Abstract

A polyploid organism by possessing more than two sets of chromosomes from one species (autopolyploidy) or two or more species (allopolyploidy) is known to have evolutionary advantages. However, by what means a polyploid accommodates increased genetic dosage or divergent genomes (allopolyploidy) in one cell nucleus and cytoplasm constitutes an enormous challenge. Recent years have witnessed efforts and progress in exploring the possible mechanisms by which these seemingly intangible hurdles of polyploidy may be ameliorated or eventually overcome. In particular, the documentation of rapid and extensive non-Mendelian genetic and epigenetic changes that often accompany nascent polyploidy is revealing: the resulting non-additive and novel gene expression at global, regional and local levels, and timely restoration of meiotic chromosomal behavior towards bivalent pairing and disomic inheritance may ensure rapid establishment and stabilization as well as its long-term evolutionary success. Further elucidation on these novel mechanisms underpinning polyploidy will promote our understanding on fundamental issues in evolutionary biology and in our manipulation capacities in future genetic improvement of important crops that are currently polyploids in genomic constitution. This review is intended to provide an updated discussion on these interesting and important issues within the scope of a specific yet one of the most important plant groups—polyploid wheat and its related species.