Tropentag, October 7-9, 2008, Hohenheim

"Competition for Resources in a Changing World:
New Drive for Rural Development"

Gaseous Nitrogen and Carbon Emissions from Urban Gardens in Niamey, Niger

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Abstract

Measurements of horizontal nutrient fluxes in African urban gardens show highly positive balances for nitrogen (N) and carbon (C), leading to the assumption that massive nutrients losses occur through gaseous emissions and leaching. To quantify vertical nutrient losses through volatilisation, fluxes of NH_3, N_2O, CO_2 and CH_4 were measured in Niamey, Niger using a mobile INNOVA photo-acoustic infrared multi-gas monitor connected to a custom-made cuvette. For one year in three gardens, two irrigated with river water and one irrigated with sewage water, six replicate measurements were taken in vegetable-plots during 6 days in the coldest (6 am) and hottest (2 pm) period of the day. Measurements were repeated every 6 weeks.

For all measured gases, flux rates were lower in the morning than in the afternoon. Throughout the year seasonal effects on emissions ($p < 0.001$) were more pronounced at midday regardless of ambient temperature.

Within a season, emission rates of NH_3 and CH_4 during the morning did not differ significantly between the three gardens and afternoon values varied only slightly. Afternoon missions of CO_2, in contrast, were significantly different between gardens, peaking in all cases at the end of hot dry season with > 3 kg CO_2–C ha^{-1} h^{-1} for the low input garden receiving river water, and reaching 5.5 kg CO_2–C ha^{-1} h^{-1} in the high input garden irrigated with sewage water. Differences in N_2O volatilisation were largest in the afternoon, when the annual averages for the two gardens using river water ranged from 34 to 43 kg N_2O-N ha^{-1}, while the values for the garden receiving sewage water exceeded 100 kg N_2O-N ha^{-1}.

The estimated yearly gaseous nitrogen losses were 50 kg N ha^{-1} for the gardens receiving river water and 90 kg N ha^{-1} for the one receiving sewage water. High N volatilisation in the urban gardens are reflecting surplus N application and indicate that nutrient management in these very intensive production systems is inefficient.

Keywords: Carbon, gaseous emissions, Niger, nitrogen, urban agriculture

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