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Growth Performance of *Tetrapleura Tetraptera* (Schum and Thonn) Seedlings to Green Manure and Inorganic Fertilizer

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ABSTRACT: The use, types and method of fertilizers for agricultural and forest plants should be sustainable, eco-friendly and natural to the environment. Application of green manure is being used nowadays for soil nutrient management, growth and plant yields because of their natural effects. This study investigated the use of green manure andinorganic fertilizer on the growth performance of *Tetrapleura tetraptera*. Topsoil, leucaenana *leucoephala* (leave powder) and inorganic fertilizer (NPK 15: 15:15) were used. The fertilizer were weighed and applied to the 5kg of soils at 0g, 10g and 20g each and were replicated six times. Growth parameters such as seedling heights, number of leaf and stem diameter were assessed weekly for aperiod of three months. The application leucaenana *leucoephala's* leave powder as green manure showed significantly high effects on the growth parametersof *Tetrapleura tetraptera* seedlings at $p \leq 0.05$. This study has shown the efficacy of leucaenana *leucoephala's* leave powder as green manure for optimum growth of *Tetrapleura tetraptera* seedlings.

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INTRODUCTION

The increase in population, urbanization, industrialization, and mismanagement of land practices has led to deforestation, over exploitation of forest tree species, degradation of soil and land. Plant serves as source of solution to its environment. They have been important source of medicine for thousands of years. The world health organization estimates that up to 80% of people still rely on traditional remedies such as herbs for their medicines (World Health Organization, 2003). The World Health Organization (2003) defines medicinal plants as herbal preparations produced by subjecting plant materials to extraction, fractionation, purification, concentration or other physical or biological processes which may be produced for immediate consumption or as a basis for herbal products. Apart from these, forest trees stabilizethe climate, maintain the water resources, conserve, beautify, and preserve the environment form natural and anthropogenic activities (Tuner, 2001). Unfortunately, man has misused these forest resources due to over exploitation and lack of purposeful management, with a resultant negative effect on the environment. In order to thwart the extinction and obtain utmost benefits from this indigenous forest trees (Akachuk, 1997), it is essential to safeguard and preserve their germplasm as well as promote their conservation in the environment. The demand for indigenous, valuable and economic tree species are widely increasing and most of these important tree species are tending towards extinction, thus a need for domestication, afforestation, reforestation of these tree species. However, most of these forest trees are uncultivated and exhibit varying levels and different kinds of seed dormancy. Therefore overcoming the problem of seed dormancy becomes imperative for promotion and conservation of tree species. *Tetraptera* commonly known as Aridan (Fruit) in the South Western Nigeria is a medicinal plant of fabaceae family. The plant reaches 20-25 m height, with a girth of 1.5-3m. The bole is slender and older trees have very small, low. In the forest, the crown is fairly smooth, grey-brown, very thin, slash reddish, string smelling, fairly thick, twigs and young foliage virtually glabrous or minutely hairy (Oruwa, 2009). It is generally found in the lowland forest of tropical Africa. The fruits consist of a fleshy pulp, small, brown-black seeds. Its fruit is used for the management of convulsions, leprosy, inflammation and rheumatism (Ojewole and Adewunmi, 2004). The phytochemical screening revealed the presence of alkaloids, flavonoids, tannins, saponins, anthraquinnes, mucilages, oses and holosides, coumarin and reducing sugar and these could be

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responsible for its varied biological, medicinal and pharmacological properties(Abii,2007; Aderounmu *et al.,* 2020). Despite, the economic important of *Tetrapleura tetraptera,* the population of the plant is declining at an alarming rate due to over exploitation and lack of sustained conservation measures. Apart from this, only few percentage of its seed germinated when planted due to the dormancy, thus posing a challenge. The agricultural and forest industries rely on seed that exhibit high rates of germination and vigorously synchronous growth after germination, hence dormancy is sometimes considered undesirable traits (Akachuku, 1999). These forest plants can be regenerated by coppicing, seedlings growing in their natural habitat (in-situ) or by transplanting to a suitable place (ex-situ) where they can be established (Olajide and Udoh, 1997). Application of inorganic fertilizer is one of the method used to increase the plant growth and yield but its intensive and continuous usage has resulted into soil deterioration such as salinization, increase in heavy metal contents, reduction in microorganism activities, greenhouse effect, health hazards, eutrophication in groundwater resource among others (Erkoven *et al.,* 2015; Cherfi *et al.,* 2015). Thus, one of the recent and common methods used as an alternative for reduction of the inorganic fertilizer usage is green manure. Green manures as an organic manure being added to soil is one of a good management practice in agricultural production due to its positive impact on cropping system and sustainability, reduction of soil erosion, ameliorating soil physical properties, soil organic matter, nutrient retention and fertility content as well as reduction of global warming influenceincrease (Smith *et al.,* 1987; Power, 1990; Dinnes *et al.,* 2002; Robertson *et al.,* 2000). They are eco-friendly and contain no toxic elements that can be harmful to plant, animal and human (Verbruggen *et al.,* 2010; Schmid, 2011). Tejada *et al* (2008) reported that organicmatter, enzymatic activities and biological properties of soil, yield parameters and nutritionstatus of plants were increased on green manure appliedorchards. *Leucaena leucocephala* tree roots may improve soil structure and create macro-pores, thus increasing water infiltration, reducing surface runoff and erosion, and improving soil penetration by crop roots (Sanginga *et al,* 1992). *Leucaena leucoephala* affect the soil function in a verity of ways, and could be used as indicators of nutrient status to *T.tetrapleura*(Warren and Zoux, 2007). Thus, this study investigated the use of green manure andinorganic fertilizer on the growth performance of *Tetrapleura tetraptera.*

MATERIALS AND METHODS

The experiment was carried out at the nursery C within the premises of Federal College of Forestry, Ibadan, Oyo State. The experimental site lies between Latitude 7˚26′N and Longitude 3˚54′E. The climatic pattern of the area is tropically dominated by annual rainfall which ranges from 1,400-1,50Omm and average relative humidity of about 65% while the average temperature is about 26°C (FRIN, 2016). The seed of *Tetrapleura tetraptera* were collected from the mature tree of *T.tetraptera* at the snailry experimental site opposite Muslim co-operative of the Forest Conservation and Protection Department Forestry Research Institutes of Nigeria (FRIN), Ibadan The top soil used was collected from the Gmelina plantation within the Federal College of Forestry, Ibadan while *Leucaena leucocephala*'s leaves used for the study were collected from the Forestry Research Institute of Nigeria (FRIN) Quarters. The fertilizers used in this study are *Leucaena leucocephala*'s leaves and NPK (15:15:15). The polythene pots (30cm x 15cn) were perforated and filled with 5kg of topsoil. The *L. leucocephala*'s leaves were air dried and ground into powdery form and sieved prior to weighing and mixing with the soil. Top soil and *L. leucocephala*'s leaf powder were analyzed for physicochemical parameters using standard instrumentation techniques. Each of the fertilizers weighing 0g, 10gand 20g were mixed with the soil in the polythene pots and replicated five times. Nine treatments: T0: control (topsoil +0g); T1: top soil+10g of *L. Leucocephala's* leaf powder; T2: top soil+20g of *L. Leucocephala's* leaf powder; T3: top soil+10g of NPK (15:15:15) and T4: top soil+20g of NPK (15:15:15) were replicated six times making a total of thirty polythene pots used in the study. Both the *L. Leucocephala's* leaf powder andNPK (15:15:15) weremixed thoroughly for 3days prior to sowing. 90 healthy seedlings were picked from germination boxes and 3 seedlings each were transplanted into the polythene pots. The pots were arranged in a completely randomized design and the experiment lasted for 12 weeks (3 months). Growth parameters such as seedlingheight, number of leaf, and stem diameter were assessed weekly for three months. Analysis of Variance (ANOVA) was used to analyze the data obtained while Duncan Multiple range test was used for further test of significance using SPSS statistical software.

RESULTS AND DISCUSSION

The topsoil used is loamy sandy soil with the particle size percentage of sand (73.11%), silt (12.01%) and clay (14.88%). The pH of the soil is slightly acidic (Table 1) while the organic matter content of the soil (3.35%) and available phosphorous are medium. The

soil contained considerable amount of Na, Ca, K, Mg, Fe, Cu and Mn as seen in Table 1. The *L. leucocephala*'s leaf powder (green manure) has high organic matter content (35.11%), Fe (398.22mg/kg) and Mn (120.00mg/kg); moderately amount of total nitrogen content (2.01 %), available phosphorus (7.60mg/kg), Cu(25.00mg/kg) and Zn (10.00mg/kg). The high nutrient contents in the L. *Leucocephala's* leaf powder may influence the growth performance of the studied tree species.The height, stem diameter and leaf production of *T. tetraptera* for the different treatments is presented in Table1, 2 and 3 respectively. The higher mean values of *T. tetraptera* heights were observed at the weeks (1-4) for T0 (7.22-9.41 cm), T3 (6.87-7.89 cm) and T4 (6.71-7.56cm)when compared to T1 (5.99-7.01cm) and T2 (5.21 -6.99cm) as presented in Table 1. Results indicated significant difference ($p < 0.05$) between the control (T0), T1 and T3 for all the weeks after transplanting (Table 1). The mean plant height for all the treatments increased withweeks after transplanting.Topsoil with the addition of 10g of green manure (T1: 15.49-22.09 cm) gave the greatest mean plant height from week6 to week 12 followed by topsoil with the addition of 20g of green manure (T: 14.22-21.02cm) while the least mean plant height was from the (T4: 12.05-18.01cm).The highest mean values at early weeks of growth in T0, T3 and T4 may be attributed to availability of nitrogen from inorganic fertilizers and the soil used as compared to those from green manure that has to decomposed and released gradually to seedlings (Okoroafor*et al.,* 2013). This is similar to the findings of Akintola*et al* (2021) lower values in heights of *Senecio biafrae* grown in organic manure were observed at five weeks after transplanting

Table 1: Physicochemical parameters of the green mare and top soil used in the study

Parameters	Green manure	Top soil
Sand (%)		73.11
Silt (%)		12.01
Clay (%)		14.88
pH	6.78	6.21
Organic matter content (%)	35.11	3.25
Total Nitrogen (%)	2.01	0.22
Available phosphorus (mg/kg)	7.60	3.99
Na Cmol/kg)	-	9.11
K Cmol/kg)	0.98	8.12
CaCmol/kg)	0.25	6.2
Mg (Cmol/kg)	0.81	5.18
Fe (mg/kg)	398.22	172.51
Cu (mg/kg)	25	28
Mn (mg/kg)	120	82
Zn (mg/kg)	10	0.9

Table 2. *Mean values of T. tetraptera seedling heights in cm*

Treatments	Weeks after transplanting					
	Week 2	Week 4	Week 6	Week 8	Week 10	Week 12
T0	7.22±0.05a	9.41±0.01a	12.48±0.02c	13.91±0.05c	15.62±0.01c	18.91±0.01c
T1	5.99±0.02c	7.01±0.01c	15.49±0.02a	16.99±0.01a	18.01±0.02a	22.09±0.01a
T2	5.21±0.01bc	6.99±0.05c	14.22±0.04ab	16.01±0.01ab	17.56±0.05ab	21.02±0.02ab
T3	6.87±0.03b	7.89±0.04b	13.79±0.07b	14.86±0.02b	16.81±0.08b	19.92±0.05b
T4	6.71±0.03b	7.56±0.01b	12.05±0.06cd	13.22±0.03cd	15.01±0.01cd	18.01±0.02cd

Mean values with different letters within the column were significantly different from each other at p<0.05

Table 3. Mean values of *T. tetraptera*seedling stem diameter in mm

Treatments	Weeks after transplanting					
	Week 2	Week 4	Week 6	Week 8	Week 10	Week 12
T0	1.31±0.01b	1.69±0.05b	1.88±0.03b	2.45±0.01b	2.99±0.01b	3.28±0.02b
T1	1.46±0.01a	1.81±0.03a	2.11±0.01a	2.91±0.04a	3.79±0.01a	4.84±0.05a
T2	1.27±0.02bc	1.61±0.04bc	1.80±0.01bc	2.39±0.02bc	2.66±0.03bc	2.98±0.02bc
T3	1.12±0.01c	1.49±0.02c	1.61±0.05c	2.11±0.01c	2.49±0.05c	2.61±0.02c
T4	1.01±0.01c	1.40±0.01c	1.58±0.01c	1.99±0.01c	2.38±0.01c	2.56±0.01c

Mean values with different letters within the column were significantly different from each other at p<0.05

Table 4. Mean values of *T. tetraptera* seedlings number of leaf

Treatments	Weeks after transplanting					
	Week 2	Week 4	Week 6	Week 8	Week 10	Week 12
T0	101.98±0.02b	142.45±0.05b	191.32±0.05b	219.06±0.01b	249.41±0.01b	257.09±0.08b
T1	135.22±.03a	198.89±0.01a	247.87±0.02a	271.09±0.04a	291.33±0.03a	315.01±0.04a
T2	121.31±0.02ab	173.75±0.01ab	209.11±0.05ab	256.48±0.02ab	271.35±0.01ab	288.56±0.02ab
T3	92.11±0.05c	108.98±0.01c	131.66±0.05c	167.01±0.01c	186.21±0.02c	194.22±0.03c
T4	91.98±0.02c	105.67±0.02c	127.81±0.02c	161.09±0.05c	179.99 ±0.01c	190.93±0.02c

Mean values with different letters within the column were significantly different from each other at p<0.05

Mean values of *T. tetraptera* seedlings stem diameter increased with weeks after transplanting (Table 3). It was observed that *T. tetraptera* seedlings in topsoil with 10g of green manure (T1: 1.46 -4.84 mm) has the highest mean values of stem diameters in all the weeks followed by those grown in T0 (1.31 -3.28mm) while those in T3 (1.12-2.61mm) had the least values. Significant difference was also noticed among the treatments (T0, T2 and T3) ($p<0.05$).Numbers of leaf of *T. tetraptera* seedlings also increased with weeks after transplanting for all treatments (Table 4). The mean number of leaves after transplanting were T0 (101.98-257.09), T1 (135.22-375.01), T2 (121.31-288.56), T3 (92.11-194.22) and T4 (91.98-190.93). Results indicated that treatments from green manure had the highest production of leaves followed by control while inorganic fertilizer had the least values. Significant difference was also noticed among the treatments ($p<0.05$). Generally, the better growth performance of *T. tetraptera* seedlings observed in *leucocephala*'s leaf powder mixture to others may be due to the availability of nutrients in the green manure which was released to the soil, thus improving the soil chemical and physical properties and enhance crop growth and development (Dauda *et al.,* 2008; Uko *et al.,* 2009). The significant recital of organic (green manure) over the control and inorganic fertilizer on growth of seedlings could be attributed to the essential nutrient elements present *L. leucocephala*'s leaf powder that are associated with high photosynthetic activities which in turn promote vigorous growth (Idem *et al.,* 2012). The result of this finding agreed with the work of Akintola et al (2021) where higher significant difference were obtained in the growth parameters of S. *biafrae* seedlings grown in organic manure than the inorganic fertilizer mixture and control soil. However, the result of study is higher than what was obtained by Usman *et al* (2019) using topsoil, sawdust and river stand. The significant growth performance of *T. tetraptera*seedlingsmay be attributed to high nutrient contents in the L. *Leucocephala's* leaf powder may influence the growth performance of the studied tree species.This study also buttressedthe findings of Imogie et al. (2008) that *L. Leucocephala* recycles nutrients and maintain the soil fertility through biological processes. This work has thus proven the efficacy of L. *Leucocephala's* leaf powder as green manure for adequate growth of *T. tetrapteras*eedlings in the nursery.

Conclusion: The mixture of Leucaena *leucocephala*'s leaf powder showed significant effect on the heights, stem diameter and number of leaf of *T. tetraptera* seedlings than the inorganic fertilizer and the control media. The amount of Leucaena *leucocephala*'s leaf powder also affected the growth performance of *T. tetraptera* seedlings. This study has thus showed that application of Leucaena *leucocephala*'s leaf powder as green manure has proven effective on growth performance and development of T. *tetrapteras*eedlings.

REFERENCES

Abii, TA; Elegalam, A (2007). Investigation into the chemical composition of dry fruit of Tetra pleuratetraptera (Ubukirihu). *J. Food Techno.* 3:229-232

Aderounmu, AF; Akintola, OO; Shittu, AJ; Adeniran, T; Abodunrin, EK; Agboola, F. ;Olokeogun, O (2020).Phytochemical analysis of barks leaves and roots of *Tetrapleuratetraptera, Treculia Africana* and *Dacryodesedulis*tree species. Technical reports, Forestry Research Institute of Nigeria, P22

Akachuku, AE (1997). Prospects and constraints of biodiversity. in: Ayua, IA and Ajayi, O(eds).Implementing the Biodiversity Convention, Nigerian and African perspectives. Nigerian Institutes of Advance Legal Studies, Lagos.Pp138-152

Akachuku, AE (1999). Prospects and constraints of biodiversity conservation in South-Western Nigerian. In: PC. Obiaga, J.E. Abu (eds).Natural Resources and Threatened Environment .Proc. Forestry Ass. Nigeria pp.200-211

Akintola, OO; Abiola, IO; Akinola, OO; Babatunde, KO; Ekaun, AA; Olajiire-Ajayi, BL (2021). Effects of Organic and Inorganic Fertilizers on the Growth of Seneciobiafrae (WOROWO) OLIVE & HIERN. *J. Appl. Sci. Environ. Manage.* 25 (2):145-149

Cherfi, A; Achour, M; Cherfi, M; Otmani, S; Morsli, A (2015). Health risk assessment ofheavy metals through consumption of vegetables irrigated with reclaimed urban waste waterin Algeria. *Proc. Saf. Environ. Protec*. 98:245-252

Dauda, SN; Ajayi, FA; Ndor, E(2008). Growth and yield of water melon (*Citrulluslanatus*) as affected by poultry manure application *J. Agric. Soc. Sci.* 4: 121 – 124

Dinnes, DL; Karlen, DL; Jaynes, DB; Kaspar, TC; Hatfield, JL; Colvin, TS; Cambardella, CA(2002). Nitrogen management strategies to reduce nitrate leaching in tile-drained midwestern soil. *Agron. J.*94:153–171

Erkovan, HI; Erkovan, S; Memur, M; Erdem, E; Koc A (2015). Response of the seedlingsof four cool-season grasses to plant growth-promoting bacteria and mycorrhizae in two differentsoils. *Fresen. Environ. Bull.* 24: 1673-1678

FRIN (2016). Forestry Research Institute of Nigeria, Metrological Report.

Idem, NU; Ikeh, AO; Asikpo, NS; Udoh, EI. (2012). Effect of organic and inorganic fertilizer on growth and yield of fluted pumpkin (*Telfariaoccidentialis*, hook f.) in Uyo, AkwaIbom State, Nigeria. *J. Agric. Soc. Res.*12(2):75-84

Imogie AE, Udosen CV, Ughah MM; Utulu SN (2008). Long term effect of Leucaenaleucocephala on soil physic-chemical properties and fresh fruit bunch (FFB) production of oil palm, African *J. Plant Sci*.2 (11): 129-132

Ojewale, J. A., and Adewumi C. O., (2004). Anti-inflammatory and hypoglyceanic effectsof T.tetraptera (Thaub), Fabaceae fruits Aqueous Extract inrats.*J. ethnopharmacol*.95:177-182

Okoroafor, I; Okelola, E; Edeh, O; Nemehute, V; Onu, C; Nwaneri, T; Chinaka, GE (2013). Effect of organic manure on the growth and yield performance of Maize in Ishiagu, Ebonyi State, Nigeria. *IOSR J. Agric. Vet.Sci.* 5: 28–31.

Olajide, E and Udo, EO(1997).Exploiting and developing the potentials of forest plant ofimportance in food production. *Appl.Res.* 2(3): 233-250

Oruwa, C; Mutua, A; Kindt, R; Jamnadass, R; Simons, A (2009): Agro-forest treedatabase:a tree reference and selection guide. Version 4.0. (http:www.worldagroforestry.org/af/treedb/. Retrievedon 10/03/2021

Power, JF(1990). Use of green manures in the Great Plains. In: Havlin, JL; Jacobsen, JS. (Eds.), Proceedings of the Great Plains Soil Fertility Conference, Denver, CO. 6–7 March. Kansas State University, Manhattan, KS, P18

Robertson, GP; Paul, EA; Harwood, RR (2000). Greenhouse gases in intensive agriculture: contributions of individual gases to the radioactive forcing of the atmosphere. *Sci*.289: 1922–1925

Sanginga, NK; Mulonogy, M; Ayanaba, A (1998). Response of Leucaena /RizobiumSymbiosis to mineral nutrient in Southern Western, Nigeria. *Plan. Soi. J*.112:121-128.

Schmid, F; Moser, G; Müller, H; Berg, G. (2011). Functional and structural microbial diversity in organic and conventional viticulture: organic farming benefits natural biocontrol agents. *Appl. Environ. Microbiol*. 77(6): 2188-2191.

Smith, MS; Frye, WW; Varco, JJ (1987). Legume winter cover crops. *Adv. Soil Sci*. 7:95–139.

Tejada, M; Gonzalez, JL; García-Martínez, AM; Parrado, J (2008). Application of a green manure and green manure composted with beet vinasse on soil restoration: Effects on soil properties. *Biores. Technol*. 99: 4949–4957.

Tuner,IM (2001). The ccology of trees in the tropical rainforest. CambridgeUniversity.Press, Cambridge, UK.P 298

Uko, AE; Udo, IA; Shiyam, JO (2009) Optimizing poultry manure rates for two okra (*Abelmoschhusesculentus*) varieties in a warm wet climate. *J. Agric. Biotech. Ecol.*, 2(3): 273 – 285.

Usman, IA; Uleh, M; Onyeri, CD (2019). Germination and Growth response of *Tetrapleuratetraptera*(Shum and Thonn) Taub to Different Growth media. *Sustain. Agric. Food Environ. Res.* 7(3): 241-250.

Verbruggen, E; Röling, WF; Gamper, HA; Kowalchuk, GA; Verhoef, HA; van der Heijden, MG (2010). Positive effects of organic farming on below-ground mutualists: largescale comparison of mycorrhizal fungal communities in agricultural soils. *New Phytologist*. 186(4): 968-979.

Warren, MW; Zoux, IO. (2002).Soil macrofauna and litter nutrients in three tropical tree plantations on a disturbed site in Puerto Rico. *Forest Ecol. Manage*. 170: 161–171

WHO (2003). World Health Organization Fact Sheet No. 134 Traditional Medicine URL: http://www.who.int/mediacentre/factsheets/fs134/en/. Accessedon 10th march, 2021.