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$_2$O, 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 % NH$_3$-N, 40 % N$_2$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 % CO$_2$-C, 1 % CH$_4$-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 NH$_3$-N and CH$_4$-C. Crop rotation had a significant effect on emissions of CO$_2$-C and N$_2$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