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Can we solve soil surface salt accumulation problem by controlling subsurface groundwater fluctuation?

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Shallow groundwater tables (SGW) and associated salinity problems have become dominant features in agricultural areas around the world (FAO, 2002). This is especially so in arid and semi-arid regions where rising water tables and associated soil salinization are an increasing agricultural and environmental threat. In Tunisia, salt affected soils have an area of about 1.5 Million ha representing 10 % of the country total area. (Hachicha, 2007). The majority of Tunisian Oasis (South Tunisia) encounters a problem of shallow groundwater rise and soil salinization (Ben Aissa et al. 2004). Whilst there have been several studies on ground water associated salinity, the movement of groundwater in particular with respect to added water events and its impact on soil surface salt accumulation phenomenon still remains to be clarified. In particular, intensive sampling of short-term fluctuations of the water table and the associated processes of solute movement and accumulation have received very little research attention (Northey et al., 2006). Hence, this phenomenon of soil salinization was addressed in the present study by using a comprehensive methodology combining high frequency field observations, laboratory experiments and numerical simulations. The Metouia Oasis (South Tunisia) was chosen for field investigation. In this Oasis, shallow groundwater fluctuations were intensively monitored using automatic data acquisition system. Water levels in the observation well were monitored at 30 min intervals for a period of 250 days from 10 Mars 2009 till November 13 of the same year. During this period the total rainfall was 24 mm. A total of 11892 water level readings were obtained. Laboratory experiments were carried out using highly equipped soil columns in order to investigate the combined effects of water table rise, evaporation rate and solute concentration on soil surface salt accumulation. Results showed that over the whole study period the water table fluctuated in a range from 0.56 m (4/19/09) to 1.58 m (10/16/09) below the soil surface. We identified two different phases of short-term seasonal ground-water-level fluctuations. The first is a declining phase of the groundwater level which was observed between Mars and mid-October 2009 controlled mostly by the increase of the water uptakes by soil evaporation and crop transpiration during spring and summer seasons. The second phase had an upward trend which began from 16 October 2009. Laboratory experimental results showed that SGW exhibited rapid and large rise following water input at soil surface. Such behavior is known as Reverse Wieringermeer Effect (RWE). The analysis of salt profiles showed an enhancement of the build-up of soluble salts in soil columns where RWE occurs compared to control ones. This suggests that salinization from saline SGW can be rapid in irrigated areas in hot climates and can not be accurately predicted if the RWE was not considered in the modeling process. Overall, experimental findings showed that the rate of soil salinity accumulation from shallow water table depends upon water input (e.g. irrigation, rainfall), salt concentration and depth of the groundwater, soil type, and climatic conditions (evaporation rate).

Ref: Ben A?ssa I., Bouksila F., Bahri A., Bouarfa S., Chaumont C. and Hichri W. 2004. Gestion eau et des sels au sein oasis Sud tunisien. Projet INCO-WADEMED ; FAO. 2002. Biodrainage - Principles, Experiences and Applications. Knowledge Synthesis Report No. 6; Hachicha M. 2007.

Les sols sales et leur mise en valeur en Tunisie, Secheresse 18, 1 : 45-50 ; Northey, J.E., Christen, E.W., Ayars, J.E. and Jankowski, J., 2006. Occurrence and measurement of salinity stratification Agr. Water Manage. 81, 23?40.

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