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Evaluating the Efficiency of Clay Reservoirs for the use of Unconventional Waters in Subsurface Irrigation

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Extended Abstract
Introduction:

Introduction: As Iran faces limited water resources, it should take the use of unconventional waters into account in its drought management. In many countries, including Iran, conventional water is relatively scarce. However, should water, soil, and plants be appropriately managed, there would be significant saline water sources for irrigation purposes. Together with reducing salinity and refining polluted waters, subsurface irrigation is now considered as an increasingly important tool in improving the quality of unconventional waters. In this system, besides the application of subsurface irrigation, water is used at lower volumes and pressures, and soil and plant contamination are minimized, and thus, concerns regarding the use of wastewater in specific plant irrigation are reduced to some extent. This study, therefore, sought to investigate the efficiency of clay reservoirs in subsurface irrigation as a way to manage unconventional waters properly. It should be noted that such reservoirs are formed when saline and polluted waters with different concentrations are used

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Material and Method: having been conducted at the lands of Isfahan University of Technology, Iran, this study investigated the possibility of making use of unconventional waters for subsurface irrigation through clay reservoirs. To this end, an experiment was performed with three replications, using random sampling. Some 50 cm×50 cm (width and depth) planting pits were drilled with a 2 m distance from each other. The clay reservoirs were made in 4.7-liter size, and solutions were prepared with their salinity concentrations being 4, 8, and 32 ds/m, and nitrate and phosphate concentrations being 5, 50, and 100 mg/L and 5, 30, 60 mg/L, respectively. The output of nitrate and phosphate was measured by UV spectrophotometry, and the electrical conductivity output was measured by an electrical conductivity meter. The depletion percentage of conventional water, saline water with different concentrations, and water with varying nitrate and phosphate concentrations were also measured over time. Moreover, the data analysis was performed in SPSS 22.0 Software.

Result: The results of the study showed that the difference between nitrate and phosphate concentration of clay reservoirs before and after the irrigation was 1.1, 0.8, and 2 mg/l and 1, 0.8, and 1.1 mg/l at concentrations of 5, 10, and 50 mg/l, respectively. The difference in sodium chloride concentration before and after the irrigation was 0.7, 0.7, and 1.4 ds/m at concentrations of 4, 8, and 32 dS/m, respectively, so the difference was not significant statistically ($P>0.05$). The depletion percentage in the control reservoir was higher than water polluted with nitrate and phosphate and the reservoirs filled with saline water.

Discussion and conclusion: The advancement of the wetting front increased with decreasing salinity levels of the pitchers' water. Salt concentration in the soil with pitcher irrigated by saline water was found to be minimum near the pitcher and maximum at the periphery of the wetted zone around the pitcher. One reason for a decrease in the flow rate with an increase in salt concentration could be the increase in the aqueous viscosity with concentration. It could, thus, be concluded that the rate of depletion partly decreases with increasing salinity and the amount of nitrate and phosphate in irrigation water over time, which was not noticeable and was attributed to the higher viscosity of saline water and the water contaminated with nitrate and phosphate. Should those responsible for developing water resources in Iran do not seek logical solutions for using other water resources, such as using low-quality water, the country would face serious problems. As water resources are limited, using unconventional waters would be very useful in drought management. Therefore, it seems that changing the policies regarding water management and arranging for the application of this irrigation method could help relevant Iranian officials manage the country's water crisis efficiently. In the last two decades, subsurface clay irrigation has been implemented in parts of the country. The use of saltwater and wastewater in this method would open new windows for the use of unconventional waters. As a result, pottery depletion is a suitable way to meet the plants' water needs, provided that proper filtration and acceptable irrigation water quality are used.

Keywords: Depletion percentage, Unconventional waters, Nitrate and Phosphate, Water pollution, Clay reservoirs, Arid areas