

# Contamination Processes of Soils and Water Resources in Israel by Micro-Elements Due to Irrigation with Sewage Effluent

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The levels of a number of micro elements are increasing slowly in agricultural soils because of atmospheric deposition, additives in animal feeds and fertilizer, and irrigation with sewage effluents. In Israel, which is characterized by scarce conventional water resources, sewage effluent can be used as irrigation water.

The objective of this paper is to determine the potential of the soils and water resources in Israel for contamination by microelements as a result of irrigation with secondary effluent. The annual averages of microelement concentrations in secondary effluent in Israel are, in general, lower than the permissible limits for irrigation water. However, the variation with time of the microelement concentrations in the effluent was high and sometimes the concentration of some elements was higher than the permissible limit. The major source of microelements in noncontaminated Israeli soils is weathering of parent material, and their total concentration in soil (element weight/soil weight) is three times as great as their concentration in effluent. Heavy metals tend to be adsorbed or to precipitate in soil. Accumulation of heavy metals in the upper layer (0-30 cm) was observed in various soil types in Israel, that were irrigated for 28 years or more with secondary effluent. Moreover, in these fields, the irrigation with effluent increased the metal concentrations in water and acid extracts more than it increased their total concentration in soil. The concentration of heavy metal in plant tissue was affected by the kind of metal and the plant species. The effect of heavy metals uptake on yield reduction was in the order: Rhodes grass > corn > cotton. Complexation reactions between ion metals and soluble organic molecules increased the heavy metals concentration in soil solution and their downward movement. Enrichment of heavy metals was observed in groundwater from a site in the coastal aquifer of Israel that had been irrigated for about 30 years with secondary effluent. The downward movement of the metal in this case was by mobile suspended matter.

*Key Words:* microelement, heavy metal, sewage effluent, adsorption, irrigation

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