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WHEAT BREEDING FOR RESPONDING TO ENVIRONMENTAL CHANGES: ENHANCEMENT OF MODERN VARIETIES USING A WILD RELATIVE FOR INTROGRESSION OF ADAPTED GENES AND GENETIC BRIDGE

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The forecasted changes in abiotic environmental conditions, including the effects of global warming and the release of pollutants in the environment for crop protection and growth, will all play their part for promoting sustainable agricultural practices. This will require a genetic remodelling of plant varieties to maintain high yield performance and quality of basic agricultural commodities. Traditional breeding is limited by the narrow gene pool of the cultivated plant species and reshuffling the same genetic variation slow the pace of the improvement rate. Natural biodiversity of the secondary and tertiary gene pools of crop species such as wheat, often are unexploited sustainable resources that can enrich the genetic basis of the cultivated primary gene pool. *Dasypyrum villosum*, (*Dv*; 2n=14; VV), a distantly related wild species of the secondary gene pool of wheat, is a large natural resource of novel gene variants already refined and tested by over a half-billion years of evolution and natural selection. When transferred into wheat genome, those genes can increase adaptability and ultimately grain productivity and quality traits. Gene transfer occur during meiosis of the F_1 plants from hexaploid "Chinese Spring" (CS) wheat (2n=42, $A^BA^BB^BB^BDD$) x *Dv* hybridization: some of the chromosomes of the two species pair and recombine, others undergo homoeologous fragments exchange, others remain intact. Therefore, aneuploid or euploid wheat lines with cryptic or large Dv chromosome fragments have been produced after backcross to wheat. Those wheat lines directly express the *Dv* novel gene variants. Particularly intriguing are the following results: (1) Wheat lines that simultaneously inherited from *Dv* the *VRN-A1* and *VRN-B3* like promoter regions, showed dominant expression of flowering earliness, low GxE interaction, and over 15% increase in grain yield, compared to CS. (2) Wheat lines aneuploid for chromosome 6V, expressed: (i) a gene for immunity to powdery mildew (probably a case of non-host resistance) associated to the expression of adult-plant resistance to leaf rust, and (ii) genes promoting the increase to 17-18% of the protein content compared to 13 % in CS. (3) Wheat lines carrying chromosome exchanges with 1V and 6V, showed improved values of Farinograph parameters and bread volume in comparison with CS. Breeding innovations were also obtained after hybridization of the MxV amphiploid (*T. turgidum* var *durum* x *Dv*; 2n=42; $A^DA^DB^DB^DVV$) to CS. Eighty percent of the pollinated florets produced F_1 caryopses and the selfed F_1 plants were partially fertile; about 42% of the F_2 seeds produced complete fertile plants. Root-tip

chromosome counting of the resulting F_3 seeds showed 14A, 14B and 14 D chromosomes, and no apparent trace of V chromosomes. Hence, *Dv* genome acted as a genetic bridge to transfer genes from tetraploid to hexaploid wheat. After 5 years of selfing and seed multiplication, two lines from the full-fertile F_2 plants were better than the highest yielding check in a four-environment trial.