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Feeding the Competitors – The Role of Heterotrophic N Immobilisation in Regulating Soil Nitrifier Activity

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Abstract

Biological nitrification inhibition (BNI) has been conceptualised as a plant exerted regulation of soil nitrifier activity as a result of production and release of allelochemicals via the root. The tropical forage grass *Brachiaria humidicola* (Bh) has gained attention due to its remarkable BNI activity. Inconsistencies between the BNI ratings obtained by means of different methodological approaches led to the question whether low net nitrification rates solely originated in reduced gross nitrification rates or not rather in a plant facilitated heterotrophic microbial N consumption/immobilisation. Aim of the presented work was to determine which of both possible strategies would be the dominant under field conditions and under which edaphic environment Bh would most efficiently reduce net nitrification. For this purpose, a two-factorial pot trial with the factors "soil texture" and "Bh genotype" was conducted at CIAT headquarters (Cali, Colombia). Net nitrification rates were assessed via *in situ* monitoring of soil nitrate evolution using micro-suction cups. Growth response of both ammonia-oxidising archaea (AOA) and bacteria (AOB) to ammonium fertilisation was estimated by quantifying the respective amoA genes prior and 14 days after fertilisation. Microbial N immobilisation was calculated based on encountered microbial biomass N (Nmic) before and 14 days after fertilisation. Soil texture revealed a significant influence on net nitrification rates ($p < 0.05$) and nitrifier community abundances ($p < 0.0001$), both increasing with clay content. $^{AOA}/_{AOB}$ abundance confirmed the allelopathic activity of Bh with a strong tendency for reduced growth response of both nitrifying populations under the previously high BNI ranked genotype in all soils ($p = 0.0532$). However, the observed suppression of nitrifier growth did not translate into lower but rather coincide with higher topsoil nitrate concentrations (net nitrification rates). As nitrifier growth response to N shall theoretically be a robust indicator for their metabolic activity, this discrepancy was mainly attributed to differences in subsequently immobilised nitrate by heterotrophic microbes. The latter hypothesis is currently being validated via respective Nmic analysis. So far, it can be concluded that rather heterotrophic N immobilisation, but not allelopathic inhibition of nitrifiers is the major reason for low net nitrification rates encountered in Bh pastures.

Keywords: Allelopathy, biological nitrification inhibition, *Brachiaria humidicola*, intermicrobial competition, N cycle

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