

A SYSTEMIC APPROACH TO INCORPORATE THE HIGHEST LEVELS OF FHB RESISTANCE WITH AGRONOMIC MERIT AND QUALITY IN WHEAT

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To create FHB resistant germplasm (and cultivars), the systemic approach described by Comeau *et al.* (2010) is significantly more successful than other approaches used by Canadian breeding programs, with probability levels ranging from about $p < 0.05$ to $p < 0.00006$ for many key traits. In Canada, the systemic approach was used to create complex crosses that were selected with complex stress for a few generations (F₁ to F₅-F₇). Stresses included BYDV, *Fusarium* and rust inoculations. Then, the resistant germplasm selected was shared with public and private breeding projects for further crosses. Breeders also isolated candidate lines for cultivar registration directly from the systemic germplasm. The result is clear: for disease resistance traits at large, and especially for FHB, the systemic-derived lines significantly surpass other candidate lines. Frequently the systemic approach delivered better protein and sometimes higher yields. High protein correlates to low yield; the systemic approach slightly reduced this undesirable effect. We got a protein increase (significant, $p < 0.006$) with fewer drawbacks. The method effect on yield is not significant: some systemic lines are high yielders, and others, low yielders. Yet some good yielders have the FHB resistance with very good agronomics, and quality getting close to what would make a cultivar popular. Putting high FHB resistance in a short statured plant remains a challenge, not impossible, but it is a difficult goal which has not yet been achieved. We have developed medium-height genotypes with proper straw properties-for lodging resistance; this compromise works best in Eastern Canada. Other methods exist to create FHB resistant lines, but so far the systemic way is the best. The method has a parallel in systemic methods used by EMBRAPA in Brazil, where the overall emphasis is stronger on quality and agronomics than on FHB and BYDV. Success also crowned the EMBRAPA endeavour. Therefore the systemic approach had success in two different countries. We conclude that wheat breeders should pay attention to such new ideas, in which the focus is on globally better phenotypes rather than on specific genes. The method is adaptable to other species, once the basics are understood.

Keywords: breeding; systemic approach; stresses; diseases