Nitrous oxide emission in pasture under rotational and continuous managements

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Introduction

One of the most important anthropogenic methane and nitrous oxide sources in Brazil are the agricultural activities. In 2010 it was estimated that the emissions of methane (CH_4) and nitrous oxide (N_2O) were 13,133 and 521 Gg, respectively (BRAZIL, 2013). Pasturelands contribute with N_2O emissions, which vary with the adopted management and other variables.

The types of management used in pastures may be distinct, with the extensive cultivation, in which there is no reseed or fertilization, and the intensive cultivation, with periodic fertilization and reseeding (HANSEN et al., 2014). The grazing method is an important mechanism in the production system, being potentially effective in providing answers to improve the productivity and sustainability of cattle production systems in pastures.

Southeastern Brazil is a region with expressive production beef cattle. Grazing methods used in the country are commonly classified as continuous or rotational pasture. In the first one, animals have uninterrupted access to the pasture area, during all the period grazing is allowed (ALLEN et al., 2011). Rotative pasture utilize grazing and rest periods between the paddocks. In this experiment, Nelore cattle grazed rotative pasture during 7 days, after which period the area rested 28 days, totalizing a cycle of 35 days at the paddock.

Mensuration of nitrogenous gas losses in tropical savanna are still scarce in literature, especially about nitrous oxide emission factors in soils with the addition of nitrogen fertilizer (SMITH, BOUWMAN, BRAATZ, 1999). This study aimed to quantify nitrous oxide emissions in pastures under two grazing methods, not fertilized and fertilized rotational, in Southeastern Brazil.

Material and Methods

This work was carried out between January 24 and March 19, 2014, corresponding to 56.7% of the rainy season in the summer, in a pasture of the experimental station of the *Faculdade de Zootecnia e Engenharia de Alimentos, São Paulo University*, located at 21°57´S-47° 28´W, 661 m altitude, in the municipality of Pirassununga, State of São Paulo, Brazil. The climate is subtropical, according to Koppen-Geiger's classification, with annual precipitation of 1,300

mm and mean temperature of 23°C, with a wet season distributed throughout the summer and a dry season in winter. However, in 2014, the precipitation in the period between January 24 to December was 19.7% below the mean, with 1,043 mm. The soil in area is classified as red Ferralsol (FAO classification), with 31% clay in the top 20 cm.

The determination of N_2O emissions from *Brachiara brizantha* was made in two grazing methods: under rotational pasture (RP) and continuous pasture (CP). In RP, an area of 0.315 ha was used, where cattle of Nelore occupied for 7 days, and after this, the pasture rested for 28 days, completing a 35 days cycle of pasture in the plot, thus, the period of this experiment was of approximately two cycles in summer. In the first cycle, nine male animals, with average weight of 279.06 kg, and seven animals in the second, with average weight of 304,29 kg. An application of nitrogen fertilizer was made on February 3, with ammonium nitrate. The quantity used was of 18.9 kg, corresponding to 60 kg of N in 1 hectare, being one part of the area isolated by canvas, not receiving the addition of fertilizer. At the continuous grazing method, animals stayed in the paddock during the whole period. Three animals with mean weight of 274.4 kg were used in the beginning and 316.0 kg in the end of the second cycle.

Gas sampling for soil N_2O flux determination occurred in alternated days, using PVC chambers installed in the experimental plots, according to the chamber technique described by Davidson & Schimel (1995). The chambers are composed for a PVC base of 30 cm diameter and 20 cm height, a 10 cm deep lid containing a septum for the collection of gas and a leak. The bases were inserted in the soil to a depth of 3 cm.

Twenty chambers were used to 15 sampling events, being eight of them to the fertilized treatment and four to not fertilized of rotational manure, and eight to the management of continuous pasture. Sampling were collected with 60 mL BD plastic syringe, and transferred to evacuated 12 to 20 mL LABCO vials. Embrapa Environment's Biogeochemistry and Trace Gases Laboratory, Jaguariúna, SP, analyzed the sampling using a Shimadzu GC-2014 gas chromatograph, equipped with an electron capture detector (ECD) and a flame ionization detector (FID). Soil N_2O flux was calculated according to Jantalia el at. (2008).

Results and Conclusions

The accumulated precipitation in the studied period was 141.8 mm, of the total 299.4 mm registered in the summer season, 66% below the summer of the year before, when 905 mm were registered. The mean temperature was 25.2°C, according to USP (2016). Figure 1 presents precipitation and temperature data to the summer season.

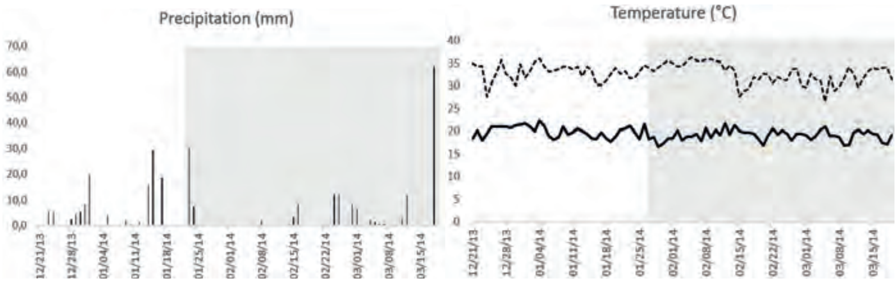

Figure 1. Precipitation, maximum and minimum temperature for the summer in Pirassununga, SP. In gray, the period of the experiment.

In the fertilized pasture, the minimum N_2O emission occurred on February 3, with a rate of 0.007 mg N-N_2O $m^{-2.day}$, after one week without raining, and the maximum, on February 25, with 5.295 mg N-N_2O $m^{-2.day}$, and occurrence of two consecutive days of rain, totalizing 24.4 mm. Not fertilized pasture had the minimum emission of 0.007 mg N-N_2O $m^{-2.day}$, also on February 4, and maximum on March 12, with 0.804 mg N-N_2O $m^{-2.day}$, with 14.4 mm of accumulated rain to the day before and the day of sampling. In the continuous grassland, minimum emission occurred on February 11, with 0.007 mg N-N_2O $m^{-2.day}$, after 14 days without raining, and maximum, on February 25, as observed at the fertilized field, with 4.348 mg N-N_2O $m^{-2.day}$.

Emission pulses of N_2O in the summer season were driven by the raining events, as observed by others authors (XU et al., 2002; SIGNOR et al., 2013; LIU et al., 2014; ROWLINGS et al., 2015). The cumulated emissions for the fertilized pasture were 33.328 mg N-N_2O $m^{-2.day}$, while at not fertilized pasture were 5.863 mg N-N_2O $m^{-2.day}$ and at the continuous management pasture were 19.153 mg N-N_2O $m^{-2.day}$.

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