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Comparison of water distribution mechanisms under two localized irrigation techniques (Drip Irrigation & Buried Diffuser) for one week irrigation period in a sandy soil of southeastern Tunisia

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The majority of agricultural ecosystems in the Mediterranean basin of northern Africa suffer from water shortage and positions these regions in a highly vulnerable to climate change. In arid regions of Tunisia and exactly in the Southeastern part, during each growing season, plant productivity in sandy-loamy soils is dramatically reduced by limited availability of soil water and nutrients. Thus, highly permeable soils are unable to retain adequate water and nutrient resource in the plant root zone. Moreover, the investments of supplemental irrigation and agricultural amendments of additional fertilization are not sustainable due to the leaching of water supplies and nutrients, which severely limit agricultural productivity. In addition, inadequate soil water distribution, costly irrigation and fertilization leads to negative responses to plant nutrients added to highly permeable soils. That's why we should use irrigation techniques with high water use efficiency.
This paper focuses on the comparison between two localized irrigation techniques which are the Drip Irrigation (DI) and the Buried Diffuser (BD) that has the same flow rates (4 l/h). The BD is buried at 15 cm depths. Experimental data was obtained from Smar-Médenine located in South-East of Tunisia.
The water distribution at the soil surface for BD is very important about 195 cm2 while for the DI is about 25.12 cm2. The HYDRUS 2D/3D model helped to evaluate the water distribution and compare the water balance obtained with those two irrigation techniques for one week irrigation period.
There is a rapid kinetic which has a duration of 3 hours (irrigation time) and a slow kinetic which is the result of the water distribution in the soil, the plant uptake and the effect of climatic condition. There are two mechanisms that affect the two irrigation techniques: the water distribution and the position of irrigation system.
As a result, irrigation with BD goes dipper in the soil. The transmission zone for this technique achieved vertically a depth of 36 cm and a surface moistened area of 1294 cm2. For the DI the transmission zone of infiltration reached vertically a depth of 25 cm and a surface moistened area of 907.46 cm2. The installed BD shows that the water may reach the soil surface only after one hour of irrigation, while the water tends more to the depth of the soil profile. At the end of the irrigation period, we found that the final stock is high under the two techniques which led to improve irrigation efficiency. This was done by the decrease of the irrigation time and the increase of the irrigation period. The simulation showed better results for BD. The stock of water under this technique has a sufficient value to be used by the plant uptake and this was not observed for the DI technique.