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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 was 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 or S1 families in the field for FHB resistance to select 20 best families each cycle. The 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. One cycle of phenotypic selection was done in 2019. In the FY2020-21, we will conduct the second cycle phenotypic selection and develop/validate GS model. We will also identify new resistant germplasm from progenies derived from number of crosses between hard red spring wheat and durum wheat and add them into our recurrent selection population to broaden the resistance resources. The populations derived from this project will be great materials to study the genetic basis of FHB resistance through association mapping. This project as a pre-breeding program will provide breeders FHB resistant germplasm for cultivar development.