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Enhancement of Growth and Medicinal Potential of *Senna alata* (L.) Roxb. Through the Application of Organic Manures

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Abstract:

The importance of medicinal plants in the healthcare delivery of man cannot be overemphasized. Enhancing optimum production and improving the performances of these plants both quantitatively and qualitatively is therefore, very important. The growth and Secondary metabolites (phytochemical) composition of an important medicinal plant- *Senna alata* was investigated under different organic manures in pot- experiments conducted in Ado- Ekiti, Nigeria. Organic manures namely; goat manure (GM), poultry manure (PM) andcow dung (CD) were applied to the plant at the rate of 100, 150 and 200g per 5 kg of soil. The results of the experiments revealed that application of these manures, most especially GM improved the number of leaves per plant, leaf area, stem girth, root and shoot wet weights and shoot dry weight of *S. alata*. Interestingly, application of CD, GM and PM also lead to an increase in the total phenol, tannin and flavonoid contents of this plant. It could therefore be concluded that, growth and medicinal potential of *S. alata* could be enhanced through the application of organic manures.

***Keywords*:** *Senna alata*, organic manure, growth, secondary metabolites, medicinal potential.

INTRODUCTION

Senna alata (L) Roxb. is a medicinal plant that belongs to the family Fabaceae. It is a widely distributed ornamental plant found in Nigeria, Malaysia, Thailand, Tropical America and many other parts of the world. It grows between 1-2m high but sometimes grows up to 5m high with horizontal branches. Leaves are paripinnate, 30-60cm long with 8-14 pairs of leaflets. Each leaflet is oblong, rounded at both ends and glabrous. According to Chatterjee *et al.* (2012), the leaves are ever green. Flowers are in axillary raceme and the bracts are caduceus. The petals are bright yellow, ovate-orbicular to spathulate. Fruit is a thick, flattened wing with glabrous pod. Seeds are about 50 to 60, flattened, more or less triangular. The plant grows well in a wide range of soil that retains moisture adequately. The plant is usually propagated by seeds and sometimes cultivated for medicinal purposes (Farnsworth and Bunyapraphastsara, 1992).

S. alata is traditionally used in Nigeria in treatment of several infections which include eczema and ringworm. It has wide range in the management of dermatological diseases (Ajibesin *et al*., 2008) as well as treatment of convulsion, gonorrhea, heart failure, abdominal pains, fever, asthma, snake bite and as a purgative (Owoyale *et al*., 2005).

Medicinal plants have been used as remedies for various types of diseases and ailments for ages because of their chemical components which have therapeutic values. Many natural products have been reported to have better results in the treatment of human diseases than the use of drugs and surgery without any side effects (Davis *et al*., 2010).In spite of the medicinal importance of *Senna alata,* many constrains still hamper its production in large scale for industrial uses in Nigeria. One of such constrains is the condition of rapid depletion of the soil constituent which could be a strong limitation to maximum production. In order to achieve increased productivity through increase in growth and yield, it is therefore pertinent to ameliorate the depleted soil nutrients.

Integrated use of organic and inorganic fertilizer to supply the needed plant nutrient for sustainable maximization of crop production had been advocated by many researchers (John *et al*., 2004; Aluko *et al*., 2014; Ugwu, 2016). Application of organic manure could improve the soil quality and is more economical and eco-friendlier when compared with application of chemical fertilizer alone (Roy and Kashem, 2014). Organic manures such as cow dung, poultry manure, goat manure and vermin compost improve the soil structure, aeration, slow release of nutrients and water retention capacity which promote root development and in turn, leading to higher growth and plant yield (Obi and Ebo, 1995; Palekar, 2007; Ramsi, 2014). Organic manure can provide significant quantity of nutrients when properly used and have a persistence effect on the soil for many years.

Studies have been conducted and reported on the methods of breaking the seed dormancy, antimicrobial properties, proximate and phytochemical composition of *S.alata* (Chomnawang *et al*., 2005; Arowosegbe, 2016; Onyegeme-Okerenta *et al*., 2017). However, no reports on the effects of organic manures on the growth, yield and phytochemical composition of this plant had been made. This study was therefore conducted, to investigate the influence of some manures from animal wasteson the growth, yield and phytochemical composition of *S. alata*.

MATERIALS AND METHODS

Experimental site

The experiment was conducted in the experimental site of the Department of Plant Science and Biotechnology, Faculty of Science, Ekiti State University (EKSU), Ado Ekiti with GPS coordinates of $7^0 37' 16''$N and $5^0 13' 17''$E. The town is situated in the tropical region of South-western Nigeria with an average annual rainfall of 1,400mm (Arowosegbe, 2016) and mean ambient temperature of 34^0C.

Collection of materials

Senna alata seeds were obtained from the Botanical garden of the Department of Plant Science and Biotechnology, EKSU and was authenticated in the University herbarium. Three different types of organic manure; poultry manure (PM), goat manure (GM) and cow dung (CD) were used in the study. The PM was collected from decomposedpoultry droppings, while CD was obtained from the animal farms of the Faculty of Agricultural Sciences, EKSU. The GM was collected from Iworoko Ekiti, a town about 3 km away from the Campus. Top soil used for the experiments was collected from a plot previously used for planting maize within the University premises. The collected soil samples were subjected to routine soil analysis and found to be a sandy clay loam with an organic matter content of4.25; 0.28%N; 10.90mg/kg P; 495mg/kg K; and a pH of 5.68. The poultry manure, goat manure and cow dung were analyzed. The poultry manure was found to contain2.45%N; 5.02mg/kg P; 5851.72mg/kg K; and a pH of 7.55. The goat manure contained 2.73 N; 6.10 mg/kg K; 7657.46mg/kg K and a pH of 7.86 while the cow dung contained 2.13%N; 4.22mg/kg P; 8359.45mg/kg K; and a pH of 8.10.

Planting procedure

Thirty polythene bags were filled with 5kg soil each and portions of 100, 150 and 200g each of the air-dried organic manures were incorporated into the 5kg soil to make a total of nine treatments. Soil without any manure served as control. The experiment was set up in a Complete Randomized Block Design (RCBD) with each treatment replicated three times. The set up was watered for two weeks after which five viable seeds of *S. alata* were sown into each of the 30 polythene bags. Thinning of the resulting seedlings to two stands followed two weeks after.

Data Collection and Statistical Analysis

Data were collected on the following growth and yield components; plant height (cm), number of leaves per plant, leaf area (cm^2), stem girth (cm), wet and dry weights of shoot and root (g). The plant height was measured from the soil surface to the plant apex using meter rule. The number of leaves per plant was taken by counting the average number of leaves per plant while leaf area was estimated according to the method of Kayode and Otoide (2007). The stem girths of the samples were measured using Vernier calliper. The Fresh weight of the shoots and roots were taken immediately after the plants were harvested while the dry weight of the shoots and roots were recorded after air-drying for 4weeks. All data collected were subjected to statistical Analysis of Variance (ANOVA) and Duncan's Multiple Range Test (DMRT) was used as a follow up test to separate the means.

Preparation of samples

The fresh leaves of the plants from all the treatments were washed in distilled water, air- dried for four weeks and ground into powder using a blending machine. They were later subjected to standard phytochemical analyses for different constituents such as tannins, alkaloids, flavonoids, glycosides, saponins and phenols.

Qualitative phytochemical Screening of samples

Test for Alkaloids: To 3mL of the extract was added 1mL of 1% HCL. This resulting mixture was then treated with few drops of Meyer's reagent. The appearance of a creamy white precipitate confirmed the presence of alkaloids

Test for Saponins: Five drops of olive oil was added to 2mL of each of the plant extracts and the mixture shaken vigorously. The formation of a stable emulsion indicated the presence of saponins (Trease and Evans, 1996)

Test for Tannins: Two drops of 5% $FeCl_3$ was added to 1mL of the plant extracts. The appearance of a dirty-green precipitate indicated the presence of tannins (Trease and Evans, 1996).

Test for Flavonoids: To 1mL of the extract from each sample was added 3 drops of ammonia solution followed by 0.5mL of concentrated HCl. The resultant pale brown colouration of the entire mixture indicated the presence of flavonoids (Odebiyi and Sofowora, 1978).

Test for Terpenoids: Five (5) mL of each extract was mixed in 2 mL of chloroform and 3 mL of concentrated H_2SO_4 wascarefully added to form a layer. A reddish-brown coloration of the interface was formed to showpositive results for the presence of terpenoids (Trease and Evans, 2005).

Test for Phenols: A small amount of extract was dissolved in distilled water; to this solution a few drops of lead acetate solution were added. Formation of white precipitate indicates the presence of phenolic compounds.

Quantitative Phytochemical Analysis of Samples

***Determination of Alkaloid Contents*:** Total alkaloid contents of the samples were determined quantitatively using the method of Harborne (2005). A volume of 200µL of 10% acetic acid was prepared in ethanol and added to 5 g of each of the samples, covered and allowed to stand for 4h. The filtrates were reduced to one-fourth of their original volume over a water bath. Concentrated ammonium hydroxide was added in drops to the extracts until precipitation was complete. The whole solution was allowed to settle and re-filtered after washing with dilute ammonium hydroxide.

The residue obtained for each sample was dried, weighed and the percentage composition was determined using the formula:

$$\% \text{ alkaloid} = \frac{\text{Final weight of the sample}}{\text{Initial weight of the extract}} \times \frac{100}{1}$$

***Determination of Flavonoid Contents*:** The amount of flavonoids in the extract of each of the samples was determined by using the aluminium colorimetric assay method (Arowosegbe *et al.* 2012). To 0.5mL of the sample solution was added 0.5mL of 2% $AlCl_3$ ethanol solution. After 1h at room temperature, the absorbance was measured at 420nm using UV spectrophotometer. Extract samples were evaluated at a final concentration of 0.1mg/mL. Total flavonoids were calculated as mg/g of quercetin standard curve using the following calibration: Y = 0.0255x; R^2 = 0.9812, where x was the absorbance and Y was the quercetin equivalent.

***Determination of Total Phenol Contents*:** The amount of phenols in each of the samples extract was determined spectrophotometrically using the modified method of Oyedemi *et al*. (2012). An aliquot of the extract (1mg/mL) was mixed with 5mL Folin-Ciocalteu reagent that was previously diluted with water (1:10*v/v*) and 4mL (75g/L) of sodium carbonate. The tubes containing all these were vortexed for 15 s and allowed to stand for 30min at 40^0C to allow for colour development. The absorbance was then measured at 765nm using the UV spectrophotometer. Results obtained were expressed as mg/g of tannic acid equivalent using the calibration curve from the equation: Y = 0.1216x; R^2 = 0.936512, where x was the absorbance and Y the tannic acid equivalent.

***Determination of Saponin Contents*:** Saponin contents of the samples were determined using the method of Obadoni and Ochuko (2001). Each ofthe plant sample (20 g) was added to 100 mL of 20 % aqueous ethanol and kept in a shaker for 30min. The samples were heated over a water bath for 4h at 55^0C and then filtered. The residues were re-extracted with 200 mL of 20 % aqueous ethanol. The extracts obtained were concentrated over a water bath at 90^0C to approximately 40 mL. The concentrate was transferred into a 250 mL separatory funnel and extracted twice with 20 mL diethyl ether. The ether layer was discarded and the aqueous layer retained and to which 60 mL *n*-butanol was added. The *n*-butanol extracts were washed twice with 10 mL of 5% aqueous sodium chloride. The samples were dried in the oven at 40^0C to a constant weight after evaporation. The saponins content was then calculated using the formula:

$$\% \text{ Saponin} = \frac{\text{Final weight of sample}}{\text{Initial weight of extract}} \times \frac{100}{1}$$

***Determination of Tannin Contents*:** The method of AOAC (1990) was used, with little modification. To 0.02g of each of the samples was added 20mL of 50% methanol, shaken together and incubated in a water bath at 80^0C for 1h. The extract was then filtered into a 100mL volumetric flask and 20mL distilled was added followed by 2.5mL Folin-Dennis reagent and then 10mL of 17% aq. Na_2CO_3. The mixture was made up to 100mL with distilled water and allowed to stand for 20min. The absorbance of the tannic acid standard and the samples were measured at 760nm. Results were expressed as mg/g of tannic acid equivalent using the calibrated curve from the equation: Y= 0.0593x – 0.0485; R^2 = 0.9826, where x was the absorbance and Y tannic acid equivalent.

RESULTS

The results of the effects of goat, poultry and cow dung manures on plant height, number of leaves per plant, leaf area, root wet weight, root dry weight, shoot wet weight, shoot dry weight and stem girth of *S. alata* at different weeks after planting (WAP) are presented in Tables 1-4. The qualitative and quantitative phytochemical constituents of the plants treated with different organic manures and the control are shown in Tables 5 and 6.

Effects of Manures on Plant Height

Results obtained on the effects of application of the three manures on the plant height at 6WAP, 8WAP, 10WAP, 12WAPand 14WAP indicated that there were no significant differences in plant height among the various treatments at the early stages of growth (6 WAP to 14 WAP) when compared with the control. However, at 16WAP, 18WAP and 20WAP;plantstreated with PM (200g) had the tallest height with mean values of 28.50, 36.00 and 48.50cm respectively, while the least plant height was recorded for CD(100g) treated plants at 16WAP, 18WAP and 20WAP (Table 1). Despite the fact that PM (200g) treatment gave the best results in terms of plant height, it was significant different only from GM (100g), CD (100g) and the control at 20WAP.

Table 1: Effects of Goat manure (GM), Poultry manure (PM) and Cow dung (CD) on the plant height (cm) of *Senna alata* at different weeks after planting.

	Weeks after planting (WAP)							
Treatment	**6**	**8**	**10**	**12**	**14**	**16**	**18**	**20**
Control	11.30a*	12.97a	14.67a	17.50a	19.03a	22.00b	24.83b	32.40cd
GM100g	10.17a	12.00a	14.10a	16.60a	19.50a	25.00ab	28.20ab	36.50bcd
GM150g	11.97a	13.63a	16.20a	18.17a	21.67a	26.27ab	31.60ab	42.93abc
GM200g	11.87a	13.67a	15.63a	18.67a	21.27a	25.40ab	29.83ab	42.67abcd
PM100g	11.47a	13.27a	15.43a	18.70a	23.27a	25.83ab	31.27ab	41.17abcd
PM150g	11.20a	13.07a	15.99a	18.73a	22.17a	25.50ab	31.40ab	42.87abcd
PM200g	11.03a	12.50a	15.67a	19.00a	24.07a	28.50a	36.00a	48.50a
CD100g	11.33a	13.13a	15.00a	17.27a	19.83a	21.50b	24.70b	31.33d
CD150g	11.87a	13.33a	15.43a	19.27a	22.17a	25.00ab	29.10ab	38.67abcd
CD200g	11.67a	12.83a	15.63a	18.07a	21.83a	26.27ab	31.43ab	43.67abcd
MSE	1.59	1.55	1.87	2.39	2.62	3.02	4.75	5.62
CV%	13.98	11.85	12.26	75.17	12.14	12.01	15.92	14.03

MSE= Mean Standard Error, CV= Coefficient of Variation.
*Values with the same letter(s) within a column are not significantly different at P≤ 0.05 according to Duncan Multiple Range Test (DMRT).

Effects of Manure on the Number of leaves per plant

The results obtained on the influence of the three manures on the number of leaves per plant showed that there were no significant differences among the varying treatments and the control at 6, 8, 10 and 12WAP (Table 2). The average number of leaves counted per plant (10.67, 11.33) in plants treated with GM (200g) was more than the control (8.33, 9.00) at 14WAP and 16WAPrespectively. However, GM (150g) and PM (150g) treatments gave the highest number of leaves per plant at 20WAP; while the least number of leaves was recorded in the control.

Effects of Manure on the Leaf Area

The Leaf area of *S. alata* treated with different organic manure for the period of twenty weeks is as shown in Table 3. Plants treated with GM (200g) gave the significantly highest leaf area of 157.1 cm^2 at 14WAP.Meanwhile, the control plants had the least leaf area (70 cm^2).However, there seemed to be no significant differences between these treatments and the control in most cases at later age of the plant.

Effects of Manure on the stem girth, Wet and dry weights of the root and shoot

The results of the study showed that application of GM, PM and CD irrespective of the quantity applied, produced thicker stem girth at 20WAP when compared with the control (Table 4). It is interesting to note that only *S. alata* plants treated with GM (150g) showed significantly higher root wet weight when compared with others including the control; while the least root wet weight was recorded in the plant treated with PM (100g). Plants treated with GM (100 and 150g) produced the highest shoot wet weight than some other treatments and the control, with the PM (100g) also having the least. Application of GM, PM and CD seemed to have no significant effects on the root dry weight

of the plant. However, highest shoot dry weight was observed in plants treated with GM (200g) which was only significantly higher that PM (100g), CD (100g) treated plants and the control.

Table 2: Effects of Goat manure (GM), Poultry manure (PM) and Cow dung (CD) on the number of leaves per plant of *Senna alata.*

	Weeks after planting							
Treatment	**6**	**8**	**10**	**12**	**14**	**16**	**18**	**20**
Control	5.33a*	6.00a	7.00a	8.00a	8.33b	9.00b	9.67a	7.67b
GM100g	5.00a	7.00a	6.67a	8.33a	10.33ab	10.33ab	10.33a	9.33ab
GM150g	5.33a	7.00a	7.67a	8.33a	9.33ab	1033ab	11.67a	10.33a
GM200g	6.33a	8.67a	8.33a	9.33a	10.67a	11.33a	12.00a	10.00ab
PM100g	6.33a	7.00a	7.00a	8.33a	10.00ab	10.67ab	10.67a	8.33ab
PM150g	6.00a	7.67a	7.33a	8.67a	10.33ab	10.00ab	10.67a	10.33a
PM200g	6.33a	7.67a	8.33a	8.67a	9.67ab	9.67ab	10.67a	8.67ab
CD100g	5.67a	7.67a	7.33a	8.33a	8.67ab	9.67ab	9.67a	9.00ab
CD150g	6.67a	8.33a	7.00a	8.67a	9.67ab	9.67ab	10.00a	8.67ab
CD200g	6.33a	7.67a	8.00a	8.67a	9.67ab	9.67ab	10.33a	8.33ab
MSE	0.98	1.46	0.92	0.72	1.09	1.05	1.56	1.22
CV%	16.51	19.54	12.28	8.44	11.31	10.52	14.81	13.47

MSE= Mean Standard Error, CV= Coefficient of Variation.
*Values with the same letter within a column are not significantly different at P≤ 0.05 according to Duncan Multiple Range Test (DMRT).

Table 3: Effects of Goat manure (GM), Poultry manure (PM) and Cow dung (CD) on the leaf area (cm^2) of *Senna alata*.

	Weeks after planting (WAP)				
Treatment	**12**	**14**	**16**	**18**	**20**
Control	52.10a*	70.00b	81.60a	132.63a	150.13ab
GM100g	57.10a	112.40ab	124.30a	140.20a	189.37a
GM150g	88.50a	101.37ab	111.37a	157.10a	178.07a
GM200g	88.50a	125.27a	127.13a	134.10a	154.90ab
PM100g	62.33a	93.67ab	100.27a	109.43a	122.57ab
PM150g	52.97a	77.50ab	103.37a	155.17a	168.93ab
PM200g	82.13a	99.53ab	98.97a	127.40a	141.20ab
CD100g	55.27a	72.73ab	93.73a	103.83a	120.03ab
CD150g	66.17a	96.17ab	107.57a	145.77a	152.73ab
CD200g	61.77a	101.23ab	102.57a	121.10a	125.47ab
MSE	2.48	7.59	7.51	7.00	4.46
CV%	33.60	29.05	26.18	20.35	33.07

MSE= Mean Standard Error, CV= Coefficient of Variation.
*Values with the same letter within a column are not significantly different at P≤ 0.05 according to Duncan Multiple Range Test (DMRT).

Table 4: Effects of Goat manure (GM), Poultry manure (PM) and Cow dung (CD) on the stem girth, wet and dry root and shoot weights of *Senna alata* at 20 Weeks after planting.

Treatment	Stemgirth (cm)	Root wet weight (g)	Root dry weight (g)	Shoot wet weight (g)	Shoot dry weight (g)
Control	0.43b*	1.93bc	1.33a	16.27de	8.63b
GM 100g	0.70a	2.67ab	2.00a	37.53a	12.40a
GM 150g	0.70a	3.30a	2.27a	35.47a	12.00a
GM 200g	0.70a	2.87ab	1.90a	32.90ab	12.53a
PM 100g	0.65a	1.47c	0.92a	13.60e	6.47b
PM150g	0.67a	2.53ab	1.67a	28.73b	10.03a
PM 200g	0.67a	2.67ab	1.63a	27.33bc	10.07a
CD 100g	0.63a	2.30abc	1.17a	21.67cd	7.47b
CD 150g	0.63a	2.20abc	2.13a	27.33bc	12.27a
CD 200g	0.70a	1.90bc	1.13a	21.80bc	9.63a
MSE	0.12	0.54	0.73	3.62	4.28
CV%	28.28	22.73	45.06	13.78	42.13

MSE= Mean Standard Error, CV= Coefficient of Variation.
*Values with the same letter within a column are not significantly different at P≤ 0.05 according to Duncan Multiple Range Test (DMRT).

Effects of Manures on the Phytochemical Composition of *S. alata*

The results of the qualitative and quantitative phytochemical analyses of *S. alata* under different organic manure treatments are shown in Tables 5 and 6. The results revealed the presence of alkaloids, saponins, tannins, phenols and flavonoids while terpenoids was not detected in all the treated plants and the control. Estimation of the amount of phytochemicals present in the various treated plants revealed that plants treated with CD (200g) had the significantly highest amount of alkaloids followed CD (150g), CD (100 g) and PM (200 g) respectively; while the control had the least. The highest saponins yield was however obtained for GM (150g) followed by CD (100g), while the least was obtained for CD (150g). The highest amount of phenols and tannins were recorded for 200g CD and the least for 150g GM. The quantities of alkaloids, tannins and flavonoids were found to increase with increase in the quantity of cow dung applied (Table 6).

Table5: Qualitative Phytochemical composition of *Senna alata* under different organic manure treatments

Phytochemical	T_1	T_2	T_3	T_4	T_5	T_6	T_7	T_8	T_9	T_0
Alkaloids	+	+	+	+	+	+	++	++	++	+
Saponins	++	++	++	++	+	+	++	+	+	+
Tannins	+	+	+	+	+	+	+	+	++	+
Phenols	+	+	+	+	+	++	+	+	++	+
Flavonoids	+	+	+	+	+	++	+	+	+	+
Terpenoids	-	-	-	-	-	-	-	-	-	-

T_1- GM(100g), T_2- GM(150g), T_3- GM(200g), T_4-PM(100g), T_5-PM(150g), T_6-PM(200g), T_7-CD(100g), T_8-CD(150g), T_9-CD(200g) and T_0-Control.
+++ Present in abundance, ++ Moderately Present, + Present, - Absent

Table 6: Quantitative Phytochemical composition of leaf extract of *Senna alata* as affected by the different organic manure treatments

Treatment	Phytochemical				
	Alkaloids (%)	**Saponins (%)**	**[1]Total Phenols (mg/g)**	**[1]Tannins (mg/g)**	**[2]Total Flavonoids (mg/g)**
Control	7.17h	2.51f	21.34i	7.31f	20.09h
GM 100g	8.21e	2.85e	21.61h	9.89c	25.83c
GM 150g	7.76f	8.18a	20.59j	7.30f	20.12g
GM 200g	7.78f	4.65c	25.57d	8.29e	22.65e
PM 100g	8.09e	4.27d	26.25c	8.78d	25.21d
PM 150g	7.53g	2.76e	25.21e	8.33e	20.00h
PM 200g	9.21d	2.46f	26.63b	10.06b	27.25a
CD 100g	10.53c	4.87b	22.43f	8.66d	18.96i
CD 150g	12.13b	2.10g	21.80g	8.74d	21.31f
CD 200g	12.53a	2,21g	27.69a	10.69a	26.52b
SME	0.09	0.08	0.08	0.07	0.05
CV%	1.02	2.16	0.32	0.77	0.23

GM= Goat Manure, PM= Poultry Manure, CD= Cow Dung, MSE= Mean Standard Error, CV= Coefficient of Variance. Values with the same letter within a column are not significantly different at P≤ 0.05 according to Duncan Multiple Range Test (DMRT). [1] Expressed as mg tannic acid/g of dry plant materials [2] Expressed as mg quercetin/g of dry plant materials.

DISCUSSION

The results obtained in this study revealed that goat manure(GM) at 200g, 150g and 100g gave the best results in term of stem girth, number of leaves per plant, leaf area, root and shoot wet weight respectively, while cow dung (CD) 100g and control gave the least results. The plant responded well to poultry manure (PM) treatments in terms of plant height only. Comparatively, the best result was obtained in goat manure applications. This may be attributed to the increase in leaves Nitrogen (N), Phosphorous (P), Potassium (K), Calcium (Ca) and Magnesium (Mg) contents of the *S. alata* plant as caused by the application of goat manure. This assertion agrees with the previous work of Ojeniyi and Adegboyega (2003); Smith and Ayenigbara (2001) on Celosia and India spinach respectively. Ojeniyi and Adegboyega (2003) reported in their previous work that goat manure increased soil pH, Nitrogen (N) and yield of Celosia. The best performance of *S. alata* treated with goat manure could probably be due to the increase in availability of nutrients supplied by goat manure which led to enhanced shoot growth. The results from this study is also in tandem with the earlier reports of some authors who attributed superior root growth in the plants they investigated to the application of goat manure (Awodun *et al*., 2007; Akanni and Ojeniyi, 2008; Nweke *et al*., 2013). The goat manure used in this study was obtained from free range animals. These goats have access to different kinds of feeds including human food items. Intake of such diets by goat could be responsible for the conversion of these foods into useful and better nutrients in the dung for the plant utilization.

Various researchers had carried out screening of different botanicals for medicinal values with the help of preliminary phytochemical analysis (Oyedemi *et al*., 2012; Arowosegbe *et al*., 2015; Khalid *et al*., 2018). Investigation of active secondary metabolites in plants is of paramount importance in identifying new sources of therapeutically and industrially valuable compounds which are of great use (Mungole *et al*., 2010). Different phytochemicals have been reported by various authors to possess a wide range of physiological and biological activities which may help in ameliorating or curing certain diseases (Adinortey *et al*., 2012; Majouli *et al*., 2017). The phytochemical components of *S. alata* in this study are similar to the reports of Owoyale *et al.* (2005). Several studies on the biological activities of *S. alata* extracts have been documented. It has been reported severally that *S. alata* leaf

possesses strong antimicrobial and antifungal properties. The leaves had been tested and found to have strong inhibitory effects against some organisms such as *Propionibacterium acnes*, *Staphylococcus epidermidis* (Chomnawang *et al*., 2005) as well as antimicrobial activities against *Cryptococcus neoformans*, *Microsporium Candidas albicans, Streptococcus pyogenes and S. aureus* (Ehiowemwenguan, 2014). The medicinal importance of *S. alata* lies in its phytochemical richness.

Tannins have been reported to have antibacterial, anti-inflammatory and antiviral properties (Andzouna and Mombouli, 2012) while Phenols in considered to have antimicrobial properties (Olofokansi *et al*., 2005). Alkaloids- an important phytochemical in plants have been documented for their analgestic, antimalarial, antispasmodic, antibacterial and antidiarrheal (Andzouna and Mombouli, 2012). The presence of these beneficial secondary metabolites might be attributed to the protective, preventive and therapeutic properties of *S. alata*. The presence of the identified phytochemicals in this plant validate the claim that it can be used as remedy for diseases such as dermatoses, skin rash, eczema, ring worm, constipation and flu.

It was observed in this work that application of organic manure enhanced the production of flavonoids, saponins, tannins, alkaloids and phenols in S. *alata*. Cow dung manure gave the best results quantitatively for alkaloids and tannins composition followed by cow dung. Goat manure produced best yield of saponins followed by poultry manure application.

CONCLUSION AND RECOMMENDATION

The findings in this study indicated that the application of goat manure increased the growth and yield of *S. alata*. Moreover, applications of difference manure to *S. alata* had positive effects on the phytochemical composition of the plant when compared with the control. Interestingly, Cow dung and goat manure gave the best phytochemical yield. Goat manure could therefore be recommended as the best manure in the cultivation of *S. alata* for better growth and phytochemical yield. Also,poultry manure can be used in the absence of goat manure.

REFERENCES

1. Adinortey, M.B., Sarfo, J.K., Quayson, E.T., Weremfo, A., Adinortey, C.A., Ekloh, W. and Ocran, J. (2012) Phytochemical Screening, Proximate and Mineral Composition of *Launaea taraxacifolia* Leaves. *Research Journal of Medicinal Plants*. 6: 171-179.
2. Ajibesin, K.K., Ekpo, B.J., Bala, D.N., Essien, E.E. and Adesanya, S.A. (2008). Ethnobotanical Survey of AkwaIbom State of Nigeria. *Journal of Ethnopharmacology*. 115 (3):387- 408.
3. Akanni, D.I. and Ojeniyi, S.O. (2008). Residual effect of goat and poultry manures on soil properties, nutrient content and yield of *Amaranthus* in Southwest Nigeria. *Research Journal of Agronomy*. 2(2): 44-47.
4. Aluko, O.A., Olanipekun, T.O., Olasoji, J.O., Abiola, I.O., Adeniyan, O.N., Olanipekun, S.O., Omenna, E.C., Kareem, K.O. and Douglas, A.I. (2014). Effect of organic and inorganic fertilizer on the yield and nutrient composition of jute mallow. *Global Journal of Agriculture Research*.2(3):1-9
5. Andzouana, M. and Mombouli, J.B. (2012). Proximate, mineral and phytochemical analysis of the leaves of *H. Myriantha* and *Uveratrinervis. Pakistan Journal of Biological Sciences.* 15: 536-541.
6. AOAC (1990). Official method of analysis.(15thed.). Association Official Analysis Chemists. Washinghton DC.
7. Arowosegbe, S. (2016). Studies on methods of breaking seed dormancy and germination enhancement in *Senna alat a*(l.) Roxb., a plant with great medicinal value. *International Research Journal of Natural Sciences.* 4(2): 31-40
8. Arowosegbe, S., Wintola, O. AandAfolayan, A.J. (2012). Phytochemical constituents and allelopathic effect of *Aloe ferox Mill*. root extract ontomato. *Journal of Medicinal Plants Research.* 6(11): 2094-2099.
9. Arowosegbe, S., Oyeyemi, S.D. and Alo, O. (2015). Investigation on the medicinal and nutritional potentials of some vegetables consumed in Ekiti State, Nigeria. *International Research Journal of Natural Sciences.* 3(1): 16-30.

10. Awodun, M.A., Omonijo, L.I. and Ojeniyi, S.O. (2007). Effect of goat dung and NPK fertilizer on soil and leaf nutrient contents, growth and yield of pepper. *International Journal of Soil Science*. 2(2):142-147.
11. Chatterjee, S., Chatterjee, S and Dutta, S. (2012). An overview on the ethno-Phyto-pathological studies of *Cassia alata*- an important medicinal plant and the effect of VAM on its growth and productivity. *International Journal of Research in Botany*. 2(4):13-19.
12. Chomnawang, M.T., Surassmo, S., Nukoolkarn, V.S. and Gritsanapan, W. (2005). Antimicrobial effects of the Thai medicinal plants against acne- inducing bacteria. *Journal of Ethnopharmacology*. 101: 330-333.
13. Davis, S.J., R.J. Fabermann, J. Haltiwanger, R.Jarmin and J. Miranda (2010), "Business Volatility, Job Destination, and unemployment", *American Economic Association* Vol. 2 (2), pp. 259-87, April.
14. Ehiowemwenguan, G., Inetianbor, J.E. and Yakubu, J.M. (2014). Antimicrobial qualities of *Senna alata*. *IOSR Journal of Pharmacy and Biological Sciences*. 9(2):47-52
15. Farnsworth, N.R. and Bunyapraphatsara, N. (1992). Thai medicinal plants recommended for primary healthcare system. Medicinal Plants Information Center, Thailad. 409 pp.
16. Harborne, J.B. (2005). Phytochemical Methods-A Guide to Modern Techniques of plant Analysis, 3rd ed.; *Springer Pvt.Ltd*.: New Delhi, India.
17. John, L.W., Jamer, D.B., Samuel, L.T and Waner, L.W. (2004). Soil fertility and fertilizer:an introduction to nutrient management. *Pearson Education.* India, 106-153pp.
18. Kayode, J. and Otoide, J.E. (2007). Leaf cuticle variation in *Amaranthus spinosus*as indicators of environmental pollution. *Pakistan Journal of Scientific and Industrial Research*. 50(5): 327-329.
19. Khalid, S. Shahzad, A., Basharat, N., Abubakar, M. and Anwar, P. (2018). Phytochemical screening and analysis of selected medicinal plants in Gujrat. *Journal of Phytochemistry and Biochemistry*. 2:108.
20. Majouli, K., Hamdi, A. and Hlila, M.B. (2017). Phytochemical analysis and Biological activities of *Hertiacheirifolia* L. roots extracts. *Asian Pacific Journal of Tropical Medicine*. 10(12): 1134-1139.
21. Mungole, A.J., Awati, R., Chaturvedi, A. and Zanwar, P. (2010). Preliminary phytochemical screening of Ipomoea obscura (L.) – A hepatoprotective medicinal plant. International *Journal of pharmTech Research*. 2 (4):2307- 2312.
22. Obadoni, B.O. and Ochuko, P.O. (2001). Phytochemical studies and comparative efficacy of the extracts of some haemostatic plants in Edo and Delta state of Nigeria. *Global Journal ofPure Applied Science*. 8: 203-208.
23. Obi, M.E and Ebo, P.O. (1995). The effect of organic and inorganic Amendments on soil physical properties and maize production in a severely degraded sandy soil in southern Nigeria. *Bioresour. Technol*.51 (213): 117-123.
24. Odebiyi O.O. and Sofowora E.A. (1978). Phytochemical Screening of Nigeria Medicinal Plants, Lioydia, 41(3): 239–246.
25. Ojeniyi, S.O. and Adegboyega, A.A. (2003). Effect of combined use of urea and goat manure in *Celosia. Nigerian Agric. J*.54: 87-90.
26. Onyegeme-Okerenta, B.M., Nwosu, T. and Wegwu, M.O. (2017). Proximate and phytochemical composition of leaf extracts of Senna alata (L) Roxb. *Journal of Pharmacognosy and Phytochemistry*. 6(2): 320-326.
27. Owoyale, J.A, Olatunji, G.A. and Oguntoye, S.O. (2005). Antifungal and antibacterial activities of an ethanolic extract of *Senna alata*leaves. *Journal of Applied Science and Environment Management*. 9: 105-107.
28. Oyedemi, S.O., Oyedemi, B.O., Arowosegbe, S. and Afolayan, A.J. (2012), Phytochemical analysis and medical potential of hydroalcoholic extract from *Curtisia dentate* (Burm. f) C.A. Sm stem bark. *International Journal of Molecular sciences*. 13:6189-6203.
29. Palekar, S. 2007. Text book on Shoonya Bandovalada Naisargika Krushi, Published by Swamy Anand, Agri Prakashana, Bangalore, 65p.
30. Ramsi, K.V. (2014). Nutrient management in the organic farming of Cucumber. *M.Sc. Thesis,* Department of Agronomy, Kerala Agricultural University, Kerala, Indian. 176p.
31. Roy, S. and Kashem, Md.A. (2014). Effects of organic manures in changes of some soil properties at different incubation periods. *Open Journal of Soil Science*. 4: 81-86.

32. Smith, M.A.K. and E.A. Ayenigbara, (2001). Comparative growth and nutrient composition of Indian spinach in an enriched humid tropical environment. *African Crop Science Conference. Proceedings.* 5: 1007-1013.
33. Trease, G.E. and Evans, W.C. (1996). Phenols and Phenolic Glycosides in Trease and Evans Pharmacology and Bikere. Tindall, London. Pp. 832-836.
34. Trease, G.E. and Evans, W.C. (2005). Pharmacognosy, 11th edition. Brailliar Tinidel Can. Macmillian Publishers.
35. Nweke, I. A., Ijearu, S.I. and Igili, D.N. (2013). Effect of different sources of animal manure on the growth and yield of okra *(Abelmuschus esculentus (L.) Moench)* in ustoxic dystropept at Enugu, south eastern Nigeria. *International Journal Scientific and Technology Resources.* 2(3): 135-137.
36. Ugwu, O.E. (2016). Effects of Organic and Inorganic Fertilizers on the growth and yield of physic nut (*Jatropha curcas*). *International Journal of Advances in Agricultural and Environmental Engineering*. 3(1):131-135.