Journal of Agriculture and Environment
Vol. 20 No. 1, 2024: 313-320

Effect of organic fertilizers on growth performance of *Mansonia altissima* A. Chev. seedlings

M.O. Ojo[1], I.O. Asinwa[2] and O.H. Odomo[3]

[1]Elizabeth Ehi-Ebiewele Biodiversity Linkage Center, Forestry Research Institute of Nigeria, Ibadan, Nigeria
[2]Rainforest Research Station (RFRS), Forestry Research Institute of Nigeria, Ore, Ondo State, Nigeria
[3]Adekunle Ajasin University Akungba Akoko, Ondo State

ABSTRACT

Mansonia altissima A. Chev plays an important role in timber industry but is a very slow growing species at seedling stage. The study, therefore, investigated the influence of different organic fertilizers on the growth potentials of *M. altissima* with a view to producing seedlings of high vigour for the establishment of healthy plantation. Two weeks old uniform seedlings of *M. altissima* were transplanted into the polythene pots containing topsoil amended with different organic manures. There were four (4) treatments {Topsoil + Goat droppings (T1); Topsoil + Poultry droppings (T2); Topsoil + Pig droppings (T3) and Topsoil alone (control) (T4)}, replicated five times. The experimental design was a Completely Randomized Design (CRD). Data on shoot heights (cm), collar diameters (mm), leaf area (cm^2) and leaf production were collected weekly and analyzed using analysis of variance (ANOVA). There were significant differences ($p<0.05$) among the treatments in shoot heights, leaf production and leaf area. But there was no significant difference in collar diameter ($p>0.05$). T1 had highest mean shoot height (9.9±1.35cm), Leaf production (2.0±0.29) and Leaf area (29.17±5.60 cm^2) while the least leaf production (1.89+0.24) was observed in the control treatment. Application of different organic fertilizers had significant effects on the growth performance of *Mansonia altissima* seedlings within period of study with the best performance in the seedlings raised with T1.

Keywords: Organic manure; amendment; growth; plantation

INTRODUCTION

Trees are perennial plants with an elongated stem or trunk, supporting branches and leaves. According to Sankaran *et al.* (2008), trees are vital as the biggest and longest plants on the planet, in which they tend to be long-lived. Trees have been in existence for 370 million years and it is estimated that there are just over 3 million mature trees in the world (Sankaran *et al.*, 2008). Trees play significant role in reducing soil erosion, moderating the climate, removal of carbon dioxide from the atmosphere and storage of large quantities of carbon, they provide habitat for many species of plants and animals, timbers for construction,

Correspondence: israelasinwa@gmail.com
https://dx.doi.org/10.4314/jagrenv.v20i1.29

sources of fuel for cooking, heating and charcoal production, some trees provide fruits as food for man and animal consumption (Asinwa*et al*., 2020).

Mansonia altissima A. Chev. natively known as "Ofun" in Yoruba is a tree species in the family Sterculiaceae of flowering plant. It is a semi- deciduous forest species that grows up to 37m high with trunk of about 2.5m girth (Maku *et al*., 2014). Akinnagbe *et al*. (2010) classified *Mansonia* as a non - pioneer light demander. It is commonly found in dense semi-deciduous forest areas with about 1,600mm annual rainfall and a pronounced dry season. The southern limit of its distribution area largely corresponds with the transition of semi-deciduous forest to evergreen forest; to the north its distribution extends to patches of dense forest in the savannah. Seedlings are most common on forest soil on drier sites; they are fairly drought resistant (Akinnagbe*et al*., 2010). The wood of *M. altissima* is used for general and high-class joinery, cabinet work, furniture, turnery, decorative veneer and handicrafts (Ohene, 2008). It is also used in construction of doors and windows (Osunlaja*et al*., 2017). The bark contains a highly toxic compound known as mansonine, which is related to cardenolides from *Digitalis purpurea* and Ouabain from *Stropkanthuspreussii* (Akinnagbe*et al*., 2010).

Presently, the rate at which many indigenous tree species are exploited especially the rare ones such as *M. altissima* cannot be overemphasized. The problems of illegal felling and over exploitation of trees have changed the conservation status of many tree species to the state of extinction (Osunlaja *et al*., 2017).The increasing demand for Forest products as a result of rapid population increase as well as deforestation activities associated with expansion in infrastructural facilities all combine to erode the genetic base of most economic tree species (Akinnagbe *et al*., 2010).More so, *M. altissima* like other several candidate species for domestication have some challenges ranging from short period of seed viability, damage from pests and pathogens to irregular flowering (Osunlaja*et al*., 2017).

Notwithstanding, *M. altissima* can be regenerated either by artificial or natural process, growing seedlings in their natural habitat (in-situ) or by transplanting it to a suitable place where they can be nursed and established. However, for optimum growth of *Mansonia species*, there must be adequate soil nutrients supporting the tree growth, whether the nutrients occur naturally or artificially through application of organic fertilizers.

M. altissima is known to have slow growth and this affects mass production as well as domestication of the species. The slow growing syndrome of *M. altissima* has always thwarted early maturity of the seedlings and eventually has negative influence on its availability for afforestation/reforestation programme. Nevertheless, application of fertilizer to the soil improves the growth rate of the seedlings thereby ensuring healthy and vigorous seedling growth over time (Maku *et al*., 2014).

Organic fertilizer has been proven to stimulate beneficial soil microorganisms and improve soil structure. Soil microbes play an important role in converting organic fertilizers into soluble nutrients that can be absorbed by plants. In most cases, organic fertilizers and compost will provide all the secondary macro and micronutrients the tree needs to grow well during germination (Amjad *et al*., 2016).Organic fertilizer also helps to improve the fertility of nursery soils which will guarantee the production of high-quality seedlings for nursery establishment (Rafiqul *et al*., 2004).The proper application and the use of appropriate organic fertilizers to forest nursery soils is of considerable importance since it may profoundly influence growth of seedlings. The objectives of establishing tree crop nurseries will only be achieved if quality seedlings are produced and supplied for afforestation and reforestation programmes (Adelani, 2015). Perhaps, improving the fertility of nursery soil is essential to

guarantee the production of high-quality seedlings for plantation establishment (Rafiqul *et al.,* 2004). Therefore, having established the usefulness and important roles of *M. altissima* in timber industry coupled with its slow growth associated problem, the study investigated the influence of different organic fertilizers on the growth potentials of *M. altissima* with a view to producing seedlings of high vigour for the establishment of healthy *M. altissima* plantation.

MATERIALS AND METHODS

Experimental Site

The experiment was carried out in the Nursery of the Department of Forestry and Wildlife Management, located along Faculty of Agriculture Teaching and Research farm at Adekunle Ajasin University Akungba-Akoko Ondo State (AAUA). The nursery is located between latitudes 7°23'and7°28'N and between longitudes 5° 47'and 5° 44'E. The topography of the Nursery is mountainous; soil type is basically volcanic making it suitable for agriculture (Cable, 1998), the soils in the nursery are mainly Sandy loam with topsoil. The area falls under Guinea Savannah with which the climate is equatorial with two peaks of rainfall and dry season, where the first peak falls between April and July and the second peak between late August and October, these two peaks are marked by heavy rainfall with mean annual rainfall of 1500-2000 mm, relative humidity varies from75-95% resulting in severe cold condition in most cases (Olabode, 2014), the mean annual temperature is 23-26°C while dry season is from November to March.

Experimental Procedure

Topsoil used for the study was collected from fallow land in AAUA campus. The soils were bulked, mixed properly to ensure uniformity and sieved with 2mm sieve to remove large particles, roots and debris. Poultry droppings, Goat droppings and pig droppings were collected from Teaching and Research farm of AAUA. They were sundried and grounded into powdery form, then sieved with 2mm sieve. Samples of the organic manure (Poultry droppings, Goat droppings and Pig droppings) and soil were also analyzed for soil physicochemical properties and chemical properties respectively at the Forestry and Wood Technology Department of the Federal University of Technology (FUTA) Akure, using conventional methods for soil analysis as described by Udo *et al*. (2001). The topsoil and organic fertilizers were measured at ratio 7:3 (Aderounmu and Olajuyigbe, 2019). The organic fertilizers after adequate measurement were mixed with the topsoil in a potting mixture thorough with hand trowel forming the potting mixture. Two kilograms of the treatments were weighed using mechanical weighing balance and filled into polythene pots of (4×10cm).

Two weeks old uniform and healthy seedlings of *M. altissima* were collected from Ministry of Natural Resources, Department of conservation, regeneration and environmental management, Central nursery Omi eja, Alagbaka Akure. They were transplanted into polythene pots containing potting mixtures and allowed to stabilize for two weeks. The potted seedlings were carefully stacked in seedling rack and transported into the study site. There were four (4) treatments {Topsoils + Goat droppings (T1); Topsoil + Poultry droppings (T2);

Topsoil + Pig droppings (T3) and Topsoil alone (control) (T4)}, replicated five times. The experimental design was a Completely Randomized Design (CRD).

Data Collection and Analysis

Seedlings under every treatment were watered daily to full capacity and data on shoot heights (cm)were measured from above the soil to the tip of the seedlings with the aid of a metre rule., .collar diameters (mm)were measured using graduated veneer caliper at the collar above the soil., leaf area (cm^2) was measured with the use of leaf area metre while and leaf production were recorded after visual counting. All data were collected weekly for twelve (12) weeks. Data obtained were analyzed using analysis of variance (ANOVA) with SPSS 16. Analytical tool and Least Significant Difference (LSD) was used to separate the significant means.

RESULTS AND DISCUSSION

The physico-chemical properties of the topsoil used in the study is shown in Table 1. The soil was moderately acidic (5.83). The total N level in the soil (0.18mg kg^{-1}) is lower than required level of N in the soil (10mg kg^{-1}), organic carbon (2.30mg kg^{-1}) and total organic matter (4.10mg kg^{-1}) which are below the critical range (Adeoye and Agboola, 1985).The soil is moderate in potassium k (3.30 Cmol/kg)and sandy loam in soil textural class.

Table 1: Physico-chemical properties of the topsoil used in the study

Parameters	Values
PH	5.83
O.C (mg/kg)	2.30
O.M (mg/kg)	4.10
K (Cmol/kg)	3.30
Na (mMol/100mg)	4.0
Ca (mMol/100mg)	1.2
P (mg/kg)	1.0
Total N(mg/kg)	0.18
CEC (Cmol/kg)	7.35
Particle size	
Sand (%)	70.22
Silt (%)	12.66
Clay (%)	17.19

The pH of the organic manure used for the study ranged from moderately acidic (5.8) to 7.2 (Slightly alkaline) for pig droppings and poultry manure respectively (Table 2). The Phosphorous content of goat droppings was higher (10.5mMol/100g) followed by goat droppings (9.45 mMol/100g) while poultry manure had the highest Nitrogen composition (0.77mMol/100g) (Table 2). According to Afa *et al.* (2011) mineral composition and quantity is the function of component of the animal intake, and they usually possess enormous potentials which eventually lead to enhancement of soil fertility for luxuriant plant growth.

Aderounmu and Olajuyigbe, (2019) also asserted that enhancement of soil fertility is the key to the production of high-quality seedlings required for plantation establishment.

Table 2: Chemical properties of organic fertilizers used in the study.

Parameters	Goat droppings	Pig droppings	Poultry Manures
pH	6.57	5.88	7.2
K (Cmol/kg)	0.03	0.04	1.65
Na (mMol/100mg)	0.48	0.28	1.78
Ca (mMol/100mg)	2.04	1.76	5.0
Mg (mMol/100g)	0.81	0.81	5.1
C(mMol/100g)	0.35	0.31	2.70
N(mMol/100g)	0.33	0.01	0.77
P (mMol/100g)	10.5	9.45	5.25
Cu (mMol/100g)	0.65	0.03	2.70
Zn (mMol/100g)	0.52	0.17	1.04
Fe (mMol/100g)	2.69	4.5	6.10

There were significant differences ($p<0.05$) among the treatments in shoot heights, leaf production and leaf area. But there was no significant difference in collar diameter ($p>0.05$) (Table3). This implies that different organic manure used in the study affected the growth variables differently. The post-hoc test shows that T1(Topsoil + Goat droppings) had highest mean shoot height (9.9±1.35cm), Leaf production (2.0±0.29) and Leaf area (29.17±5.60 Cm^2).

Table 3: Analysis of variance (ANOVA) for shoot height (cm), collar diameter (mm), leaf production and leaf area as influenced by different organic fertilizer within period of study

Parameters	SV	Df	SS	MS	F-cal	P-Value
Shoot Height	Treatments	3	80.991	26.997	1.9324	0.000*
	Errors	16	223.514	13.970		
	Total	19	304.505			
Collar Diameter	Treatments	3	0.002	0.007	0.058	0.084^{ns}
	Errors	16	0.187	0.012		
	Total	19	0.189			
Leaf Production	Treatments	3	0.552	0.184	0.362	0.000*
	Errors	16	8.134	0.508		
	Total	19	8.686			
Leaf Area	Treatments	3	594.353	198.118	1.046	0.000*
	Errors	16	3029.478	189.342		
	Total	19				

*****=significant at $P<0.05$ ns = not significant at $P>0.05$

The least leaf production (1.89+0.24) was observed in the control treatment (Table 4). This implies that despite the nutrient status of the topsoil used, goat droppings still had influence in the growth parameters of the seedlings of *M. altissima*. The edge that goat droppings had on the growth could be ascribed to its feed intake which is capable of giving myriads of nutrients for the plants. This corroborates the findings of Dachung and Kalu,

(2019) who stated that organic manure enhanced nutrient availability for optimal growth of *Tamarindus indica* seedlings in terms of shoot height, collar diameter and leaf production. Topsoil amended with Pig droppings (T3) performed better (0.0 47± 0.061mm) in terms of collar diameter. It was observed from the study that the application of organic fertilizers enhanced better growth performance of the seedlings.

Table 4: Mean separation (post-hoc test) for shoot height (cm), collar diameter (mm), leaf production and leaf area as influenced by different organic fertilizer within period of study

Variables	Treatments	Values
Height (cm)	Topsoil + Goat droppings	9.9 ± 1.35^{a}
	Topsoil + Poultry manure	8.4 ± 1.20^{c}
	Topsoil + Pig droppings	8.5 ± 1.38^{c}
	Topsoil (control)	9.1 ± 1.25^{b}
Collar diameter (mm)	Goat droppings	0.040 ± 0.015^{b}
	Poultry manure	0.042 ± 0.016^{b}
	Pig droppings	$0.0\,47 \pm 0.061^{a}$
	Topsoil (control)	0.043 ± 0.015
Leaf production	Goat droppings	2.02 ± 0.29^{a}
	Poultry manure	1.92 ± 0.24^{b}
	Pig droppings	1.92 ± 0.33^{b}
	Topsoil (control)	1.89 ± 0.24^{b}
Leaf area (cm^2)	Goat droppings	29.17 ± 5.60^{a}
	Poultry manure	21.87 ± 4.70^{c}
	Pig droppings	24.98 ± 6.21^{bc}
	Topsoil (control)	27.29 ± 6.77^{ab}

According to Husseini *et al*. (2016), the use of organic fertilizers in seedlings production is becoming important in order to achieve optimum growth of tree crop seedlings in the tropics. Most especially when the unavailability and affordability of inorganic fertilizers make one to yield to the use of alternatives obtained from organic sources (Rafiqul-Hoque *et al*., 2004).Seedling height, collar diameter, leaf production and leaf area are major morphological variables that are used in grading seedling quality in the nursery and their vigour is subjected to the mineral nutrients available for their metabolism (Rafiqul-Hoque *et al*., 2004;Abubakari*et al*., 2015). The results of this study support the expected general response that seedlings treated with appropriate organic fertilizer yield better growth and seedling quality (Abubakar *et al*., 2015; Dianda *et al*., 2009). The differences observed in the response of the seedlings of *M. altissima* to organic fertilizer treatments imply that edaphic and climatic factors have crucial roles in plant growth and development as evident in performances of different treatments in the study. Organic fertilizers have been found to be good sources of Nitrogen, Phosphorus and Potassium which are needed by plants' optimum growth (Essien *et al*., 2015). They also improve the physical texture of the soil by helping it to retain moisture in the case of sandy soils and by improving aeration in clay soils. This depicts the fact of recognizing organic manure as an eco-friendly, economically viable and ecologically sound material that plays a significant role in soil biology, chemistry and physics (Suthar,2009). Furthermore, the influences of goat dropping, poultry manure and pig droppings on the growth of the seedlings confirm the assertion of Glaser *et al.* (2002) that

amelioration of physical and chemical properties of highly weathered tropical soil using fertilizers improves growth and plant development. The findings from the study show that when there is adequate organic fertilizer application to seedlings the yield will be better than when there is no fertilizer application. Most especially, Nitrogen regulates water and enhances nutrient intake, Potassium facilitates protein synthesis and translocation of photosynthates, while calcium plays important roles in building cell wall and membranes. This is in conformity with reports on the influence of organic manure on trees species like *Khaya ivorensis* and *Entandrophragma cylindrical* (Rafiqul-Hoque *et al*., 2004; Ndah, 2011).

CONCLUSION

Application of different organic fertilizers had significant effects on the growth performance of *Mansonia altissima* seedlings within period of study with the best performance in the seedlings raised with Goat droppings. Though the growth potentials of seedlings in control treatment were encouraging but application of fertilizers will increase the soil nutrient level towards having seedlings of high vigour. It is therefore recommended that forest nursery managers should make use of organic fertilizers for optimum growth of *M. altissima* seedlings and influence of organic manure on the species in the field should be studied as an area of future research.

REFERENCES

Abubakar, A., L, Atuah., B., Banful, and H,Bayor. (2015). Use of soil amendments for urban horticulture in the savannah and forest areas of Ghana, *Journal of Soil Science and Environmental Management*, 6: 51-57, 2015.

Adelani, D.O. (2015). Effects of pre-germination treatments and sowing depths on early growth of sesban (*Sesbania sesban*). *Applied Tropical Agriculture*, 20(1): 31-36

Adeoye, G.O., and A.A, Agboola (1985). Critical level for soil pH, available P, k, Zn and maize ear leaf content for P, Cu and Mn in sedimentary soils of Southwestern Nigeria.6: 65 – 71.

Aderounmu, A.F and S.O., Olajuyigbe (2019). The effects of organic and inorganic fertilizers on the early growth and development of Vitellaria paradoxa C.F. Gaertn. *Applied Tropical Agriculture*, 24(2): 132-140.

Afa, F.D., E. Bechem, F.A. Genla, F.B. Ambo, and N. Rol. (2011). Effects of organic and inorganic fertilizers on early growth characteristics of *Khaya ivorensis* Chev (African mahogany) in nursery. *African Journal of Plant Science*, 5(12): 722-729.

Akinnagbe, A., O. Gailing and R. Finkeldey (2010). Genetic diversity of *Mansonia altissima* A. Chev. under different regimes of human impact in Akure Forest Reserve, Nigeria. *Forestry Studies in China*, 12 (4): 193-200, doi: 10.1007/s11632-010-0407

Amjad, A.A., J.K. Theodore, H.V. Radovich, J.U. Nguyen, A. Alton, C. Jeana, P. Robert, A. Sugano, and T. Glenn (2016). Use of Organic Fertilizers to Enhance Soil Fertility, Plant Growth, and Yield in a Tropical Environment. *Journal on the Uses of Organic Fertilizer.* DOI: 10.5772/62529.

Asinwa, I.O., F. Kazeem, Ibrahim, A.O. Agbeja, A.O. Fawole and K.A Olaifa (2020). Sustainable Management of Non- Timber Forest Products and Their Potentials on Livelihood in Nigeria. *In:* B. O. Agbeja, A.C. Adetogun, O.V. Oyerinde, J.A. Olusola

& O.S. Olaniran (Eds.). *Proceedings of the 3rd Annual Conference of the Commonwealth Forestry Association, Nigeria Chapter*, Federal university of Technology, Akure, Nigeria 2 – 3 December, 2020, Pp. 598-602

Cable, S. and Cheek, M. (1998). The plants of mount Cameroon: A conservation checklist. *Royal Botanic Gardens*, Kew; 43-56484774.

Dachung, G. and M. Kalu (2019). Effect of organic and inorganic fertilizers on the early growth of *Tamarindus indica* L. in Makurdi, Nigeria. *Journal of Research in Forestry, Wildlife and Environment*, 11(3): 1-7.

Dianda, M., J. Bayala, T. Diop and S. J. Ouedraogo (2009). Improving growth of Shea butter tree *Vitellaria paradoxa* C.F. Geartn) seedlings using mineral N, P and arbuscular.

Essien, E, M. Efeanacho and G. Nwachukwu (2015). The impact of cow dung augmentation for remediation of crude oil polluted soil by *Eleusine indica*. *Journal of Applied Sciences and Environmental Management,* 19: 103-107.

Glaser, B. J. E. Lehmann and W. Zech (2002). Ameliorating physical and chemical properties of highly weathered soils in the tropics with charcoal – A review. Biology and Fertility of Soils (4) pp. 35.

Husseini, R., G.K. Mahunu, P.1. Wireku and I.K. Dzomeku (2016). Response of growth and leaf yield of *Adansonia digitata* seedlings to soil amendments and harvesting regimes. *Journal of Multidisciplinary Engineering Science and Technology*, 3(12): 6114- 6119

Maku, J.O., A.E. Gbadamosi and O.A. Fadoju (2014). Germination and seedling growth of *Mansonia altissima* (A. Chev) in response to hormonal treatment. *International Journal of Agriculture and Forestry* 2014, 4(4): 269-274

Ndah, N. (2011). Effects of organic and inorganic fertilizers on early growth of characteristics of *Khaya ivorensis* Chev. (African mahogany) in nursery. *African Journal of Plant Science*. 5. 722-729.

Ohene, C.F. (2008). *Mansonia altissima* (A Chev). A. Chev. (Internet) Record from PROTA4U. Louppe D, Oteng.Amoako AA and Brink M (Eds). PROTA (Plant Resources of Tropical Africa /Resources vegetales de L'Afrique tropical). Wageningen, Neverther-Lands. http://www. prota4u.org/search.asp.

Olabode A., (2014). Rural climate and adaptive strategies for sustainable food security Akungba-Akoko, Ondo state. Book of Chapters. *Article No*:27 1101-723, pp. 07-16.

Osunlaja, O.A., D.B. Olomola, J.O. Nwogwugwu, J.O. Afolabi and E.O. Oloyede (2017). Effect of media composition on shoot initiation of *Mansonia altissima* A Chev. Using nodal culture technique. *Journal of Forestry Research and management*, 14 (1): 103-109.

Rafiqul-Hoque, M.K., M. Hossain, L. Mohinuddih and M.M Hoque (2004). Effect of inorganic fertilizers on the initial growth performance of *Anthocephalus chinensis* (Lam) Rich.Ex. Walp seedlings in the nursery. *Journal of Applied Sciences*, 4: 477-485.

Sankaran, M., J. Ratnam and N. Hanan (2008). Woody cover in African savannas: the role of resources, fire and herbivory. *Global Ecology and Biogeography*, 17(2):236-245. https://doi.org/10.1111/j.1466-8238.2007.00360

Suthar, S. (2009). Impact of vermicompost and composted farmyard manure on growth and yield of garlic (*Allium stivum* L.) field crop, *International Journal of plant production*, vol. 3, pp. 27-38, 200.