Geophysical Research Abstracts
Vol. 15, EGU2013-538, 2013
EGU General Assembly 2013

Prototype of a subsurface drip irrigation emitter: Manufacturing, hydraulic evaluation and experimental analyses

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Root and soil intrusion into the conventional emitters is one of the major disadvantages to obtain a good uniformity of water application in subsurface drip irrigation (SDI). In the last years, there have been different approaches to reduce these problems such as the impregnation of emitters with herbicide, and the search for an emitter geometry impairing the intrusion of small roots. Within the last this study, has developed and evaluated an emitter model which geometry shows specific physical features to prevent emitter clogging. This work was developed at the Biosystems Engineering Department at ESALQ-USP/Brazil, and it is a part of a research in which an innovated emitter′s model for SDI has been developed to prevent root and soil particles intrusion. An emitter with a mechanical-hydraulic mechanism (opening and closing the water outlet) for SDI was developed and manufactured using a mechanical lathe process. It was composed by a silicon elastic membrane a polyethylene tube and a Vnyl Polychloride membrane protector system. In this study the performance of the developed prototype was assessed in the laboratory and in the field conditions. In the laboratory, uniformity of water application was calculated by the water emission uniformity coefficient (CUE), and the manufacturer's coefficient of variation (CVm). In addition, variation in the membrane diameter submitted to internal pressures; head losses along the membrane, using the energy equation; and, precision and accuracy of the equation model, analyzed by Pearson's correlation coefficient (r), and by Willmott's concordance index (d) were also calculated with samples of the developed emitters. In the field, the emitters were installed in pots with and without sugar cane culture from October 2010 to January 2012. During this time, flow rate in 20 emitters were measured periodically, and the aspects of them about clogging at the end of the experiment. Emitters flow rates were measured quarterly to calculate: relative flow rate (QR); flow disturbance (FD); CUE; and, variation coefficient of relative flow (CVQR). In the laboratory, both "CVm" and "CUE" were small since emitters were manufactured manually, the manufacturing variation was higher than in processed emitters. Variation in the membrane diameter decreased 1/4.5 from the central toward to the emitter end; and, the head loss increased. Estimated pressures were in good agreement to the observed ones with r and d values of 0.95, and 0.85, respectively. In the field tests, coefficients CVQR and QR were variable showing a poor classification according with ABNT (1986) and Solomon (1984). FD values were ranged between 11 and 24%and there was no observed clogging by roots and/or soil intrusion at the end of the experiment. On the other hand, emitter's flows were close to the average, indicating that water application kept according to the initial results. This study shows the suitability of this emitter model to prevent root and soil intrusion within the research conditions however further studies would be needed assessing the membrane performance, emitter physical characteristics, and control of emitter flow rate in order to develop the final prototype.