Tropentag, September 18-21, 2016, Vienna, Austria

"Solidarity in a competing world — fair use of resources"

Climate-Smart Crop-Livestock Systems for Smallholders in the Tropics: Regulation of Nitrification in Soil by *Brachiaria humidicola* Hybrids

Jacobo Arango[1], Danilo Moreta[1], Jonathan Núñez[1], Ashly Arevalo[1], Hannes Karwat[2], Manabu Ishitani[1], John Miles[1], Margaret Worthington[1], Michael Peters[1], Joe Tohme[1], Mario Cuchillo Hilario[1], Stefan Burkart[1], Ngonidzashe Chirinda[1], Glenn Hyman[1], Jesus Martinez[1], Jeimar Tapasco[1], Michael Selvaraj[1], Paola Pardo[1], Mauricio Efren Sotelo Cabrera[1], Rein van der Hoek[3], Martín Mena[3], Alvaro Rincón[4], Reynaldo Mendoza[5], Marc-André Sparke[2], Konrad Egenolf[2], Guntur Subbarao[6], Georg Cadisch[2], Idupulapati Rao[1]

[1] *International Center for Tropical Agriculture (CIAT), Colombia*
[2] *University of Hohenheim, Inst. of Agricultural Sciences in the Tropics (Hans-Ruthenberg-Institute), Germany*
[3] *International Center for Tropical Agriculture (CIAT), Nicaragua*
[4] *Corporación Colombiana de Investigación Agropecuaria (Corpoica), Colombia*
[5] *Univesidad Nacional Agraria, Suelos, Nicaragua*
[6] *Japan International Research Center for Agricultural Sciences (JIRCAS), Japan*

Abstract

Poor management of nitrogen (N) applied as fertiliser to agricultural systems results in massive loss of N due to a rapid nitrification process in soil, posing serious environmental and economic constraints. The N is lost in the form of nitrate through leaching which contaminates water and in the form of nitrous oxide (N_2O) to the atmosphere causing global warming. Tropical forage grass, *Brachiaria humidicola* (Bh), exudates from its roots chemical compounds that inhibit nitrification in soil and this characteristic is known as Biological Nitrification Inhibition (BNI). The BNI technology represents a smart alternative to mitigate climate change by using N more efficiently in agropastoral systems and this technology was the centre of focus for a four years (March 2012 to December 2015) interdisciplinary project work in Colombia and Nicaragua funded by GIZ-BMZ (Germany) and led by the International Center for Tropical Agriculture (CIAT) in collaboration with the University of Hohenheim, Corpoica and the University of Llanos in Colombia and MIS-UNA consortium in Nicaragua. The major findings of this project were: 1) Using phenotyping methods developed for the BNI trait, high genetic diversity was found among Bh hybrids suggesting BNI as a quantitative trait; 2) High saturated linkage maps were developed and minor QTLs identified for BNI using a bi-parental mapping population; 3) Through participatory agronomic evaluation with farmers in Colombia and Nicaragua, promising Bh hybrids were identified that combine the BNI capacity with superior forage production and nutritional quality; 4) The residual BNI effect in soil was evaluated in maize as subsequent crop, observing an improvement in the N use efficiency as well as an increase in maize grain yields; and 5) Using a modelling approach (EcoCrop model), potential areas

Contact Address: Jacobo Arango, International Center for Tropical Agriculture (CIAT), Tropical Forages, A A 6713, NA Cali, Colombia, e-mail: j.arango@cgiar.org

to use the BNI technology around the world were identified and an economic analysis of this technology was made for its use in agropastoral systems. Results obtained from this project together with previous research highlight the potential of Bh as a climate-smart forage grass with several desirable attributes (e.g., adaptation to problem soils and climate variability; deep and vigorous root system to accumulate large amounts of carbon in soil).

Keywords: *Brachiaria humidicola*, climate change, Livestock, nitrogen, nitrogen use efficiency