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PROJECT 1 ABSTRACT
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The project develops FHB resistant germplasm for the NDSU winter wheat breeding program. To compensate for insufficient native resistance in winter wheat, validated resistance QTL were transferred from spring wheat. Winter germplasm with *Fhb1*, *Qfhs.ifa-5A*, *Qfhb.rwg-5A.1, Qfhb.rwg-5A.2* (PI277012) and *Fhb6* (added singly or in combinations) was produced. Results showed that *Qfhs.ifa-5A* and *Qfhb.rwg-5A.1* are likely the same gene, and thus, the various sources represent four apparently different resistance QTL: *Fhb6* (on chromosome 1AS), *Fhb1* (3BS), *Qfhs.ifa-5A/Qfhb.rwg-5A.1* (5AS), and *Qfhb.rwg-5A.2* (5AL). Based on their different chromosome locations, the QTL may represent four non-orthologous genes with different resistance mechanisms. Preliminary data suggested resistance complementation in at least some QTL combinations; thus, it constitutes a potentially very valuable breeding resource. However, due to its recent transfer from spring wheat, the material has narrow genetic background variability. In addition, the winter-hardy starting materials were highly susceptible to FHB; had poor agrotype or lacked resistance to other diseases. Strong emphasis must therefore be put on moving the resistance QTL into more productive and genetically varied hybrid backgrounds. This can be done through carefully planned, convergent crosses to select and breed increasingly more varied and complex resistance combinations with improved commercial utility. Thus, the following specific project objectives:

1. Increase (annually) the frequencies of the four FHB resistance genes within the NDSU breeding population through careful planning and execution of new convergent crosses coupled with marker screening and agronomic evaluation of the segregating progenies.
2. Hasten the selection of high yielding, FHB resistant inbred lines in each of three 2-year selection studies. Specific, well-chosen crosses will be employed and large numbers of progeny will be extensively evaluated.
3. Initiate (annually, in a greenhouse) the development of 500-600 new (near-random) single seed descent (SSD) inbred lines from 25 select crosses that each segregate for one or more FHB resistance QTL (plus resistance to the wheat rusts). From the second year, the F_4 populations will be grown in the field for resistance selection and pure line development.
4. Conduct an annual Winter Wheat x Fungicide performance trial (field) to evaluate the response of advanced breeding lines and controls to fungicide application for the reduction of DON content.

Availability of new genetic material with resistance not only to FHB, but also to other major wheat diseases will greatly facilitate the breeding of commercially appealing cultivars for the production of ample, safe and good quality wheat.