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Sommario/riassunto

Aquaporins (AQPs), a class of integral membrane proteins, form channels facilitating movement of water and many other solutes. In solute transport systems of all living organisms including plants, animals and fungi, AQPs play a vital role. Plants contain a much higher number of AQP genes compared to animals, the likely consequence of genome duplication events and higher ploidy levels. As a result of duplication and subsequent diversification, plant AQPs have evolved several subfamilies with very diverse functions. Plant AQPs are highly selective for specific solutes because of their unique structural features. For instance, ar/R selectivity filters and NPA domains have been found to be key elements in governing solute permeability through the AQP channels. Combination of conserved motifs and specific amino acids influencing pore morphology appears to regulate the permeability of specific solutes such as water, urea, CO2, H2O2, boric acid, silicic acid and many more. The discovery of novel AQPs has been accelerated over the last few years with the increasing availability of genomic and transcriptomic data. The expanding number of well characterised AQPs provides opportunities to understand factors influencing water transport, nutritional uptake, and elemental balance. Homology-based search tools and phylogenetic analyses offer efficient strategies for AQP identification. Subsequent characterization can be based on different approaches involving proteomics, genomics, and transcriptomic tools. The combination of these technological advances make it possible to

efficiently study the inter-dependency of AQPs, regulation through phosphorylation and reversible phosphorylation, networking with other transporters, structural features, pH gating systems, trafficking and degradation. Several studies have supported the role of AQPs in differential phenotypic responses to abiotic and biotic stress in plants. Crop improvement programs aiming for the development of cultivars with higher tolerance against stresses like drought, flooding, salinity and many biotic diseases, can explore and exploit the finely tuned AQP-regulated transport system. For instance, a promising approach in crop breeding programs is the utilization of genetic variation in AQPs for the development of stress tolerant cultivars. Similarly, transgenic and mutagenesis approaches provide an opportunity to better understand the AQP transport system with subsequent applications for the development of climate-smart drought-tolerant cultivars. The contributions to this Frontiers in Plant Science Research Topic have highlighted the evolution and phylogenetic distribution of AQPs in several plant species. Numerous aspects of regulation that seek to explain AQP-mediated transport system have been addressed. These contributions will help to improve our understanding of AQPs and their role in important physiological aspects and will bring AQP research closer to practical applications.