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Response of *Corchorus olitorius L*. to application of poultry and little brown bat (*Myotis Lucifugus*) droppings in Mokwa sothern guinea savannah agro ecological zone of Nigeria

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Abstract

Organic farming is gaining attention around the world and farmers in Nigeria have realized the potentials of soil amendments by using available organic resources for sustainable crop production. The study was conducted at the Niger State College of Agriculture, Mokwa Research Orchard, to evaluate the effects of amending the soil with poultry droppings (PD) and Little Brown Bat droppings (BD) on growth and yield of *Corchorus olitorius* L. Treatments comprised of soil amended with three rates (0, 2, 4 and 6 t ha^{-1}) each of poultry and Little Brown Bat droppings. The experiment was laid in Randomized Complete Block Design (RCBD) with three replications. Data collected on growth and yield parameters were subjected to Analysis of Variance (ANOVA). Generally, all the parameters investigated increased significantly ($P \leq 0.05$) across all stages of growth with the highest values recorded in plots treated with 6 t ha^{-1} in both poultry (1108.00 g plant^{-1}) and Little Brown Bat (1110.00 g plant^{-1}) manure amended soils, when compared with the control (238.00 g plant^{-1}). The relative herbage yield increase in poultry and little brown bat droppings at 6 t ha^{-1} treated soils when compared with control was 77.88 and 79.00 % respectively. However, the herbage yields recorded in Little Brown Bat treated with 4 and 6 t ha^{-1} were numerically higher than those of the poultry manure amended soils. The highest herbage yields recorded in 6 t ha^{-1} treatment plots in both manure types were only marginally higher than those obtained in the 4 t ha^{-1} treatment plots. The economically recommended rate of application for both manure types is 4 tha^{-1}. Result of nutrient content analysis of Little Brown Bat droppings was generally higher than that of poultry droppings. Little Brown Bat droppings is therefore, recommended to be included in the farming systems of Nigeria's Southern Guinea Savannah agroecological zone.

Keywords: Corchorus olitorius; Poultry dropping; Little Brown Bat dropping; soil Amendment .

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1.0. Introduction

Jute Mallow or Krin-Krin (*Corchorus olitorius* L.) commonly known as "Oyoyo" (Yoruba) and "Ayoyo" (Hausa) belongs to the Tiliaceae family. They are important leafy vegetable cultivated in many tropical countries of Africa and Asia (Grubben, 2004). The leaves are mucilaginous like Okra fruits, which is prepared as a sauce. The sauce is enhanced with tomato stew for the consumption of starch balls of cassava, maize, sorghum and yam (Oyedele *et al*., 2015).

The leaves of Jute Mallow is rich in calcium, galactose, magnesium and iron and contains a high percentage of vegetable protein as well as fesolate and iron which are used for the prevention of anaemia (Fordio and Grubben, 2004 and Obatulu, 2005). it also contains

The yield is estimated at 20 to 41 t ha^{-1} for herbage (Obatulun 2005). Similarly, Fordio and Grubben (2004) reported a yield of 20 to 25 t ha^{-1} in Nigeria a yield of 5 t ha^{-1} in Bangladesh and 38 tones ha^{-1} in America respectively. Luxuriant foliage growth is encouraged by growing the vegetable under ample soil nitrogen supply. Farmers in Nigeria have realized the need for soil amendments by using available organic resources such as green manure, crop waste, farmyard manure and animal wastes.

The quality and quantity required of these materials limit their use. On one hand, poultry droppings contain nutrient element that can support crop production (by making them healthy and green) and enhance the physical and chemical properties of the soil John *et al.,* 2013, , Iren *et al.,* 2015). On the other, Guano of Little Brown Bat (*Myotis lucifugus*) (Family Vespertilionidae) commonly called "Ptingi" (in Nupe) has a long history of use as a soil enricher since it is a fruit and insect feeding species (Nikki, 2018). Nikki (2018) also reported that *Myotis lucifugus* guano is fast acting when worked into the soil prior to planting or during active growth. Benefits of brown bat guano application to soil include soil conditioning, soil drainage and texture improvement, control of nematode, compost activator (Nikki, 2018).

No wonder small holder farmers in Mokwa Southern Guinea Savanna agroecological zone commonly use Little Brown Bat dropping to amend their soils before the onset of rains. However, there is little or no documented research or information on the use of Little Brown Bat dropping as soil amendment organic material in Mokwa Southern Guinea savannah. This is despite its adoption and widespread use by many smallholder farmers for crop production in this agroecological zone. An On - Station study was therefore conducted to evaluate the response of Jute Mallow to different rates of poultry and Little Brown Bat droppings applications as well as establishing their optimum levels of application for Jute Mallow production in Mokwa Southern Guinea Savannah zone of Nigeria.

2.0. Materials and Methods

2.1. Study area

An On - Station trial was conducted at the Niger State College of Agriculture, Mokwa Teaching and Research Orchard in the Southern Guinea Savannah zone of Nigeria. The site is located at Latitude 09^0 18'N and Longitude 05^0 4'E of the equator in the Southern Guinea Savannah zone of Nigeria. The average annual rainfall distribution of the area is 1,177.90 mm per annum and temperature of 33.6^0C (College of Agriculture, Mokwa (CAM) Metrological Unit, 2019).

2.2. Source of Corchorus olitorius L. seed and droppings of Poutry (PD) and Little Brown Bat (BD) (Myotis lucifugus)

Seed of *Corchorus olitorius* L. was obtained from the Department of Horticulture, Federal University of Technology, Minna.

The droppings of poultry (PD) and little Brown Bat (BD) were collected from poultry pen at the Livestock Unit of Niger State College of Agriculture, Mokwa and caves located around Mokwa town in Mokwa Local Government of Niger State, respectively.

2.3. Treatments and Experimental Design

The treatments comprised of four levels each of poultry droppings (PD) (0, 2, 4 and 6 t ha^{-1}) and Little Brown Bat droppings (BD) (0, 2, 4 and 6 t ha^{-1}) with the 0 t ha^{-1} serving as control. These droppings were applied one week before transplanting. The experiment was laid out in randomized complete block design (RCBD) and replicated three times.

The plant spacing was 20 x 20 cm between and within the ridges. The plot size was 3 x 4 m to give 12 m^2. 1 m was the pathway between treatments and replicates. The total experimental area was 48 m^2.

2.4. Chemical analyses of soil and manures

Soil samples were taken from the experimental site before the commencement of experiment using soil auger at a depth of 0 - 15 cm. Ten (10) samples were randomly taken from each block, bulked and mixed thoroughly to give a composite sample. The composite soil sample was coned and quartered to obtain a sub-sample.

The sub-sampled soils were air dried, lumps broken and sieved through 2 mm sieve and subjected to routine soil analysis in the laboratory. Soil reaction (pH), organic carbon (OC), available phosphorus (P), total nitrogen (N), calcium (Ca), Magnesium (Mg), potassium (K) and sodium (Na), cation exchange capacity (CEC), exchangeable acidity (EA) and physical characteristics were analyzed using standard methods described by Anderson and Ingram (1993) and IITA (1979).

Poultry and Little Brown Bat droppings were also air dried in the laboratory. A subsample was taken, ground and sieved using 2 mm sieve for laboratory analysis. Organic carbon (OC), available Phosphorus (P), total Nitrogen (N), manure reaction (pH), Calcium (Ca), Magnesium (Mg), Potassium (K) and Sodium (Na) were analyzed using standard methods described by Anderson and Ingram (1993) and IITA (1979).

2.5. Cultural practices

2.5.1. Land preparation

Land preparation commenced as soon as rain was well established. Cutlass and hoe were used to clear the shrubs. Big hoe was used to make ridges thereafter.

2.5.2. Nursery preparation and seedling transplanting

A nursery bed of 1m x 4 m in size and 20 cm in height was constructed to raise seedlings before transplanting at 3 weeks after sowing (WAS).

At 3 weeks after planting (WAP), vigorous and disease-free seedlings were carefully up rooted with the ball of earth from the nursery bed and transplanted to the main field along the ridges. Weeds were manually cleared when the need arose.

2.5.3. Droppings treatment and application

Both droppings used in this work were collected and air dried in the Soil Science Laboratory. The lumps in both droppings were broken to obtain ground manure.

Manures were uniformly applied according to treatment specification and worked into the soil by light hoeing at one week before transplanting viz a viz control (No application), poultry droppings (2, 4 and 6 t ha^{-1}) and Little Brown Bat droppings (2, 4 and 6 t ha^{-1}).

2.6. Data collection

Three (3) plants were randomly selected within the net plot, tagged and used for growth and yield measurements. Growth parameters measured were plant height, number of leaves, leaf area, stem girth and number of branches were carried out at 3, 6 and 9 WAT, while the yield parameter (herbage yield) was at 9 WAT.

2.6.1. Plant height

This was carried out at 3, 6, and 9 weeks after transplanting (WAT) using tape rule. The height was taken from the base of the plant to the apical tip of the randomly selected plants

2.6.2. Number of branches

This was counted from the three randomly tagged plants and the average was determined. This was done at 3, 6, and 9 weeks after transplanting (WAT).

2.6.3. Stem girth

This was measured from the five tagged plant using rope and the average was determined. at 3, 6, and 9 weeks after transplanting (WAT)

2.6.4. Leaf area

This was measured from the five tagged plants and the average was determined. This was at 3, 6, and 9 weeks after transplanting (WAT)

2.6.5. Number of leaves

This was done at 3, 6 and 9 weeks after transplanting (WAT) by counting the leaves on each plant.

2.6.6. Herbage yield

This was taken at 9 WAT after transplanting. The plant was cut with knife a about the ground level.

2.7. Data analysis

Data collected were subjected to analysis of variance (ANOVA) and treatment means was separated using Duncan Multiple Range Test (DMRT) at 5% level of probability using the General Linear Model (GLM) procedure of version 9.3 (SAS, 2010).

3. Results and Discussion

3.1. Results

Physical and chemical properties of soil at experimental site are presented in Table 1, while nutrient concentrations of poultry and Little Brown Bat droppings are shown in Table 2.

The textural class of the soil at the experimental site was Sandy Loam (Table 1). The values obtained for chemical properties of soil at the site indicated that the soil was of low fertility status when compared with the critical limit values of nutrients reported by Esu, (1991). The soil at the site was slightly acidic and suitable for *C. olitorius* L. production.

Table 1: physical and chemical properties of Soil at the site before commencement of the experiment

Parameter	**Value**
	6.47
pH(H_20)	
Organic carbon g kg^{-1}	11.4
Available P mg kg^{-1}	13.23
Total N g kg^{-1}	0.11
EXCHANGEABLE CATIONS	
K (cmol kg^{-1})	0.24
Na (cmol kg^{-1})	0.32
Ca (cmol kg^{-1})	2.69
Mg (cmol kg^{-1})	1.25
Exchangeable acidity (EA) (cmol kg^{-1})	0.30
CEC (cmol kg^{-1})	6.60
SOIL PARTICLE SIZE	
Sand (%)	92.24
Clay (%)	3.76
Silt (%)	4.00
TEXTURAL CLASS	Sandy Loam

Values represent means of triplicate determination.

The pH values recorded in poultry and Little Brown Bat droppings were 7.58 (mildly alkaline) and 8.02 (moderately alkaline) respectively (Table 2). The concentrations of OC, total N, available P, CEC and EA in both droppings fall within the medium to high ratings range reported by Esu, (1991).

Table 2: Chemical composition of cured droppings (manure)

Parameter	**Value**	
	Poultry Manure (PD)	**Little Brown Bat Manure (BD)**
pH (H_20)	7.58	8.02
Organic carbon (OC) (%)	21.18	31.43
Organic matter (OM) (%)	36.62	54.34
Available P (%)	1.86	2.29
Total N (%)	3.30	7.99
Exchangeable Cations		
K (%)	1.68	1.85
Na (%)	1.17	0.95
Ca (%)	1.13	2.08
Mg (%)	1.30	2.37
Exch. Acidity (EA) (%)	0.88	0.78
Cation Exch. Capacity (CEC) (%)	11.21	19.37

Values represent means of triplicate determination.

Generally, the Little Brown Bat droppings had higher nutrient values than poultry (Table 2). This could be attributed to the insectivorous feeding habit of the Little Brown Bat. Nikki (2018) reported 10, 3 and 1 percent N, P and K respectively in insectivorous bats which was higher than values obtained in bats that were fruitivorous (3 % N, 1 % P and 1 % K). This work corroborates the findings of Musa *et al.* (2010). They obtained values for OC, N, P, CEC, K and Ca in Bumblebee Bat (insectivorous bat) that were comparable to the medium to high nutrient critical limit range reported by Esu (1991).

Plant height

The effect of poultry dropping (PD) and Little Brown Bat dropping (BD) rates on plant height of Jute Mallow (*C. olitorius* L.) at Mokwa is shown in Table 3. Jute Mallow treated with poultry droppings (PD) produced significantly ($P \leq 0.05$) higher plant height than the control. As the rate of poultry droppings increased, plant height also increased. Also, irrespective of the treatments, plant height increased from 3 WAT (27.80 cm) through 9 WAT (125.40 cm).

At 9 WAT, Jute Mallow treated with 6 t ha^{-1} poultry manure produced significantly ($P \leq 0.05$) highest plant height (125.40 cm), but, did not differ significantly ($P > 0.05$) from 4 t ha^{-1} treated plots that recorded 123.10 cm. While, those in 0 t ha^{-1} had the least plant height value of 87.40 cm at 9 WAT.

Generally, the Little Brown Bat Droppings (BD) increased plant height over those of the control. However, the increase was only significant at 6 and 9 WAT.

At 6 WAT, plants that were fertilized with 2, 4 and 6 t ha^{-1} of Little Brown Bat Droppings (BD) produced plant heights that were not significantly ($P > 0.05$) different (75.50, 77.80 and 76.20 cm) respectively. These plant height values differed significantly ($P \leq 0.05$) from those of the 0 t ha^{-1} plot, that had the least plant highest of 65.80 cm.

At 9 WAT, Jute Mallow plots which received 6 t ha^{-1} of BM had plant height of 126.40 cm followed by those which received 4 (112.50 cm) and 2 (109.80 cm) t ha^{-1} of BD in that order and the least plant height of 88.40 cm was observed from the control plot (Table 3).

On the whole, the tallest plant in both PD and LBBD treated plots was observed in 6 t ha^{-1} amended plot at 9 WAT (Table 3).

Number of Branches

At 3 WAT, plants treated with 6 and 4 t ha^{-1} PD produced significantly ($P \leq 0.05$) highest number of branches of 12 and 11 per plant respectively, while, those fertilized with 2 t ha^{-1} had 9 number of branches, and the least value was recorded from plants with 0 t ha^{-1} plots (Table 3).

At 9 WAT, highest number of branches (24.00) was observed with plots fertilized with 4 t ha^{-1} PD followed by 19 branches plant^{-1} from 6 t ha^{-1} PD, while plants treated with 2 t ha^{-1} PD and the control had branch number per plants values of 14 and 11 respectively (Table 3).

Plots amended with BD droppings significantly ($P \leq 0.05$) increased number of branches over those of the control treated plots. The values obtained in 2, 4 and 6 t ha^{-1} treatment plots at 3 and 6 WAT only differed numerically. At 9 WAT, the highest value of 21 branches was obtained in 4 t ha^{-1} treated plots, which was not significantly ($P > 0.05$) different from 6 t ha^{-1} treated plots (Table 3).

The number of branches of Jute Mallow in BD treated plots was generally higher than those of PD amended plots (Table 3).

Table 3: Effect of poultry and little brown bat droppings on plant height, number of branches and stem girth of Jute Mallow (Corchorus olitorious L.) plant-1 at Mokwa.

Poultry dropping (P)	Plant height (cm)			Number of branches			Stem girth (cm^3)		
	3 WAT	6 WAT	9 WAT	3 WAT	6 WAT	9 WAT	3 WAT	6 WAT	9 WAT
0 t ha^{-1}	27.80^c	52.90^c	87.40^c	5.00^c	10.00^c	11.00^c	0.93^c	2.32^c	2.40^c
2 t ha^{-1}	33.10^b	53.30^c	110.90^b	9.00^b	14.00^b	14.00^b	1.27^b	4.44^b	4.60^b
4 t ha^{-1}	41.30^{ab}	70.70^b	123.10^{ab}	11.00^a	18.00^a	24.00^a	1.69^a	5.17^a	6.10^a
6 t ha^{-1}	44.70^a	76.70^a	125.40^a	12.00^a	18.00^a	19.00^{ab}	1.84^a	6.02^a	6.50^a
LSD	4.56	2.75	43.54	4.25	4.10	8.90	0.87	1.83	1.49
Bat dropping (B)									
0 t ha^{-1}	32.40^b	65.80^b	88.40^c	6.00^b	7.00^b	9.00^b	1.00^b	2.21^b	2.40^b
2 t ha^{-1}	36.50^{ab}	75.50^a	109.80^b	10.00^a	17.00^a	18.00^a	1.35^a	5.10^a	5.40^a
4 t ha^{-1}	39.30^{ab}	77.80^a	112.50^b	11.00^a	18.00^a	21.00^a	1.41^a	5.20^a	6.10^a
6 t ha^{-1}	43.80^a	76.20^a	126.40^a	11.00^a	18.00^a	20.00^a	1.54^a	5.20^a	6.70^a
LSD	4.56	2.75	43.54	4.25	4.10	8.90	0.87	1.83	1.49
P x B	*	*	*	*	*	*	*	*	*

Means followed by the same superscript letter (s) in same column are not significantly different at 5% level of probability (DMRT)

Stem girth

Jute Mallow stem girth was significantly ($P \leq 0.05$) affected by application of PD and BD compared with the control (Table 3) at 3, 6 and 9 WAT. Treatment plots that received 4 and 6 t ha^{-1} PD were significantly ($P \leq 0.05$) higher than those that received 2 and 0 t ha^{-1} PD. However, the 4 and 6 t ha^{-1} treated plots did not differ significantly ($P > 0.05$). The highest stem girth value (6.50 cm) was obtained in 6 t ha^{-1} treatment at 9 WAT in the PD amended plots.

In Table 3, treatment plots amended with BD produced significantly ($P \leq 0.05$) higher stem girth than control plots. The stem girth in the plots treated with 2, 4, and 6 t ha^{-1} BD only differed numerically at 3, 6 and 9 WAT. The largest stem girth value of 6.70 cm was recorded in 6 t ha^{-1} treated plots at 9 WAT. This differed only marginally with 4 t ha^{-1} treated plot that recorded 6.20 cm stem girth.

Stem girth in BD were generally larger than those obtained in the PD plots.

Leaf area

Table 4 revealed that leaf area of Jute Mallow (*C. olitorius* L.) in PD amended plots was significantly ($P \leq 0.05$) higher than those of the control. The exception was leaf area obtained in plots treated with 0 and 2 t ha^{-1} at 3 WAT. *C. olitorius* L. treated with 6 t ha^{-1} PD had significantly ($P \leq 0.05$) highest leaf area values of 19.40, 57.80 and 45.90 cm at 3, 6 and 9 WAT respectively. The largest leaf area (57.80) was observed in 6 t ha^{-1} PD treated plots at 6 WAT (Table 3).

Except for plots that were treated with 0 and 2 t ha^{-1} BD which did not differ significantly ($P > 0.05$) at 3 WAT, all the plots that received BD significantly ($P \leq 0.05$) affected

Jute Mallow leaf area. The highest leaf area (48.60 cm) was recorded in 6 t ha $^{-1}$ BD treated plots at 6 WAT. The lowest values were observed in the control treatments (Table 3). Generally, the PD treated plants had higher leaf area than the BD plants (Table 3).

Number of leaves

Application of PD significantly (P≤0.05) increased leaf number over that for the control. (Table 4). At 6 WAT, significant (P≤0.05) differences in number of leaves of Jute Mallow was observed. As the number of WAT increased, number of leaves per plant also increased. The highest leaf number (507) was observed in plants treated with 6 t ha $^{-1}$ PD at 9 WAT (Table 4). Those treated with 2 t ha $^{-1}$ had the lowest value of 247 leaves plants $^{-1}$ at 6 WAT among PD treatments. Table 4 showed that the leaf number obtained in BD treated plots were significantly (P≤0.05) higher than the control treatments.

At 6 WAT, plants fertilized with BD at 6 t ha $^{-1}$ produced significantly (P≤0.05) highest values of leaves (301) which did not differ significantly (P>0.05) from the 4 t ha^{-1} treated plots which produced 290 leaves.

At 9 WAT, plants which received 6 t ha $^{-1}$ BD gave the highest leaf number (498 plant^{-1}) among treatments followed by those which received 4 t ha^{-1} (465 plant $^{-1}$) and the least value of 108 was observed in the control plot. Leaf number was generally higher in PD amended plots than BD plots (Table 4).

Table 4: Effect of poultry and bat droppings on leaf area, leaf number and herbage yield of Jute Mallow (Corchorus olitorious L.) plant-1 at Mokwa

	Leaf area (cm2)			Number of leaves			Herbage
Poultry dropping (P)	**3 WAT**	**6 WAT**	**9 WAT**	**3 WAT**	**6 WAT**	**9 WAT**	**Yield (g)**
0 t ha $^{-1}$	8.90^{c}	32.50^{c}	28.20^{d}	39.34^{c}	210.00^{c}	112.00^{d}	245.00^{b}
2 t ha $^{-1}$	9.40^{c}	36.70^{b}	30.20^{c}	44.23^{b}	247.00^{b}	374.00^{c}	812.00^{a}
4 t ha $^{-1}$	11.60^{b}	38.40^{b}	39.60^{b}	64.70^{a}	324.00^{a}	464.00^{b}	1002.00^{a}
6 t ha $^{-1}$	19.40^{a}	57.80^{a}	45.90^{a}	67.40^{a}	335.00^{a}	507.00^{a}	1108.00^{a}
LSD	2.73	18.18	20.49	21.67	129.23	388.8	67.73
Bat dropping (B)							
0 t ha $^{-1}$	8.40^{c}	23.30^{c}	21.20^{b}	34.23^{b}	124.00^{c}	108.00^{d}	231.00^{c}
2 t ha $^{-1}$	9.10^{c}	37.10^{b}	38.60^{a}	56.67^{a}	279.00^{b}	296.00^{c}	657.00^{b}
4 t ha $^{-1}$	11.60^{b}	37.20^{b}	41.30^{a}	57.56^{a}	290.00^{a}	465.00^{b}	1004.00^{a}
6 t ha $^{-1}$	12.90^{a}	48.60^{a}	43.60^{a}	62.06^{a}	301.00^{a}	498.00^{a}	1110.00^{a}
LSD	2.73	18.18	20.49	21.67	129.20	399.80	67.73
P x B	*	*	*	*	*	*	*

Means followed by the same letter (s) in same column are not significantly different at 5% level of probability (DMRT).

Fresh herbage yield

Herbage yields plant $^{-1}$ are presented in Table 4. PD amendment significantly (P≤0.05) affected herbage yield of *C. olitorius* L. compared with the control. As the rate of PD increased from 2 to 6 t ha $^{-1}$ the herbage yield of *C. olitorius* L. also increased numerically (812.00 to 1108.00 g plant $^{-1}$). The highest herbage yield (1108.00 g plant $^{-1}$) was observed in in 6 t ha $^{-1}$ among PD treated plot, however, this value was not significantly (P>0.05) different from that of the 4 t ha^{-1} treatments that recorded 1002.00 g plant $^{-1}$.

A trend in herbage yield similar to that of PD treated plots was observed with the BD treatments (Table 4). As the rate of BD increased, the herbage yield plant^{-1} also increased. The herbage yield in plots that received 6 t ha^{-1} was significantly (P≤0.05) the highest among BD treatments, but, it did not differ statistically (P>0.05) from the 4 t ha $^{-1}$ treated plot.

Generally, higher herbage yield was observed with *C. olitorius* L. that received BD when compared with those that received PD. This was, however, marginal.

3.2. Discussion

The Soil test and fertility interpretation reported by Esu (1991) indicated that OC, OM, N, P, K, Ca, Mg, Exchangeable Acidity and CEC obtained in this work were below critical level and limiting for crop production, which are characteristic of most tropical soils (Senjobi *et al*., 2013 and Lawal *et al*., 2012). The low fertility status might be attributed to the nature and continuous cropping of the soil over the years. The low nutrient status of the soil necessitated the need for application of soil amendments to meet with *C. olitirius* L. requirements.

Organic amendments were reported to be one of the important inputs contributing to crop production, because it improves crop yield and quality (Abdulmalik *et al***.,** 2017 and kayode *et al*., 2018) as well as add organic matter to the soil which improves soil structure, nutrients availability and its retention, aeration, increase microbial population, reduce soil bulk density, soil moisture holding capacity and infiltration (Gerei *et al.*, 2018).

The application of both PD and BD significantly increased plant height, number of branches, stem girth, leaf area, leaf number and herbage yield above the control. Response to application of PD and BD in the present study could be attributed to the inherently low fertility properties of the soil at the experimental site.

The positive response of *C. olitorius* L. to application of PD in this study could also be attributed to organic matter addition and availability of nutrient. This corroborates the findings of Dinkinya and Mufwanzala, (2010) and Abdulmaliq *et al*. (2015).

The general increase in the growth and yield parameters as rates of PD and BD increased from 2 to 6 t h^{-1} revealed that nutrients seemed to be more readily available to plants with higher doses of treatments than the lower doses. Musa (2016) reported similar trend in his work.

Several studies have confirmed that increasing the rate of application of organic manures significantly increased performance of the crop (Edmunds, 2010, Iren *et al*., 2015 and Musa *et al*., 2016 and John *et al*., 2013**,).**

Also, there was a general increase in growth parameters from 3 to 9 WAT, irrespective of rates of organic amendments. Iren *et al.* (2012) and Ndor *et al.* (2013) observed similar trend in their works. They attributed it to slow release pattern of nutrients in organic manure.

Generally, the values obtained in growth and yield parameters of *C. Olitorius* L. were higher in Bat droppings (BD) than PD. The higher nutrient contents in BD than PD in this study probably explained the difference in performance.

4.0 Conclusion and Recommendation

The present study concludes that application of both poultry droppings (PD) and Little Brown Bat Droppings (BD) significantly increased all the growth and yield parameters investigated in this study above the control. As the rate of the amendments increased, all the growth and yield parameters also increased. Herbage yield was highest in plots with 6 t ha^{-1} at 9 WAT, but not significantly different from 4 t ha^{-1}. *Corchorus olitorius* L. that received Little Brown Bat droppings generally had higher values in all the parameters investigated than Poultry Droppings.

The Little Brown Bat (BD) at the rate of 4 t ha^{-1} is hereby, recommended for adoption by smallholder farmers in Mokwa Southern Guinea savannah agro ecological zone of Nigeria.

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