Project FY22-SP-001: Developing Improved Cultivars of North Dakota Hard Spring Wheat

Note: Report must cover the *entire* duration of the project period of performance, May 1, 2022-July 30, 2026.

1. **What are the major goals and objectives of the research project?**
   1) Continue to develop varieties adapted to North Dakota which are moderately resistant to FHB
   2) Increase efficiency of data collection and line advancement for FHB resistance

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

Continue to develop varieties adapted to North Dakota which are moderately resistant to FHB

What were the major activities?

In 2022, we conducted three inoculated nurseries and screened 3028 entries for FDK and 2096 were ground and submitted for DON analysis.
In 2023, we conducted three inoculated nurseries and screened 9,882 entries for FDK and ground and submitted 4,000 for DON analysis (which included some special project work for collecting training population data).
In 2024, we conducted four inoculated nurseries and screened 3570 entries for FDK, and ground and submitted 3570 for DON analysis.
In 2025, we conducted four inoculated nurseries and screened for FDK and ground 3233 which were submitted for DON analysis.

What were the significant results?

Our program released the following varieties, which we classify as Moderately Resistant to FHB, when compared to long term checks.
ND Thresher- improved straw strength and bacterial leaf streak with good FHB resistance
ND Stampede- Hard red spring wheat adapted statewide, including Minnesota, South Dakota, and parts of Montana.
ND Nighthawk- Hard white specialty wheat with improved FHB resistance vs. prior HWSW varieties, primarily intended for western ND
ND Horizon- Primarily intended for eastern ND in heavier soils- improved straw strength to ND Stampede, with similar MR for FHB.
ND Blockade- hard red spring wheat intended for northwestern ND, solid stemmed variety for wheat stem sawfly resistance.

List key outcomes or other achievements.

Our most recent release which was grown commercially, ND Stampede, was planted on 7.3% of the wheat acreage in North Dakota during 2026.

Increase efficiency of data collection and line advancement for FHB resistance

What were the major activities?

During this funding cycle, we have fully adopted using our VIBE machine for taking Fusarium Damaged Kernel data. We no longer use any subjective visual measurements. This decision was made after careful comparison of the visual ratings, FDK from VIBE, and DON. If nursery samples are harvested in a timely fashion, we are able to see a high correlation ($r>0.7$) between visual kernel damage and the readings from the VIBE. We also routinely observe a higher linear relationship between FDK from the VIBE and DON.

Through collaboration with the USDA-ARS lab, we now genotype all new experimental lines with the Illumina 3k. This allows us to do basic marker-assisted selection for known FHB resistance genes, as well as genomic prediction using training data from the breeding program.

The long-term goal with both approaches are to decrease the number of lines which need to be fully phenotyped, to increase efficiency of personnel, and to increase the overall level of resistance in the program.

What were the significant results?

Our sample processing is now complete in 6-8 weeks less than it previously took to finish all subjective FDK ratings, and the data are more repeatable.

We only plant yield trial plots and nursery screening rows of genotypes which have shown major QTL (Fhb 1, Fhb5) or a favorable prediction through the genomic selection model. This decreases field screening cost for two of our most expensive phenotypes- yield, and FHB resistance.

The aforementioned correlation of VIBE FDK with DON should continue to increase the level of resistance in most elite-by-elite crosses, and more importantly, will allow us to make wider crosses and identify those progenies which are more resistant.

List key outcomes or other achievements.

Prior to utilizing our genomic selection + MAS approach, we never knew anything about the FHB resistance of the newly derived lines beyond the performance of their parents, unless opportunistic scab infections were observed in the segregating populations. It has only been three years of utilizing these models to advance new lines into the program so it is perhaps too early to know if the FHB resistance of the new experimental lines is increasing, but it cannot be worse than minimal selection used before.

3. **What opportunities for training and professional development has the project provided?**
   Assistant Breeder, Andre Miranda has attended the annual forum and continues to return with innovative ideas for collecting FHB data. Research technician Kayla Provencher was at the Forum in 2025 and benefitted with ideas from the "Nuts and Bolts Session". Both will return in 2026 and have been asked to help facilitate this training. PhD candidate Amber Hermanson also attended the Forum in 2025, and has been funded with USWBSI funds for three years. Her work on developing a speed breeding protocol with marker-assisted selection for FHB resistance has been integral in accelerating the breeding process. She will defend her PhD work in 2027 and graduate. We have also annually hired two part-time student workers, who were exposed to research for the first time by working for our program during the Summer and then processing seed and FHB nursery samples during the school year.

4. **How have the results been disseminated to communities of interest?**
   Fusarium head blight scores are reported in the annual variety trial results and selection guide. Data are compiled from multiple sources for this publication, with our program growing two sites in inoculated nurseries. These data are used by myself and Dr. Friskop in his Extension talks during winter meetings. I also speak at 6-7 field days each Summer where these data are utilized. Additionally, each time a variety is released from our program, the data are used because the majority of our efforts are focused on developing enhanced germplasm.

5. **What do you plan to do during the next reporting period to accomplish the goals and objectives?**
   Not applicable, this is the final report for the agreement.