



The transport and differentiation laws of salt ions in irrigation-soil-groundwater-drainage systems (ISGDS)

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Soil salinization is a long-standing problem that has threatened crop production and food security in many arid and semi-arid regions. The utilization of saline-alkali soil is one of the hottest issues in the field of global degraded land management. Flood irrigation is used to remove the accumulated salt in the soil tillage layer during the non-growth period (fallow period), and to provide an appropriate water-salt environment for crop growth in the next year. A lateral water flow was formed under the difference of hydraulic gradient between irrigated and unirrigated area, i.e. dry drainage (DD). The concentration of soil salinity, GEC and the combinations of salt ions was redistributed during the irrigation and drainage processes. The salt transport ability, leaching difficulty and its influence mechanism on crops vary greatly with different chemical properties of salt ions and their interactive effects. Therefore, the combinations of soil salinity are constantly being transformed, and the differentiation of salt ions aggravated salinization hazards. In our study, the spatio-temporal dynamics of groundwater electrical conductivity (GEC), drainage electrical conductivity (DEC) and the combinations of its salt ions were measured during the year of 2017 and 2018. The effects of artificial drainage and DD on the dynamics of GEC and the differentiation mechanism of salt ions in ISGDS were studied based on equilibrium analysis of groundwater below the unirrigated area. With the recharge of groundwater lateral flow from irrigated area, the GEC and the groundwater table depth (GTD) below un-irrigated area were increased slightly. The process of water infiltration was sustained about 10 days with the GTD fluctuating from 2 m to 0.5 m, then rising to the surface with smaller increasing rate. Moreover, the corresponding GEC below irrigated farmland dropped sharply by more than 50%. With the decrease of infiltration water and the increase of drainage, the GTD declined slowly and the GEC showed an upward trend to the pre-irrigation level after 15 days. This study provides critical guide for policy-makers in efficient irrigation management of farmland, prevention and control of salinized soil.