

Project FY22-HW-005: Developing FHB-resistant Hard Red Winter Wheat for Texas and the S. Great Plains

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

The overarching goal of this proposal is to use traditional breeding techniques and marker-assisted selection (MAS) to develop FHB-resistant HRW cultivars adapted to Texas and the Southern Great Plains. Our specific objectives are to 1) develop, screen, and release HRW that combine superior yield and end-use quality with tagged or native FHB resistance, 2) use MAS to complement traditional breeding methods and improve gain from selection, and 3) enter promising FHB-resistant lines into regional nurseries to facilitate development of resistant cultivars. New FHB-resistant HRW cultivars with high yield, tolerance to other stresses, and superior end-use quality will provide effective means of resistance not only in Texas but also in other areas of the central and southern Great Plains where TAM wheat is adapted and where FHB levels require adequate host plant resistance.

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

What were the major activities?

A mist-irrigated FHB evaluation nursery was successfully established at the main campus for evaluating incidence, disease severity, FDK, and DON. We have specifically evaluated the Southern Regional Germplasm Nursery (SRPN), Texas elite lines (TXE), and some breeding lines in advanced and preliminary yield trials. In addition, some selected segregating populations with known FHB resistant parents were planted in the scab nursery. This nursery had heavy scab infection during the 2023-2024 growing season.

Another nursery was planted near Dumas, TX. Selected trials were planted into heavy corn residue and irrigated with pivot and surrounded with taller triticale to make favorable scab infection micro-environments. This is the third consecutive year of doing this and the results have been successful. This year the SRPN, the Texas Uniform Variety Trial, the Texas Elite trials, and Advanced breeding trials were planted.

What were the significant results?

During our third year of testing in the scab misted nursery at College Station, there were severe symptoms in 2023. The FHB index ranged from 4.0 to 7.5, based on a scale of 0 - 9 in the Southern Scab Nursery at 20 days after heading and the FDK ranged from 19.0% - 47.0% in the same nursery. The FHB index and FDK were not correlated this year ($r = -0.40$, $P = 0.2$). Heading date was highly negatively correlated with the FHB index, indicating that the earlier lines typically expressed higher symptoms. However, heading date was not correlated with FDK ($r = 0.5$, $P = 0.10$). DON was ranged from 0 to 0.5 ppm. Some promising lines TX18A001119 had 0 ppm DON and TX18DH313 had 0.2 ppm. SRPN samples followed the similar trends.

The FHB disease ratings in the nursery near Dumas for incidence ranged from 5% to 90% with an average of 39%, for severity ranged from 5% to 90% with an average of 51%, for FHB index ranged from 0 to 81% with an average of 24%. The data was consistent across replications and was used for advancement decisions. Some breeding lines were discarded

because of significant susceptibility two years in a row while others were marked to advance because of low FHB scores in 2022 and 2023. Jackie rated for FDK but not DON. In 2024, College Station nursery had severe symptoms but not the Dumas location.

List key outcomes or other achievements.

Our third-year nursery showed that we can produce and apply inoculum appropriately, mist irrigate, establish symptoms, and take good ratings of wheat head scab. The correlation between FHB index and heading was -0.90 ($P < 0.01$), which indicates that the later lines had lower FHB symptoms. This association is still high despite the grouping of entries we followed during symptom evaluation. We applied the corn spawn early right at the beginning of stem elongation. FHB pressure was higher compared to the 2021-2022 growing season, when we had dryer than normal weather conditions across the region. This is also confirmed by higher FDK ratings compared to year 2. The scab nursery at Dumas, TX had significant FHB symptoms and the known resistant and susceptible lines were consistent with data from previous nurseries. Several lines with good resistance were forwarded from Advanced trials in 2022 to Elite trials in 2023 and some of the 2023 elite entries will become variety candidates. The trials were rated for diseases index in the field. The grain was evaluated for FDK, and 100 selected samples were sent to NDSU for DON testing. FDK was up to 47% but DON was low, <0.5 ppm.

Based on the FHB data from SRPN, Texas elite and advanced lines, FHB incidence was ranged from 0 to 100% with the mean of 47%; FHB severity was ranged from 0 to 100% with the mean of 45%; FHB index ($=Inc*sev/100$) was ranged from 0-84% with mean of 25%; FHB FDK was ranged from 2.5-55% with mean of 30%. A set of 170 DON samples were submitted to NDSU for analyses.

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

Three technicians and several undergraduate and graduate students were trained in symptom rating, including disease incidence, severity, and FDK, as part of this project.

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

So far, data of regional nurseries has been shared with colleagues in the HRW region. Results was communicated in producers' meeting and field days in 2023 and 2024. Any future significant outcomes of this project will also be highlighted in popular press articles. Furthermore, results will be communicated to scientific peers via peer-reviewed scientific journals upon the release of current candidates screened during the project terms in 2025.

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

170 seed samples from 2024 were shipped to Fargo DON lab to test. These scab results collected from 2023 and 2024 will be summarized with other yield, quality and agronomic traits that will be used to determine which lines can be released.