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Pesticide leaching from a heavy clay and a loamy soil amended with black carbon

Elisabeth Löfstrand (1), Mats Larsbo (1), David van Alphen de Veer (2), and Barbro Ulén (1)

(1) Department of Soil and Environment, Swedish University of Agricultural Sciences (SLU), P.O. Box 7014, 75007 Uppsala, Sweden, (2) HS Konsult AB, Ulfhälls Gård, 64594 Strängnäs, Sweden

Black carbon (also known as bio-char or charcoal) has during the last decade received a lot of interest as a soil amendment because of its potential to improve soil structure and to store carbon, thereby reducing the amount of carbon dioxide released to the atmosphere. Because of its large sorption capacity black carbon incorporation in soil may also have beneficial effects on the leaching of organic pollutants. The objective was to study the potential pesticide leaching from two Swedish topsoils amended with black carbon. A total of 16 undisturbed soil columns (20 cm high, 20 cm diameter) were sampled from a heavy clay soil (Bornsjön) and a loamy soil (Säby). After preparing the lysimeters the top 10 cm of soil was manually mixed with black carbon powder (0.01 kg kg-1) for 8 of the columns. The non-reactive tracer bromide and five pesticides (sulfosulfuron (mobile), isoproturon (moderately mobile), imidacloprid (moderately mobile), propyzamid (slightly mobile) and pyraclostrobin (non-mobile)) with different sorption strengths (Koc values in the range 33-11000 mL g-1) were evenly applied to the soil surface. The columns were then exposed to simulated rain three times with a weekly interval. The total volume of applied water was 72 mm. Concentrations of the applied compounds and total organic carbon were measured in collection samples of the effluent water after each simulation. All compounds were found in the effluent water from both soils after the first irrigation indicating preferential transport. Total relative losses of the pesticides ranged from 0.004–4% and 0.006–3% for the heavy clay and the loam, respectively. The relative losses were negatively correlated to the Koc-values for both soils. Black carbon incorporation decreased leaching with 50, 95, 93 and 90% for sulfosulfuron, isoproturon, imidacloprid and propyzamid, respectively, for the heavy clay soil. However, leaching was increased by 100% for pyraclostrobin suggesting that the black carbon may have leached and acted as a carrier for this strongly sorbing compound. This hypothesis was not supported by the total organic carbon losses which showed no significant treatment effect. For the loam soil the only significant effect was a 50% decrease in the leaching of imidacloprid. It is not clear to us why the black carbon incorporation had a larger effect on the heavy clay soil compared to the loam soil. The black carbon incorporation did not influence the leaching of bromide significantly. This suggests that the pore geometry was not affected by the black carbon and, hence, any effects on the leaching of the pesticides were due to changes of the sorption properties of the soils.