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Scab or Fusarium head blight (FHB) has been major wheat disease in the spring wheat region. Combating this disease while protecting our environment by growing genetically resistant and adapted cultivars is the soundest, efficient, economical, and safe strategy. Recently developed HRSW cultivars by NDSU breeding program (Faller, Howard, Glenn, Steele-ND, and Alsen) with moderate FHB resistance are being grown extensively in ND. In the past 6 years, these cultivars were grown on more than 50% of North Dakota wheat acreages which oscillate 7 million acres annually. Additional acreages grown to these cultivars are also found in MN and SD. However, new adapted cultivars with different and/or higher resistance levels, combining different sources of resistance to FHB and other diseases are needed. In, 2004 and 2006, 'Steele-ND' and 'Howard' with scab resistance source different from Alsen were released. Steele-ND was grown on more than 9% of ND wheat acreages in 2006, 2007, and 2008. Similarly, in 2005, "Glenn" was released combining both Alsen and Steele-ND resistance. Glenn covered about 20 and 27.9, and 23% of ND wheat area in 2007, 2008, and 2009 respectively, replacing Alsen as the major HRSW cultivar grown in the region. Following the release of Glenn, 'Faller', a cultivar with FHB resistance similar to Steele-ND and Alsen, was released in 2007. This cultivar was the second leading cultivars in ND with more than 17% of ND wheat acreages. Faller was also the leading cultivar in MN with more than 23% of MN wheat acreages. Therefore, using classical breeding techniques and modern tools, including MAS techniques, this project aims to (1) continue developing adapted HRSW cultivars that have resistance to FHB and grain shattering combined with good agronomic and quality attributes; (2) identify and introgress novel FHB resistance that reduces disease infection and DON levels into adapted HRSW germplasm base; and (3) use molecular markers to facilitate screening of FHB resistant genotypes.

To achieve these objectives, adapted superior genotypes will be used to develop segregating populations for selection and advancement of elite lines that combine FHB and other diseases resistances with desired agronomic and quality traits. Grain shattering resistance will be also selected for. Advanced and elite lines will be tested in multiple field trials in ND to identify FHB and other major diseases resistant genotypes that meet the desired adaptation, agronomic and quality criteria for cultivar release. The complex nature of genetic resistance to FHB in wheat is significantly affected by the environmental conditions. Continuous search of new sources of resistance, particularly type I resistance coupled with appropriate breeding strategies and selection methodologies are needed to deal with a diverse germplasm and large breeding populations. Appropriate field and greenhouse evaluation for FHB resistance and the newly identified molecular markers –mainly QTL's located on 3 BS and 3 A chromosomes- are useful tools to select efficiently and to combine several types of resistance to FHB with other economical-value traits. In addition, we will use the off-season nursery in New Zealand (NZ), Puerto Rico, and Arizona to accelerate the generation advance and seed increase for ND trials. Past experience showed that selection for maturity, height, lodging resistance, and grain shattering can be done in NZ. The introgression of diverse germplasm sources of FHB and shattering resistance will provide the germplasm base for selection of enhanced and combined types of FHB resistance. This project has been taking a leading role in developing superior HRSW cultivars with resistance to FHB as a control measure to minimize the negative effects of FHB on the production, export, processing, and consumption of HRSW.