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Effect of Rice Farming's Water Saving Managements on Greenhouse Gas Emissions and Micronutrient Availability in Philippine Paddy Soils

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Abstract

The main challenge for global rice research and development for long-term sustainability as well as climate change adaptation is to find ways to reduce emission of greenhouse gases and limit micronutrient deficiency in soils using less water. This greenhouse pot study investigated the effects of water saving irrigation management (CF-continuous flooding, MSD-mid-season drainage and AWD-alternate wetting and drying) in rice farming on GHG emissions and micronutrient availability in three farmer's field in the Philippines (S1-Bay, Laguna, S2-Ubay, Bohol and S3-Sagbayan, Bohol). The impacts of water management among three soil types on different soil parameters were investigated, namely: soil Eh and pH, N_{min} (nitrogen mineralisation), DOC (dissolved organic carbon), soil temperature, VWC (volumetric water content). The impacts of water management among three Philippines soils in plant parameters were also investigated namely: plant height, no. of leaves, tiller count and fresh weight biomass.

The evolution of soil Eh, ph, N_{min} and DOC over one rice-growing season under different water managements in three soils followed expectable trends except Nmin. The soil Eh were significantly different among water managements but not in the three soils used. CF and MSD water treatments maintained negative soil Eh values throughout the season compared to positive soil Eh values in AWD treatments, which fluctuates as a respond to irrigation.

The soil parameters: soil Eh, pH, N_{min} and DOC, were all interrelated to each other. They were linked directly and indirectly to the GHG emissions from paddy soils that may had affected the biochemical processes in water and soil treatments. Methane emission increased when the soil was flooded (low Eh) and decreased when the soil Eh became positive. Nitrous oxide showed opposite findings compared to methane emissions. AWD emitted more nitrous oxide gas compared to CF as well as MSD. Based on the results of this study, water saving management affects the CH_4 and N_2O gas emission in three Philippine paddy soils. CH_4 emission rates were significantly higher in the CF for all three soils and AWD yielded the lowest emissions throughout the experiment, but not significantly different than that of MSD.

Keywords: Climate change, greenhouse gases, rice, soil micronutrients, water-saving

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