proceedings of the 2019 National Fusarium Head Blight Forum* (p.12), Milwaukee, WI; December 8-10. University of Kentucky, Lexington, KY.

Status: Abstract Published and Poster Presented

Acknowledgement of Federal Support: YES (Abstract and Poster)

### **Journal publications.**

Peluola, C., Hoesel S., and F. Crutcher. 2020. Chlorine gas in an effective alternative to sterilize carnation leaves for *Fusarium* spp. identification. *Journal of Microbiological Methods* 170: 105841.

Status: Published

Acknowledgement of Federal Support: YES

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

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