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Genomic selection (GS) is a promising new approach to marker assisted selection that uses large DNA marker and trait data sets to calibrate models that are used to predict the performance of breeding lines that have not undergone phenotypic evaluation. GS predicted genetic values of breeding lines can be used to select parents in early generations substantially shortening the breeding cycle from the three to four years that it typically takes now to a single year. Given the relatively low heritability of FHB severity and DON concentration and the high cost of phenotyping these and other important traits, GS should be useful to accelerate efforts to breed resistance to FHB. The overall goal of this project will be to conduct two cycles of GS within the two year funding cycle to generate a set of 60 F2 populations that will be distributed to three Midwest six-row breeding programs in the spring of 2012. The major tasks to be carried out will be crossing of selected parents, advancing populations to the F3 generation, and GS prediction of breeding values. About 20 elite FHB parents from three Midwest six-row breeding programs will be crossed in a partial diallel generating at least 60 F2 populations. At least 1,000 F3 lines will be grown in the greenhouse in the fall of 2010, genotyped with 384 SNP markers that will be used to make GS model predictions to select parents. The GS model will be developed using previously collected marker and phenotypic data from a set of ~900 six-row breeding lines that were part of the Barley Coordinated Agricultural Project (CAP). Predicted values for DON, yield, height, heading date, and major malting quality traits (malt extract, grain protein, ratio of soluble to total protein, diastatic power, alpha amylase activity, and wort beta-glucan) will be used to select superior parents for crossing. Crosses among these F3 lines will be made in the 2010 fall greenhouse. These populations will be advanced to the F1 in the winter 2011 greenhouse, F2 in the summer of 2011, and F3 in the fall of 2011 where the model prediction and parent selection will be carried out for a second cycle of selection. About 60 F2 populations will be available for distribution in the spring of 2012 to the three Midwest barley breeders to incorporate into their breeding programs. In addition, a set of 100 randomly selected and GS selected breeding lines in each cycle of selection will be advanced and evaluated to measure the effectiveness of this GS project. This research should generate elite breeding lines that combine favorable alleles for disease resistance, agronomic performance, and malting quality. Variety candidates developed from this two cycles of GS would be ready for entry into industry malting quality evaluations in the 2015 crop year.