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Biogas Sludge Reduces Aluminium Toxicity and Improves Tubers Performance on Acid Sulphate Soil of the Mekong Delta

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Abstract

In the rice-based systems of the Mekong Delta in Viet Nam, there is a trend towards replacing the traditional rice double cropping with a rotation of wet season rice and dry season upland crops (vegetables and tuber crops). However, in the prevailing acid sulphate soils, the build-up of excessive concentrations of exchangeable aluminium (Al^{3+}) during the aerobic soil phase is strongly limiting upland cropping to few relatively Al-tolerant tuber crops that farmers grow on raised beds to enhance Al^{3+} leaching process. The use of organic amendments can reportedly increase soil pH and plant available P, while decreasing the concentration of active Al^{3+} throughout the formation of non-toxic Al-DOM complexes or the formation of humic complexes with Al and Fe. This research studied the performance of major tuber crops (cassava, sweet potato and yam) in relation to soil exchangeable Al^{3+} concentration and as affected by the application of locally produced biogas sludge. Experiments were conducted on three farmers? fields at the Hoa An research station of the University of Cantho, Viet Nam on a typical acid sulphate soil. Observation plots were laid out on raised beds and were categorised based on the initial exchangeable Al^{3+} content of the topsoil in classes of <10, 10–15, and >15 meq Al^{3+} 100^{-1} g. Biogas sludge was applied at 3 Mg ha^{-1} (dry matter) to tuber crops and compared with an unamended control. Soil total acidity and exchangeable Al^{3+} were determined from KCl extracts after subsequent NaOH and NaF titration, respectively. Dry biomass accumulation, tuber yield, and nutrient uptake by 12-week-old crops were compared. Biogas sludge tended to reduce soil exchangeable Al^{3+} concentrations but significantly increased the tolerance to given Al concentrations with higher tuber yield and P uptake in all tuber crops. However, Al-tolerant cassava showed stronger responses to amendment than Al-sensitive yam. We conclude that in the absence of soil liming, the application of organic wastes can improve the performance of Al-tolerant wile permitting the cultivation of more Al-sensitive crop on acid sulphate soils. Further research aims at identifying most appropriate substrate types and application rates for specific acid soil conditions and crop tolerance levels.

Keywords: Active aluminium, *Dioscorea* sp., *Ipomoea patatas*, *Manihot esculenta*, *Oryza sativa*, Viet Nam

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