

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

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 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?

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 grow the colchicine treated seedlings in the greenhouse till maturity. 5) seed increase for DHLs developed in 2022 and 2023.

In 2022 Fall, 363 seeds from 20 crosses from six breeding programs in the hard winter wheat region were sent to wheat genetic program led by Shuyu Liu at Texas A&M AgriLife Research at Amarillo for the development of DHLs with Fhb1 and Fhb6 genes and with other QTLs. A total of 1304 embryos were cultured, and 352 haploid plants were produced in 2023 spring. 192 DHLs were harvested in 2023 and further planted in GH for seed increase. For soft wheat (WD), five F1 crosses with 114 seeds in 2022 fall were sent to Amarillo for DHL development with Fhb1 gene. A set of 934 embryos were cultured in 2023. From them, 279 haploid plants were produced, and 156 DHLs were harvested in 2023. The seed increase of these DHLs was done in GH and harvested for Russell now in Amarillo. A total of 172 lines were harvested and threshed this year and weighing of seed weight is in process. Many of these lines will be planted in yield trials and scab nursery in the fall of 2024.

In the current cycle of 2023, 366 seeds were received from five breeding programs in the hard winter wheat region and more than 990 embryos were dissected. 184 haploids plants were produced so far and out of which 17 were treated with colchicine for DH development with Fhb genes. For soft wheat (WD), 124 seeds from five crosses were planted and a set of 995 embryos were cultured in 2024. 315 haploid plants have been produced so far and out of which 138 were treated with colchicine. Work on treating haploid plants with colchicine is in progress and we are expecting to harvest a good number of DH lines by the end of this cycle.

What were the significant results?

A set of 150 DHLs were harvested so far, and 75 DHLs were sent to Russell for seed increase in the fall of 2023 so yield trials and scab test can be conducted in the fall of 2024. About 156 DHLs 2023 with increased seeds will be shared with Russell. 499 haploid plants were produced in 2024 and 155 were treated with colchicine so far.

List key outcomes or other achievements.

A total of 51 DHLs were developed in 2022, 360 DHLs were developed in 2023 and more are in the process of development for 2024. During the current cycle of 2024, 499 seedlings were obtained. 155 seedlings were treated with colchicine.

From 2022 cycle, the ratio from embryos to seedling was 0.28 and from plants to DHLs was 0.55. Seeds from available DHLs will be shared with all the contributors and the USDA-ARS Bai lab to screen to screen the corresponding markers for those major FHB resistance genes and QTL.

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 in China, we hired a new postdoc Sumandeep Bazzar who started on June 3, 2024. We trained her and another PhD student, Luke Whiteley who came to Amarillo to help the dissection of embryos.

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

The results have been shared with the contributing breeders, presented to the regional scab workers meeting in May of 2023, Field day and Texas small grain workers meeting.

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

We will summarize the results so far for how many DHLs we have developed, share the seeds with breeders so they can have some lines with enough seeds in the field headrows or plots for observation or yield trials.