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"Bridging the gap between increasing knowledge and decreasing resources"

Developing Climate-Smart Crop-Livestock Systems for Smallholders in the Tropics through Regulation of Nitrification in Soil

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Abstract

It is widely recognised that crops use less than 50 % of applied nitrogen (N) fertiliser, and the estimated economic value of this "wasted N" globally is US$90 billion annually. Worse still, this "wasted N" has major effects on the environment. CIAT researchers and their collaborators in Japan reported a major breakthrough in managing N, benefiting both agriculture and the environment. Termed "Biological Nitrification Inhibition" (BNI), this is a mechanism by which certain plants naturally inhibit the conversion of N in the soil from a stable form of ammonium to a mobile form of nitrate and a potent greenhouse gas, N_2O. *Brachiaria humidicola* (Bh) is well adapted to the low-nitrogen soils of South American savannahs and has shown high BNI-capacity among the tropical grasses tested. The major nitrification inhibitor released from Bh is brachialactone, a cyclic diterpene. Reduction of N loss from the soil under a Bh pasture has a directly beneficial environmental effect. We hypothesise that conservation of soil N will have additional positive impact on a subsequent crop (e.g., maize). Presently, recovery of fertiliser N and the impact on crop yield is not known. The goal of our interinstitutional and multidisciplinary project, targeting small-scale farmers, is to develop the BNI innovative approach using Bh forage grass hybrids to realise sustainable economic and environmental benefits from integrated crop-livestock production systems.

The project started in March 2012 and we intend to report the major achievements from the following outputs of the project.

1. Rural livelihood benefits enhanced by involving small-scale farmers as decision makers and co-researchers in the integration of new Bh hybrids in smallholder crop-livestock systems.

2. Bh hybrids with different levels of BNI identified.

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3. Quantitative trait loci (QTL) associated with the BNI trait identified and molecular markers developed for Bh hybrid selection.

4. Indicators of BNI activity developed for use under field conditions based on the role of BNI in improving the efficiency of utilisation of fertiliser N while reducing N_2O emissions from agricultural production systems.

5. Application domains of BNI technology in crop-livestock systems identified, potential economic benefits assessed and local capacity to evaluate BNI strengthened.

Keywords: *Brachiaria*, molecular markers, nitrogen use efficiency, nitrous oxide emissions, participatory evaluation