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Effect of biochar and digestate on microbial respiration and pesticide degradation

Santanu Mukherjee (1), Wolfgang Tappe (), Diana Hofmann (), Stephan Köppchen (), Ulrich Disko (), Lutz Weihermüller (), Peter Burauel (2), and Harry Vereecken ()

(1) Forschungszentrum Jülich, Institut für Bio- und Geowissenschaften, IBG-3 Agrosphäre, Germany, (2) Forschungszentrum Jülich, Stabsstelle Zukunftscampus

To overcome the problem of on farm point sources of pollution stemming from improper handling, spillages, and leakages of pesticides during filling and cleaning of spraying equipment, environmental friendly and low cost technology filter systems are currently under development. Based on a laboratory screening approach, where different biomixtures (soil, with biochar and/or digestate) are tested a full scale outdoor system will be developed. Therefore, different fundamental processes like pesticide mineralization, metabolization, sorption-desorption, and transport behavior of three radiolabelled pesticides (Bentazone, Boscalid and Pyrimethanil) will be investigated. Biochar and digestate mixtures with two contrasting soils (sandy and silt loam) had been used as a novel biofilter material for respiration study instead of conventional soil and straw mixtures. To analyze the pesticide degradation potential and to gain information about the temporal evolution of the degradation process of the biochar and digestate soil mixtures microbial respiration was measured over the course of three month. As expected, digestate acts as an easily available C-source leading to highest release of CO_2 compared to other biomixtures used. In contrast, the addition of even small amounts (1 %) of biochar caused a profound suppression in the CO_2 release from digestate based mixtures. The exact driving mechanism for this suppression can be manifold likes negative priming or chemisorption of CO_2 on biochar or NH3 toxicity induced by the large amount of digestate applied in the experiment (30 %) or can be combination of all effects. Surprisingly, a repeated experiment with same but aged digestate did not show such negative priming.

On the other hand, the fate of applied organic contaminants to biomixtures depends on several factors like soil properties and climatic conditions as well as biological degradation. To analyze the degradation potential of the different soil/amendment mixtures a degradation study was performed to determine the effects of biochar and digestate in different mixing rates on the metabolization behavior of the studied pesticides, and to identify and quantify the metabolites derived during the degradation process. The results from the 14C Bentazone study indicate that 5 % digestate and 5 % biochar mixture showed highest (nearly$\sim$ 15 %) and 1 % biochar lowest rate of mineralization ($\sim$1 %), whereby highest microbial activity was measured in the soil/digestate mixture.