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Simulations of soil water balance in an irrigated district of Southern Italy

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The available approaches for predicting the soil hydraulic functions include direct methods, using laboratory and field experiments, and indirect methods, such as the application of pedo-transfer functions or inverse methods. This last approach consists of a non-linear estimation of the soil hydraulic parameters by minimising the residuals between observed and simulated values of variables, such as the volumetric water content (theta) and the soil water pressure head (h). Numerical models are increasingly being used to simulate water and solute movement in the vadose zone for a variety of applications in research and soil/water management.

While a large number of models of various complexity have been developed over the years, relatively few have been tested under field conditions.

Soil water flow in physically-based models is described by Richards' equation. Application of this equation requires knowledge of the two functions: the soil water retention, theta(h), and the hydraulic conductivity, K(h).

Inverse procedures have been successfully applied to analyse laboratory results using multistep or evaporation methods. During the last years, the application of inverse method is increasing by being applied to field experiments. Recently, several Authors have estimated the effective soil hydraulic function parameters with the inverse method by using evapotranspiration (ET) and soil water content data collected from a lysimeter experiment for a soil cropped with wheat.

The objective of this paper is to test different strategies to optimize the simulation of soil water content dynamics for a typical cultivation of water melon (Cuccumis citrullus) for the area of "Arco Jonico Metapontino" located in Basilicata and Puglia regions (Southern Italy). The strategies utilized in the comparison are based on: (i) direct measurements of the theta(h) and the K(h); (ii) utilization of pedotransfer functions starting from textural information and (iii) inverse procedures including data of soil water content. Such data were collected in a private farm by means of an instrument system including TDR 100, datalogger, multiplexers and 16 15-cm trifilar probes installed in horizontal and vertical positions between two rows of water melon.

The theta(h) and K(h) functions were directly measured by means of the laboratory method og evaporation. It consists in submitting undisturbed and saturated soil cores to a progressive evaporation and following the temporal variation of the mass of soil volume. Three microtensiometers were horizontally placed into the cores to monitor pressure heads at three heights. Finally, the METRONIA program (Ver. 3.04) was utilized to derive the soil hydraulic functions.

With the approaches utilized here, it was possible to describe the evolution of soil water content during the water melon cultivation with the HYDRUS-1D model reproducing the general trends of measured soil water content at the field site reasonably well.

We could individuate the contribution of the inverse optimisation to improve the simulation of soil water content compared to the other strategies included in this paper.