

Sewage sludge biochar can be used as a potential phosphorus fertilizer based on the column-leaching experiment undergoing wet-dry cycles

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Biochar produced from the pyrolysis of sewage sludge is a promising phosphorus (P) fertilizer for land application. However, leaching experiments of P from sewage sludge biochar under natural conditions and in intermittently wet and dry periods are still lacking. Therefore, we performed column experiments to investigate the amount and species of P released from sewage sludge biochar over time. Fine quartz sand (0.02-0.05 mm) was packed into a 10 cm diameter glass column with the top 10 cm amended with 5% biochar. To simulate periodic wet and dry cycling, water was added from the top of the column and allowed to sit for 24 hours of incubation, after which depth-resolved water samples were taken from openings along the column. The column was then drained for 2 days before the wetting step was repeated. This wet-dry cycling was repeated 10 times. Our results suggest that, after 10 cycles, a total amount of 1.45 mg P was leached out from the biochar, which amounts to 77% of the bio-available P in the sewage sludge biochar amended in the sand (1.88 mg). However, in a subsequent experiment where 5% of humic acid was amended into the column, the leached P more than doubled to 3.02 mg. Except for the 0.65 mg P leached out from the humic acid itself, this number still exceeded the total bio-available P in the sewage sludge biochar, indicating that humic acid stimulates the dissolution of P in biochar through complexation. Healthy agriculture soil requires about 3.12 mg/kg P supply, and in our column experiment the sewage sludge supplied 3.02 mg/kg P into the sand. Our findings indicate the sewage sludge biochar has the potential to release a sufficient amount of P into the soil under wet-dry conditions and, therefore, can serve as a valuable P fertilizer.