Geophysical Research Abstracts
Vol. 12, EGU2010-12911-2, 2010
EGU General Assembly 2010

Nitrous oxide isotopomers and N_2O/N_2 ratios from denitrification after biogas waste application as fertilizer to grassland soil

Jan Reent Köster (1), Laura Cardenas (2), Reinhard Well (3), Roland Bol (2), Mehmet Senbayram (1,4), Karl H. Mühling (1), and Klaus Dittert (1)

(1) Christian-Albrechts-University Kiel, Institute for Plant Nutrition and Soil Science, 24118 Kiel, Germany (email jrkoester@plantnutrition.uni-kiel.de / fax 00494318801625), (2) North Wyke Research, Okehampton, EX20 2SB, UK, (3) Johann Heinrich von Thünen-Institut, 38116 Braunschweig, Germany, (4) Yara GmbH & Co. KG, 48249 Dülmen, Germany (present address)

Biogas waste, applied to agricultural land, provides an additional carbon source in soil and, therefore, can raise denitrification under certain soil conditions.

Here, we present N_2O isotopomer and N_2O/N_2 ratio data derived from two soil incubation experiments carried out in a helium-oxygen atmosphere using an automated soil incubation system (Cárdenas *et al.*, 2003. *SBB* 35: 867-870).

In the first experiment, soil was amended with biogas waste (from food waste fermentation) at an application rate equivalent to 160 kg NH_4^+-N ha^{-1} and 80% soil WFPS. Gas samples were taken at frequent intervals and the N_2O isotopomers were analyzed for $\delta^{15}N_{bulk}$ and the intramolecular ^{15}N distribution (according to Well *et al.*, 2006. *SBB* 38: 2923-2933) and compared to literature values. During the initial 3 weeks the N_2O-^{15}N site preference (SP) clearly indicated denitrification to be the major N_2O forming process with most SP values between 6 and 16‰ while $\delta^{15}N_{bulk}$ was in the range of -20 to -40‰. After this period the CO_2 fluxes reached the control background level indicating depletion of the added carbon source. Henceforth, SP values increased to 26‰ within the next 3 weeks in a 'Michaelis-Menten' shaped curve and $\delta^{15}N_{bulk}$ decreased to -50 to -55‰. This was attributed to nitrification becoming the main N_2O forming process under low carbon availability as nitrification is characterized by higher SP as well as higher discrimination against ^{15}N.

In the second incubation experiment with oxygen availability being reduced to 10 kPa and higher soil moisture (90% WFPS), denitrification was the overall dominant source of N_2O after application of different types of biogas waste and cattle slurry at the same N application level as above. During the initial 15 to 20 days the N_2O/N_2 ratio was below 0.1 in all treatments due to low nitrate but high carbon availability and high denitrification rates promoting complete denitrification to N_2. Later on, when carbon availability was lower – as indicated by decreasing CO_2 fluxes – the N_2O/N_2 ratio increased to 1 and higher. In contrast, the N_2O/N_2 ratio of the untreated control was constantly in the range of 2 or higher right from the start. We attribute this to low carbon availability and, therefore, low denitrification.