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Priming effects and enzymatic activity in Israeli soils under treated wastewater and freshwater irrigation

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Irrigation of soils with treated wastewater (TWW) directly influences microbial processes of soil. TWW contains easily decomposable organic material, which can stimulate the activity of soil microorganisms and, as a result, lead to the excessive consumption of soil organic carbon pool. We investigated the effects of irrigation with TWW relative to those of irrigation with freshwater (FW) on the microbial parameters in soils with low (7%) and medium (13%) clay content in a lysimeter experiment. The objectives of our study were to (i) determine the impact of water quality on soil respiration and enzymatic activity influenced by clay content and depth, and (ii) work out the changes in the turnover of soil organic matter (PE, priming effects). Samples were taken from three soil depths (0-10, 10-20, and 40-60 cm). Soil respiration and PE were determined in a 21-days incubation experiment after addition of uniformly 14C-labeled fructose. Activity of 10 extracellular enzymes (EEA, from C-, N-, P-, and S-cycle), phenol oxidase and peroxidase activity (PO+PE), and dehydrogenase activity (DHA) were assayed. Microbial Community-Level Physiological Profiles (CLPP) using four substrates, and microbial biomass were determined. The results showed that the clay content acted as the main determinative factor. In the soil with low clay content the water quality had a greater impact: the highest PE (56%) was observed in the upper layer (0-10cm) under FW irrigation; EEA of C-, P-, and S-cycles was significantly higher in the upper soil layer under TWW irrigation. Microbial biomass was higher in the soil under TWW irrigation and decreased with increasing of depth (50 μg/g soil in the upper layer, 15 μg/g soil in the lowest layer). This tendency was also observed for DHA. Contrary to the low clay content, in the soil with medium clay content both irrigation types caused the highest PE in the lowest layer (65% under FW irrigation, 48% under TWW irrigation); the higher substrate mineralization (10%) and the highest phosphatase activity (in the case of FW irrigation) was observed. The PO+PE activity was two to three times higher than in the soil with low clay content and increased clearly with increasing of soil depth. The last tendency was also valid generally for the enzymes of C-, N-, and P-cycles under both types of irrigation. The upper layer in the soil under TWW irrigation was characterized by the highest microbial biomass value (74 μg/g soil). DHA in all soil depths under both types of irrigation was significantly higher than in the corresponding depths of soil with low clay content. CLPP data showed the highest consumption of ascorbic acid and D-glucosamine hydrochloride in comparison to consumption of D-glucose and L-glutamine in both irrigation types.