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# EFFECTS OF GRADED LEVELS OF ORGANIC AND INORGANIC FERTILIZERS AS AN AMENDMENT TO POTTED SEEDLINGS OF *Artocarpus heterophyllus* Lam.

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## ABSTRACT

*Artocarpus heterophyllus* is the tree bearing the largest fruit in the world and has not been widely cultivated in Nigeria. The study was carried out to investigate the effects of graded levels of organic and inorganic fertilizers on the growth of *Artocarpus heterophyllus* seedlings. The experimental design was completely randomized design consisting of 16 treatments including control and replicated 5 times. The treatments were 2, 4 and 6 g (composted household waste, fortified composted household waste, *Gliricidia sepium* leaves and *Leucaena leucocephala* leaves, respectively), 0.03, 0.05 and 0.07 g of urea and control (top soil only). 2 kg of soil was used for this experiment. Seedling height, collar diameter and leaf production of *A. heterophyllus* were assessed The result indicated no significant effect of the different graded levels of organic and inorganic fertilizers on the height, collar diameter and leaf production of the seedlings. The study has shown that *A. heterophyllus* is a fast growth species and do not require fertilizer application at the seedling stage. Thus, further studies should be carried out to determine the required quantity of fertilizers necessary for the good growth and yield of *A. heterophyllus* on the field in Nigeria.

**Keywords:** *Artocarpus heterophyllus*, early growth, fertilizer application, household waste, nutrients

## Introduction

Forest provides numerous goods and services to man such as medicine, food, wood, and fibers (Adewunmi *et al.*, 2014). It has added various values to the environment such as; maintenance of water supply, prevention of erosion and stabilization of climate, protection of the soil against radiation and excessive diurnal temperature fluctuations by the dense canopies of the trees in the forest (Nwoboshi, 1982; FAO, 2005). Production of healthy seedlings in the nursery in Nigeria and other developing countries is achieved by the addition of organic manure into nursery soil which has been common practice in recent time for the improvement of soil fertility. Addition of manure has been recognized as one of the effective silvicultural tools for raising healthy forest nursery stock and for hastening growth of trees in the plantation (Fagbenro and Adeola, 1981; Moyin – Jesu and Adeofun, 2008).

*Artocarpus heterphylus* which is commonly known as Jackfruit belongs to the family Moraceae, It is the largest fruit in the world and is one of the most significant trees in tropical home gardens and perhaps the most widespread and useful tree in the important genus Artocarpus (Elevitch and Manner, 2006). Jackfruit is a tropical tree valued for its heavy yields of nutritious fruits and durable timber. It is one of the potential new crops that have attracted increased interest in the world (Samaddar, 1990; Choy and Chan, 2005). The tree is reported native to India, Bangladesh and Nepal (ICUC, 2002). , spread and cultivated across the world. The tree is evergreen and monoecious. The compound or aggregate fruit is green to yellow when ripe with weight of 4.5 – 50 kg (Morton, 1987; Elevitch and Manner 2006).).

In Nigeria, the cultivation of *A. heterophyllus* has not been encouraged, though it is found in the south-coastal parts of the country where it grows wild or semi-conserved (Ajayi and Adewale, 2013) and in this area, the seeds are collected, boiled and eaten by children. However, this practice has stopped and the seeds now substantially go to waste (Bello and Olawore, 2012) and the species not widely cultivated (Bello *et al.*, 2008). Little or no information has been reported on the nutrient requirement for seedlings of *A. heterophyllus*. This study will aid the selection of the most appropriate type and quantity of fertilizer that will facilitate the optimal seedling growth performance of the species. Due to the importance of this species, information on how to produce healthy seedlings of this species could be of great value for reforestation effort in Nigeria.

## MATERIALS AND METHODS

The study was carried out at the Nursery site of the Department of Sustainable Forest Management (SFM), Forestry Research Institute of Nigeria (FRIN), Jericho Hill, Ibadan,

Nigeria. FRIN is located on the longitude $07^0$23'18"N to $07^0$23'43"N and latitude $03^0$51'20"E to $03^0$51'43"E. The climate of the study area is the West African monsoon with dry and wet seasons. The dry season is usually from November through March and is characterized by dry cold wind of harmattan. The wet season usually starts from April to October with occasional strong winds and thunderstorms. Mean annual rainfall is about 1548.9 mm, falling within approximately 90 days. The mean maximum temperature is $31.9^0$C, minimum $24.2^0$C while the mean daily relative humidity is about 71.9% (FRIN, 2015)

Fruits of *A.heterophyllus* were collected from the mother tree in the botanical garden, University of Ibadan, Oyo State. Then, *A. heterophyllus* fruits were cut opened with knife, seeds were separated from the fleshy sheaths that enclose the seeds. The thin, slimy coating around the seed (perianth lobe) was removed and the seeds thoroughly rinsed in water to remove any remaining pulp juice or sugary residue. Seeds were air-dried for about an hour for ease of handling. A total of one hundred and fifty (150) seeds of *A. heterophyllus* were sown in germination trays containing river sand. Two weeks after germination, eighty (80) seedlings of *A. heterophyllus* with four leaves were selected for this experiment.

Top soil was collected from FRIN. The topsoil was analyzed to know the nutrient status of the soil (Table 2). The result obtained guided the use of the fertilizers.

Compost house hold waste (CMA) and Fortified compost house hold waste (CMA3) was collected from Waste to Wealth Industry at Aleshinloye Market, Ibadan, Oyo State. Urea was also procured from Aleshinloye Market, Ibadan, Oyo State. Leaves of *Gliricidia sepium* and *leucaena leucocephala* were collected from the arboretum of FRIN. The leaves of *G. sepium* and *L. leucocephala* were air dried for 2 weeks, after which they were grinded and sieved to remove shafts.

The experiment design adopted was Completely Randomized Design (CRD) with sixteen (16) treatments replicated five (5) times.

At four-leaf stage, a total of 80 uniformly growing seedlings were pricked out and planted into polythene pots (24 x 22 cm) filled with the 2 kg topsoil and the various graded levels of fertilizers. The graded levels of fertilizers are as follows; 2, 4 and 6 g of composted household waste (CMA); 2, 4 and 6 g of fortified composted household waste (CMA3); 2. 4 and 6 g of *G. sepium* leaves (CGS); 2, 4 and 6 g of *L. leucocephala* leaves; 0.03, 0.05 and 0.07 g of Urea and control (without fertilizer). Watering was done every morning. Growth variables assessment commenced at two weeks after transplanting for the period of three (3) months. Growth variables that were assessed are plant height (cm), collar diameter (mm) and leaves production. Plant height was measured with meter rule from the soil surface to the highest leaf. The leaves production per seedling was obtained by counting. Collar diameter was measured at the base of

the stem with vernier caliper. Data were subjected to Analysis of Variance (ANOVA) to compare the effects of the different treatments on early growth performance of *A. heterophyllus* seedlings. Results were presented in tables and figures.

Table 1: Fertilizers and there rates.

| Treatments | Amendments | Rate/2kg top soil | Equivalent/hectare. |
|---|---|---|---|
| 1 | CM $A_1$ | 2g | 2 tons |
| 2 | CM $A_2$ | 4g | 4 tons |
| 3 | CM $A_3$ | 6g | 6 tons |
| 4 | CM $A3_1$ | 2g | 2 tons |
| 5 | CM $A3_2$ | 4g | 4 tons |
| 6 | CM $A3_3$ | 6g | 6 tons |
| 7 | C G. $S_1$ | 2g | 2 tons |
| 8 | C G. $S_2$ | 4g | 4 tons |
| 9 | C G. $S_3$ | 6g | 6 tons |
| 10 | C L. $L_1$ | 2g | 2 tons |
| 11 | C L. $L_2$ | 4g | 4 tons |
| 12 | C L. $L_3$ | 6g | 6 tons |
| 13 | $Urea_1$ | 0.03g | 30kg |
| 14 | $Urea_2$ | 0.05g | 50kg |
| 15 | $Urea_3$ | 0.07g | 70kg |
| 16 | Control | No application | No application |

Treatment 1- 12 = Organic fertilizers, Treatment 13-15 = Inorganic fertilizer, CMA= Composted house hold waste, CMA3= Fortified Composted house hold waste, C.G.S= *Gliricidia sepium* (Green manure) C.L.L=*leucaena leucocephala* (Green manure)

## RESULTS AND DISCUSSION

### Soil and organic fertilizer analysis

The result of topsoil and organic fertilizers shows that the status of nitrogen is higher in Urea compared to the amount of nitrogen in the soil and other fertilizers. The available phosphorus is very high in the soil compared to the phosphorus in the fertilizers applied while amount of potassium in the soil was very low compared to the potassium in the fertilizers applied (Table 2).

Table 2: Initial properties of soil and the Amendments analysis

| Parameters | Soil | CMA | $CMA_3$ | G.S | L.L | Urea |
|---|---|---|---|---|---|---|
| pH($H_2O$) | 6.4 | 6.75 | 6.46 | - | - | - |
| Organic C (%) | 1.32 | 27.7 | 29.76 | - | - | - |
| Total N (%) | 0.131 | 3.5 | 3.54 | 3.47 | 3.86 | 46 |
| Avail P (mg/kg) | 32.4 | 3.0 | 1.68 | 0.08 | 0.08 | - |
| C/N | - | - | - | - | - | - |
| K (%) | 0.35 | 2.0 | - | 1.46 | 1.29 | - |
| Ca (cmol/kg) | 7.17 | 23.26 | - | 1.08 | 1.09 | - |
| Mg (cmol/kg) | 1.96 | 0.19 | - | 0.34 | 0.41 | - |
| Na (cmol/kg) | 0.17 | 35 | - | - | - | - |
| Mn(ppm) | 186.23 | 93.34 | - | - | - | - |
| Fe (ppm) | 93.71 | 71.52 | - | - | - | - |
| Cu (ppm) | 1.84 | 14.97 | 4.2 | - | - | - |
| Zn (ppm) | 35.99 | 1.53 | 3.28 | 50.17 | 37.05 | - |
| Cd (ppm) | - | - | 1.36 | - | - | - |
| Cr (ppm) | - | - | 11.18 | - | - | - |
| Ni (ppm) | - | - | 9.3 | - | - | - |
| Textural class | Sandyloam | - | - | - | - | - |

CM (A) = Fortified organic fertilizer, CM($A_3$) = Organo mineral, G.S= *Gliricidia sepium*, L.L= *Leucenia leucocephala*

**Seedling height**

Analysis of Variance (ANOVA) indicated that there were no significant differences ($p>0.05$) among the fertilizers applied (Table 3). The mean seedlings height for all treatments ranged between 53.70 to 66.33 cm with the highest mean height from seedlings grown with Urea of 0.05 g and the least height obtained from seedlings grown with CLL of 6 g (Figure 1).

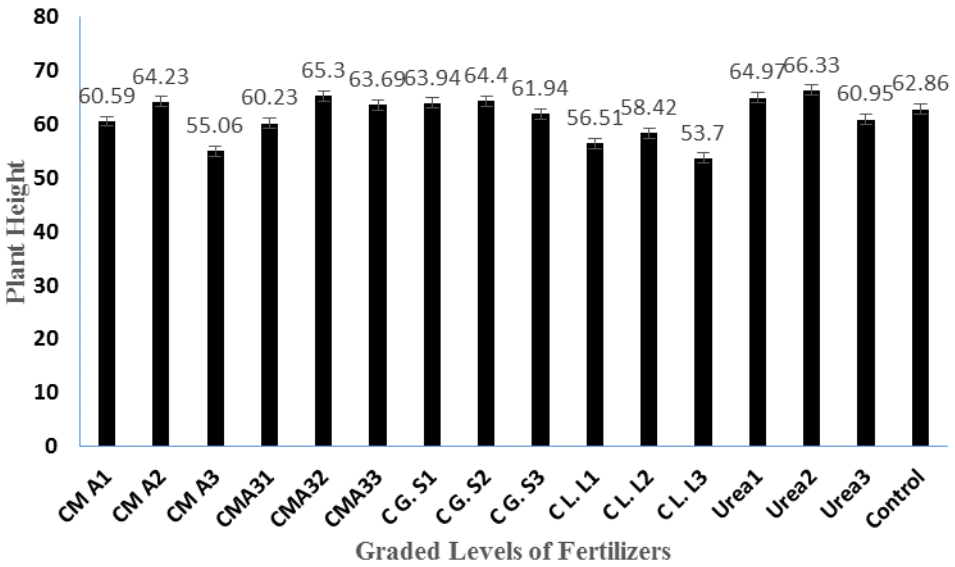


Figure 1: Effect of different fertilizer application on the height of *A. heterophyllus* seedlings

Table 3: ANOVA result for the effect of different fertilizer application on the height, collar diameter and leaves production of *A. heterophyllus*seedlings

| Variable | SV | df | SS | MS | F | Sig. |
|---|---|---|---|---|---|---|
| Height | Fertilizer application | 15 | 1089.07 | 72.60 | 0.68 | $0.79^{ns}$ |
| | Error | 64 | 6835.14 | 106.80 | | |
| | Total | 79 | 7924.21 | | | |
| Collar Diameter | Fertilizer application | 15 | 10.78 | 0.72 | 0.76 | $0.72^{ns}$ |
| | Error | 64 | 60.60 | 0.95 | | |
| | Total | 79 | 71.38 | | | |
| Leaves Production | Fertilizer application | 15 | 46.33 | 3.09 | 1.11 | $0.36^{ns}$ |
| | Error | 64 | 177.68 | 2.78 | | |
| | Total | 79 | 224.01 | | | |

**ns- not significant (p>0.05)**

**Seedling Collar Diameter**

The mean seedling diameter ranged from 5.73 to 7.27 mm with the highest mean observed for the seedlings grown with CMA of 2 g and the least mean diameter obtained from seedlings grown with CLL of 6 g (Fig. 2). The various levels of fertilizer applications did not significantly (p>0.05) affect the growth in diameter of the seedlings of *A. heterophyllus* (Table 3).

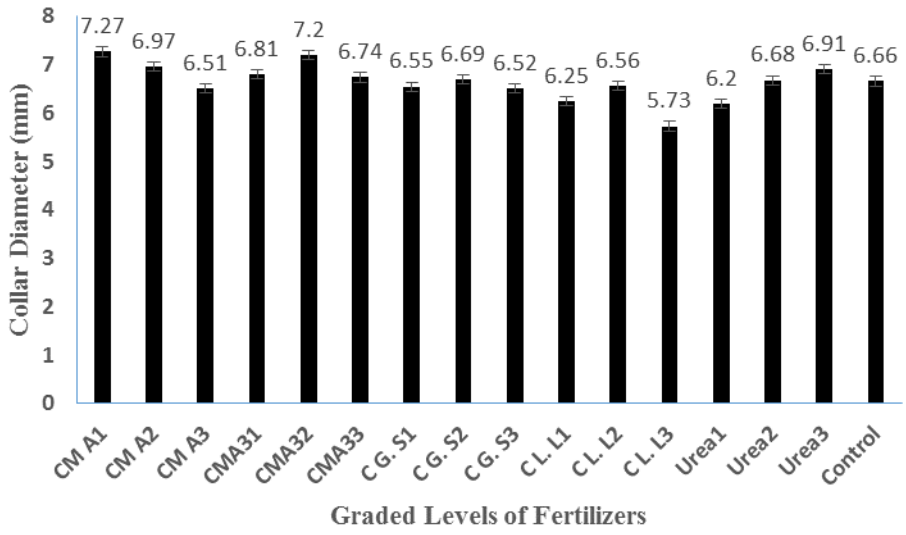


Figure 2: Effect of different fertilizer application on the collar diameter of *A. heterophyllus* seedlings

**Leaf Production**

The leaf production increased with increase in age of the seedlings. Mean leaf production ranged from 8 to 12 with the highest recorded for seedlings grown with CMA of 6 g while the least production from CLL of 6 g (Fig. 3). However, ANOVA for leaf production revealed that there were no significant difference (p>0.05) among different fertilizers applied to *A. heterophyllus* seedlings (Table 3).

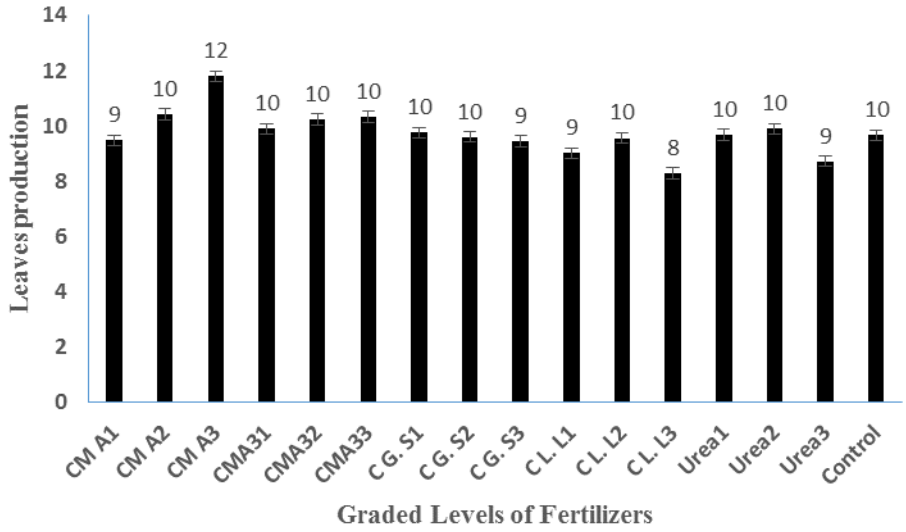


Figure 3: Effect of different fertilizer application on the leaf production of *A. heterophyllus* seedlings

## DISCUSSION

Fertilizer requirement of species differs, as such, effort must be made to identify the appropriate fertilizer preference of any species (Offiong *et al.*, 2010). The result on the height, collar diameter and leaf production of *A. heterophyllus* seedlings in this study is in correlation with the findings of Adepoju *et al*. (2016) who reported that the different levels of fertilizers applied did not significantly affect the height, collar diameter and leaf production of *Entandrophragma angolense* seedlings and also in agreement with the work of Okunomo (2010) who reported that the organic manures applied did not significantly affect the collar diameter and leaf production of *Tetrapluera tetraptera* seedlings. However, application of 0.05 g of urea increased the growth height of the seedlings. This might be due to the higher amount of nitrogen present in the urea. This is in line with the work of Offiong *et al*. (2010) who observed that nitrogen increased growth height of *T. tetraptera* seedlings. Higher rate of urea over 0.05 g did not increase the growth in height of the seedlings of *A. heterophyllus*. This agrees with the reports of Okeke and Omeliko (1999) on the depressive effect of 150 kghN/ha on the growth of *Dialium guineense* seedlings. The result obtained in this study might be due to ability of *A. heterophyllus* seedlings to utilize the food in the seed at seedling stage thereby not really making use of the fertilizers applied as there was no significant difference in the parameters assessed despite the application of fertilizers.

## CONCLUSION

The results of the study showed that application of different fertilizers did not have significant differences in terms of height, collar diameter and leaf production of *A. heterophyllus* seedlings. Since urea performed best in terms of height and composed household waste performed best in terms of collar diameter and leaf production, any of these two fertilizers can be added to the forest topsoil in the nursery to enhance the growth of *A. heterophyllus* seedlings. The study has shown that *A. heterophyllus* is a fast growing species and require little or no fertilizer application at the seedling stage. Thus, further studies should be carried out to determine the required quantity of fertilizers necessary for the good growth of *A. heterophyllus* on the field in Nigeria

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