Geophysical Research Abstracts,
Vol. 10, EGU2008-A-10983, 2008
SRef-ID: 1607-7962/gra/EGU2008-A-10983
EGU General Assembly 2008
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An automated system for tension infiltrometer measurements: design, test and data analysis.

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During last decades tension infiltrometer has became largely used to obtain several soil hydraulic parameters and characteristics by a single in situ measurement campaign, i.e. unsaturated hydraulic conductivity, sorptivity and the influence of macroporosity in preferential flow.

This methodology requires a large number of accurate measurements of infiltration rates and a constant control of tensions, generally manually made; thus it is time consuming and expensive. Efforts have been made by some authors to set up automated systems and to improve measurements accuracy. The first objective of this work was to realize the complete automation of a hand operating commercial tension infiltrometer, testing it both in laboratory and in field experiments. This objective was achieved taking into account factors such as low cost of the devices and a friendly use for an operator in the field activities. The second objective was to compare the data collected, manually and automatically, both in terms of precision of measurements and as effects on the determination of hydraulic parameters.

The device used in this work is a two-piece tension infiltrometer with a 20 cm diam. disc separated from the water column. To get the automated tensions setting the original Mariotte system was substituted with a new one in which seven fixed points of air entry (corresponding to tensions of -1, -3, -6, -9, -12, -15 and -18 cm) were connected to solenoid normally-closed valves. The decreasing of level of water in the reservoir tower was measured by a differential pressure transducer connected to the head-space and to the bottom of the tower. A second transducer was allocated on the plate to mea-

sure the effective imposed tensions. Then both the valves-system and the transducers were wire-connected with a new low-cost developed datalogger. Also a new software was developed to control the data storage and retrieving and the management of the valves-system. The software allows to set the data acquiring parameters (numbers of steps, fixed time of acquisition for each tension, variable time of acquisition as function of reaching steady state, etc.).

The new system was tested performing laboratory measurements on two reconstructed soils with different texture (loamy sand and clay loam). On each of them three repetitions with manual data collection and other three tests with automatic acquisitions were done. The same type of measurements were conducted on the superficial Ap horizons of two different natural soils of the Campania region (Italy): the first one was a sandy horizon of a Vitrandic Haplustept; the second was a clay loam horizon of a Udic Calciustert. For each test, the initial and final water contents were determined.

Both manual and automatic data collected were compared and analyzed, determining k(h) relationship with both steady state and transient flow approaches.

The use of the automated system demonstrated to have better accuracy than the handmade data acquiring, especially in the early time of the infiltration process, when data collection has to be very intensive to be useful for performing inverse models approach. The continuous monitoring of the real imposed tensions bypass the problem relived by some authors concerning the discrepancy between the tension settled in the Mariotte system and that existing beneath the infiltrometer disc. The whole system was demonstrated to be easy and practice to use in field activities, especially when many infiltrometers have to be mounted in the same location.