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Soil moisture responses to vapour pressure deficit in polytunnel-grown tomato under soil moisture triggered irrigation control

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The aim of this work has been to investigate soil-to-atmosphere water transport in potted tomato plants by measuring and processing high-resolution soil moisture data against the environmental driver of vapour pressure deficit (VPD). Whilst many researchers have successfully employed sap flow sensors to determine water uptake by roots and transport through the canopy, the installation of sap flow sensors is non-trivial. This work presents an alternative method that can be integrated with irrigation controllers and data loggers that employ soil moisture feedback which can allow water uptake to be evaluated against environmental drivers such as VPD between irrigation events. In order to investigate water uptake against VPD, soil moisture measurements were taken with a resolution of 2 decimal places - and soil moisture, air temperature and relative humidity measurements were logged every 2 minutes. Data processing of the soil moisture was performed in an Excel spread sheet where changes in water transport were derived from the rate of change of soil moisture using the Slope function over 5 soil moisture readings. Results are presented from a small scale experiment using a GP2-based irrigation controller and data logger. Soil moisture feedback is provided from a single SM300 soil moisture sensor in order to regulate the soil moisture level and to assess the water flow from potted tomato plants between irrigation events. Soil moisture levels were set to avoid drainage water losses. By determining the rate of change in soil moisture between irrigation events, over a 16 day period whilst the tomato plant was in flower, it has been possible to observe very good correlation between soil water uptake and VPD - illustrating the link between plant physiology and environmental conditions. Further data is presented for a second potted tomato plant where the soil moisture level is switched between the level that avoids drainage losses and a significantly lower level. This data illustrates the possibility that rate-of-change of soil moisture and VPD measurement could be employed to highlight plant stress conditions.