



Tropentag, September 17-19, 2013, Stuttgart-Hohenheim
“Agricultural development within the rural-urban continuum”

Effects of Goat Manure Enriched with Activated Charcoal on Leaching of Carbon and Nitrogen from a Subtropical Sandy Soil - A Comparison between Suction Plates and Ion Exchange Resins

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Abstract

Leaching losses are often high in sandy soils that are low in organic matter. Additions of activated charcoal (AC) to soil are known to increase nutrient retention capacities and may thereby decrease such losses. We investigated (i) how AC affects manure mineralisation and leaching of dissolved organic and inorganic nitrogen (DON, NO_3) and dissolved organic carbon (DOC) and (ii) whether ion exchange resins and suction plates are equally suited to capture dissolved nutrients. To this end, a greenhouse experiment was conducted in which glass tubes were filled with sandy soil from Oman and fitted to glass suction plates at the bottom. As a comparison, ion exchange resins were mixed with silica sand (1:1:2 cation:anion:sand ratio), filled into glass cartridges, and installed below the soil columns. Five fertiliser treatments were compared, consisting of manure with: (1) 0% AC (control), (2) 3% AC, (3) 5% AC, (4) 7% AC, and (5) 9% AC in goats' diet. Each treatment was filled into $65 \times 65 \text{ mm}^2$ nylon gauze bags of 1 mm mesh and buried at 10 cm depth. The amount of nutrients applied was equivalent to 160–81–42 kg N-P-K ha^{-1} . Over a period of twelve weeks, soil water samples were collected weekly at -120 hPa after irrigation events equivalent to 450–500 mm. First results from two sampling dates (1st and 8th week after installation; WAI) show that NO_3 leaching was highest shortly after the onset of the experiment with 194 mg $\text{NO}_3 \text{ l}^{-1}$ lost across all treatments, while by the 8th WAI, mean NO_3 leaching was about eight times lower. Also, at the 8th WAI, NO_3 leaching was lowest for 7% AC (18 mg $\text{NO}_3 \text{ l}^{-1}$) and highest in the control treatment (28 mg $\text{NO}_3 \text{ l}^{-1}$). One WAI, leaching of DOC averaged about 104 mg DOC l^{-1} and diminished to 81 mg DOC l^{-1} by the 8th WAI. Further analyses of soil water, manure decomposition from litterbags and microbial biomass indices are underway.

Keywords: Biochar, charcoal feeding, dissolved organic carbon, nutrient leaching