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Effects of biochar on greenhouse gas fluxes of agricultural soils

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The need to stabilize greenhouse gas (GHG) concentrations in the atmosphere is an urgent challenge to respond to global climate change. The application of biochar, the solid residue after pyrolysis of biomass, to soils is a promising technology to mitigate the potent GHG carbon dioxide (CO2) by increasing long-term soil carbon sequestration. To evaluate this practice as a sustainable, future mitigation strategy, the soil-atmosphere flux of CO2 but also of non-CO2 greenhouse gases have to be considered. The gases of interest are nitrous oxide (N2O) and methane (CH4) with a global warming potential of 298 and 25, respectively. Only a better mechanistic understanding of the effects of biochar used in agricultural settings will allow for its systematic application. Strategies to optimize biochar qualities and amendment levels to specific soil types and bioclimatic zones have to be developed in order to maximize carbon sequestration, while increasing plant production and decreasing environmental risks such as nutrient leaching and greenhouse gas emissions.

This study aims at the evaluation of GHG fluxes from different biochar qualities, different soil types and biochar treated versus non-treated soils and at several stages of plant development. Therefore, a pot experiment was conducted: two different arable soils (sandy and loamy) from Lower Austria were chosen. Straw, wood mix and vine wood were pyrolysed whereby vine wood was pyrolysed at two different pyrolysis temperatures (400°C and 525°C). These were mixed at two different application rates (1 M-% - 3 M-%) to the mineral soil. To better understand the effects of plant development on soil treated with biochar, planted and non-planted variations were prepared. From these 25 variations, gas samples were taken after 0, 5, 10 and 20 minutes at several stages of plant development in order to compare the effect of different biochar qualities on GHG emissions. Furthermore, we investigated the effect of nitrogen fertilization on N2O, CO2 and CH4 fluxes. The closed chamber technique was used and gas samples were analysed by gas-chromatography. Our hypothesis is that biochar-treated and non-treated soils will show significant differences in soil GHG emission. In agreement with our hypothesis, we found a significant effect of biochar on N2O, CO2 and CH4 fluxes depending on a range of factors such as the biochar feed stock and soil type. First results of the effects on GHG emissions will be presented.