

Project FY22-DU-006: Recurrent Selection to Improve FHB Resistance in Durum Wheat

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

Objective 1. Develop durum wheat germplasm with improved FHB resistance through recurrent phenotypic selection.

Objective 2. Explore genomics-assisted recurrent selection to accelerate genetic improvement.

Objective 3. Develop new durum wheat lines with improved FHB resistance through introgression of resistance genes from hard red spring wheat.

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

What were the major activities?

Towards Objective 1

A total of 194 S0:1 lines from the Cycle4 population were evaluated for FHB severity in 2023 at Prosper, ND. Top 20 lines were selected. Nine seeds of each of the top 20 selected lines and top three BC1F3:4 lines selected from interspecies crosses (see Objective 3) were planted and intercrossed in greenhouse in 2023 winter. The resulted hybrids were self-pollinated in 2024 spring; a total of 215 S0:1 lines were obtained, which will serve as the Cycle 5 population.

Towards Objective 2

Genomic prediction model was updated by adding the data collected from the Cycle4 population. The 215 S0 parents of the Cycle5 population were genotyped using 40K SNP array.

Towards Objective3

A total of 50 BC1F3:4 lines derived from the interspecific crosses (HRS-RSC1/Riveland) between top lines selected from hard red spring (HRS) wheat recurrent selection Cycle1 population and ND Riveland (a durum wheat check cultivar) were evaluated in field nurseries in 2023 summer. Top three lines with significant lower FHB severity than ND Riveland were selected and integrated into the durum wheat recurrent selection Cycle5 population.

What were the significant results?

Objective1

Two S0:1 lines from the Cycle4 population were identified with significant lower FHB severity than the check cultivar ND Riveland.

Objective2

Prediction models for FHB severity, plant height, and days-to-flowering were updated and validated using the Cycle2, Cycle3, and Cycle4 populations.

Objective3

Three BC1F3:4 lines (23S2001, 23S2039, and 23S2069) from the interspecific crosses (HRS-RSC1/Riveland) were identified with significant lower FHB severity than the check cultivar ND Riveland in 2023.

List key outcomes or other achievements.

A total of six BC1F3:4 lines from the interspecific crosses (HRS-RSC1/Riveland) were identified with significant lower FHB severity than the check cultivar ND Riveland. Three of them, 22S2393, 22S2407, and 22S2408 were evaluated for two years (2022 and 2023). The other three lines, 23S2001, 23S2039, and 23S2069 were evaluated for one year (2023). All six lines will be evaluated in 2024, where damaged kernel and DON will be measured as well.

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

All graduate students and hourly students have been involved in inoculation and disease scoring in greenhouse and field nurseries. This provided them a training opportunity for phenotypic evaluation of FHB resistance. Graduate students were also trained for marker genotyping and genomic prediction modeling.

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

The results of FHB resistance of our recurrent selection population and other germplasm were shared with wheat breeders and research scientists through personal communication and the annual FHB forum. A peer-reviewed paper was published on the journal Crop Science.

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

Towards Objective 1

One cycle of phenotypic selection will be conducted. The 215 S0:1 lines of the Cycle5 population will be evaluated in 2024 summer at Prosper, ND, from which top 20 lines will be selected based on the phenotypic evaluation of FHB severity.

Towards Objective 2

Two cycles of genomic selection for FHB severity will be conducted in 2024 fall and 2025 spring on the same Cycle 5 population. Genetic gain between phenotypic selection and genomic selection will be compared.

Towards Objective 3

The six BC1F3:4 lines from interspecies crosses with significant lower FHB severity will be evaluated at two locations in 2024. In addition to FHB severity, plant height, days-to-flowering, and other traits like damaged kernel, DON, etc. will be measured as well.