

ADVANCING DEVELOPMENT OF WINTER DURUM WHEAT USING GENOMIC APPROACHES

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Fusarium head blight (FHB) disease resistance and winter hardiness (WH) are the two priority traits in the Canadian winter durum wheat (WDW) breeding program. Currently, no WDW candidates are available for testing in Western Canada. Our study uses Genome-Wide Association Studies (GWAS) and Genomic Selection (GS) to dissect the genetic basis of these traits and enable precise breeding value predictions. A panel of 295 WDW accessions was phenotyped for FHB traits (incidence, severity, Fusarium Damaged Kernels [FDK], and Deoxynivalenol [DON]) and winter survival across multi-environment trials (MET) in Winnipeg, Carman, and Ottawa (2021-2024). GGE Biplot analysis identified stable, superior accessions across MET. Multi-locus GWAS utilizing Genotyping-by-Sequencing (GBS) derived 68,994 SNPs revealed 121 QTNs for FHB resistance and 15 for WH, with key haploblocks on chromosomes 2B, 5A, and 7B. Prediction accuracies (r^2) from five-fold cross-validation showed improved FHB index predictions (19–40%) with GWAS preselected markers using Random Forest (0.424–0.514). MKRKHS achieved higher accuracies for FDK (0.574–0.631) and DON (0.540–0.627). Winter survival prediction was most accurate with EGBLUP (0.705–0.726). Our findings offer valuable insights into the genetics of the investigated traits and underscore the potential of GS for early-generation screening for accelerated genetic gains.