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Uptake of micropollutants from treated wastewater, sewage sludge and composted sewage sludge by plants

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Various micropollutants (including pharmaceuticals, UV filters, cosmetics, cleansers, etc.), are increasingly being detected in the environment because of their partial or incomplete removal from wastewater in wastewater treatment plants (WWTPs). These compounds can be taken up by plants if treated wastewater is used for irrigation or if biosolids are used for soil amendment. Previous studies focused on this subject were usually performed under greenhouse conditions. Therefore, the aim of this study was to evaluate a behavior of studied compounds under natural climatic conditions. Experiment was carried out directly in the wastewater treatment plant, where nine raised beds were installed, which contained soils taken from topsoil of two soil types Arenosol (two beds) and Cambisol (seven beds). Either maize or a mixture of different vegetables (lettuce, carrot and onion) was grown in these beds. Of the seven beds with the Cambisol, one of the beds containing either maize or vegetables was irrigated with tap water and other pair of beds (maize or vegetables) was irrigated with treated wastewater (i.e., WWTP effluent). In another pair of beds (maize or vegetables), composted sludge from WWTP Three beds containing both types of biosolids were irrigated with tap water. Only vegetables were grown in the beds with the Arenosol, which were irrigated with either tap water or treated wastewater. Climatic data, irrigation doses, drainage water volumes, soil water contents and plant growth were monitored during the experiment. Selected compounds concentrations were measured in WWTP effluent, both biosolids, drainage water, soils, and plant tissues. Fifty five of 77 analyzed compounds were quantified in WWTP effluent. Main compounds were pharmaceuticals (e.g., telmisartan, gabapentin, diclofenac, carbamazepine, and its metabolites), UV filters (e.g., phenylbenzimidazole sulfonic acid) and compounds used in anticorrosive paints (e.g., 1H-benzotriazole). In the case of both biosolids, the dominant compounds were telmisartan, sertraline, trazodone, citalopram, diclofenac (i.e., pharmaceuticals) and 1H-benzotriazole. Uptake of different compounds by plants depended on a plant and properties of organic molecules, which affected their sorption in soils and mainly their ability to be taken up and translocated in plants. For instance, pharmaceuticals carbamazepine, gabapentin tramadol and venlafaxine were mainly found in lettuce leaves.

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