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Fate and treatment of pharmaceutical emerging pollutants in the context of wastewater reuse for agricultural irrigation.

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The current global change, associated to economic and demographic developments lead to a continuous growth of water needs. In order to avoid degradation or non-preservation of this resource, some optimized management strategies must be considered, such as shorter water usage cycles, where treated wastewater can be seen as a resource. This comes necessarily with research and innovation issues, especially on the management of emerging pollutants.

Here, the scenario of a domestic wastewater effluent treated and reused for agricultural irrigation was explored. A particular attention was given to the risk associated to the transfer of pharmaceuticals initially present in the wastewater and possibly transferred to the soil and the plant.

Our approach included both (i) the development of a nature-based solution for water treatment aimed at the removal of pharmaceuticals; and (ii) the study of the mobility and fate of these molecules through the irrigated soil/plant system.

To this end, new water treatment processes were developed and tested, including adsorbent materials prepared from local resources (clay, compost, olive stone biochar). They were tested for pharmaceutical removal in liquid batch, in flow-through filtration column, and finally in advanced constructed wetland.

Experiments on a cultivated soil were carried out in pots in order to study the natural attenuation of the pharmaceutical pattern in the soil solution, and to quantify the actual transfer from the irrigation water to the soil matrix and finally to a lettuce plant. Different parameters were varied such as the water salinity and organic content, or the amendment of the soil with swelling clay or compost, in order to decipher their possible roles in the fate of pharmaceuticals.

A synthetic wastewater effluent was used in this work in order to control the pharmaceutical pattern. It contained a cocktail of ten molecules representative of the main medicine categories: ofloxacine, tetracycline, sulfamethoxazole, carbamazepine, caffeine, atenolol, diclofenac, ibuprofen, gemfibrozil, and triclocarban.

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