Tolerance of maize to drought: a matter of aquaporins?

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Interactive exhibit

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Plant aquaporins play key roles in the cellular water permeability by enhancing the transport of water molecules across lipophilic membranes. In maize, four aquaporin subfamilies were identified, among them were found the PIPs standing for plasma membrane intrinsic proteins. Despite the fact that PIP aquaporins are water channels, their function in the plant response to water deficit is not well characterized (Chaumont and Tyerman, 2014). Gene candidate approaches based on the overexpression of one specific *PIP* gene can lead to either deleterious or beneficial effects for plants under water shortage. Microarray global expression studies on five *Arabidopsis thaliana* accessions showed a decreased transcription of most *PIP* genes under progressive drought (Alexandersson et al., 2010). In addition, physiological and pharmacological approaches conducted among several crops showed that aquaporins are involved in both leaf elongation and transpiration rates in response to atmospheric water deficit (Sadok and Sinclair, 2010; Caldeira et al., 2014). Altogether these data indicate that aquaporins are involved in the plant response to water limitation.
Under the frame of the European DROPS project, the expression of 12 *PIP* isoforms was investigated by quantitative PCR in 30 maize lines grown under two contrasted water regimes in the PhenoArch phenotyping platform (LEPSE, Montpellier) where biomass, water use efficiency and transpiration were measured in parallel. Under water limitation, the mRNA level of *PIP*s belonging to the PIP1 group was weakly regulated while it was down-regulated for most *PIP2*s, in both leaf elongation and mature zones. *PIP* expression pattern to water deficit also relied upon the plant life cycle. Furthermore, principal component analysis revealed that expression of most *PIP*s contributed to the first component while biomass and hydraulic parameters contributed to the second component in well-watered conditions. Under water deficit, this distribution changed indicating that aquaporin expression adjustment to water limitation is involved in the regulation of these physiological parameters.

Keywords: Aquaporins, Leaf, Maize (Zea mays), Plasma membrane intrisic protein (PIP), Water deficit