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PROJECT 1 ABSTRACT

(1 Page Limit)

The objectives of this research are: 1) to increase the number of varieties with improved FHB resistance and high grain yield and grain quality tested in statewide variety trials; 2) to increase efficiency of the CPs' funded projects to develop and release FHB resistant varieties and germplasm, and 3) evaluate and implement new breeding technologies and develop germplasm to further enhance short term and long-term improvement of FHB resistance. The Southern Uniform Winter Wheat Scab Nursery, coordinated at NC State, continues to play a vital role in the development of FHB resistant cultivars and germplasms in the Coordinated Project. The nursery provides timely data on resistance levels in advanced generation breeding lines compared with the resistant check cultivars Ernie, Bess and Jamestown. A nursery of 60-70 entries is desired, and it will be evaluated by approximately 12 cooperators. The nursery also serves as a platform for germplasm exchange. We will include PopVar output to compare crossing decisions among nursery entries with those based on genomic selection predictions and phenotypic means. We will investigate the utility of (GS) to increase efficiency in Southern wheat programs breeding FHB resistant varieties by predicting, and also phenotyping, FHB resistance of entries in the Sungrains, Sunpre, Sunwheat and GAWN nurseries. The accuracy of the genomic estimated breeding values (GEBV) in predicting FHB resistance levels is of key importance to utilizing this approach to selection. The accuracy of the model will be determined by the correlations between the phenotypic measures of FHB resistance and the GEBV. Training population optimization will be examined for improving estimate accuracies. These approaches will include using biplots to select appropriate environments, minimization of prediction error variance to estimate optimal training populations for specified validation sets, using STPGA and updating training populations with phenotyped lines from recent breeding cycles. The long term objective is the elimination of the labor and cost intensive evaluation of these nurseries in specialized scab inoculated tests and spend resources on more evaluation of lines exhibiting superior agronomic traits combined with other required disease and insect resistances. The experiment will be conducted in the 2020-21, and 2021-22 seasons with the training population being updated annually. We will determine the genetics of FHB resistance in NC13-20076 utilizing a population of 200 doubled haploid lines. NC13-20076 has exhibited excellent moderate resistance to FHB but contains none of the identified major or minor QTL for resistance. The experiment will be conducted in the 2019-20, and the 2020-21 seasons. We plan to produce 3,500 DH annually in-house with 2,400 of those under contract to other universities. The primary goal will be the production of DH cultivars with moderate resistance to FHB. Each of the crosses will have one, or both, parents expressing moderate resistance to FHB. Over 90 percent of our variety development breeding populations result from crosses between one or more parents exhibiting partial to high levels of resistance to FHB. Approximately 550 F_2 and F_3 bulks (combined) will be advanced in both seasons utilizing mass selection. Approximately 30,000 headrows in the F_4, F_5 and F_6 generations (combined) will be advanced each season using the pedigree method. We will sequence approximately 750 new $F_{5:7}$ lines entering first year yield testing annually.