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Design factors of an automated tension infiltrometer affecting accuracy of the measurement

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Tension infiltrometers are widely used to determine unsaturated hydraulic conductivity in-situ. Pressure transducers are often employed to automate the water level readings. Ankeny et al., 1988 reported the advantages of the automation as follows: i) the automation can manage measurements at shorter time intervals; ii) it improves precision of the measurements, especially for low flow rates; iii) the data handling and data analysis are more efficient. The aim of this paper is to characterize some design factors affecting the tension infiltrometer measurement. Sensor sensitivity (0-1psi, 0-5 psi), water reservoir diameter (i.d. 44 mm, i.d. 21 mm), and bubbling rate (0, 9, 18, 45, and 72 ml min^{-1}) were tested in the laboratory. An automated tension infiltrometer based on design reported by Ankeny et al., 1988 was built in-house and used in the experiments. An automatic syringe pump creating bubbles through a Mariotte bottle was used to carry out the tests. The syringe was connected to the top of the infiltrometer, while the bottom was open to the atmosphere. The piston of the syringe was withdrawn at a constant rate q creating suction in the upper part of the infiltrometer. The bubbles were released from the Mariotte bottle, in which the tension was set at -0.5 cm. Change in the pumping rate caused change in the bubbling rate. There were no water level changes in the reservoir during the tests, because water could not flow through the membrane. Only bubbles caused the reading fluctuations. The results were statistically processed using the software STATISTICA version 7.0, applying an F test, α = 0.05. As expected the more sensitive 0-1 psi sensor performed significantly

better than the 0-5 psi sensor, however the difference in standard deviations was relatively small. When characterizing the water reservoir diameter effects, a “double tube” water reservoir was found and tested. As to the results, the reading fluctuations were significantly smaller when using a single tube with a large diameter compared to that obtained for a single tube with a diameter approximately twice as small. By using a double tube water reservoir, the fluctuations were reduced even more. A large increase in reading fluctuations with increasing flow rate at low flow rates (up to 18 ml min^{-1}) was observed, however the difference in fluctuations between flow rates was small at large flow rates (45, and 72 ml min^{-1}).