Soil salt balance and simulation in a high efficiency film-mulched drip irrigation and subsurface pipe drainage system

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Abstract

Soil salinisation is vital factor limited crop yield in dryland oasis cropland. A film-mulched drip irrigation and subsurface pipe drainage (MDI-SPD) system has been proved its high efficiency all over the world. However, soil salt balance and simulation in time and spatial dimension are unclear in this system. Based on four-year observation data, we use HYDRUS-2D model to simulate the soil salt balance in a MDI-SPD system in western China. We conducted a set of MDI-SPD experiments three times in a field in Manas River Basin, western China: The laying depth of the subsurface pipe was 1 m, and drain spacing was 15 m. Three treatments were set at 0, 5, and 7.5 m horizontal from the subsurface pipe. Results after four years indicated that the total salt output in the irrigated area was 260.16 t, with 103.4 t salt drained by the subsurface pipe (39.74% of the total salt output in the irrigation area). Soil salt balance indicated desalination state. Soil EC response ranged from 8.33 to 11.21 dS m⁻¹. The mineralization of subsurface pipe drainage was positively correlated with drainage flow and salt discharge, and negatively correlated with drainage discharges and time ($P < 0.05$). If salinity leaching stops, 0-200 cm depth soil salt balance will achieve critical value in 8 years. Thus, we recommend salinity leaching once every three years. An increase in shaft drainage would also reduce the deep seepage of salt.

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