Brachiaria humidicola grass reduces nitrous oxide emissions from bovine urine patches in soil under dry tropical conditions

Jonathan Nùñez[1], Ryan Byrnes[1,2], Laura Arenas[1], Catalina Trujillo[1], Carolina Alvarez [1,3], Idupulapati Rao[1], Ngonidzashe Chirinda[1] & Jacobo Arango[1]

[1]International Center for Tropical Agriculture (CIAT), A.A. 6713, Cali, Colombia. ⁎Corresponding author: j.arango@cgiar.org
[2]Department of Land, Air and Water Resources, One Shields Avenue, University of California, Davis, CA 95616, United States of America
[3] National Institute of Agriculture Technology (INTA), EEA Manfredi, Ruta Nac. 9, Km 636, Manfredi, Córdoba, Argentina. CP: 5988

Jacobo Arango

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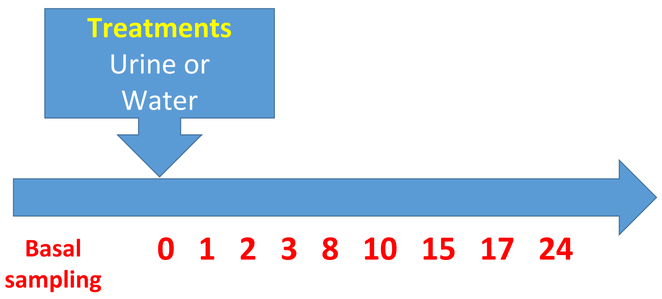
Aim

- High nitrogen (N) content in bovine urine results in the formation of hotspots of N loss when urine is deposited on grazed pasture soils.
- Exudates from the roots of tropical forages such as *Brachiaria humidicola* inhibit the activity of soil microbial nitrifies (biological nitrification inhibition-BNI), thus reducing ammonium oxidation and, consequently, nitrate and N_2O production.
- We hypothesized that N_2O emissions from urine patches deposited on soils under forages with high BNI capacity are lower than those on soils under forage species with low BNI capacity.
- To test the hypothesis, field plots with two forage cultivars, *Brachiaria humidicola* c.v Tully (BT) and *Brachiaria* hybrid cv. Mulato (BM) which have low and high BNI capacity respectively, were selected from a long-term field experiment (10 years) at CIAT, in Colombia.
- Over a 1 month period nitrifier activity and nitrous oxide emissions were measured under water and bovine-urine treatment.

Photo *Brachiaria humidicola* in the Eastern Plains of Colombia

Materials and methods



Soil and gas sampling days after urine or water application

Treatments:

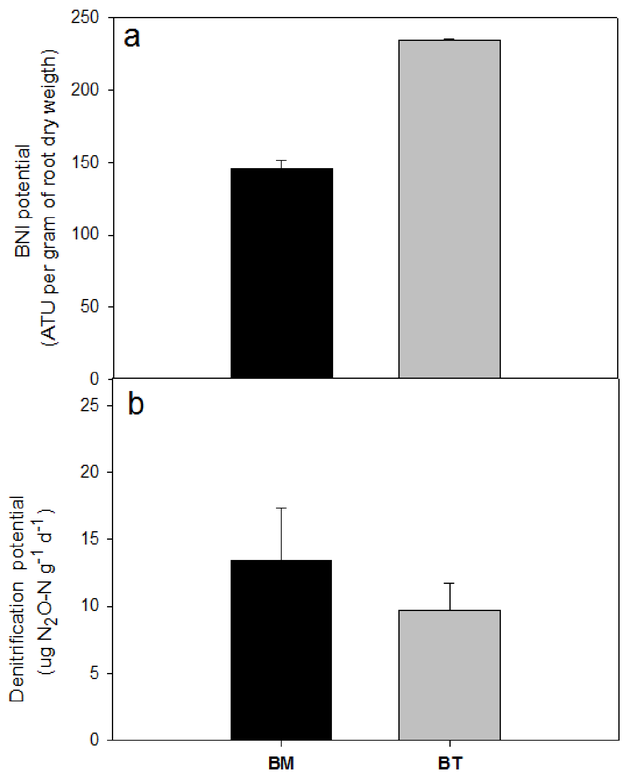
1. *Brachiaria humidicola* cv. Tully (BT, high BNI) + urine
2. *Brachiaria humidicola* cv. Tully + water
3. *Brachiaria* hybrid cv. Mulato (BM, low BNI) + urine
4. *Brachiaria* hybrid cv. Mulato + water

Differences in the rhizosphere zone transforming ammonium to nitrate (Nitrification)

Parameters evaluated

- Soil inorganic nitrogen (ammonium and nitrate)
- Potential nitrifier and denitrifier activity
- Nitrous oxide gas emission

Results



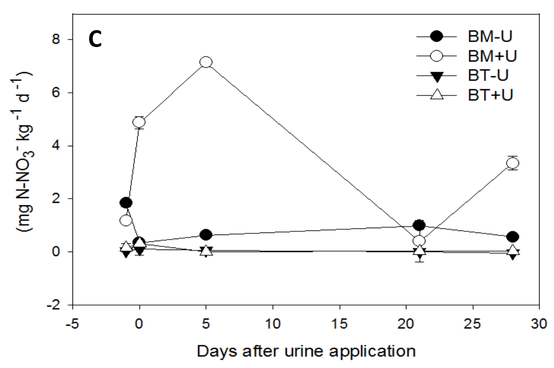


Figure 1. A) Root tissue BNI potential, **B)** Denitrification potential from rizospheric soil, **C)** Soil nitrification potential from rizospheric soil. BT: *Brachiaria humidicola* c.v Tully; BM: *Brachiaria* hybrid cv. Mulato. -U: No urine (water treatment). +U: Urine treatment.

Soil nitrification rates (NR) and denitrification potential (DP) were evaluated through laboratory assays conducted using soils from the selected field plots. Bovine urine in BM plots induced higher NR compared to water treatment and BT. Differences in the BNI potential and DP was confirmed according to previous studies (Subbarao *et al*., 2009)

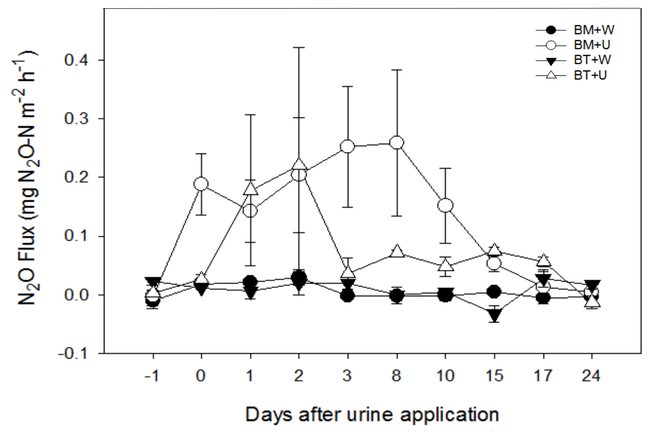


Figure 2. Soil nitrous oxide fluxes after applying urine or water. BT*: Brachiaria humidicola* c.v Tully; BM: *Brachiaria* hybrid cv. Mulato. -U: No urine (water treatment). +U: Urine treatment.

Bovine urine resulted in higher cumulative N_2O fluxes from soils under BM (153 mg N_2O -N m^2) compared to those under BT 679 (63 mg N_2O -N m^2). Consequently, N_2O emissions were higher for soils under BM (0.05%) than under BT (0.02%).

Conclusion

Our results demonstrate that, under tropical conditions N_2O emissions from bovine urine patches can be regulated by selecting forages with the ability to inhibit nitrification process in soil, postulating the use of these Brachiaria grasses as a climate change mitigation strategy.

Acknowledgments

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CONTACT Dr. Jacobo Arango
j.arango@cgiar.org

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