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Assessing HYDRUS-2D model to estimate soil water contents and olive tree transpiration fluxes under different water distribution systems

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In Mediterranean countries characterized by limited water resources for agricultural and societal sectors, irrigation management plays a major role to improve water use efficiency at farm scale, mainly where irrigation systems are correctly designed to guarantee a suitable application efficiency and the uniform water distribution throughout the field.

In the last two decades, physically-based agro-hydrological models have been developed to simulate mass and energy exchange processes in the soil-plant-atmosphere (SPA) system. Mechanistic models like HYDRUS 2D/3D (Šimunek et al., 2011) have been proposed to simulate all the components of water balance, including actual crop transpiration fluxes estimated according to a soil potential-dependent sink term. Even though the suitability of these models to simulate the temporal dynamics of soil and crop water status has been reported in the literature for different horticultural crops, a few researches have been considering arboreal crops where the higher gradients of root water uptake are the combination between the localized irrigation supply and the three dimensional root system distribution.

The main objective of the paper was to assess the performance of HYDRUS-2D model to evaluate soil water contents and transpiration fluxes of an olive orchard irrigated with two different water distribution systems.

Experiments were carried out in Castelvetrano (Sicily) during irrigation seasons 2011 and 2012, in a commercial farm specialized in the production of table olives (*Olea europaea* L., var. Nocellara del Belice), representing the typical variety of the surrounding area. During the first season, irrigation water was provided by a single lateral placed along the plant row with four emitters per plant (ordinary irrigation), whereas during the second season a grid of emitters laid on the soil was installed in order to irrigate the whole soil surface around the selected trees.

The model performance was assessed based on the comparison between measured and simulated soil water content and actual transpiration fluxes, under the hypothesis to neglect the contribute of the tree capacitance. Moreover, two different crop water stress functions and in particular the linear model proposed by Feddes et al. (1978) and the S-shape model suggested by van Genuchten et al. (1987), were considered.

The result of the study evidenced that for the investigated crop and under the examined conditions, HYDRUS-2D model reproduces fairly well the dynamic of soil water contents at different distances from the emitters ($RMSE$<0.09 cm^3 cm^{-3}) and actual crop transpiration fluxes ($RMSE$<0.11 mm d^{-1}), whose estimations can be slightly improved by assuming a S-shape crop water stress function.

Key-words: Olive tree, HYDRUS-2D, Soil water content, Actual transpiration fluxes