

**Project FY22-BA-021:** Developing Scab Resistant and Low DON Winter Barley Varieties for the Great Plains

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

Our main objectives for this proposal are to 1) better characterize FHB resistance in NE winter barley germplasm, 2) introgress additional native resistance and major QTLs from other breeding programs, and 3) evaluate pedigree-based methods for genomic prediction in barley. In addition, we will develop and promote best management strategies for FHB in Great Plains barley production. These objectives address VDHR and MGMT priorities including Objective 1: Increase the number of resistant varieties with high grain yield and quality; Objective 2: Evaluate and Implement new breeding technologies; and Objective 3: Enhance communication and coordination.

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

**What were the major activities?**

Obj 1- Our key accomplishment for FY23 funding was completing our third year of testing UNL barley and the Winter Malting Barley Trial in our inoculated mist nursery. We also completed the second year of evaluating the Winter NABSEN. In Fall 2023, we again planted the UNL barley trials, WMBT, and Winter NABSEN in our inoculated mist nursery. The data collection from the 2024 trials is complete.

Obj 2 – With additional phenotypic data, we have been able to increase the number of crosses made to improve FHB tolerance or maintain tolerance in the UNL barley program. In the March 2024 crossing block, we made 16 successful crosses specifically for improving FHB tolerance. We made 28 additional crosses with a parent demonstrating moderate tolerance in the 2022 or 2023 Lincoln, NE inoculated nursery.

Obj 3- We have begun testing prediction methods for barley FHB phenotypes but do not have results to report at this time.

**What were the significant results?**

Obj 1- Due to drought and winter damage, the 2023 barley results were poor for both the Winter NABSEN and the MBYT compared to the UNL BVT. We achieved much better results for the 2024 trials (Table 1, Table 2).

**Table 1: Mean nursery results for the 2024 Barley FHB Irrigated Nursery in Lincoln, NE**

| 2024 Nursery  | Average Severity | Average Incidence | Average Index |
|---------------|------------------|-------------------|---------------|
| UNL BVT 2024  | 16.6             | 59.5              | 11.2          |
| MBYT 2024     | 14.2             | 70.0              | 10.8          |
| Winter NABSEN | 17.8             | 52.2              | 10.4          |

**Table 2: Fusarium Head Blight Disease Symptoms, in the BVT Nursery, Havelock Farm, Lincoln, NE, 2022-2024.**

| Entry | Nursery | Name    | 2024 UNL BVT Performance |           |       | Three-Year Mean Performance (2022-2024) |           |       |      |      |
|-------|---------|---------|--------------------------|-----------|-------|---|-----------|-------|------|------|
|       |         |         | Severity                 | Incidence | Index | Severity                                | Incidence | Index | FDK  | DON  |
|       |         |         | %                        |           |       | %                                       |           |       |      |      |
| 1     | BVT24   | NB14404 | 28                       | 63        | 16    | 21                                      | 46        | 20    | 30   | .    |
| 2     | BVT24   | NB17401 | 18                       | 53        | 10    | 17                                      | 55        | 19    | 21   | .    |
| 3     | BVT24   | NB17411 | 31                       | 73        | 27    | 29                                      | 64        | 41    | 0    | 7.7  |
| 4     | BVT24   | NB17431 | 28                       | 60        | 19    | .                                       | .         | .     | .    | .    |
| 5     | BVT24   | NB18406 | 20                       | 80        | 18    | 17                                      | 59        | 20    | 13   | .    |
| 6     | BVT24   | NB18429 | 11                       | 53        | 6     | 13                                      | 53        | 10    | 11   | .    |
| 7     | BVT24   | NB19406 | 12                       | 47        | 7     | .                                       | .         | .     | .    | .    |
| 8     | BVT24   | NB19420 | 9                        | 53        | 5     | 12                                      | 52        | 14    | 21   | 6.4  |
| 9     | BVT24   | NB19422 | 6                        | 33        | 3     | 6                                       | 28        | 7     | 12   | 5.7  |
| 10    | BVT24   | NB20409 | 9                        | 63        | 7     | 11                                      | 44        | 20    | 23   | .    |
| 11    | BVT24   | NB20420 | 33                       | 73        | 28    | .                                       | .         | .     | .    | .    |
| 12    | BVT24   | NB20421 | 21                       | 70        | 15    | 15                                      | 56        | 14    | 14   | .    |
| 13    | BVT24   | NB20435 | 17                       | 63        | 11    | 15                                      | 53        | 11    | 20   | .    |
| 14    | BVT24   | NB21214 | 18                       | 77        | 14    | 14                                      | 59        | 16    | 15   | .    |
| 15    | BVT24   | NB21411 | 9                        | 47        | 5     | 14                                      | 42        | 23    | 11   | 12.3 |
| 16    | BVT24   | NB21418 | 5                        | 37        | 2     | 16                                      | 57        | 16    | 51   | .    |
| 17    | BVT24   | NB22202 | 14                       | 40        | 8     | 10                                      | 37        | 8     | 51   | .    |
| 18    | BVT24   | NB22208 | 22                       | 77        | 17    | 22                                      | 78        | 21    | 33   | .    |
| 19    | BVT24   | NB22212 | 10                       | 47        | 7     | 25                                      | 51        | 37    | 55   | 20.2 |
| 20    | BVT24   | NB22214 | 12                       | 57        | 7     | 14                                      | 52        | 20    | 25   | 6.9  |
| 21    | BVT24   | NB22215 | 23                       | 60        | 15    | 21                                      | 62        | 19    | 24   | .    |
| 22    | BVT24   | NB22216 | 17                       | 73        | 12    | 17                                      | 68        | 16    | 54   | .    |
| 23    | BVT24   | NB22217 | 11                       | 57        | 7     | 11                                      | 49        | 11    | 69   | .    |
| 24    | BVT24   | NB22221 | 10                       | 63        | 7     | 24                                      | 65        | 25    | 49   | .    |
| 25    | BVT24   | NB22228 | 18                       | 60        | 11    | 18                                      | 54        | 27    | 5    | 4.9  |
| 26    | BVT24   | NB22229 | 19                       | 70        | 14    | 17                                      | 54        | 17    | 18   | .    |
| 27    | BVT24   | NB22230 | 18                       | 60        | 11    | 20                                      | 62        | 17    | 50   | .    |
| 28    | BVT24   | NB22233 | 8                        | 43        | 3     | 17                                      | 47        | 17    | 13   | 4.1  |
| 29    | BVT24   | NB22235 | 20                       | 30        | 7     | 23                                      | 52        | 24    | 26   | .    |
| 30    | BVT24   | NB22237 | 14                       | 63        | 9     | 18                                      | 68        | 13    | 26   | 2.0  |
| 31    | BVT24   | NB22240 | 8                        | 50        | 4     | 17                                      | 50        | 10    | 16   | 2.1  |
| 32    | BVT24   | NB22246 | 23                       | 87        | 20    | 13                                      | 48        | 25    | 30   | 4.2  |
| 33    | BVT24   | NB22259 | 15                       | 63        | 9     | .                                       | .         | .     | .    | .    |
| 34    | BVT24   | NB22260 | 26                       | 67        | 19    | 18                                      | 48        | 17    | 40   | 2.6  |
| 35    | BVT24   | NB15420 | 15                       | 70        | 10    | .                                       | .         | .     | .    | .    |
| 36    | BVT24   | P954    | 20                       | 60        | 12    | 25                                      | 61        | 24    | 24   | 2.6  |
| Mean  |         |         | 16.6                     | 59.5      | 11.2  | 17.1                                    | 54.0      | 18.7  | 27.4 | 6.3  |
| StDev |         |         | 7.1                      | 13.3      | 6.3   | 5.0                                     | 9.8       | 7.5   | 17.0 | 5.0  |
| CV    |         |         | 43.0                     | 22.4      | 56.7  | 29.5                                    | 18.2      | 40.3  | 62.0 | 78.6 |
| Range |         |         | 28.0                     | 57.0      | 26.0  | 23.0                                    | 50.0      | 34.0  | 69.0 | 18.0 |

**List key outcomes or other achievements.**

We have generated multiyear data for barley FHB phenotypes. This data is being used to inform selection and advancement decisions as well as to select parents for crossing to develop superior breeding lines with increased FHB resistance. We also participate in the Doubled Haploid generation project at Oregon State University.

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

This project and the UNL HWW-CP project have supported a summer research intern in 2023 and 2024. Interns receive training in wheat breeding and genetics, field data collection, harvest and data analysis. The data summaries presented in this report were supported by 2024 Intern Jennifer Antwi.

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

We share updates on all nurseries with collaborators as well as at conferences and presentations. We also include updates on FHB infections, prevention, and research at field days such as the annual UNL Wheat Variety Tours.

**5. What do you plan to do during the next reporting period to accomplish the goals and objectives?**

**May 2024-July 2024:** Field-based phenotyping of elite, advanced, and potentially preliminary breeding nurseries as well as regional nurseries. Management of misted nursery including inoculation, plot management, data collection, and harvest. Preliminary development of genomic prediction models. Selection of lines for fall crossing block.

**July 2024-Sept 2024:** Harvest field disease nursery, data analysis, processing samples for DON analysis, genomic selection model testing with preliminary 2024 phenotypic data, selection of breeding lines based on GEBV and phenotypic data

**Sept- Oct 2024:** Complete fall crossing block. Fall planting in the field, selection of lines for winter crossing block.

**Nov 2024-Jan 2025:** Advance lines for backcrossing, DNA extraction for genome-wide marker analysis if available

**Feb-March 2025:** Analysis of genome-wide marker data, testing new training model optimization, complete main barley crossing block for the year, prepare inoculum for the field season.

**April 2025:** Plant selected lines for additional backcrossing and/or three-way crosses