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"Resilience of agricultural systems against crises"

Effects of Activated Charcoal and Tannin Added to Soil and Compost on Carbon and Nitrogen Emissions

Greta Jordan[1], Martina Predotova[1], Mariko Ingold[1], Herbert Dietz[2], Andreas Buerkert[1]

[1] *University of Kassel, Organic Plant Production and Agroecosystems Research in the Tropics and Subtropics, Germany*

[2] *Royal Gardens and Farms, Royal Court Affairs, Oman*

Abstract

The use of organic fertilisers such as compost and goat manure is an important approach to sustainable soil fertility management under irrigated subtropical condition, particularly in organic agriculture starting to be practised in Oman. However, high losses due to leaching and especially volatilisation are hampering the efficiency of substrate applications. This study was therefore conducted to quantify changes of gaseous carbon (C) and nitrogen (N) emissions after application of activated charcoal and tannins to compost or directly to the soil. For this, gaseous emissions of carbon dioxide (CO_2), ammonium (NH_3) and nitrous oxide (N_2O) were measured by a dynamic closed chamber system consisting of a cuvette connected to a photo-acoustic infrared multi-gas monitor (INNOVA 1312–5). Carbon and N emissions were monitored for 69 days of composting. Activated charcoal and tannins were added to compost consisting of goat manure and plant material at a rate equivalent to 0.5 t activated charcoal ha^{-1}, 0.8 t tannin ha^{-1} and 0.6 t activated charcoal and tannin ha^{-1} as a mixed application. Based on the observations in Oman, a 20-day incubation experiment under greenhouse conditions was conducted in Germany. Carbon and N emissions from soil amended with goat manure (equivalent to 135 kg N ha^{-1}) and additionally mixed with either 3 t activated charcoal ha^{-1}, 2 t tannin ha^{-1} or the sum of both these additives were determined.

The results showed that peaks of gaseous C and N emission were reduced and/or temporally shifted in tannin amended compost and also whith tannin application to the soil. Tannins applied directly to the soil significantly reduced N_2O (17 %) and significantly NH_3 (51 %) emissions in comparison to the control. Application of tannins to compost reduced cumulative gaseous emission for C by 2100 g C m^{-2} 69 d^{-1} (36 %) and for N emissions by 6 g N total m^{-2} 69 d^{-1} (40 %) compared to the unamended compost. In contrast to these results, emissions of all gases increased in activated charcoal amended compost. Based on these results, tannins appear to be a particularly promising amendment to composts to mitigate gaseous emissions and to soils as organic fertiliser amendment, especially under subtropical conditions.

Keywords: Organic fertiliser, photo-acoustic gas monitor

Contact Address: Greta Jordan, University of Kassel, Organic Plant Production and Agroecosystems Research in the Tropics and Subtropics, Steinstr. 19, 37213 Witzenhausen, Germany, e-mail: gretajordan@gmail.com