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Research Category: VDHR-NWW

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Project Title: Implementing Genomic Selection for FHB Resistance in Soft Winter Wheat (SWW) Adapted to the Corn Belt.

PROJECT 3 ABSTRACT

(1 Page Limit)

Soft red winter wheat has considerable useful “native” genetic variation for FHB resistance. The published literature suggests most genetic variation for FHB resistance in SRWW is due to genes of small effects. Thus much of the genetic variation for FHB resistance in SRWW is not amenable to traditional marker-assisted selection (MAS). Currently only traditional plant breeding employing phenotypic selection (PS) can affect those genes. The main problem with PS for FHB resistance is that it takes many years to complete a breeding cycle due to the years needed to inbreed a population, generate lines, obtain sufficient seed to test the lines, and acquire data over years to produce phenotypes with good predictive ability.

Our objectives are:

1. To implement Genomic Selection (GS) for FHB resistance in soft winter wheat by completing two cycles of GS.
2. Initiate evaluation of the effectiveness of GS.

Genomic selection (GS) is a new technology that allows marker selection to affect nearly all the genes that control FHB resistance, including those with small effects. Genomic selection begins with a training population of lines that is phenotyped and then genotyped. A prediction model is built using the phenotypic and genotypic data from a training population. That model can then be used to predict the value of other genotyped individuals that are related to the training population even without phenotyping those individuals. For example the best lines from the training population can be crossed and selfed to make an F2 population. The F2 plants can be genotyped and their value predicted using the GS model without the need to phenotype. This allows a breeding cycle to be completed very quickly: we estimate that a breeding cycle of PS for FHB takes five years in winter wheat while a breeding cycle of GS in winter wheat can be completed in one year.

The accuracy of GS versus PS has been evaluated in wheat and the results suggest that GS can be very effective in wheat for many traits, including FHB resistance in SRWW. Rudkowski et al (ref) evaluated GS for FHB resistance in Soft Winter Wheat using data from the USWBSI uniform scab trials and reported a RE of 0.38 to 0.64 for different FHB resistance traits. The Ohio State University program has estimated the accuracy of GS in SRWW for FHB resistance (index) to be 0.48. Given that a cycle of PS and GS for FHB in winter wheat takes five and one year, respectively, then reported accuracies for GS should provide a significant increase in gain per year over PS. These results indicate that GS has potential to significantly improve the annual gain in improving FHB resistance in soft winter wheat.

Over the past three years the USWBSI has funded the phenotyping of a training population of 649 lines. The population consists almost solely of native FHB resistance. Analyses of the available training population phenotypic data indicates considerable variation for all traits and moderate to high heritability. These 649 lines will be genotyped and use the phenotypic and genotypic data to develop a GS model to predict the value for each FHB trait. The model will then be used to execute two cycles of GS during the duration of this grant.