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Irrigation with treated wastewater (TWW): a trigger for subsurface soil sodification

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Use of treated wastewater (TWW) for irrigation has grown considerably in recent years, especially in arid and semi-arid regions where shortage in fresh water is frequently experienced. Recently, following long-term irrigation with TWW having SAR <5 it has been noted in Israel that subsurface (depth >30 cm) exchangeable sodium percentage (ESP) in orchards is reaching levels of 6-9, which are higher than expected based on the SAR-ESP relationship proposed by the U.S. Salinity Laboratory in 1954. In an attempt to understand the reasons for these unexpected high ESP levels at the subsurface layers, the relationships between the SAR of the irrigation water, the SAR of the soil solution and the ESP of the studied soils were carefully examined. Soil samples were taken from different depths (up to 120 cm) from orchards grown in two different soil types that had been irrigated for >10 years with TWW. In each soil sample non-adjusted SAR (which considers total Ca concentration) and adjusted SAR (SARadj; which considers the concentration of effective Ca) of the saturated paste, and ESP were determined. It emerged that in all sampled sites, but for one, accumulation of adsorbed sodium in the subsurface layers was noted. The obtained ESP levels were higher than those expected when considering the SAR of the TWW used for irrigation. A satisfactory agreement was noted between ESP data and the non-adjusted SAR and SARadj of the soil solution, signifying that the correction of the SAR for effective Ca concentration cannot explain the unexpected high ESP levels. The results further indicated that a chemical equilibrium exists between the soil exchange phase and the soil solution. It is postulated that the properties of the irrigation water do not always determine those of the soil solution especially at sub-surface layers and that the ESP in those layers is, therefore, not dictated by the cationic composition of the irrigation water.