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Influence of Vermicast on Early Growth of Black Afara (*Terminaliaivorensis* A. Chev.) Seedlings

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ABSTRACT: This study assessed the effect of vermicast on the early growth of *Terminalia ivorensis A.Chev. (Black Afara)* seedlings which belongs to the family *Combretaceae.* Seedlings were raised on Vermicast (100%), Vermicast + Topsoil (1:1,) and topsoil media. There were three (3) treatments, replicated four (4) times and laid in Completely Randomized Design (CRD). The experiment was monitored for 12 weeks and the following variables were assessed, plant height (cm), stem diameter (mm), leaf production and the leaf area (cm^2). Data collected were subjected to descriptive statistics and Analysis of Variance (ANOVA). Results revealed that the seedling growth parameters measured were not significantly affected by the vermicast treatments at 5% probability level, except plant height. The best performance was observed in the seedlings raised with T_2 (Vermicast + Topsoil) in plant height, stem diameter, leaf production and leaf area with mean values of 28.55cm, 0.55mm, 18.25 and 38.87cm^2 respectively while the least performance was recorded in T_3 (100% top soil) in plant height, stem diameter, leaf production and leaf area with mean values of 22.06cm, 0.49mm, 15.25 and 49.72cm^2 respectively. It is therefore recommended that 50% vermicast should be used to improve the growth media in order to enhance the early growth of *Terminalia ivorensis* seedlings at the nursery stage.

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Terminalia ivorensis, of the family *Combretaceae* is an important timber species in Nigeria. The tree of the species attains the heights of up to 50 m and girth of 5 m, while young trees often attain only 1-1.5 m height after 5 years, compared to some other timber species, which are fast-growing (Osei-Begyina, 2007). The branches are whorled in young shoots and foliage (Keay, 1989). It is used for construction and other wood-based purposes and also serves as reforestation and afforestation species for devastated forest ecosystem (Jones and Averre, 2000). Soil nutrients and availability to crop are essential for the maximum production of food and trees in the development of any nation. However, soil nutrient decline is almost universal in Africa and this has led to the introduction and addition of both organic manure and inorganic fertilizers to enhance plant growth and productivity (Alabi *et al*., 2005). But there has been emerging concern for application of organic manures, as it may pose serious negative environmental impact. This led to the use of varieties of organic materials from both plants and animals for fertilizing the soil. As opined by Sinha *et al.,* (2010), vermiculture technology is becoming prominent as an "environmentally sustainable", "economically viable" and "socially acceptable" technology all over the world. Vermicomposting is the term given to the process of conversion of biodegradable matter by earthworms into vermicast (Gajalakshmi and Abbasi, 2004). In this process, the unavailable nutrients contained in the organic matter are partly converted to more bio-available forms. The use of earthworms was known for ages as "waste managers" for efficient "composting of food and farm wastes" and as "soil managers" for "fertility improvement" for "farm production (Gajalakshmi and Abbasi, 2002). Vermicast is an organic/natural fertilizer that is produced by using composting earthworm. This is produced by the feeding action of earthworms as they ingest organic matter, fragment and grind it into a finely divided peat-like material with high porosity aeration and water holding capacity. This process enhances microbial activities and accelerates the rate of decomposition. This leads to humification effect where unstable organic matter or decomposing plants and animal matters are oxidized and sterilized (Edward and Burrows, 1999).Vermicast enriches the soil and helps to ensure that plants receive all the nutrients needed to grow successfully. Such nutrients are Nitrate,

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exchangeable phosphorus, soluble potassium, calcium and magnesium (Edward and Burrows, 1999).

Due to climate change awareness which led to increase rate of tree planting, it has become expedient for nursery owners to produce healthy and vigorously growing seedlings essential for plantation establishment which may be achievable through the use of vermicast. Therefore, this study investigated the effect of vermicast fertilizer on the early growth of *Terminalia ivorensis* seedlings in the nursery.

MATERIALS AND METHODS

The experiment was carried out within the premises of Federal College of Forestry, Ibadan, Oyo State. It is located in Ibadan North West Local Government area of Oyo State. The area lies between latitude 7^0 26'N and Longitude 3^0 36'E, the climatic condition of the area is tropically dominated by rainfall pattern ranging from 140mm-1500mm, the average temperature is about 35.2^0C, the area experiences two distinct seasons which are dry and rainy seasons. The rainy season normally commences from April-October while the dry season commences from November-March. Seeds of *Terminalia ivorensis* were collected from the seed store of Sustainable Forest Management Department of Forestry Research Institute of Nigeria, Jericho Hill, Ibadan. The seeds were sown into wooden germination boxes (60cm x 60cm), filled with washed and sterilized river sand while watering was done daily. After germination, resulted seedlings were pricked into polythene pot filled with topsoil which was analyzed in the laboratory for routine parameters using standard method. At two (2) weeks old, vigorous and uniformly growing healthy seedlings were selected and then transplanted into polythene pots filled with 2kg of growing media, (T_1-Vermicast only, T_2-mixture of topsoil and Vermicast (1:1, v/v), and T_3-topsoil only). The treatments were laid out in a Completely Randomized Design (CRD). Each of the three treatments was replicated four times. Parameters measured include: Seedling height (cm), Leaf production, Stem diameter (mm), Leaf Area (cm^2). The data collected were subjected to means, descriptive statistics and Analysis of Variance (ANOVA) to test for significance at 5% probability level.

RESULTS AND DISCUSSION

Physical and Chemical properties of the experimental soil: Some physical and chemical properties of the experimental soil are presented in Table 1. The soil was moderately acidic and loamy sand in texture. The organic carbon and available phosphorus are within the critical values of $15.0g^{-1}$and 10-16 $mgkg^{-1}$ respectively (FMA and RD 2002). While total nitrogen content was lower than the critical value of $1.5kg^{-1}$. Therefore, the soil was moderately suitable for the experiment.

Effects of Vermicast Treatments on Early Growth of T. ivorensis Seedlings: Seedling height: The analysis of variance revealed that vermicast treatments had significant effect on the seedling height of *T. ivorensis* (Table 2). Seedlings treated with mixture of topsoil and Vermicast at 1:1, v/v (T_2) recorded the highest mean height value of 28.55cm while seedlings in Topsoil only (T_3) had the least mean value (Table 3). Generally, there was increase in the height of seedlings as the period of assessment increased (Fig. 1) but T_2 showed remarkable increase throughout the period of assessment followed by T_1 while least values were recorded in T_3. At week 2 after transplanting, T_2 had 9.73cm followed by T_1 (7.81cm) while least value was recorded in T_3 with 6.83cm and this order was followed throughout the period of assessment of the seedlings.

Stem diameter: According to Table 2, stem diameter of the seedlings was not significantly influenced by vermicast treatments though T_2 recorded the highest mean diameter value of 10.96mm while T_3 recorded the least mean value with 9.64mm (Table 3). Figure 2 shows that stem diameter increased throughout the period of assessment. At week 2 after transplanting, highest value was recorded for T_2 (0.4mm) followed by T_1 (0.33mm) while least value was recorded in T_3 (0.32mm). This order was maintained throughout the period of assessment.

Number of leaves: Leaf production of the seedlings subjected to vermicast treatments were not significantly influenced (Table 2) as no significant difference was recorded in the mean number of leaves. But the highest mean number of leaves produced was recorded in T_2 (0.48) followed by T_1 (0.44) while the least was observed in T_3 (0.42) (Table 3). Throughout the period of assessment, there was increase in the number of leaves produced. At week 2 after transplanting, T_2 had highest mean value of 4.8 while T_3 had the least value of 4.3. But at week 6, T_1 had the highest mean value of 9.4 which later dropped at week 10. At week 10, T_2 recorded the highest mean value (14.2) while least value was observed in T_3 with 11.85 (Fig. 3).

*Leaf Area***:** The analysis of variance showed that leaf area of seedlings treated with vermicast was not significantly affected at $p \leq 0.05$ (Table 2) but highest mean value was observed in T_2 ($38.87cm^2$) while least was recorded in T_3 with 30.16 cm^2 (Table 3).

Generally, leaf area increased throughout the period of study. At week 2 after transplanting, same value was recorded in T1 and T2 (12.9 cm^2) but at week 10, highest value was recorded in T_2 (46.94 cm^2) while T_3 had the least value with 39.94 cm^2 (Fig. 4).

Table 1: Results of physical and chemical properties of the top soil used

Soil parameters	Values
Sand	83.6
Silt	10.4
Clay	6.0
Textural class	LOAMY SOIL
pH ($CaCl_2$)	5.8
CEC (Cmol kg^{-1})	1.31
Organic Carbon (gkg^{-1})	15.6
Total Nitrogen (gkg^{-1})	1.16
Available P ($mgkg^{-1}$)	10

Table 2: ANOVA for the mean effects of vermicast on early growth of *Terminalia ivorensis* seedlings

Parameter	SV	DF	SS	MS	F	P-VALUE
Height	Treatments	2	15.93562	7.96781	7.7923*	0.0108
	Error	9	9.20275	1.02253		
	Total	11	25.13837			
Stem Diameter	Treatments	2	0.00522	0.00261	0.4044^{ns}	0.6789
	Error	9	0.05805	0.00645		
	Total	11	0.06327			
Leaf Production	Treatments	2	1.88132	0.94066	0.3379^{ns}	0.7219
	Error	9	25.05558	2.78395		
	Total	11	26.93689			
Leaf Area	Treatments	2	71.96802	35.98401	3.9550^{ns}	0.0585
	Error	9	81.88488	9.09832		
	Total	11	153.85289			

NS: Not significant ($p \leq .05$)

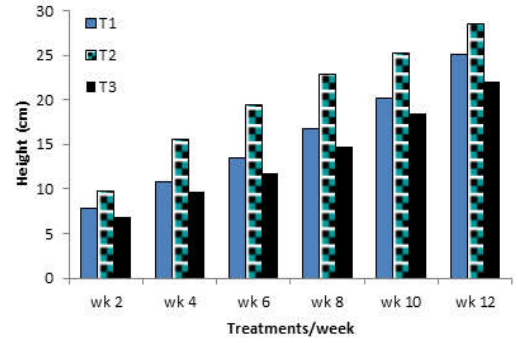

Fig 1: Mean effect of vermicast on the height (cm) growth of *Terminalia ivorensis* seedlings

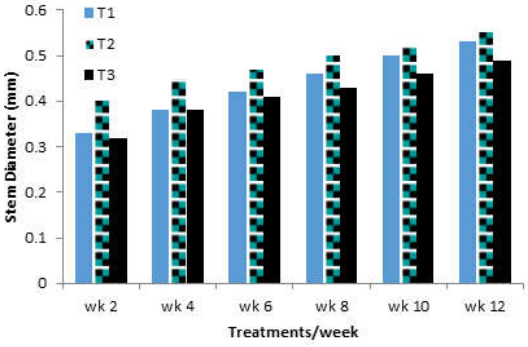

Fig 2: Mean effect of vermicast on the stem diameter (mm) of *Terminaliaivorensis* seedlings

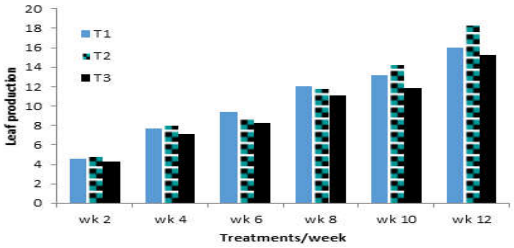

Fig 3: Mean effect of vermicast on the leaf production of *Terminalia ivorensis* seedlings

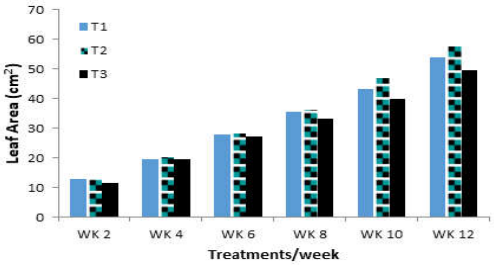

Fig 4: Mean effect of vermicast on the seedling leaf area (cm^2) of *Terminalia ivorensis* seedlings

Table 3: Follow-up test for the mean effect of vermicast on early growth *Terminalia ivorensis* **seedlings**

TRT	Seedlings Height(cm)	Stem Diameter (mm	Leaf Production	Leaf Area (cm^2)
T_1	25.07ab	0.44	10.48	32.17
T_2	28.55a	0.48	10.96	38.87
T_3	22.06b	0.42	9.64	30.16

NOTE: Means with the same letter along the column are not significantly difference from one another

The vermicast is pellet-like excretions of earthworms known to contain elevated levelled nutrients, improves soil structure, and enhances fertility as well as habours beneficial microorganism than the surrounding soil or worm un-worked organic materials (Aranconet *al.*, 2004; Kang and Ojo, 1996). In raising *T. ivorensis* seedlings, the mixture of equal quantities of vermicast and topsoil gave the best mean plant height, stem diameter, leaf production and leaf area growth of 28.55cm, 0.48mm, 10.96 and 38.87cm^2 respectively, followed by the usage of 100% vermicast with 25.07cm, 0.44mm, 10.48 and 32.17cm^2 respectively while the least performance was recorded in seedlings raised on topsoil only with 22.06cm, 0.42mm, 9.64 and 30.16cm^2 respectively. The result was identical with Kumar *et al.,*(2011) and Shadanpour *et al.*, (2011) who found that application of vermicompost increased the plant height in Stevia and Marigold, respectively. In another study, addition of vermicompost significantly increased the growth and yield of tomato plants compared to plant without it (control) (Azarmi*et al.,* 2008). Agarwal *et al.*, (2003) also recorded increased in growth parameters of *Triticum aesticum* by addition of earthworm cast to the soil used. This remarkable growth observed in the

study may be attributed to the availability of optimum conditions necessary for plants growth. Dianda *et al*., (2009) and Oviasogie *et al*., (2013) also strongly support the use of alternative fertilizers from organic sources. Fertilizing plants from organic sources add value to soil in terms of replenishment, increased healthy growth and yield, improvement of the organic Carbon, Nitrogen, Phosphorus and Potassium availability in the soil.

Conclusion: This study showed that seedlings of *Terminalia ivorensis* grown in T_2 (Vermicast + Topsoil, 1:1) had the best performance in terms of height, stem diameter, leaf production and leaf area and this is a clear indication that vermicast contains the required nutrients needed for the plant growth. Therefore, it could be recommended that vermicast be adopted to improve the growth of *T. ivorensis* seedlings especially at the nursery stage.

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