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EFFECT OF ORGANIC AND INORGANIC FERTILIZERS ON THE SHOOT GROWTH OF *Irvingia wombolu* Vermoesen

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ABSTRACT

This study investigated the effect of two levels of organic and inorganic fertilizer on the shoot growth of the *Irvigia wombolu* planted on a 46m x 36m square plot in the arboretum of Forestry Research Institute of Nigeria Ibadan. This field trial was established in 2010 to observe the response of the tree to applied treatments in order to enhance its management. The study involves a 2 x 2 factorial in Completely Randomized Design (CRD) with three replicates. The factors include A: NPK 15-15-15 and B: Sun-dried Poultry manure, applied at levels A_0 (0kg NPK 15-15-15 /ha), A_1 (30kg NPK 15-15-15 kg/ha), B_0 (0 t Sun Dried Poultry manure /ha) and B_1 (2.5t Sun Dried Poultry Manure /ha. Data collection (Height (Ht), Root Collar Diameter (RCD) and the Crown Diameter (CD)) were made at the end of December on yearly basis. Data collected for three consecutive years (2013, 2014 and 2015) were subjected to Analysis of variance at a = 0.05. The results showed that there were no significant differences within each of the years for all the growth parameters. This also revealed that the growth of *I. wombolu* from the treated plots were similar to control though the magnitude of the treatments means generally indicated that A_1B_0 was the highest followed by A_1B_1, A_0B_0 and A_0B_1. Hence, for effective management and to increase productivity of *I. wombolu* on the Alfisol of southwestern Nigeria, inputs with higher proportion of N and P should be considered during fertilizer application.

Keywords: *Fertilizer, Growth, levels, Height.*

Introduction

Irvingia wombolu commonly called bush mango or dika nut is an important high-value indigenous multi-purpose tree species found in West and Central Africa (Harris, 1996; Lowe, *et al*., 2000; Atangana, *et al*., 2002). These species produce the edible nuts widely marketed within and outside the region (Leakey, 1999; Ladipo, 2000) and form an important diet providing carbohydrates, oils and proteins to enhance health and nutrition (Fajimi, *et al*., 2007); it is highly beneficial not only to the farmers but to the whole human race as food (for instance "Ogbono soup", a popular delicacy in Southern Nigeria), medicine and timber, among others. Constraints

to domestication of the species include the long gestation period of the trees raised from seeds (Moss, 1995; Ladipo, *et al*., 1996), poor germination capacity (Nya, *et al*., 2000) variability of fruits and kernel characteristics, variability in tree size (Ladipo, *et al*.,1996, Schreckenberg, *et al*., 2001) and limited knowledge base (Tchoundjeu, *et al*., 2002). Although bush mango is recently being domesticated, less than 10 percent of the total annual harvest of fruits or kernel is harvested from planted trees while the rest are collected from the natural forests (Ladipo, 2000). Seed is the common propagation material for most tropical tree species (Bowes, 1999). Unfortunately**,** *Irvingia wombolu* is still exploited mostly in the wild. The need for the establishment of pure commercial plantations will help and ensure sustainable production of *Irvingia* in Nigeria. Consequently, cultivation and domestication outside of the forest may be the only means to increase economic returns and reduce pressure on wild resources. Application of the knowledge of optimum fertilizer requirement of a tree species is expected to improve the economic productivity (Troeh and Thompson, 1993). Hitherto there is no known information on the effect of fertilizer on the growth of this species. Therefore, the objective of this study is to investigate the effects of two selected levels of organic and inorganic fertilizer on the shoot growth of *Irvingia wombolu.*

MATERIALS AND METHOD

The study started in 2010 on a 62m x 44m land in the Arboretum of the Forestry Research Institute of Nigeria Headquarter, located on longitude 3^{o} 51'E and latitude 7^{o} 23'N. The area falls under the rainforest zone. The soil, according to USDA (1987) is regarded as an "Alfisol". It is sandy and low in essential plant nutrients (Table 1). The vegetation is dominated by forest species such as shrubs (*Gliricidia sepium* and *Leucaena leucocephala),* weeds (*chromolena odorata* and grasses *anicum maximum*., and *Andropogon* . The rainfall is bimodal, usually with a break between August and September (FRIN, 2015)**.**

The land is plain. Pre-planting representative soil samples were collected randomly from the plough layer (0-15cm depth) using an Indian hoe, air-dried and sieved through 2mm-mesh screen before being analysed at the International Institute of Tropical Agriculture, Moniya, Ibadan. poultry manure used was collected from a local farmer, spread on a polythene sheet and sun-dried before analysis at Agronomy Department, University of Ibadan.

The trial was a 2 x 2 factorial laid out in a Completely Randomized Design (CRD). The factors include A: NPK 15-15-15 and B: Sun-dried Poultry manure, applied at two levels each; A_0 (0kg NPK 15-15-15 /ha), A_1 (30kg NPK 15-15-15 kg/ha), B_0 (0 t Sun Dried Poultry manure /ha) and B_1 (2.5t Sun Dried Poultry Manure /ha. The resulting four treatments (AoB_1, A_1Bo, A_0B_0 and A_1B_1) were each represented by a plot of 4 trees with a spacing of 10m x 10m between trees and 8m x 8m between plots. These were replicated 3 times resulting in 12 plots. The poultry manure

was applied radially, approximately 10cm pit (dug round about the tree) and 6cm apart while NPK was done by broadcast.

Growth measurements were made on the plants at the end (December) of each of three years, namely 2013, 2014 and 2015. Height was by use of a graduated tape suspended vertically from the top of an inclined long wooden pole, Collar diameter (CD) was by girth tape. Additionally, Fresh Bole Volume Factor (FBVF) was calculated as the product of height and square of the collar diameter. This was used as a means of measuring the productivity (p) of *I. wombolu* trees based on each treatment, where P=

$$\{(Y_{2015} - Y_{2013}) \div (3\text{-}1)\} \times 4_{trees} \times 3_{replicates} \times \{(10^4 m^2) \div (44m \times 62m^2)$$

Where Y_{2015} = Mean FBVF of the plant as at 2015

and Y_{2013} = Mean FBVF of the plant as at 2013

Table 1: Selected characteristics of FRIN Arboretum site soil of *Irvingia wombolu* before planting

Properties	Value
pH	6.7
Organic carbon (g/kg)	5.3
N (g/kg)	0.59
Available P (Mehlic)(mg/kg soil)	2.60
Exchangeable acidity (cmol/kg soil)	0.00
ECEC	5.10
Exchangeable cations (cmol/kg soil)	
K	0.07
Ca	4.41
Mg	0.44

Micronutrient (ppm)	
Zn	20.63
Cu	0.63
Mn	212.81
Fe	159.14
Particle size (g/kg)	
Sand	760
Silt	80
Clay	160

Table 2: Selected elemental analysis of sun-dried Poultry manure

Parameters	Value
Ca (g/kg)	34.3
Mg (g/kg)	4.49
K (g/kg)	19.9
Na (g/kg)	6.2
Mn (mg/kg)	320.0
Fe (mg/kg)	2075.0
Cu (mg/kg)	38.0
Zn (mg/kg)	467.50
Total P (g/kg)	30.2
Total N (g/kg)	20.39

RESULTS AND DISCUSSION

The results are summarised in the Tables 3 to 6 and figures 1 to 3. Analysis of variance showed that there was no significant difference at a = 0.05, between the treatment means for each of the parameters (namely plant height, root collar diameter and the crown diameter) for the three years (2013, 2014 and 2015) observed. However the magnitude of the mean values indicated that there was a general trend whereby the factorial combination (treatments) followed a trend in which A_1B_0 (30kg /ha NPK 15-15-15 + 0t/ha poultry manure) was the highest and followed by A_1B_1 (30kg /ha NPK 15-15-15 + 2.5 t/ha poultry manure) and A_0B_0 (0kg /ha NPK 15-15-15 + 0 t/ha poultry manure), respectively; the least was A_0B_1 (0kg /ha NPK 15-15-15 + 2.5t/ha poultry manure) (Tables 3-6). This may be attributed to relative nutrient balance (Arnon and Hoagland, 1940; Shodeke, *et al.*, 2006 and Thomson, 1993) which correspondingly varied along the trend in decreasing order. For instance, the micronutrient Fe and Zn which were already very high in the native soil (Table 1), as represented by the control or treatment A_0B_0, became further enhanced by the presence of poultry manure (Table 2) in some treatments such as A_0B_1, therefore leading to their comparatively lower performance (growth): some hidden components of the poultry manure could also be additional growth limiting factors. The order of performance could be manifested from the growth factor, the fresh bole volume factor or FBVF (Shodeke, *et al*., 2012; Table 6 and Figure 4). The prominence of A_1Bo and A_1B_1 did not disagree with Fox, *et al*., (2007) because of relatively higher proportion of nitrogen and phosphorus in them. The lower performance of A_1B_1 in this pair could be due to added level of micronutrients in the component poultry manure (Table 2). A tree fruited in one of the plots of AoB_1 at the end of 2015 and at a younger age of seven years which was similar to observation of Moss in (1995). This followed the special trait that emerged in the studies of Ladipo (1996).

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Table 3: Mean height of *Irvingia wombolu*

Treatments	Plant height (m)		
	2013	2014	2015
A_0B_0	1.77 C	3.21 C	3.81 B
A_1B_0	1.97 A	3.54 A	3.97 A
A_0B_1	1.40 D	2.33 D	2.84 D
A_1B_1	1.93 B	3.43 B	3.52 C

A_0B_0 = 0.0kg/ha NPK 15-15-15 + 0.0t/ha PM), A_1B_0 (30kg/ha NPK 15-15-15 + 0.0kg PM), A_0B_1 (0.0kg (NPK 15-15-15 + 2-5t/ha PM) A_1B_1 (30kg/ha NPK 15-15-15 + 2.5t/ha PM).

(The alphabets A, B, C and D represent the Plant height growth in decreasing order).

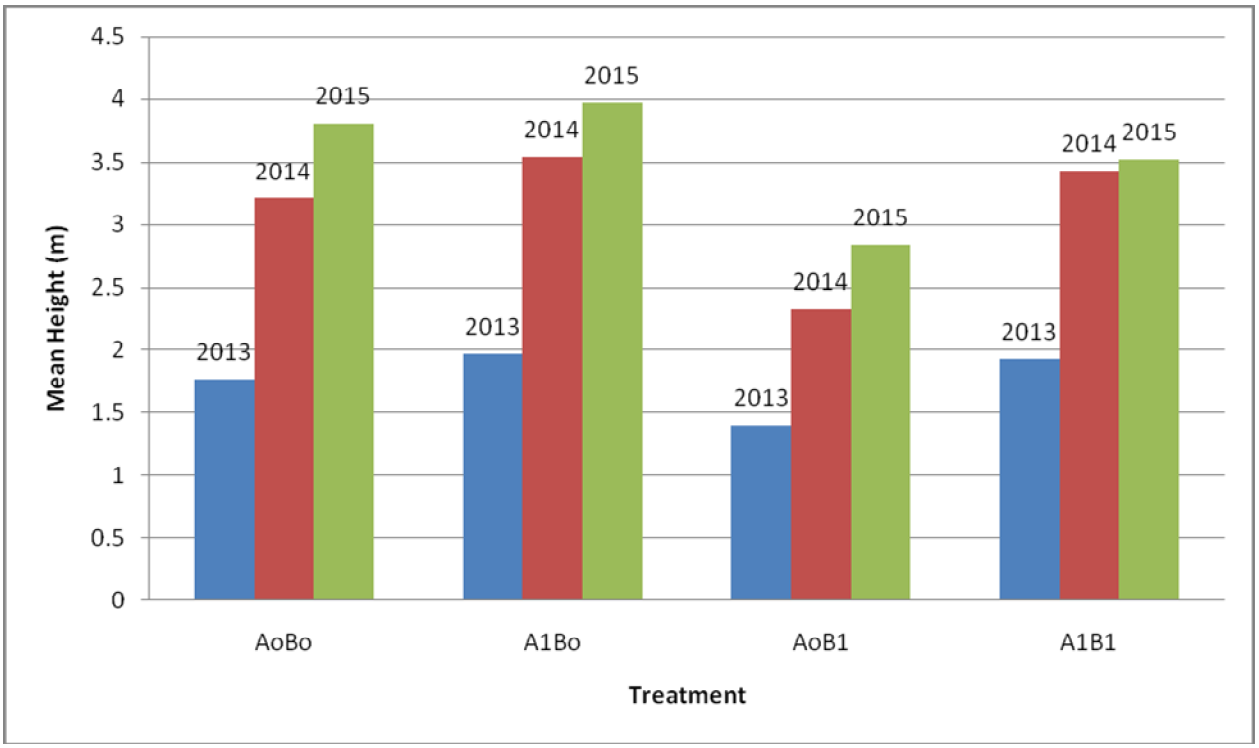

Figure 1: Effect of NPK 15-15-15 and Poultry manure on the height of *Irvingia wombolu*

A_0B_0 = 0.0kg/ha NPK 15-15-15 + 0.0t/ha PM), A_1B_0 (30kg/ha NPK 15-15-15 + 0.0kg PM), A_0B_1 (0.0kg (NPK 15-15-15 + 2-5t/ha PM) A_1B_1 (30kg/ha NPK 15-15-15 + 2.5t/ha PM)

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Table 4: Mean Root collar diameter of *Irvingia wombolu*

Treatments	Root collar diameter (m)		
	2013	2014	2015
AoBo	0.051 C	0.063 C	0.084 C
A_1Bo	0.060 A	0.084 A	0.096 A
AoB_1	0.038 D	0.056 D	0.073 D
A_1B_1	0.057 B	0.080 B	0.091 B

(The alphabets A, B, C and D represent the collar diameter growth magnitude in decreasing order)

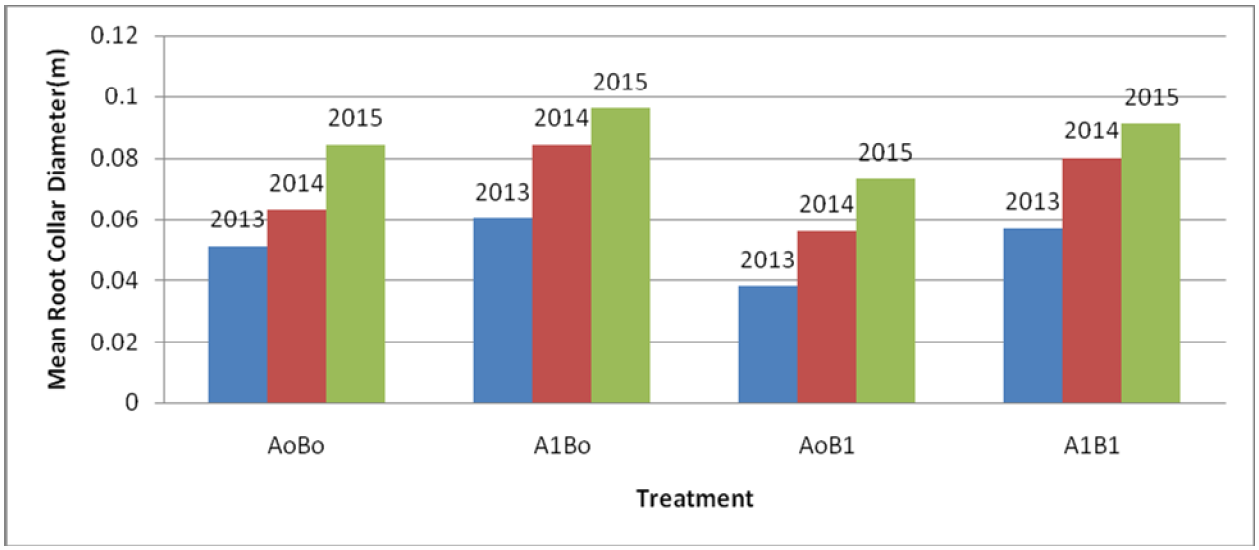

Figure 2: Effect of NPK 15-15-15 and Poultry manure on the Root collar diameter of *Irvingia wombolu*

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Table 5: Mean crown diameter of *Irvingia wombolu*

Treatments	Crown diameter (m)		
	2013	2014	2015
AoBo	1.79 C	2.13 C	2.43 B
A_1Bo	2.22 A	2.61 A	2.54 A
AoB_1	1.48 D	1.79 D	1.90 D
$A1B_1$	2.12 B	2.34 B	2.23 C

(The alphabets A, B, C and D represent the Crown diameter growth in decreasing order)

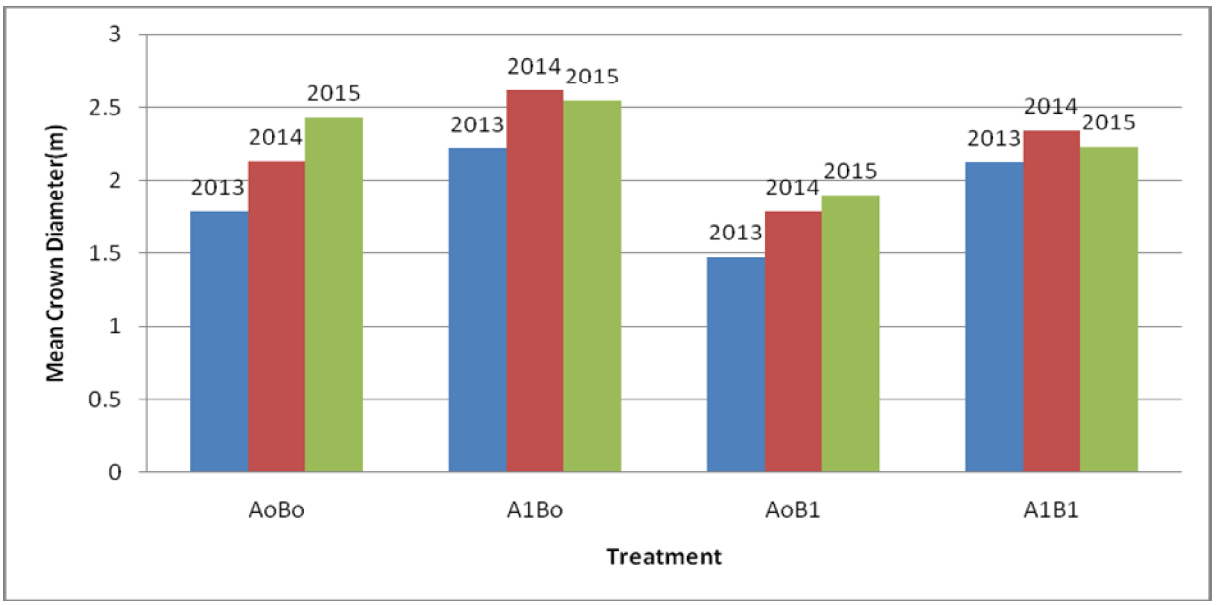

Figure 3: Effect of NPK 15-15-15 and Poultry manure on the Crown diameter of *Irvingia wombolu*

Table 6: Mean Fresh Bole Volume Factor of *Irvingia wombolu*

Treatments	Fresh Bole Volume Factor ($x10^{-3}m^3$)		
	2013	2014	2015
A_0B_0	4.6 C	12.7 C	26.9 C
A_1B_0	7.1 A	25.0 A	36.6 A
A_0B_1	2.0 D	7.3 D	15.1 D
A_1B_1	6.3 B	22.0 B	29.1B

The alphabets A, B, C and D represent the productivity in decreasing order.

CONCLUSION

The result of this study revealed that the growth of *I. wombolu* trees from the treated plots were similar to control though the magnitude of the treatments means generally indicated that A_1B_0 was the highest followed by A_1B_1, A_0B_0 and A_0B_1. Hence, for effective management and to increase productivity of *I. wombolu* on the Alfisol of southwestern Nigeria, inputs with higher proportion of N and P as well as lower/more moderate levels of micronutrients than those used in this study, should be considered during fertilizer application.

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