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Biological Nitrification Inhibition (BNI) Potential of the Tropical Pasture Grass Megathyrsus Maximus

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Abstract

Modern agricultural systems have a low nitrogen (N) use efficiency due to rapid nitrification driving huge N losses to the environment which cannot be uptaked by plants. Previous studies have demonstrated the ability of some plants to exudate chemical compounds to the soil reducing the activity of nitrifier microbes. Megathyrsus maximus is a tropical grass recognised for its high productivity, nutrition quality and stocking capacity, traits that make it a suitable pasture for sustainable intensification of livestock in the tropics. With the aim to assess the Biological Nitrification Inhibition (BNI) potential of M. maximus, we evaluated a germplasm population of 119 accessions at greenhouse conditions through measurement of: i) nitrification potential of soil; ii) nitrous oxide emissions; iii) abundance of ammonia-oxidant microbes; iv) BNI potential of root tissue through the bioassay and iv) forage quality. This study presents the first evidence of significant nitrification inhibition capacity of M. maximus in a plant-soil system and its effect in reducing nitrous oxide emissions. The population assessed achieved reductions between 30–70 % in soil nitrification compared to the bare soil control, finding some genotypes with higher inhibition capacity than *Brachiaria humidicola* (the highest reported before). Similarly, it was found a significant inhibitory effect of M. maximus root extract on nitrite production in recombinant Nitrosomonas europaea assay. However, discrepancies were found between BNI potential of the genotypes and nitrification in soil, possibly due to differences in stability and releasing mechanisms of BNI compounds by roots. The abundance of nitrifier archaea was negatively correlated with the BNI potential, suggesting an inhibitory effect of BNI compounds on the structure of soil microbial communities. Otherwise, no correlation was found between soil nitrification and N content in the plants (productivity and protein). Possibly, higher differences between genotypes in N uptake and utilisation would be observed in more limiting conditions, since BNI has been proposed to evolve as a strategy to conserve this nutrient in low N environments. BNI potential found in M. maximus and other tropical grasses is a trait that could be genetically improved through breeding to add environmental services to new climate-smart cultivars for sustainable livestock production.

Keywords: Climate change, Nitrifier microbes, Nitrogen use efficiency, Plant-soil interaction

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