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"Reconcile land system changes
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Wastewater reuse for sustainable agriculture: A pilot implementation study

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Abstract

Water scarcity for agriculture is becoming an increasingly urgent challenge, particularly in view of growing global food demands and climate change resulting in changes in precipitation patterns and more frequent droughts. To mitigate these impacts, re-using wastewater for agricultural irrigation has emerged as a promising approach. Wastewater is often rich in plant essential nutrients, thus contributing to both agricultural sustainability and environmental protection. In pursuit of sustainable water use, this study was conducted to evaluate hydroponic plant growth in reclaimed municipal waste water and to explore the plants' potential to purify this water. To this end, growth and biomass composition of greenhouse-grown tomato plants irrigated with reclaimed municipal wastewater enriched with nutrients relative to nitrogen was compared with plants irrigated with conventional rainwater-based nutrient solution. No significant differences were found in the biomass of the plants, the concentration of potassium and sulfur accumulated in the plants irrigated with reclaimed water decreased over the experimental period, from 12 – 10 and 1.25 – 0.75 g per plant, respectively. Concentrations of heavy metals such as cadmium and lead remained at negligible levels (0.68 10–2 and 0.68 10–3 mg kg^{-1} fresh weight, respectively), which is well below the maximum limits set by European Union regulations, ensuring food safety required for commercial production. In addition, the system demonstrated a strong capacity to remove ammonium from the irrigation solution, with outflow concentrations reduced to less than 1.5 mg L^{1} by the end of the experiment. As an implementation-phase study, these findings reinforce the potential of reclaimed water for safe, sustainable food production in commercial agriculture. However, in order to support broader implementation, it is essential to establish clear, science-based threshold values for all relevant contaminants in food crops, enhancing consumer confidence and regulatory clarity.

Keywords: Agricultural sustainability, food security, reclaimed water, wastewater purifying

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