Project FY22-HW-002: Breed FHB Resistant Hard Winter Wheat Cultivars and Germplasm Via Doubled Haploid

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

   The major goal is to develop FHB resistance germplasm and cultivars by pyramided FHB resistant genes. The objective is to pyramid *Fhb1*, *Fhb6*, *Fhb7* and other major QTL into hard red winter wheat for breeders and geneticists.

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

   What were the major activities?
   Major steps for doubled haploid (DH) lines (DHLs): 1) Wheat heads were pollinated using the corn pollens to develop seeds; 2) Seeds were dissected 18 days after pollination to rescue haploid embryos, cultured them on the growth media, and vernalized the seedlings for 6-8 weeks; 3) Vernalized seedling were transplanted into soil pots and grown to 2-3 tillers and treat the crown and roots with colchicine; 4) Transplanted and grew the colchicine treated seedlings in the greenhouse till maturity; 5) Seed increase for DHLs.

   In the fall of 2023, 460 F1 seeds as progenies of parental lines with *Fhb1*, *Fhb6*, and several major QTL were received from five breeding programs in the hard winter wheat region and more than 2176 embryos were dissected from March to July of 2024. A total of 650 haploid seedlings were transplanted into pots from June 7 to August 15. A total of 634 seedlings were treated with colchicine from July 10 to September 23. Then they were moved to the greenhouse to grow to maturity after they recovered from the treatment. By July of 2025, a total of 351 DHLs were harvested with seed amount ranging from a few seeds to a few grams. They will be planted in the greenhouse or as head rows in the field for seed increase.

   A set of 124 DHLs that were harvested in 2022 and 2023 were planted in the 2025 scab nursery. Incidence (INC) and severity (SEV) ranged from 5 to 100% with respective means as 61% and 51%. The FHB index (FHBI=INC*SEV/100) ranged from 0.3 to 100% with a mean of 33.7%. Among the 140 DHLs that have enough seeds to be planted in the field, 121 lines were planted in College Station and 44 lines were planted in Uvalde additionally.

   Due to the shortage of employees, no new set of seeds for DHL development was not requested from collaborators in the fall of 2024. The project will be continued in the fall of 2025 and 2026 to develop DHLs for the region as planned in the proposal.

Year	Crosses	Embryos	Seedlings	DHLs	Note
2022	15	422	192	59	1st attempt before the funding started. It was late in May which was not a good time for growing plants in the greenhouse. Diseases were severe, so plants were not healthy.
2023	25	2291	707	360	1st year optimum time development. The number of embryos rescued was up to the target but the germinated seedling number was low. There

					were contaminations so the final DHL number was low.
2024	24	2176	634	351	2nd year normal development. Seedling number was low. Postdoc without any previous experience used colchicine to treat seedlings, so the number of obtained DHLs were similar as the 1st year based on the number of seedlings.
2025					102 DHLs were planted in College Station field as plots; 39 DHLs were planted in Uvalde field as plots; 124 DHLs were planted in the scab nursery in College Station for scab resistance evaluation. 113 DHLs are screened for the Fhb1 marker. 13 lines had Fhb1.

What were the significant results?

Based on Fhb1 marker screening, 13 lines out of those 113 lines have Fhb1. They are TX22DH280, TX23DH209, TX23DH212, TX23DH217, TX23DH221, TX23DH227, TX23DH235, TX23DH236, TX23DH237, TX23DH249, TX23DH252, TX23DH92, TX23DH93.

In the spring of 2024, we collected 2176 embryos but the seedling number was low. Otherwise, we will produce more than 1000 DHLs. For those 140 DHLs tested in the College Sation scab nursery, 44 DHLs had FHBI score <15%. Their Fusarium-damaged kernels (FDK) and deoxynivalenol (DON) are under evaluation. All DH lines will be shared with all 8 collaborating breeding programs in the HRWW region.

List key outcomes or other achievements.

Among the 121 DHLs that were harvested from the field in College Station, 7 lines had higher yield than first check cultivars TAM 116 and four out of seven had very good agronomic traits. Additional 18 DHLs had higher yield than the top cultivar TAM 114. Among the 44 lines that were planted in Uvalde, two lines, TX23DH97 and TX23DH219, had a higher yield than TAM 116 and an additional 18 lines had a higher yield than TAM 114.

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

In addition to two PhD students, one new PhD student and a new postdoc were trained for the whole process of DHL development. With the previous postdoc left for a new position, we hired a new postdoc Sumandeep Bazzer who started on June 3, 2024. We trained her and another PhD student, Luke Whiteley who came to Amarillo, TX to help the haploid seed dissection for embryo rescue. They have done a good job to maintain the plant growth. Unfortunately, Suman left the program due to her family moving in January 2025. Our previous postdoc, Yahya Rauf, who was trained on DHL development, has come back to work with us on DHL development since May 2025. We have trained 3 PhD students and 2 postdocs on DHL development and 2 technicians and 1 additional PhD student on scab symptoms ratings.

The new wheat geneticist Dr. Junli Zhang from UC-Davis will start on September 1, 2025. He will work with Dr. Yahya Rauf on the development of DHLs using the new genetic lab and growth room in the new facility on the West TAMU campus where the Texas A&M AgriLife Research Center from Amarillo will move by the end of this year.