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Gross Nitrogen Transformation Rates Do not Support Previously Described BNI Capacities of Selected *Brachiaria* Genotypes

Eduardo Vazquez[1], Nikola Teutscherová[2], Mirjam Pulleman[3], Michael Dannenmann[4], Klaus Butterbach-Bahl[4], Paul Töchterle[4], Jacobo Arango[5]

[1] *Universidad Politécnica de Madrid, Dept. of Agricultural Production, Spain*
[2] *Czech University of Life Sciences Prague, Fac. of Tropical AgriSciences, Dept. of Crop Sciences and Agroforestry, Czech Republic*
[3] *Wageningen University and Research, The Netherlands*
[4] *Karlsruhe Institute of Technology, IMK-IFU, Germany*
[5] *International Center for Tropical Agriculture (CIAT), Colombia*

Abstract

Nitrification is one of the key processes leading water contamination and greenhouse gas emissions in the form of N_2O in pasture systems. As vast areas of tropical pastures are considered nitrogen (N) limited, grasses from the *Brachiaria* genus have adapted to reduce N losses and increase N use efficiency by releasing substances capable of biological nitrification inhibition (BNI) in the rhizosphere. Although the release of BNI compounds and its impact on N_2O emissions and net nitrification rates in soil have been studied, the impact of BNI on gross nitrogen transformation rates have not been addressed, despite its relevance to mechanistic understanding of this phenomena. Using intact soil cores and ^{15}N dilution technique we evaluated gross N transformation rates in five *Brachiaria* genotypes, including high (CIAT-679, CIAT-16888 and Bh08–1149) and low BNI (Mulato hybrid and CIAT-26146) accessions. Two experimental plots, one established 14 and one 5 years ago were used, located in areas with contrasting soil types of Colombia were used.

Contrary to our expectations, gross nitrification was not lower in soil covered by the high-BNI than in low-BNI genotypes. Surprisingly, gross nitrification rates in the long-term plot were higher under CIAT-16888 compared to Mulato. However, in the long-term plot, the high-BNI CIAT-16888 soil exhibited the highest gross ammonification rates and immobilisation of both ammonium and nitrate, when compared to other genotypes. Similarly, in the medium-term plot, CIAT-16888 and Bh08–1149 (considered high-BNI) showed higher ammonium immobilisation rates than both low-BNI genotypes (Mulato and CIAT-26146). Nevertheless, the relative microbial N retention, i.e. the ration of microbial immobilisation and microbial production of inorganic N, was not affected by *Brachiaria* genotype at any of field locations studied.

Our results suggest, for the first time, that BNI capacity may not be due to a suppression of the gross nitrification rates but to higher N immobilisation rates, which could equally explain lower net nitrification rates and N_2O emission previously described in fields under high-BNI genotypes. The N immobilisation could lead to temporal N storage and reduce N availability to leaching or gaseous losses.

Keywords: N immobilisation, N mineralisation, nitrification, tropical grassland

Contact Address: Eduardo Vazquez, Universidad Politécnica de Madrid, Dept. of Agricultural Production, Av. Puerta de Hierro, 2, 28040 Madrid, Spain, e-mail: eduardo.vazquez@upm.es