Beneficial and Potential Adverse Effects of Irrigation with Treated Wastewater

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The application in agriculture of treated wastewater (effluents; TWW) is expanding worldwide and in particular in dry land regions of the world such as the Mediterranean region in general, and the Middle East in particular. Fresh water which was formerly directed to agricultural utilization is increasingly being utilized by the ever increasing municipal sector as a result of population increase and improved standard of living. A major source that can account for the demand for water in the agricultural sector is TWW. Therefore, the percentage of wastewater that undergoes treatment is constantly increasing. However, this presentation will focus on the need to not only increase the quantity of TWW, but to thoroughly enhance their quality prior to soil application. This abstract will focus on potential adverse effects related to TWW irrigation and to briefly discuss means that can be employed to reduce or avoid their effects. A number of undesired traits are higher in TWW than in their fresh water (FW) source. Of these, the most important ones are: (i) organic – suspended and soluble organic matter (DOM) and micro pollutants; and (ii) inorganic – total soluble salts, sodium, chloride, boron and heavy metals. All of the above pose a threat to soil quality, as well as plant and human health. Total salt concentration is about 5 meq L^{-1} higher than that of the source FW due to "pick-up" processes. Salt picked up during home, industrial and agricultural utilization is not being removed during conventional treatments and will therefore end up in the soil. Salts added to fields may accumulate on the surface and/or be washed into the groundwater, thus causing water quality deterioration. Removal of salts is only possible via reverse osmosis which is usually too expensive. TWW contains however, high concentrations of nitrogen (N), phosphorus (P) and potassium (K). These are of great value to agriculture. However, when in excess, these nutrients may pose a threat to FW and groundwater resources. Therefore, their presence in TWW at given concentrations need to be considered while using these water resources, aiming to avoid excessive fertilization. Sodium which is often present in TWW at elevated concentrations is known to have adverse effects on soil structure. Research conducted by our group has shown that DOM originating from TWW may enhance these effects. DOM originating from TWW has also been shown in a number of publications by our group, to induce water repellency in soil (soil hydrophobicity) which may force farmers to change the irrigation regimes employed. Both problems (soil structure and hydrophobicity) can be avoided to a great extent provided the DOM in the TWW is removed. An additional trait of adverse effects typical of TWW is an elevated concentration of boron (B), which is picked up from homes, industry and agriculture due to its use as a cleaning and bleaching agent. Boron is essential to plants at a low concentration range (0.2 – 0.4 mg L^{-1}), but is highly toxic to most crops at a higher concentration. Our group found that its toxicity can be reduced by addition of compost to boron polluted soils. More important is to introduce policies that will reduce or eliminate boron utilization in homes, industry and agriculture. Toxic and non-toxic heavy metals have been detected in TWW and a vast volume of research has been dedicated to it. Actually the only proven approach recommended is, to force industries to source treat their wastewater on site and remove the metals before they are incorporated in the main wastewater stream. Organic micro pollutants are a group of compounds that are present in TWW. Their concentrations and effects have not been clarified to date, but they require further research and future attention.