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Macroscopic root water uptake modelling using High-Throughput Screening (HTS) systems: Design and Validation

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Climate change and intensive agriculture are responsible for the increasing frequency and intensity of abiotic stresses generating conditions of water scarcity. Currently, there is the need to select and release, in a short time, plants adaptable to the current and future environmental conditions and resistant to biotic and/or abiotic stress. This study presents the design and validation of a High-Throughput Screening (HTS) system for the continuous and simultaneous monitoring of the plant stress response to drought in a semi-controlled environment.

Structurally, the HTS-system is formed by three hardware segments to detect with high-frequency the agrometeorological variables (i.e., atmometry), the weights (i.e., gravimetry), and the soil water content (SWC) (i.e., time domain reflectometry, TDR) of sixteen pots in which the medicinal crop *Salvia officinalis* L (sage) was grown. Two irrigation treatments, one based on full irrigation and the second on soil water deficit conditions, were applied following a feedback control irrigation scheduling protocol, and an automated micro-irrigation system was designed to manage them.

The system was able to model the sage water stress function following the root water uptake (RWU) macroscopic approach. The threshold of soil water status below which crop water stress occurred was also identified. The gravimetric-based daily evapotranspiration ($ET_{c\ act}$) and the time domain reflectometry (TDR) -based RWU rates showed a high correlation, which allowed validating the RWU indicators based on soil moisture sensors to estimate the $ET_{c\ act}$ fluxes.

Keywords. Agro-hydrological modelling, high-throughput systems; root water uptake; sage; water stress function