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Using Hydrus 2-D to assess the emitters optimal position for Eggplants under surface and subsurface drip irrigation

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The main objective of the work is to assess the emitters optimal position for Eggplant crop (Solanum melongena L.) in a sandy loam soil irrigated with surface or subsurface drip irrigation systems, by means of field measurements and simulations carried out with Hydrus-2D model.
Initially, the performance of the model is evaluated on the basis of the comparison between simulated soil water contents (SWC) and the corresponding measured in two plots, in which laterals with coextruded emitters are laid on the soil surface (T0) and at 20 cm depth (T20), respectively.
In order to choose the best position of the lateral, the results of different simulation runs, carried out by changing the installation depth of the lateral (5 cm, 15 cm and 45 cm) were compared in terms of ratio between actual transpiration and total amount of water provided during the entire growing season (WUE).
Experiments were carried out, from April to June 2007, at Institut Supérieur Agronomique de Chott Mériem (Sousse, Tunisia). In the two plots, plants were spaced 0.40 m along the row and 1.2 m between the rows. Each plot was irrigated by means of laterals with coextruded emitters spaced 0.40 m and discharging a flow rate equal to 4.0 l h-1 at a nominal pressure of 100 kPa.
In each plot, spatial and temporal variability of SWCs were acquired with a Time Domain Reflectometry probe (Trime-FM3), on a total of four 70 cm long access tubes, installed along the direction perpendicular to the plant row, at distances of 0, 20, 40 and 60 cm from the emitter. Irrigation water was supplied, accounting for the rainfall, every 7-10 days at the beginning of the crop cycle (March-April) and approximately once a week during the following stages till the harvesting (May-June), for a total of 15 one-hour watering.
To run the model, soil evaporation, Ep, and crop transpiration, Tp were determined according to the modified FAO Penman-Monteith equation and the dual crop coefficient approach, whereas soil hydraulics and rooting system parameters were experimentally determined.
Simulated SWCs resulted fairly close to the corresponding measured at different distances from the emitter and therefore the model was able to predict SWCs in the root zone with values of the Root Mean Square Error generally lower than 4%. This result is consequent to the appropriate schematization of the root distribution, as well as of the root water uptake.
Simulations also evidenced the contribute of soil evaporation losses when laterals are installed from the soil surface to a 20 cm depth, whereas significant water losses by deep percolation occured at the highest installation depth.
The values of WUE associated to the different examined installation depths tend to a very slight increase when the position of the lateral rises from 0 to 15 cm and start to decrease for the higher depths.