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Water saving at the field scale with Irrig-OH, an open-hardware environment device for soil water potential monitoring and irrigation management

Daniele Masseroni, Arianna Facchi, and Claudio Gandolfi

Department of Agricultural and Environmental Sciences (DiSAA), Università degli Studi di Milano, Via Celoria 2, 20133 Milano, Italy

Sustainability of irrigation practices is an important objective which should be pursued in many countries, especially in areas where water scarcity causes strong conflicts among the different water uses. The efficient use of water is a key factor in coping with the food demand of an increasing world population and with the negative effects of the climate change on water resources availability in many areas. In this complex context, it is important that farmers adopt instruments and practices that enable a better management of water at the field scale, whatever the irrigation method they adopt. This work presents the hardware structure and the functioning of an open-hardware microstation based on the Arduino technology, called Irrig-OH, which allows the continuous and low-cost monitoring of the soil water potential (SWP) in the root zone for supporting the irrigation scheduling at the field scale. In order to test the microstation, an experiment was carried out during the agricultural season 2014 at Lodi (Italy), with the purpose of comparing the farmers' traditional management of irrigation of a peach variety and the scheduling based on the SWP measurements provided by the microstation. Additional measurements of leaf water potential (LWP), stomatal resistance, transpiration (T), crop water stress index (CWSI) and fruit size evolution were performed respectively on leafs and fruits for verifying the plant physiological responses on different SWP levels in soil. At the harvesting time, the peach production in term of quantity and quality (sucrose content was measured by a rifractometer over a sample of one hundred fruits) of the two rows were compared.
Irrigation criteria was changed with respect to three macro-periods: up to the endocarp hardening phase (begin of May) soil was kept well watered fixing the SWP threshold in the first 35 cm of the soil profile at -20 kPa, during the pit hardening period (about the entire month of May) the allowed SWP threshold was -30 kPa and, finally, from the end of May to the harvesting time (maturation process), irrigation was applied when SWP reached -25 kPa. Every time irrigation events were stopped when SWP at the field capacity (-10 kPa) was restored in the upper part of the root zone. Results showed a water saving of nearly 50% using the Irrig-OH device, without consequences on the quantity and quality of the production. Plant physiological status based on LWP, T and CWSI measurements showed that despite the different irrigation treatments adopted, no considerable plant stress was found in both rows. In particular, maximum values of the previous indices, performed at midday, were respectively -2 MPa, 1.4 mm h-1 and 0.6, which were in good agreement with those observed by many researches for no-stressed peach orchards in Mediterranean areas.