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Research Article
Effect of Organic and Inorganic Fertilizer on the Biomass Reserve of *Deinbollia pinnata* Schum. and Thonn.

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Abstract

Background and Objective: It is essential to increase the productivity of agricultural crops through fertilizer application which will provide the necessary plant nutrients. Meanwhile, the search for sustainable means of decreasing damage caused by effects of chemical fertilizers must be taken note of. Therefore, this study investigated the effects of organic manure and inorganic fertilizer treatments on biomass accumulation of *Deinbollia pinnata* for a period of 16 weeks. **Materials and Methods:** The experimental design was a complete randomized design replicated 10 times. Variables assessed were plant height, collar diameter, number of leaves and number of branches and biomass accumulations. **Results:** However, the best performance was recorded in the seedlings raised with cow dung with a mean value in plant height (20.59 cm), number of leaves (36) and number of branches (32), while control has the highest mean value in collar diameter (6.96 mm), respectively. Also, organic fertilizer was said to have a significant effect on biomass accumulation. As cow dung gave the highest value for stem, leaf and root at 10, 23 and 17 g, respectively. **Conclusion:** It is therefore, recommended that organic fertilizers should be applied in raising *Deinbollia pinnata* seedlings. This research advocates for the use of naturally produced fertilizers as products from such is safe for human consumption. This can also reduce the harmful effect of inorganically produced crop on mankind.

Key words: *Deinbollia pinnata*, organic, inorganic fertilizers, growth variables, biomass, seedlings, human consumption, crop production

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Competing Interest: The authors have declared that no competing interest exists.

Data Availability: All relevant data are within the paper and its supporting information files.

INTRODUCTION

Since the beginning of human existence medicinal plants have been providing security to rural people in primary healthcare[1]. Besides, indigenous medicinal plants are used as spices and food by man, some are added as food supplements for pregnant and nursing mother's medication[2]. As a result, identifying these beneficial plants is highly imperative as a guide for gaining all the benefits they offer[3].

More attention is needed in the development of medicinal plants due to the important role they play in the improvement of human's health. Hamann[4] reported that 75-90% of world rural populations depend on traditional herbal medicine in their primary health care. Furthermore, in this decade, the world is experiencing an increasing rate of resistance by pathogens to some synthetic drugs, there is also the struggle against cancer and Acquired Immune Deficiency Syndrome (AIDS) which has not found treatments from modern medicine. Consequently, this has challenged the scientific community to seek solutions from plant species. This is reflected by number of research programmes aimed at testing plants species for pharmacological values [5].

Some examples of plants used in traditional medicine include *Entada abyssinica*, (igbaa), *Calotropis procera*, (Bomubomu), *Zanthoxylum xanthoxyloides* (Ata) and *Calophyllum inophyllum*e etc.

Apart from these medicinal plants mentioned above *Deinbolia pinnata* Schum. and Thonn. is another important beneficial medicinal plant. It is locally known as Ogiri-egba and belongs to family Sapindaceae. Plants in Sapindaceae are widely reported for pharmacological, antioxidant, antidiabetic and anti-inflammatory activities[6,7]. Ethnobotanical reports indicated that plants in Sapindaceae are used for treating ulcer, boils, pain, dermatological problems, wound healing, diarrhea and dysentery[6,8,9].

Ethnobotanical information revealed that the roots and leaves of *D. pinnata* are used as remedy for febrifuge, analgesic, bronchiectasis intercostal, intestinal pains, jaundice, cough, asthma and aphrodisiac infections[9,10]. The medicinal plants value to human livelihood is essentially infinite as they solve 2 vital problems of humans which are health and financial problems. Despite all these contribution to human livelihood, these plants are facing a lot of problems that threatens their future existence. One of these problems includes the high rates of decline in soil fertility.

Soil productivity maintenance is a major constraint of tropical agriculture system. Crop cultivation is usually moved between fields to utilize only fertile soils for some years without use of fertilizers. However, this cannot be sustained to meet increased demand of an increasing population. Most tropical soils and forests are deficient in nitrogen and phosphorus nutrients and uptake of these limited quantities of nutrients by plant roots from litter is difficult[11,12]. Soil fertility and plant nutrition are essential aspect of cropping system and these include an adequate supply of essential nutrients for soil productivity, plant nutrition and qualitative crop yield. The availability of these nutrients to plant contributes a lot to its growth and yield. Deficiency of mineral elements essential for plant crop is evident in poor yield, yield quality and biomass accumulation. An adequate supply of mineral elements is of importance in the tropics where the soil is poorly formed and continuous cropping is on the increase. For any sustainable crop production, soil fertility amelioration is essential. Tropical soils are inadequate in soil nutrients.

Photosynthesis is the most essential process in the plant for growth and biomass production, hence it is the driving force for yield formation[13,14]. However, low availability of nutrient can negatively influence photosynthesis[15] and photosynthetic pigments[16]. Biomass accumulation is an important indicator of crop final product and plant performance. It is, thus, considered a key trait in plant breeding, agriculture improvement and ecological applications[17]. Biomass accumulated by plants is the final product of photosynthetic activity and is the food reserve for most plants. An understanding of biomass accumulation during the growing season and the relationship between yield and biomass can assist in attaining yield improvements through plant breeding and better agronomic practices[18].

Thus, the application of fertilizer or manure for amelioration of soil fertility is an integral part of suitable production[19,20]. Despite numerous folkloric utility of *D. pinnata* in traditional medicine, there are no known scientific studies on its silvicultural assessment, fertilizer application and biomass accumulation. Hence, to ensure the proper domestication, sustainable use and management of this species, efforts must be made to ascertain fertilizer preference to this crop with reference to its efficient use by the plant. Therefore, the objective of this study was to investigate the application of organic and inorganic fertilizer to improve soil fertility for seedlings growth and biomass components of *D. pinnata.*

MATERIALS AND METHODS

Experimental site: The experiment was carried out from April-August, 2017 in the Multipurpose Tree Species multiplication and Improvement Unit Nursery at Forestry Research Institute of Nigeria (FRIN), Ibadan, Oyo state, Nigeria,

Table 1: Pre-planting analysis of soil sample

Soil properties	Value
PH	7.28
Sand (%)	73.00
Silt (%)	9.00
Clay (%)	18.00
P (mg kg^{-1})	0.09
Ca (cmoL kg^{-1})	3.30
Mg (cmoL mg^{-1})	0.40
Na (cmoL mg^{-1})	0.04
K (cmoL kg^{-1})	0.12
Mn (mg kg^{-1})	82.00
Zn (mg kg^{-1})	28.00
Fe (mg kg^{-1})	40.00
Cu (mg kg^{-1})	22.00

Table 2: Laboratory analysis of the used cow dung

Parameters	Values
C	18.23 (cmol kg^{-1})
N	1.34 (cmol kg^{-1})
P	1.50 (cmol kg^{-1})
K	0.6701 (cmol kg^{-1})
Na	1.34 (cmol kg^{-1})
Ca	2.34 (cmol kg^{-1})
Mg	0.21 (cmol kg^{-1})
Cu	20.40 (mg kg^{-1})
Zn	120.60 (mg kg^{-1})
Fe	340.00 (mg kg^{-1})
Mn	115.00 (mg kg^{-1})

which is located within the Jericho Government Reserve Area (GRA) of Ibadan South-West Local Government area. The area lies within latitude 7°23′15″N, 3°51′00″E and 7°24′00″N, 3°52′15″E. The climatic pattern of the area is tropical, annual rainfall ranges from 1,300-1,500 mm and average relative humidity of about 71.9% while the average temperature is about 26°C.

Procurement of seed and processing: Matured fresh fruits of *Deinbollia pinnata* were collected from the wild. Selections were made for desirable fruit and seeds were later extracted from the pulp, washed and air dried at room temperature for 3 days before sowing. These were germinated in washed and sterilized river sand for two weeks in a propagator. After two weeks of germination, seedlings with desirable vigor were randomly selected and transplanted into polythene-pots (2×6 cm) filled with mixture of top soil and the fertilizers.

Preparation of potting mixtures and experimental lay-out design: Top soil was used in this experiment and was collected at the Forestry Research Institute of Nigeria arboretum. The soil was air dried, visible roots, leaves and other debris were removed from the sand by sieving through a 2 mm sieve size and then analyzed in the laboratory to determine its physico-chemical properties (Table 1).

Two fertilizer treatments were applied i.e., cow dung and urea with the control (without any treatment). The cow dung was collected from Federal College of Forestry cattle ranch. It was air-dried and allowed to decompose for 4 weeks. It was later grounded into powdery form. In addition to cow dung, urea was also used in the research. The cow dung amendments analysis was also carried out to determine its nutritional composition (Table 2).

Seventy seedlings were transplanted into polythene bags by using 10 seedlings for each treatment. A completely randomized design was adopted for the work. The amendments were weighed with a bean analytical balance into different ratio and mixed with the soil according to respective treatments. Watering was done once a day. The amounts of nutrients added to each potting mix and the experimental combinations were as follows:

Treatments:

- 2.5 kg of cow dung+5 kg of soil
- 5.0 kg of cow dung+10 kg of soil
- 7.5 kg of cow dung+15 kg of soil
- 0.5 g of urea+5 kg of soil
- 1.0 g of urea+10 kg of soil
- 1.5 g of urea = 15 kg of soil
- Control (no fertilizer application)

Data collection: After establishment of the experiment data were collected monthly for a period of four months and the following growth variables were assessed. The number of leaves produced by seedlings was counted and number of branches by counting the branches. Plant height (cm) was taken from the ground level to the tip of the seedlings by using a graduated meter rule. Measurement of diameter at collar region was taken at the ground level by using a digital venire caliper.

Statistical analysis: The data was obtained for the growth parameters of *D. pinnata* seedlings were analyzed by using analysis of variance (ANOVA). Where significant differences occurred, Least Significant Difference (LSD) was employed to separate the means.

RESULTS

Influence of cow dung and urea on growth variables of *Deinbollia pinnata* seedlings: Analysis of variance showed the effects of fertilizers application on all the growth variables of *D. pinnata* seedlings. From the result of analysis of variance,

Table 3: ANOVA for the effect of fertilizers on the growth of *Deinbollia pinnata* seedlings

Growth parameters	SV	SS	DF	MS	S
HT	Time	3246.662	3	1082.221	0.000
	TRT	1984.218	3	283.460	0.000
	Time*TRT	629.755	9	29.988	0.002
	Error	3787.018	304	13.288	
	Total	81874.530	319		
CD	Time	768.706	3	256.235	0.000
	TRT	83.565	3	11.938	0.000
	Time*TRT	67.833	9	3.230	0.000
	Error	341.779	304	1.195	
	Total	14719.292	319		
NL	Time	13135.26	3	4378.42	0.000
	TRT	9607.94	3	1372.56	0.000
	Time*TRT	775.69	9	36.94	0.900
	Error	16996.60	304	59.02	
	Total	242420.00	319		
NB	Time	4126.73	3	1375.58	0.000
	TRT	17898.20	3	2556.89	0.000
	Time*TRT	4526.34	9	215.54	0.000
	Error	2738.90	304	9.51	
	Total	80169.00	319		

TRT: Treatment, NB: Number of branches, CD: Collar diameter, NL: Number of leaves, HT: Height, SV: Source of variation, SS: Sum of square, MS: Mean square, DF: Degree of freedom, S: Significance

Table 4: Average mean value of growth variable of *Deinbollia pinnata* seedlings as influence by cow dung

Parameters	HT	CD	NL	NB
CD1	14.85^{bc}	5.36^{a}	30^{c}	11^{bc}
CD2	20.59^{e}	6.17^{b}	36^{d}	32^{d}
CD3	13.44^{ab}	6.70^{bc}	24^{b}	10^{bc}
CD4	13.97^{bc}	6.96^{cd}	19^{a}	7^{a}

Means with the same letter under each column are not significantly different from each other at probability level 0.05 according to LSD, **CD1: Cow dung (2.5 g), CD2: Cow dung (5.0 kg), CD3: Cow dung (7.5 kg) and CD4: Control (without addition of organic manures), HT: Height, CD: Collar diameter, NL: Number of leaves, NB: Number of branches

it was found out that fertilizer application had a significant effect on all the growth variables at 0.05 probability level (Table 3). The two organic and inorganic fertilizers affect the vegetative growth of *D. pinnata.*

However, when 5.0 kg of cow dung was used plant height was highest with a value of 20.59 cm and this was followed by 2.5 kg with a mean of 14.85 cm (Table 4). Highest mean value 6.96 for collar diameter was observed in *Deinbollia pinnata* seedlings without fertilizer application and this was followed by 7.5 kg of cow dung fertilizer application with a mean value of 6.70 (Table 4). Furthermore, number of leaves and number of branches recorded highest mean values of 36 and 32 at 5.0 kg level of application followed by 30 and 11 at 2.5 kg, respectively (Table 4).

While in terms of urea application 17.15 cm was recorded for highest mean value for height when 0.5 g of urea was applied followed by 1.5 g/pot (15.34) (Table 4). However, seedlings with 1.5 kg/pot level of application gave the highest mean value for collar diameter of 7.22 mm followed by 6.61 mm at 0.5 g/pot (Table 5). Number of leaves has the highest mean values of 28 followed by 23 at 0.5 and 1.5 kg ha^{-1}, respectively. Moreover, number of branches also has it highest value of 11 followed by 10 at 1.0 kg ha^{-1}, control and 1.5 kg ha^{-1}, respectively (Table 5).

Comparing cow dung and urea fertilizers application, cow dung produced seedlings that have the highest height and number of leaves while urea fertilizer application produces plant with the highest collar diameter. The two types of fertilizer were able to produce highest number of branches.

Influenced of time of planting on growth variables of *Deinbollia pinnata* seedlings: The results in Table 6 showed the effects of time on all the growth variables of *D. pinnata* seedlings and it was discovered that time had a significant effect on all the growth variables at probability level of 0.05%. With a mean height of 19.85 cm (Table 6), the greatest effect of time on height was achieved at the 4th month after planting as plant height increases with time of planting.

Time of planting also had a significant effect on collar diameter, as it increases progressively and the highest mean recorded was at 4 months after planting 8.72 mm (Table 6).

Table 5: Average mean value of growth variable of *Deinbollia pinnata* seedlings as influence by urea

TRT	HT	CD	NL	NB
UR1	17.15[d]	6.61[bc]	28[c]	9[b]
UR2	13.45[ab]	6.37[b]	22[ab]	11[bc]
UR3	15.34[c]	7.22[e]	23[ab]	10[bc]
UR4	11.92[a]	6.58[bc]	19[a]	11[c]

Means with the same letter under each column are not significantly different from each other at probability level 0.05 according to LSD, **UR1: Urea (0.5 kg), UR2: Urea (1.0 kg), UR3: Urea (1.5 kg), UR4: Control (without addition of inorganic manures), HT: Height, CD: Collar diameter, NL: Number of leaves, NB: Number of branches

Table 6: Average number of growth variables under the influence of time

Time	Height	CD	NL	NB
T1	10.83[a]	4.43[a]	16.36[a]	7.09[a]
T2	14.51[b]	5.88[b]	22.41[b]	12.05[b]
T3	16.94[c]	6.98[c]	28.53[c]	14.53[c]
T4	19.85[d]	8.72[d]	33.43[d]	16.76[d]

**T: Time, HT: Height, CD: Collar diameter, NL: Number of leaves, NB: Number of branches

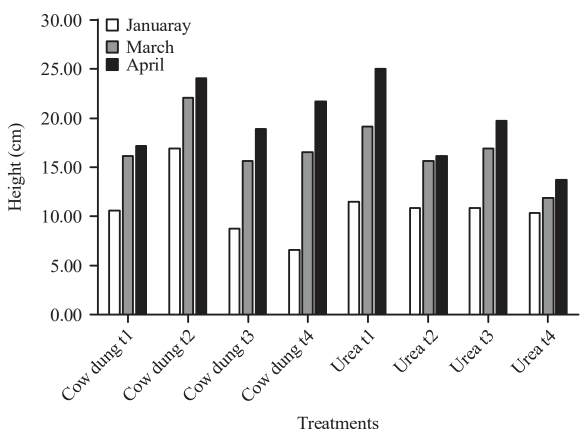

Fig. 1: Effect of fertilizer application on height of *Deinbollia pinnata* seedlings months after planting

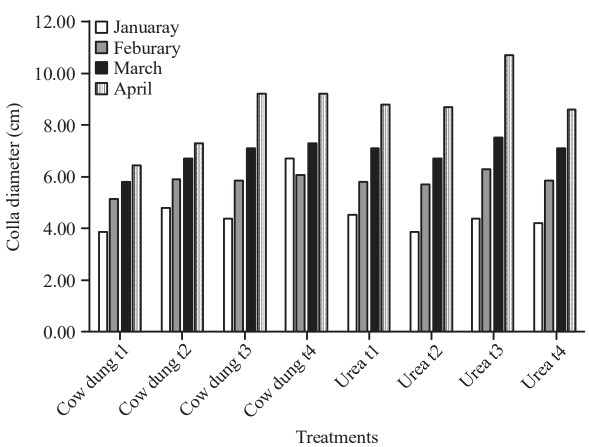

Fig. 2: Effect of fertilizer application on collar diameter of *Deinbollia pinnata* seedlings months after planting

Furthermore, both number of leaves and number of branches increases with the increasing months of planting as highest mean value was also recorded at the 4th month, 33.43 and 16.76, respectively.

Effect of fertilizer application on growth of *Deinbollia pinnata* seedlings months after planting: However, in the effect of time and treatment, analysis of variance showed a significant effect at p>0.05 probability level (Table 6), but it is exceptional in the case of effect of time and treatment on number of leaves which is not significantly different at p>0.05 level of probability (Table 6).

Effect of fertilizer application on height of *Deinbollia pinnata* seedlings months after planting: Fertilizer application increases with time from the first month through to the last month, but highest value was recorded for cow dung in the 4th month at 5.0 kg level of application and this was followed by control also in the 4th month (Fig. 1).

Urea application also increases with time throughout the month. Highest mean value was recorded in the 4th month at 0.5 g/pot level of application which is followed by 1.5 kg also at the 4th month (Fig. 1). Urea has the highest mean value with 0.5 g level of application at the 4th month when compared with cow dung (Fig. 1).

Effect of fertilizer application on collar diameter of *Deinbollia pinnata* seedlings months after planting: Application of cow dung at 7.5 kg and control both has the same mean value of collar diameter at 4th, respectively, but in the case of urea at 1.5 kg level of application the mean value recorded was also high at the 4th month. In comparison urea also gave the highest value of collar diameter at the 4th month (Fig. 2).

Effect of fertilizer application on number of leaves of *Deinbollia pinnata* seedlings months after planting: At the 4th month highest value for number of leaves with cow dung at 5.0 kg level of application was recorded. Urea has it highest

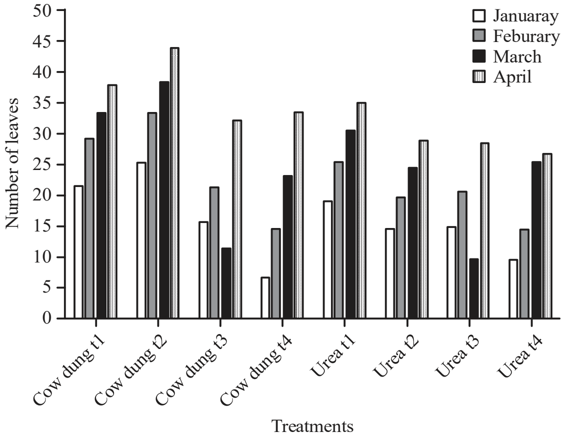

Fig. 3: Effect of fertilizer application on number of leaves of *Deinbollia pinnata* seedlings months after planting

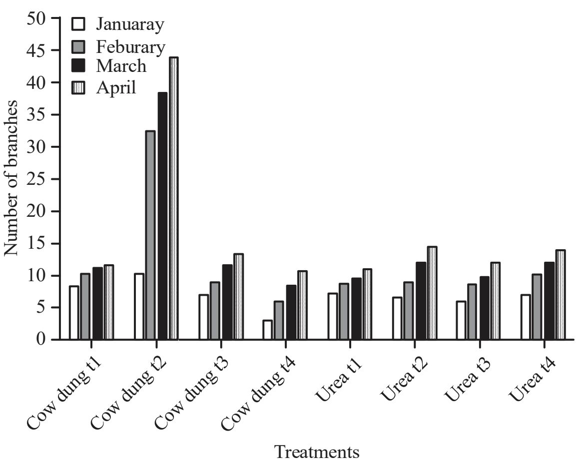

Fig. 4: Effect of fertilizer application on number of branches of *Deinbollia pinnata* seedlings months after planting

value achieved at the 4th month also with 0.5 g level of application, but cow dung treatment still performs best than urea (Fig. 3).

Effect of fertilizer application on number of branches of *Deinbollia pinnata* seedlings months after planting: There was a drastic reduction in the effect of treatment and time of planting on the number of branches as there was a great difference in the time of planting with cow dung at 5.0 kg as compared to urea treatment. Highest value was recorded in the 4th month with cow dung at 0.5 g level of application (Fig. 4).

Effect of fertilizers application on *D. pinnata* seedling biomass: Biomass accumulations of *D. pinnata* seedlings were determined after 16 weeks of growth assessment. Selections

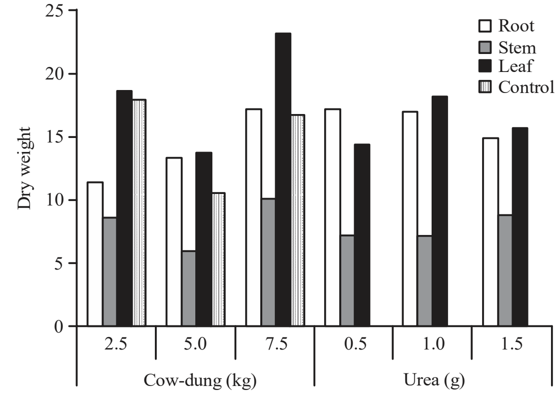

Fig. 5: Dry weight of *Deinbollia pinnata* as influenced by organic and inorganic manures

of 5 seedlings per treatment were and sectioned into leaf, stem and root components. The samples were then oven-dried at 70°C for 24 h and weighed until constant weight were achieved in order to determine the dry weight. These were weighed with sensitive weighing scale (AND GF 2000 Digital Scale).

Leaf Dry Weight (LDW) of *D. pinnata* seedlings as influenced by cow dung and urea: Mean values of Leaf Dry Weight (LDW) are presented in Fig. 5. However, it was observed that fertilizers application, level of application with their interaction significantly affects leaf dry weight of *D. Pinnata.* Cow dung at 7.5 kg level of application had the highest value of leaf biomass (23 g) followed by 2.5 kg (19 g) and 5.0 kg had the least value of leaf dry weight (11 g). While, under urea application the least mean value of dry leaf dry weight was recorded in 0.5 g level of application (14 g) followed by 1.5 kg (19 g) and the highest mean value was recorded in 1.0 g (16 g). In comparing cow dung, urea and the control, the highest mean value for LDW was still recorded in cow dung followed by urea and the least in control (18 g).

Stem Dry Weight (SDW) of *D. pinnata* seedlings as influenced by cow dung and urea: The stem dry weight result of *D. pinnata* seedlings are presented in Fig. 5 and it was observed that highest mean value for SDW was recorded from seedlings grown under cow dung condition (7.5 kg) with 10.0 g as the mean value followed by seedlings grown under cow dung condition (2.5 kg) with a mean value of 9.0 g and the least was found in 5.0 kg having 6.0 g mean value, respectively. Seedlings grown under urea application at 1.5 g has the highest mean value of SDW (9.0 g) while both 0.5 and 1.0 g of urea application where not different from each other with a mean value for SDW (7.0 g), respectively. In comparison of the effect of fertilizer application on the dry weight of the seedling 7.5 kg of cow still records the highest mean value when compared to urea and control.

Root Dry Weight (RDW) of *D. pinnata* seedlings as influenced by cow dung and urea: The *D. pinnata* seedlings Mean values for root dry weight production are presented in Fig. 5. Root dry weight of seedlings under 7.5 kg of cow dung condition also has the highest mean value of 17 g followed by 5.0 kg with 14 g and 2.5 kg with 12 g, respectively.

Furthermore, the results of the root dry weight production for *D. pinnata* seedlings under urea condition are presented in Fig. 5 and it can be deduced that highest mean value for RDW was recorded from seedlings grown under urea condition at 1.0 g with a mean value of 10.0 g which was followed by seedlings grown under 1.5 g urea condition with a mean value of 16.0 g and the least was found in 0.5 g with a mean value of 14.0 g.

DISCUSSION

In plants, leaf formation, height increase as well as stem enlargement are aspects of plant growth which are manifestations of physiological processes. The above morphological expressions in a plant are responses to internal and external factors. The application of chemical fertilizers is costly and gradually leads to the environmental problems such as; nutrient loss, surface water and groundwater contamination, soil acidification or basification, reductions in useful microbial communities and increased sensitivity to harmful insects[21].

Organic residue recycling is becoming an increasingly important aspect of environmentally sound sustainable agriculture. Now-a-days, agriculture production based on organic applications is growing in interest and the demands for the resulting products are increasing. The application of organic materials is fundamentally important in that they supply various kinds of plant nutrients including micronutrients, improve soil physical and chemical properties and hence, nutrient holding and buffering capacity consequently enhance microbial activities[22]. Application of plant waste and farmyard manure, etc. had also advanced in interest. Among them, animal wastes are rich in nutrients including micronutrients readily available and commonly used by farmer around the world[23].

It was evident from this study that the amendments, especially the organic fertilizer have further enhanced better growth performance of *Deinbollia pinnata* seedlings in all the parameters measured and compared to the inorganic fertilizer urea. The addition of organic matter content resulting from organic fertilizer application helps to improve nutrient availability to plants, especially in tropical soils that are generally low in soil organic matter and clay[24].

The highest growth parameters of *D. pinnata* occurred in organic manure more than inorganic urea did. This might be as a result of the highest release of essential nutrients from the organic fertilizer. This was in accordance with Rosen and Eliason[25], who reported that higher rate of plant growth in organic fertilizer application reiterates the fact that organic fertilizers steadily release available nutrients overtime and not like inorganic fertilizers that release nutrients within a short period to plant, then leaches away from the root zones. Research reports had shown that *coffee Arabica*[26] and *Anacardium occidentale*[27] were successfully produced organically with animal manure. Also, Osaigbovo *et al.*[28] reported that *Dennettia tripetala* seedlings had a superior performance in a combination of top soil and cow dung medium. Suge *et al.*[29] discovery also buttress the use of cow dung as organic fertilizer as it provided the optimal yield of *Solanum melongena* when compared with urea mixture. More so, Clementina[30] found that cow dung gave optimal growth parameter on *Cucurbita maxima* as compared to the inorganic fertilizer. Moreso, Moyin-Jesu and Adeofun[31] found that organic fertilizers increased *Irvingia gabonensis* seedlings height, leaf area, stem girth, leaf number and root length by 22, 50, 33, 21 and 49%, respectively when compared to the NPK chemical fertilizer treatments.

Furthermore, the total biomasses of seedlings increased the most when organic fertilizers was used and this however, indicated that organic manure perform better than those from inorganic source. This is evident from the findings of Janet *et al.*[32], who reported that animal manure produced the highest fresh root weight, fresh shoot weight, dry root weight and dry shoot weight of *Solanum nigrum*, respectively. Falana *et al.*[33] also discovered that cow dung animal manure gave a higher yield of biomass in *Khayase negalensis.* In addition, findings of Han *et al.*[34] suggested that fertilization treatment increases the available nutrients in the soil, that biomass production is increased by the nutrients which are absorbed by *Liriodendron tulipifera*. Similarly, Masarirambi *et al.*[35] reported a trend of superiority of the different level of animal manure application on *Lactuca sativa* and it was observed that the species exhibited a higher of mean values leaf dry mass.

The positive growth response of the *Deinbollia pinnata* seedlings to organic and inorganic soil amendments than control indicated that the soil collected for this research is inherently low in some essential nutrients (Table 1), hence, the level of many essential nutrients in these soils is lower and was readily available and supplied from the organic and inorganic amendments. The *Deinbollia pinnata* seedlings were more responsive to the animal sourced (organic manure) amendments compare to the inorganic fertilizer, thus indicated there were some important nutrients that were being supplied to the *Deinbollia pinnata* seedlings by the organic manures which were not available in the inorganic fertilizer urea. Organic and inorganic sourced fertilizers were competitive in the growth pattern of *Deinbollia pinnata* seedlings and after 4 months of their application, they resulted to a general significantly higher plant growth.

Animal manure is readily available as waste from farmers. It cost less than the synthetic inorganic fertilizers. It is environmental friendly as it does not damage the soil as against the inorganic fertilizer which can cause soil acidity due to continuous use. The organic fertilizer does not require expertise for its application[36]. It is recommended that *D. pinnata* can be cultivated with organic fertilizers. The fruits produced through this medium will be safer for mankind to avert the likely diseases derived from the consumption of foods produced through inorganic fertilizers.

However, the soil must not be seen as a dumping ground for organic wastes. If too much nitrogen fertilizer is applied, whether in the form of organic matter or chemical fertilizer, some of the excess nitrogen is converted to nitrates, which are harmful to human health[37,38]. Improper use of organic fertilizers can cause nitrates to accumulate in groundwater and also in crops if they are taken up by the plant roots.

CONCLUSION

It could be deduced from this study that application of nutrient supplements as soil amendments enhanced the growth performance of *D. pinnata* seedlings resulting in rapid plant height, leaf production and increased plant stem girth that are inevitable for plant vigorous growth. Cow dung fertilizer showed higher significant differences on collar diameter, plant height, number of leaves number of branches and increased biomass accumulation.

SIGNIFICANCE STATEMENT

This study discovered the use of organic fertilizers from animal source that can be beneficial for producing *D. pinnata* for consumption as a fruit. Also, this study will help the researchers to uncover the critical areas of fertilizer application on soil amendment that many researchers were not able to explore. Thus, a new theory on organic farming advocacy may be arrived at.

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