Exploiting Alien Germplasm Resources against Biotic Stresses in Wheat

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Wheat is truly global, being one of the few crops grown over most of the world. There are hundreds of wild species, landraces, and local cultivars within the *Triticum* species that constitute the wheats of the world. The role of germplasm in wheat improvement is well established. A highly successful phase of germplasm utilization was initiated with incorporation of dwarfing and photoperiod insensitivity genes from Japanese and Italian germplasm into widely adapted, rust resistant genetic background at CIMMYT. Finally, exploitation of Norin 10 dwarfing gene ushered Green Revolution in India. This very success was based on strategic exploitation of genetic resources.

Wheat, being the most important food crop of the world, has attracted most attention and it has been hybridized extensively with 'alien' species belonging to several related genera (Sharma and Gill, 1983 and Islam and Shepherd, 1990). The prospect of transferring desirable traits like disease and pest resistance drew attention of early workers to attempt wide hybridization resulting into introgression of alien genes to cultivated wheat species. More recent considerations are to transfer nematode and disease resistance genes from barley to wheat. Wild relatives have contributed a great deal to the improvement of cultivated wheat. Dwarf alien germplasm resources possessing various important traits have already been transferred or are potentially transferable (Gautam *et al.*, 1998, Nanda *et al.*, 1998 and Friebe *et al.*, 1996.

Recently protoplast fusion and regeneration alone has widened the wide hybridization range by facilitating union of wheat x alien species that were not possible earlier by direct crossing. Wide crosses have already moved into cellular and molecular approaches where the diagnostic techniques are a boon for effecting alien transfers. There are four major groups of markers with applications in wheat wide crosses-morphological, genetic, cytological and biochemical. Combined use of these markers adds to efficiency.

The fact that several of the resistance genes mapped in wheat have been introgressed from alien species explains the success of tagging them since a higher level of polymorphism is detected compared to segments where no alien DNA is transferred. In the last decade, a large number of genes of various functions have been mapped to specific wheat chromosomal regions. Several mapping/ tagging strategies using mostly RFLPs and RAPDs have led to these results. A number of RFLP and RAPD linked markers were then converted to PCR-based, more robust markers, such as sequence tagged sites (STSs), sequence characterized amplified regions (SCARs) or allele specific amplicons (ASAs) (Hoisington *et al.*, 2003).

There seems every possibility that biotechnology may soon overcome the constraints related to the actual transfer of desired alien genes into their respective hosts. The enormous array of genetic stocks in *Triticum* offers remarkable opportunities for alien gene transfers. There is need of enforcing crop improvement protocols based upon the utilization of genetic diversity, crucial for durability of stress resistances and tolerances and for the ensuring sustainability. The useful variability from the wheat germplasm needs to be constantly explored and introgressed into cultivated wheats for ensuring adequate food and nutritional security to the ever-increasing global population.

References

Hoisington D, N Bohorova, S Fennell, M Khairallah, A Pellegrineschi and JM Ribaut. The application of bio-technology to wheat improvement. http://www.fao.org/DOCREP/006/Y4011E/y4011e0d.htm#bm13

Gautam PL, SK Mithal and S Kochar (1998) Wheat genetic resource management and its use in National PGR system. In: S Nagrajan, G Singh and BS Tyagi (Eds.) *Wheat: Research Needs Beyond 2000 AD.* (eds.) Narosa Publishing House, New Delhi, p 39-50.

Nanda GS, VSP Rao and D Mohan (1998) Wheat germplasm-utilised and underutilized. In: S Nagrajan, G Singh and BS Tyagi (Eds.) *Wheat:Research Needs Beyond 2000 AD.*, Narosa Publishing House, New Delhi, p 51-58.

Friebe B, J Jiang, WJ Raupp, RA McIntosh and BS Gill (1996) Characterization of wheat alien translocations conferring resistance to diseases and pests: Current status. *Euphytica* **91:** 59-87.

Islam AKMR and KW Shephered (1990) Incorporation of barley chromosome into wheat. In: YPS Bajaj (Ed.) *Biotechnology in Agriculture and Forestry*, **Vol.13** *Wheat*, Springer-Verlag Berlin Heidelberg.