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Nitrous oxide (N_2O) emissions from soil cultivated with grass Marandu and subjected to rates and sources of N fertilizers in Amazon of Mato Grosso

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Introduction

Nitrogen is the nutrient required for the fodder production, and main sources are urea and ammonium sulfate, with 45% and 24% of N, respectively. The application of nitrogen may greatly increase the production of forage since improves the availability of exchangeable N in soil. The minimum and maximum rate usually applied are 40 and 80 kg ha^{-1} of N (SOUZA et al., 2004).If on the one hand it promotes the growth of plants, on the other the nitrogen fertilization increases N_2O emissions from soils. Hence, the increase in emissions because of this agricultural practice must be understood as it contributes to the increase in greenhouse gas concentrations in the atmosphere, which are related to climate changes (RODRIGUES, 2006).

Among the gases considered significant to global warming, the N_2O is importance to agricultural systems because most global emissions of this gas are from processes occurring in the soil triggered by the N fertilization (Mosier et al., 2004). N_2O has a global warming potential 310 times higher than CO_2 (GWP - Global Warming Potential) (IPCC, 1997).

The aim of this work was to measure the N_2O emissions and to calculate the emission factors of two sources and two rates of N fertilizers in pasture of *B. brizantha* cv. Marandu in the Amazon of Mato Grosso.

Material and Methods

The study was carried out at Embrapa Agrosilvopastoral in Sinop / MT. The soil of the experimental area is classified as Oxisol, with 46% of clay and flat relief. The experimental period was 28 days, a cycle of grass growth, starting on January 13 and end on February 10, 2016. The experimental design was a randomized block with three replications and five treatments. The grass *Brachiaria brizantha* cv. Marandu was subjected to different N rates (N): (1) control (without application), (2) Ammonium sulfate 40 kg ha^{-1} of N, (3) Ammonium sulfate 80 kg ha^{-1} of N, (4) Urea 40 kg ha^{-1} of N, (5) Urea 80 kg ha^{-1} of N.

The gas samples were taken daily in the first two weeks, starting two days before the application of the treatments. After two weeks of daily collections of gas samples, the sampling was made every 5 days to complete the 28-day cycle. The gases were sampling between 8 and 11 am in static chambers, top-base model, where four 20 mL aliquots were collected in one hour intervals (0, 20, 40, and 60 min). The determination of the N2O concentration in the samples was performed on a Gas Chromatography.

The N_2O emissions were presented in graph as a function of time (days). For each day the data were compared by the standard error of the mean, and this calculation was also used to compare the daily average emissions. The emission factor for the period of 28 days was calculated using the cumulative emissions of such treatment, minus the accumulated emissions of the control treatment divided by the amount of N applied, multiplied by 100, to get value in percentage (%).

Results and Conclusions

N_2O emissions were lower than 20 μg N m^{-2} h^{-1} before the application of treatments. After applying the fertilizer, the higher emission of N_2O was observed in the treatment with urea at a rate of 80 kg ha^{-1} of N, increasing the emissions till the sixth day (Figure 1). Despite the highest absolute values of emissions, the application of urea at a rate of 80 kg ha^{-1} of N resulted in N_2O emissions similar to ammonium sulfate in the same rate, with the exception only of the day January 18 and 22, in which the urea supply resulted in higher emissions.

In general, although with higher absolute values emissions than the control, treatments with rates of 40 kg ha^{-1} of N showed emissions similar to the control over the study period, with few exceptions. From the day 27/01, as observed at the beginning of the assessments, emissions were similar for all treatments.

Throughout the experimental period, the daily average flux of N_2O of the treatments with nitrogen supply was higher compared to the control (Table 1), ranging from 18.98 to 29.91 μg N m^{-2} h^{-1} for ammonium sulfate supply, and 18.88 to 45.13 μg N m^{-2} h^{-1} for urea supply. In treatment without N application the daily average flux was lower than the other treatments:

11.18 μg N m^{-2} h^{-1} (Table 1). Taking into account the standard error of the mean it was observed that the increasing order of higher average daily emission follows the sequence: control; 40 kg ha^{-1} of N via urea and ammonium sulfate (similar); 80 kg ha^{-1} of N via ammonium sulfate; and 80 kg ha-1 of N via urea.

In 28 days, the highest emission factor (0.19%) was observed with the application of urea at the rate of 80 kg ha-1 N, followed by ammonium sulfate at a rate of 80 kg ha-1 N, urea at a rate of 40 kg ha-1 of N, and ammonium sulfate at a rate of 40 kg ha-1 with values of 0.11%, 0.09% and 0.04%, respectively. These values are below the default emission factor used by the IPCC (1997) for inventory calculations. Thus, for the conditions of the Amazon of Mato Grosso recommends the revision of this factor.

Therefore, regardless of source, treatments in which the N rates were lower proved more environmentally suitable in relation to the daily emissions of N_2O. The daily average emissions were higher at higher N rates, mainly when using urea as a source. However, future works should advance to correlate the emissions of N_2O with forage yield in treatments with N rates and fertilizers in order to identify the best ratio productivity/emission.

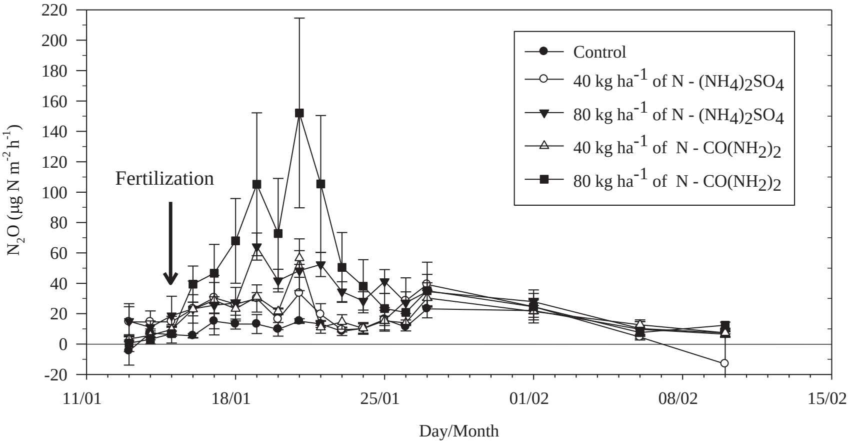

Figure 1. N2O emissions from two rates and two sources of N fertilizer on grass Marandu. Vertical bars represent the standard error of the mean.

Table 1 – Average N2O emissions and emission factors of two rates and two sources of N fertilizer on grass Marandu

Treatment	Average emission N_2O (µg N m^{-2} h^{-1})	Emission factor %
Control	11,18 ±1,5	-
40 kg ha^{-1} de N - $(NH_4)_2SO_4$	18,98 ±2,9	0,04
80 kg ha^{-1} de N - $(NH_4)_2SO_4$	29,91 ±3,6	0,11
40 kg ha^{-1} de N - $CO(NH_2)_2$	18,88 ±3,0	0,09
80 kg ha^{-1} de N - $CO(NH_2)_2$	45,13 ±9,8	0,19

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