Geophysical Research Abstracts
Vol. 18, EGU2016-17147, 2016
EGU General Assembly 2016

Modeling Cd and Cu mobility in soils amended by long-term urban waste compost applications

Vilim Filipović (1,2,3), Philippe Cambier (2), Lana Matijević (1), Yves Coquet (3), Valérie Pot (2), Sabine Houot (2), and Pierre Benoit (2)

(1) University of Zagreb, Faculty of Agriculture, Department of Soil Amelioration, Zagreb, Croatia (vfilipovic@agr.hr), (2) UMR ECOSYS, INRA, AgroParisTech, Université Paris-Saclay, Thiverval-Grignon, France , (3) Université d'Orléans; CNRS/INSU; ISTO, BRGM; UMR, Orléans, France

Urban waste compost application to soil is an effective way for organic waste disposal and at the same time may have a positive effect on various soil rhizosphere processes. However, long term applications of organic waste amendments may lead to a noteworthy accumulation of micropollutants in soil. The long-term field experiment QualiAgro, an INRA-Veolia partnership (https://www6.inra.fr/qualiagro_eng/), has been conducted since 1998 with the objectives to characterize the agronomic value of urban composts and the environmental impacts of their application. Numerical modeling was performed using HYDRUS-2D to estimate the movement of Cd and Cu from compost incroporation in the tilled layer. Experimental plots regularly amended with co-compost of sewage sludge and green wastes (SGW), or a municipal solid waste compost (MSW) have been compared to control plot without any organic amendment (CONT). Field site was equipped with wicks lysimeters, TDR probes and tensiometers in order to determine water balance and trace metal concentrations during a 6 years' time period (2004-2010). In the tilled layer different structures (Δ – compacted clods, Γ – macroporous zone, IF – interfurrows, PP – plough pan) corresponding to the tillage and compost incorporation were delimited and reproduced in a 2-D model. The increase of Cd and Cu concentrations due to each compost addition was assumed to be located in IFs for further modeling. Four compost additions were performed during 2004-2010 period which increased the Cd and Cu concentrations in the IF zones considerably. After successful model description of water flow in highly heterogeneous soil profiles, Cd and Cu were added into the model and their fate was simulated during the same time period. Two approaches were followed to estimate plausible trace metals sorption coefficients (Kd), both while assuming equilibrium between dissolved and EDTA-extractable metals. The first approach was based on Kd estimated from ratios between EDTA and CaCl2-extracted metals (Kd-1). In the second approach we have calculated Kd from generic equations (literature), using soil organic carbon (SOC) and pH for Cd, and SOM, pH and DOC for Cu (Kd-2). Lysimeter data of Cu leaching were successfully reproduced by using first Kd-1 approach for three plots (model efficiency ESGW=0.97, EMSW=0.37; ECONT=0.95). Smaller agreement in MSW plot could be explained by the less stabile organic matter of MSW composts which increased its Cu mobile fraction after soil incorporation. The Cd leaching could be reproduced with the second Kd-2 approach for the two amended plots (ESGW=0.55, EMSW=0.80) while control plot simulations produced poorer fitting (ECONT=-0.57), probably due to an overestimation of the influence of the low pH of that plot on Kd-2(Cd). However, numerical modeling revealed interesting results in which, even with the high values of hydraulic conductivity in the interfurrow zones, the Cd and Cu showed low mobility. Although, the amended plots showed increased metal leaching below the tilled layer in both amended plots, their mobility in the tilled layer is reduced due to retention capacity of the applied composts.
Acknowledgements: the involvement of INRA and Veolia members in the QualiAgro experiment and the financial support of Veolia are gratefully acknowledged

Keywords: Compost amendments; Soil heterogeneity; Trace metals; Sorption; HYDRUS-2D