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Project Title: Transfer of FHB Resistance to NDSU Hard Red Winter Wheat Breeding Material

PROJECT 1 ABSTRACT

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This ongoing project was initiated in 2012 to develop FHB resistant germplasm for a new NDSU winter wheat breeding program. Initially, literature-validated resistance genes that included *Fhb1* and *Qfhs.ifa-5A* (CM82036); *Qfhs.ifa-3A* (Frontana); *Qfhb.rwg-5A.1* and *Qfhb.rwg-5A.2* (PI277012), and *Fhb6* (TA5660, with an *Elymus tsukushiensis* translocation) were transferred to winter-hardy wheat backgrounds using backcrosses, single seed descent inbreeding and doubled haploid production. Initially, greater emphasis was placed on the use of *Fhb1* in breeding program crosses due to its clear effect and suitable markers. We then began to develop and study simple pyramids of *Fhb1* plus 1-2 of the remaining QTL to find those that would add substantively to the effect of *Fhb1*. The results showed that *Qfhs.ifa-5A* and *Qfhb.rwg-5A.1* are probably alleles of the same gene. Both genes strongly supplement *Fhb1* and several cold-hardy genotypes carrying these QTL combinations have since been developed and used in crossing blocks. Combinations of *Fhb1* with *Qfhs.ifa-3A* were less promising, and the latter gene will be used to a lesser extent. *Fhb6* in combination with either *Fhb1* or *Qfhs.ifa-5A* gave a useful level of resistance. Since *Fhb6* has a reliable marker and appears to be without deleterious linked effects, its use in crosses will increase. The transfer of *Qfhb.rwg-5A.2* to winter wheat and an evaluation of its usefulness is in the final stages. The following project objectives are proposed with respect to 2019-20:

1. Complete an evaluation of the ability of the above resistance QTL to complement the *Fhb1* resistance.
2. Continue to increase the frequency of *Fhb1* and FHB resistance QTL that strengthen its effect in the NDSU hard red winter wheat germplasm and crossing blocks.
3. Broaden the overall genetic variability of the FHB-resistant germplasm, i.e. combine FHB resistance with resistance to other prevailing diseases, broad adaptation, yield and quality.

In the next year, strict selection will be done using molecular markers (when possible), phenotypic data from natural field infections, and artificially (greenhouse and field) inoculated FHB nurseries. This will be combined with convergent crossing and selection schemes to purposely enrich the NDSU breeding material with effective FHB resistance genes. The research aims to facilitate breeding of broadly adapted winter wheat varieties with good winter-hardiness, high yield, acceptable quality and multiple pest resistance, in particular to FHB and rust diseases. Complementing QTL that effectively raise FHB resistance will be integrated into the breeding pool with the purpose to breed increasingly more varied and complex resistance combinations with improved winter-hardiness and commercial utility.