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Dietary Tannins Reduce Soil Respiration after Goat Manure Application on an Irrigated Sandy Soil in Oman

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Abstract

The combined hot and moist conditions of irrigated agriculture on sandy soils in Northern Oman lead to high gaseous carbon (C) and nitrogen (N) losses and impedes the accumulation of soil organic matter due to its high microbial turnover. In the millennia old oasis in Oman, goat manure is traditionally used as fertiliser and soil conditioner, which is, however, often of poor quality. By altering the goat's diets using condensed tannins, organic matter can be stabilised and N retention of soils improved. To investigate the effect of dietary tannins on soil respiration after application of manure to soil, a two-year field experiment was conducted on a sandy alluvial soil in the Al-Batinah Plain/northern Oman with the following treatments: mineral fertiliser (MIN); goat manure (GM); tannin-enriched goat manure (TM). GM was obtained from goats fed a basal diet of 50 % hay, 47 % maize and 3 % soybean and TM from goats additionally fed 3.4 % Quebracho tannins to the basal diet and applied to radish at 2.6 and 2.8 t C ha⁻¹ year⁻¹ in 2011 and 2012, respectively. CO₂ emissions were analysed on field using a portable multi-gas monitor (Innova 1312, LumaSense Technologies A/S) at 1–7 day intervals starting with manure application in February until harvest end of March (n=453).

The CO₂-C emissions were highest during the first eight days after manure application in the GM and TM treatments. Generally, CO₂-C emissions were more than twice as high in the afternoon (at hottest day temperature) than early in the morning (coolest day temperature). In February 2011, daily mean flux rates under radish cultivation were 127 (se: 12) < 263 (se: 21) < 286 (se: 21) CO₂-C mg m⁻² h⁻¹ in MIN, TM, and GM, respectively, whereas in March mean flux rates were 103 (se: 8) < 196 (se: 13) < 211 (se: 13) CO₂-C mg m⁻² h⁻¹ in MIN, TM, and GM, respectively.

The results show that soil respiration was reduced in TM compared with GM, supporting previous results on organic matter decomposition, and C and nutrient release from manure applied to soil. Analysis of soil respiration during the second year are under way.

Keywords: Goat manure, radish cultivation, soil respiration, subtropics, tannins