Unraveling the Intricacies of Water Flow in Conductive Systems of Maize Leaves Using Multi-Level Data

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The plant organism is formed through coordinated self-organizing mechanisms, in which water flows play a key role at the level of organs, tissues, and cells. Therefore, it is important to investigate how transport processes depend on the xylem architecture resulting from phenotypic plasticity of the plant regulated by environmental factors within a given genotype that determines the plant's internal developmental factors. This study used a comprehensive approach, including physiological measurements, multi-view, microscopy, contrast-enhanced magnetic resonance imaging, and modeling of water flows in porous media to study the transport processes in maize leaves growth zone under contrasting environmental conditions. Experimental data were obtained from young maize seedlings exposed to high light during 4-8 leaf development. The results of inverse modeling made it possible to establish quantitative dependences between the parameters of water flows and the parameters of growth and transpiration processes in leaves.

The main publications of authors on the subject of the abstract:

Zubairova, U. S., Kravtsova, A. Y., Romashchenko, A. V., Pushkareva, A. A., Doroshkov, A. V. (2022). Particle-based imaging tools revealing water flows in maize nodal vascular plexus. Plants, 11(12), 1533. https://doi.org/10.3390/plants11121533

Nikolaev, S. V., Zubairova, U. S. (2021). A computational model of the cereal leaves hydraulics. In Journal of Physics: Conference Series (Vol. 2099, No. 1, p. 012039). IOP Publishing. https://doi.org/10.1088/1742-6596/2099/1/012039

Take-home message:

Modeling of water flows in porous media based on data from multi-view, microscopy, and contrast-enhanced magnetic resonance imaging revealed quantitative dependences between water flows, growth, and transpiration processes in young maize leaves.

DOI 10.18699/PlantGen2023-64