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Influence of soil organic C content on the greenhouse gas emission potential after the application of biogas residues or cattle slurry – Results from a pot experiment

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ABSTRACT

The change in the EU energy policy markedly promoted the expansion of biogas production. As a consequence, huge amounts of nutrient-rich residues are used as organic fertilizers. The study aimed to simulate the high-risk situation of enhanced GHG emissions following organic fertilizer application in energy maize cultivation. We hypothesize that, i) cattle slurry application enhances the CO_2 and N_2O fluxes compared to the biogas digestate due to the overall higher C and N input, and ii) that with increasing SOC and N content, higher emissions of CO_2 and N_2O can be expected. The study was conducted as a pot experiment. Biogas digestate and cattle slurry were applied to and incorporated into three different soil types with varying SOC contents (Cambisol, termed C_{low}; Mollic Gleysol, termed C_{medium} and Sapric Histosol, termed C_{high}). The application rate was equivalent to 150 kg NH_4^+-N ha^{-1}. GHG exchange (CO_2, CH_4 and N_2O) was measured on five replicates over a period of 22 days using the closed chamber technique. Generally, it was found that the application of cattle slurry resulted in significantly higher CO_2 and N_2O fluxes compared to the application of biogas digestate. No differences were found with regard to CH_4 exchange, which was close to zero for all treatments. Significantly higher CO_2 emissions were observed with C_{high} treatments compared to the other two soil types investigated, whereas the highest N_2O emissions were found with the C_{medium} treatments. The results clearly demonstrate the importance of soil type-adapted fertilization with respect to changing soil physical and environmental conditions.

Key Words: Energy crops, C and N mineralization, mineral soil, organic soil, peatland, fertilization

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