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

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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 FY24 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 2024, we planted the UNL barley trials, WMBT, and Winter NABSEN in our inoculated mist nursery. Inoculation with corn spawn took place on 4/25/2025, 5/3/2025, and 5/10/2025. A Fusarium spore suspension was applied on 5/21/25. The data collection from the 2025 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 18 successful crosses specifically for improving FHB tolerance (17% of crosses made). We utilize 5 winter barley parents and 5 spring barley parents.

   Obj 3- We initiated genomic selection with data from the 2023 and 2024 FHB nurseries. However, due to the limited number of genotypes that have been evaluated for FHB traits, our genomic selection accuracy was ≤0.1 for severity and incidence. We believe that an additional year of data from the 2025 nursery will improve our models as we have added ~40 additional genotypes.

   What were the significant results?

   The tables below show the results from the 2024 Irrigated FHB Nursery. Data from the most recent season is not available yet.

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
			%			%				ppm
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 multi-year 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 and submitted lines for DH production in 2024 and 2025.

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 from 2023-2025. Interns receive training in wheat breeding and genetics, field data collection, harvest and data analysis. This project also supported travel for PI K. Frels to attend the 2024 FHB Forum.

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 2025-July 2025: 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 2025-Sept 2025: 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 2025 Complete fall crossing block. Fall planting in the field, selection of lines for winter crossing block.
Nov 2025- Jan 2026: Advance lines for backcrossing, DNA extraction for genome-wide marker analysis if available
Feb-March 2026: 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 2026: Plant selected lines for additional backcrossing and/or three-way crosses