

**Project FY22-HW-009:** Pyramiding & Deployment of Multiple FHB Resistance QTLs in Hard Winter Wheat

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

- Pyramid three major QTLs (*Fhb1*, *Fhb7* and *Fhb9*) in 15 locally adapted germplasm lines from HWW-CP breeding programs using marker-assisted backcrossing.
- Select breeding lines (Bc2F3/F4) with at least two major FHB resistance QTLs from each backcross population and send to HWW-CP breeding programs for further development of FHB resistant varieties
- Release germplasm lines with single *Fhb7* and *Fhb9* (2DL QTL) and combined three QTLs in US HWW backgrounds.

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

**What were the major activities?**

- Selected Bc1F1 heterozygous plants with all three major genes (*Fhb1*, *Fhb7* and *Fhb9*) as the resistance gene donor parents using diagnostic markers
- Crossed marker-selected Bc1F1 plants with all three major genes to each recurrent parent.
- All parents were evaluated for FHB resistance in greenhouses.

**What were the significant results?**

- We successfully selected Bc1F1 plants with all three genes from each of 14 crosses using markers for backcrossing by planting them with four different times due to large variation in flowering times among the parents.
- We made second backcrossing and harvested at least 60 Bc2F1 seeds per cross from 14 crosses and BC1F1 seeds from 1 cross.
- Original parent of *Fhb9* (Ji5265) was increased in greenhouse for seed distribution.

**List key outcomes or other achievements.**

- We repeatedly evaluated the Fielder-*Fhb7* transgenic and gene-edited plants for FHB resistance, confirmed that *Fhb7* we used in the gene pyramiding project is a major gene for FHB resistance.
- We identified the 2DL QTL from another source of Chinese cultivar, confirmed that they are the same QTL, officially named as *Fhb9* in a new publication.

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

- Two post-doc (Dr. Lanfei Zhao and Dr. Ruolin Bian) and a new MS student (Ms. Jinan Park) have been trained on marker-assisted backcrossing and FHB evaluation.

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

Development of breeding lines is in progressing and the selected lines carrying all three genes from BC2F3 will be released to breeders for further breeding process and cultivar development. Also, lines with single gene *Fhb7* or *Fhb9* will be selected, increased and deposited in USDA seed bank for global seed distribution.

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

1. Screen and select Bc2F1 and Bc2F2 for pyramided target genes using diagnostic markers.
2. Advance the progenies to Bc2F3 and select for lines with at least two homozygous resistance genes for release to HWW-CAP breeding programs.
3. Advance the marker-selected lines with all three heterozygous resistance genes and continuously select homozygous lines to be released to the HWW-CAP breeding programs.
4. All selected resistant lines will be genotyped using MRAsq for background selection.
5. Select lines with single gene of *Fhb7* and *Fhb9* using markers and phenotype them to select single gene resistant lines in hard winter wheat backgrounds for germplasm release.