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Potential dual use of biochar for wastewater treatment and soil amelioration

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Irrigating crops with wastewater from open drainage channels is a common practice in urban agricultural production in many dry regions of Africa, Asia and Latin America. While the wastewater-borne nutrients reduce the need for inputs of mineral fertilizers or manures and thus reduce production costs, wastewater-borne pathogens and contaminants pose a health risk for the producers and consumers of the crops. Furthermore, the input of nutrients with the irrigation water may greatly exceed crop requirements and thus lead to unproductive leaching losses of nutrients. It is generally acknowledged that biochar additions can increase the soil's sorption and retention capacity for nutrients and water. However, positive effects on crop production are generally only observed, if this is combined with mineral fertilizers or manures due to the low nutrient content of biochars. Biochar possibly also has a high potential for use in water purification, replacing the coal-based activated carbon as a sorbent for contaminants and pathogens. It was therefore hypothesized that biochar can be used for pathogen removal from wastewater while at the same time being loaded with nutrients and contaminants. If contaminants are of minor concern the "loaded" biochar can be used as a soil amendment, providing not only long-term sorption capacity but also nutrients.

Experiments were conducted with pyrochar from Miscanthus, rice husks and wood chips, which strongly differed in elemental composition, MIR-DRIFT spectra, surface charge properties and sorption potential for DOC and phosphate. When used as top filter layer in a sand column system, the biochars effectively reduced E. coli concentrations from raw wastewater by up to 2 log units. While biochars from rice husks and Miscanthus accumulated N substantially, wood chip biochar showed no N retention. On the other hand, P accumulation was most pronounced for wood chip biochar. Ongoing incubation experiments with the "loaded" and fresh biochar in soils indicate that the pretreatment with wastewater alters biochar's stability and their effects on N-mineralization.