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

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**Abstract.** In this work we designed and validated a High-Throughput Screening (HTS) system for the continuous and simultaneous monitoring of plant drought stress response in a semi-controlled environment. Structurally, the HTS-system consists of three hardware segments for high-frequency detection of the agrometeorological forcing 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 ornamental crop (Prunus lusitanica) was grown. An automated micro-irrigation system was designed to manage water by following a feedback control irrigation scheduling protocol. The three monitoring segments and the irrigation system were controlled in an algorithm written in CRBasic programming language and implemented in a CR1000 datalogger (Campbell Scientific Inc.). The elementary module of the HTS-system consisted of a 5.0 l pot, implemented with a load cell and a TDR probe used, respectively, to detect the weight [g] and the volumetric soil water content [m3 m-3].

The weights and/or the volumetric water content measured in each module represented the feedback control variables used to manage the irrigation events. The validation procedure of the HTS-system has embedded two types of soils with different physical properties (coarse-grained and fine-grained soil), and, for each soil treatment, two levels of soil water deficit conditions were settled. In the water deficit treatments (DI) the SWC was maintained below the critical soil water status (i.e., stress incipient condition), whereas in the full-irrigation treatment (FI) the SWC was maintained between the field capacity and the critical soil water status. The system was able to model the crop water stress function following the root water uptake macroscopic approach. The root water uptake model was represented by a nonlinear (logistic) relationship between the crop water stress and soil water status, which allowed to identify the critical threshold of SWC defining the incipient occurrence of water deficit conditions for the analyzed crop.