Effect of Liquid Digestate of a Biogas Plant Using Rice Straw, as Biofertilizer In Paddy Rice Cultivation in Comparison with Mineral Fertilizer in Tien Giang Province, Vietnam

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Introduction

In South East Asian countries is a gap between demands of organic material for improving the soil fertility and the sources or technologies to provide such material. Appropriate fertilization is very important for sustainable environmental friendly agriculture, in particular in paddy rice cultivation as the main agricultural crop. Therefore, mineral fertilizers should be partly replaced with organic fertilizers, e.g. by using of liquid digestate of biogas plants. There is a big potential by using rice straw residues in biogas plants for producing of electricity. In the period until 2020 could be produced 94.2 million MWh/year from rice straw and 18.5 million MWh/year from rice husk. Beside manure, increasingly rice straw should be used mixed with other crops or cow dung in biogas plants. First model experiments in 2017 showed there are possibilities to replace the mineral fertilization method by the use of digestate. The aim of this experiment was to show the possibility to use liquid digestate based on rice straw, as organic fertilizers for cultivation of paddy rice under typical conditions of paddy rice cultivation.

Material and Methods

The research based on experimental pilots with three treatments
1. 100% Mineral fertilizer (MF)
2. 100% Organic-fertilizer (OF)
3. 50% Mineral – 50% Organic fertilizer)

The treatments were differentiated based on the amount of nitrogen, whereas the basic was 55 N kg/ha.

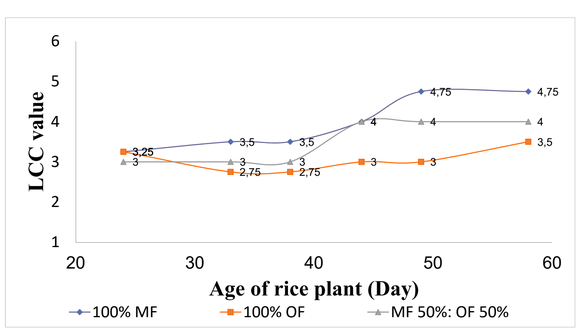
The size of one field plot was 9 m², every treatment with 3 repetitions.

The parameters collected include:
- Leaf's Color Chart (LCC) method.
- The height of the paddy rice plant
- The length of the paddy rice inflorescences
- Number of branches on rice inflorescence
- The number of seeds
- The marketable rice grains

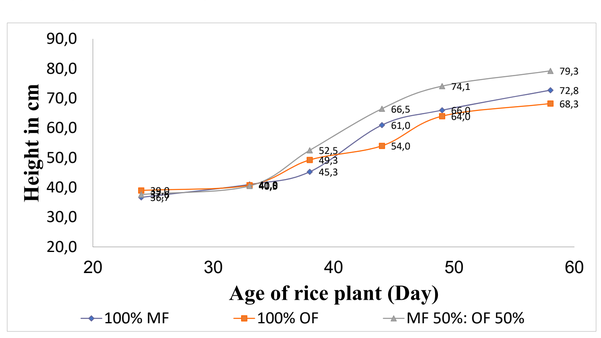
Results

Parameters of the yield			
Parameter	Treatment		
	100% MF	100% OF	MF50%:OF50%
Length of paddy rice inflorescences (cm)	20.05 ± 1.80 a	24.25 ± 1.56 b	20.72 ± 1.13 a
Number of branches on paddy rice inflorescences	8.85 ± 0.86 ab	8.76 ± 0.91 a	9.80 ± 0.83 b
Number of seeds on paddy rice inflorescences	92.65 ±15.57 a	80.03 ± 17.26 a	94.93 ± 13.94 a
The marketable rice grains (%)	92.64 ± 1.39 a	88.55 ± 4.01 a	91.48 ± 0.82 a

Different letters indicate significant difference among treatments (Tukey-test, P≤0.05)

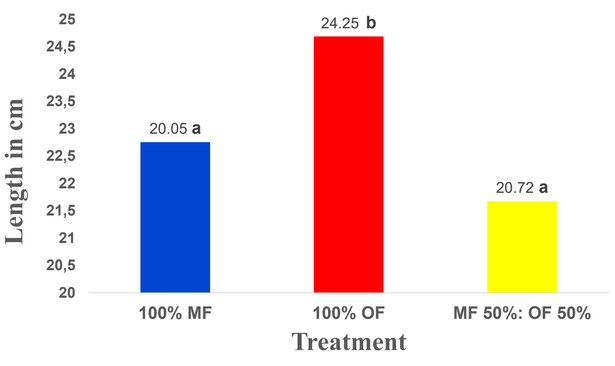


Leaf's Color Chart for paddy rice using the 6 panel IRRI LCC

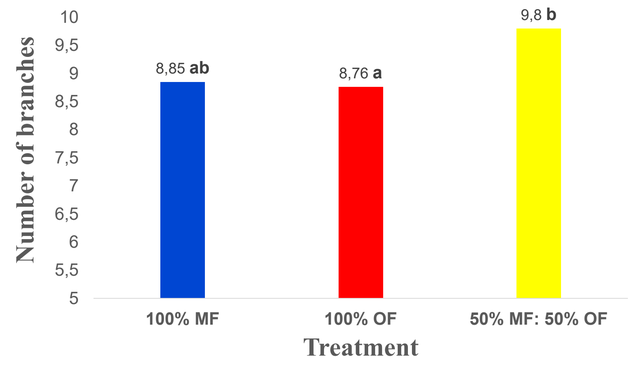


Height of the paddy rice plants

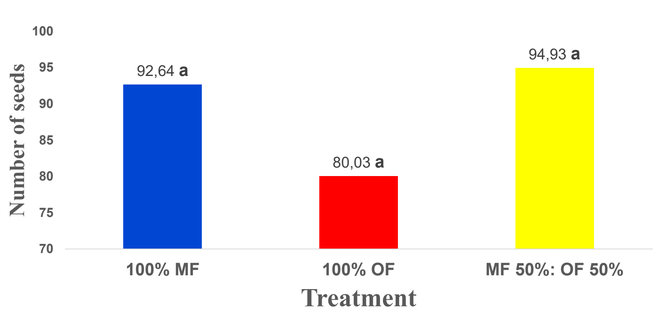
Characteristics of liquid waste from biogas tank	
Parameter	Value
N (%)	0.11
K (%)	0.15
P (%)	<0.06
Organic (%)	6.37
pH	7.78



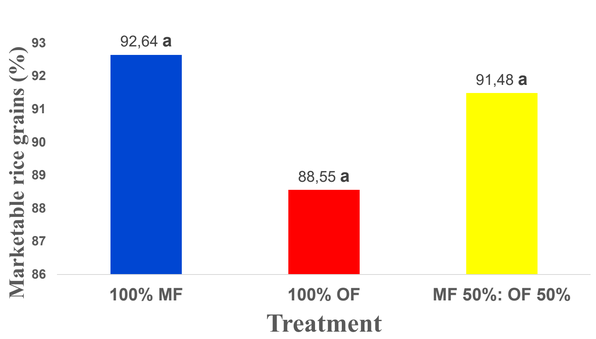
Length of the paddy rice inflorescences
Tukey-Test p<0.05, n=10



Number of branches on paddy rice inflorescences
Tukey-Test p<0.05, n=10



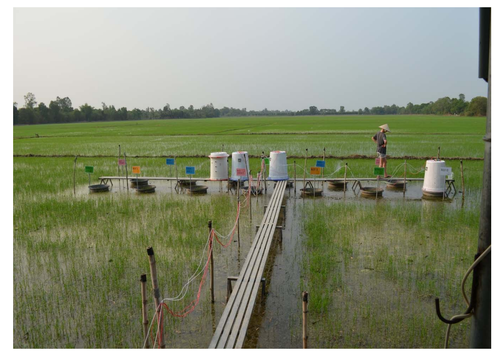
Number of seeds on rice inflorescences
Tukey-Test p<0.05, n=10

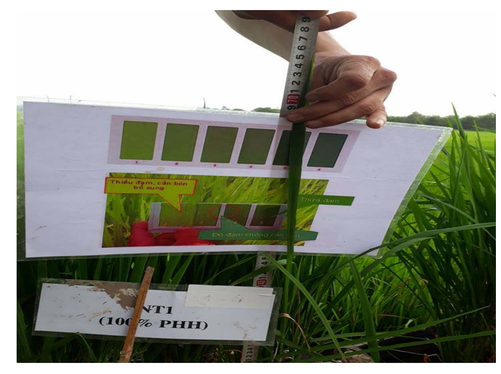


Marketable rice grains
Tukey-Test p<0.05, n=10

Comments to the results

- Using 100% digestate as OF or 50% mixed with MF no deficiency of Nitrogen for growth of paddy rice plants was detected.
- The length of rice inflorescence was significant higher in the treatment 100% OF
- The number of branches and number of seed are significant higher if 50% OF and 50% MF was used.
- Nevertheless, marketable rice grains were higher with 100% MF, but no significant difference to the other treatments. This result is difficult to explain, further analyses are necessary.





Conclusions

The highest length of was determined in the treatment 2 in comparison to other treatments, but their marketable yield was lowest comparison to other treatments, probably it was a deficiency of potassium. The yield of treatment 3 (MF: OF 50:50) was similar to control treatment (100% MF).

It can be concluded it is possible to replace mineral fertilizer in rice cultivation to some extent with biofertilizer as for example with digestate from biogas plants.

Further experiments regarding the amount of biofertilizer, the frequency of application and their dosage, as well the influences of the microbial activity in the soil are necessary