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Ratio of nitrous oxide (N_2O) emission from soil to forage productivity in the Amazon of Mato Grosso

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Introduction

Fertilizers used as sources of nitrogen (N) are essential to increase the forage production (Costa et al., 2009), however, they lead to a higher N_2O emission from soil (Gagnon et al., 2011). Nowadays, researches are establishing relationships between grass production and gas emission to figure out the better application N rates that harmonize productivity and less environmental impacts, i.e., more efficiency of N uptake by plants (Bell et al., 2016). Thus, the goal of this work was to establish the ratio between the amounts N_2O emitted from soil to forage production in the Amazon of Mato Grosso.

Material and Methods

The study was carried out at Embrapa Agrosilvopastoral in Sinop / MT. The experimental period was 28 days, a cycle of grass growth to forage production. The experimental design was a randomized block with three replicates and five treatments. The grass Brachiaria brizantha cv. Marandu was subjected to different N rates: control (without application), ammonium sulfate 40 kg N ha^{-1}, ammonium sulfate 80 kg N ha^{-1}, urea 40 N kg ha^{-1}, urea 80 kg N ha^{-1}. The gas were sampling between 8 and 11 am daily during 15 days, and each 5 days until 28 days. Samples were collected in four times in an hour period (0, 20, 40, and 60 min) between 8 and 11 am in static chambers,

where four 20 mL aliquots were collected. The determination of the N2O concentration in the samples was performed in a Gas Chromatography. The amount of N_2O emitted (g ha^{-1}) was divided by the forage productivity (Mg dry matter ha^{-1}), creating a relationship, which was plotted in a graph in function of the N rates of ammonium sulfate and urea. To compare treatments was used standard error of the mean.

Results and Conclusions

The ratio between the amounts of N-N_2O emitted (g ha^{-1}) and forage accumulation (Mg of dry matter ha^{-1}) during 28 days showed the better strategy to increase the forage productivity linked to N_2O emission from soil (Figure 1). This ratio was similar independent of the N rate of ammonium sulfate. However, if compared to the treatment that no received N (control), applying 80 kg N ha^{-1} using urea as source led to a higher N_2O emission per Mg of dry matter of forage, but it is similar to that treatment which received 40 kg N ha^{-1}. Comparing both N sources at a rate of 80 kg N ha^{-1}, we observed lower N_2O emission per Mg of dry matter with application of ammonium sulfate (Figure 1). These initial results to the Amazon of Mato Grosso indicate that applying ammonium sulfate at different rates does not increase N_2O emission per Mg of dry matter of forage, so, the use of this fertilizer may increase forage productivity without emitting more N_2O per unit of product in relation to pasture that does not receive fertilization.

On the other hand, it is not true when is used urea at a rate of 80 kg N ha^{-1}, because there is more N emission per forage production when compared to the control (no N supply). Urea at a rate of 40 or 80 kg N ha^{-1} are similar in the ratio, suggesting that the choice of a higher N rate does not increase the emission of this gas from soil to atmosphere per Mg of grass produced. If the application of N fertilizers to the grass Marandu is required at a rate of 80 kg N ha^{-1}, the better choice in terms of decreasing N_2O emission should be ammonium sulfate, which emits less than urea per Mg of dry matter of forage. Nevertheless, studies in this biome must advance to achieve a more representative relationship between N_2O emissions and forage production of Marandu when applying N fertilizers.

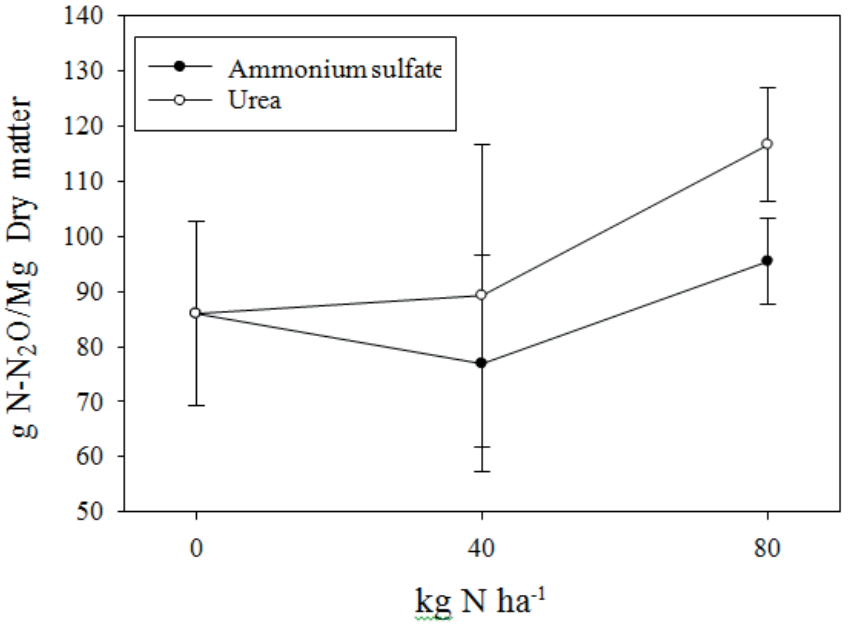

Figure 1. N-N_2O emission (g ha^{-1}) per Mg of dry matter of Marandu accumulated during 28 days after ammonium sulfate and urea fertilization at a rate of 0, 40, and 80 kg N ha^{-1}.

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