AP 28 Can the inclusion of high tannin forage legumes in native grasslands modify the N_2O emissions from cattle urine?

Alecrim F.B. [1,2], Simón C.[1], Mariotta J.[1], Santander D.[1], Muleta E.[3], Marchelli, J.P.[4], Lattanzi, F.A.[1], Alves B.J.R.[5], Nóbrega G.N.[2] y Ciganda V.S. [1]*

[1] Instituto Nacional de Investigación Agropecuaria (INIA-Uruguay), [2]Universidade Federal Fluminense (UFF-Brazil), [3]Jimma University (JU-Ethiopia),[4]Secretariado Uruguayo de la lana, [5]Empresa Brasileira de Pesquisa Agropecuária (Embrapa-Brazil)

*E-mail: vciganda@inia.org.uy

Estudio de mitigación de emisiones de N_2O de orina bovina en campo natural

Introduction

In Uruguay, agriculture and livestock contribute 73% of total national greenhouse gases emissions in carbon dioxide equivalents, requiring the adoption of mitigation strategies.

In this sense, studies have reported the inhibitory capacity of tannins on GHG emissions (Zhou *et al.*, 2019). These substances modify the partition of N in the animal, which can alter the composition of urine and the transformation of mineral N in the soil.

The objective of this work was to determine to what extent the inclusion of legumes with different tannin contents in native grasslands (NG) affect the N_2O emissions from beef cattle urine.

Materials and Methods

The experiment was conducted at the Research and Experimentation Center Dr. A. Gallinal, Uruguay. Urine was collected from beef heifers grazing pasture of NG and NG mixed with legumes of medium (4%) and high (6%) condensed tannin content: NG without legumes, NG with *Lotus uliginosus* cv E-Tanin (NG+LE), and NG with *Lotus subbiflorus* cv El Rincón (NG+LR), respectively.

A complete randomized block experiment was installed in NG with four treatments and four repetitions (16 plots). Thus, on each plot a stainless-steel closed static chamber was inserted in the soil for gas flux measurements. An area of 0.6 x 0.6 cm was established next to each chamber for soil sampling. Soil initial conditions were: pH = 5.5, Organic Carbon = 2.3%, total N = 0.23%, and bulk density = 1.2 mg/m^3.

The amount of 1 L of urine was applied into each plot, except in the control plots. Nitrous oxide fluxes were measured daily during the first five days after applying urine (Chadwick *et al.*, 2014). The N_2O concentrations in air samples were determined by gas chromatography. Soil samples were performed during a period of 120 days to monitor the concentration of soil nitrate (NO_3^-), ammonium (NH_4^+), water filled pore space (WFPS), whereas plant samples were collected for quantification of total N in the biomass.

All data were analyzed by normality test and ANOVA using the general linear mix model procedure of R (R Core Team).

Results and Discussion

The WFPS ranged from 15 to 87% during the evaluated period, with higher values on days 8 (54%), 57 (63%), and 62 (87%) after the application of urine, indicating the potential for denitrification. The concentration of NH_4^+ in the soil quickly increased after urine application (Figure 1A), with higher values from NG and NG+LR urine, respectively, compared to NG+LE urine (P<0.05). NO_3^- concentrations increased as NH_4^+ decreased (Figure 1A and B) and increasing WFPS from 15% to 55%, suggesting that nitrification was taking place.

On the other hand, NO_3^- and NH_4^+ in the soil can be uptaken by the plants, reducing the substrate for nitrification and denitrification. In this study, increased plant N concentration was observed in treatments receiving urine compared to the control (P<0.05), with the highest values detected after 67 and 80 days of the application of urine (Figure 1C) irrespective of urine source (P>0.05).

During the first five days after urine deposition, higher N_2O fluxes were observed in the treatments with urine compared to the control (Figure 1D). Among urine treatments, there was a trend towards lower N_2O fluxes from those whose urine came from cattle grazing the NG+LE and NG+LR pastures compared to NG.

Conclusions

Improving natural pastures using high tannin legumes is a promising management practice to reduce N_2O emissions from livestock production.

Reference

Zhou K, Bao Y y Zhao G (2019). Journal of Animal Physiology and Animal Nutrition. 103: 1675-1683.

Chadwick DR (2014). European Journal of Soil Science. 65:295-307.

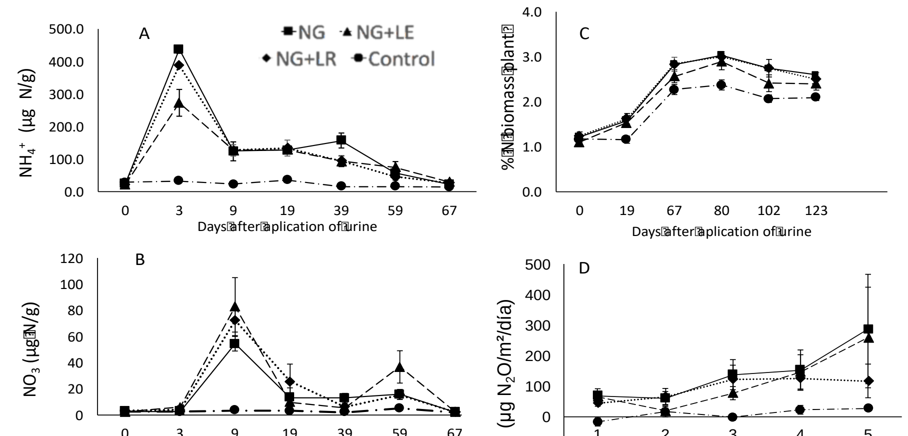

Figure 1. (A) soil ammonium (NH_4^+)- N content, (B) soil nitrate (NO_3^-)- N content, (C) N concentration in plant, and (D) Nitrous oxide (N_2O) emissions follow in urine beef cattle applications in native Campo grasslands.