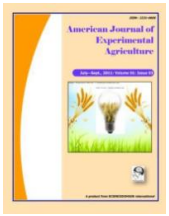

American Journal of Experimental Agriculture
6(3): 147-157, 2015, Article no.AJEA.2015.074
ISSN: 2231-0606

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Influence of Pelleted and Unpelleted Composted Organic Waste Materials on Growth, Dry Matter Accumulation and Yield of Three Varieties of Cucumber (*Cucumis sativus*) in the Greenhouse

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Authors' contributions

This work was carried out in collaboration between all authors. All authors read and approved the final manuscript.

Article Information

DOI: 10.9734/AJEA/2015/13601
Editor(s):
(1) Peter A. Roussos, Lab. Pomology, Agricultural University of Athens, Greece.
(2) Masayuki Fujita, Department of Plant Sciences, Kagawa University, Japan.
Reviewers:
(1) Robert Kalbarczyk, Institute of Landscape Architecture, Wrocław University of Environmental and Life Sciences, Poland.
(2) Anonymous, Nigeria.
(3) Anonymous, Egypt.
Complete Peer review History: http://www.sciencedomain.org/review-history.php?iid=742&id=2&aid=7321

Original Research Article

Received 25th August 2014
Accepted 30th October 2014
Published 16th December 2014

ABSTRACT

The study was conducted in a greenhouse to determine the influence of pelleted and unpelleted composted organic waste materials on the morphological growth, dry matter accumulation and yield of three varieties of cucumber (*Cucumis sativus*). The experiment was a 3 × 13 factorial trial in a completely randomized design (CRD) with three replications. The trial consisted of one hundred and seventeen polythene pots laid out in the greenhouse of the Teaching and Research Farm of Department of Crop Science, University of Nigeria, Nsukka. The treatments were pelleted and unpelleted composted rice husks (100%), moringa pod husks (100%), maize cobs (100%), rice husks + poultry manure (75%:25%, volume to volume; v/v), moringa pod husks + poultry manure (75%:25%,v/v), maize cobs + poultry manure (75%:25%,v/v), control and three varieties of cucumber (Poinsett, Marketer and Supermarketer) giving a total of thirty-nine treatment combinations. Cucumber plants grown in soil amended with unpelleted composted rice husks + poultry (75%:25%, v/v) had significantly (P = .05) the highest values of plant height, leaf area per

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plant, number of leaves per plant, stem girth, dry matter accumulation in the leaves and stems while those grown in the pelleted rice husks + poultry manure significantly (P = .05) gave the highest values of dry matter accumulation in the roots of the three cucumber varieties after six weeks of planting (the peak of vegetative growth). The unpelleted rice husks + poultry manure significantly (P = .05) also gave the highest values of number of fruits and fruit weight per plant. Supermarketer gave the highest values of the morphological growth traits, dry matter accumulation and yield in all the treatments followed by Marketer, then Poinsett.

Keywords: Pelleted; unpelleted; compost; poinsett; marketer; supermarketer.

1. INTRODUCTION

One of the challenges facing crop production in the tropics is the inherent low concentration of essential nutrients in the soil for crop growth and development. Essential nutrients are those required by plants to complete their life cycle such as nitrogen (N), phosphorus (P), potassium (K) known as primary elements; calcium (Ca), magnesium (Mg) and sulphur (S) known as secondary elements; and micronutrients like boron (B), copper(Cu), manganese (Mn), iron (Fe), molybdenum (Mb) zinc (Zn) etc.[1]. These nutrients can be provided to the soil through the use of organic or inorganic fertilizers. The inorganic fertilizers are associated with increased soil acidity, leaching and nutrient imbalance [2]. The nutrients in organic manures are released more slowly and are stored in the soil for a long time. Manure application also increases soil porosity, aggregate stability, soil water infiltration and holding capacity. It also enhances soil organic matter content, pH, cation exchange capacity and nutrient availability [3, 4 and 5]. However, the main defect in the use of organic fertilizers (manures) in crop production is the limited nutrient supply and bulkiness. Composting is a management practice in agriculture to improve manure quality and efficiency. Well managed compost has good agronomic properties such as good water holding capacity, light weight, small particle size. It is cheap and can easily supply nutrients to the crop [6].

Cucumber (*Cucumis sativus*) is a vegetable crop eaten by most families in the Tropics. It is one of the most popular members of *Cucurbitaceae* (vine crop) family. It is cultivated for fresh fruit which is locally consumed or exported to increase national income. The crop is cultivated in most parts of Northern Nigeria and some parts of Eastern Nigeria by peasant farmers who lack information on some important cultural practices [7]. Cucumber is a vital ingredient in vegetable salads. The production of this crop requires soil with high levels of organic matter content to provide the essential nutrients and soil physical conditions needed for proper growth and development of the crop. However, there is paucity of information on the use of pelleted and unpelleted composted organic materials for the production of cucumber crop. The aim of this study was to determine the influence of pelleted and unpelleted composted organic materials on the morphological growth, dry matter accumulation and yield of three varieties of cucumber (*Cucumis sativus*) in the greenhouse.

2. MATERIALS AND METHODS

2.1 Experimental Site

The experiment was carried out at the Teaching and Research Farm of the Department of Crop Science, University of Nigeria, Nsukka. Nsukka, is located on latitude 06º 52'North, longitude 07^0 24'East and altitude 447.26 meters above sea level (m.a.s.l). Rainfall distribution pattern in this region is bimodal with peaks in July and September and a short dry spell around mid-August. The soil of the experimental site is a reddish-brown clay loamy Ultisol (Oxicpaleustult) belonging to the Nsukka series [8]. The experimental site was on a flat land and, therefore, did not need any drainage system. Nsukka is located in a derived savanna vegetation zone with mean annual minimum and maximum temperatures of 25 and 32ºC respectively [9].

2.2 Composting and Pelleting of the Organic Waste Materials

Organic waste materials such as rice husks, moringa pod husks, maize cobs and poultry manure obtained from Songhai Farm Adani, Nsukka and Telefood Research Project, University of Nigeria, Nsukka (Hujii-UNN) were composted. Table 1 below shows the organic materials and their mixing ratios during composting.

Table 1. Organic waste materials and their mixing ratios during composting

Symbol	Organic waste materials	Mixing ratio (v/v)
1. RH	Rice husks	100%
2 .MPH	Moringa pod husks	100%
3. MC	Maize cobs	100%
4. RH3:PM2	Rice husks + poultry manure	75%:25%
5. MPH3:PM2	Moringa pod husks + poultry manure	75%:25%
6. MC3:PM2	Maize cobs + poultry manure	75%:25%

Before composting, the organic materials were air-dried for seven days. The moringa pod husks and maize cobs were shredded into smaller coarse particle sizes (not mesh sizes) for quick degradation during composting. Composting was done aerobically in perforated black plastic buckets with lids for three months. Turning and watering were done whenever necessary throughout the period of composting. After composting, the organic materials were air-dried for seven days to get rid of moisture before pelleting them. The dried composted organic materials were ground at the Project Development Institute (PRODA), Enugu using the institute's milling machine after which they were passed through a sieve with two millimeter (2 mm) standard mesh size. Corn starch obtained from Farm Associates Nigeria Limited, Enugu was used as a binder during the pelleting operation. The milled organic materials and corn starch were homogenized and watered to form a coarse paste. Pelleting was done by using small electrically operated screw pelleting machine. The average diameter of a pelleted material was 6 mm. Tables 2 and 3 show the physical and chemical properties of the pelleted and unpelleted compost materials.

2.3 Experimental Design

One hundred and seventeen black perforated polythene pots of 23 cm diameter and 17 cm depth were filled with topsoil/compost manure mixtures mixed in the ratio of 3:2 (v/v) and laid out in the greenhouse of the Faculty of Agriculture, University of Nigeria, Nsukka, in a completely randomized design (CRD). The compost manure consisted of pelleted and unpelleted rice husks (100%), moringa pod husks (100%), maize cobs (100%), rice husks + poultry manure (75%:25%,v/v), moringa pod husks + poultry manure (75%:25%,v/v), maize cobs + poultry manure (75%:25%,v/v), control and three varieties of cucumber (*Poinsett, Marketer and Supermarketer*). A total of thirty-nine treatment combinations were used, each replicated three times.

Table 2. The physical properties of pelleted and unpelleted composted organic materials

Variable	Bulk density (g cm^{-3})	Total porosity (%)	Available water holding capacity (%)
RH	0.62	76.60	111.68
MPH	0.65	75.47	109.35
MC	0.69	73.96	107.40
RH3:PM2	0.71	73.21	103.11
MPH3:PM2	0.72	72.83	98.32
MC3:PM2	0.78	70.57	81.68
*RH	0.68	74.34	108.24
*MPH	0.73	72.45	92.53
*MC	0.77	70.94	87.37
*RH3:PM2	0.81	69.43	78.32
*MPH3:PM2	0.84	68.30	74.36
*MC3:PM2	1.07	59.62	53.31
CONTROL	1.21	54.34	45.59
F-LSD $_{(.05)}$	0.03	0.15	0.02

*RH = rice husks (100%), MPH = moringa pod husks (100%), MC = maize cobs (100%), RH3:PM2 = rice husks + poultry manure (75%:25%, v/v), MPH3:PM2 = moringa pod husks + poultry manure (75%:25%, v/v), MC3:PM2 = maize cobs + poultry manure (75%:25%, v/v), F-LSD $_{(.05)}$ = Fishers least significant differences at P = .05, * = pelleted*

Topsoil and the composted materials were thoroughly mixed two weeks before planting. Three varieties of cucumber (*Poinsett, Marketer and Supermarketer*) were planted to the depth 2 cm. Planting was done at the rate of two seeds per hole and thinned down to one plant after seedling emergence. Vertical staking was done by tying a twine at the base of the polythene pots to the roof of the greenhouse.

Prophylactic application of 15 mls of Karate in five liters of water was done at five days of seedling emergence to avert pest incidence. Routine watering was done every other day and manual weeding whenever necessary. The experiment was carried out between December, 2012 and March, 2013.

Table 3. The chemical properties of pelleted and unpelleted composted organic materials

Variable	TN (%)	OM (%)	OC (%)	C:N	pH (water)
RH	0.88	17.72	10.28	11.68	6.50
MPH	0.81	23.10	13.40	16.54	6.60
MC	0.54	26.48	15.36	28.44	6.80
RH3:PM2	1.03	11.60	6.73	6.53	7.10
MPH3:PM2	0.98	14.02	8.13	8.30	7.83
MC3:PM2	0.83	17.02	9.87	13.52	7.90
*RH	0.62	17.71	10.27	16.57	6.70
*MPH	0.59	22.19	12.87	21.81	6.74
*MC	0.51	26.07	15.12	29.65	6.90
*RH3:PM2	0.96	10.52	6.10	6.35	7.02
*MPH3:PM2	0.92	12.66	7.34	8.00	8.10
*MC3:PM2	0.80	15.55	9.02	11.28	8.13
CONTROL	0.04	1.85	1.07	25.48	5.00
F-LSD $_{(.05)}$	0.03	0.03	0.02	0.03	0.02

*RH = rice husks (100%), MPH = moringa pod husks (100%), MC = maize cobs (100%), RH3:PM2 = rice husks + poultry manure (75%:25%, v/v), MPH3:PM2 = moringa pod husks + poultry manure (75%:25%, v/v), MC3:PM2 = maize cobs + poultry manure (75%:25%, v/v), OC = organic carbon, OM - organic matter, TN - total nitrogen, C:N - carbon nitrogen ratio, F-LSD $_{(.05)}$ = Fishers least significant differences at P = .05, * = pelleted*

2.4 Data Collection and Analysis

Morphological growth parameters were measured biweekly for six weeks (peak of vegetative growth). Plant height was determined by measuring the length of the plant from the soil level to the shoot tip using a measuring tape. Leaf area per plant was estimated as leaf length (L) x width (W) x 0.85 as described by Blanco et al. 10. Number of leaves per plant was determined by counting. Stem diameter of the main vine was measured with vernier calipers and converted to girth using the following formula:

$$SG = SD\pi = SD \times 22/7$$

Where SG is stem girth and SD is the stem diameter.

The dry weights of the leaves, stems and roots were also measured at six weeks of planting. Five plants from each treatment combination/replicate were taken from the greenhouse and their roots carefully removed from the soil medium by eroding the soil around the root system in a bucket of water. The leaves, stems and roots were carefully separated and dried in an electric oven at 80ºC until constant weights were obtained. The yield parameters i.e. fruit length, fruit diameter, fruit circumference, number of fruits/plant and total fruit fresh weight/plant were measured at harvest. Data collected were subjected to analysis of variance (ANOVA) as outlined by Obi [11]. Significant means were separated using Fishers least significant difference (F-LSD) at 5% probability level.

3. RESULTS AND DISCUSSION

The results of the morphological characteristics are presented on Tables 4 and 5. At At six weeks of planting, cucumber plants grown in unpelleted composted rice husks + poultry manure significantly (P = .05) had the highest values of plant height, stem girth, leaf area and number of leaves with *Supermarketer* (P3) variety having the greatest values followed by *Marketer* (P2) and *Poinsett* (P1). The interaction effects of the sowing media x cucumber varieties on the morphological characteristics were also significant.

The pelleted composted rice husks + poultry manure significantly (P = .05) gave the highest dry matter accumulation in the roots while the unpelleted rice husks + poultry manure significantly gave the highest values in the stems and leaves. The *Supermarketer* variety had the highest values of the dry matter accumulation in the roots, stems and leaves followed by *Marketer* and *Poinsett* in that order.

Table 4. The effects of pelleted and unpelleted composted organic materials on the plant height (cm) and stem girth (cm) of three varieties of cucumber (C*ucumis sativus*) at two and six weeks after planting (WAP) in the greenhouse

Organic materials	Plant height (cm)							Mean	Stem girth (cm)							
	2WAP				6WAP				2WAP				6WAP			
	P1	P2	P3	Mean	P1	P2	P3		P1	P2	P3	Mean	P1	P2	P3	Mean
RH	15.30	26.90	27.40	23.20	149.00	174.76	184.97	169.58	0.80	1.00	1.30	1.03	3.00	3.62	4.70	3.77
MPH	13.58	24.39	25.13	21.03	143.30	172.38	180.20	165.29	0.60	0.80	1.00	0.80	2.51	3.60	4.70	3.60
MC	9.10	22.89	24.02	18.67	139.03	169.30	179.01	162.45	0.60	0.80	0.90	0.77	2.51	3.52	4.63	3.55
RH3:PM2	23.30	30.00	37.20	30.17	167.91	187.29	204.57	186.59	2.10	3.00	4.20	3.10	3.49	4.60	5.67	4.89
MPH3:PM2	20.16	28.42	35.30	27.96	161.37	183.07	201.00	181.81	2.00	2.00	3.10	2.37	3.33	4.55	5.50	4.46
MC3:PM2	19.47	26.80	34.12	26.80	159.00	178.83	198.31	178.71	1.00	2.00	2.00	1.67	3.31	4.20	5.31	4.27
*RH	13.50	23.52	24.70	20.57	136.74	168.97	175.20	160.30	0.50	0.60	0.80	0.63	2.30	3.40	4.12	3.27
*MPH	10.62	20.17	23.60	18.13	135.63	162.40	173.10	157.04	0.50	0.50	0.80	0.60	2.15	3.12	4.00	3.09
*MC	8.69	19.34	21.45	16.49	134.40	160.53	170.69	155.21	0.40	0.50	0.70	0.53	1.91	3.10	3.90	2.97
*RH3:PM2	19.80	28.30	34.00	27.37	158.71	178.24	196.23	177.73	1.00	2.08	3.30	2.13	3.09	4.17	5.30	4.19
*MPH3:PM2	17.82	26.50	32.27	25.53	154.13	175.05	194.13	174.44	1.00	1.20	2.20	1.47	3.09	4.00	5.00	4.03
*MC3:PM2	17.03	24.63	31.03	24.23	151.94	173.41	189.37	171.57	0.90	1.00	1.10	1.00	3.04	4.00	5.00	4.01
CONTROL	6.10	15.03	19.31	13.48	106.00	124.23	134.73	121.65	0.70	0.90	1.00	0.87	0.90	1.34	2.94	1.73
Treatment mean (T)	14.96	24.38	28.43	22.59	145.94	169.88	183.19	166.34	0.93	1.26	1.72	1.31	2.66	3.63	4.68	3.66

	Plant height		Stem girth per plant	
	2WAP	6WAP	2WAP	6WAP
F-LSD $_{(.05)}$ for 2 varieties means (V)	.72	.95	.04	.32
F-LSD $_{(.05)}$ for 2 organic materials means (AT)	1.50	1.97	.07	.67
F-LSD $_{(.05)}$ for 2 V × T means	2.59	3.41	.13	1.16

*RH = rice husks (100%), MPH = moringa pod husks (100%), MC = maize cobs (100%), RH3:PM2 = rice husks + poultry manure (75%:25%, v/v), MPH3:PM2 = moringa pod husks + poultry manure (75%:25%, v/v), MC3:PM2 = maize cobs + poultry manure (75%:25%, v/v), * = pelleted, P1 – Poinsett, P2 - Marketer, P3 - Supermarketerand F-LSD $_{(.05)}$ = Fishers least significant difference at P = .05*

Table 5. The effects of pelleted and unpelleted composted organic materials on the leaf area (cm^2) and number of leaves per plant of three varieties of cucumber *(Cucumis sativus*) at two and six weeks after planting (WAP) in the greenhouse

Organic materials	Leaf area per plant (cm^2)								Number of leaves per plant							
	2WAP				6WAP				2WAP				6WAP			
	P1	P2	P3	Mean (V)	P1	P2	P3	Mean (V)	P1	P2	P3	Mean (V)	P1	P2	P3	Mean (V)
RH	39.49	66.60	86.68	64.26	232.52	357.49	406.30	332.10	3.00	6.00	5.67	4.90	10.33	17.00	17.00	14.78
MPH	36.80	61.55	81.42	59.92	212.71	349.48	398.30	320.16	2.67	5.67	5.33	4.56	10.33	16.00	16.67	14.33
MC	32.21	58.93	77.89	56.34	204.90	342.06	384.45	310.47	2.00	5.33	5.00	4.11	9.67	15.67	16.00	13.78
RH3:PM2	57.72	97.84	120.67	92.08	388.34	545.26	648.34	527.32	4.00	7.00	8.33	6.44	15.00	20.00	21.00	18.67
MPH3:PM2	54.61	76.22	113.08	81.31	374.52	479.99	555.26	469.92	3.67	6.67	7.33	5.89	14.67	20.00	20.00	18.22
MC3:PM2	52.97	71.57	107.57	77.37	343.59	431.05	506.60	427.08	3.67	6.33	7.00	5.67	14.67	19.00	19.67	17.78
*RH	32.62	63.54	70.79	55.65	205.89	345.10	381.93	310.97	2.00	5.33	5.00	4.11	9.00	15.00	16.00	13.33
*MPH	29.53	55.71	66.22	50.49	198.09	301.61	367.15	291.95	2.00	5.00	4.67	3.89	8.67	14.33	15.33	12.78
*MC	27.81	52.05	62.30	47.39	186.22	290.26	354.26	276.91	2.00	5.00	4.33	3.78	7.33	14.00	15.00	12.11
*RH3:PM2	49.84	76.68	105.49	77.34	310.54	436.31	509.24	418.70	3.00	6.33	7.00	5.44	13.33	18.33	18.67	16.78
*MPH3:PM2	45.01	70.03	99.33	71.46	294.27	406.49	430.49	377.08	3.00	6.33	6.33	5.22	13.00	18.00	18.33	14.78
*MC3:PM2	43.45	65.14	96.97	68.52	287.43	387.47	406.20	360.37	3.00	6.00	6.00	5.00	13.00	17.67	18.00	16.22
CONTROL	17.30	25.78	44.57	29.22	99.12	248.29	311.05	219.49	2.00	2.67	3.67	2.78	6.00	11.00	13.33	10.11
Treatment mean (T)	39.95	64.74	87.15	63.95	256.78	379.22	435.35	357.12	2.77	5.67	5.82	4.75	11.15	16.62	17.31	15.03

	Leaf area per plant		Number of leaves per plant	
	2WAP	6WAP	2WAP	6WAP
F-LSD $_{(.05)}$ for 2 varieties means (V)	.86	.31	.20	.34
F-LSD $_{(.05)}$ for 2 organic materials means (T)	1.79	.64	.41	.71
F-LSD$_{(.05)}$ for 2 V × T means	3.11	1.10	.71	1.22

The interaction effects of media x varieties on dry matter accumulation were also significant (P = .05) (Table 4). The fruit length, fruit diameter, fruit circumference, number of fruits per plant and total fruit fresh weight per plant were significantly (P = .05) greatest in unpelleted rice husks + poultry manure compared to the other sowing media. The *Supermarketer* variety significantly (P = .05) also had the highest values of the yield traits followed by *Marketer* and *Poinsett* in that order. There were significant (P = .05) media x variety interaction effects on all the yield attributes (Tables 6, 7, 8 and 9).

Generally, the plants grown with unpelleted composts performed better than those grown with pelleted ones in terms of morphological growth characteristics, dry matter accumulation and yield traits.

The consistent superiority of unpelleted composts over the pelleted ones in terms of morphological characteristics, dry matter accumulation and yield attributes could be due to the coarse and fragmented nature of the particles which would have increased soil aeration, drainage and rate of nutrient release for plants absorption. The compact nature of the pelleted composts would have contributed to slow nutrient release and relatively poor performance of the plants in the media. The observed best performance of the plants in unpelleted rice husks + poultry manure could be attributed to the high protein content of rice husks in addition to that in the poultry manure. This agrees with the earlier findings of Ndubuaku et al. [12] who obtained outstanding performance of okra plants in the liquid fraction (biol) of fermented rice husks + topsoil. Rice bran contains a lot of protein. During rice grain processing, a lot of the protein is removed with the bran and the husks. This can be one of the reasons for high level of protein in the rice husks. Mixtures of other organic materials i.e. rice husks, moringa pod husks, maize cobs with poultry manure gave higher values of dry matter accumulation, morphological growth and yield attributes compared with the single organic material treatments. This result reflects the substantial contribution of poultry manure in enriching soil nutrient contents. Poultry manure is rich in nitrogen which enhances crop development especially vegetative growth.

Table 6. The effects of pelleted and unpelleted composted organic materials on the root dry weight (g/plant), stem dry weight (g/plant) and leaf dry weight (g/plant) of three varieties of cucumber *(Cucumis sativus*) at six weeks after planting in the greenhouse

Organic materials	Root dry weight				Stem dry weight				Leaf dry weight			
	P1	P2	P3	Mean (V)	P1	P2	P3	Mean (V)	P1	P2	P3	Mean (V)
RH	0.80	1.00	1.29	1.03	6.52	9.14	12.00	9.22	16.42	19.56	21.63	19.20
MPH	0.65	0.90	1.10	0.88	6.14	9.10	11.78	9.01	16.02	19.00	20.52	18.51
MC	0.65	0.90	1.00	0.85	6.00	9.00	11.69	8.90	15.41	18.71	20.00	18.04
RH3:PM2	1.00	1.25	1.43	1.23	9.89	12.70	14.70	12.43	20.20	23.60	25.17	22.99
MPH3:PM2	0.85	1.24	1.40	1.16	9.60	12.27	14.60	12.16	20.00	23.35	24.20	22.52
MC3:PM2	0.85	1.20	1.40	1.15	9.13	12.05	14.50	11.89	19.34	23.10	24.00	22.15
*RH	1.20	1.40	1.75	1.45	5.14	8.03	10.67	7.95	15.00	17.87	19.73	17.53
*MPH	1.18	1.40	1.31	1.30	5.09	7.81	10.63	7.84	14.34	17.60	19.32	17.09
*MC	1.02	1.40	1.60	1.34	5.00	7.55	10.00	7.52	13.80	17.00	19..00	16.60
*RH3:PM2	1.36	1.63	1.99	1.66	8.63	11.40	13.70	11.24	18.05	21.73	23.61	21.13
*MPH3:PM2	1.24	1.60	1.92	1.59	8.51	11.25	13.10	10.95	17.71	21.40	23.03	20.71
*MC3:PM2	1.20	1.60	1.90	1.57	8.43	11.10	12.50	10.68	17.30	21.00	23.00	20.43
CONTROL	0.20	0.40	0.70	0.43	2.99	5.00	8.50	5.50	11.50	13.00	16.10	13.53
Treatment mean (T)	0.94	1.23	1.50	1.20	7.01	9.72	12.18	9.64	16.55	19.76	21.49	19.27

	Root dry weight	Stem dry weight	Leaf dry weight
F-LSD $_{(.05)}$ for 2 varieties means (V)	.11	.27	.32
F-LSD $_{(.05)}$ for 2 organic materials means (T)	.22	.55	.66
F-LSD $_{(.05)}$ for 2 V × T means	.39	.96	1.14

Table 7. The effects of pelleted and unpelleted composted organic materials on the fruit length (cm) and fruit width (cm) of three varieties of cucumber *(Cucumis sativus*) at harvest in the greenhouse

Organic materials	Fruit length (cm)				Fruit diameter (cm)			
	P1	P2	P3	Mean (V)	P1	P2	P3	Mean (V)
RH	16.36	19.75	22.00	19.37	3.90	5.40	7.00	5.43
MPH	16.04	19.37	21.57	18.99	3.62	5.10	6.99	5.24
MC	16.00	18.31	21.39	18.57	3.60	5.04	6.52	5.05
RH3:PM2	21.30	24.90	26.34	24.18	5.67	7.50	8.60	7.26
MPH3:PM2	20.00	23.79	25.60	23.13	5.40	7.29	8.17	6.95
MC3:PM2	19.87	21.13	24.80	21.93	5.20	7.10	8.00	6.77
*RH	15.71	17.69	20.70	18.03	3.10	5.00	6.00	4.70
*MPH	15.40	17.42	20.02	17.61	2.90	4.38	5.50	4.26
*MC	15.02	17.03	19.69	17.25	2.50	4.25	5.49	4.08
*RH3:PM2	19.50	21.83	23.00	21.44	4.50	6.92	7.65	6.36
*MPH3:PM2	19.00	21.04	22.94	20.99	4.41	6.50	7.50	6.14
*MC3:PM2	17.39	20.00	22.30	19.90	4.00	6.00	7.30	5.77
CONTROL	11.50	13.97	16.00	13.82	2.40	3.00	5.00	3.47
Treatment mean (T)	17.16	19.71	22.03	19.63	3.94	5.65	6.90	5.50

	Fruit length	Fruit diameter
F-LSD $_{(.05)}$ for 2 varieties means (V)	.13	.08
F-LSD $_{(.05)}$ for 2 organic materials means (T)	.26	.16
F-LSD $_{(.05)}$ for 2 V × T means	.46	.29

Table 8. The effects of pelleted and unpelleted composted organic materials on the fruit circumference (cm) and number of fruits per plant of three varieties of cucumber *(Cucumis sativus*) at harvest in the greenhouse

Organic materials	Fruit circumference (cm)				Number of fruits per plant			
	P1	P2	P3	Mean (V)	P1	P2	P3	Mean (V)
RH	12.92	17.48	18.71	16.37	5.67	7.67	11.00	8.11
MPH	12.05	17.25	18.50	15.93	5.67	7.33	10.33	7.78
MC	11.00	17.03	18.20	15.41	5.33	7.33	10.00	7.56
RH3:PM2	15.55	19.79	21.50	18.95	10.67	13.67	15.00	13.11
MPH3:PM2	15.34	19.50	21.30	18.71	10.33	13.33	14.00	12.56
MC3:PM2	15.00	19.30	21.00	18.43	10.00	13.00	13.67	12.22
*RH	10.70	16.59	17.43	14.91	5.00	6.67	9.33	7.00
*MPH	10.20	16.25	17.04	14.50	4.00	6.00	9.00	6.33
*MC	10.00	16.05	17.00	14.35	4.00	6.00	8.00	6.00
*RH3:PM2	14.90	19.00	20.90	18.27	8.67	11.00	12.33	10.67
*MPH3:PM2	14.37	18.57	20.30	17.75	8.00	10.00	12.00	10.00
*MC3:PM2	14.02	18.23	19.00	17.08	7.67	9.33	12.00	9.67
CONTROL	8.92	10.52	14.00	11.15	3.00	4.00	6.33	4.44
Treatment mean (T)	12.69	17.35	18.84	16.29	6.77	8.87	11.00	8.88

	Fruit circumference	Number of fruits per plant
F-LSD $_{(.05)}$ for 2 varieties means (V)	.26	.36
F-LSD $_{(.05)}$ for 2 organic materials means (T)	.54	.74
F-LSD $_{(.05)}$ for 2 V × T means	.94	1.29

Table 9. The effects of pelleted and unpelleted composted organic materials on the total fresh fruit weight (g/plant) of three varieties of cucumber (C*ucumis sativus*) at harvest in the greenhouse

Organic materials	P1	P2	P3	Variety mean (V)
RH	657.00	860.00	900.00	805.67
MPH	640.00	853.00	874.00	789.00
MC	635.00	850.00	865.00	783.33
RH3:PM2	754.00	980.00	1015.00	916.33
MPH3:PM2	740.00	971.00	1013.00	908.00
MC3:PM2	734.00	963.00	1010.00	902.33
*RH	610.00	843.00	855.00	769.33
*MPH	581.00	837.00	842.00	753.33
*MC	576.00	830.00	837.00	747.67
*RH3:PM2	708.00	920.00	1004.00	877.44
*MPH3:PM2	700.00	911.00	996.97	869.22
*MC3:PM2	694.00	905.00	970.00	856.44
CONTROL	358.67	400.33	600.67	452.89
Treatment mean (T)	645.15	855.64	906.36	802.38
F-LSD $_{(.05)}$ for 2 varieties means (V)		2.31		
F-LSD $_{(.05)}$ for 2 organic materials means (T)		4.81		
F-LSD $_{(.05)}$ for 2 V × T means		8.34		

The low nitrogen to carbon ratios in poultry manure help rapid decomposition of the organic materials and subsequent release and uptake of nutrients for plant growth and development according to Adeniyi et al. [13]. The varietal differences obtained in the responses of *Spermarketer, Marketer* and *Poinsett* to the different manure amendments could be attributed to their genotypic differences.

4. CONCLUSION

Generally, the plants grown with unpelleted composts performed better than those grown with pelleted ones in terms of morphological growth characteristics, dry matter accumulation and yield traits. The unpelleted rice husks + poultry manure significantly gave the highest values of morphological growth characteristics, yield and dry matter accumulation, especially in leaves and stems. In all the growth attributes, *Supermarketer* was the best followed by *Marketer*, then *Poinsett.*

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Barker AV, Pilbeam DJ. Handbook of plant nutrition. 5th ed, Taylor and Francis Group; 2007.
2. Schlecht E, Buerkert A, Tielkes E, Batino A. A critical analysis of challenges and opportunities for soil fertility restoration in Sudan-Sahelian West Africa. In: Advances in integrated soil fertility management in Sub-Sahara Africa: Challenges and opportunities, Springer Publishers. Dordrecht, Netherlands; 2007.
3. Powell JM, Unger PW. Alternatives to crop yield residues for sustaining agricultural productivity and natural resources conservation. J. Sust. Agric. 1998;11(2-3):59-84.
4. Powell JM, Fernandez-Rivera S, Hiernanx P, Turner MD. Nutrient cycling in integrated rangeland / crop system of Sahel. Agric Syst.1996;52:143-170.
5. Powell JM, Ikpe FN, Somda ZC. Crop yield and the fate of nitrogen and phosphorous following application of plant materials and faeces to soil. Nutr. Cycl. Agro-ecosyst.1999;54:215-226.
6. Miller JH, Norman J. Organic and compost-based growing media for tree seedling nurseries. World Bank Technical Paper. Number 264 forestry series; 1992.
7. Ekwu LG, Utobo, EB,Oyesola, CA. Vegetative and yield response of cucumber (*Cucumis sativus* L) to staking and nitrogen fertilizer application. J. Appl. Sci. 2007;19(4):7509-7519.
8. Mbagwu JSC. Maize (*Zea mays*) responses to nitrogen fertilizer on an ultisol in southern Nigeria under two tillage and

mulch treatments. J. Sci. Food Agric.1990;52:365-376.
9. Igwe CA, Stahr K. Water stable aggregate of flooded inceptisols from south-eastern Nigeria in relation to mineralogy and chemical properties. Aust. J. Soil Res. 2004;42:171-179.
10. Blanco FF, Folegatti MV. A new method for estimating the leaf area index of cucumber and tomato plants. Hortic. Bras. 2003;2(4):666-669.
11. Obi IU. Statistical methods of detecting differences between treatment means and research methodology issues in laboratory and field experiments. 2nd ed; 2002.
12. Ndubuaku UM, Imegwu CN, Ndubuaku NE. Nutrient compositions of liquid and solid fractions of organic waste fermentation and the influence on growth and yield of okra. Int. J. Cur. Tr. Res. 2013;2(1):415-424.
13. Adeniyi OT, Akanbi WB, Adediran JA. Growth, nutrient uptake and yield of tomato response to different plant residue composts. Food, Agric. and Enivron. 2004;2(1):310-316.

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