リター・コンポストと水分管理が砂質土壌の理化学性と水稲生産に及ぼす効果
Effect of Forest Litter Compost and Moisture Regimes on Sandy Soil and Rice Growth

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1. Introduction

There is considerable concern that, if soil organic matter concentrations in soils are allowed to decrease too much, then the productive capacity of agriculture would be compromised by deterioration in soil physical properties and by impairment of soil nutrient cycling mechanisms. The objectives of this study were to identify the effect of forest litter compost and moisture regimes on some physico-chemical properties of sandy soil reclaimed from a mountain and rice growth.

2. Materials and Methods

Pot experiments were conducted on forest litter compost bought from the market and applied at the following rates namely; M_0 (Control), M_1 (5t/ha), M_2 (10t/ha), M_3 (15t/ha), and M_4 (20t/ha). Four moisture regimes imposed on the experiments included; 1) Continuous Flooding or submergence throughout the cropping period (W_0), 2) Maintaining Field Capacity throughout the growing season (W_1), 3) Alternate Flooding for eight weeks and Field Capacity for the rest of growing season W_2), and 4) Alternate Flooding for 4 weeks, field capacity for 4 weeks followed by another 4 weeks flooding and 4 weeks field capacity (W_3). The field capacity of soil in each pot was determined before transplanting 30 days old rice seedlings The experiment had a 4x5 factorial arrangement in a randomized complete block (RCB) design with 3 replications. Rice plants growth at 15, 43, 57, and 71 days after transplanting measured included plant height, tillers, booting, above and below ground biomass, and yield. Total carbon (C) and total nitrogen (N) as well as C/N ratio were using a High Sensitive NC Analyzer (NC-95A). The physical properties measured included pF, permeability, bulk density and aggregate distribution.

3. Results and Discussion

Organic matter had a great significance difference on the agronomic parameters as shown in table 1. Mo and M1 gave significantly higher grain yield and harvest index than M2, and M3. The table shows that the agronomic parameters measured decreased with increasing amount of organic matter.

Table 1. Effect of Organic Matter on Agronomic Parameters and Permeability(K)

Manure Rate	Grain Yld (kg/ha)	Biomass (kg/ha)	Piant ht (cm)	Harvest Index (%)	K cm/s
M0	2412.2	10498.0	47.1	18.4	$1.59x10^{-3}$
M1	2131.3	9084.0	43.0	18.9	$1.84x10^{-3}$
M2	1915.5	8071.0	39.5	19.2	$2.82x10^{-3}$
M3	1352.1	6990.0	35.0	15.8	$2.38x10^{-3}$
M4	1463.4	7129.0	34.5	15.9	$2.3x10^{-3}$
LSD 0.05	466.0	798.8	2.1	2.5	$4.77x10^{-4}$

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This may be due to serious immobilization of N in the litter compost during decomposition process in the soil. On the other hand no significant differences were observed with moisture regime treatments on the agronomic parameters as shown in table 2. Rice is a water loving plant and everything being equal the crop will do well once there is adequate water. It is therefore clear that all the moisture regimes provided enough water for the crops hence the non-significance in the various parameters. Significance differences in soil total carbon under organic matter treatments could be observed at both initial and final stages of growth as shown in table 3. Regarding total nitrogen, significance difference could be observed at the initial stage while no significance difference was observed at the end of growth period. However the C/N ratio showed no significance difference at both growth stages. Table 4, shows that total carbon, total nitrogen and C/N ratio showed no significant differences under various water regimes.

Table 2. Effect of Water Regime on Agronomic Parameters and Permeability (K)

Water Regime	Grain Yld (kg/ha)	Biomass (kg/ha)	Piant ht (cm)	Harvest Index (%)	K cm/s
W0	1773.5	8274.0	41.4	16.9	$2.18x10^{-3}$
W1	1882.4	8203.0	38.3	18.4	$2.27x10^{-3}$
W2	1852.1	8363.0	38.3	18.0	$2.11x10^{-3}$
W3	1911.5	8578.0	41.3	17.2	$2.19x10^{-3}$
LSD 0.05	NS	NS	NS	NS	NS

Table 3. Changes in TN and TC under various Compost application rates

Organic Matter	Total Nitrogen (g/kg)		Total Carbon (g/kg)		C/N Ratio	
	Initial	Final	Initial	Final	Initial	Final
M0	0.01	0.22	0.10	0.19	10.00	0.86
M1	0.09	0.13	2.23	2.54	24.78	19.54
M2	0.17	0.21	4.75	4.86	27.94	23.14
M3	0.32	0.33	8.59	8.11	26.84	24.58
M4	0.49	0.39	13.53	9.22	27.61	23.64
LSD 5%	0.13	NS	4.01	1.75	NS	NS

Table 4. Changes in TN and TC under various water regimes

Water Regime	Total Nitrogen (g/kg)		Total Carbon (g/kg)		C/N Ratio	
	Initial	Final	Initial	Final	Initial	Final
W0	0.21	0.18	6.07	4.28	28.90	23.78
W1	0.25	0.21	6.71	4.68	26.84	22.29
W2	0.21	0.23	5.67	5.36	27.00	23.30
W3	0.18	0.40	4.90	5.62	27.22	14.05
LSD 5%	NS	NS	NS	NS	NS	NS

The improvement in soil physical properties as a result of build up of organic matter supplied increased total pore space, water stable aggregates and hydraulic conductivity of the soil. On the other hand, water regimes had no significance on the measured soil physical properties and agronomic parameters but had effect on C and N as shown in table 4.

4.Conclusion

The forest litter compost used could improve the soil physical properties in all treatments. However there was little or no effect on the chemical and agronomic parameters. The C/N ratio of the compost was around 27.4. Where C and N are the available quantities, a C/N ratio of 20 has been widely accepted as the upper limit at which there is no danger robbing the soil of N. Hence with high C/N of the compost immobilization of N might have caused the poor rice growth performance. When soils are brought under submerged conditions, some soil- fertility-related chemical properties change as compared to those under aerobic conditions. Nitrogen requirements of microorganisms that decompose organic matter in flooded soils are lower than for decomposers in aerated soils. However water regimes seemed to have no significant effect in the agronomic parameters measured after 16 weeks of the experiment.