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Investigating Root Intrusion in Subsurface Drip Irrigation Systems: A Comparative Study

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In Subsurface Drip Irrigation (SDI) systems, the emitter flow rate is affected by the root intrusion phenomena and the so-called back pressure that limit the buried emitters' outflow. Several technological solutions have been developed over the years to mitigate these undesired effects (Souza et al, 2014). In this work, in a 6-year experimental campaign, from 2018 to 2023, carried out in a Citrus orchard in Sicily, Italy (38° 4' 53.4" N, 13° 25' 8.2" E), the effect of root intrusion and back pressure on SDI performance was investigated. The experimental field is divided into 4 equivalent plots, in which different root guard emitter treatments were tested. Specifically, two kinds of different herbicides substances (He 1 and He 2), one with copper (Cu) and one without additional substances that was used as a reference (control, Ctrl), were considered. During the six irrigation seasons, inlet discharges and pressure heads were collected, and their variations were used to quantify the effect of root intrusion in terms of local losses. The change in the SDI hydraulic performance was studied using a recent and innovative methodology (Baiamonte et al., 2024) based on a modified Hardy Cross method (HCM), which is suitable for lopped drip irrigation networks. The HCM applications considered local losses and back pressure and required a comprehensive hydraulic characterisation of the soil to estimate accurately the parameters influencing back pressure. Specifically, the influence of root intrusion in different emitters was analysed by considering the time variation of the coefficient of local losses, namely the α-fraction of the kinetic head. The results showed various behaviours among the four root guard emitter treatments. Emitters treated with different herbicides (He 1 and He 2), revealed no significant α-fraction variation in the analysis periods, denoting the effectiveness of He 1 and He 2 treatments in root intrusion protection. On the contrary, for Copper (Cu) and control (Ctrl) treatments, a severe decrease in emitter flow rate was observed, which was determined by high α-fraction variations over the investigated period, reaching $\alpha = 50$ and $\alpha = 32$, respectively, by 2023, thus limiting the benefits of SDI systems.

References

Baiamonte G, Vaccaro G, Palermo S (2024) Quantifying local losses due to root intrusion in subsurface drip irrigation systems by monitoring inlet discharge and pressure head. Irrig Sci. https://doi.org/10.1007/s00271-024-00990-y

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