Rice: Increasing Agronomic NUE in Flooded and Rain-fed Rice Production

Production Systems: Rice growth is strongly influenced by the use of synthetic fertilisers but only 30-40% of reactive nitrogen (N) added onto rice is converted into harvested products (Doberman et al. 2002). Despite significant losses of reactive and non-reactive N forms (Bouman et al. 2007), little is known about the impacts on GHG emissions and N leaching in the Brazilian tropics. In this research theme we will focus on two key rice production systems: (1) For flooded rice appropriate management of soil fertility is vital for production systems sustainability. N is key for the development of leaf plant area, photosynthesis, and consequently yield (Fageria and Stone, 2003). The current recommendation for the application of N is around 100 kg ha^{-1}, in delivered in two to three applications however there is a lack of synchronization between the timings of N application. One strategy to increase the synchronization between N-supply and demand and to reduce N-losses via denitrification or leaching is slow release N (Shoji et al, 2001) testable using the technology implemented in this research theme; (2) Upland rice can be produced as part of an integrated crop-livestock system (ICL) that combines annual crop production and livestock grazing. Utilising an established trial at the Federal University of Goias, N_2O emissions can be monitored real-time in situ. The ICL rotation is composed of 3.5 years of Brachiaria pasture and 2.5 years of annual crops including soybean, rainfed rice and maize intercropped with *Brachiaria*.

Pathogens: Maranhão state is the biggest rice producer in Northeastern Brazil, but contrary to the national trend of increasing rice output, productivity in Maranhão has stagnated or declined in recent years (CONAB, 2013). Rice productivity is affected by the occurrence of various diseases influenced by factors such as climate, cultivars and seed quality, and, most conspicuously, a lack of effective measures of pathogen control. The main diseases affecting rice cultivation are: rice blast (*Magnaporthe oryzae*), rice brown spot (*Bipolaris oryzae)* and grain spots (such as *Fusarium)*. Rice blast is one of the main factors affecting rice productivity in Brazil, both in upland and flooded systems, making it difficult to express the potential cultivar yield (Lobo, 2008). Plant growth-promoting rhizobacteria *(*PGPR) can be used in integrated management with fungicides. Luz (2003) found rice seeds treated with different combinations of *Paenibacillus macerans* and difenoconazole significantly reduced the incidence of diseases such as *Fusarium graminearum*. This combined effect of growth promotion and plant disease control illustrates the importance of research to use these microorganisms as part of agricultural crop management strategies**.**

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