

Project 2: A Double Haploid Initiative to Speed Development of FHB Resistant Soft Winter Wheat

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

This project strategically addresses each of the three priorities in the VDHR-SWW Action Plan.

- (1) Increase the number of FHB resistant varieties available to farmers to reduce DON in the US grain supply. Utilizing doubled haploid (DH) technology decreases the breeding cycle from inception to pure line evaluation by a minimum of two years, which results in releasing FHB resistant varieties at a faster rate with improved efficiency. Saturating the number of FHB resistant varieties in the commercial marketplace for farmers is key to reducing DON presence within the national wheat supply chain. Approximately 1,400 DH lines will be generated from this project, with all of them potentially possessing multiple FHB resistance QTL in addition to high yield potential and quality.
- (2) Increase efficiency of coordinated project breeding programs to develop and release FHB resistant varieties. Promising lines (from the 1,400 total DHs) selected by individual breeders will be shared among the VDHR-SWW group to evaluate within scab nurseries in additional locations for regional adaptation. This will practically ensure that no line goes unnoticed and robust, multilocation data for individual lines will provide appropriate information needed to justify release and licensing to companies for marketing to growers.
- (3) Implement breeding technologies to enhance short term and long-term improvement of FHB resistance and to efficiently introgress effective resistance genes into breeding germplasm. Prior to selection of crosses for DH production, enrichment of FHB QTL and QTL for other agronomically important traits was completed for carefully chosen topcross populations using established markers and genotyping by Dr. Gina Brown-Guedira at the USDA ARS Eastern Regional Small Grains Genotyping Lab. This improves efficiency of the DH technology by eliminating undesirable lines and increasing the chance of stacking the appropriate genetics (FHB QTL + other QTL) in a DH line that will meet the requirements for release, or at a minimum, be used as a FHB donor parent in future crosses to effectively introgress resistance.

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

The grant period covers harvest (May-June) through preparation for planting for the programs of the VDHR-SWW. As per our group protocol we submitted F1 seed from crosses made in the spring of 2023 for creating new DHs for their planting in fall 2024. The parents of these F1s submitted for DH development were chosen to pyramid FHB resistance genes and have a high probability of combining yield, agronomic traits, other biotic pest resistance and resistance to FHB. About 50% of the DH lines that we received from HPI had less than 5 seeds, so we planted them in the GH and increased the seed volume for field testing. A total of 450 DH lines were generated in the performance period and tested in the headrows for the selection of high-yielding FHB resistant germplasm.

What were the major activities?

Selection of F1 lines based on genotypic data for making decision of DH creation.
Shipping of selected F1 seeds to Heartland Plant Innovation for DH production
Test and evaluation of selected DH lines for FHB resistance
Seed increases for plot testing for yield evaluations. In parallel we also started to optimize the DH protocol at the UMD.

What were the significant results?

Tested DH provided enhanced level of FHB resistance
Effectively reducing the generation time of cultivar development pipeline
We tested a highly selected set of 98 DH lines from previous DH cycles. These lines showed high yield and significant improvement on FHB resistance.

List key outcomes or other achievements.

Two high-yielding FHB tolerant DH lines are advanced for large scale seed production for their release and licensing process. A set of 42 selected DH headrows are advanced to statewide test for their critical evaluations.

Two high-yielding DH cultivars (MDW447-4 and MDW1-98) lines are being licensed to private seed companies.

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

Three PhD students, one MS student, one postdoc, and three undergraduate students were trained under this project. All the trainees worked with the PI to conduct the nursery and collect and analyze data. These students also participated in conferences and commodity board meetings with their work.

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

The PI presented the results in oral presentations and disseminated updates on FHB in wheat through emails. PI presented the research updates in the FHB forum as well as online project update meetings. The graduate students in the team presented the results as posters and handouts to the stakeholders in commodity board meetings. The results were published as wheat trial Factsheets and was disseminated via emails and the UMD extension system to the broader grower community.

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

We are increasing the seeds of 4 high-yielding DH lines with excellent FHB resistance in our MD germplasm and these lines will move forward for multilocation testing and advancement decisions. Update on these as well as new DHs will be presented.