Evaluation of Residue Management in Irrigated Rice-based Systems of the Mekong Delta

Background

Agricultural land use in the Mekong Delta is dominated by intensive irrigated rice double and triple cropping on alluvial and acid sulphate soils.

A generally observed decline in productivity is linked to a low N use efficiency and soil organic matter content on the alluvial soils (An Binh site).

Crop production is constraint by nutrient imbalances such as aluminum toxicity and P deficiencies on the acid sulphate soils (Hoa An site).

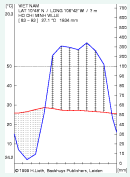
Recently, the cultivation of higher-value cash crops in aerobic soil during the dry season has been emerging.

Organic substrates from decentralized waste/water management are widely available but are unlikely to be applied to lowland rice.

However, they may help alleviate the problems of low soil organic matter content and Al toxicity, particularly in the high-value upland crops, grown in rotation with rice.

Materials and Methods

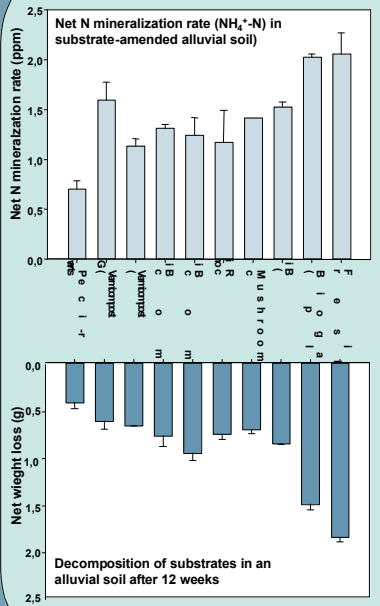
Geographical location:
105 43'40'' E and 10 00'05'' N.
Monsoon climate, dry season between December and April.



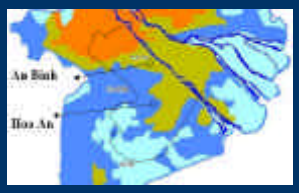
Alluvial soil:
Silty clay (57% clay, 34% Silt, 9.0% Sand).
pH: 4.9 – 5.1, C org.: 3.7 – 3.9 %, N tot.: 0.14 – 0.17 %.
Acid sulphate soil:
Silty clay (44% clay, 55% Silt, 1.0 Sand).
pH: 3.3 – 3.5, Al^{3+}:37 mg $100g^{-1}$, P available: 1.2 – 2.5 mg $100g^{-1}$.
Laboratory experiments:
Anaerobic N mineralization (NH_4^+ in amended soils with different substrates) in the dark at 30 – 35 °C for three weeks. Weekly NH_4^+ content was analyzed after KCl extraction by colorimetry. Organic substrates decomposition (weight loss) was determined by weight loss from litter bags after 12 weeks.

Field experiments:
1. Comparison of substrates: Unamended control, pig manure – rice straw compost, biogas sludge from cement tank, biogas sludge from plastic tank, biogas compost, champost, rice straw compost, vermicompost from pig manure, vermicompost from goat manure, fish pond residue (1. 3 Mg ha^{-1}). RCBD, 4 Reps, *Vigna radiata* as test crop.
2. Comparison of application rates: Biogas sludge applied at 0, 1.5, 3, 4.5, 6, 7.5, and 9 Mg ha^{-1}. RCBD, 4 Reps, *Vigna radiata* as test crop.
3. Comparison of test crops: Biogas sludge applied 3 Mg ha-1 . Seven test crops (tubers – yam, cassava, sweet potato; legumes – mungbean, cowpea, soybean; vegetables – tomato, sweet corn.

Alluvial Soil



N mineralization of substrate-amended soil (upper) and weight loss from litter bags (lower)



Mineralization patterns of organic substrates are affected by substrate quality and soil type.

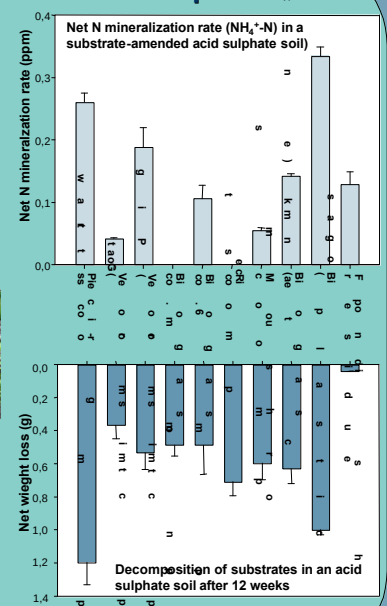
Organic substrates differentially affect crop biomass with biogas sludge showing largest effects.

Mungbean production increased significantly with substrate application rates.

Cowpea and mungbean responded more to substrate application than tubers or vegetables.

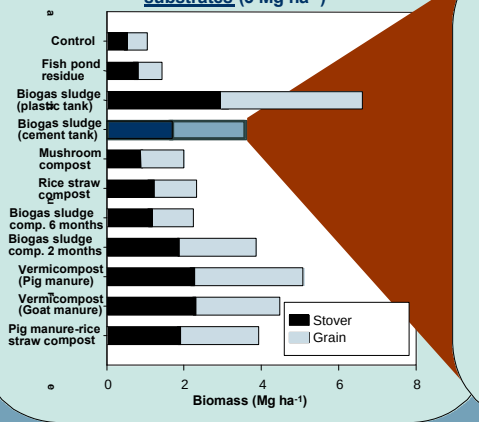
These results are seen to guide nutrient cycling from decentralized waste/wastewater treatment in the Mekong Delta.

Acid Sulphate Soil

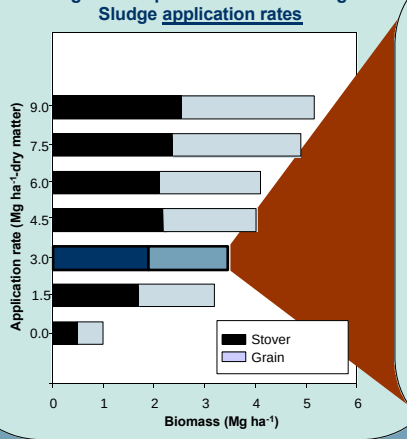


N mineralization of substrate-amended soil (upper) and weight loss from litter bags (lower)

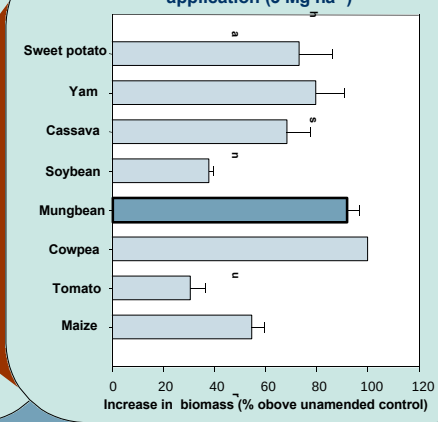
Mungbean response to different organic substrates (3 Mg ha^{-1})



Mungbean response to different Biogas Sludge application rates



Crops response to Biogas Sludge application (3 Mg ha^{-1})



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Closing Nutrient Cycles by the Use of Organic Substrates from Decentralized Water Management

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