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Soil biota response to amendment with biochar as P and K fertilizer

Anne Winding (1), Valentina Imparato (1), Susana Santos (1), Veronika Hansen (2), Henrik Haugaard-Nielsen (3), Patrick Browne (1), Lars Hestbjerg Hansen (1), Paul Henning Krogh (4), and Anders Johansen (1)

(1) Department of Environmental Science, Aarhus University, Roskilde, Denmark (aw@envs.au.dk), (2) Department of Plant & Environmental Sciences, University of Copenhagen, Denmark, (3) Department of People and Technology, Roskilde University, Denmark, (4) Department of Bioscience, Aarhus University, Silkeborg, Denmark

Thermal gasification converts biomass into a combustible gas at oxygen-poor conditions, the bi-product being biochar which can be used as soil amendment to increase pH, sequester carbon to mitigate climate change, and supply phosphate and potassium to crops; replacing chemical or other alternative organic fertilizers. Amending soil with biochar can support three soil functions: production of food, carbon sequestration, and biodiversity. This was tested in a field experiment with reduced-tillage agricultural management, where the effect of biochar amendment on soil ecosystem services, especially biodiversity and carbon sequestration were studied.
The effects on soil microorganisms and fauna (protists and earthworms) were assessed with activity based assays and Next Generation Sequencing (NGS). Crops were alternating oil seed rape and winter wheat, and biochar was added annually for 3 years. The soil was a sandy loam soil with SOM content of ca. 5%. Earthworms and soil were sampled from field plots either left untreated, amended with straw or annually amended with either 6-8 t ha-1 or ca. 1 t ha-1 biochar. Soil was sampled from bulk soil and earthworm drilosphere.
Earthworms had a priming effect on protist abundance and basal soil respiration. However, in biochar amended soil the protist abundance decreased in the drilosphere. Culturable bacteria and extracellular enzymatic activities were not significantly affected by earthworms. The abundance of only one earthworm species increased at high compared to low application levels of biochar, while still not differing from controls without biochar. Thus, no harmful effects were detected for earthworms.
At the lower biochar amendment, significant changes were observed for the activity of a few selected enzymes related to biochar and also a relative increase in abundance of low abundant microorganisms was seen. At the high doses of biochar the abundance of protists increased compared to control. NGS analysis was more sensitive than activity based functional assays as metagenomics of bacterial communities (16S rDNA) revealed effects of biochar and metagenomics of fungi/protist communities (18S rDNA) revealed effects of biochar and less priming effects of earthworms.
Generally, the addition of biochar as soil amendment and alternative fertilizer had limited effect on soil microorganisms and fauna in the tested agricultural soil, and could be a sustainable P and K fertilizer while sequestering carbon to mitigate climate change.