Geophysical Research Abstracts
Vol. 21, EGU2019-1304, 2019
EGU General Assembly 2019

Identifying the threshold of soil water content for the precise irrigation scheduling of a Citrus orchard under subsurface drip irrigation

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Proper irrigation scheduling requires the knowledge of the soil-plant-atmosphere system, including the relationships existing between its various components. During the last decade, the monitoring of soil water content (SWC) has been considered a standard way to determine when crops need to be irrigated. However, under drip irrigation systems in which laterals are laid on the soil surface or buried at a certain depth, the gradients of soil water content are rather high and therefore the threshold of SWC below which crop water stress occurs should account for the position of the sensors; the threshold, in fact, depends on the specific crop system, as well as on the relative position of the measuring sensors with respect to the emitters. The knowledge of this threshold is crucial for irrigation scheduling, especially when regulated deficit irrigation (RDI) strategies are planned during specific stages of crop growth. Objective of this work was to identify the threshold of SWC to be used for the precise irrigation scheduling of a citrus orchard irrigated with a sub-surface system. To this aim, the soil water content measured during irrigation season 2018 in the root zone depth and in two different treatments, were integrated with the measurements of predawn and midday stem water potential and transpiration fluxes.
The experiments were carried out in a commercial citrus orchard (C. reticulata cv. Tardivo di Ciaculli) located near the city of Palermo, Italy (38° 4' 53.4" N, 13° 25' 8.2" E), in which a subsurface drip system with twenty emitters per plant was installed at 30 cm depth. Each emitter discharged 2.3 l/h at pressure of 150 kPa. Experimental field was divided in eight plots, half of which constantly maintained under full irrigation (FI) and the other half under deficit irrigation (DI) during the phase II of fruit growth (from July 1 to August 20). The layout was equipped with a standard weather station (Spectrum Technologies, Inc) and eight "drill & drop" sensors (Sentek, Stepney, Australia) installed in a central tree of each plot, 30 cm apart from one emitter; all the sensors were interfaced with a communications board that uses the cellular 3G data network to make an internet connection. The Scholander chamber was used to measure predawn and midday stem water potential, whereas the Granier thermal dissipation probes (two per tree) were installed in four trees to monitor sap flow.
Experimental data evidenced that during the examined period transpiration fluxes in treatments DI resulted about 75% of those measured in FI, due to the reduced irrigation volumes and the parallel reduction in vegetative growth observed in the summer flush as a consequence of the lower pre-dawn water potential in DI (-1.1 MPa) compared to FI (-0.4 MPa). Similar results were obtained when considering midday stem water potentials. Finally, the thresholds of SWC below which crop water stress occurs resulted, in the different plots, variable from about 0.20 and 0.25 cm3/cm3.