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Identification of a temporal variability of soil hydraulic properties under drip irrigation using Beerkan infiltration method

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The identification of a temporal variation in soil hydraulic properties in the course of a cropping season subject to drip irrigation can contribute to the improvement of water use efficiency and the mitigation of adverse environmental effects. Saturated hydraulic conductivity, K_s, capillary length, α_h, and the characteristic microscopic pore "radius" i.e., the mean characteristic dimension of hydraulically functional pore, ξ_m, are fundamental parameters governing water transfer in soil under drip irrigation. Series of 3D infiltration tests, using the Beerkan infiltration method, were carried out on a loamy soil of a corn field drip irrigated in the southern of France. Two treatments: a full (FT) and a limited (LT) treatment were investigated. Seven infiltration measurement sets were taken within each treatment on the top soil layer during the cropping season between June and September. The 1^{st} set of measurements was done before 1^{st} irrigation. At each set, six to eight infiltration measurements were performed on a 9m^2 pre-selected sub-plot. The results show that for the both irrigation treatments, soil hydraulic properties are strongly affected by the first irrigations. K_s and ξ_m drastically decrease with cumulative water application depth from the first irrigation until the root systems approximately reach its maximal value. Then these two parameters seem to re-increase slowly with time. Capillary length has an inverse behavior of these

two parameters. At the first times, this temporal evolution could be due to the soil restructuration process under irrigation. While, at the end of irrigation season, where irrigation decreased due to lower water requirements for the both treatments, the irrigation effect was overlaid by the biological activity and the root development effect creating new channels or continuity between existing pores. Indeed, we found that the variations with time in these soil properties are in agreement with the temporal evolution of bulk density during the crop season. The processes affecting these properties are similar for both irrigation treatments, but with a different response intensity. For the measurements covering the irrigation season, limited drip irrigation treatment (LT) presents higher mean values for both K_s and ξ_m and smaller mean values of capillary length, α_h, than those of the full irrigation treatment (FT). This can be due to the different water amounts applied to the treatments especially at the beginning of the irrigation season. This can be also attributed to the alternated daily effects of wetting and drying cycles of the soil during limited treatment (LT). As a consequence of irrigation and root development, soil hydraulic properties showed a dynamic evolution in time. This state of fact raises the question about the interest to take into account this phenomenon for improving water use efficiency. Modelling could be a first step to assert if yes or not the evolution of the soil parameters merit to be taken into account in the course of a cropping season to improve water management and to mitigate the environment risks under drip irrigation.