Original Research Article

Efficacy of two (2) organic fertilizer sources (oil palm bunch and vermicasts) on the growth response of *Tetrapleura tetraptera*

Abstracts

To increase awareness of *T. tetraptera* potential uses, enhance its utilization and promote its domestication as a fruit trees, a potential use of organic manure as soil amendment in afforestation, reforestation, agroforestry, fruit tree orchards, and bio-energy plantations cannot be over emphasized. Therefore, the study to determine the efficacy of organic manure (sole application and its interaction) on the growth of *Tetrapleura tetraptera* under a screen house condition was carried out in Federal College of Forest, Ibadan located within the government Reserve Area (GRA), Jericho Ibadan. . The experimental design was a 2 x 8 factorial arranged in a Completely Randomized Design (CRD) with seven (7) replicates each making a total of 112 experimental samples. The treatments used were as follows: vermicast at two levels (20t/ha, 40t/ha), oil palm bunch at two levels (20t/ha, 40t/ha), interaction of vermicast and oil palm bunch (1:1, 1:2 and 2:1) and Control (no amendment). . Data on plant height number of leaves, collar diameter and dry matter yields were generated and subjected to analysis of variance and significant means separated using Duncan's Multiple Range Test at 5 % level of significance. The results shows that, the collar diameter of *Tetrapleura tetraptera* increased (P=0.05) with the sole application of oil palm bunch at 40t/ha with a mean value of 2.16mm , however, this increase can also be comparable to the sole application of oil palm bunch at 20t/ha with a mean value of 2.04mm. Oil palm bunch at 20t/ha recorded the highest plant of *Tetrapleura tetraptera* with a mean value of 18.00cm while the interaction of VC+OB (2:1) and VC 40t/ha are also relatively comparable to the control (no amendment) to improve the plant height. The highest leaves number was observed when oil palm bunch 20t/ha was used as an amendment with a mean value of 14.0 while the lowest number of leaves was recorded with the interaction VC+OB 1:1 with a mean

value of 12.0. From the results obtained, oil palm bunch residue as an organic fertilizer improves the growth of *Tetrapleura tetraptera.*
Key word: *Tetrapleura tetraptera, oil palm bunch (OB), vermicast (VC), growth parameters*

Introduction

The use of wild fruit trees as food and medicine is a popular practice in developing economies like rural Africa (Kehlenbeck *et al*. 2013) and some parts of Asia (Joshi *et al*. 2018). This practice is further facilitated by cultural beliefs, rural poverty and high cost of conventional health care. For instance, several indigenous fruit trees such as *Tamarindus indica*, *Garcinia buchananii*, Canarium schweinfurthii and *Tetrapleura tetraptera* have been reported to be useful for food and medicine, especially in communities with limited health facilities (Katende *et al*. 1995; Okullo *et al*. 2014; Ranaivoson *et al*. 2015). However, *Tetrapleura tetraptera*, with its sweet tasty fruit pulp and pleasant aroma which makes it suitable for food and beverage flavouring (Ogbunugafor *et al*. 2017), seems to have received less attention in social economic research compared to other indigenous fruit tree species. Despite its medicinal and nutritional potential, *T. tetraptera* local use in the various communities where it is native has not been well documented. Most studies have focused on the chemical and pharmacological properties of *T. tetraptera* fruit (Abugri and Pritchett 2013; Lekana-Douki *et al*. 2011), with limited information on its local applications, scientific findings indicate the medicinal and nutritional properties of fruit trees, which is vital for rural livelihood sustainability.

Waste is an inevitable by-product of human actions. Better financial conditions and life style in some part of the world had increased the quantity and density of generated waste. Agro-industrial waste disposal is a main problem in many industries around the world. The disposal of industrial wastes in the nearby areas causes environmental dangers. The recycling of wastes is a disposal mechanism and resource management. China harvests the biggest quantities of agriculture waste and crop residues followed by India in the Asian and Pacific region (ESCAP 1997). Nutrient requirement of crops by organic manures as compost resulting from agro-industrial

wastes is a major source of soil fertility and crop productivity which reduces use of chemical fertilizers (Kayikcioglu 2013).

Organic manure contribute to the fertility of the soil by adding organic matter and nutrients such as nitrogen, phosphorus and potassium amongst others, that are utilized by bacteria, fungi and other organisms in the soil (Mattar,2000). Higher organisms then feed on the fungi and bacteria in a chain of life that comprises the soil food web. Its products are obtained after decomposition of organic materials like plants and animal sources which replenishes the soil with essential elements and add humus to the soil (Mattar, 2000).

Palm bunch refuse is the solid waste generated during the processing of oil palm fruits. In the palm oil manufacture practice there is generally a surplus of by-product and the utilization pace of these by-products is small particularly for palm oil mill effluent (Rupani *et al.* 2010).. The better nutrient reuse will perk up soil fertility and sustainability of palm oil production. Techniques available, such as normal composting, co-composting and vermicomposting are being practiced however, have not been exploited in its full strength as huge quantity of palm waste could be decomposed in short time and the compost made from oil palm waste could not only be applied to palm plantations but also to various crops. This will ultimately eliminate the synthetic fertilizers application (Embrandiri et al. 2013).

Vermicomposting is the term given to the process of conversion of biodegradable matter by earthworms into vermicast (Abbasi and Ramasamy, 2001). In the process, a major fraction of the nutrients contained in the organic matter is converted to more bioavailable forms. Application of vermicomposting improves the soil structure by increasing porosity and reducing the bulk density. It improvises soil aeration, water-holding capacity, buffer capacity, and cation exchange capacity of soil (Nada *et al*., 2013). In addition, the vermicast is also reported to contain biologically active substances such as plant growth regulators and have been shown to increase growth of many plants (Tomati *et al*., 1990, 1995; Abbasi and Ramasamy, 1999; Atiyeh *et al*., 2002; Arancon *et al*., 2004; Gajalakshmi and Abbasi, 2004; Edwards, 2004; Sinha, 2009). Although a considerable number of studies have been carried out on vermicast and their impact on the soil and plant growth (Gajalakshmi *et al*., 2001a, 2002; Singh and Sharma, 2002;

Gajalakshmi and Abbasi, 2003, 2004; Padmavathiamma *et al*., 2008), there is still a lack of knowledge on the interaction with other organic materials. Therefore, this study was carried out to determine the efficacy of organic manure (sole application and its interaction) on the growth of *T. tetraptera* under a screen house condition.

MATERIALS AND METHODS

Experimental site

The experiment was carried out in Federal College of Forest, Ibadan located within the government Reserve Area (GRA), Jericho Ibadan and South-West local Government area of Oyo state. It lies on latitude $7^0 90^{'}$N and longitude $3^0 54^{'}$E, the climate pattern of the area is tropically dominated by annual rainfall which ranges from 1,200-1,250 mm and average relative humidity of about 37.2^0C. The eco-climate of the dry season (usually commencing from November-March) and the raining season start from April to October (FRIN, 2016).

Procurements of materials

The soil samples was collected from farm practical area (FAP), Federal College Forestry, Ibadan. Top soil of 0 – 20 cm depth was be used for the experiment. The soil was air dried; grounded and sieved using 2mm sieve to remove gravel and large plant roots. The soil samples was chemically analyzed for nitrogen and other nutrient content. Two kilogram soil was weighed in a polythene bag and incorporated with organic manure at different levels.

Vermicast was collected from the Fadama site at Forestry Research Institute of Nigeria (FRIN), the vermicast was grounded into powdery form for easy application and weighed with sensitive scale into varying levels. Oil palm bunch was collected from oil processing farm Gbongan, Osun State. The oil palm bunches were dried, grounded and sieve with 2mm mesh and also weighed by sensitive scale into varying levels

Seedlings of *Tetrapleura tetraptera* was collected from the mother tree from the wild at Eruwa and raised in a germination basket for four (4) weeks , 112 healthy seedlings was selected from the basket based on the uniform treatments and then transplanted into a 2kg pot of soil. Watering was done regularly and data collection was taken every three (3) weeks on plants height, collar

diameter, number of leaves for a period of 18weeks while biomass was also done to determine the wet and dry weight of the plants samples. The experimental design was a 2 x 8 factorial arranged in a Completely Randomized Design (CRD) with seven (7) replicates each making a total of 112 experimental samples. The treatments used were as follows: vermicast at two levels (20t/ha, 40t/ha), oil palm bunch at two levels (20t/ha, 40t/ha), interaction of vermicast and oil palm bunch (1:1, 1:2 and 2:1) and Control (no amendment).

Data collection

The following growth parameter of *Tetrapleura tetraptera* was taken

i) Plant height
ii) Number of leaves
iii) Collar diameter
iv) Dry matter yield

Soil analysis

Soil sample was analyzed for pre-planting and post-planting for the essential elements (Macro and Micro nutrients).

Statistical analysis

Quantitative data will be analyzed using the ANOVA procedure and means separated using the Duncan Multiple Range Test (DMRT) at 5% probability (SAS Institute, 2002).

Results and Discussion

Table 1: physical and chemical properties of soil, vermicast and oil palm bunch used for the experiment.

Properties	Soil	Vermicast %	Oil palm bunch %
pH (1:1)	6.5	5.9	5.1
N %	0.86	1.02	1.72
P mg/kg	37.2	12.5	9.45
K %	0.13	3.47	32.1
Mg%	1.08	2.7	8.1

Fe %	425	310	2.11
Mn %	58.6	59.9	26.3
Zn %	3.56	14.4	3.40

Key: OC = Organic carbon, N = Nitrogen, P = Phosphorous, K = Potassium and Mg = Magnesium, Fe = iron.

The soil is a sandy loam, moderately furnished with Zinc, high in phosphorus with low Nitrogen and potassium. Vermicast used for the experiments was high in zinc, phosphorus and manganese but relatively low in potassium when compared to the oil palm bunch which has a higher potassium, Nitrogen and organic carbon.

Table 2: **Influence of organic amendments on the collar diameter of *Tetrapleura tetraptera* under a greenhouse condition**

treatments	0 WAT	3 WAT	6 WAT	9 WAT	12 WAT	15 WAT	18 WAT
Control	1.01^{c}	1.16^{c}	1.31^{ab}	1.44^{ab}	1.60^{b}	1.77^{ab}	1.89^{a}
VC 20t/ha	1.03^{c}	1.24^{a}	1.36^{ab}	1.51^{a}	1.60^{b}	1.76^{ab}	1.91^{a}
VC 40t/ha	1.02^{b}	1.20^{a}	1.34^{ab}	1.49^{ab}	1.64^{b}	1.80^{a}	1.94^{a}
OB 20t/ha	1.06^{b}	1.21^{b}	1.39^{ab}	1.54^{a}	1.70^{ab}	1.86^{a}	2.04^{a}
OB 40t/ha	1.04^{c}	1.23^{b}	1.44^{a}	1.63^{a}	1.81^{a}	1.97^{a}	2.16^{a}
VC+OB 1:1	1.04^{c}	1.21^{b}	1.36^{ab}	1.51^{a}	1.66^{b}	1.80^{a}	1.97^{a}
VC+OB 1:2	1.04^{c}	1.19^{b}	1.34^{ab}	1.49^{ab}	1.66^{b}	1.81^{a}	1.99^{a}
VC+OB 2:1	1.04^{c}	1.19^{b}	1.36^{ab}	1.53^{ab}	1.71^{ab}	1.86^{a}	2.00^{a}

VC= vermicast: OB = oil palm bunch: VC+OB= interaction of vermicast and oil palm bunch

There was no significant difference ($p<0.05$) in the plant height of *Tetrapleura tetraptera* among all the treatments used across the weeks after transplanting except at 3WAT when the sole

application of vermicast ,oil palm as well as their various interactions were significantly higher ($p<0.05$) than the control (no amendment). Sole application of oil palm bunch (OB 40 t ha-1) and oil palm bunch (20 t ha-1) recorded the highest collar diameter in *tetrapleura tetraptera* plants with a mean value of 2.16mm and 2.04mm respectively which are also comparable to every other treatments used (sole application and it interactions) except the control (no amendment) that recorded the least collar diameter with a mean value 1.89mm at the 18th week of the experiment. This results corroborates with the research of (Baharuddin et al. 2011) who reported that oil palm bunch waste improves soil, enhances vigor and production.

Table 3: **Influence of organic amendments on the plant height of *Tetrapleura tetraptera* under a greenhouse condition**

treatments	0WAT	3WAT	6 WAT	9 WAT	12 WAT	15 WAT	18 WAT
Control	7.7ab	9.2a	10.9a	12.6a	14.0a	15.5ab	17.0ab
VC 20t/ha	6.6b	8.2a	9.9ab	11.5ab	12.9ab	14.6b	16.7ab
VC 40t/ha	7.9ab	9.5a	11.0a	12.7aa	13.9a	15.2ab	17.3ab
OB 20t/ha	8.5a	9.9a	11.5a	12.9a	14.4a	16.4a	18.0a
OB 40t/ha	7.5ab	9.0a	10.5a	11.9ab	13.6a	15.1ab	16.8b
VC+OB 1:1	7.2ab	8.6a	10.1ab	11.5ab	13.0a	14.8b	16.5b
VC+OB 1:2	6.0b	7.2ab	8.7b	10.2b	11.9b	13.2b	15.0b
VC+OB 2:1	7.1ab	8.5ab	10.3b	11.9ab	13.5a	15.2ab	17.7b

VC= vermicast: OB = oil palm bunch: VC+OB= interaction of vermicast and oil palm bunch

There was no variation among all treatments used. However, oil palm bunch at OB 20 t/ha was higher with mean value of 18.00cm as compared with other treatments used. The interaction of VC+OB (2:1) and VC 40t/ha are also relatively comparable to the control (no amendment) to improve the plant height. These result supports the findings of Canelles *et al* 2002) who stated that vermicast increases growth yield and also contain higher amount of nitrogen and also contain nitrifying power than the corresponding soil.

Table 4: **Influence of organic amendments on the leaves number of *Tetrapleura tetraptera* under a greenhouse condition**

treatments	0 WAT	3 WAT	6 WAT	9 WAT	12 WAT	15 WAT	18 WAT
Control	5.3[b]	6.3[ab]	7.6[ab]	9.0[ab]	10.1[ab]	11.6[b]	12.9[bc]
VC 20t/ha	5.4[b]	6.4[ab]	7.6[ab]	9.0[ab]	10.1[ab]	11.6b	12.9[bc]
VC 40t/ha	5.7[b]	6.7[ab]	7.7[ab]	9.1[ab]	10.6[ab]	11.6[b]	12.7[bc]
OB 20t/ha	7.0[a]	8.0a	9.0[a]	10.6[a]	11.7a	12.9[ab]	14.0[ab]
OB 40t/ha	5.4[b]	6.4[ab]	7.7[ab]	9.3[ab]	10.3[ab]	11.4[b]	13.0[a]
VC+OB 1:1	5.1[b]	6.1[ab]	7.1[ab]	8.6[ab]	9.7[ab]	10.7[b]	12.0[b]
VC+OB 1:2	5.9[b]	6.9[ab]	7.9[ab]	9.1[ab]	10.6[ab]	11.7[b]	13.0[ab]
VC+OB 2:1	7.2[b]	8.2[a]	9.3[a]	10.3[a]	11.3[a]	12.3[ab]	13.7[ab]

There was no significant difference in all treatments used. At 18 WAT, all the treatments used were comparable. The highest leaves number was observed when OB 20t/ha was used as an amendment with a mean value of 14.0 while the lowest number of leaves was recorded with the interaction VC+OB 1:1 with a mean value of 12.0. The control plot did relatively well and it is comparable to the sole application of vermicast at 20t/ha and 40t/ha as well as their interactions at (VC+OB 1:2 and VC+OB 2:1).

Table 5: **Dry matter yield**

Treatments	shoot	Leaves	Root
Control	149.7	146.5	84.6
VC 20t/ha	88.3	163	87.5
VC 40 t/ha	63.1	210	97.2
OB 20 t/ha	95.6	164	81
OB 40 t/ha	120.4	235.2	171.4
VC+ OB 1:1	130.7	212	126
VC+ OB 1:2	88.3	158.4	103.0
VC+ OB 2:1	82.3	195	89.8

There was no variation in the dry matter yield. The highest dry matter yield was recorded for oil palm bunch at 40t/ha and it is comparable to other treatments used including the control the interaction of VC+ OB 2:1 was relatively low compared to other treatments for the shoot while OB 20 t/ha had the lowest in root.

Conclusion

Sole application of oil palm bunch at 40t/ha and 20t/ha proves effective for the enhancement of the growth parameters (height, collar diameter) of *Tetrapleura tetraptera* .The plants height and the collar diameter of *Tetrapleura tetraptera* increased (P=0.05) with the sole application of oil palm bunch at 40t/ha, although this increase can also be comparable to the sole application of oil palm bunch at 20t/ha and comparatively higher than the control treatment. For the number of leaves, the control plot did relatively well and it is comparable to the sole application of vermicast at 20t/ha and 40t/ha as well as their interactions at (VC+OB 1:2 and VC+OB 2:1). The enhanced plant growth in soil supplemented with palm bunch as observed in this study may be attributed to the important role played by the organic supplement in supplying the available plant minerals and in providing favorable condition for microbial activity as well as providing better

soil conditions (Omoti *et al*., 1999). Therefore the potential of oil palm bunch residue should be harnessed by agro allied industries.

REFERENCES

Abbasi, S.A. and E.V. Ramasamy, 1999. *Biotechnological Methods of Pollution Control*. Orient Longman, Universities Press India Ltd., Hyderabad, India. p.168.

Abbasi, S.A. and E.V. Ramasamy, 2001. *Solid Waste Management with Earthworms*. Discovery Publishing House, New Delhi. p.178.

Abugri DA, Pritchett G. 2013. Determination of chlorophylls, carotenoids, and fatty acid profiles of *Tetrapleura tetraptera* seeds and their health implication. Journal of Herbs Spices and Medicinal Plants. 19(4):391–400

Arancon, N.Q., C.A. Edwards, R. Atiyeh and J.D. Metzger, 2004. Effects of vermicomposts produced from food waste on the growth and yields of glasshouse peppers. *Bioresour. Technol*., 93: 139-144.

Atiyeh, R.M., N.Q. Arancon, C.A. Edwards and J.D. Metzger, 2002. The infl uence of earthworm-processed pig manure on the growth and productivity of marigolds. *Bioresour. Technol*., 81: 103-108.

Edwards, C.A. 2004. *Earthworm Ecology*. 2nd ed. CRC Press. Washington, D.C. p. 183-210.

Embrandiri A (2013) Application of palm oil mill wastes (decanter cake) as soil amendments: appraisal of potential effects on selected vegetables and soil (unpublished dissertation)

Embrandiri A, Mahamad HI, Rajeev PS (2013) Palm oil mill wastes utilization; sustainability in the Malaysian context. Int J Sci Res Pub 3(3):1–7

ESCAP (1997) Guidelines and manual on land-use planning and practices in watershed management and disaster reduction. Economic and social commission for Asia and the Pacific, United Nation, Bangkok

Gajalakshmi, S. and S.A. Abbasi, 2003. High-rate vermicomposting systems for recycling paper waste. *Indian. J. Biotech*., 2: 613-615.

Gajalakshmi, S. and S.A. Abbasi, 2004. Neem leaves as a source of fertilizer-cum-pesticide vermicompost. *Biores. Technol*., 92: 291-296.

Gajalakshmi, S., E.V. Ramasamy and S.A. Abbasi, 2001a. Potential of two epigeic and two anecic earthworm species in vermicomposting water hyacinth. *Biore. Technol*., 76: 177-181.

Gajalakshmi, S., E.V. Ramasamy and S.A. Abbasi, 2001b. Screening of four species of detritivorous (humus-former) earthworms for sustainable vermicomposting of paper waste. *Environ. Technol*., 22: 679-685.

Joshi SK, Ballabh B, Negi PS, Dwivedi SK. 2018. Diversity, distribution, use pattern and evaluation of
wild edible plants of Uttarakhand, India. Defence Life Sci J. 3(2):126–135.

Kayikcioglu, HH (2013) Effects of composts from agro industrial wastes on microbial activity of a typic xerofluvent soil under Mediterranean conditions, SE Turkey. Geomicrobiol J 30(9):228–236

Katende AB, Birnie A, Tengnas B 1995. Useful trees and shrubs for Uganda. identification, propagation and management for agricultural and pastoral communities. Regional Soil Conservation Unit (RSCU), Swedish International Development Authority (SIDA).

Kehlenbeck K, Asaah E, Jamnadass R 2013. Diversity of indigenous fruit trees and their contribution to nutrition and livelihoods in sub-Saharan Africa: examples from Kenya and Cameroon. Diversifying food and diets: Using agricultural biodiversity to improve nutrition and health.257–269.

Lekana-Douki JB, Liabagui SL, Bongui JB, Zatra R, Lebibi J, Toure-Ndouo FS. 2011. In vitro antiplasmodial activity of crude extracts of Tetrapleura tetraptera and Copaifera religiosa. BMC Res Notes. 4:506.

Ogbunugafor HA, Ugochukwu CG, Kyrian-Ogbonna AE. 2017. The role of spices in nutrition and
health: A review of three popular spices used Southern Nigeria. Food Quality and Safety. 1(3): 171–185

Omoti U, Obatili CR, Fagbara JA. Complementary use of organic and inorganic fertilizer for tree and forest crops. First National Organic Fertilizer Seminar, Kaduna. March, 26-28; 1999.

Nada, W.M., L. van Rensburg, S. Claassens and O. Blumenstein, 2011. Effect of vermicompost on soil and plant properties of coal spoil in the Lusatian Region (Eastern Germany). *Commun. Soil. Sci. Plant. Anal*., 42: 1945-1957.

Okullo JBL, Omujal F, Bigirimana C, Isubikalu P, Malinga M, Bizuru E, Agea JG. 2014. Ethnomedicinal uses of selected indigenous fruit trees from the lake Victoria Basin Districts in Uganda. J Med Plants. 2(1):78–88.

Ranaivoson T, Brinkmann K, Rakouth B, Buerkert A. 2015. Distribution, biomass and local importance of tamarind trees in south-western Madagascar. Global Ecology and Conservation. 4:14– 25

Rupani PF, Singh RP, Ibrahim H, Esa N (2010) Review of current palm oil mill effluent (POME) treatment methods: vermicomposting as a sustainable practice. World Appl Sci J 11(1):70–81

Tomati U, Galli E, Grappelli A, Dihena G (1990) Effect of earthworm casts on protein synthesis in radish (*Raphanus sativum*) and lettuce (*Lactuca sativa*) seedlings. *Biology and Fertility of Soils* 9, 288-289