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Effect of dumpsite organic manure soil on growth, nutrient content, and yield of *Curcuma longa L.*(turmeric) in Owerri, Imo State

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Abstract

Curcuma longa L.(turmeric) is one of the most essential available spices in Nigeria. The field study was conducted at Teaching and Research Farm of Faculty of Agriculture and Veterinary Medicine, Imo State University, Owerri, Nigeria. During the planting season of 2019 to assess effect of different levels of Dumpsite Organic Manure Soil on Growth parameters, nutrient content and yield of turmeric. The experiment was laid in Randomized Block Complete Design with three replications. T_1: Control, T_2: 05 tons; T_3 10 tons, T_4: 15 tons of Dumpsite Organic Manure Soil. The result of the study revealed that high doses (T_4) of Dumpsite soil significantly influenced maximum growth parameters viz; plant height, leaf area, leaf length, leaf area index.15 tons of Dumpsite Organic Manure Soil (T_4) recorded the maximum yield per hectare (17.66kg/h) while the lowest (6.863kg) was obtained from control. The result of proximate composition showed that 15 tons (T_4) of dumpsite organic manure soil significantly improve the Ash, Fibre, Protein and carbohydrate contents compare to control. Moisture content (81%) and fat content (0.6369%) were higher in control compare to other treatment levels. The result has shown that Dumpsite Organic Manure Soil has potential to improve growth of Turmeric (*Curcuma longa* L.) and other crops.

Keywords: Dumpsite Organic manure soil; Turmeric, Growth; Nutrient content; *Curcuma longa*

1. Introduction

Dumpsite Manure is a product of indiscriminate waste disposal in urban cities of Nigeria. Majority of these Dumpsites are located in residential streets where people consciously or unconsciously dump their household waste. However, over the years individuals tend to cultivate in such places especially after it has been reclaimed by the owners of the site without minding whether it is safe for crop growth or not. In order hand, some people collect composted Dumpsite Manure Soil as source of organic manure and use it as a medium for garden farming or for potted planting. The use of residue from human consumption, agricultural activities, and municipal waste can improve soil physical and chemical properties and also the fertility and production [1] Compost manure is an essential resource to maintain and restore soil fertility and are greatly valued these days where the organic matter content of the soil is low [2,1]. Soil organic matter plays a major role in maintaining soil quality [3]. In addition, to supplying plant nutrients, the type and amount of soil organic matter influences several soil properties [4]. However, the application of composted waste to agricultural soils requires caution due to possibility of food chain contamination and negative effects on soil microbiology, particularly rhizobia [5]. [1] observed that dumpsite soil had an increasing effect on the height of *Phaceous vulgaris.*[1], reported that an increase in dumpsite soil proportion influence an increase in the moisture, ash, crude fibre, fat and protein content while the carbohydrate content decreased.

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The problem of solid waste is not just that of generation nor collection but also that of disposal and its effects on the quality of soil and plants, [6]. Most of such disposal sites are significantly selected nor well planned, or properly managed so they are usually accessible to scavenges, animal and vegetable cultivators [6].

[7] reported that N and P content in plant shoots were highly dependent on the dose of municipal solid waste compost. [8], from those organic wastes stimulate the availability of NO_3-N in soil as reported by [9].

Organic wastes not only influence soil properties but also play a great role in the growth and development of plants thus improves agricultural productivity [10]. This observation corresponds with [11] reporting that the application of Municipal Solid Waste at 40tha^{-1} in growing *Mebembryantheniumedule*enhanced nutrient (N.P. and K) uptake which led to the increase of plant biomass and relative growth rate (+93% on average) as compared to the control. These results are supported by [12] who concluded that manure MSW compost stimulated the yield of spiny chicory and increased bioavailability of trace elements (Cu, Zn, Fe, Mn, Cr, Ni, Pb, Cd) in soils.

The positive effects of waste on plant growth were also proved by [13]. The authors evaluated the agronomic characteristics of five urban waste types and registered by 5-30% higher ryegrass yields. Furthermore, the addition of MSW compost at approximately 45 and 90Mgha^{-1} increased the yield of Timothy and red clover forage crops [14]. [15] reported that P availability increased in acid and weathered soils with the application of organic amendments.

[16] reported that incorporated organic gave 32% higher yields than an unfertilized fields. The addition of manure improved the growth of *Chenopodium album* andreduced the heavy metal in contaminated soil [17]. [18], found that the application of farm waste compost at 2700kg per 10 acres led to significantly higher fresh weight of lettuce than in control and commercial compost treated soils. [16], reported that in case of MSW and SS addition to soil, various kinds of harmful components, especially heavy metals are entered into soil as well as into plants.The organic wastes also provide essential plant nutrients and maintain soil fertility and thus stimulate crop growth and yield [10].

The adverse effect of continuous use of high dose of chemical fertilizers on soil condition and environment has been realized recently by scientific community, local farmers are not showing considerable inclination towards organic farming with decrease usage of inorganic fertilizers although, Nigeria and State Government have not really shown seriousness in curbing the use of chemical fertilizer with its attending high cost in our agricultural productivity. Farmers in urban cities and local have resorted to the use of Composted Dumpsite Organic Manure Soil as cheap means of source of fertilizer without minding the effect of harmful substances in it. Also not much has been done on the use of Dumpsite Organic Manure in Production of Turmeric in Nigeria, justifies the need to study the effect of Dumpsite Organic Manure on growth, nutrient content and yield of *Curcuma longa L.* (turmeric).

2. Material and methods

The study was carried out at Research and Experimental Farm of Faculty of Agriculture and Veterinary Medicine, Imo State University, Owerri, Imo State, Nigeria. Owerri lies between latitudes 5^0 20'N and 6^0 55'E, and longitudes 6^0 35'E and 7^0 08'E on elevation of 71m above the sea level, within the South East Rain Forest Agricultural Zone of Nigeria. The area as reported by [19] maintains an average annual rainfall of 2,500mm, 27^0C temperature and relative humidity of 85%.

2.1. Experimental Materials

Rhizome of *Curcuma longa L.*(turmeric) was collected from Imo State Agriculture Development Programme (ADP) here in Owerri. Dumpsite Organic Manure Soil was collected from Dumpsite at Works Layout Owerri. The seeds of rhizome collected were five from unwanted materials such as weeds and are healthy.

2.2. Treatments

The treatments for the study are grouped in different levels of Dumpsite Organic Manure Soil and were used in the study as follows: T_1(control), T_2(5tons), T_3(10tons) and T_4(15tons).

2.3. Experimental Design and Layout

The experiment was carried out in a Randomized Complete Block Design (RCBD) with four (4) treatments which were replicated three (3) times.

2.4. Data Collection

Data were collected on the following parameters.

They are: plant height, leaf length, leaf area, and leaf area index, number of rhizomes, fresh weight and yield per hectare. Proximate compositions were analyzed using [20].

2.5. Statistical Analysis

Data collected were subjected to analysis of variance (ANOVA) using SPSS Version 2.0, while the mean differences were separated using Duncan's Multiple Range Test (DMRT) at 5% confidence level.

3. Results

The result on soil physicochemical properties is presented intable 1. The analysis show that Dumpsite contained more of organic matter, organic carbon, Nitrogen, phosphorus and potassium including high heavy metals evaluated.

Table 1 Physicochemical Properties of Dumpsite soil and Top soil

Parameters	Dumpsite organic manure soil	Top soil
Chromium ppm	0.207	1.25
Zinc ppm	21.165	1.65
Copper ppm	0.024	1.83
Cadmium ppm	1.087	-
Lead ppm	17.582	1.37
Silver ppm	0.883	-
Iron ppm	18.910	1.65
Cacmol/kg	0.1026	3.20
Mg cmol/kg	0.0522	2.90
Na cmol/kg	0.0217	0.19
Phosphorous mg/kg	66.213	12.5
Total organic carbon %	0.1275	1.34
Total Nitrogen %	2.408	0.12
Potassium	43.315	0.21
% Sand	65.6	77.60
% Silt	27.2	8.0
% Clay	7.2	14.4
Class	SL	LS
pH	5.8	5.36
CEC Cmol/kg	5.7548	7.70
Organic matter	3.25	1.53

3.1. Plant height

The data in pant height (Table 2) showed that application of Dumpsite manure significantly improved the plant height of *Curcuma longa L.* (turmeric) as month increases. T_4 at 1 and 2 MAP recorded the tallest plant heights (6.533cm and 26.333cm respectively) which was not statistically different ($P<0.05$) from the lowest (00cm) obtained on both months, among the Dumpsite treatments levels, whereas at 3 months after planting, T_2 recorded the tallest plant height of

41.90cm which was significantly different (P<0.05) from the shortest plant height (14.17cm) recorded from control and other treatment levels from Dumpsite. However, at 4, 5 and 6 months after planting T_4 from Dumpsite manure recorded tallest plants (74.067cm, 74.83cm and 89.80cm respectively) compare to control and other treatments levels. It was observed that the rhizome took up to 2 months before it sprouted.

Table 2 Effect of dumpsite organic manure soil on plant height (cm) of *Curcuma longa L.*(turmeric)

Treatments	1 MAP	2 MAP	3 MAP	4 MAP	5 MAP	6 MAP
T_1	0.00^{a}	0.000^{a}	14.17^{c}	39.670^{c}	50.40^{b}	60.48^{b}
T_2	3.467^{a}	20.700^{ab}	37.57^{abc}	53.000^{bc}	66.30^{ab}	79.71^{ab}
T_3	3.867^{a}	16.500^{b}	41.90^{ab}	68.400^{ab}	74.60^{ab}	89.52^{ab}
T_4	6.533^{a}	26.333^{ab}	33.33^{bc}	74.067^{a}	74.83^{ab}	89.80^{ab}

Means in the same column with the same letter(s) are not significantly different (P<0.05)

3.2. Effect of Dumpsite Organic manure soil on Leaf Length (cm) of *Curcuma longa L.*(turmeric)

The application of different levels of Dumpsite on the leaf lengths per plant of Turmeric differed significantly among various levels of applications. Among different levels of the Dumpsite, Treatment 4 recorded the longest leaf lengths (45.033cm) compared to the lowest obtained from control which was statistically different (P<0.05) also statistically different between the intermediate levels as shown in Table 3.

Table 3 Effect of Dumpsite Organic manure soil on leaf length (cm) of *Curcuma longa L.*(turmeric)

Treatments	1 MAP	2 MAP	3 MAP	4 MAP	5 MAP	6 MAP
T_1	0.000^{a}	0.000^{b}	16.033^{c}	24.100^{d}	29.467^{b}	34.387^{c}
T_2	4.500^{a}	19.567^{a}	28.833^{b}	32.733^{c}	36.267^{ab}	39.373^{bc}
T_3	4.333^{a}	21.167^{a}	31.900^{ab}	36.200^{bc}	40.800^{ab}	39.700^{bc}
T_4	3.233^{a}	24.333^{a}	34.167^{ab}	40.50^{bc}	41.500^{a}	45.033^{abc}

Means in the same column with the same letter(s) are not significantly different (P<0.05)

3.3. Effect of Dumpsite Organic manure soil on leaf Area (cm)of *Curcuma longa L.* (turmeric)

Leaf area per plant was influenced by application of Dumpsite Organic Manure Soil. It was observed at 1 and 2 MAP that there was no significant different (P<0.05) among the various values recorded from different treatment levels and sources as shown in Table 4. While at 3MAP to 6MAP. The organic manure source at different levels significantly influenced the leaf area of turmeric. In T_4 from Dumpsite Organic Manure at 1, 2, 3 and 4 MAP recorded maximum leaf area (266.2cm^2, 2482.8cm^2, 6197.7cm^2 and 7515.0cm^2 respectively) compared to the lowest obtained in control . T_3also recorded the highest leaf areas of 8455cm^2 and 10149cm^2 respectively which was significantly different from control as shown in Table 4.

Table 4 Effect of Dumpsite soil manure on leaf area (cm^2) of *Curcuma longa L.(*turmeric)

Treatments	1 MAP	2 MAP	3 MAP	4 MAP	5 MAP	6 MAP
T_1	0.0^{a}	0.0^{b}	1241.1^{c}	2954.0^{c}	4681^{b}	5617^{b}
T_2	17.9^{a}	1770.1^{a}	5140.4^{b}	5274.0^{b}	7234^{ab}	8681^{ab}
T_3	96.1^{a}	1794.8^{a}	6159.7^{ab}	6687.0^{ab}	8458^{ab}	10149^{ab}
T_4	266.2^{a}	2482.8^{a}	6197.7^{ab}	7515.0^{ab}	7662^{ab}	9194^{ab}

Means in the same column with the same letter(s) are not significantly different (P<0.05)

3.4. Effect of Dumpsite organic manure soil of Leaf Area Index of *Curcuma longa L.*(turmeric)

Table 5 shows the effect of rates of Dumpsite Organic Manure Soil on leaf area index of Turmeric at 1, 2, 3 and 4 MAP. The results also showed that there was no significant difference between the leaf area indexes at 1 MAP as influenced by Dumpsite Organic Manure. It was observed on leaf area index,that there was no trend on the values recorded. However, at 3MAP T_3 of Dumpsite Organic Manure Soil recorded the maximum leaf area index of 4.2067 which was not significantly different from control and other intermediate values. Whereas, at 4, 5 and 6 MAP content recorded the highest leaf area index which was not significantly different from other treatment levels.We observed a decrease of leaf area index at 6MAP.

Table 5 Effect of Dumpsite organic manure soil on leaf area index of *Curcuma longa L.*(turmeric)

Treatments	1 MAP	2 MAP	3 MAP	4 MAP	5 MAP	6 MAP
T_1	0.000^{a}	0.000^{c}	1.8920^{b}	3.1547^{a}	3.4063^{a}	2.8383^{a}
T_2	0.4817^{a}	3.1480^{ab}	3.0780^{ab}	2.3863^{ab}	3.1543^{a}	2.6297^{a}
T_3	1.6420^{a}	2.6383^{ab}	4.2067^{ab}	2.0390^{ab}	3.0807^{ab}	2.5677^{a}
T_4	0.4933^{a}	2.3067^{b}	3.4753^{ab}	1.7767^{b}	1.6497^{c}	1.3747^{c}

Means in the same column with the same letter(s) are not significantly different (P<0.05)

3.5. Effect of Dumpsite organic manure soil *Curcuma longa* L. (turmeric) on Proximate Composition

Dumpsite organic manure soil application significantly improved quality of nutrient content of *Curcuma longa L.(*turmeric)rhizome as shown in figure 1.

On moisture content, control significantly recorded the highest moisture content (81%) compare to the lowest (72%) recorded from T_4. This was followed by T_3 (76%) and T_2 (75%) at moisture respectively.

Data on Ash content showed that T_4 recorded the highest Ash content (7.146%) which was significantly different from the lowest (0.15%) recorded from T_2. Whereas, T_3 obtained significantly higher Ash content (3.983%) than control (2%) and T_2 (0.15%). Data analysis showed that fat content was not improved significantly by addition of Dumpsite Organic Manure Soil, because it was observed that control recorded the highest percentage of fat content (0.6369%) compare to the lowest (0.395% obtained from T_3. This was by T_4 (0.445%) and T_2 (0.396%). The result on fibre content revealed that T_3 gave the highest fibre content of 8.427% which was significantly different (P<0.05) from the lowest (2.283%) recorded from control. This was followed by T_4 with 2.939% fibre content and T_2 with 2.852% fibre content. Data on Protein showed that T_4 and control had similar protein percentage content of 4.9% respectively which was significantly different (P<0.05) from the lowest (4.2%) recorded from T_2. This was followed by T_3 (4.55%) and T_2 (4.2%).

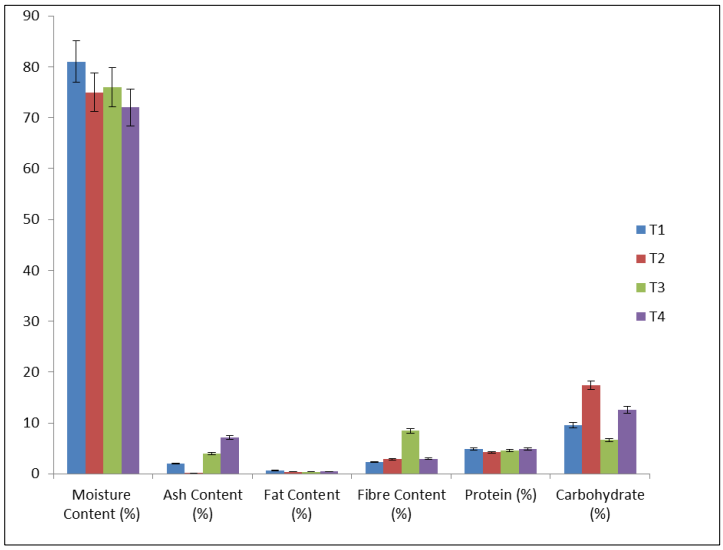

Figure 1 Effect of Dumpsite Organic Manure Soil on Proximate Composition of Turmeric

A perusal of the data on proximate composition revealed that percentage of carbohydrate content was significantly influenced by different levels of Dumpsite Organic Manure Soil. T_2 recorded the highest amount (17.412%) of percentage carbohydrate content significantly different from the lowest 6.644% obtained from T_3 control 9.563%. However, T_4 significantly gave higher carbohydrate content of 12.57% than control and T_2 as shown in figure 1

3.6. Effect of Treatments on Yield and Yield Component of *Curcuma longa L.* (turmeric)

3.6.1. Number of Turmeric Rhizomes

Among the different doses of Dumpsite Organic Soil Manure treatment 3 gave the highest number of Rhizomes (328.7) compared to the lowest (189) number recorded in T_1 there was no statistical effect amongthe treatment as shown in figure,2

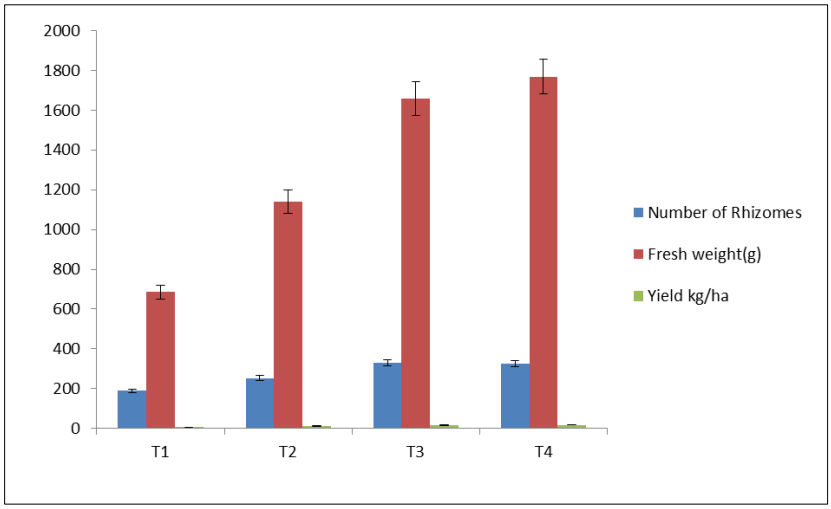

Figure 2 Effect of Dumpsite organic manure soil on Yield and Yield Component of *Curcuma longa*. L(turmeric)

3.7. Fresh Weight

On fresh weight, T_4 among the Dumpsite recorded the highest weight (1769.3g) which was not statistically different from the lowest 686.3g obtained from T_1. However, in all, the T_7 gave maximum weight of 2643.0g which was statistically different from the lowest 686.3g from control and other intermediate levels.

3.8. Yield

The effect of Dumpsite showed that yield per hectare of *Curcuma longa L.*(turmeric) did not differed significantly ($P<0.05$) due to the application of various doses of Dumpsite Organic Manure Soil used. The highest per hectare (17.66kg/h) was recorded in T_4 among the Dumpsite Organic Manure soil compared the lowest obtained from T_1.

4. Discussion

The study revealed that application of Dumpsite Soil Organic Manure soil influenced growth and yield of *Curcuma longa* L .(turmeric). The vegetative traits as shown in the results were significantly improved by application of Dumpsite Organic Manure. This could be attributed to release of micro and macro elements that are essential to growth of plant from Dumpsite Organic Manure soil which help in protein synthesis by the incorporation of release nitrogen and other minerals which enhance vegetative growth of *Curcuma longa L.*(turmeric)plant. The findings are in agreement to the results of [21], who reported also that, favourable growth observed could be as a result of improved soil physical and chemical properties due to incorporation of organic manure. This conformed to works of [22] and. [21]. Also,[10],reported that organic waste also provide essential plant nutrients and maintain soil fertility and thus stimulates crop growth and yield.

The highest leaf length and leaf area observed from high rate of Dumpsite Manure could be that nutrients released in the soil from these manure types could lead to optimum vegetative growth and enhance maximum leaf length .This correspond to work of [23], who recorded longest leaf length from highest amount of nutrient from their

experiment.The results are similar to finding of [24] recorded data for plant height, number of leaves per plant, number of tillers per plant, leaf area, leaf biomass, shoot biomass and yield on *Curcuma longa* L. (turmeric)

In this study, it was revealed that weight of rhizome increased with increase in the amount of Dumpsite application, it could be that the higher rate of application enhanced maximum plant nutrients in available form in Dumpsite manure which help proper growth of *Curcuma longa* L. (turmeric) resulting in highest fresh weight. [10] also reported that the organic wastes also provide essential plant nutrients and maintain soil fertility and thus stimulate crop growth and yield.

The yield of *Curcuma longa L.* (urmeric was observed varied significantly among the different levels of application of Dumpsite manure. Though, comparatively the 15 tons recorded maximum yield than other rates. This could be due to fact that 15-tons contain more nutrients that improved growth of roots of *Curcuma longa* L. more which enhanced absorption of nutrients necessary for production of rhizomes, thereby increasing yield. This confirmed the work [23] who reported that organic manures improved the root system of turmeric, so the roots could absorbs the minerals and irons from soil solution efficiently, resulting in higher yield. Our findings in this study corresponds to findings of [12] who concluded that manure MSW compost stimulated the yield of spiny chicory and increased bioavailability of trace elements (Cu, Zn, Fe, Mn, Cr, Ni, Pb, Cd) in soils

Similarly [25] found that the FYM application significantly improved plant height, number and weight of mother, primary and secondary rhizome. Nitrogen, phosphorus and potassium contents in leaves and rhizome improved with farmyard manure application [25].

Increase observed in crude fibre, Ash content, fibre content, protein and carbohydrate compare to control, could be due to supply of macro element and microelement necessary for synthesis of these parameters in available form by application of Dumpsite Organic Manure Soil. This finding is in agreement with work of [26], in Guava, similar findings were reported by [27] in *Curcuma aromatic* and [28], in *Amaranthus* where crude fibre content was influenced by the application of vermicompost.The findings in this study on carbohydrate content is in sharp contrast with work of [1], who reported a decrease in carbohydrate content in *Phaseolus vulgaris .C.*

5. Conclusion

The result of this study revealed the potential of Dumpsite Organic Manure Soil in the growth and production of *Curcuma longa L. (*turmeric). The application of Dumpsite Organic Manure Soil had a significant effect on the performance of morphological parameters of *Curcuma longa L.* (Plant height, leaf length, leaf area, leaf area index, yield and yield components) measured. Also, it was concluded that the nutrients quality (Ash content, fibre, protein and carbohydrate) was improved compared to control, as a result it could be used for growth of crops provided harmful and toxic substances are not in excess in the soil which could affect animals and humans through bioaccumulation.

Compliance with ethical standards

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Disclosure of conflict of interest

The authors declared that there is no conflict of interest that could possibly arise in this work

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