EARLY GROWTH RESPONSES OF *TECTONA GRANDIS* L. f. TO LOCALLY MANUFACTURED LEGUME-BASED ORGANIC FERTILIZER

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ABSTRACT
A field trial was conducted to evaluate growth responses of *Tectona grandis* L.f seedlings to a locally manufactured legume-based organic fertilizer at Umudike, Abia State, Nigeria. Three (3 weeks old vigorous seedlings of *T. grandis* which was raised in the nursery of Department of Forestry and Environmental Management , Michael Okpara University of Agriculture Umudike (MOUAU) were used for the experiment. There were four treatments consisting of legume-based organic fertilizer 15 t/ha, N.P.K 15:15:15 2500 kg/ha, complimentary application of organic manure 7.5t/ha and NPK 1250 kg/ha (i.e. 1/2 OM + 1/2NPK) and a control (no fertilizer). The experiment was laid out in a randomized completely block design in 3 replication and monitored for 10weeks. Data were collected weekly on growth variables of plant height, collar diameter and number of leaves for six weeks (from four weeks after germination (4 WAG) to ten weeks after germination (10 WAG)). Collected data were subjected to descriptive and inferential statistics such analysis of variance (ANOVA). Mean separation was conducted using $LSD_{0.5}$. At the end of the experiment, 9 weeks after planting (9wap), the seedlings treated solely with legume-based organic fertilizer recorded significantly ($P<0.05$) highest seedlings height (10.2cm), Collar diameter (1.4cm), and number of leaves (10) than the other treatments. The control treatment had correspondingly least values for the various parameters (7, 0.8 and 9 cm) respectively. The use of the fortified organic fertilizer significantly ($P<0.5$) favoured the early growth of *T. grandis* and therefore is recommended for management of forest nursery for healthy growth and production.
Key words: *Tectona grandis*, soil fertility and legume-based organic fertilizers, growth

INTRODUCTION
Tectona grandis commonly known as Teak is a deciduous tree found in mixed hardwood forest or in a deciduous forest. It is used for soil conservation and improvement (Agbogidi and Onomeregbor, 2007). The tree makes an important contribution to the economy by providing timber, pole, wood, etc. and also helps in regulating the degraded land and environmental pollution (Etukudo, 2000; Agbogidi *et al.*, 2008). The tree crop became essential to forestry due to the multiple benefits -both socioeconomic and ecological- to man and the high demand for the species. Hence the continuing searches for methods of enhancing their growth and productivity. Soil degradation has led to the disappearance of some indigenous species and causing difficulty in growing some seedlings (Nwoboshi, 1985; Etukudo, 2000). Together with deforestation and population pressure the low germination rate and lack of knowledge of silvicultural requirement for germination and growth has remained a problem to indigenous trees in Nigeria. Seed germination and early seedling growth phases are considered critical for raising a successful crop as they directly determine the crop stand density and consequently the yield of resultant crop. It is indicated that the seed germination, seedling growth and survival percentage in the nursery are governed by many intrinsic and extrinsic factors which include the nutrient component of the soil.

The use of organic manure has played a significant role in the growth of some forest and agricultural species. Organic fertilizers: rice mill waste manure (RMM), swine waste manure (SWM), poultry manure (PM), compost, among others have been used for crop production for centuries. The use of these forms of fertilizers certainly pre-date chemical (mineral) fertilizers and is currently being encouraged. In contrast to chemical fertilizer, it adds organic matter to soil which improves soil structures, nutrient retention, aeration, soil moisture holding capacity and water infiltration (Deksissa *et al.*, 2008), and they are more environmentally friendly, since they are of organic source.

In spite of the numerous economic uses of *T. grandis,* documented reports on cultivation and seedling growth of this multipurpose tree known commonly as African mahogany are scarce. In addition, the high demand for *T. grandis* leaves, seeds, roots and barks for various uses has resulted in corresponding increase in the exploitation at such a rate that sustainability of this natural resource cannot be guaranteed. If the benefits derivable from *T. grandis* must continue especially to the future generations, there is the need to stimulate farmers' interest in the cultivation of *T. grandis* including techniques for successful nursery management practices for enhanced growth of the species. This will help to reduce poverty.

MATERIALS AND METHOD

Study Area

The experiment was carried out at the Nursery Unit of the Department of Forestry and Environmental Management (FOREM), Michael Okpara University of Agriculture Umudike (MOUAU), Abia State. Umudike is located between latitudes 5^0 31'N to $6^0$17' N and longitudes $7^0$11'E to $8^0$10' East in the lowland rain forest zone of southeast Nigeria,at an elevation of 122 meters above sea level (Nwosu *et al.*, 2011) (Fig. 1).

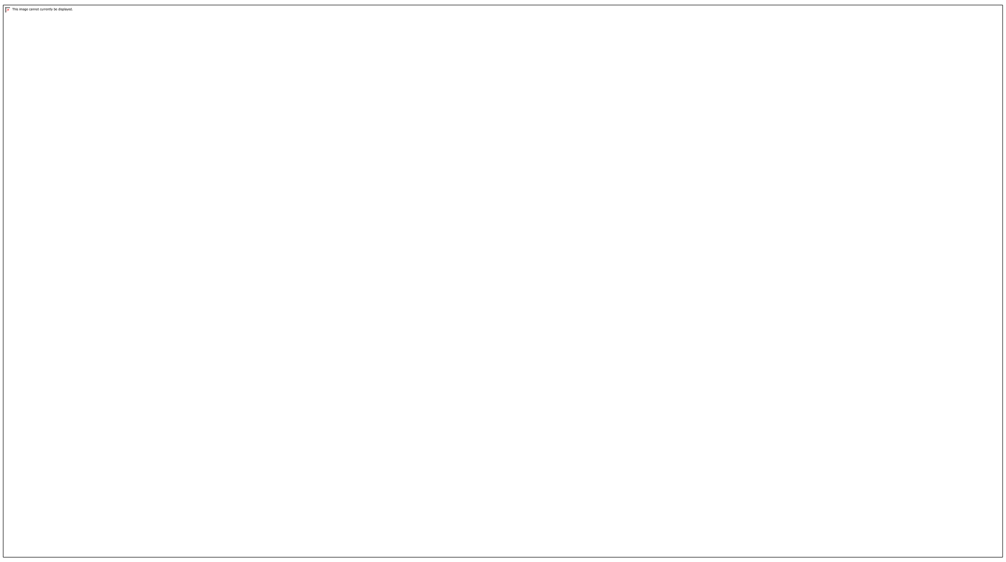

Fig. 1. Map of Ikwuano LGA showing location of FOREM Nursery in MOUAU, Abia State.

Climate is essentially humid tropical. Though the vegetation is typical rainforest, much of the forest estate have been destroyed leaving behind few patches of forest stands (Akachuku, 2006). The zone is characterized by two distinct seasons: the rainy season from March/April to October with bimodal peaks (June and September) by a short break in August, and a dry season from November to March (Audu *et al*., 2008). Annual rainfall ranges from 1800mm to 2200mm with the intensity reaching up to $100mmhr^{-1}$ (Audu *et al*., 2008, Nwosu *et al.*, 2011). Temperature is high throughout the year with a range of 33^0C -35^0C as the maximum and 28^0C to 29^0C as minimum (Nwosu *et al.*, 2011), while relative humidity varies from 51% to 87%. The soil is acidic sandy loam in the ultisol and haplic acrisol group (Enwezor *et al*., 1990; Omenihu *et al*., 2011). Agriculture is the major occupation of the people especially in the rural areas, and involves over 70% of the population.

***Tectona grandis* Seeds:** The seeds of *Tectona grandis* were collected from a Teak parent plant at the back of department of forestry and environmental management. After picking the fallen seeds, the chaff was sieved off and the seed viability was tested using the floatation method. Viable seeds were soaked in water for seven days before planted.

Fertilizers: NPK 15:15:15 and a locally manufactured organic fertilizers were used. The organic fertilizer was produced from composting a mixture of the vegetal matter of *Lablab purpureus,* a leguminous plant with ricehusk, poultry manure and swine dung in the ratio 5:4:4:4. The mineral element composition of the organic fertilizer has been determined at the laboratory of the National Root Crops Research Institute (NRCRI) Umudike, Abia State and reported by Nwajiobi *et al.*, 2020).

Top soil and poly pots: Top soil was collected from fallow farm land besides the Nursery Unit of FOREM using spade, after clearing and weeding. The collected topsoil soil was bulked, properly mixed and sieved to remove large particles, roots and debris. The composite soil sample was analyzed for physico-chemical properties at the Soil Laboratory of the National Root Crop Research Institute (NRCRI),Umudike, using standard methods of soil analysis according to Udo *et al.* (2001). Eight grams (8g) of the soil was collected into poly pots measuring 35cm × 30cmfor the experiment. A total of ninety eight (98) poly pots measuring 35cm × 30cm were used for planting for the experiment

Experimental Layout: The experimental site was cleared manually. Poly pots measuring 17cm x 8cm containing appropriate treatment growth media were subsequently arranged on the plot in a Randomized Complete Block Design in three replications. With sample size of nine (9) plants per treatment, a total of 108 poly-pots were used for the experiment (Table 1 and Plate 1).

Table 1. Experimental treatments

Treatment	Description
1.	15t/ha Organic Fertilizer
2.	7.5t/ha NPK+12.5kg/ha of Organic Fertilizer
3.	2500kg/ha NPK 15 15 15
4.	Control (No Fertilizer Application)

Plate 1. Teak seedlings in the experimental plot.

Seed Sowing: Three Teak seeds were planted per poly pot at 2-3cm depth and 5cm apart, which were thinned to one seedling at 14 days after planting (DAP).

Cultural Practices: Watering was done once, in the evenings, daily. Weeds were hand-picked from the pots, while the space between the blocks and treatments were weeded with hoe.

Data Analysis: Data collected of the growth parameters were subjected to Analysis of Variance (ANOVA). Mean Separation was done using the Fishers Least Significance Difference at P<0.05.

RESULT AND DISCUSSION

Effects of organic manure and NPK on the height (cm) of *Tectona grandis*

The result (Fig. 1) shows that the height growth of *T. grandis* significantly varied with the treatments from the 4th week to the 9th week. In all the weeks, the sole organic fertilizer-treatment recorded significantly highest growth in height than all the other treatments except at week 4. At week 4, plant height of *T. grandis* treated with NKP fertilizer recorded the highest value of 4.2±0.05. Though it was not significantly different from the sole organic manure treatment (4.2±0.05), it was significantly higher than the NPK and Organic manure combination (3.4±0.02) as well as the control treatment (3.6±0.03). From the 5th week however, the organic fertilizer treatment grew significantly higher in height (5.7±0.01) than the NPK treatment (5.0±0.01) and this continue to the last (week9) of data collection. By week 6, the height of NPK - organic fertilizer combination treatments (5.8±0.05) was no longer less than the NPK treatment (5.7±0.03). In fact, from the 7the week, height of plant treated with NPK-organic fertilizer combination has become significantly higher than the NPK treatment, and this continued to the last week of data collection. The higher plant height of the NPK treatment than the organic fertilizer treatment and the NPK-Organic fertilizer treatment at the early week of data collection indicated a slow release of the nutrient to the plants with the organic fertilizer treatment and the NPK-Organic fertilizer treatment. This could be the reason that the plants treated with the organic fertilizer treatment and the NPK-Organic fertilizer treatment later grew to higher heights than the NPK treatment. The findings agree with Basso and Ritchie (2005), Akanbi *et al. (*2010), Quattara *et al*. (2008), Louisa and Taguiling (2013) and Chukwuka *et al.* (2014) that organic fertilizers supply the essential plant nutrients that enhances growth, development and optimum productivity of crops. It also supported Roy *et al*. (2006) who noted that concentrated organic manures are comparatively richer in NPK.

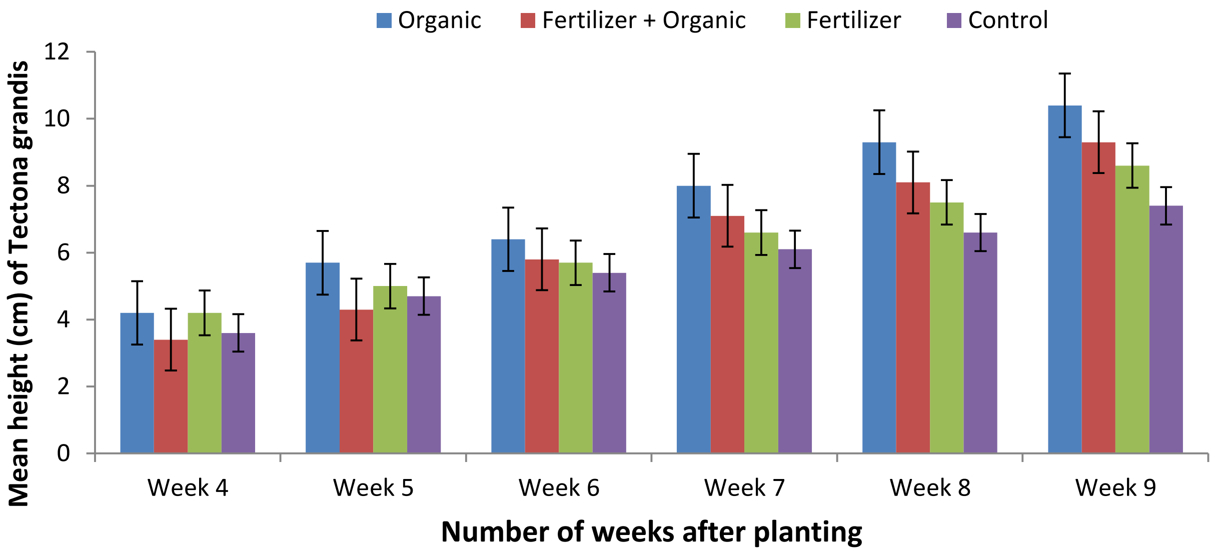

Fig. 1: Effects of organic manure and NPK on the height (cm) of *Tectona grandis*

Effects of organic manure and NPK on stem diameter (r) of *Tectona grandis*

The result show that there was no significant difference in the collar diameters of all the various treatments in the fourth and fifth week after germination. In the 6th week, only the organic fertilizer treatment had significantly higher collar diameter (0.8±0.05 cm) than all the other treatment. By the last week of data collection (week 9), the organic fertilizer treatment has significantly (P<0.05) highest collar diameter (1.5±0.05cm) that all other treatments, and was followed by the NKP-organic fertilizer combination treatment (1.3±0.01cm). Plant collar diameter was least in the control (0.9±0.28). However, there was no significant difference in the NPK and control treatments. The findings also support Basso and Ritchie (2005), Akanbi *et al.* (2010), Quattara *et al*. (2008), Louisa and Taguiling (2013), and Ibrahim and Fadni (2013) that organic fertilizers supply the essential plant nutrients that enhances growth, development and optimum productivity of crops; and that concentrated organic manures are comparatively richer in NPK (Roy *et al*., 2006).

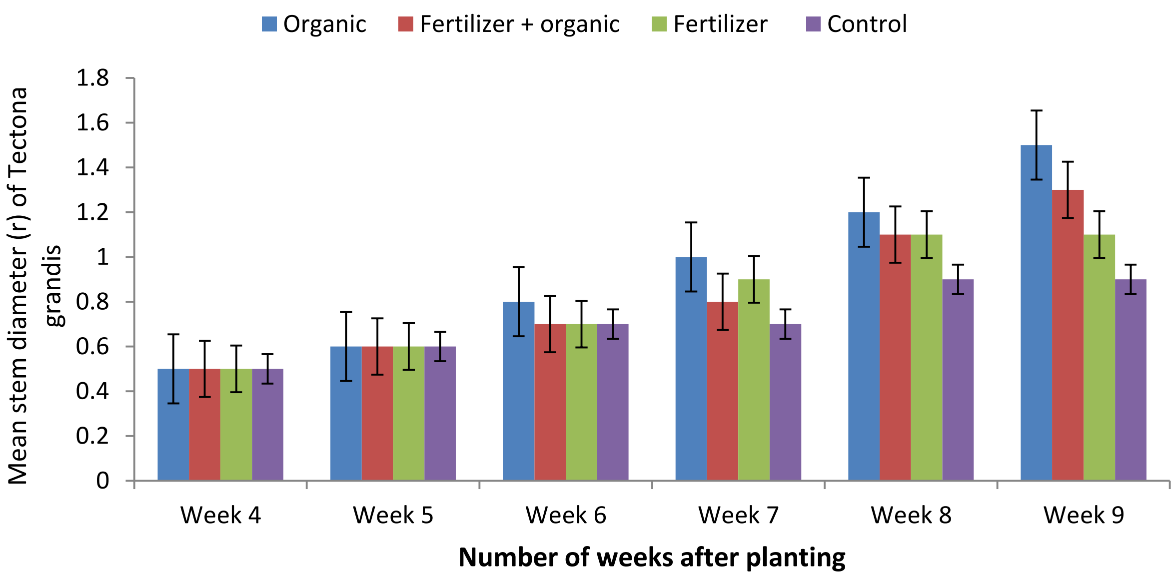

Fig. 2. Effects of organic manure and NPK on stem diameter (r) of *Tectona grandis*

Effects of the fertilizers on number of leaves of *Tectona grandis*

The control treatment recorded the least number of leaves throughout the period of data collection (Fig. 2). The organic fertilizer and the NPK + organic fertilizer, and the NPK treatments were not significantly different in the first three months of data collection. From the seventh month, however, the organic fertilizer treatment recorded significantly greater number of leaves than the NPK and the control treatments respectively. Only until the 8th and 9th week were the number of leaves of the organic fertilizer treatment (9.7±0.02 and 10.8±0.05) significantly greater than that of the NPK + organic fertilizer treatment (9.0±0.06 and 10.1±0.05 correspondingly). The slow release of nutrient by the organic fertilizers (Nwosu *et al.*, 2011, Adeniyan *et al.*, 2011; Uka *et al.*, 2013) could be the reason for the differences in the number of leaves of the organic fertilizer treatment from all othetr treatment at the later periods of data collection. Nevertheless, the result supported that Basso and Ritchie (2005), Akanbi *et al. (*2010), Quattara *et al*. (2008), Louisa and Taguiling (2013) and Chukwuka *et al.* (2014) that organic fertilizers supply the essential plant nutrients that enhances growth, development and optimum productivity of crops.

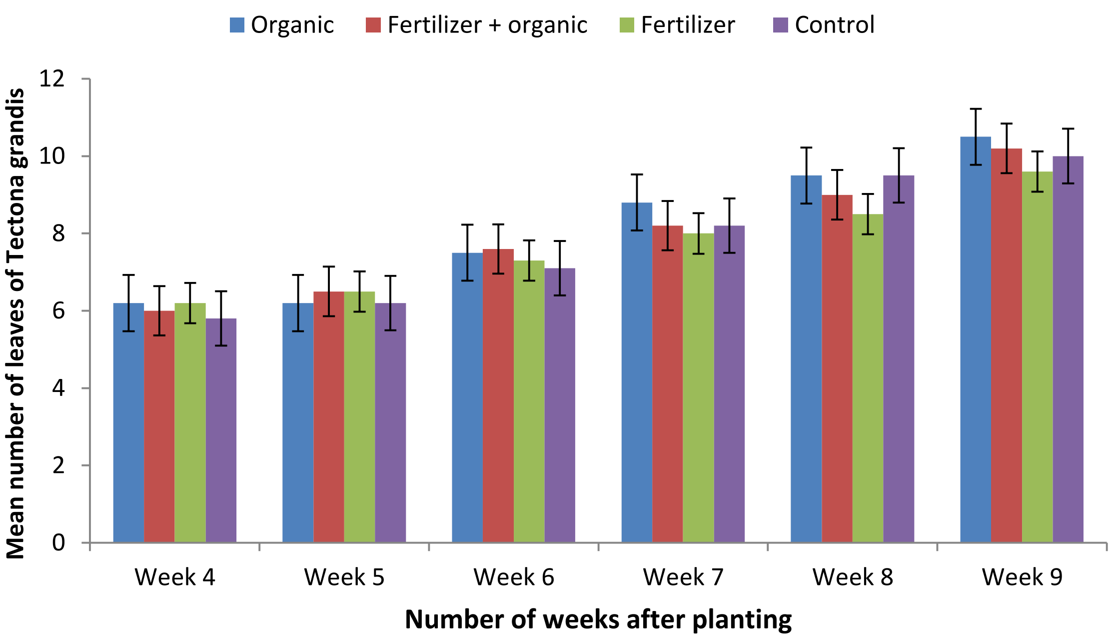

Fig. 3. Effects of the fertilizers on number of leaves of *T. grandis*

CONCLUSION AND RECOMMENDATIONS

Leguminous species are increasingly appreciated for their roles in especially animal nutrition, soil amendment and soil fertility enhancement. Nigeria is endowed with numerous underutilized leguminous species, many of which are growing in the wild as weeds. Few of these are only used as cover crops and for green manuring in improved fallow technologies.The vegetal matter of the legumes, as well as other agricultural wastes are rich in minerals and plant nutrient in varying composition. The use of these relatively abundant organic materials for organic fertilizer production has potentials for soil management, biodiversity conservation and agro-ecosystem stabilization in Nigeria. The legume-based organic fertilizer significantly improved Teak seedlings growth in the field trials. Hence the legume-based organic fertilizer should be recommended to foresters to significantly improve forest crop production. Forest practitioners are encouraged to also identify and use locally available organic materials for enhancing soil fertility rather than the overdependence on inorganic fertilization. Further studies are required especially with many other legumes species which are abundantly growing in the wild but of which their usefulness are not well known in order to enhance the conservation status of these species based on the conservation theory of use enhances conservation.

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