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Short and mid-term effects of different biochar additions on soil GHG fluxes

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The application of biochar (BC) to soils may have a positive influence on physico-chemical soil properties and the mitigation of greenhouse gas (GHG) emissions. Furthermore, biochar contributes to a long-term soil carbon sequestration.
The aim of this study is to explore short and mid-term effects (one day up to six months) of different BC-compost applications on soil GHG emissions, particularly CO_2, CH4, N2O and NO_x. In addition, compounds of the nitrogen cycle like NH4+, NO_3- and the microbial biomass nitrogen (Nmic) were measured.
For this purpose a field experiment in Kaindorf (Styria/Austria, gleyic Cambisol, loamy, 376 m.a.s.l.) with 16 plots and four different treatments was conducted.
K = no BC-compost mixture but fertilized (NH4SO4) corresponding to T3 in 2013;
T1 = 1 % BC-compost mixture, no addition of N in 2013 and 2014;
T2 = 0.5 % BC-compost mixture, + 175 kg N ha-1 in 2013 and 2014;
T3 = 1% BC-compost mixture, + 350 kg N ha-1 in 2013.
Nitrogen was added as (NH4)2SO4 directly to the freshly produced biochar before mixing it with compost.
Greenhouse gas fluxes (CO_2, CH4, N2O) were measured monthly from closed chambers in the field over a period of six months, starting 30 days before BC application and ended shortly before harvesting in September. For the analysis of nitric oxide (NO) fluxes intact soil cylinders were taken from each plot and incubated at the laboratory at ambient air temperature. Mineral N contents were measured by the extraction with KCl-solution and the microbial biomass with chloroform-fumigation extraction (CFE).
Biochar application to our agricultural soil showed no reduction potential of NO emissions, but N2O fluxes were significantly lower at T1 and T3 compared to treatment K.
Gaseous N fluxes of the pure BC-compost mixture and the additional N fertilization with (NH4)2SO4 led to enormous gaseous N losses in form of N2O and NO. However, after application to the soil, fluxes were only higher for a short time period. We suggest that an optimized storage strategy for the fertilized BC-compost mixture will reduce N losses.