Tetraploid wheat wild relatives as tools of wheat improvement

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The accessions of two tetraploid wheat wild relatives (Triticum timopheevii Zhuk. [2n=4x=28, A1A2G1G2] and Triticum turgidum L. ssp. dicoccum [Shrank ex Schübler Thell. [emmer wheat] [2n=4x=28, A1A2B1B2]) preserved at the Martonvásár Cereal Gene Bank are promising sources of wheat improvement through the utilization of their characteristics and wide resistance to several biotic and abiotic stresses.

Crossings were carried out with a semi-dwarf line of diploid cultivated einkorn (Triticum monococcum L. ssp. monococcum ‘LT-1’, 2n=2x=14, A1A2) bred in Martonvásár, which has also remarkable resistance and other promising phenotypic characters. (seed set=13.3%)

First registered Hungarian emmer variety (‘Mv Hegyes’) for alternative (organic) wheat growers.

Characterization and exploitation of gene bank accessions have started more than 10 years ago in Martonvásár

One T. timopheevii accession (Acc. No.: MVGB845) out of 56 was selected for the development of new synthetic amphiploid wheat prebreeding materials.

Steps of development

1. Germination of F1 seeds (germination rate=91.1%), and vernalization of seedlings for 6 weeks
2. Selection of triploid progenies (2n=3x=21, A1A2G1) (using root tip preparations)
3. Plant regeneration in climate chamber (tILLering-program)
4. Doubling the triploid genome with colchicine treatment (treated F1 = C1 ; survival of plants=80.9%)
5. Continue the regeneration of C1 fertile plants: Triticum timococcum Kost. (isolation of ears; seed set=4.2%)
6. Confirmation of genome composition (2n=6x=42, A1A2G1A2G1A2) via fluorescence in situ hybridization (FISH, GISH) – Fig. 1.
7. Phenotypic characterization of the synthetic amphiploid progenies in C2 generation (Fig. 2-4.)

T. timococcum in prebreeding

1. Crossing with Mv9kr1 bread wheat line (carrying recessive crossability allele kr1) — seed set=21.2%
2. Regeneration of hybrids (Fig. 5.), and backcross with Mv9kr1 (seed set=2.2%)
3. Identification of chromosomes of BC plants with molecular cytogenetic methods (FISH and GISH)
4. Development of new synthetic amphiploid lines from registered cultivars of T. turgidum ssp. dicoccum and T. monococcum

Further tasks

1. Further characterization of Triticum timococcum in the field
2. Selection from C4 generation
3. Development of backcross wheat x T. timococcum hybrids and further backcrosses with wheat
4. Development of new synthetic amphiploid lines from registered cultivars of T. turgidum ssp. dicoccum and T. monococcum

Fig. 1. FISH (left) and GISH (right) patterns on mitotic chromosomes of the same hexaploid Triticum timococcum C6 cell using repetitive (left) and genomic (right) DNA probes. Chromosomes labelled with yellow are from the T. monococcum parent, and chromosomes labelled with white are from the T. timopheevii parent. (Bar=10 μm)

Fig. 2. ‘TT-1’ (left), MVGB845 (right) and their C4 hybrid: Triticum timococcum (middle)

Fig. 3. Increased pubescentness of T. timococcum leaves compared to MVGB845

Fig. 4. Spikes of Triticum timococcum C6 (2 of the middle 3 are double-peaked) and its parents (left: T. timopheevii var. rubiginosum MVGB845; right: T. mon. ssp. mon. ‘TT-1’) Bar: 5 cm

Fig. 5. Hybrids of Mv9kr1 and T. timococcum

Fig. 6. Hybrids of Mv9kr1 and T. timococcum

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