

Project FY22-HW-003: Transfer of FHB Resistance to NDSU Hard Red Winter Wheat Breeding Material

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

The relevance of the project's objectives to the USWBSI's goals and research priorities is as follows:

1. Increase the genetic diversity of targeted exotic FHB resistance genes in the HRWW breeding program.
2. Identify and breed lines with useful levels of native and novel resistance to FHB and combine these resistance genes. These lines can be used in crosses to enhance contributions from exotic resistance, ultimately pyramiding validated FHB resistance QTL from different resistance sources.
3. Employ single-seed descent (SSD) inbreeding to accelerate generation advance. This approach will be applied to promising cross combinations to accelerate the development of resistant cultivars.
4. Conduct an annual Winter Wheat x Fungicide performance field trial. Evaluate the response of advanced breeding lines and controls to fungicide application and determine the effects on grain yield and DON content.

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

Dr. François Marais retired in 2025, and the breeding program was temporarily on hold. In August 2026, Dr. Sepehr Naraghi was hired as the Oat and Winter Wheat Breeder to lead the program. Since Dr. Marais' retirement, Sepehr has overseen the transition, resumed breeding activities, and made progress toward several of the goals listed above.

What were the major activities?

1. 24 lines, comprising 19 commercial cultivars and 5 elite breeding lines, were evaluated in winter wheat variety trials throughout North Dakota.
2. A Winter Wheat x Fungicide performance field trial was conducted to evaluate the response of advanced breeding lines and control cultivars to fungicide application and to determine its effects on grain yield and DON content.
3. 456 F₄s were developed with different sources of FHB resistance, including *Fhb1* and *Fhb7*.
4. 458 F₂ populations were developed incorporating native and novel sources of FHB resistance, including *Fhb1*, *Fhb7*, *Qfhb.rwg-5A.1*, and *Qfhb.rwg-5A.2*.

What were the significant results?

- The 24 lines evaluated in the variety trials and the Winter Wheat x Fungicide trial were assessed for disease resistance, agronomic performance, and grain quality traits, including stem rust, leaf rust, grain yield, and DON content.

- The development of 456 F₄s and 458 F₂ populations expanded the breeding material available for incorporating and combining multiple sources of FHB resistance into adapted winter wheat germplasm.
- The resulting breeding populations provide a foundation for ongoing selection, generation advancement, and pyramiding of FHB resistance genes within the NDSU winter wheat breeding program.

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

No formal training or professional development activities were provided to students during the reporting period due to the leadership transition in the winter wheat breeding program.

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

Gave presentations at NDSU Research Centers and the ND Wheat Commissions.

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

- Screen 145 FHB Regional Nursery lines in Casselton, ND, under greenhouse conditions.
- Conduct a Winter Wheat × Fungicide performance field trial in Casselton, ND, and evaluate grain yield, test weight, protein content, and DON levels.
- Evaluate Elite Yield Trials in Crookston, MN, and Casselton, ND, for agronomic performance, disease resistance, and quality traits.
- Evaluate 150 Senior Yield Trials for agronomic performance, disease resistance, and quality traits.
- Evaluate 520 Junior Yield Trials for agronomic performance and resistance to disease.
- Evaluate and select 1,200 F₄s in the field.
- Evaluate and select heads from 554 F₃s in the field.
- Evaluate and select heads from 1,100 F₂ populations in the field.