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Project Title: Genomics-Assisted Recurrent Selection to Enhance FHB Resistance in Durum Wheat

PROJECT 1 ABSTRACT

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For a complex quantitative trait like FHB resistance, integration of favorable alleles of the involved genes - even of minor effect - from both exotic donors and native durum lines promises to provide high and stable resistance. Recurrent phenotypic selection is an integral tool to improve complex traits by increasing frequency of the favorable alleles in a synthetic population. Genomic selection (GS) is a molecular breeding approach with the capability to accelerate genetic improvement. In this project, we aim to utilize a male sterile facilitated recurrent phenotypic selection combined with GS to enhance FHB resistance in durum wheat. Accomplishing sufficient recombination through numerous crosses between candidate lines before each selection cycle is essential; however, doing so is difficult in self-pollinated wheat. To facilitate inter-crossing, we developed a male sterile durum line (Ms3-Carpio) by introgression of a dominant male sterile gene (Ms3) into a durum cultivar 'Carpio'. The founding synthetic population for this project will be developed by two generations of inter-crossing Ms3-Carpio, five elite durum lines, and 10 FHB resistant lines. We plan to evaluate about 200 half-sib families from male-sterile plants in the field for FHB resistance to select 20 best families. The 200 male-sterile parents will be genotyped, and serve as the training population to develop a GS model. GS in off-season greenhouse will be applied on seedlings (200 or more) from the remnant seeds of the selected 20 families; the best 40 plants (20 male-sterile and 20 male-fertile) will be randomly inter-crossed for the next cycle selection. We expect to increase genetic gain for FHB resistance through genomic-assisted recurrent selection with one cycle of phenotypic selection and one or two cycles of GS each year. In the FY2017-18, we will develop the founding population, conduct one cycle phenotypic selection, and develop and validate GS models. The synthetic populations derived from this project will be great materials to study the genetic basis of FHB resistance through association mapping and selective sweep. This project as a pre-breeding program will provide breeders FHB resistant germplasm (half-sib families) to be integrated into the F_2 generation of durum wheat breeding program for cultivar development.