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GROWTH RESPONSE OF *Erythrophleum suaveolens (GILL AND PERR.) BRENAN* AS INFLUENCED BY DIFFERENT ORGANIC MANURES

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ABSTRACT

Indigenous forest species mostly suffer from both man and natural disasters in the areas of exploitation, pathogenic and genetic instability. As a result of over-exploitation due to the economic importance and medicinal values of *Erythrophleum suaveolens*, the species risk going into extinction. This study therefore investigated the effects of organic manure (poultry droppings and horse dung) on the early growth of *E. suaveolens* seedlings. Four week old seedlings were transplanted into polythene pot containing 2kg top soil thoroughly mixed with varying level of poultry manure, horse dung and combination at 10g, 20g and 30g application rate and control (without treatment). The experiment was laid in a Completely Randomized Design with 10 treatments and replicated 4 times. Plant height, collar diameter, leaf production, biomass accumulation and relative growth rate were assessed. The data collected was subjected to analysis of variance at 5% level of significance. The results obtained revealed that there were no significant difference in all the treatments. However, seedlings treated with 10g horse dung recorded the highest plant height with mean value of 34.42 cm while seedlings treated with 10g poultry manure exhibited the highest diameter and number of leave with 5.79 mm and 152.60, respectively. Furthermore, seedlings treated with combination of poultry manure and horse dung at 30g recorded the highest total dry weight (13.35g) while the lowest total dry weight 7.68g was observed in 20g poultry manure. It is therefore pertinent to know that the organic manures applied to *Erythrophleum suaveolens* seedlings had insignificant effect on its growth parameters and thus there is need for further study on the species nutrients requirement with a view to achieving significant results.

Keywords: Forest, medicinal plant, *Erythrophleum suaveolens*, organic manures, soil fertility,

Introduction

Forests are indispensable natural resources with wide range of benefits to mankind as they provide social, economic and environmental goods and services which in turn contribute to the well-being of rural-poor farmers, local and national economies and global environmental health (Adewunmi *et al.*,2014; Adepoju *et al.*,2016). Over the years, African forests have witnessed devastating depletion, indiscriminate felling of important tree species and in many cases, resulting in genetic degradation which threatens biodiversity, hydrology, soils, plant and animal lives, as well as stability and quality of life especially for the rural communities who depend mainly on the vegetation for a variety of products and services (Agbo-Adediran *et al.*, 2016). In order to regenerate forest tree species and maintain it, there is need for soil nutrient enrichment. However, due to the high cost of synthetic fertilizer and its negative impact on the environment, the use of organic manures

as an alternative becomes necessary to enhance the growth and development of important medicinal plant species like *Erythrophleum suaveolens.*

Erythrophleum suaveolens commonly known as sasswood, ordeal tree or red bark tree, is a medium-sized tree belonging to the family 'Fabaceae' (Adeoye and Oyedapo, 2004). It can grow up to a height of 30m with bole rarely straight, up to 90 cm diameter and slightly buttress and low branching (Okeyo, 2006). In Nigeria, *E. suaveolens* is locally called several names by people of diverse ethnic origin among which are ''Ingi" or "orachi" (Igbo), "Erun" or "Obo" (Yoruba), ''Saachi'' (Nupe), "Baska" (Hausa), "Ovinyin" (Akinpelu *et al.* 2012; Idyu *et al*. 2014). The leaves of *E. suaveolens* are bi-pinately compound with acute and ovate, leaflet that are smooth, curvaceous and alternate. The flowers are in dense terminal compound racemes which are regular with 5-cleft calyx 5 petals unbricate in buds with 10 distinct stamen.

The fruit is thick, leathery and bright containing 3–5 oblong seeds (Wikipedia, 2020). *E. suaveolens* is a very popular and important medicinal plant in Africa with very durable wood which is commonly harvested for trade (Protabase, 2020). Apart from economic importance of *E. suaveolens,* the bark of this species contains a range of alkaloids which are extremely strong, rapid-acting cardiac in warm-blooded animals causing shortness of breath, seizures and cardiac arrest in a few minutes (Protabase, 2020). In the report of Ziba (2016) *E. suaveolens* has been reported to be traditionally used for various medicinal purposes; the bark when crashed is used to treat swellings caused by filariasis, the powdered bark is snuff to treat headache, decoction of the bark and roots is used to ease general body pains and decoction of roots is used as anthelminthic especially against tape worms. In West Africa, boiled mixture of *E. suaveolens* powdered bark and palm oil is used as an insecticide for stored grains and pulses. Also, dried leaves are mixed with stored grains and pulses to repel or kill storage insects (Ziba, 2016).

In order to improve the soil fertility for plant optimum growth, the soil needs to be enriched with nutrients through manure application. Oso (1995) defines organic manures as fertilizers from either plants or animals origin which are used for improving soil nutrients and consequently to stimulate the growth of plant. Organic manure usage has been reported to replace important nutrient into the soil, nourishes soil organisms, which in turn steadily make minerals available for plants uptake (Erin, 2007) and also improve soil physical properties by increased water infiltration, water holding capacity, aeration, permeability and soil aggregation (Musa *et al*., 2018). In Nigeria and some other developing countries, the practice of adding organic manures to soils in the nursery has been the common practice in supplementing soil fertility and improving production of vigorous seedlings because it is believed to be non-toxic, eco-friendly, and readily available (Uddin *et al*., 2012). Several studies have been reported on the successful use of organic manure for various plants and tree species (Agera *et al*., 2019). However the knowledge of proper application of organic fertilizers to forest nursery soils for growth and development of various species is immensely important to the value of seedlings produced.

Meanwhile, several studies have been reported on the ethno-medicinal and pharmacological importance of *E. suaveolens* which include anti-inflammatory and analgesic properties; anesthetic properties; anti-fungi and diuretic effect (Harborne and Baxter, 1983; Mgbenka and Ejiofor, 1999; Onuorah, 2000; Dongmo *et al.*, 2001). Whereas, there is dearth of knowledge on its silvi-cultural requirements especially at the nursery stage. Furthermore, due to the numerous and frequent use of *E. suaveolens*, therefore, there is an urgent need to conserve this medicinal plant both in-situ and ex-situ hence, the need for the study. This study was aimed at evaluating the effect of different organic manures on the growth of *E. suaveolens* with a view to determining the best organic manure of animal origin for its optimal growth and ensuring its sustainable use.

Materials and Methods

Experimental site

The experiment was carried out at the Herbal Garden Nursery, Forestry Research Institute of Nigeria (FRIN) Ibadan, which is located on the longitudes 07°23'18"N and 07°23'43"N and latitudes 03°51'20"E and 03°51'43"E with a climate characterized by the West African monsoon having dry and wet seasons. The dry season usually spreads from November through March with characteristic dry cold wind of harmattan. The wet season is usually from April to October with occasional strong winds and thunderstorms. The mean annual rainfall is 1548.9 mm, falling within approximately 90 days. The mean maximum temperature is 31.9°C and minimum is 24.2°C, while the mean daily relative humidity is about 71.9% (FRIN, 2015).

Sample collection and preparation

Matured and clean seeds of *E. suaveolens* collected from a mother tree in Alagbaaka village, Iddo Local Government Area (LGA), Oyo state, Nigeria, were pretreated with 70% HCl for 10 minutes and planted in germination trays containing sterilize river sand and kept under a mist propagator chamber. Watering was done daily and growth was monitored from when first emergence was noticed 2 weeks after sowing until they were ready for transferring into the polythene pots. Poultry manure and horse dung were collected from Federal College of Forestry Ibadan poultry pens and Ibadan Polo Club respectively. The manures were cleaned and incorporated into topsoil (2kg) according to treatments which were allowed to decompose and mineralize for 4 weeks prior to transplanting of the seedlings.

Soil and organic manures analysis

Soil samples were collected from six (6) different locations at the herbal garden with the aid of a soil auger. The samples were collected at depth of 0 – 15cm prior to application of manure. They were homogenized and a representative sample was taken from it. The representative sample was air dried ground and sieved using a 2mm sieve. Soil physical and chemical properties were determined according to the standard methods (Amhakhian and Isaac, 2016). In addition, physico-chemical properties of the organic manures (poultry manure and horse dung) used were analysed using the standard analytical procedures.

Experimental layout

This experiment was conducted for a period of twelve weeks where growth parameters were evaluated. Forty seedlings of *E. suaveolens* were transferred into the polythene pots individually and were laid in a

Completely Randomized Design with 10 treatments, replicated 4 times. The seedlings were watered daily and growth variables such as plant height (cm), collar diameter (mm) and leaf production were taken. Biomass estimation was done as described by Adepoju *et al.* (2016) and relative growth was determined using standard method where 2 seedlings were selected from each treatment and carefully uprooted by separating the seedling from the soil; the uprooted seedlings from each treatment were washed and sectioned into roots, stems and leaves and labelled appropriately. The initial (fresh) weight of leaves, stems and roots of the seedlings were taken to the Biomedicinal Research Centre, FRIN Ibadan, using a sensitive weighing balance. The three components were also placed in an electric oven and dried at 70°C until a constant weight was obtained. The dry weight of each component was taken as their biomass. Seedling total biomass was then obtained by summing the biomass of the various components. The treatments were listed as follow:

- T_1 – 10g of poultry manure (PM)
- T_2 – 20g of poultry manure (PM)
- T_3 – 30g of poultry manure (PM)
- T_4 – 10g of horse dung (HD)
- T_5 – 20g of horse dung (HD)
- T_6 – 30g of horse dung (HD)
- T_7 – 10g poultry manure + horse dung (PM + HD)
- T_8 – 20g poultry manure + horse dung (PM + HD)
- T_9 – 30g poultry manure + horse dung (PM + HD)
- T_{10} – Control (Top soil only)

Data analysis

Data collected were subjected to analysis of variance (ANOVA), and treatment means were compared using the Duncan's multiple range test (DMRT) at 5% probability level.

Results and Discussion

Physicochemical properties of soil and organic manures

The physicochemical properties of soil and organic manures used in this study revealed that the soil is loamy-sand and the pH was found to be 7.22 which is classified as Neutral (Table 1). The organic carbon and organic matter content detected in the soil used were 1.26 % and 2.17 % respectively. The organic carbon and total nitrogen present in the soil is rated low but the available phosphorus is adequate as reported in Landon's (1996) classification. Furthermore, the result also showed that the organic carbon content of the organic manures used is higher in horse dung (8.18 %) than poultry manure (6.18 %) but both are higher than soil's content. However the total nitrogen was noticed to be higher in horse dung (0.71 %) but the available phosphorus only present in traces in both poultry manure (0.0003 mg/kg) and horse dung (0.0023 mg/kg). Besides, poultry manure had highest exchangeable cations (Ca, Mg Na and K) contents (117.5, 100.8, 32.0 and 13.10 cmol/kg respectively) compared to horse dung. In contrast, horse dung had the highest contents (2760, 508, 158 cmol/kg) for extractible micronutrients (Fe, Mn, and Zn respectively) except Cu that had lower content.

The soil used for the experiment was loamy-sand texture with high sand (86.5 %), averagely low silt (11 %) and low clay (2.5 %). The pH of the soil was found to be neutral according to the United State Department of Agriculture (USDA)

classification, this implies the soil pH fall in between the pH range that is most favorable for plant growth because all plant required nutrient are readily available USDA (1998). The soil organic carbon was rated very low based on the classification of Landon (1996) and Amhakhia and Isaac (2016) which signifies the need for manure application to improve the soil fertility. However the organic manures used had organic carbon ranging from high to very high. The total nitrogen is low in the soil but found to be higher in the organic manures while phosphorus is adequate in the soil but found in minute quantities in the organic manures base on Landon's classification (Landon 1996).

Table 1: Physico-chemical properties of soil and organic manures used for the study

Parameters	Soil	Poultry manure	Horse dung
pH (H_20)	5.27	Nil	Nil
Organic matter (%)	5.85	10.66	14.10
Organic carbon (%)	3.39	6.18	8.18
Total nitrogen (%)	0.29	0.53	0.71
Available P (mg/kg)	1.304	0.0003	0.0023
	Exchangeable cations (cmol/kg)		
Ca	5.489	117.5	88.8
Mg	4.770	100.8	90.80
Na	0.457	32	24
K	0.031	13.10	0.90
	Extractible micronutrients (mg/kg)		
Fe	203	1150	2760
Mn	21	150	508
Zn	7	150	158
Cu	2	32	24
	Mechanical analysis (%)		
Sand	80.5	Nil	Nil
Silt	5.27	Nil	Nil

Clay	11	Nil	Nil

Effect of organic manures on the early growth of *Erythrophleum suaveolens* seedlings

The results obtained in this study for the plant height, collar diameter, leaf number, biomass, net assimilation rate and relative growth rate show that all parameters evaluated increases as rate of organic manure application decreases (Table 2). Analysis of variance revealed no significant differences among the treatments (Table 3).The highest mean plant height was recorded in the treatment containing 10g of horse dung (T_4) with mean value of 34.42cm followed by treatment consisting 10g poultry manure (T_1) having mean value of 34.20 cm while treatment containing 30g horse dung (T_6) had the lowest (25.64 cm). Additionally, the highest mean collar diameter was observed in the treatment containing 10g poultry manure (T_1) with 5.79 mm, followed by treatment containing 10g poultry manure and horse dung (T_7) having 5.68 mm and 30g horse dung (T_6) had the lowest (3.84 mm). Meanwhile, highest mean number of leaf (152.60) was found in the treatment consisting 10g poultry manure (T_1), followed by treatment containing 10g horse dung (T_4) with 138.40 and treatment containing 30g poultry manure and horse dung (T_9) had the least (94.20).

Table 2: Effect of organic fertilizers on the early growth of *Erythrophleum suaveolens* seedlings (Mean ± S.E)

Treatment description	Treatment quantity	Height (cm)	Collar diameter(mm)	Leave production
Poultry manure (T_1)	10g	34.20±1.24	5.79±0.29	152.60±7.22
Poultry manure (T_2)	20g	29.06±2.29	4.36±0.50	114.20±9.40
Poultry manure (T_3)	30g	28.34±7.30	4.60±1.16	116.40±15.16
Horse dung (T_4)	10g	34.42±1.57	4.75±0.36	138.40±3.58
Horse dung (T_5)	20g	31.00±2.91	4.95±0.48	117.40±6.77
Horse dung (T_6)	30g	25.64±6.96	3.84±0.99	108.00±14.34
Poultry manure + horse dung (T_7)	10g	32.14±3.31	5.68±0.51	134.20±4.88
Poultry manure + horse dung (T_8)	20g	30.74±2.47	5.31±0.50	116.20±4.19
Poultry manure + horse dung (T_9)	30g	29.64±4.08	4.81±0.83	94.20±14.63
Control (T_{10})	0	27.76±1.14	4.84±0.59	119.00±5.00
Sig.		$.862^{ns}$	$.652^{ns}$	$.622^{ns}$

ns- not significant at (p>0.05)

Mineral nutrients like nitrogen, potassium and phosphorus (NPK) are required by plants and greatly essential for their growth and development. The use of organic manure to replenish lost essential nutrients in the soil is a common practice in many tropical and

developing countries (Mohil and Jain, 2016). Although, the nutrient requirement of tree species varies so, appropriate application of fertilizer is crucial for optimal growth and development for a particular species. The results obtained from this study indicated that the two sources of organic manures applied had no significant effect on the height, collar diameter and leaf production of *E. suaveolens* seedlings (Table 3). This corroborates the earlier findings of Adepoju *et al.* (2016) and Okunomo (2010) who both reported that the application of organic manures had no significant effect on the plant height, collar diameter and leaf production of *Entandrophragma angolense and Tetrapleura tetraptera* seedlings respectively. In contrast, the present result negates findings of Agera *et al.* (2019) who claimed that soils incorporated with poultry droppings had highest plant height, collar diameter and leaf production in *Eucalyptus camaldulensis* seedlings. This present results also negates the findings of Rufai *et al*. (2020) who submitted that poultry manure and horse dung added to the soil enhanced the growth and development of *Hibiscus physaloides* seedlings.

Table 3: Analysis of variance of plant height, collar diameter and leaf production of *Erythrophleum suaveolens* seedlings

Parameters	SV	Df	SS	MS	F-cal	P-value
Plant height	Treatment	9	351.176	39.020	.506	.862
	Errors	40	3087.492	77.187		
	Total	49	3438.668			
Collar diameter	Treatment	9	15.656	1.740	.761	.652
	Errors	40	91.451	2.286		
	Total	49	107.107			
Leaf production	Treatment	9	12350.820	1372.313	.796	.622
	Errors	40	68944.000	1723.600		
	Total	49	81294.820			

Significant at 5% level of probability (P<0.05)

Effect of organic manures on biomass accumulated by *Erythrophleum suaveolens* seedlings

The results obtained from the effect of poultry manure and horse dung application on the biomass accumulation of *E. suaveolens* seedlings are presented (Table 4). The seedlings grown with the treatment consisting 20g combination of poultry manure and horse dung (T_8) had the highest mean leaf dry weight with 5.28g, followed by treatment containing 30g combination of poultry manure and horse dung (T_9) 5.08g and seedlings grown with treatment containing 20g poultry manure (T_2) had the least mean leaf dry weight with 3.04g (Table 4).

Meanwhile, seedlings grown with treatment containing 30g combination of poultry manure and horse dung (T_9) had the highest stem dry weight, followed by treatment consisting 10g horse dung (T_4) with mean value of 5.82g and 5.52g respectively while the least (3.32g) was control (Table 4) . Also, it was observed that seedlings grown with treatment containing 30g combination of poultry manure and horse dung (T_9) had the

highest root dry weight with 2.46g, followed by treatment consisting 20g combination of poultry manure and horse dung (T_8) which had 2.29g while seedlings grown with treatment containing 20g poultry manure (T_2) had the least (1.27g). Similarly, seedlings grown with treatment containing 30g combination of poultry manure and horse dung (T_9) had the highest total dry weight with 13.35g, followed by treatment consisting 20g poultry manure and horse dung (T_8) which had 13.03g, while the least (7.68g) was treatment containing 20g poultry manure (T_2) (Table 4). Similarly, both the highest (0.52/g/day) and lowest (0.20/g/day) relative growth rates were observed in the treatments containing 10g poultry manure (T_1) and 20g poultry manure (T_2) respectively. Analysis of variance revealed that the two organic manures applied had no significant effect on the leaf dry weight, stem dry weight, root dry weight, total dry weight and relative growth rate of *E. suaveolens* seedlings (Table 5).

Table 4: Effect of organic manures on biomass accumulated and relative growth rate by *Erythrophleum suaveolens* seedlings (Mean ± SE)

Treatment	Quantity	LDW (g)	SDW (g)	RDW (g)	TDW (g)	RGR (/g/day)
PM (T_1)	10g	4.78±0.69	5.46±0.27	2.07±0.12	12.30±1.07	0.52±0.01
PM (T_2)	20g	3.04±0.46	3.38±0.81	1.27±0.45	7.68±1.71	0.20±0.08
PM (T_3)	30g	4.63±0.80	5.01±0.25	1.80±0.12	11.43±1.16	0.51±0.07
HD (T_4)	10g	4.24±1.16	5.52±1.25	2.09±0.50	11.85±2.91	0.37±0.16
HD (T_5)	20g	3.34±0.99	3.86±1.01	1.74±0.51	8.93±2.50	0.38±0.12
HD (T_6)	30g	4.82±0.45	5.14±0.04	2.19±0.26	12.14±0.66	0.45±0.09
PM+HD (T_7)	10g	4.41±0.14	4.60±0.15	2.06±0.15	11.06±0.43	0.32±0.02
PM+HD (T_8)	20g	5.28±0.22	5.47±0.16	2.29±0.13	13.03±0.24	0.48±0.03
PM+HD (T_9)	30g	5.08±0.35	5.82±0.01	2.46±0.06	13.35±0.29	0.39±0.00
Control (T_{10})	0	3.82±0.53	3.32±0-.03	2.08±0.27	9.21±0.82	0.21±0.07
Sig.		.354	.083	.376	.223	.159

PM: Poultry manure; HD: Horse dung; LDW: leaf dry weight SDW: stem dry weight; RDW: root dry weight and TDW: total dry weight; RGR: Relative growth rate

ns: nonsignificant at 5% level of probability ($p<0.05$)

This result corroborates the earlier findings of Falana *et al.* (2016) who reported that organic manure (cow dung and *Gliricida sepium* leaf manure) has no significant difference on leaf dry weight stem dry weight and root dry weight of *Khaya senegalensis* seedlings and

on the other hand negate the findings of Imoro *et al.* (2012) who reported that the organic manures significantly affected the biomass accumulated by *Moringa oleifera* seedlings and Adepoju *et al.*, (2016) who claimed that organic manure (poultry manure) enhanced the growth and biomass accumulation of *Entandrophragma angolense* seedlings. The results of this study also negate the report of Rufai *et al*. (2020) who claimed that poultry manure and horse dung had significant effect on the growth of *Hibiscus physaloides* seedlings.

Table 5: Analysis of variance of biomass accumulated and relative growth rate of *Erythrophleum suaveolens* seedlings

Parameters	SV	Df	SS	MS	F-cal	P-value
LDW	Treatment	9	9.832	1.092	1.273	.354
	Errors	10	8.583	.858		
	Total	19	18.415			
SDW	Treatment	9	15.421	1.713	2.523	.083
	Errors	10	6.791	.679		
	Total	19	22.213			
RDW	Treatment	9	1.999	0.222	1.225	.376
	Errors	10	1.814	0.181		
	Total	19	3.813			
TDW	Treatment	9	63.966	7.107	1.652	.223
	Errors	10	43.019	4.302		
	Total	19	106.985			
RGR	Treatment	9	0.2281	0.0253	1.940	.159
	Errors	10	0.1307	0.0131		
	Total	19	0.3588			

Significant5% level of probability ($p<0.05$)

Conclusion

The application of organic manures such as poultry droppings and horse dung to the growing seedlings like *E. suaveolens* becomes imperative in order to enhance growth and development with optimal aim of preventing such *species* from being threatened. This preliminary study revealed that *E. suaveolens* can be successfully raised using poultry manure and horse dung. However, there is need for intensive research into the species' nutrient requirement with a view to achieving significant result. Also, it is recommended that the experiment be conducted for a longer period in order to draw meaningful conclusion.

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