Nitrous oxide emissions from Soddy podzolic sandy loam soil after long-term fertilizer and manure application

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Abstract

The objective of this study was to estimate direct N_2O emissions from Soddy podzolic sandy loam soil after long-term manure and N-fertilizer application. Closed chamber technique was used to measure the fluxes from the soil with different treatments: (1) Control, (2) FYM 10 t ha^{-1}, (3) FYM 20 t ha^{-1}, (4) N50P25K60, (5) N25P12K30 + FYM 5 t ha^{-1}, (6) N50P25K60 + FYM 10 t ha^{-1}, (7) N100P50K120. The studied soil was characterized by very low direct N_2O emission independent of the FYM or mineral fertilizer rates.

Keywords: sandy loam arable soils, nitrous oxide, farm yard manure, mineral fertilizer, field experiment

1. Introduction

The information available on N_2O emissions from agricultural soils in different countries varies widely. Emissions in Western Europe, the USA, Canada and elsewhere have been well documented (Stehfest and Bouwman 2006), but for some other countries, including Russia, there is almost no information available, except for soils of North-Western region and soils of Central Russia (Buchkina et al., 2009, 2010).

The objective of this study was to estimate direct N_2O emissions from Soddy podzolic sandy loam arable soil in Central Russia after long-term application of manure and mineral fertilizer in different rates.

2. Materials and Methods

The measurements of direct N_2O emission from the soil were conducted for one growing season at the long-term field experiment established in 1968 (56°03'N, 40°29'E). There were seven different treatments for which the N_2O flux measurements were conducted: (1) Control, (2) FYM 10 t ha^{-1}, (3) FYM 20 t ha^{-1}, (4) N50P25K60, (5) N25P12K30 + FYM 5 t ha^{-1}, (6) N50P25K60 + FYM 10 t ha^{-1}, (7) N100P50K120.

The closed chamber technique was used to measure direct N_2O fluxes from the soil. Gas samples were collected twice a week (between noon and 2 pm). Daily and cumulative N_2O fluxes were calculated based on the measurements.

3. Results

The minimum daily N_2O fluxes varied between 0,05 and 0,21 g N_2O-N ha^{-1} day^{-1} for all the studied treatments with the significantly lowest flux measured from the soil with the FYM 20 t ha^{-1} treatment (Fig. 1a). The maximum daily N_2O fluxes varied between 5 and 39 g N_2O-N ha^{-1} day^{-1} with no significant differences between the studied treatments (Fig. 1b).

The variability of the daily fluxes was higher for those treatments where higher rates of mineral N fertilizer or manure, or the combinations of the two were applied.

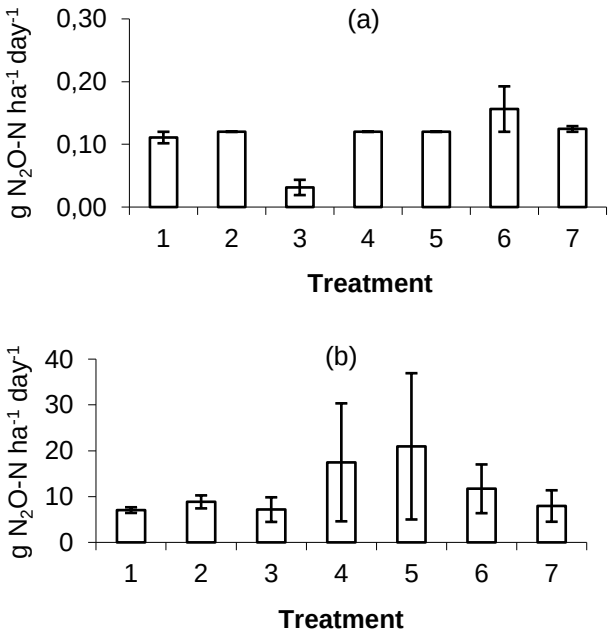

Fig. 1. Minimum (a) and maximum (b) daily N_2O fluxes from Soddy podzolic sandy loam soil after long-term fertilizer and manure application.

Cumulative N_2O fluxes for the growing seasons for all the studied treatments were between 350 and 900 g N_2O-N ha^{-1}. There was no significant differences in this parameter between all the studied treatments.

4. Conclusions

Soddy podzolic sandy loam soil of the long-term field experiment with different rates of fertilizer and manure application are characterized by very low direct N_2O emission during the growing season independent of the FYM or mineral fertilizer rates which is a result of low precipitation in the area during the growing season and low concentrations of available nitrogen in the soil.

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