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Fusarium head blight (FHB) is the most serious fungal disease that currently threatens the durum wheat (*Triticum durum*) production in the U.S. Absence of a high level of FHB resistance in the durum germplasm seriously hinders development of FHB-resistant durum cultivars. Therefore, overall goal of this project is to develop high breeding value durum lines with a high level of FHB resistance that can be directly utilized in the U.S. durum breeding programs. To achieve this goal, we have been transferring FHB resistance to North Dakota (ND) durum cultivars from hexaploid bread wheat (*T. aestivum*) and other tetraploid wheat species or subspecies. So far, we have developed over 400 durum lines derived from various crosses using emmer wheat (*T. dicoccum*), Persian wheat (*T. carthlicum*), and hexaploid wheat as resistance donors and eight ND durum cultivars as recipients. Among these lines, approximately 150 lines showed various levels of FHB resistance and 17 of the lines exhibited a high level of FHB resistance similar to the level of resistance in bread wheat cultivars carrying *Fhb1*. Two of the lines with the high level of FHB resistance also showed excellent agronomic traits and they may represent the first success globally in developing elite durum germplasm with a high level of FHB resistance. The specific objectives of this project are: 1) to determine the FHB resistance QTLs in the resistant durum lines, 2) to rapidly incorporate these elite durum lines into ND durum breeding program for developing new durum germplasm and cultivars with combination of low cadmium, high yield, and excellent quality with FHB resistance, and 3) to develop PCR-based STARP (semi-thermal asymmetric reverse PCR) markers for three major FHB resistance QTLs introduced to durum wheat from bread wheat. In proposed research, we will evaluate 298 durum lines for FHB resistance and genotype them using wheat 90K iSelect array and the markers linked to FHB resistance QTLs from donors. The marker and FHB data will be used to detect the QTLs in the resistant lines using marker haplotype and association analysis. We will cross the two elite lines having a high level of FHB resistance to five ND durum breeding lines with low cadmium, high yield, and excellent quality to produce about 300 new durum lines using marker-assisted selection and our optimal single seed descend facility. We will then select the top lines with combination of low cadmium, high yield, and excellent quality and high level of FHB resistance. By implementation of this project, we expect that a number of high breeding value durum lines with FHB resistance will be developed and will be directly entered the pipelines of durum cultivar development in the ND durum breeding program.