Geophysical Research Abstracts
Vol. 13, EGU2011-13158, 2011
EGU General Assembly 2011

Use of DFOT Heat Pulse Method For Wetting Pattern Determination in Drip Irrigation Emitters

María Gil-Rodríguez (1), Leonor Rodríguez-Sinobas (2), Javier Benítez-Buelga (3), Raúl Sánchez-Calvo (4), Luis Juana-Sirgado (5), Guillermo Castañón-Lion (6), and Francisco Laguna-Viñuelas (7)

(1) Research Group: Irrigation Hydraulics. Technical University of Madrid, Spain (maria.gil@upm.es), (2) Research Group: Irrigation Hydraulics. Technical University of Madrid, Spain (leonor.rodriguez.sinobas@upm.es), (3) Research Group: Irrigation Hydraulics. Technical University of Madrid, Spain (javier.benitez@upm.es), (4) Research Group: Irrigation Hydraulics. Technical University of Madrid, Spain (raul.sanchez@upm.es), (5) Research Group: Irrigation Hydraulics. Technical University of Madrid, Spain (luis.juana@upm.es), (6) Research Group: Irrigation Hydraulics. Technical University of Madrid, Spain (guillermo.castanon@upm.es), (7) Research Group: Irrigation Hydraulics. Technical University of Madrid, Spain (he15@caminos.upm.es)

Although there are numerous accurate measuring methods to determine soil moisture content in a spot, until very recently there were no precise in situ and in real time methods that were able to measure soil moisture content along a line.

By means of the Distributed Fiber Optic Temperature Measurement method or DFOT, the temperature in 0.12 m intervals and long distances (up to 10,000 m) with a high time frequency and an accuracy of +0.2º C is determined. The principle of temperature measurement along a fiber optic cable is based on the thermal sensitivity of the relative intensities of backscattered photons that arise from collisions with electrons in the core of the glass fiber. A laser pulse, generated by the DTS unit, traversing a fiber optic cable will result in backscatter at two frequencies. The DTS quantifies the intensity of these backscattered photons and elapsed time between the pulse and the observed returned light. The intensity of one of the frequencies is strongly dependent on the temperature at the point where the scattering process occurred. The computed temperature is attributed to the position along the cable from which the light was reflected, computed from the time of travel for the light.

Heat pulse methods are well established for the determination of soil thermal properties, soil water content and water movement. This method consists on applying a line source of energy to the soil with the resulting temperature fluctuation monitored by one or more parallel probes. The rate of radial transmission of heat depends on the soil bulk density, particle shape, mineralogy, and, principally, soil water content.

The combination of both methods, DFTO heat pulse method, allows very accurate soil moisture content measurements (maximum error 4%).

In order to experimentally study the wetting patterns shape, size and the water distribution from a drip irrigation emitter, a plastic column (0.7 m high and 0.6 m diameter) was built. Coils of fiber optic cable with a still sheet were placed inside of the column, forming three concentric helixes of different diameters. This ultimately lead to a 150 point three-dimensional measurement network. Then, the column was refilled with sandy soil. Heat pulses, with electrical power of 10 W/m, were applied at certain times during infiltration and within the redistribution processes. A capacitive sensor was used to measure soil moisture content at several depths. Meanwhile, this was also determined by the gravimetric method in several samples that were taken right after the tests.

Results show that the DFOT heat pulse method is a useful tool for studying wetting patterns from drip irrigation emitters in soil columns. This could be of interest in designing and managing drip irrigation units. Likewise, they also show the potential for its use in the field.