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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 (then) newly implemented NDSU winter wheat breeding program. Initially, literature-validated resistance QTL (*Fhb1, Qfhs.ifa-5A,* two QTL on chromosome 5A of PI277012 (*Qfhb.rwg-5A.1; Qfhb.rwg-5A.2*), a QTL on 3A of Frontana (here referred to as *QTL3A*) and *Fhb6*) were transferred to winter-hardy wheat backgrounds using backcrosses, single seed descent inbreeding and doubled haploid production. These single gene introgressions were used as breeding parents with greater emphasis being put on the use of *Fhb1* due to its clear effect and suitable markers. Since 2016 we also developed and studied 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* strongly supplements *Fhb1* and several cold-hardy genotypes carrying this QTL combination have since been developed and used in crossing blocks. Preliminary data suggested that *Qfhb.rwg-5A.1* from PI277012 occurs within the same chromosome region and produces a similar effect to *Qfhs.ifa-5A*. However, due to heterogeneity of the donor source, the second PI277012 locus, *Qfhb.rwg-5A.2*, was lost during the transfer attempt. Presently, combinations of *Fhb1* with either *QTL3A* or *Fhb6* are being developed and evaluated for their usefulness. The following project objectives are proposed with respect to 2018-19:

1. Complete an evaluation of the ability of resistance QTL to complement the *Fhb1* resistance.
2. Continue to increase the frequency of *Fhb1* and those FHB resistance QTL that strengthen its effect in the NDSU hard red winter wheat germplasm.
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 two years, significant progress can be made towards these goals through strict selection based on molecular markers (when possible), use of 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 high yield, acceptable quality and multiple pest resistance, in particular to FHB. 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.