Nitrogen fluxes in *Urochloa*-based pasture soils in the northwestern Amazon

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1. Introduction

Unfertilized grass monocultures with extensive grazing management dominate pastures in Colombia's Caquetá region. These practices contribute to significant nutrient losses, particularly nitrogen (N).

Pasture's N supply could be improved by the inclusion of legumes in pastures (Homem et al. 2021, Thomas, 1992) or grasses with capacity of biological nitrification inhibition (BNI) (Subbarao et al., 2013).

Understanding soil N cycling is key to develop strategies that improve sustainability of Amazon pastures' management.

Figure 1. *Urochloa* pasture in the Caquetá region, Colombia

2. Objective

To quantify major soil N fluxes in *Urochloa*-based farmers' pastures in the northern Caquetá region of Colombia.

3. Methods

Pasture treatments (n):

- *Uh: Urochloa humidicola* grass alone (6) and grass-legume (6)
- *Ud: Urochloa decumbens* grass alone (3) and grass-legume (3)
- *Ub: Urochloa brizantha* grass alone (3) and grass-legume (3)

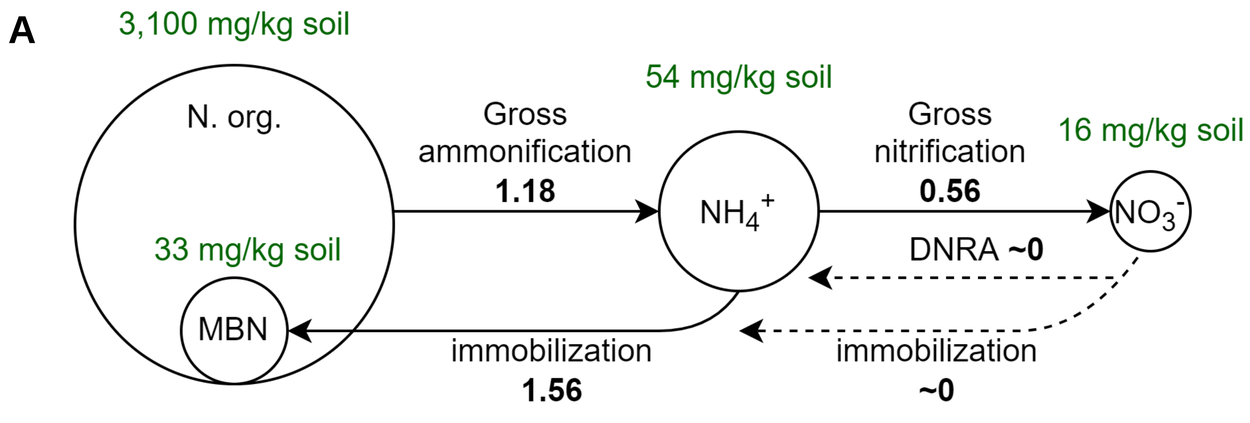
BNI capacity Uh > Ud > Ub (Subbarao et al., 2007)

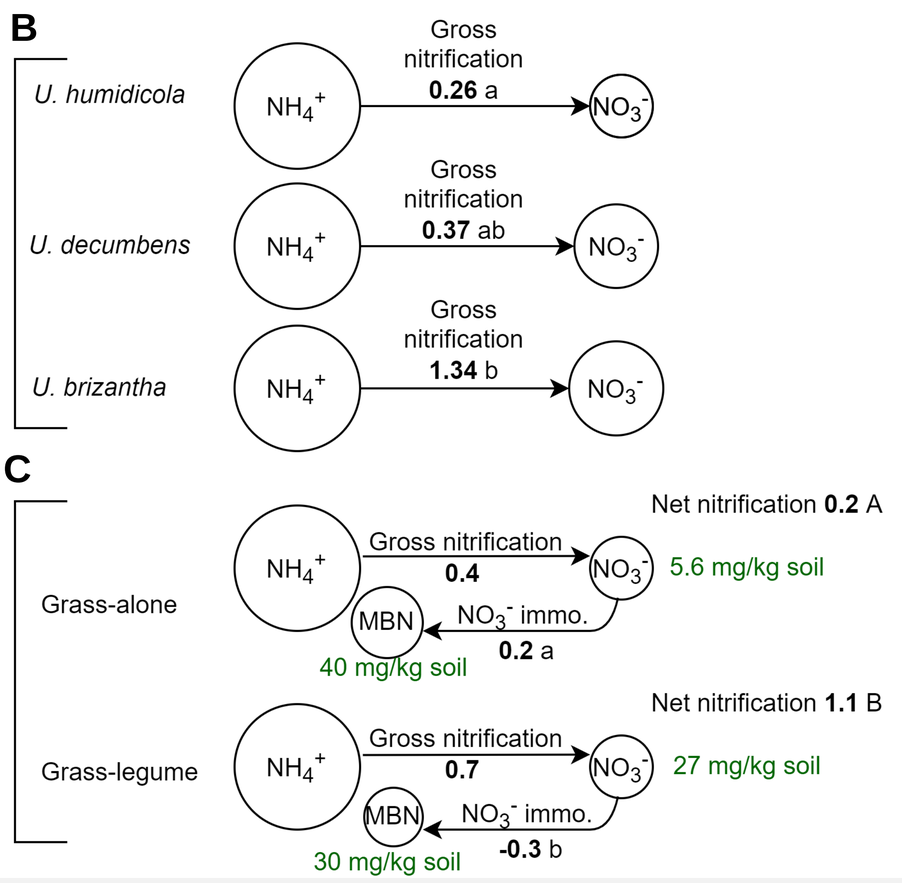
Methods:

- Topsoil sampling (0-20 cm), sieved at 4 mm and pre-incubated.
- Soil incubation at 25°C at 60% of soil water-holding capacity (96 h after ^{15}N labelling of NH_4^+ and NO_3^- pools).
- ^{15}N pool dilution method for gross N fluxes determination (Di et al., 2000).

4. Results

Figure 2. A. Average soil N transformation rates for 24 pasture plots in Caquetá, Colombia. **B.** Gross nitrification rates per grass species. **C.** Net nitrification rates per pasture type. Rate values followed by different letters in panels B and C denote statistical differences according to Tukey's test (α=0.05). Pool sizes were provided for B and C panels only when significantly different between treatments.





Circles denote N pools and arrows N transformation processes. Green text indicates pool sizes in **mg/kg soil** and black text process rates in **mg N/kg soil/day**.
MBN: microbial biomass N. DNRA: dissimilatory nitrate reduction to ammonium.

5. Conclusions

- Soils under *U. humidicola* pastures exhibited 80% lower gross nitrification rates than *U. brizantha*, likely due to the capacity of biological nitrification inhibition (BNI) (Subbarao et al., 2009).
- Net nitrification was higher in grass-legume pastures due to lower NO_3^- immobilization compared to grass-alone pastures.

6. References

Di, H. J., Cameron, K. C., & McLaren, R. G. (2000). Soil Research, 38(1), 213-230.

Homem, B. G., de Lima, I. B. G., Spasiani, P. P., Guimarães, B. C., Guimarães, G. D., Bernardes, T. F., ... & Casagrande, D. R. (2021). Nutrient Cycling in Agroecosystems, 121(2), 167-190.

Subbarao, G. V., Rondon, M., Ito, O., Ishikawa, T., Rao, I. M., Nakahara, K., ... & Berry, W. L. (2007). Plant and Soil, 294, 5-18.

Subbarao, G. V., Nakahara, K., Hurtado, M. D. P., Ono, H., Moreta, D. E., Salcedo, A. F., ... & Ito, O. (2009). Proceedings of the National Academy of Sciences, 106(41), 17302-17307.

Subbarao, G. V., Sahrawat, K. L., Nakahara, K., Rao, I. M., Ishitani, M., Hash, C. T., ... & Lata, J. C. (2013). Annals of botany, 112(2), 297-316.

Thomas, R. J. (1992). Grass and forage science, 47(2), 133-142.

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