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Nitrous oxide emission by pastures in tropical beef production systems

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Introduction

Brazil has a total of 851.58 million ha and 158.75 million ha occupied by pastures, amounting to 18.6% of its territory and 58.1% of farmland area in the country (IBGE,2010). The Brazilian beef production is based on tropical pastures. The recovery and intensive management of pastures have shown potential for mitigation of greenhouse gases (GHG) due to the high biomass production of tropical grasses (Oliveira, 2015). The main GHG related to agriculture are carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O) (Oliveira, 2015). The concentration of N_2O in the atmosphere is much lower compared to the CO_2 concentration but evaluating its emissions is important due to its high greenhouse effect potential, which is 270 to 310 times higher than that of CO_2 (Snyder et al., 2008; MCTI, 2014). The aim of the study was to investigate the effect of different tropical beef production systems and seasons on N_2O emissions by pastures.

Material and Methods

The study was carried out at an experimental station of the Brazilian Agricultural Research Corporation (EMBRAPA), São Paulo state, Southeast of Brazil, in 2014. Treatments consisted of four grazing systems, with two replications each (blocks): 1) IHS: irrigated pasture with high stocking rate (5.9 - animal units - AU/ha; *Panicum maximum*); 2) DHS: dryland pasture with high stocking rate (4.9 AU/ha; *Panicum maximum*), 3) DMS: dryland pasture with moderate stocking rate (3.4 AU/ha; *Brachiaria brizantha*); 4) DP: degraded pasture with low stocking rate (1.1 AU/ha; *Brachiaria decumbens*). Pastures in IHS, DHS and DMS were managed as rotational grazing systems with three days of occupation and 33 days of rest cycles. Each replicate area in IHS and DHS systems had 1.75 ha, divided in 12 paddocks. Pastures in IHS received five applications of 80 kg of N during the rainy season and five applications of 40 kg of N during the dry season and were overseeded with temperate grasses in autumn. Pastures in DHS received five applications of 80 kg of N during the rainy season. Each area in DMS had 3.3 ha, divided in six paddocks managed in a rotational system with 6 x 30 d cycles, and received five applications of 40 kg of N during the rainy season. Urea was used as the N source. Pastures in DP were managed under continuous grazing and were not fertilized. The stocking rate in all systems was adjusted using the "put and take" technique (Mott and Lucas, 1952) and visual evaluation of forage availability. Net flows of N_2O emissions were evaluated using air samples collected from cylindrical PVC "static chambers". The chamber body was 17cm height and 30 cm in diameter and was covered with insulating material. Six chambers were used per treatment (three per block or pasture area). Three chambers were also allocated in an Atlantic Forest area (positive control). A digital thermometer was adapted to each of the chambers for internal temperature measurement. Three collections of air samples were done in each chamber, at 30 min intervals, with polypropylene syringes. Samples were taken between 8:00 and 10:00 a.m. Samples were transferred to evacuated vials, provided with rubber septa and aluminum seals, for later chromatography analysis.

Results

Accumulated N2O emissions were effect by the different systems and by the seasons. It was also observed a system and season interaction (Table 1 and Figure 1). The total emission was higher in IHS, intermediate in DHS and similar and lower in DMS, DP and in the forest (Figure 1). Emissions in IHS were higher in summer compared to other seasons but in DHS emissions were more evenly distribute throughout the year. Emissions did not vary during the year in the dryland pasture with moderate stocking rate, in the degrade pasture and in the forest.

Table 1. Accumulated N_2O emission* (g) in different beef production systems, and forest, during the four seasons of 2014.

	Summer	Autumn	Winter	Spring	Means
Forest	0,3505 Ca	0,6048 Aa	0,0034 Ba	0,2201 Aa	0,2947
IHS	3,9806 Aa	1,2969 Ab	0,6996 Ab	0,1547 Ac	1,5329
DHS	1,3456 Ba	1,0558 Aab	0,4158 Abc	0,1113 Ac	0,7321
DMS	0,3225 Ca	0,266 Aa	0,4567 Aa	0,3060 Aa	0,3378
DP	0,1456 Ca	0,2329 Aa	0,1968 Aa	0,2652 Aa	0,2101
Means	1,2289	0,6913	0,3544	0,2114	

*Means followed by the same letter, lowercase within a line and uppercase within a column, do not differ by the Tukey test at 5% probability.

IHS: irrigated pasture with high stocking rate; DHS: dryland pasture with high stocking rate; DMS: dryland pasture with moderate stocking rate; DP: degraded pasture.

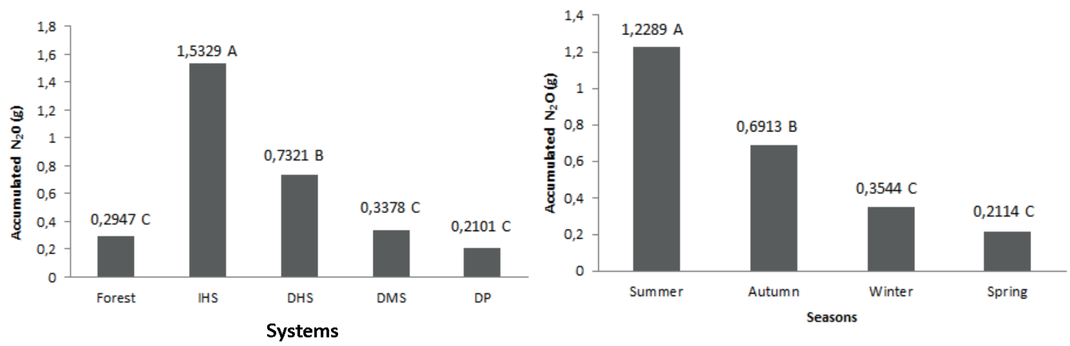

Figure 1. Accumulated N_2O emission* (g) in different beef production systems, and forest, during the four seasons of 2014.

*Means followed by the same letter do not differ by the Tukey test at 5% probability.

IHS: irrigated pasture with high stocking rate; DHS: dryland pasture with high stocking rate; DMS: dryland pasture with moderate stocking rate; DP: degraded pasture.

Conclusions

Nitrous oxide emissions were low in the tropical pastures, independent of the intensification level.

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