Tropentag, September 11-13, 2024, hybrid conference

"Exploring opportunities …
for managing natural resources and a better life for all"

Fertiliser management effect on rice growth and CH_4 emissions in lowland paddy rice in Madagascar

Lalaina Andrianarijaona[1], Andry Andriamananjara[1], Tantely Razafimbelo[1], Manoa Arifetra Raminoarison[1], Michel Rabenarivo[1], Yasuhiro Tsujimoto[2], Aung Zaw Oo[2]

[1] *University of Antananarivo, Lab. des Radioisotopes, Madagascar*

[2] *Japan International Research Center for Agricultural Sciences, Crop, Livestock, and Environment, Japan*

Abstract

Rice fields are a major source of CH_4 emissions, a potent greenhouse gas responsible for 0.6°C of global warming. Recent rice intensification and expansion in Africa have contributed to the rise in CH_4 emissions, which account for 7 % of global emissions. In Madagascar, rice is a staple food and the third largest rice producer in Africa. However, rice production is still limited in fulfiling the entire population's needs due to low soil nutrient availability. Conventional organic amendments and mineral fertilisers can enhance soil nutrients and rice growth. However, fertiliser management can stimulate CH_4 production by providing a carbon source for the CH_4-producing bacteria. The potential CH_4 emissions from fertiliser management in a tropical context are not well known. To assess the effect of fertiliser management on CH_4 emissions and rice production, a pot experiment with farmyard manure (FYM: 10 t ha^{-1}), P-broadcasting (60 kg P ha^{-1}), and control (no fertiliser), and a field experiment with FYM (10 t ha^{-1}) and N:P:K (45:45:45 kg ha^{-1}) were conducted. In the pot experiment, low rice growth under control resulted in low rice yield and CH_4 emissions. Meanwhile, FYM and mineral fertiliser significantly increased CH_4 emissions by 84.8 % and 71 %, respectively, compared to the control. Compared to FYM, mineral fertiliser reduced CH_4 emissions by 7.47 % while increasing grain yield two fold. Field experiments further confirmed that mineral fertiliser had lower CH_4 emissions (133.4 kg ha^{-1}) than FYM (185.3 kg ha^{-1}). However, rice yield increase by mineral fertiliser over FYM was minimal (0.27 t ha^{-1}) and not significant. In both experiments, high CH_4 emissions under FYM would mainly be attributed to the high carbon input into the flooded rice fields, which is a major carbon substrate for methanogenic bacteria in CH_4 production. The results also showed that mineral fertiliser significantly reduced greenhouse gas intensity (CH_4 emissions per unit grain yield) compared to FYM due to low CH_4 emissions while improving rice yield. In conclusion, mineral fertiliser application decreased CH_4 emissions while increasing rice productivity, illustrating its environmental and agronomic potential in climate change mitigation and food security.

Keywords: Fertiliser management, greenhouse gas intensity, methane, nutrient deficient soils , rice yield

Contact Address: Lalaina Andrianarijaona, University of Antananarivo, Lab. des Radioisotopes, Lot iie 8bis ae Ambohimirary Route d'Andraisoro, Antananarivo, Madagascar, e-mail: lalaina.andrianarijaona@gmail.com