Nitrous oxide emissions from soil of natural grassland under different intensifications in Pampa biome

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Introduction

The Pampa Biome occurs in just 2.07% of Brazilian territory, but in Rio Grande do Sul state occurs in 63% (176,496 km^2) of gaucho territory. Is characterized by predomination of natural grassland with shrubs and tree vegetation in mosaic (Campos). Because of the natural grasslands, livestock production is one of the main economic activities. Despite of the potential of mitigation, the society has paid attention in this livestock production system, mainly in your environmental impact, and greenhouse gas emissions. In addition to the sporadic deferral and stocking rate adjustment, other alternative practice to make more productive this livestock system (in Campos) is fertilizer application, and hibernal forages sowing (Overbeck et al, 2007; Boldrini, 2009; Nabinger et al, 2009). The objective of this work was evaluating the nitrous oxide emissions from soil with natural grassland under different intensifications rates in two seasons (winter and summer).

Material and Methods

The work was conducted at Embrapa Pecuária Sul (Bagé/RS, Brazil), in two seasons (August- September 2014 and February-March 2015). The soil is classified as a sandy clay Luvisol (Soil Taxonomy) or Luvissolo Órtico háplico típico (Brazilian System of Soil Classification – Embrapa, 2006). The experimental area has 61 ha with 3 treatments

(3 repetitions): natural grassland (CN); natural grassland improved by fertilization (CN+A); and natural grassland improved by fertilization and introduction of exotic season species ryegrass (Lolium multiflorum Lam.) and red clover (Trifolium pratense L.) (CN+A+F). The CNT treatment - natural pasture with traditional management without stocking rate adjustment - was conducted in neighboring adjacent area with the same soil. During all experiment time, the area was grazed by Hereford steers with forage offers of 12 kg/ 100 kg of live weight. In the days 25/08/2014 and 23/02/2015, were applied equivalent doses of 300 kg/ha of diammonium phosphate (DAP), at the treatments CN+A and CN+A+F. The N_2O emission rates were measured in situ regularly with static cameras (4 cameras by repetition) and the soil temperature was checked to 5 cm depth. Gas from the chamber was collected with a 20 mL polypropylene syringe (Costa et al, 2008). The gases were measured in Geochemistry Soil Laboratory (UFRGS) with a Gas Chromatography (Shimadzu GC-2014 model Greenhouse) equipped with an electron capture detector (ECD).

Results and Conclusions

The soil temperature at 5 cm depth fluctuated between 10.5 °C and 16 °C in winter (Figure 1a) and between 24.5 °C and 26 °C in summer (Figure 1b). The N_2O flow rates measured at the first and last day of each experimental period were very low and similar to those observed by Godoi et al (2016) under similar conditions (Figure 2). The treatments that received fertilizer application (CN+A and CN+A+F), the largest N_2O emission rates occurred 7 days after application of DAP, independent of temperature differences in the soil (Figure 1) and the season. The highest values of N_2O emission rate were observed in summer (103 $\mu gN_2O\ m^{-2}h^{-1}$ in average between two fertilized treatments), while in winter the highest values were lower (20.5 $\mu gN_2O\ m^{-2}h^{-1}$ in average between two fertilized treatments). The treatments without fertilization (CN and CNT) had very low levels of N_2O emission rate, both in winter and in summer.

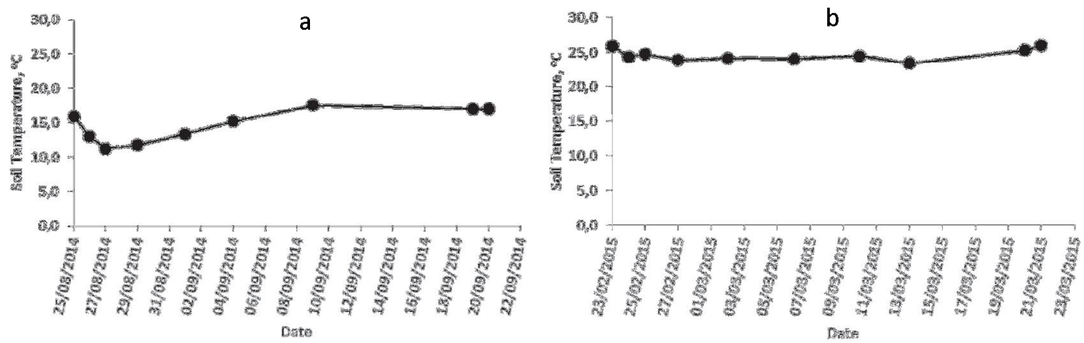

Figure 1. Soil temperature at 5 cm depth in the sampling dates. (a – winter, b – summer).

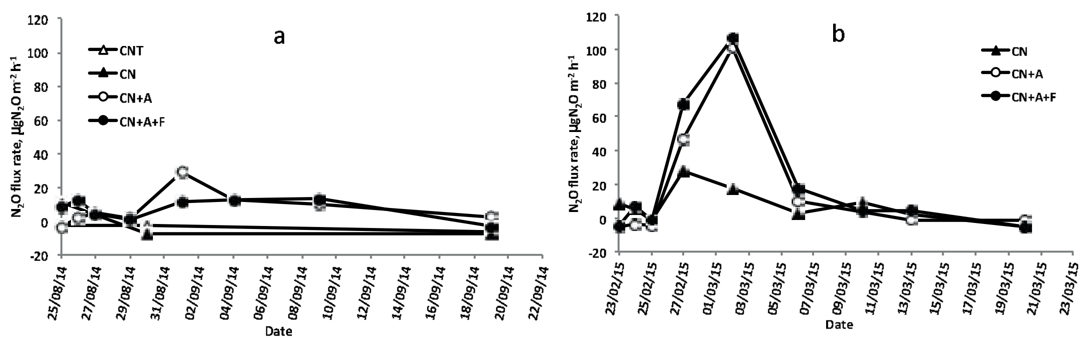

Figure 2. Flux rate of N_2O in a Luvisol under natural grassland in different treatments in two seasons (a- winter, b – summer).

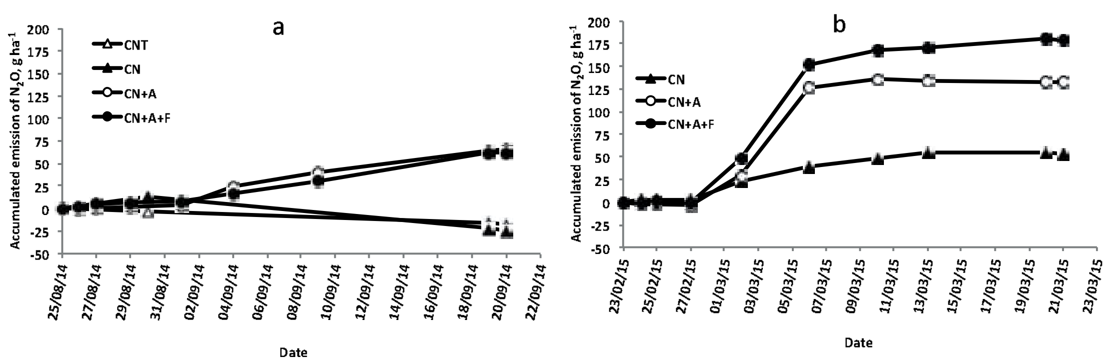

Figure 3. Accumulated emission of N_2O in a Luvisol under natural grassland in different treatments in two seasons (a- winter, b – summer).

Due to the differences in N2O emission rates, the treatments with fertilization showed higher cumulative emissions than treatments without fertilization (Figure 3). At the end of the evaluation period in the winter had issued, on average, 63 g N2O ha^{-1} (Figure 3a) and the end of the evaluation period in the summer had issued, on average, 155 g N2O ha^{-1} (Figure 3b).

We conclude that the application of fertilizer in natural grassland may increases N_2O emissions, with a higher emission in the summer, but de emissions values are low.

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