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Effect of Poultry Manure Rates on the Growth and Yield of Turmeric (Curcuma Longa L) In Nigeria

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Abstract: *The assessment of different rates of poultry manure on the growth and yield of turmeric (Curcuma longa L.) was conducted at Imo State Polytechnic Teaching and Research Farm. The area is in a humid tropical agro-ecological zone. The objective was to evaluate yields under different poultry manure rates. The study was laid out in a Randomized Complete Block Design (RCBD) replicated four (4) times. Each replicate was made up of six (6) plots. Treatments include poultry manure of rates of 0, 4, 8t/ha and turmeric rhizome seeds. Evaluations of growth parameters were made at 4, 8, 12, 16 and 20 weeks after planting (WAP) on plant height, No of leaves/plant, leaf area, No of days to 50% flowering on each plots while yield values were determined at harvest at thirty six weeks after planting. Analysis of variance result (ANOVA) indicate that application of poultry manure at 8t/ha increased rhizome yield 2185.7kg/ha, dry matter 33.50kg/ha, plant height, No of leaves/plant & leaf area significantly (P < 0.05) and enhance flowering to 151.50days. The post-harvest physcio-chemical analysis of the experimental site indicates that the application of poultry manure decreased soil bulk density (from 1.23 to 0.98), increased pH (from 5.25 to 6.27). It was concluded that poultry manure application at 8t/ha is optimum for improved performance of turmeric.*

Keywords: *Turmeric, poultry manure, application rates, yield, Nigeria.*

I. Introduction

Turmeric (Curuma longa L.) belongs to the family Zingiberaceae and is cultivated extensively in India, Pakistan, Bangladesh, China, Indonesia and Sri Lanka. In Nigeria, about 19 states are prominent in the cultivation of turmeric and it assumes different local names depending on the locality. Turmeric and other minor crops such as rizga and Hausa potato have been playing significant role in the food chain supply in Nigeria (Olojede et al, 2005).

Nigeria has a favorable condition for turmeric cultivation and thus may play a dominant role in turmeric production. Turmeric is found useful as coloruing agents for food, cosmetics and pharmaceuticals in the treatment of various kinds of diseases (Semwal et al, 1997). With increasing population pressure in tropical Africa, shifting cultivation is no longer sustainable and the length of traditional bush fallow for maintaining the productivity of the soil is becoming shorter (Mbah and Mbagwu, 2006). In the rainforest agro ecology of south eastern Nigeria, intensive cropping has become more common and the primary function of soil productivity and fertility restoration is becoming less effective (Okaigbo, 1982). Organic manure on the other hand is known to be effective in the maintenance of adequate supply of organic matter in the soils with attendant improvement in soil physical and chemical conditions and enhanced crop performance (Obi and Ebo, 1995, Ikpe and Powel, 2003, Ano and Agwu, 2005).

The need to use renewable forms of energy and reduce cost of fertilizing crops has revived the use of organic fertilizers worldwide. Improvement of environmental conditions and public health are important reasons for advocating increased use of organic materials (Seifritz, 1982, Ojeiniyi 2000, Mauritius and Vlelc, 2001). Therefore the objective of this study is to estimate the appropriate poultry manure rate required for the optimum production of turmeric in south east Nigeria.

II. Materials And Methods

This study was conducted at the Teaching and research farm of the department of agricultural technology Imo State Polytechnic Umuagwo. The study area is situated at latitude 07^{0}0E and longitude 07^{o}0E in the humid tropical rain-forest zone of south eastern Nigeria. Before and after the experiment, surface soil samples 0- 20cm were randomly collected at the experimental site using soil auger at (12) twelve different points. The samples were bulked to produce composite samples which were air dried and sieved with 2mm sieve. Also samples of poultry manure were subjected to chemical analysis. The experimental site were manually cleared of vegetation with matchets and marked out into blocks. Seedbed preparations were constructed using weeding hoe. The size of each plot was 3 x 3m separated from each other within the block or replicate by a 1m alley and between blocks by 2m access route. The experiment was laid out in a Randomized

Complete Block Design (RCBD) replicated four (4) times. Each replicate in made up of six (6) plots making a total of 24 (twenty four) plots. The treatments comprised of poultry manure at the rate of 0, 4 and 8t/ha. The test crop healthy rhizome of turmeric variety NCL NVRI primary rhizome obtained from National Root Crop Research Institute (NRCRI) Umudike Abia State. The test crop turmeric was planted immediately at a spacing of 50 x 45cm apart to obtain a plant population of 44, 444 plants/ha. Poultry manure from deep litter (completely decomposed) was applied two weeks after emergence at the rate of 0, 4 and 8t/ha as appropriate using band placement method. The farm plot was weeded manually using weeding hoe and matchet at an interval of one month till harvesting period. Earthen up operation was done twenty four (24) weeks after planting (WAP). Evaluation of growth parameters was collected on plant height, number of leaves/plant, leaf area, number of days to 50 percent flowering at 4, 8, 12, 16 and 20 weeks after planting while yield values (rhizome and dry matter) were determined at harvest in each of the experimental plot at thirty six (36) weeks after planting. The data collected were subjected to analysis of variance (ANOVA) and the treatment means separated using Ducan multiple range test at 5% probability level (Hinkelman and Kemptohorne, 1994).

III. Results

Soil

The result of the pre-planting and post-harvest soil analysis of the experimental site is shown in Table 1. The initial analysis of the soil indicate low nitrogen, phosphorus, and higher bulk density. The pH was 5.25 which show that the soil is acidic. The soil was also low in nutrient contents. Result showed that with regard to the analysis of the soil on treatment basis, the application of poultry manure increased pH status of the soil and reduced bulk density. There was an improvement in nitrogen, available phosphorus, and organic carbon of residual nutrient status. Thus, the application of poultry manure improved and sustained the soil. The nutrient content of poultry manure is also presented in Table 2.

Table 1: Physical and chemical Properties of soil before and after the experiment (0 - 20cm)

Treatments	Before									(MEQ/100g soil)				
	Sand (%)	Silt (%)	Clay(%)	pH(H_2O)	pH(KCl)	OC	OM	TN	P	Ca	Mg	H^+	Al^{3+}	BD
	92.0	**8.0**	**10.0**	**5.25**	**5.20**	**0.60**	**1.34**	**0.02**	**0.20**	**0.30**	**0.14**	**0.48**	**0.95**	**1.23**
	After													
8t	87.0	4.8	8.0	6.26	5.10	0.439	0.757	0.38	26.32	0.600	0.200	0.95	Trace	0.98
4t	90.0	3.6	4.4	6.34	5.55	0.200	0.344	0.02	18.69	0.08	0.036	1.00	Trace	1.05
0t	79.2	7.7	13.1	5.50	5.78	0.409	0.705	0.030	19.74	0.65	0.180	1.10	Trace	1.23
0t	72.7	8.7	19.6	5.44	5.80	0.319	0.550	0.03	26.11	0.35	0.200	1.10	Trace	1.22
4t	85.1.	3.7	4.2	6.32	5.40	0.359	0.619	0.029	22.4	0.40	0.180	1.20	1.15	1.10
8t	76.4	12.0	10.6	6.20	5.47	0.419	0.722	0.03	22.19	0.38	0.117	0.90	Trace	1.01
0t	83.7	5.8	10.1	5.26	5.44	0.339	0.585	0.02	17.50	0.40	0.160	1.10	Trace	1.10
4t	78.8	8.4	12.8	6.45	5.75	0.200	0.344	0.04	34.02	1.00	0.350	1.15	Trace	1.09
8t	90.7	3.2	6.1	6.63	5.97	0.219	0.378	0.030	19.53	0.45	0.220	1.05	Trace	1.04
0t	90.6	2.8	6.6	5.70	5.91	0.259	0.447	0.019	18.2	0.15	0.084	1.20	Trace	1.20
4t	80.4	6.1	13.5	6.25	5.65	0.249	0.430	0.024	19.88	0.30	0.167	1.35	Trace	1.16
8t	87.2	5.2	7.6	6.33	5.45	.299	.516	0.03	32.45	0.55	0.250	1.35	0.95	1.12

Oc	=	Organic carbon
Om	=	Organic matter
BD	=	Bulk density
T_N	=	Total Nitrogen

Table 2: Chemical composition of poultry manure

Elements	Percentage
pH (H_20)	7.56
Organic carbon (%)	28.22
Organic matter (%)	48.65
Nitrogen (%)	2.27
Phosphorus (Ppm)	47.80
Potassium(Cmol/100g soil)	2.60
Magnesium(Cmol/100g soil)	0.52
Calcium (Cmol/100g soil)	1.42
Sodium(Cmol/100g soil)	0.64

Plant height

The mean plant height of turmeric (Curcuma longa L.) as affected by poultry manure rate is presented on Table 3. Poultry manure application increased the height of turmeric throughout the experimental period. Poultry manure application at the rate of 8t/ha significantly ($P < 0.05$) increased the plant height of turmeric above the 4t/ha application at 16 and 20 weeks after planting. The plants treated with 8t/ha at 16 WAP had a mean plant height value of 7.18cm significantly ($P < 0.05$) different from 6.58cm obtained for 4t/ha application rate. At 20 WAP 8t/ha (9.54cm) 4t/ha 8.27cm and the lowest was consistently recorded at 0t/ha.

Table 3: Effect of Poultry manure rates on turmeric (Curcuma longa L.) plant height (cm)

Treatment	4	8	12	16	20 WAP
0t/ha	2.09^{b}	4.33^{b}	$4..41^{b}$	4.69^{c}	6.61^{c}
4t/ha	2.36^{a}	4.90^{ab}	5.15^{ab}	6.58^{b}	8.27^{b}
8t/ha	2.68^{a}	5.20^{a}	5.43^{a}	7.18^{a}	9.54^{a}

Means in the same column having the same letters are not significantly ($P < 0.05$) different using DMRT.
WAP = Weeks after planting

Number of leaves/plant

Poultry manure application significantly ($P < 0.05$) increased the number of leaves per plant from 8 weeks after planting (WAP) (Table 4). The highest number of leaves per plant 7.03 was obtained at 8t/ha manure rate at 20WAP, followed by 4t/a (6.27). The 0t/ha manure rate recorded the lowest leaf number per plant of (5.63). The difference in the number of leaves per plant at 4 WAP was however not statistically significant ($P < 0.05$). The leaf number per plant value between 8t/ha and 4t/ha were statistically the same at 16 WAP. Increasing poultry manure rates significantly ($P < 0.05$) increased the number of leaves/plant. The lowest values in leaf number per plant were consistently recorded at 0t/ha manure rate.

Table 4: Effect of poultry manure rates on turmeric (Curcuma longa L.) leaf number per plant

Treatments	4	8	12	16	20WAP
0t/ha	2.55^{a}	4.34^{a}	4.63^{b}	4.69^{b}	5.63^{c}
4t/ha	2.80^{a}	4.82^{a}	4.90^{b}	5.15^{a}	6.27^{b}
8t/ha	2.98^{a}	4.93^{a}	5.15^{a}	5.43^{a}	7.03^{a}
	NS				

Means in the same column having the same letters are not significantly ($P < 0.05$) different using DMRT.
NS = Not significant ($P < 0.05$)

Leaf area

Increasing poultry manure rates significantly ($P < 0.05$) increased the average leaf area per plant in turmeric (Table 5). The highest leaf area per plant value of 66.95cm^2 was obtained 20 WAP using the poultry manure rate of 8t/ha. This is however not significantly ($P < 0.05$) different from the leaf area per plant value of 63.40cm^2 obtained at 4t/ha poultry manure rate 20 WAP. The 0t/ha poultry manure rate gave the lowest leaf area per plant, significantly ($P < 0.05$) different from all others throughout the period of the experiment. At 20 WAP the leaf area per plant was 41.27cm^2 at 0t/ha manure rate (Table 5).

Table 5: Effects of poultry manure rates on turmeric (Curcuma longa L.) leaf area per plant (cm^2)

Treatment	4	8	12	16	20WAP
0t/ha	21.87^{b}	32.41^{b}	34.41^{b}	38.79^{b}	41.27^{b}
4t/ha	25.63^{a}	37.80^{a}	40.16^{ab}	48.49^{ab}	63.40^{a}
8t/ha	27.51^{a}	38.93^{a}	47.71^{a}	53.50^{a}	66.95^{a}

Means in the same column having the same letters are not significantly ($P < 0.05$) different using DMRT.

Number of days to 50 percent flowering

The highest level of poultry manure application (8t/ha) had a pronounced effect in flowering, decreasing the number of days to 50 percent flowering to 151.50 days. This is not significantly ($P < 0.05$) different from 152.1days obtained with 4t/ha manure rate application. Plots that did not receive the poultry manure treatment (0t/ha) had the highest number of days to 50 percent flowering of 156.22 days significantly ($P < 0.05$) different from others (Table 6).

Dry matter yield

The result of the dry matter yield at harvest is presented on Table 7. The dry matter yield of turmeric that received poultry manure significantly ($P < 0.05$) differed from the control. Highest dry matter yield of 33.52t/ha were recorded in plants treated with 4t/ha of poultry manure whereas plants treated with 8t/ha of poultry manure gave 33.50kg/ha dry matter yield. These are statically ($P < 0.05$) the same. There was no

significant ($P < 0.05$) difference between the plants that received 8t/ha and 4t/ha poultry manure. The control plants without any manure (0t/ha) gave the lowest dry matter yield of 25.08kg/ha significantly ($P < 0.05$) different from the others (Table 6).

Rhizome yield

Increasing poultry manure rates in turmeric significantly ($P < 0.05$) increased the rhizome yield (Table 6). Application of 8t/ha poultry manure produced the highest mean rhizome yield of 2185.7t/ha, significantly ($P < 0.05$) different from 2046.5t/ha rhizome yield produced at 4t/ha poultry manure application rate. The control treatment with 0t/ha poultry manure gave the lowest rhizome tuber yield of (1520.9t/ha), significantly ($P < 0.05$) different from all others (Table 6).

Table 6: Effect of poultry manure rates on number of days to 50% flowering, dry matter and rhizome yield of turmeric (Curcuma longa L.)

Treatments	No. of days to 50% flowering	Dry matter (t/ha)	Rhizome yield (t/ha)
0t/ha	156.22[a]	25.08[b]	1520.9[c]
4t/ha	152.11[b]	33.52[a]	2046.5[b]
8t/ha	151.50[b]	33.50[a]	2185.7[a]

Means in the same column having the same letters are not significantly ($P < 0.05$) different using DMRT.

IV. Discussion

The result of soil physico-chemical analysis of the experimental site after the experiment revealed that poultry manure at 4t/ha and 8t/ha reduced bulk density and increased the pH from 5.25 – 6.27, however, the degree of effect increased with increase in the quantity of manure applied. The improvement in soil physical properties with increasing levels of poultry manure as observed in the results can be attributable to increase in soil organic matter. Organic matter stabilizes soil structure thereby reducing bulk density, increasing porosity and water content. This influence of poultry manure application in improving the soil physical conditions is in conformity with the reports of several researchers (Weil and Kroontje, 1979; Mbagwu 1992; Khaliel et al, 1981, Paglial et al, 1987, Akanni, 2005).

The significant increase in rhizome, dry matter yield and other parameters with an increase in poultry manure rates is in agreement with the report of Manhas & Gill (2010), who stated that application of farm yard manure (FYM) increased the growth, dry matter accumulation, yield and quality of turmeric. Hossain and Ishinine (2007); Velmurugan et al, (2007); Mohapatra and Das (2009); Roy et al, (2010), and Dinesh et al, 2010) reported that organic fertilizer improved soil productivity and fertility which in turns improved yield and quality of such long duration crop like turmeric. This is also in line with the work of Ibeawuchi et al. (2012), who reported that, the use of 10t/ha poultry manure without mineral fertilizer gave highest yield in respect of crop growth and yield performance in cassava, groundnut and sorghum intercrop.

V. Conclusion

From the forgoing, poultry manure showed great potentials in growth and yield enhancement of turmeric (Curcuma longa L), improved the soil nutrient status, reduced acidity. Within the limits of this study, it suffices to say that application of poultry manure at the rate of 8t/ha is optimal for the production of turmeric in this agro-ecology. It is therefore recommended that higher rates of poultry manure and/or other sources of organic manure be tried in subsequent studies.

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