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"Development on the margin"

Influence of Biochar and Tannin Amendments to Goat Manure on Gaseous C and N Emissions

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Abstract

In subtropical irrigation agriculture year-round high temperature and soil moisture lead to high microbial turnover of organic matter and thus potentially high losses of nitrogen (N) and carbon (C) by gaseous emissions. To investigate the effect of biochar and tannin amendments to manure on gaseous losses of N and C, an incubation experiment was conducted in a climate chamber over 10 days during which air temperature and humidity were kept at 30°C and 50 %, respectively. Soil moisture was adjusted every 24h to 60 % field capacity. Goat manure was amended with biochar and tannins at two different concentrations through addition (i) to the goat feed and (ii) directly to dried goat manure, before its application to the soil at a rate equivalent to 0.25 and 0.8 t biochar ha^{-1}, and 0.4 and 1.0 t tannins ha^{-1}. Soil emissions of NH_3, N_2O and CO_2 were measured for the amended and unamended manure treatments and for pure soil using a closed chamber system connected to a photo-acoustic infrared multi-gas monitor.Maximum N_2O flux rates varied from 0.62–1.06 mg h^{-1} m^{-2} and were only decreased for tannins fed to goats by 42 % compared to unamended manure (control). Despite this, flux rate peaked 48hrs later for tannins mixed to manure compared to the control treatment and, in contrast, 72hrs earlier for biochar fed to goats. Total N emissions, (60 % as N_2O-N and 40 % as NH_3,-N) ranged from 42–78 g m^{-2} $10d^{-1}$. Emission peaks of CO_2 were not temporally shifted, but distinctly lowered by biochar (42 %) and tannins (20 %) fed to goats compared to the control treatment. In contrast, direct addition of biochar and tannins to manure enhanced CO_2-C by 14 and 24 %, respectively. Total C emissions ranged from 40–75 g m^{-2} $10\,d^{-1}$ (97 % as CO_2-C). CH_4 and NH_3 emission rates and cumulative emissions of all manure treatments did not differ from emissions of the pure soil. The causes of the contrasting effects of the two application modes of biochar and tannins on CO_2 and N_2O emissions merit further research.

Keywords: Biochar, carbon, gas emissions, nitrogen, tannin

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