Novel insights into plant aquaporin trafficking

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Plant plasma membrane aquaporins (PIPs) are channels facilitating the passive movement of water through biological membranes. A tight regulation of aquaporin density/activity in cell membranes is essential to control transcellular water flows and to maintain plant water status under challenging environments. A wide variety of mechanisms regulate PIP trafficking to the plasma membrane and their activity or gating. These mechanisms usually involve physical interactions of PIPs with other proteins and also depend on trafficking motifs present on the sequence of these PIPs.

Post-Golgi trafficking of PIPs was shown to involve an interaction with the SNARE proteins SYP61 and SYP121 that also appeared to be physically associated in a SNARE complex (Hachez et al., 2014). These findings suggest that several SNAREs modulate the activity of PIP aquaporins in the cell membrane by mediating their subcellular routing. We are currently characterizing the role of other PIP interactants in controlling their cell surface abundance under abiotic stress.

PIP aquaporins are divided in two groups PIP1 and PIP2 that differ in their subcellular localization. When expressed alone in mesophyll protoplasts, maize PIP2s reach the cell PM while PIP1s are blocked in the endoplasmic reticulum (ER). A protein domain-swapping approach was utilized to demonstrate that a new LxxxA motif in the transmembrane domain 3 of PIP2s regulates their anterograde routing along the secretory pathway and, more particularly, their export from the ER (Chevalier et al., 2014). The reason why such motif impacts the trafficking of PIPs is currently under investigation.

Altogether, these data support the view that tight modulation of PIP trafficking contributes to the fine tuning of the plasma membrane water permeability in plant cells.

Chevalier, A.S., Bienert, G.P., and Chaumont, F. (2014) A new LxxxA motif in the transmembrane helix 3 of maize PIP2 aquaporins is required for their trafficking to the plasma membrane. Plant Physiol. In press

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