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EFFECTS OF ORGANIC MANURE ON EARLY GROWTH PERFORMANCE OF *Hibiscus physaloides* (GUILL. & PERR) SEEDLINGS

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ABSTRACT

The protracted destruction of forest has endangered several important medicinal plant species like *Hibiscus physaloides* due to scanty information on its growth and regeneration principles for conservation, sustainable use and management. This study was carried out to investigate the effects of organic manures on the early growth performance of *H. physaloides* seedlings. The experiment was arranged in a Completely Randomized Design with 4treatments and 10 replicates each for 12 weeks. The treatments were T_1 (2kg of top soil+ 25g poultry manure), T_2 (2kg of top soil +25g horse dung), T_3 (2kg of top soil +25g poultry manure +horse dung), T_4 (Control 2kg of top soil only).Seeds were sown into germination baskets filled with top soil to raise seedlings for this study. Five days after first emergence, germination was monitored and germination percentage was calculated. At two-leaf stage, uniform seedlings (40) were transplanted into poly-pots filled with top soil and organic manure according to the experimental treatments and watering appropriately. Thereafter, data were collected fortnightly on growth parameters and were subjected to Analysis of variance and mean separation using Duncan Multiple Range Test at $p<0.05$.Results obtained show that there were significant differences in the growth responseof *H. physaloides* seedlings to the different organic manure. Seedlings raised with 25g of poultry manure performed best in terms of the variables measured with 57.15cm in height, 15.31cm in collar diameter and average leave production of 19.3 while the control recorded the least height (23.38cm), collar diameter (8.50cm) and average number of leaves of 9.50.It is therefore important to note that organic manure can improve the growth of *H. physaloides* at the early stage and thus recommended that for optimum growth response.

Keywords: Medicinal plant, *Hibiscus physaloides*, propagation, organic manure, seedling.

Introduction

Forests are very crucial natural resources as it contains resources that fuel the continuous economic and social development of many countries (Sim *et al*., 2002; Agbo-Adediran *et al.,* 2018). It a very complex ecosystem which provide a wide range of goods and services for human benefits, According to FSI (2009) the forest provide renewable raw materials, mitigate climate, protect land and water resources and also harbors biological diversity including medicinal plants.

Medicinal plants are reported to be the largest group of plants with about 30,000 species used for therapeutic purposes worldwide and in this century they have received a lot of attention mainly because of there are no side effects attributed to natural products (Rahbarian, 2014; Agbo-Adediran *et al.,* 2016).Due to increased human activities and higher demand for medicinal plants/ products,

there has been a marginal depletion of wild population of medicinal plants and disappearance of valuable forest resources at an alarming rate(Oladele *et al.,* 2011; Offiong *et al.,* 2010; Iroko *et al.,* 2019).

Hibiscus physaloides is a neglected medicinal herb of the family Malvaceae. It is commonly called wide okra; its flowers are ingested while the leaves are used in treating parasitic infections (Royal Botanic Gardens, 2018; Adeniyi and Lawal, 2019). It is referred to as "Ewe-ina" by the Yorubas of Nigeria. Ethnobotanical survey revealed that it is used in curing arthritis and pains (Adeniyi and Lawal, 2019).However, most of forest plant species are collected from the wild and are yet to be integrated completely into the various traditional farming systems by farmers (Ndukwu and Ben-Nwadibia, 2006). Research is being centered on some forest species like *H. physaloides* that are of immense importance in order to fully harness their potentials and subsequently integrate them into the farming system to ensure the conservation of their rich genetic resources (Olajide and Udo, 1997).

In order to improve the soil fertility for plant optimum growth, the soil has to be enriched with nutrients which could be in form of manure application. Organic manures are fertilizers from either plants or animals used for improving soil nutrients and consequently to stimulate the growth of plant (Oso, 1995).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 (Allison, 1973; Musa *et al.,* 2018). In the developing countries like Nigeria, the practice of adding organic materials to soils in the nursery has been the common practice in supplementing soil fertility and improving production of vigorous seedlings (Jackson and Ojo, 1971) because it is believed to be eco-friendly, without any toxic compound and readily available (Uddin *et al.,* 2012). Several studies have documented the successful use of organic manure for various plants and tree species **(**Oroka and Ureigho, 2019; Musa *et al*., 2018; 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 of considerable essential since it may profoundly influence the value of seedlings produced. In addition despite the numerous importance of *H. physaloides* such as ethno-pharmacological and nutritional uses, there is dearth of information on its propagation and early growth. Also *H. physaloides* has been found to grow slowly in topsoil. Hence, this study investigated its performance in soil augmented with organic manures in order to improve its growth, yield and conservation.

Materials and Methods

Experimental site

This study was conducted at the Herbal garden nursery, Forestry Research Institute of Nigeria (FRIN) Ibadan which is located on longitude 07°23'18"N to 07°23'43"N and latitude 03°51'20"E to 03°51'43"E. The climate is West African monsoon with dry and wet seasons where the dry season is usually from November to March and is characterized by dry cold wind of harmattan. The wet season usually spans from April to October with occasional strong winds and thunderstorms. Mean annual rainfall is about 1548.9 mm, falling within approximately 90 days. The mean annual temperature is between 24.2°C to 32.9 °C while the mean

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daily relative humidity is about 71.9% (FRIN, 2015).

Soil 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).

Experimental Procedure

The matured fruits of *H. physaloides* were harvested from a mother plant located at Onikanga village, Ido Local Government, Ibadan. The seeds were extracted from the pods and sowed directly in a germination basket filled with top soil. The first emergence was noticed on the fifth day after sowing and germination was monitored for weeks and there after percentage germination was calculated. The Poultry manure (PM) and Horse dung (HD) used were collected from the Federal College of Forestry and Ibadan Polo Club respectively, air dried and ground into powder for easy mixing and fast decomposition in the soil.

Polythene pots were filled with the mixture of top soil and organic manure (poultry manure and Horse dung) according to treatment and then watered for three (3) weeks in order to hasten decomposition and mineralization as well as to avoid reduction in the concentration of organic manure before the seedlings were transplanted. At two leaf stage, a total of 40 uniform seedlings of *H. physaloides* were pricked out and transplanted into the polythene pots filled with top soil and watered adequately for two weeks. The experiment was laid out in a Completely Randomized Design (CRD) with 4 treatments replicated 10 times. The treatments include, T1- 2kg of top soil+ 25g poultry manure, T2- 2kg of top soil +25g horse dung, T3- 2kg of top soil +25g poultry manure +horse dung(1:1), T4- Control (2kg of top soil only).

Germination percentage (%)

The percentage germination of *H. physaloides* seeds was calculated by dividing the total number of seed germinated by the total number of seeds sown multiplied by 100 %.

$$Germinationpercentage = \frac{Numberofseedsgerminated}{Totalnumberofseedssown} \times 100\ \%$$

Parameters Assessed

The growth performances of *H. physaloides* seedlings were assessed and measured with the aid of a graduated meter rule, veneer caliper and by visual counting for plant height, stem collar diameter and leaf production for period of 12 weeks respectively.

Statistical analysis

Data collected was subjected to one-way Analysis of variance (ANOVA) and Duncan Multiple Range Test (DMRT) while treatment means was used to separate the significant means at 5% level of probability.

Results and Discussion

Percentage germination of *Hibiscus physaloides* seeds

The results obtained from the percentage germination trial showed that *H. physaloides* had 87% germination without any pretreatment. This implies that the seeds of *H. physaloides* use for the study were viable hence gave rise to vigorous and healthy seedlings. Low content of major soil nutrients

necessitated the application of organic manure to soil used for the study in order to optimize the soil nutrients which will in turn boost the growth and yield of the plant under study. Physico-chemical properties of the soil used for the study were analyzed and are presented as shown (Table 1).

Table 1: Physico-chemical Properties of Soil used for the study

Soil properties	Measured values
pH (H_2O)	5.27
Organic carbon (%)	3.39
Organic matter (%)	5.85
Total nitrogen (%)	0.29
Available P (mg/kg)	1.304
Exchangeable cation (cmol/kg)	
Ca	5.489
Mg	4.770
K	0.031
Na	0.457
Extractible micronutrient (mg/kg)	
Mn	21
Fe	203
Cu	2
Zn	7
Mechanical analysis (%)	
Sand	80.5
Silt	5.27
Clay	11

Results revealed that the soil had a loamy sand texture with high sand content (80.5%), average clay content (11%) and a low silt content (5.27%). The soil pH is5.27 which implies that it is slightly acidic. According to Amhakhian and Isaac (2016), the pH of the soil under study could therefore be rated low base on the obtained value (5.27). However, organic carbon and organic matter contents detected were 3.39% and 5.85% respectively. Amhakhian and Isaac, (2016) and Landon, (1996) jointly classified percentage soil organic carbon as very high (> 20%); high (10 – 20%); medium (4 – 10%); low (2 – 4%) and very low (<2%). Based on this classification, the organic carbon content of the analyzed soil was low and can be augmented by applying a cheaper source of manure like poultry manure. Meanwhile, percentage total Nitrogen(0.29%) obtained is rated as medium in Landon's classification. The soil's available phosphorus, calcium, magnesium concentrations obtained for the study were all high(1.304 mg/kg, 5.489 cmol/kg, 4.770 respectively). In contrast, low concentrations (0.031 and 0.457 cmol/kg) were obtained for K and Na respectively. Though, out of all the extractible micro nutrients only iron was found to have a very high concentration (203 mg/kg), but Manganese, Copper and Zinc had lower concentrations (21.0, 2.0 and 7.0 mg/kg respectively).

Chemical properties of the organic manures (poultry and horse dung) used for the study are presented as shown (Table 2). Results obtained for this study indicated that horse dung had higher organic carbon (8.18%), organic matter (14.1%), total nitrogen (0.71%) and available phosphorus (0.0023 mg/kg) than poultry manures which had 6.18%, 10.66%, 0.53% and 0.0003 mg/kg respectively. Poultry manures had the highest values (13.10, 117.5 and 100.8cmol/kg) for three exchangeable cations (potassium, calcium, magnesium, respectively), While horse dung only had highest value in sodium content (14.80cmol/kg). Furthermore, horse dung had the highest values (2760, 508 and 158cmol/kg) of extractible micronutrients for iron, manganese and zinc respectively while poultry manures only had highest in copper content (32cmol/kg).

Table 2: Physico-chemical properties of organic manures used for the study

Parameters	Poultry manure	Horse dung
Organic Carbon (%)	6.18	8.18
Organic matter (%)	10.66	14.10
Total Nitrogen (%)	0.53	0.71
Available P (mg/kg)	0.0003	0.0023
Exchangeable cation (cmol/kg)		
K	13.10	0.90
Ca	117.5	88.8
Mg	100.8	90.80
Na	2.00	14.80
Extractible micronutrient (mg/kg)		
Mn	150	508
Fe	1150	2760
Cu	32	24
Zn	150	158

Plant height growth *Hibiscus physaloides*

Results obtained from the plant height growth of *H. physaloides* seedlings revealed that all the seedlings responded well to the manures applied from the first week of transplanting and the plant height growth of three manure treatments used were better than the control (top soil alone) (Figure 1). Meanwhile, plants treated with poultry manure (T_1) had the best performance in terms of plant height (57.1cm) and plants without any treatment (control) T_c had the least (23.38cm).

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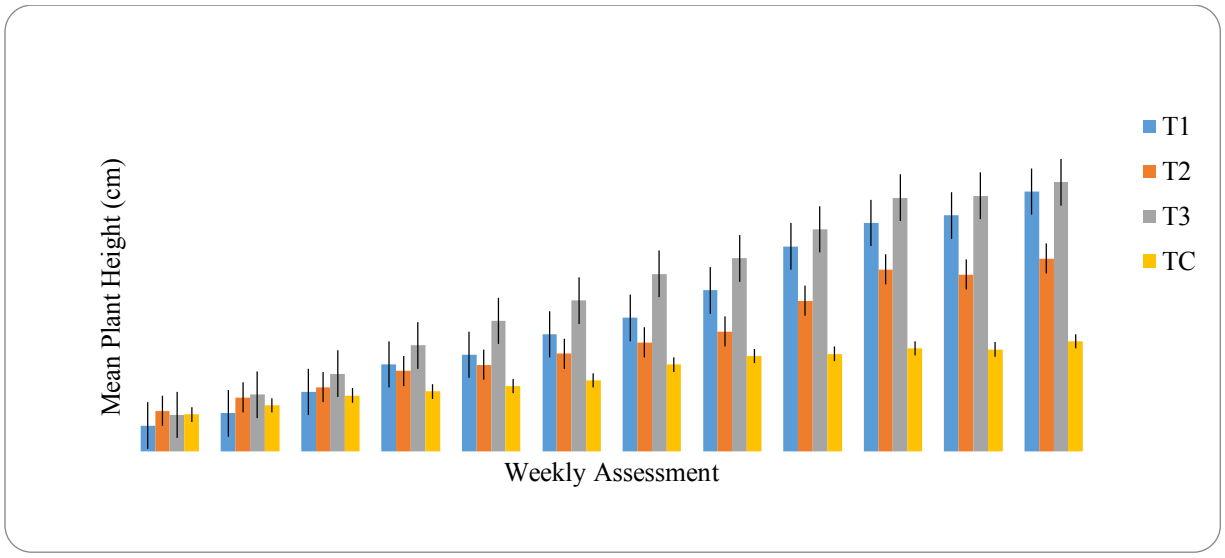

Figure1: Effect of Organic Manure on the Plant Height of *H.physaloides*

The result of analysis of variance as presented (Table 3) indicates that there were significant differences among the treatments at 5% level of probability which led to further differentiation of mean using Duncan Multiple Range Test (DMRT) presented in (Table 4).

Table 3: Analysis of variance of plant height, collar diameter and leaf production of *H. physaloides*

Parameters	SV	Df	SS	MS	F-cal	P-value
Plant height	Treatment	3	7320.727	2440.242	43.880	0.000
	Errors	36	2002.007	55.611		
	Total	39	9322.734			
Collar diameter	Treatment	3	276.278	92.093	34.745	0.000
	Errors	36	95.418	2.651		
	Total	39	371.696			
Leaf production	Treatment	3	518.675	172.892	4.376	0.010
	Errors	36	1422.300	39.508		
	Total	39	1940.975			

Significant at 5% level of Probability ($P < 0.05$)

Table 4: Mean effects of organic manures on the early growth of *H. physaloides* seedlings

Treatments	Height	Collar diameter	Leaf production
T_1(25g PM)	57.15^{c}	15.31^{c}	19.30^{b}
T_2(25g HD)	40.95^{b}	9.50^{a}	14.80^{ab}
T_3(25g PM+HD)	55.17^{c}	11.98^{b}	12.30^{a}

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Tc (Control)	23.38[a]	8.50[a]	9.50[a]
Sig	0.00*	0.00*	0.01*

Values with same superscript along same column are not significantly different

This finding is in agreement with result of Rafiu *et al.,* (2016) who earlier reported that organic manure had an influence on the height, leaf count and stem girth of *Kigelia africana* and affirmed that poultry manure best suit the growth of *Kigelia africana* in the nursery. In addition it also corroborates with the result of Adekiya and Agbede (2016), which established that application of poultry manure significantly influence the plant height, leaf area, and number of fruits per plant and fruit weight of *Lycopersicon esculentum* Mill. Agera *et al.* (2019) also find out that poultry manure best enhance the height, number of leaves and girth of *Eucalyptus camaldulensis* and thus recommend that poultry dropping is the most suitable organic manure for nurturing the seedlings of *E. Camaldulensis* in the nursery.

Stem collar diameter of *Hibiscus physaloides*

Based on the results obtained at initial stage of transplanting, it clearly shows that there was a serious competition among the stem collar diameters of *H. physaloides* seedlingswith respect to treatments over a time period but as the organic manure decomposes and mineralizes there were appreciable increase in the stem collar diameters for all the treatments (Figure 2). However, at the end of the 12th week it was obvious that seedlings treated with poultry manure (T_1) had the best collar diameter (15. 31cm) while seedlings grown without any organic manure (control) recorded the least (8.50cm).

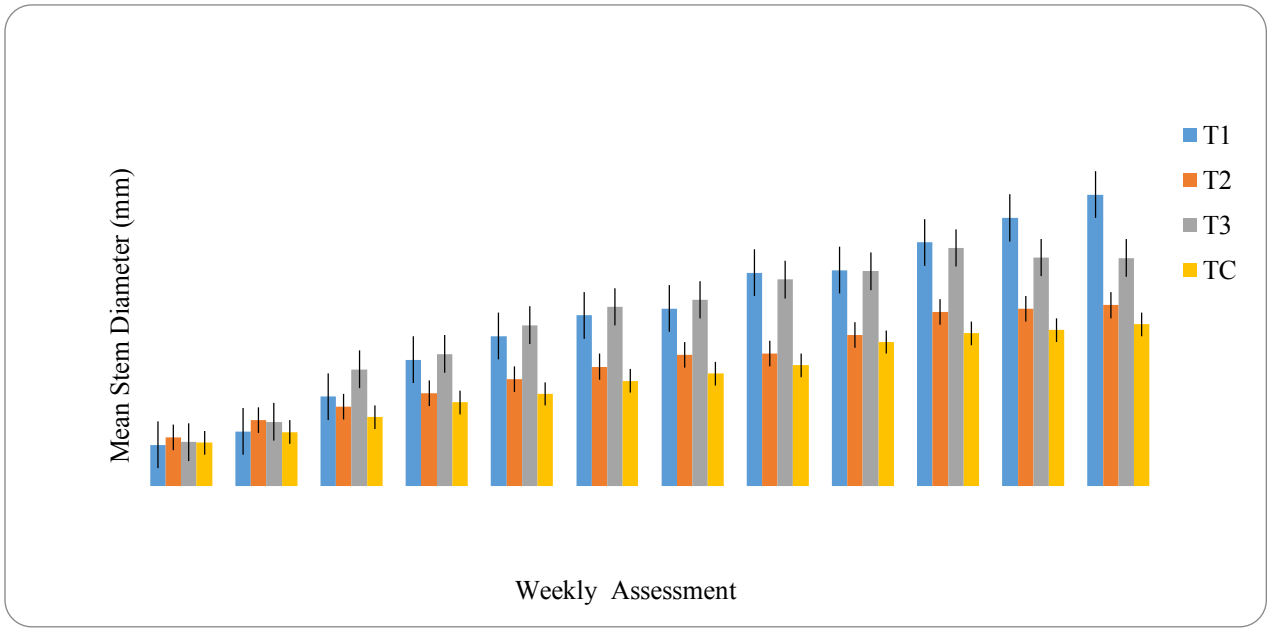

Figure2: Effect of organic manure on stem diameter of *H. physaloides*

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A further analysis of variance (ANOVA) result (Table 3) confirmed that the significant differences observed among the stem collar diameters of all the treatments were influenced by the application of organic manures and a further comparison of mean was carried out (Table 4) This is in tandem with the findings of Falana *et al.* (2016) who submitted that both cowdung and *Gliricida sepium* manures have positive effects on the stem diameter of *khaya senegalensis*.

Leaf production of *Hibiscus physaloides*

Result of the leaf production of *H. physaloides* seedlings grown on soils with organic manures in varying quantities is presented (Figure 3). This shows that the organic manures (poultry manures and horse dung) used enhanced the leaf production (number of leaves) in *H. physaloides* where poultry manure (T_1) had the highest number of leaves (19.30) from the 7th week of transplanting till the 12th week (end of the study).

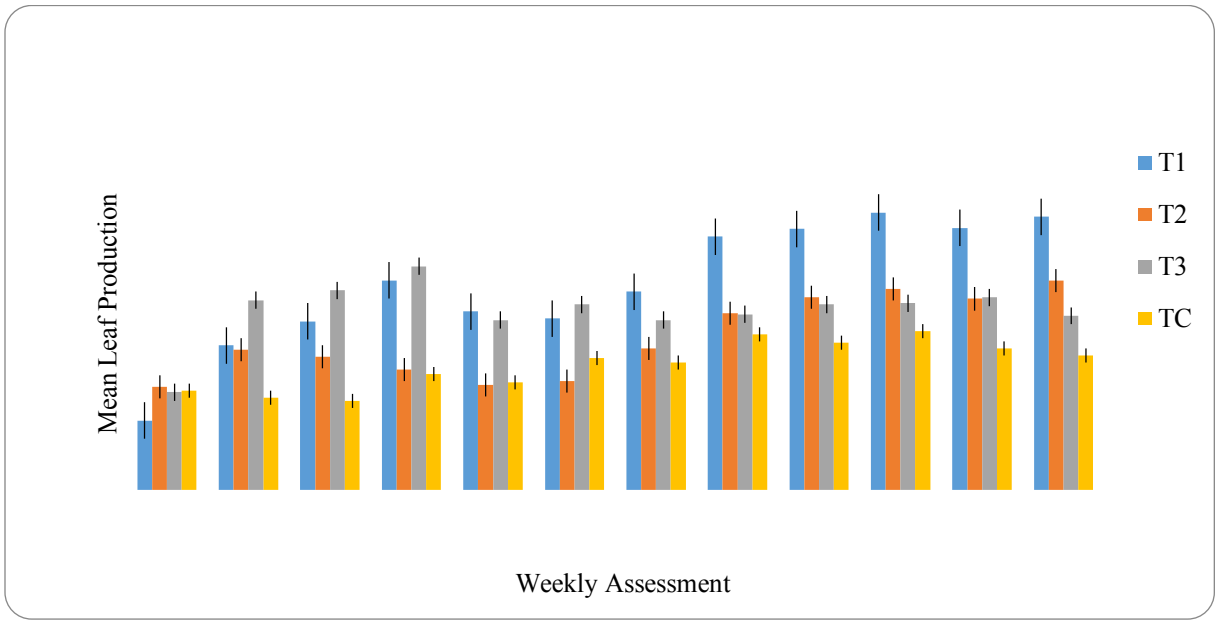

Figure 3: Effect of organic manure on the leaf production of *H. physaloides*

In addition, analysis of variance (ANOVA) presented in (Table 3) shows significant difference among the number of leaves produced and a further comparison on mean using Duncan Multiple Range Test (Table 4) indicates no significant difference between the seedlings treated with poultry manure (T_1) and those treated with horse dung (T_2). This result is in line with earlier findings of Rafiu *et al.* (2016) who reported that organic manure had an influence on the height, leaf count and stem girth of *Kigelia africana.*

Conclusion and Recommendation

In conclusion, the study revealed that *H. physaloides* germination rate through seeds is above average therefore, further studies to increase its germination percentage is required. Furthermore the overall performance of *H. physaloides* seedlings in terms of plant height, stem diameter and leaf

production were significantly enhanced by treating the growth media with organic manures (poultry manures and horse dung). The use of organic manures especially poultry manures should be encouraged as a cheap means of soil enrichment and enhancement of plants growth in the nursery.

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