

## **Project FY22-DU-004:** Genetic Characterization and Introgression of FHB Resistance in Durum Wheat

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

The major goal of this project is to genetically characterize FHB resistance sources and transfer the resistance into durum wheat. The specific objectives of the research are: 1) Finely map the 2A QTL for FHB resistance derived from the Divide X PI 254188 cross. 2) Develop user-friendly DNA markers for the 2A QTL. 3) Introgress the 2A QTL into durum wheat varieties. 4) Screen EMS mutants derived from ND Riverland and Kronos for FHB resistance. 5) Identify genes related to FHB susceptibility in durum wheat.

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

#### **a) What were the major activities?**

- We re-evaluated 500 EMS mutants derived from Kronos in both greenhouse and field experiments in order to identify genes related to FHB susceptibility in durum wheat.
- We also generated EMS mutant lines from another durum wheat line (ND Riverland-Fhb1) carrying the Fhb1 gene for identification of genes affecting Fhb1 expression in durum wheat genetic background. ND Riverland-Fhb1 is a near-isogenic line of ND Riverland and was derived from crossing between a durum wheat line and ND2710 (carrying Fhb1) followed by seven cycles of backcrossing to ND Riverland. Therefore, ND Riverland-Fhb1 has the same genetic background as ND Riverland with only difference for the Fhb1 gene.
- We are evaluating the EMS mutant lines derived from ND Riverland-Fhb1 for FHB resistance in the FHB nursery located at Fargo. This will allow us to identify candidate genes that suppress Fhb1 resistance.
- We edited wheat genes for disease susceptibility and resistance through wheat x maize hybridization coupled with genome editing.

#### **b) What were the significant results?**

- Among the 500 EMS mutants evaluated, 71 mutants were less susceptible compared to the wildtype Kronos in the first greenhouse inoculation experiment. We re-evaluated these 71 mutants again in the greenhouse by point-inoculation and confirmed that 12 of them were significantly less susceptible than Kronos and had a disease severity level below 30%. The mutated genes in these FHB resistant mutants have been identified and those genes that were mutated in multiple FHB resistant mutants but not changed in susceptible mutants are considered to be related to FHB susceptibility and will be selected as targets for FHB resistance improvement in durum wheat.
- A total of 300 M1 mutant families were generated from ND Riverland-Fhb1 by EMS treatment of the seeds and growing the M0 plants in the greenhouse. These EMS mutant lines are being evaluated for FHB resistance by point-inoculation in the field experiment.
- Using the wide hybridization between wheat varieties and maize plants expressing Cas9 enzyme and gRNA, five wheat genes (*Tsn1*, *TaMLO*, *TaHRC*, *TaPFT*, and *Fhb7*) related to

disease susceptibility or resistance were edited in doubled haploid (DH) plants generated from wide crosses with various wheat genotypes.

**c) List key outcomes or other achievements.**

- Candidate genes for FHB susceptibility in durum wheat were identified as targets.
- A quick and effective genome editing approach without wheat transformation was developed and used to edit several wheat genes related to disease susceptibility or resistance.

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

Three Ph.D. students are involved in this project and have obtained training in FHB screening, genotyping, EMS mutant generation, and genome editing through wide crosses between wheat and maize.

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

Some of the research results were presented in conference presentations and peer-reviewed articles published in scientific journals.

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

- Sequence some of the EMS mutants from ND Riverland-Fhb1. This will identify the genes suppressing the Fhb1 resistance in durum wheat.
- Edit some genes related to FHB susceptibility in durum wheat using the wheat x maize hybridization combined with genome technology.