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Research Paper

Effects of rice husk and cassava mill effluent compost on upland rice cultivation in Delta State, Nigeria

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Abstract. Low rice yields in Nigeria are attributed to poor soil fertility. Inorganic fertilizers used to improve soil fertility are expensive and not readily available. This work aimed at evaluating the nutrient potential of rice husk and cassava effluent compost for production of rice in Abraka, Delta State, Nigeria. Four formulations were made with rice husk (RH) and cow dung in ratio 7:3 by weight using water and cassava effluent [RH with water (RH), RH + cow dung with water (RHCd), RH with cassava effluent (RHC), RH + cow dung with cassava effluent (RHCdC)] and were applied at 2.5, 5 and 10 t/ha with control. Rice seeds were sown for two years in a randomized complete block design. Residual effects were monitored in the third year. Plant height (PH), leaf area (LA), dry matter (DM) and rice grain yield (GY) were measured as well as soil samples were taken for post-cropping analysis. Data were analyzed with ANOVA at $\alpha_{0.05}$. The results revealed that treatment RHCd at 10 t/ha had highest PH and LA while RHCdC at 10 t/ha produced the highest DM and GY in both years and in residual study. Treatment RHCdC at 10 t/ha had the highest soil pH value, organic carbon and RHCd at 10 t/ha had the highest total nitrogen at harvest in second year. Both treatments increased soil nutrients at harvest than other treatments and improved soil fertility.

Keywords: Soil amendment, cow dung, organic fertilizer, rice yield, Abraka.

INTRODUCTION

Cassava (*Manihot esculenta* Crantz) is a tuberous crop with high water content and when processing into other food products, it generates large volume of liquid. This is because, it is now an importance cash crop to the people of Nigeria and the largest produced crop in the world (Adeniji *et al*., 2005). The liquid is known as effluent is discharged carelessly without treatment into immediate surroundings because smallholder processors dominated the enterprises most especially in Abraka, Delta State (Akpoveta and Osakue, 2012). This has affected the soil negatively by reducing the microbial population and retarding crop germination and growth due to its high cyanogenic content in the effluent that increases soil pH (Izah *et al.*, 2018). The effluent causes serious soil pollution mostly at high concentration and it is been disposed indiscriminately within the processing vicinity. The effluent contains high percentage of cyanogenic glucoside (Akinrele, 1995) that is toxic to both plants and animals.

Processing the high quantities of cassava that are produced in Nigeria generates large volume of effluents. As at 2016, cassava production was put at 57 million tons and over 70% of the total production was used to processed garri (Pind, 2011). One tons of the cassava tuber can generate about 150 kg of effluent (Izah, 2018). This shows that high quantities of effluent are generated annually in Nigeria. Cassava production rose from 32 M ton in 2010 to 57 M ton in 2016 with corresponding increase in effluent generation that was put at 5.1 ton in 2016 (Izah, 2018). Effluent management is one of the difficult challenges facing agriculturist since it cannot be eliminated (Adewumi *et al*., 2016). Large quantities of the effluent are produced in rural communities by poor farmers due to rapid expansions of the processing mill in the areas, this has accounted for large quantity of effluent in the environment (Okechi *et al*., 2011).

Literature shows effectiveness of cassava effluent application on soil properties (Okechi *et al*., 2011). Controlled use of the effluent as soil amendment was reported by Okechi *et al*. (2011) to improve soil organic carbon and plant nutrients. It is pertinent to develop low cost technology that can efficiently use cassava effluent, cow dung and rice husk to formulate compost. This will contribute to waste management and at the same time produce organic fertilizer that can be used to amend the soil. The effluent contains plants nutrients in relative proportions that can be used to improve the declining soil fertility (Orji and Ayogu, 2018).

Composting is a biological process that converts raw organic materials into a humus-like product. The process transforms raw and toxic organic wastes into biologically stable, humic substances (Pamola and Donna, 2009). If the effluents are used for compost making, it will help to mitigate the negative effect caused by the accumulations. With the abundant cassava mill effluents in cassava processing plant sites, it is important to consider its use for compost making especially now that its potentials have not been fully utilized.

Rice husk is readily available residue in many rice producing communities. They are also underutilized. Rice production was estimated at 600 million ton per year and about 20% of the weight is rice husk and about 80% of the rice husk is made of organic matter (Ogbo and Odo, 2011). This can serve as good source of soil organic matter when it is used for compost. Rice husks are either burnt or dumped in the immediate surrounding creating environmental hazard. Agricultural use of cassava effluent and rice husk to formulate compost can be uses as organic fertilizer. Hence, this research focuses on the use of cassava effluent for rice husks compost formulation. Therefore, the objective of this study was to assess the potential of rice husks and cassava effluent compost for upland rice production in Abraka, Delta State, Nigeria.

MATERIALS AND METHODS

Description of experimental site

The experiment was conducted at the Agricultural Education Experimental Farm, Abraka Campus, Delta State University. The site is also situated in the rainforest zone of Nigeria, with longitude 6° 00' E & 6°15’ E and latitude 5°45′N & 5° 50' N. The soil of Abraka is an Ultisol, classified as Psammatic paleudults (Akamigbo, 2001). Meteorological data of the experimental site are: average precipitation 4.51 mm/day and temperature was 25.8°C while average Isolation was 19.5% (Nigeria Meteorological Center, 2017).

Preliminary work

Clearing and bed preparation were carried out manually with simple farm tools (cutlass, hoe and spade), and all debris were removed. Soil samples were taken at 0 to 30 cm with soil auger randomly and were bulk to form one composite sample for initial routine analysis.

Materials used

New Rice for Africa (NERICA) 1 variety commonly cultivated in the region was obtained from West Africa Rice Development Agency Division (WARDA), IITA, Ibadan, Oyo State, Nigeria. Composts prepared with rice husk, cow dung and cassava effluent, were used as nutrient sources. Mosquito and fishing nets were used to fence the site against rodent attack.

Compost formulation

Rice husk and cow dung in ratio 7:3 by weight was used according to Adeoye *et al*. (2005) and the components of the composts were combined in heaps in three replicates. Polythene was used to line the ground to prevent leakage of water and cassava mill effluent. On the first day, twenty seven (27) liters of water was used to mix 42 kg of rice husk and 18 kg of cow dung (RHCd), while thirty five (35) liters of water was used to mix 60 kg of rice husk (RH). The same amount of cassava mill effluent (27 liters) was used for 42 kg of rice husk and 18 kg of cow dung (RHCdC) and thirty five (35) liters water were used for 60 kg of rice husk (RHC). At three days intervals, the composts were turned and mixed manually with ten (10) liters of water and cassava mill effluent in the first ten days. Thereafter, six (6) liters of water or cassava mill effluent was added at each turning for twenty one (21) days. The total amount of water/cassava mill effluent used for the 42 kg of rice husk and 18 kg of cow dung was eighty one (81) liters while eighty nine (89) liters of water/cassava mill effluent was used for 60 kg of rice husk in each heap. The composts were allowed cure for 12 weeks before application on the field. Daily temperature of the composts was taken to monitor the composting rate. Table 1 shows the nutrient composition of the composts and materials used. The fresh rice husk was grind and 20 g was soaked with 10 ml of distilled for 24 hours before the pH was taken.

1. Fresh rice husk (60 kg) with water (RH), 2. Fresh rice

Table 1. Analysis of organic materials and the four compost types in the study.

Organic fertilizer and materials	pH	OC	N	P	K	Ca	Mg	C/N
		g/kg		mg/kg	cmol/kg			
Rice husk	6.5	543	5.9	4.6	4.9	3.9	4.1	92.0
Cow dung	7.1	233	16.1	31.0	6.0	7.5	7.1	14.5
Cassava effluent	5.2	210	13.4	23.0	7.4	7.1	6.6	15.7
RH compost	6.6	462	7.9	4.3	1.2	3.8	3.5	58.5
RHC compost	6.7	404	6.2	4.6	10.4	3.8	2.7	65.2
RHCd compost	7.2	369	6.1	4.7	11.5	21.3	3.2	55.9
RHCdC compost	7.1	334	7.6	3.7	20.5	3.5	3.4	44.0

Legend: Rice husk with water (RH), Rice husk + Cow dung with water (RHCd)
Rice husk with cassava mill effluent (RHC)
Rice husk + cow dung with cassava mill effluent (RHCdC)

husk (42 kg) + Cow dung (18 kg) with water (RHCd), 3. Fresh rice husk (60 kg) with cassava mill effluent (RHC), 4. Fresh rice husk (42 kg) + cow dung (18 kg) with cassava mill effluent (RHCdC).

Field trials

Each of the compost was applied at 0 (control), 2.5, 5.0 and 10.0 t ha^{-1} were replicated four times. The composts were spread and incorporated into the soil with hoe and spade during bed preparation a week before sowing. Seven seeds were sown per hole and later thinned to four stands two weeks after sowing. The experiment was carried out in two years, June, 2015 and 2016 at the same location while residual soil nutrients were evaluated in the third year (2017).

Treatments were:

T1 = control (Without compost application)

T2 = 2.5RH	T6 = 5 RH	T10 = 10 RH
T3 = 2.5 RHC	T7 = 5 RHC	T11 = 10 RHC
T4 = 2.5RHCd	T8 = 5 RHCd	T12 = 10 RHCd
T5 = 2.5RHCdC	T9 = 5 RHCdC	T13 10 RHCdC

Experimental design

It was laid out in a Randomized Complete Block Design (RCBD). The plot size was 38 m by 18 m, demarcated into four replicates that measured 38 m by 3 m, each subplot size being 2 m by 3 m. Replicates were spaced 2 m apart while subplots were separated by 1 m apart. The spacing of 25 cm by 30 cm was used.

Data collection

Data on growth were collected three weeks after sowing and weekly basis while yield were assessed at the harvest. Representative soil samples were taken from each subplot and were bulked to form one composite sample according to the treatment for post-harvest soil analysis in each year. Plant height (cm), plant girth (cm), leaf area (cm^2), number of tillers per plant while the yield parameters assessed were: dry matter yield (t ha^{-1}) and rice yield (t ha^{-1}). Particle size distribution, soil pH, organic matter, total N, available P, K, Ca, Mg, Na, ECEC, exchangeable acidity and base saturation were also measured.

Laboratory analysis

Soil samples were analyzed in Analytical Laboratory, IITA, Ibadan. Particle size distribution was according to Bouyoucos (1951). Soil pH was determined in a 1:2 soil-water suspension. Organic carbon was according to Walkley Black Method (Walkley and Black, 1934). Exchangeable bases were extracted using 1 N ammonium acetate extracting solution. Potassium and Na were read with flame photometer and Mg and Ca were read with Atomic Absorption Spectrophotometer (Jackson, 1964). The available P was extracted according to Bray-1 (Bray and Kurtz, 1945). Total nitrogen was determined by macro-Kjeldahl method of Jackson (1962). Exchangeable acidity was determined to Black (1975).

Statistical analysis

Data were analyzed with analysis of variance while treatment means were separated using Duncan Multiple Range Test (DMRT) at 5% level of probability.

RESULTS

Particle size analysis and chemical properties of pre-planting soils

The nutrient content of the soil before planting are shown in Table 2. The soil was sandy clay loam. The soil pH was 5.0, total nitrogen was low while available P was

Table 2. Particle size analysis and chemical properties of pre-planting soils.

Parameters	Values
pH (H_2O) 1:2	5.0
O M (gkg^{-1})	15.4
Total N (gkg^{-1})	6.3
Available P ($mgkg^{-1}$)	7.0
Exchangeable bases ($cmolkg^{-1}$)	
K	0.3
Mg	1.3
Ca	1.2
Na	0.1
Exch. Acidity	0.6
ECEC	3.5
Base saturation (gkg^{-1})	829
Particle size (gkg^{-1})	
Sand	680
Silt	90
Clay	230
Textural Class	Sandy clay loam

moderate. Exchangeable bases were low, effective cation exchange capacity was also low but base saturation was high.

Growth and yield parameters

Plant height

There were significant differences except at 3 and 4 weeks after sowing (WAS) in first year (Table 3). In first year, T4 had the tallest plant at 4 WAS, T13 had the tallest plant at 5, 6 and 7 WAS, while T12 had the highest at 9 WAS. In second year, T3 had the highest at 3 WAS. The T4 had the highest at 4 and 5 WAS and T13 had the highest at 6 and 7 WAS while T12 had the highest at 8 and 9 WAS.

Leaf area

Leaf area was significantly different except at 3 and 4 WAS in both years (Table 4). In first year, T4 had the highest leaf area at 5 and 7 WAS while T12 had the highest at 6, 8 and 9 WAS. In second year, the T4 had the highest leaf area at 3 and 4 WAS and T5 had the highest at 5 WAS while T12 had the highest at 6 to 9 WAS.

Number of tillers

In first year, T12 had the highest number of tillers while in second year, all the composts treatments significantly produced higher number of tiller than the control (Table 5).

Dry matter yield

Dry matter yield were significantly different in both years (Table 5). The T13 produced the highest dry matter yield in both years while the control (T1) had the least.

Rice yield

The treatments were significantly different in both years (Table 5). The T13 produced the highest rice yield while T1 produced the least in both years.

Residual effects

Plant height

There were significant differences and T12 had the highest plant height and was closely followed by T13 and T1had the least (Table 6).

Leaf area

Leaf area of treated plants were significantly different, T13 had the highest leaf area while T1 had the least.

Table 3. Effects of compost on above ground plants height (cm) of rice at successive weeks after sowing.

Treatments	Weeks After Sowing						
	3	4	5	6	7	8	9
2015							
T1	24.5	30.1	33.0b	36.5b	39.5f	42.9e	50.5g
T2	24.8	28.7	33.4b	38.6b	44.7de	52.1cd	56.8f
T3	23.3	26.1	24.1c	38.3b	45.3d	51.8cd	57.3f
T4	24.2	29.3	35.7a	42.3a	46.7cd	53.8c	60.3e
T5	24.5	27.8	33.5b	39.9b	45.7c	52.4c	60.1e
T6	24.8	27.8	33.1b	38.6b	45.5d	54.0c	60.7e
T7	24.6	28.4	32.8b	37.9b	45.1d	54.8c	60.7e
T8	24.5	29.1	35.3a	42.6a	51.4b	59.1ab	68.8c
T9	24.7	28.3	32.7b	41.5a	48.6c	58.3b	68.9c
T10	24.1	27.8	32.8b	40.1a	50.6b	56.8b	64.5d
T11	23.9	28.3	33.0b	43.8a	47.4c	56.6b	63.9d
T12	24.0	27.9	34.9ab	42.7a	54.5a	63.1a	74.5a
T13	23.3	27.5	36.1a	45.3a	54.9a	62.4a	70.3bc
2016	ns	ns					
T1	20.0d	25.8cd	30.0e	34.6e	36.9f	40.2f	58.0f
T2	26.6a	31.7a	35.8c	40.0c	46.8de	56.5d	62.3ef
T3	25.5bc	30.7a	36.7ab	37.7d	47.1c	52.9e	62.0ef
T4	25.0bc	32.6a	39.0a	43.3b	47.2cd	53.0e	63.1e
T5	24.0bc	26.8bc	33.4d	39.5c	45.1e	51.1e	63.0e
T6	26.4b	30.8a	35.5c	40.2c	47.6cd	56.4d	65.6de
T7	27.8a	31.0a	35.4c	37.3d	45.8e	55.9d	69.9c
T8	25.3b	32.4a	33.6d	43.5b	51.9b	60.1bc	68.9cd
T9	24.5c	28.5b	32.6d	41.9c	48.8c	58.2c	69.0c
T10	26.0ab	30.8a	35.2c	41.6c	52.7b	59.2bc	70.7c
T11	27.1a	30.4a	35.6c	43.2c	48.2c	57.7c	77.7b
T12	24.8c	31.2a	33.0d	43.6b	55.0a	64.2c	86.3a
T13	24.0c	29.3a	32.9d	45.3a	55.3a	62.9a	70.0c

Legend
T1 = control T5 = 2.5RHCdC T9 = 5.0RHCdC T13 10.0RHCdC
T2 = 2.5RH T6 = 5.0RH T10 = 10.0RH
T3 = 2.5 RHC T7 = 5.0RHC T11 = 10.0RHC
T4 = 2.5RHCd T8 = 5.0RHCd T12 = 10.0RHCd
ns = non-significant

Dry matter yield

Dry matter yield were significantly different. The T13 produced the highest while T1 produced the least.

Rice yield

The composts treatments were significantly different with while T13 produced the highest rice yield and T1 had the least.

Soil chemical properties after harvest

Soil pH

Treatments were not significantly different (Table 7). The T13 had the highest soil pH in first year while T4 had the highest in second year.

Organic matter

Soil organic matter contents of all the composts plot were not significantly different in first year (Table 7). The T12 had the highest organic matter in first year but in second year, T13 had the highest while T1 had the least in both years.

Total nitrogen

There was no significant difference in first year but in second year, there were significant differences. The T13

Table 4. Effects of composts on leaf area (cm^2) of rice at successive weeks after sowing

	Weeks After Sowing						
Treatments	**3**	**4**	**5**	**6**	**7**	**8**	**9**
2015							
T1	14.5	16.0	18.4c	21.2c	24.8e	28.3d	37.0g
T2	13.2	15.8	20.1b	24.8b	28.9d	32.7c	36.3g
T3	13.0	15.0	18.0c	22.1c	27.8d	31.5c	35.1g
T4	13.5	16.9	21.6ab	26.1a	37.4dcd	35.8c	39.9f
T5	13.2	15.8	20.2b	25.0ab	29.4bc	34.8c	39.7f
T6	13.2	16.0	20.0b	24.7b	30.8bc	35.3c	42.2de
T7	13.1	16.1	19.7ab	24.0b	31.0ab	34.6c	40.8e
T8	13.1	17.0	21.4ab	26.3a	32.1ab	38.1b	43.2d
T9	13.1	16.0	19.8b	25.1ab	31.1bc	38.8b	44.0c
T10	13.1	16.8	19.8b	25.5ab	32.0ab	39.1b	45.8bc
T11	12.4	14.8	18.5b	24.4b	31.1bc	37.5b	42.9d
T12	13.0	16.4	21.2ab	26.9a	33.9ab	42.9b	49.9a
T13	12.1	15.0	19.5b	24.7b	31.6bc	40.3b	45.3bc
	ns	ns					
2016							
T1	12.3	14.2	16.0c	18.8d	20.8e	23.4f	25.7f
T2	14.2	16.3	21.6ab	26.0a	31.0cd	34.5e	38.2e
T3	13.7	15.3	19.6	25.2bc	30.6d	33.0e	37.0e
T4	14.6	17.5	22.5a	27.7a	32.9bc	36.5d	41.3d
T5	13.5	16.8	23.1a	25.9bc	31.4cd	36.3d	42.7cd
T6	14.2	16.5	21.5ab	25.9bc	33.0bc	37.1d	44.8c
T7	13.8	16.9	21.3ab	25.4bc	33.8bc	37.1d	42.0cd
T8	14.2	17.6	22.3ab	27.9a	33.6bc	33.8e	44.8c
T9	13.4	17.0	21.7ab	26.0a	33.1bc	39.3cd	47.4b
T10	13.1	17.3	20.3b	26.7ab	34.1b	40.9bc	47.0b
T11	13.1	15.5	20.1b	25.8b	33.9b	40.0bc	49.5a
T12	14.0	17.0	22.1ab	28.5a	34.4ab	43.6b	51.9a
T13	12.4	16.0	21.3ab	25.6b	33.6bc	41.8b	48.7b
	ns	ns					

Means within each column with the same letters are not significantly different at $\alpha_{0.05.}$

Legend

T1 = control	T5 = 2.5RHCdC	T9 = 5.0RHCdC	T13 10.0RHCdC
T2 = 2.5RH	T6 = 5.0RH	T10 = 10.0RH	
T3 = 2.5 RHC	T7 = 5.0RHC	T11 = 10.0RHC	
T4 = 2.5RHCd	T8 = 5.0RHCd	T12 = 10.0RHCd	

ns = non significant

had the highest total N in first year while T12 had the highest in second year and T1 had the least.

Available phosphorus

The T12 had the highest available P content in first year while T13 had the highest in second year and T1 had the least in both years. Potassium contents in treated plots was significantly higher than in the control plot in both years, the T13 had the highest in first year while T11 had the highest in second year. Calcium contents in composts plots were not significantly different in first year but were significantly different in second year. The T13 had the highest in first year while T12 had the highest in second year. Magnesium content increased in both years and there were significant differences. The T12 had the highest Mg in first year while T13 had the highest in second year. The sodium content in treated plots was not significantly different in first year but there were significant differences in second year. The T12 had the highest in both years while T1 had the least in second year.

Table 5. Effects of compost on number of tillers, dry matter and yield of rice.

Treatments	First year			Second year			Average yield	
	Tillers	Dry matter	Rice yield	Tillers	Dry matter	Rice yield	Dry matter	Rice yield
T1	0f	3.13h	1.35f	0f	2.68h	1.09h	2.91k	1.22i
T2	2d	3.80g	1.57e	3.0c	4.20f	1.70fg	4.00j	1.64h
T3	2.6c	4.00f	1.63d	2.0d	4.51e	1.81fg	4.26h	1.72fg
T4	3.4c	4.19f	1.81c	3.0c	5.68cd	2.12e	4.94f	1.97de
T5	3.6c	4.40e	1.85c	3.0c	5.73c	2.18e	5.07f	2.02de
T6	3c	4.50e	1.89c	4.0b	5.56d	2.09d	5.03f	1.99de
T7	3.3c	4.64e	1.88c	5.0a	5.49d	2.18e	5.07f	2.03de
T8	3.8b	5.00d	2.09b	5.0a	6.88c	2.23d	5.94c	2.16de
T9	3.7b	5.50c	2.12b	3.0c	6.99c	2.30d	6.23d	2.56c
T10	4b	6.78b	2.09b	5.0a	7.04c	3.05c	6.91c	2.57c
T11	4.2b	6.85b	2.13b	5.0a	7.49b	3.33b	7.17b	2.73b
T12	4.8a	6.90ab	2.49a	5.0a	8.28a	3.53a	7.59b	3.01a
T13	4.7a	7.05a	2.54a	5.0a	8.61a	3.56a	7.83a	3.05a

Means within each column with the same letters are not significantly different at $\alpha_{0.05.}$

Table 6. Residual effects of composts applied on growth and yield of rice.

Treatments	Plant height (cm)	Leaf area (cm^{-2})	Number of tillers	Dry matter (t ha^{-2})	Grain yield (t ha^{-2})
T1	18.8e	20.3g	0f	2.72f	0.83i
T2	59.0d	32.4e	2.0de	3.52e	1.40g
T3	58.1d	32.1e	2.0de	3.62de	1.38g
T4	63.1c	35.1d	3.0cd	3.65de	1.05h
T5	64.9bc	36.2d	3.4cd	3.80d	1.69f
T6	63.8c	42.8c	3.0cd	5.42c	2.35d
T7	62.7c	42.2c	3.0cd	5.52bc	2.33d
T8	67.5b	46.3b	5.0ab	5.55bc	2.00e
T9	66.4b	47.4b	5.0ab	5.70b	2.58d
T10	70.6a	47.1b	4.0bc	7.47a	3.42b
T11	70.9a	53.8a	4.0bc	7.57a	3.40b
T12	72.8a	53.5a	6.0a	7.60a	3.07c
T13	71.2a	54.7a	6.0a	7.75a	3.77a

Means within each column with the same letters are not significantly different at $\alpha_{0.05.}$

Legend

T1 = control	T5 = 2.5RHCdC	T9 = 5.0RHCdC	T13 10.0RHCdC
T2 = 2.5RH	T6 = 5.0RH	T10 = 10.0RH	
T3 = 2.5 RHC	T7 = 5.0RHC	T11 = 10.0RHC	
T4 = 2.5RHCd	T8 = 5.0RHCd	T12 = 10.0RHCd	

Exchangeable acidity

T5 had the highest exchangeable acidity in both years.

Effective cation exchange capacity (ECEC)

In first year, T12 and T13 had the highest while in second year, T12 had the highest ECEC. Base saturation: The T12 had the highest in both years. (Figure 1)

DISCUSSION

As shown in the result, the site had low soil fertility, lead to higher response to the formulated composts. Growth rate was slow in early stages due to nutrient immobilization as observed by earlier reporters (Adeoye *et al*., 2005). As a result, no significant differences were observed in the growth parameters measured but as the week progresses, treated plant grow faster than the control. This shows evidence of mineralization taking

Table 7. Effects of compost on post-harvest soil chemical properties.

Treat	pH	OM	N	P	K	Ca	Mg	Na	EA	CEC	BS
		gkg1		mg/kg	cmolkg-1						g/kg
2015											
T1	5.1	2.0	0.7	9	0.3d	1.0	1.2de	0.2	0.8	3.5	771e
T2	5.4	2.3	0.8	12	0.5a	1.1	1.4cd	0.2	0.7	3.9	821d
T3	5.5	2.2	0.7	13	0.4cd	1.2	1.5bc	0.2	0.7	4.0	825d
T4	5.6	2.3	1.0	12	0.5bc	1.2	1.7ab	0.3	0.7	4.4	841c
T5	5.6	2.1	0.9	12	0.6ab	1.3	1.6b	0.2	0.8	4.5	822d
T6	5.5	2.9	0.9	13	0.6ab	1.2	1.5b	0.3	0.6	4.2	857c
T7	5.6	2.8	0.8	12	0.4cd	1.3	1.6b	0.2	0.7	4.2	833d
T8	5.6	2.9	1.1	14	0.6ab	1.3	1.8a	0.4	0.6	4.7	872b
T9	5.7	2.9	1.1	13	0.7a	1.4	1.7ab	0.3	0.7	4.8	854c
T10	5.6	3.4	1.0	14	0.7a	1.3	1.6b	0.3	0.5	4.4	886b
T11	5.7	3.3	0.9	13	0.5bc	1.4	1.7a	0.3	0.6	4.7	872b
T12	5.7	3.5	1.2	15	0.7a	1.4	2.0a	0.5	0.5	5.0	900a
T13	5.8	3.3	1.3	14	0.8a	1.5	1.8a	0.3	0.6	5.0	880b
2016	ns	ns	ns	ns		ns		ns	ns	ns	
T1	5.0	1.8e	0.5d	7e	0.3d	0.9d	0.8d	0.1	1.0	3.1d	677d
T2	5.6	12.5bc	0.8d	11d	0.6c	2.2c	2.3b	0.3b	0.9	6.3b	857b
T3	5.7	12.0bc	0.9d	10d	0.7bc	2.1c	2.1bc	0.2c	0.9	6.0b	850b
T4	6.8	12.9bc	1.0cd	12cd	0.6c	2.4bc	2.3b	0.4a	0.9	6.6b	864b
T5	5.8	13.0b	1.0cd	13c	0.6c	2.3bc	2.4b	0.3b	1.0	6.6b	849b
T6	5.7	13.1b	0.9d	14c	0.8bc	2.4bc	2.5b	0.4a	0.8	6.9b	884b
T7	5.8	12.4bc	1.1c	15c	0.9ab	2.3bc	2.3b	0.3b	0.8	6.6b	879b
T8	5.9	13.2b	1.3bc	18b	0.8bc	2.6ab	2.4b	0.5a	0.8	7.1b	887b
T9	6.0	13.5b	1.2c	19b	0.7bc	2.5b	2.5b	0.4a	0.9	7.0b	871b
T10	5.8	13.5b	1.6ab	19b	1.0a	2.9a	3.0a	0.5a	0.7	8.2a	915a
T11	5.9	12.8bc	1.6ab	20b	1.2a	2.8a	2.8a	0.4a	0.7	7.9a	911a
T12	6.0	14.4ab	1.9a	24a	1.1a	3.1a	2.9a	0.6a	0.7	8.4a	917a
T13	6.1	16.4a	1.7a	24a	0.9ab	3.0a	3.0a	0.5a	0.8	8.2a	902a
	ns							ns			

Legend
T1 = control T5 = 2.5RHCdC T9 = 5.0RHCdC T13 10.0RHCdC
T2 = 2.5RH T6 = 5.0RH T10 = 10.0RH T14 = NPK15:15:15
T3 = 2.5 RHC T7 = 5.0RHC T11 = 10.0RHC
T4 = 2.5RHCd T8 = 5.0RHCd T12 = 10.0RHCd
ns – non-significant

place and nutrients are gradually released to the soil (Adeoye *et al*., 2005). It was reported that microorganisms decomposing organic materials take up nutrients for their growth and reproduction initially (Adeoye *et al*., 2005). This decreases early nutrient supply to plants leading to poor growth rate. Organic acids released at initial stage of mineralization stimulate growth and reproduction of micro-organisms (Litterick *et al*., 2004). This causes nutrient immobilization accounting for poor growth performance at the early stage. From seven weeks after sowing, the composts applied treatments were significantly higher than control plot. The gradual mineralization processes accounted for the slow growth rate at the beginning. Rice husk amendment with cassava mill effluent records the highest plant girth and leaf area.

Plots treated with 10 t/ha of the composts had higher number of tiller, this could due to high nutrient released during decomposition of the composts (Garba and Mohmoud, 2010). This could have accounted for number of tillers in second year and in residual study. Tillering started at five weeks after sowing with the higher rates of compost application. The effect of compost varies according to soil native fertility which could be the reason why rice husk with cassava mill effluent produced the highest dry matter and rice grain yield.

Soil pH improves after harvest at each year and it determines nutrient availability and enhances absorption of nutrients by plant (Ebaid et al., 2005), this led to grain yield increase. Soil alkalinity also increases as a result, potassium, magnesium, calcium and sodium was improved

Figure 1. Rice plant treated with rice husk, cow dung and cassava mill effluent.

especially in cassava effluent compost. The compost had buffering effect in the soil due to acid neutralizing bacterial that decomposed the material (Akpan, 2012). Rice husk plus cow dung with cassava mill effluent raised soil pH by 10% while at the end of second year, pH was increased by 16%. Soil organic matter, total nitrogen and available phosphorus improved and were significantly enhanced after harvest in second year. It was noted that cassava mill effluent has high content of P (Akpoveta and Osakue, 2012), and might have improved the nutrient value of the compost.

CONCLUSIONS

The results of the study revealed that rice husk and cow dung compost with cassava effluent improve rice yield and soil chemical properties more than rice husk and cow dung compost with water. This shows that the RH-based organic fertilizer has the potential to substitute for inorganic fertilizer. However, there is need to improve on the nutrient release rate by possibly increasing the decomposition and mineralization rate through addition of nitrogenous fertilizer due to short duration (3 month) of rice plant.

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