



Tropentag, October 6-8, 2009, Hamburg

“Biophysical and Socio-economic Frame Conditions
for the Sustainable Management
of Natural Resources”

Estimating Nutrient and Carbon Losses on an Irrigated Sandy Soil in Northern Oman

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Abstract

Little is known about gaseous and leaching losses of carbon (C) and nitrogen (N) in irrigated agriculture of the hyperarid Arabian Peninsula. Therefore, gaseous emissions of NH_3 , N_2O , CO_2 and CH_4 were measured on an experimental field near Sohar (Oman) with an INNOVA photo-acoustic infrared multi-gas monitor connected to a custom made cuvette (closed chamber system). Conducted on an irrigated sandy soil with four replications the experiment comprised two manure types (characterised by a C/N ratio of 24 with high fibre content and a C/N ratio of 15 with low fibre content) and a control treatment with equivalent levels of mineral nitrogen (N), phosphorus (P) and potassium (K). These three fertility treatments were factorially combined with a crop rotation at two levels comprising cauliflower (*Brassica oleracea*) and carrot (*Daucus carota* subsp. *sativus*) each preceded by a crop of radish (*Raphanus sativus*). Experimental leaching losses were calculated using the solute concentrations of N, P and K in leachate samples and the cumulative amount of leached solutes determined by ion-exchange resin cartridges. Seepage was estimated with the software Hydrus 1d using estimates of crop-specific evapotranspiration.

Gaseous N emissions averaged 27 kg N ha^{-1} (60% $\text{NH}_3\text{-N}$, 40% $\text{N}_2\text{O-N}$) for a cropping period of 120 days, with little variations between treatments. During the same period C emissions were 6 t C ha^{-1} (99% $\text{CO}_2\text{-C}$, 1% $\text{CH}_4\text{-C}$) on plots treated with organic manures. Plots treated with mineral fertiliser had a mean emission rate of 3 tons C ha^{-1} . Repeated measurement analysis of the gas emission data revealed significant effects of crop rotation and manure treatment for $\text{NH}_3\text{-N}$ and $\text{CH}_4\text{-C}$. Crop rotation had a significant effect on emissions of $\text{CO}_2\text{-C}$ and $\text{N}_2\text{O-N}$. Cumulative leaching averaged 5 kg N ha^{-1} for plots treated with organic manure of low C/N, 28 kg N ha^{-1} for plots treated with organic manure of high C/N and 15 kg N ha^{-1} for the control treatment.

Keywords: Hydrus 1d, INNOVA multi-gas monitor, leaching, organic agriculture