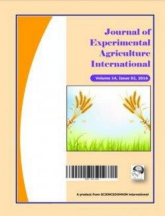

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Effects of Poultry Manure on the Growth and Yield of Basil Plant (*Ocimun gratissimum*) in a Tropical Utilsol Soil

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Author's contribution

The sole author designed, analysed, interpreted and prepared the manuscript.

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ABSTRACT

Ocimum gratissimum commonly called Basil plant or scent leaf is one of the less known, neglected vegetable with high economic value as food, medicinal and industrial uses. Studies were therefore conducted to determine the effects of poultry manure on the growth and yield of *Ocimum gratissimum* in the Teaching and research Farm, Department of Agronomy, Faculty of Agriculture, Cross River University of Technology, Obubra , Cross River State, Nigeria. The experiment has nine (9) rates of poultry manure: 0, 1.0, 1.5, 2.0, 2.5, 3.0, 3.5, 4.0, 6.5 t/ha laid out in a randomized complete block design with three replications. The application of poultry manure at 3- 4t/ha was more beneficial than higher rates. Results showed that poultry manure significantly ($p>0.05$) increased number of leaves, branches per plant and plant height. The highest Leaf index value plant height, leaves and branches per plant was obtained at 16weeks after planting with 6.5 t/ha. Poultry manure. While 4t/ha poultry manure gave the highest growth rate, Leaf fresh yield, dry matter of leaf, stem and seed yield per plant and per hectare. Farmers are advise to apply 3-4t/ha of poultry manure to cultivate *Ocimum gratissimum* for optimum growth and seed yield under the utilsol conditions .

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Keywords: Ocimum gratissimum; poultry manure; growth; yield.

1. INTRODUCTION

Scent leaf (*Ocimum gratissimum*) belong to the family *Lamiaceae* is of the less known Nigerian vegetables cultivated for its medicinal and domestic uses [1]. The leaves, flowers (inflorescences), stems and roots have high economic value.

The leaves and young immature stems are used as spices in preparing soup, stew and other local dishes because of its aromatic taste [1]. The leaves and flowers (inflorescences) are used to season meat [2,1] reported that extra extract from the leaves are used to cure diarrhea, tooth ache, fever, menstrual and abdominal pains in women. The plant extract has ethanoic, anti-septic and anti-diabetic properties and other medicinal compounds used as food preservative agent and control of black pod diseases of cocoa [3].

The soil fertility is one of the vital factors that affect the growth and yield of crops in the tropics. Many researchers have reported that the soil of the tropics are often predispose to high temperature, rainfall and erosion that cause lost of soil nutrients and increase in acidity [4].

Awodun [5] noted that the application of poultry manure play significant roles in enhancing yield of crops in the southern part of Nigeria. Dauda et al. [6] reported that poultry manure increased the leaf area total chlorophyll content and grain yield of maize and watermelon. The application of poultry manure mineralizes faster than other animal manure such as cattle or pig dung; hence it releases its nutrients for plant uptake and utilization rapidly [7].

Earlier researchers in organic matter [8,9] reported that poultry manure contains basic nutrients required for enhancing growth and yield of crops. The further stated that application of poultry manure increases carbon content, water holding capacity, aggregation of soil, and decreases bulk density. Amhakhian and Isaac [10] reported that poultry droppings applied at the rate of 10 t/ha and 20 t/ha, increased plant height, number of leaves and fruit yield of Pepper.

Despite the economic importance of *Ocimum gratissinum* plant, farmers who wish to cultivate the crop are faced with same major constraint which hinder its cultivation in commercial quantities (sale). These constraints include dearth of information in ignorance of plant spacing and appropriate rate of fertilizer application that will affect the productivity of this important crop. The few farmers who cultivate the crop in the background garden still grow the crop without proper knowledge of it nutrients requirements, fertilizer application and harvest it unconventionally, this affect its survival as well as the yield of *Ocimum gratissimum*. On the other hand, There is paucity of literature on the effects of poultry manure on the growth and yield of *Ocimum gratissimum* in Nigeria. Few workers have tried to assess the importance of organic manures in crop production. Essoka et al. [8] have reported beneficial effects of organic manure on soil properties such as bulk density, soil moisture content , water–holding capacity and other soil physical properties with increase in crop growth and yield [11].

According to Okoli and Nweke [12], published works on the organic manure use in Nigeria is rather scanty. Currently in Cross River South-South Nigeria, there are no recommended standards with respect to rate of poultry manure require for enhancement of the growth and yield of *Ocimum gratissimum* in commercial quantities in the study area.

This investigation is needed to provide agronomic information suited, to build conservation capacity, domestication, improve cultural practices, of *Ocimum gratissimum.*

The objective of this study therefore, was to determine the most appropriate rate of poultry manure require for optimum growth and yield of *Ocimum gratissimum* in ultisol soils of Obubra, Cross River State, South – South Nigeria.

2. MATERIALS AND METHODS

2.1 Description of Experimental Site

Field experiments were carried out at the Research and Teaching Farms of Department of Agronomy, Faculty of Agriculture, Obubra, Cross River University of Technology, Cross River State, South-South, Nigeria. Obubra is located at latitude 05°59' N and longitude 08°15" E Cross River Agricultural Development Project [13].

The experiment was conducted during the 2017/2018 cropping seasons in a tropical humid environment that is characterized by a bimodal rainfall pattern with peaks in July and September and an interrupted dry spell in August. The site used for this study is a tropical rainforest vegetation origin but has been reduced to derived savannah because of continuous use of land for farming . The land was under two years fallow period as at when it was cultivated for this experiment.

2.2 Land Preparation

The land measuring 30 m x 10 m^2 with area (300m^2) was prepared manually by clearing, ploughed harrowed and marked out into three blocks. Each block was divided into nine plots of 6 m x 4 m (24 m^2) separated by 0.5 m from the adjourning plot , while each block was separated by one meter.

Soil samples were collected with steel auger to a depth of 0 to 20 cm from forty representative locations before planting on 5th April, 2017 and 2018). These soil samples collected before planting were bulked together from where a composite sample was obtained for laboratory analysis in order to assess the initial phyisco-chemical properties of the site, using standard laboratory methods.

2.3 Experimental Design

The experimental design was a randomized complete block design. Treatments were nine rates of poultry manure: 0, 1.0, 1.5, 2.0, 2.5, 3.0, 3.5, 4.0, and 6.5 tones per hectare. These rate were used for the study because previous research in this location have used higher poultry manure rates of 10, 20, 30, 40 ,50 and above used for cultivating other crops like yam and maize were not too useful for the farmers adoption [8]. This is because poor resource farmers complained that it was very difficult and expensive to get such large quantities of poultry manure.

2.4 Application of Poultry Manure

Well cured poultry manure was collected from poultry pens in Obubra, Cross River State, South- South, Nigeria. The poultry manure was stored in sack bags well tie for one month before application. The chemical analysis of the poultry manure used for the experiment was also evaluated using standard laboratory methods as described in the IITA manuals. The required rate (quantity) for each plot was applied according to the schedule rate of the nine treatments (0, 1.0, 1.5, 2.0, 2.5, 3.0, 3.5, 4.0, and 6.5) tones per hectare was applied to the appropriate plots as described in the experimental design. The method of application was by broadcast plough down , where the require quantity of poultry manure per plot was sprayed on the plot and completely worked into the soil with a garden fork at two weeks before planting of *Ocimum gratissimum* seeds.

2.4.1 Planting

Ocimum gratissimum was propagated by seeds. Mature seeds were collected from an old peasant farmer who grow it as a compound crop for food and medicinal purposes, since there is yet no source for improved seed materials. The seeds were first sown in the nursery for four weeks to raised seedlings before transplanting to the field experimental plots. Nursery was prepared in March 3rd, 2017 and 2018 manually cleared , ploughed, harrow , watering , broadcasting the seeds , mulching and partial provision of shade was done close to the site of the experimental field.

Transplanting of *Ocimum gratissimum* seedlings was done on 10th April, 2017 and 2018 when seedlings were 4 weeks old. They were uprooted with ball of earth to reduce loss of moisture and death due to transplanting shock during and after transplanting of the seedlings.

2.4.2 Cultural practices

Weeding was done manually using a hand weeding hoe five times in each year (2017 and 2018) to keep the plots as weed free as possible.

2.4.3 Data collection

Three days to commencement of data collection, ten plants chosen at random from the middle row in each plot were tag and label for ease of identification for measurement vegetative growth parameters. The mean calculated from the ten tag plants were used to determine plant height, leaves and branches number per plant.

Data were collected on the following:

Plant height (cm) was determined by measuring the height of the plant from the soil level to the topmost apex leaf using a measuring tape.

The number of branches and leaves per plant was determined by taking a visual count of the green leaves and branches.

Leaf area index was determined form leaf area. Leaf area was measured by random collection of 10 ten plants from the middle row and used to measure the leaf area using the leaf area meter (Model-MK-2). The measured leaf area was used to determine the leaf area index based on the relationship as stated by Shortal and Liebbardt [14].

$$LAI = Y \times N \times A_1 \times (Ap)^{-1}$$

Where: LAI =leaf area index, Y= population of plants per plot, N=Average number of leaves per plant, A_1 = Average area per leaf, and Ap = Area of plot.

2.4.4 Plant dry matter

Destructive sampling of two plants per plot was done and the plants were taken to the laboratory for dry matter determination. The destructively sampled plants were separated into fractions: (leaves, stem and roots) put in a paper envelops and oven dried at 80ºC to a constant weight for three days for the dried matter determination of leaves, stem and roots per plant using a electronic. weighing balance in both 2017 and 2018 seasons, respectively.

2.4.5 Crop growth rate analysis

Crop growth rate was evaluated at three stages 6- 10 Weeks After Planting (WAP), 10 - 16 WAP, 16 – 20 WAP in 2017 and 2018 cropping seasons.

This was done through destructive sampling of one plant per plot using the growth analysis techniques described by Shortal and Liebbardt [14].

Crop Growth Rate (CGR) = W2 - W1 / SA (t2 - t1) g/m2/day

Where

W1 and W2 = dry weight of nodule at beginning and end of the interval of growth period. t1 and t2 = sampling time 1 and 2, SA = the area occupied by the plant at sampling.

2.4.6 Harvesting

Harvesting was done on 10WAP, 14WAP and 20WAP in 2017 and 2018 by cutting the fresh shoot leaves and soft stems towards the apex manually using a sharp knife. Yield data were collected at harvest.

Each plant was harvested separately the flowers influence that contain the seeds were carefully separated and seeds were collected. After each harvest, both the leaves and seeds yield per plant and hectare were recorded using electronic weighing balance in 2017 and 2018.

2.5 Statistical Analysis

Data collected were statistically analyzed using the analysis of variance (ANOVA) procedure for randomized complete block design experiments as out lined by Gomez and Gomez [15]. Fishers least significance difference (F-LSD) at 5% probability level was used to separate treatments means that were significant as out line by Obi [16].

3. RESULTS AND DISCUSSION

The data on the initial physico-chemical properties of the soils used for the study is presented in (Table 1). The physical and chemical properties shows that the soil texture was sandy loam, low in fertility, as Indicated by the low content of organic matter (1.38% in 2017, 1.43% in 2018) , total nitrogen, (0.09% in 2017, 0.07% in 2018) , magnesium (1.38 meg/100 g soil in 2017, 1.46 meg/100 g soil in 2018), calcium (3.51 in 2017, 1.46 in 2018). The exchangeable base sodium was 0.18 in 2017, 0.19 in 2018, While exchangeable acidity: (Hydrogen 0.53 in 2017, 0.51 in 2018, Aluminum 0.15 in 2017,0.14 in 2018). Soil p H was acidic with mean values of (5.09 in 2017, 5.07 in 2018) in water and in KCl (4.73 and 4.65) in 2017 and 2018. The available phosphorus (4.54 ppm in 2017, 4.39ppm in 2018 and water soluble potassium (0.48 in 2017, 0.51 in 2018) were seemingly low. The results indicate that it is obvious that the fertility of the soils used for these experiments were inherently low. Based on the nutrients rating for soil fertility classes in Nigeria [17] and this implies that cultivating the soil without the use of soil amendments will not give high economic yield that will justify return of the input resources.

Therefore, there is need to supplement with poultry manure. These result of the low fertility status of the soil in the experimental sites obtained in present study agreed with the results reported by earlier researchers in this

location [8,12]. They observed that most ultisols of humid tropics are strongly weathered ,highly acidic due to high rain fall with the associated erosion and leaching in the area. The recommended the addition of soil amendment with organic manure such as poultry manure to increase the soil fertility for high crop yield.

The application of poultry manure significantly increased the number of leaves and branches per plant (Table 3). At all periods of measurement (6, 10 and 16 WAP) the number of leaves and branches increased consistently with increases in the poultry manure rates .The highest number of leaves (46.33, 47.23) and branches (8.22, 8.34) were obtained in poultry manure rate of 6.5t/ha at 16 weeks after planting in 2017 and 2018 cropping seasons respectively. The least number of leaves and branches produced per plant were recorded from control plots where poultry manure was not applied. The poor development of vegetative growth parameter (leaves, LAI, branches and plant .height) observed in treatment without poultry manure (control) further confirmed the report of [9]. Akanbi [18] reported that nutrient, availability especially nitrogen determine plant vegetative growth such as leaves, branches and plant height.

Table 1. Initial phyisco-chemical properties of the soils used for the experiments

.Parameters measured	Values obtained	
	2017	**2018**
Mechanical properties		
Particle size fractions (%)		
Coarse sand (%)	18.3	17.7
Fine Sand (%)	77	74
Silt (%)	15.6	13.9
Clay (%)	7.5	7.1
Textural class	Sandy loam	Sandy loam
Chemical properties		
pH in water	5.09	5.07
pH in KCl	4.73	4.65
Organic carbon (%)	0.77	0.81
Organic matter (%)	1.38	1..43
Total Nitrogen (%)	0.09	0.07
Available phosphorus (ppm)	4.54	4.39
Base Saturation (%)	1.532	1.591
Exchangeable cation (meg/100 g soil)		
Potassium	0.48	0.51
Magnesium	1.38	1.46
Calcium	3.51	4.14
Sodium	0.18	0.19
Aluminum	0.15	0.14
Hydrogen	0.53	0.51
Cation exchange capacity (meg/100 g soil)	6.23	7.57

Table 2. Nutrients content of poultry manure used for the experiment

Nutrient	Values obtained (%)	
	2017	**2018**
Organic matter	36.74	38.38
Organic carbon	61.36	63.24
Phosphorus	1.52	1.46
Calcium	4.54	4.18
Nitrogen	1.46	1.46
Magnesium	1.98	1 . 88

Source: Laboratory results values from analysis of poultry manure used for the experiments in 2017 and 2018

Table 3. Effects of poultry manure on the plant height (cm), number of leaves, branches per plant and leaf area index on x *Ocimum gratissimum* in 2017 and 2018 cropping season

Treatments	Number of leaves per plant						Leaf Area Index (LAI)						Number of branches per plant						Plant height (Main vine length (cm)					
poultry manure rate(t/ha)	2017			2018			2017			2018			2017			2018			2017			2018		
	6 WAP	10 WAP	16 WAP	6 WAP	10 WAP	16 WAP	6 WAP	10 WAP	16 WAP	6 WAP	10 WAP	16 WAP	6 WAP	10 WAP	16 WAP	6 WAP	10 WAP	16 WAP	6 WAP	10 WAP	16 WAP	6 WAP	10 WAP	16 WAP
0	7-.12	15.23	22.31	6.32	13.14	20.22	0.0132	0.0324	0.5042	0.0126	0.0353	0.5512	0.12	2.21	3.23	0.22	2.14	3.21	14.46	23.36	32.52	13.63	21.75	33.75
1.0	9.21	19.23	27.23	11.11	20.23	26.31	0.0327	0.0632	0.8453	0.03156	0.0641	0.7986	1.13	3.11	4.13	1.22	3.12	4.21	18.35	29.27	41.43	20.13	26.78	43.32
1.5	13.23	22.14	31.21	14.11	23.12	32.13	0.0421	0.0975	1.0132	0.04312	0.0869	1.0212	1.21	3.24	5.21	1.31	3.23	4.31	23.41	31.34	48.56	25.22	33.42	46.94
2.0	17.13	25.14	35.22	16.21	26.24	36.31	0.0497	0.1215	1.2798	0.04799	0.1178	1.2854	1.34	3.41	5.23	1.23	3.43	5.13	29.45	40.13	55.37	28.45	39.67	53.84
2.5	21.22	28.14	38.31	20.13	29.14	39.24	0.0536	0.3254	1.5769	0.05474	0.3376	1.61253	1.24	4.12	5.32	1.32	4.21	5.23	33.42	44.32	63.45	31.26	42.43	61.36
3.0	24.2	32.23	40.21	25.32	31.22	41.14	0.05832	0.4345	1.7045	0.0579	0.4425	1.6104	2.11	4.33	6.24	1.52	4.4	6.35	38.42	49.27	67.41	36.15	47.35	68.51
3.5	27.14	35.22	42.24	26.11	33.12	43.21	0.0675	0.7565	1.9462	0.06543	0.7812	1.8975	2.13	4.41	6.21	2.13	4.35	6.41	44.23	53.74	73.26	42.24	51.48	68.25
4.0	29.33	37.22	44.15	30.10	36.32	43.15	0.07234	0.9785	2.1045	0.0765	0.9674	2.2087	2.22	4.32	7.13	2.32	4.42	7.23	47.21	57.29	78.41	48.69	58.38	74.32
6.5	30.2-2	39.14	46.33	32.21	39.22	47.23	0.0842	1.0345	2.5234	0.08678	1.0424	2.6359	2.31	4.41	8.22	2.24	4.45	8.34	50.12	64.56	81.43	51.35	60.58	83.28
LSD(0.05)	1.22	2.10	1.13	2.12	1.5	1.7	00.01	0.0	0.04	0.001	0.02	0.02	NS	0.10	0.51	NS	0.10	0.51	2.11	3.10	3.2	2.2	2.3	4.1

Table 4. Effects of poultry manure on dry matter weight of leaves, stem per plant (g) and their growth rate (g/m2/day) on *Ocimum gratissimum* in 2017 and 2018 cropping season

Treatments	Leaf dry wt.(g) per plant						Stem dry wt.(g) per plant						Leaf growth rate (g/m^2/day)						Stem growth rate (g/m^2/day)					
Poultry manure rate (t/ha)	2017			2018			2017			2018			2017			2018			2017			2018		
	6 WAP	10 WAP	16 WAP	6 WAP	10 WAP	16 WAP	6 WAP	10 WAP	16 WAP	6 WAP	10 WAP	16 WAP	6-10 WAP	10-16 WAP	16-20 WAP	6-10 WAP	10-16 WAP	16-20 WAP	6-14 WAP	10-16 WAP	16-20 WAP	6-10 WAP	10-16 WAP	16-20 WAP
0	0.3482	1.2231	4.32	0.41	1.27	4.13	1.47	5.35	11.24	1.62	6.10	13.25	0.0114	0.2175	0.5332	0.0112	0.2157	0.4496	0.3231	1.3432	2.1357	0.3416	1.5221	2.0645
1.0	0.6785	2.13.	6.38	0.55	2.15	5.89	3.25	8.47	22.34	3.34	8.39	20.79	0.1324	0.4357	0.9683	0.1245	0.4735	0.9487	0.7146	1.5174	3.2637	0.8221	1.6115	3.1986
1.5	0.8632	2.75	6.86	0.8413	2.882	6.76	3.89	9.64	26.35	3.92	10.25	27.26	0.1431	0.5693	1.1234	0.1487	0.6111	1.1169	0.9112	1.8425	3.6124	0.9345	1.9321	3.8963
2.0	0.94	3.24	7.52	0.972	3.27	7.32	4.32	12.36	32.15	4.18	13.17	34.35	0.16342	0.7124	1.3268	0.1673	0.7321	1.3321	1.2483	2.1574'	4.1325	1.3134	2.2342	4.2528
2.5	1.2452	3.68	8.27	1.264	3.78	8.41	5.48	17.51	39.43	5.67	18 .5	40.35	0.1752	0.7946	1.4564	0.1789	0.8123	1.5112	1.5426	2.3835	4.6411	1.6253	2.5311	5.1112
3.0	1.4632	4.15	9.34	1.5127	4.21	9.15	6.35	21,31	46.29	6.47	23.23	48.24	0.2342	0.8232	1.7056	0.2243	0.9478	1.6893	1.7483	2.6475	5.3333	1.8114	2.7894	5.8966
3.5	1.6321	4.69	9.88	1.7034	4.56	9.25	6.84	25.31	53.57	6.78	27.26	56.74	0.2478	0.8934	1.957	0.2478	0.9384	1.8795	1.9231	3.0682	5.7832	1.9735	3.124	6.3465
4.0	1.7342	5.13	10.36	1.82	5.21	10.43	7.34	32.18	61.38	7.48	34.35	66.23	0.2546	0.9518	2.1354	0.2612	0.9853	2.2435	2.8534	3.6956	6.3251	2.0351	3.7412	6.5543
6.5	1.8534	4.43	8.36	1.837	3.99	8.27	5.22	13.32	36.27	4.88	11.46	33.57	0.1212	0.3124	0.4321	0.1257	0.4231	0.5124	1.7636	2.2352	2.41236	1.824	2.1345	2.2563
LSD (0.05)	0.01	0.32	1.1	0.01	0.31	1.01	0.43	1.52	2.13n	0.32	1.20	2.2	0.01	0.02	0.03	0.001	0.02	0.03	0.04	0.11	0.41	0.12	0.12	0.42

Table 5. Effects of poultry manure on fresh leave, dry leaves and seed yield of *Ocimum gratissimum* in 2017 and 2018 cropping season

Treatment	Leaf fresh wt. per plant(g)						Leaf dry wt. per plant(g)						Leaf fresh wt. per hectare (t/ha/)						Leaf dry wt. per hectare (t/ha/)						Seed wt. per plant(g)		Seed wt. Per Ha(t/ha)	Seed wt. per Ha (kg/ha)
Poultry manure rate (t/ha)	2017			2018			2017			2018			2017			2018			2017			2018			2017	2018	2017	2018
	10 WAP	14 WAP	20 WAP	10 WAP	14 WAP	20 WAP	10 WAP	14 WAP	20 WAP	10 WAP	14 WAP	20 WAP	10 WAP	14 WAP	20 WAP	10 WAP	14 WAP	20 WAP	10 WAP	14 WAP	20 WAP	10 WAP	14 WAP	20 WAP				
0	7.37	13.2	22..14	8.21	14.64	20.15	1.34	3.32	7.25	1.25	2.47	9.34	0.0121	0..0213	0.032	0.001	0.023	0.034	0.0001	0.0001	0.00043	0.0001	0.00001	0.0001	1.23	1.06	0.0012	0.0013
1.0	13.46	18.14	32.37	14.32	19.44	30.98	2.47	4.46	16.38	2.37	3.88	15.58	0.023	0.073	0.234	0.022	0.065	0.312	0.00023	0.00042	0.00063	0.0024	0.046	0.064	3.35	2.67	0.0043	0.0042
1.5	17.75	23.53	39.45	19.23	21.34	37.47	3.18	4.85	18.27	3.24	4.26	19.31	0.035	0.096	0.329	0.034	0.043	0.432	0.00044	0.00051	0.00082	0.0045	0.00075	0.00085	3.86	3.84	0.0054	0.0053
2.0	20.12	29.38	43.21	22.35	31.17	45.68	3.75	5.14	22.38	3.89	4.87	23.64	0.0532	0..104	0.403	0.048	0.121	0.513	0.00053	0.00063	0.00094	0.0054	0.00092	0.00096	4.27	4.13	0.0061	0.0062
2.5	26.82	35.95	58.43	28.27	37.25	52.19	4.10	5.89	25.12	4.32	5.54	27.17	0.073	0.134	0.512	0.069	0.142	0.621	0.00068	0.00076	0013	0.0067	0.0014	0.0016	4.86	4.54	0.0068	0.0067
3.0	31.53	42.34	61.62	34.31	40.47	59.32	4.85	7.22	29.44	4.65	6.48	30.22	0.08	0.153	0.573	0.078	0.162	0.587	0.0007	0.00099	0.0015	0.0007	0.00098	0.0017	5.18	5.34	0.0072	0.0073
3.5	38.27	49.25	70.35	39.43	47.33	68.58	5.07	7.95	32.27	5.31	7.53	34.58	0.097	0.182	0.634	0.o85	0.176	0.685	0.00076	0.0012	0.0017	0.00084	0.0018	0.0019	5.79	6.11	0.0081	0.0083
4.0	44.57	53.12	74.28	41.36	52.94	72.56	6.32	9.65	40.32	6.23	8.78	39.99	0.121	0.231	0.852	0.133	0.312	0.872	0.00017	0.0024	0.00029	0.00018	0.0025	0.0014	6.52	7.03	0.0096	0.0098
6.5	20.12	32.47	43.34	18.48	28.57	39.26	2.58	4.78	14.31	2.19	3.75	23.15	0.0324	0.064	0.131	0.0012	0..021	0.234	0.00031	0.00032	0.00043	0.00045	0.00034	0.00047	2.11	2.31	0.0031	0.0032
LSD (0.05)	1.12	1.51	2.1	1.02	1.11	2.21	0.31	0.52	0.21	0.3	0.25	0.41	0.001	0.002	0.01	0.001	0.01	0.02	0.001	0.0001	0.0002	0.0001	.00002	0.0002	0.13	0.13	0.0001	0.000

The responses of leaf area index (LAI) to poultry manure closely follow the same trend as the number of leaves per plant which increases with increment in Poultry manure rate. At 16WAP, the poultry manure rate of 6.5 t/ha consistently produced the highest leaf area values (LAI) of 2.5234 in 2017 and 2.6359 in 2018. This findings corroborate the result obtained by Okoli and Nweke [12] who reported significant increased in the vegetative growth parameters such as higher leaves, branches and leaf area index in response to higher rate of poultry manure of 20 to 30t/ha.

Result showed that taller plant height were observed in poultry manure treated plots as compared to the untreated plots (Table 3). Throughout the period of observation either at 6, 10 or 16 WAP the tallest *Ocimum gratissimum* plants were obtained in plots that had 6.5t/ha poultry manure in the two cropping seasons. The results of the present study for this plant height character is in agreement with the findings of [1] they reported that the application of poultry manure resulted in increased in the growth of plant height. This might be due to the application of poultry manure which increased the availability of soil nutrients for the absorption and utilization by the *Ocimum gratissimum* plants resulted in higher parameters as compared to those that were not applied with poultry manure. The application of poultry manure to *Ocimum gratissimum* plants that resulted in the significant increment in the all the growth parameters recorded in the present study.

Results indicates significant higher leaf and stem dry matter weight per plant in plots applied with poultry manure than the plots not applied with poultry manure (Table 4). Throughout the period of data collection (6,10 or 16WAP) leaf and stem dry weight per plant increased significantly with successive increases in poultry manure rate. The observed increment in leaf and stem dry weight in response to poultry manure application was up to 4 t/ha of poultry manure rate beyond this rate , both the leaf and stem dry weight began to decrease as poultry manure rate increase. The highest leaf dry weight (10.36 g per plant in 2017 and –10.43 g/ plant in 2018) and vine dry weight of (61.38 g/ plant in 2017 and 66.23 g/plant in 2018) was produced by plots that received 4t/ha.

Similarly, plant growth rate measured as dry matter accumulation in leaf and vine in grams per meter square per day showed that poultry manure treated plants had more dry matter accumulation in their leaves and vines as compared to those not treated with poultry manure. The was faster dry matter accumulation rate in plants that received 2.0 – 3.5t/ha than the lower rates or where poultry manure was not applied at all. Plant that were treated with 4.0t/ha of poultry manure was always show evidence of the highest leaf (2.1354 g/m^2/day in 2017, 2.2435 in 2018) and stem (6.3251 g/m^2/day in 2017 and 6.5543 in 2018) growth rate at 16 WAP in the two planting seasons.

The significant increased in the vegetative growth parameters (such as: leaf and stem dried weight) per plant and their growth rate (dry matter accumulation rate in g/m^2/day) in response to poultry manure application observed in the present study agreed with the work of [19] who obtained significant increases in dry weight of okra due to poultry manure application. This improvement could probably be due to the contribution of essential plant nutrients elements contained in the applied poultry manure that are associated with increased photosynthetic efficiency and dry matter production [20].

The effects of poultry manure on the *Ocimum gratissimum* fresh leaf and seed yield per plant and hectare is shown in Table 5. In the present study reported here, it was observed that fresh and dry leaf yield and seed yield were better in poultry manure plots than where it was not applied. The poultry manure rate of 4.0 t/ha seemed most satisfactory in obtaining the highest *Ocimun gratissimum* seed fresh weight yield of (0.852 t/ha in 2017) and (0.872 t/ha in 2018) and seed yield of (0.0096 t/ha in 2017) and (0.0098t/ha in 2018) in both cropping seasons. Beyond this rate (4 t/ha poultry manure), increases in poultry manure application had no additional advantage on boosting *Ocimum gratissimum* fresh and dry leaf and seed yield under Obubra utisol growing conditions. This probably indicate on set of luxury consumption of nitrogen and the production of vegetative growth at the expense of higher seed yield that occurred beyond the poultry manure rate of 4t/ha as observed in this study. The increased in higher *Ocimum gratissimum* seed yield in poultry manure amendment plots than those not amended with poultry manure could be attributed to the increased in soil nitrogen, potassium and phosphorus and magnesium for the plant use. These nutrients have been implicated in the synthesis of chlorophyll, photosynthesis

efficiency and enhancement of foliage growth in plants [4]. The increased in yield parameters obtained in this present study could be attributed to improved physical and biological properties of the soil resulting in better supply of nutrients to plants. This corroborate findings of [21] that application of organic application of organic materials could ameliorate slightly acidic tropical soil to improve crop production.

4. CONCLUSION

Based on the result obtained from this study, the use of poultry manure in the cultivation of *Ocimum gratissimum* is desirable. The application of poultry manure at 3- 4t/ha was more beneficial than higher rates. Poultry manure rate of 4t/ha gave the highest fresh, and dry leaf and seed yield per plant and hectare. Farmers are advise to apply 3-4t/ha of poultry manure to cultivate *Ocimum gratissimum* for optimum growth and seed yield. It is also easier, more economical to use lower than higher rates of poultry manure that are readily available, cheap and ease to handle by the poor resource base farmers to cultivate the crop under the utilsol condition of Obubra, Cross River state, South-South agro ecological zone of Nigeria.

COMPETING INTERESTS

Author has declared that no competing interests exist.

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