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Full Length Research Paper

Effects of Synthesized Plant Growth Hormones on the Early Growth Rate of *Gnetum africanum* (Welw) in Uyo, Southeastern Nigeria

Mercy P. Akpan[1], Nyaudoh U. Ndaeyo[2*] and Hanson E. Hanson[1]

[1]*Department of Forestry and Wildlife, Faculty of Agriculture, University of Uyo, Uyo, Nigeria.*
[2]*Department of Crop Science, Faculty of Agriculture, University of Uyo, Uyo, Nigeria.*

**Corresponding Author: Nyaudoh U. Ndaeyo*

Abstract

A study was carried out in a Screen House in the Department of Crop Science, University of Uyo, Uyo, Nigeria, to assess effects of two synthesized plant growth hormones viz: Root King (RK) and More King (MK) in different mixture ratios with water on Gnetum africanum seedling growth rate and some physiological parameters. The six mixture concentrations were: 1:500ml, 1:1000ml, and 1:1500ml each for RK and MK hormones and a control (no hormone application) to give a total of seven treatments The seedlings were arranged on the bench using a complete randomized design and replicated three times The seedlings were defoliated and planted in polybags filled with forest top soil. Two months after sprouting, the hormones were applied on the seedlings according to treatments. Results revealed that plant hormone types and concentrations affected the growth rate and physiological parameters of Gnetum africanum. The MK1:500ml had the best performance in height while RK 1:1500 had the biggest diameter, numbers of leaves and branches. Also, RK 1:500ml had the highest root and shoot dry weights and leaf area. The relative growth rate was highest in RK 1:500ml for both root and shoot while average growth rate was highest in RK1:1000 and RK 1:1500ml for root and shoot, respectively. It is therefore generally concluded that plant hormones can enhance the growth and development of Gnetum africanum as the different concentrations boosted the growth of one growth and / or physiological parameter or the other particularly with 1:500ml and 1:1000ml concentrations.

Keywords: *Gnetum africanum, seedling, synthesized growth hormones*

Introduction

Throughout history, forests have been important to human being as they provide protection and products such as shelter, , food, medicine, fuel, and tools among others (Young *et al*., 2003). Non-Timber Forest Products (NTFPs), materials derived from fauna and flora other than timber, play important roles in many developing countries, including Nigeria because greater population of the world relies directly on them to reduce poverty (World Bank, 1999; Osemebo 1999). However, forest can only fulfill these key roles if it is well managed (Etukudoh, 2000; Offiong, 2008). *Gnetum africanum,* known by Efik and Ibibio speaking tribes of Nigeria as *Afang*, is one of the NTFPs. It is an African indigenous vegetable crop hitherto mainly harvested from the wild grown for their leaves (Udah and Echeiri, 1997). Dutta (1999) classified *Gnetum africanum* as a climber because it produces vines which can wind round a stake in clockwise direction. *Gnetum africanum* has other local, names in Nigeria as there are different ethnic groups that consume it. Ikom for instance, calls it "*nkani"* while the Igbos call it "*Ogazi* or *Okasi* (Ekanem, 1998).

Nutritionally, *G. africanum* is a very important leafy vegetable mostly sought after by inhabitants of the Southeastern region of Nigeria as it is a major component in cooking a continental soup known as *Ukwoho afang*. Apart from consumption, *it* is an important source of traditional medicine. It is used in the treatment of variety of diseases. In Nigeria, the leaves are used for the treatment of enlarged spleen,, sore throat and *cathartic* . In Ubangi, it is used to treat *nausea* and is considered to be an antidote to some forms of poison (Burkill, 1994). Economically, its leaves are mostly prized for its edible value (Shiembo, 1999, Umah, 2002, Udoh *et. al*., 2011). *Gnetum africanum* as a terrestrial flora survives well for a good yield in a very rich soil and a well conserved ecosystem where there are trees, which it climbs for support (Sunday, 2003). It can also thrive in wide range of habitats including farm fallows or abandoned farmland, secondary forests and supported by big and small trees, dead trees, saplings, shrubs and host of other plant

materials in the complex tropical humid forest where they grow luxuriantly and produce great quantities of leaf (Shiembo, 1999). This explains why consumers and marketers used to rely on harvesting from the wild. Unfortunately, in the past two decades the demand for *G. africanum* cannot be met partly because of deforestation,, overexploitation, uncontrolled burning, climate change and slow growth rate of this vegetable. These array of problems have prompted many *G. africanum* farmers is to commence propagating the vegetable in their homesteads in attempt to meet its demand. In doing this, seeds, roots and vines are used, though use of root remains a popular propagule. Although early growth rate of this plant tend to be very slow especially in the dry season partly because of the inability of the plant to absorb mineral nutrients, due to its shallow rooting system, it however requires a very good quantity and quality of sunlight for its carbohydrate . This explains why it sprouts in full capacity during the dry season (Ekanem, 1998). Therefore, to enhance the growth of this vegetable, it is imperative to explore ways of boosting early growth rate and foliage production and plant hormone had long been used to achieve this in some crops.

Opik *et al.* (2005) stated that plant hormones are not nutrient but chemicals that in small amounts promote and influence the growth, development and differentiation of cells and tissues. Plant needs hormones at very specific time during its growth and at specific locations. According to Srivastava (2002), plant hormones affect gene expression and transcription levels, cellular division and growth. They are naturally produced within plants though very similar chemicals are produced by fungi and bacteria that can also affect plant growth. The production of hormones occurs very often at sites of active growth within the meristems, before the cells are fully differentiated. After production, they are moved to other parts of plant, where they regulate the growth of cultivated plants (Srivastava, 2002) during different plant development stages. Against this background, a study was undertaken to evaluate effects of synthesized plant growth hormones on the early growth rate and some physiological parameters of *Gnetum africanum*.

Materials and Methods

This study was conducted in a Green House in the Department of Crop Science, University of Uyo, Uyo, Nigeria. Uyo lies within the tropical rainforest of Nigeria between latitude 4^{o} 58^{1} and 5^{0} 05^{1}N and longitudes 7^{0} 54^{1} and 8^{0} 00^{1}E (Akpabio and Chukukere, 2004).The relief of Uyo urban is that of a relatively gentle slope. Rainfall ranges from 800-3,200 mm per annum. Rain begins actively in March and continues till October with peaks in June and September (Akpabio and Chukukere 2004). Dry season starts from November and lasts till February while annual temperature varies between 22.8^{0}C and 30.13^{0}C.The mean relative sunshine is 8.31 hours. The *Gnetum africanum* seedlings were purchased from a homestead planter in Mbak Etoi in Uyo Local Government Area, Akwa Ibom State, while the synthesized plant growth hormones, (Root King and More King) were obtained from Consultech Company Limited Yanyindongli, Chaoyang District, Beijing in the People Republic of China with the help of a Chinese based Agro-scientist (Prof. A. Egrinya Eneji).

A complete randomized design with three replications was used. Two synthesized plant growth hormones viz: Root King (RK)and More King (MK) were used in different mixture ratios with water to give six concentrations as follows: 1:500ml, 1:1000ml, 1:1500ml, each for Root King (RK) and More King (MK) hormones and a control (no hormone application) to give a total of seven treatments. The seedlings were defoliated manually and planted in polybags (26cm x 16cm x 19cm) filled with a forest top soil (Plates 1 -4).

Plate 1: Established *Gnetum africanum* Seedlings Arranged in a Screen House

Plate 2: *Gnetum africanum* Seedlings After 3 months in replicate 1

Plate 3: *Gnetum africanum* Seedlings After 3 months in replicate 2

The seedlings were arranged on a bench in green house and watered once in a day to enhance sprouting. Two months after planting, the seedlings were selected for growth evaluation with 18 seedlings per treatment.. Three weeks after the application of the treatments, the following morphological and physiological parameters were assessed at fortnightly interval for three months: Seedlings Height (cm), Stem Collar Diameter (using Vernier calliper calibrated in centimeter), and number of leaves and branches per stand via visual counting and leaf area(cm^2). Physiological characteristics of *G. africanum* were assessed at monthly interval. On each occasion, three seedlings from each treatment were uprooted. The seedlings were separated into root and shoot. The root was carefully washed with distilled water; the components were oven dried at 80^0C for twenty four hours. The dry weight of the root and shoot was obtained by weighing it on the weighing balance (Surgifield Oven SM9023A Laboratory oven Model) calibrated in grams. The data collected were used to calculate the follow physiological parameters; Relative Growth Rate (RGR) and Average Growth Rate (AGR)

Where RGR (g/m) = $\frac{(\text{LnTDW}_2 - \text{LnTDW}_1}{t2 - t}$

Plate 4: *Gnetum africanum* Seedlings After 3 months in replicate 3

$$AGR\ (g/m) = \frac{(TDW_2 - TDW_1)}{t_2 - t_1}$$

Where TDw_1 =initial total dry weight, TDW2 = Final total dry weight
Ln =Natural logarithm, T_1 = Initial time (Months), T_2 = Final time (Months).
Growth parameters data collected were subjected to analysis of variance at 5% probability level and means compared using least significant difference (Wahua, 2010**).**

Results

Seedling Height and Diameter

Plant hormones significantly (P< 0.05) affected seedling height (Table 1). Seedlings that received the MK 1:500ml hormone level had the tallest (17.02 cm) plants while the shortest seedlings (13.17cm) were obtained from the MK.1000ml hormone concentration followed by MK1:1500ml (14.17cm) , RK1:1500 (13.19), RK1:1000 (15.9cm) and Rk1.500 (16.13cm.) Seedling diameter of *Gnetum africanum* was not significantly (P>0.05) affected by the plant growth hormones (Table 1). However, the biggest stem diameter (0.230 cm) on the average was obtained from the seedlings that received RK: 1000ml hormone concentration .This performance was followed by RK 1:1500ml hormone rate with a mean value of 0. 249 cm, RK 1: 1500 (0. 243cm) and MK 1: 1500 (0. 204cm). The MK1: 1000ml and MK1:500ml hormone concentrations recorded 0.222cm, and 0.225cm diameter, respectively. Seedlings under control recorded the smallest mean diameter of 0.205cm (Table 1).

Table: 1 Summary of Effect of Plant Hormones on Mean *Gnetum africanum* Seedling Growth Parameters

Treatment	Height(cm)	Diameter (cm)	NLVS	NB	RDW(g/m)	SDW(g/m) 0)
RK 1:1500	13.19	0.249	5.48	1.90	1.04	**0.82**
RK 1:1000	15.09	0.230	5.02	1.72	1.44	**0.92**
RK 1:500	16.13	0.243	4.88	0.95	1.96	**1.52**
MK 1:1500	14.17	0.204	4.82	1.23	0.75	**0.89**
MK 1:1000	13.17	0.222	4.52	1.68	1.19	**0.88**
MK 1:500	17.02	0.225	2.88	0.75	0.81	**0.77**
Control	13.70	0.205	2.80	1.22	0.63	**0.49**
LSD (<0.05)	**1.62**	**Ns***	**1.70**	**0.93**	**0.18**	**.027**

NLVS=number of leaves, NB =-number of branches, RDW = Root Dry Weight and SDW+Shoot Dry Weight, g/m = grams/month, Ns = Not significant , RK =Rootking, and MK = Moreking

Number of Leaves and Branches

Plant growth hormone concentrations significantly affected (P<0. 05) seedling number of leaves (Table 1). The highest number of leaves (5.48) was obtained from RK 1: 1500ml while the least (2.80) was from the control level. The performance in the number of leaves of *Gnetum africanum* seedlings as affected by hormone concentrations was in the order: RK 1: 1000ml (5.02)> RK 1:500ml (4. 87)> MK 1:1500ml (4.8170 > MK 1:000 (4.517) > Mk1:500ml (2.883) (Table1). Similarly, plant growth hormone concentrations significantly affected (P<0. 05) the number of branches of *Gnetum africanum* seedling (Table1). The highest number of branches (1.90) was obtained from RK1:1500ml followed by RK1:1000ml (1.72) and MK 1:1000ml (1.68). The least number of branches (0.95) was obtained from MK 1:500. RK 1:500ml recorded (0.95), Mk 1:1000 recorded (1.68) and control recorded 1.22. (Table 1).

Shoot and Root dry weight (g/m)

Seedling shoot dry weight was significantly affected (p<0.05) by hormone type and concentrations (Table 1).The highest shoot dry weight (1.52 g/m) was obtained from RK 1.500ml while the least (0.49g/m) was obtained from the control treatment. The RK 1:1500ml had 0.82g/m, Rk:1:1000ml recorded (0.92g/m), while 0.89g/m, 0.88g/m and 0.77g/m were obtained from MK 1:1500ml, MK 1:1000ml and MK 1:500ml, respectively (Table 1).

Seedling root dry weight also differed significantly (P<0.05) among the plant growth hormones (Table 1). The RK1:500ml had the highest (1.96 g/m) seedling root dry weight. The least (0.63g/m) was obtained from the control treatment. The RK 1:1500ml recorded 1.04g/m, RK 1:1000ml had 1:44g/m, while MK 1:1500ml recorded 0.75g/m. The MK1:1000ml treatment produced 1.19g/m seedling root dry weight while MK 1:500ml had the mean value of 0.82g/m.

Physiological Parameters

Relative growth rate-RGR (g/m), Average growth rate-AGR (g/m) and Leaf Area (cm^2)

Results obtained showed that relative growth rate differed significantly among the hormones concentrations (Table 2) .Seedlings that received RK 1:1000ml had the highest relative growth rate while RK1:1500ml recorded highest in shoot. The least was obtained from MK 1:1500ml in root and MK 1:500 in shoot.(Table 2).

Table 2: Effects of Synthesized Plant Hormones Growth on RGR, and AGR of *Gnetum africanum*

Treatment	RGR(g/m)		AGR(g/m)		Leaf Area(cm^2)
	Root	Shoot	Root	Shoot	
RK 1:1500	0.19	0.26	0.44	0.71	**39.61**
RK 1:1000	0.68	0.17	1.04	0.42	**51.62**
RK 1:500	0.85	0.48	0.65	0.34	**55.92**
MK 1:1500	0.12	0.12	0.34	0.23	**49.61**
MK 1:1000	0.45	0.18	0.79	0.18	**56.13**
MK 1:500	0.13	0.14	0.37	0.13	**38.63**
Control	0.11	0.09	0.44	0.44	**18.41**
LSD (<0.05)	**0.06**	**0.05**	**0.08**	**0.05**	**12.78**

RGR = relative growth rate, AGR= average growth rate

The result obtained indicated that AGR differed significantly among the hormones concentrations. Seedlings that received RK 1:1500ml hormone produced the highest average growth rate (0.85g/m) while RK 1:1500 recorded the highest (0.26g/m) shoot average growth rate. The least (0.09g/m) shoot average growth root was obtained from control treatment and least root average growth rate (0.11g/m) was obtained from control treatment (Table 2). Leaf area differed significantly (P<0.05) among the plant growth hormones (Table 2). The MK1:1000ml concentration had the widest leaf area (56.13 cm^2) followed by RK 1:500ml and RK 1:1000ml while the least (18.41 cm^2) was obtained from the control treatment.

Discussion

The result of this study shows that the height, numbers of leaves and branches, leaf area, and diameter of *Gnetum africanum* were enhanced *by* the plant hormones. These could be ascribed to the effects of the applied hormones. This agrees with findings from the work of Sunday (2003) which revealed that plant growth is controlled by certain chemical substances called the plant hormones which are also known as growth regulators. This also supports earlier observation by Srivastava (2002) that plant hormones are signal

molecules within the plant which determine the formation of stems, shape the plant and affects stem growth. The result of this study indicated that plants that received More King (MK) hormone at 1:500ml had the tallest plants compared to others. This result agrees with the findings of Camp and Arms (1979) who stated that growth of new plant parts that change the size and shape of a plant is regulated by hormonal message that pass between different parts of the plants. A similar result was obtained from numbers of leaves and branches which was higher in Root King (RK) at 1:1500ml. This is in consonance with the findings of Baxamusa (2010) who reported that plant hormones helps in the formation of leaves, flowers, stem, determining the sex of the flowers, the colour of the fruits, leaves and fruit . The variation in in the values of physiological parameters with the hormone concentrations may also be due to the physiological functions at a site remote from its place of production and are active in extremely minute quantities (Pandey and Sinha 2006). The variation between the hormone concentrations may also be attributed to the plant physiological behaviour as noted by Sunday (2011) and Swarup *et al*. (2007) that not all plant cells respond to hormones but those cells that do are programmed to respond at specific point in their growth cycle. They also noted that the greatest effects of hormones occurs at specific stages during cells life with diminished effect occurring before or after this period and this may be attributed to it ability to respond to its environment.

Shoot and root dry weights were highest with Mk 1:1000ml hormone concentration while .the highest relative and average growth rate in root occurred in RK 1:500ml and Rk1:1000ml, concentration, respectively. The highest relative and average growth rate of shoot occurred in RK 1:500 and Rk1:500ml concentrations, respectively and this may apparently be due to the enhancement of cell division of the plant by the hormones. This is also in accordance with Baxamusa (2010) observation that plant hormones stimulate cell division, enlargement and cell elongation which are the agent of growth. The leaf area was higher in MK 1:1000ml and may be attributed to the effect of plant hormone as supported by the view of Baxamusa (2010) that plant hormones are agent of leaf cell enlargement which stimulate the leaf expansion.

Conclusion

Gnetum africanum has been found and harvested in the wild for decades without proper silvicultural management and as such its productivity is left entirely to vagaries of its environment. The results of the study show that plant hormones can enhance the growth and development of *Gnetum africanum* as the different concentrations of the plant hormone boosted the growth of one growth and / or physiological parameter or the other particularly with the concentration of MK1:500ml and RK1:1500ml. However**,** there is still need for further and long term investigation.

References

Akpabio, I. A. and Chukukere, O. C. (2004). Profitability of Poultry eggs Production in Uyo Metropolis of Akwa Ibom State, Nigeria. Discussion Paper No. 10. Department of Agric. Economics and Extension University of Uyo. Uyo, Nigeria Pp29

Baxamusa, B. N. (2010). Plant Hormones and their Functions, www.google.com retrieved on 6/25/2012.

Burkill, H. M. (1994). The Useful Plant of West Tropical Africa. *White Friars Press Ltd*. Volume 2: *Families E- I Kew Royal Botanical Gardens Kew.*

Camp, P. S. and Arms, K. (1979). Biology text book 6th edition. ISBN 0-03-019931.Pp. 679 -680.

Dutta, A. C. (1999). Botany for Degree Students. Oxford University Press. Eight Edition. Pp 804

Ekanem, E. E. (1998). Leaf Epidermal Studies in the Genus Gnetum.in Uyo, South Eastern Nigeria. A Project Work. University of Uyo, Nigeria. PP.34 – 88.

Etukudoh, I. G.(2000). Potentials of Forest Resources Development in Akwa Ibom State Economy. *Proceedings of First Workshop of The Forestry Association of Nigeria. Akwa Ibom State Branch.*Nigeria. 56pp

Offiong, M. O (2008). Variation in Growth and Physiological Characteristic of *Xylopia aethiopica* (Dunal).A Rich from Akwa Ibom and Cross River State. A Ph.D Thesis, Department of Forest Resources Management. University of Ibadan, Ibadan, Nigeria.. Pp 225.

Opik, H., Rolfe, S. A., Willis, A. J. and Street, H. E. (2005). The Physiology of Flowering Plant (4th Ed.). Cambridge University Press. . Pp 191.

Osemebo, G. J. (1999). Land Issues on Wild Plant Conservation. *Nigerian Journal of Environment Management,* 36: Pp17-26

Pandey,S. N. and Sinha, B. K. (2006). Plant physiology. 4th edition/ ISBN.81-259-1879-5, Pp.446- 478.

Shiembo, P. N. (1999). The Sustainability of Eru (*Gnetum africanum* and *Gnetum buchholzianum*) Overexploited Non-Wood Forest Production from the Forest of Central Africa. *In: T. C. H Sunderland and L. E. Clark (eds.). The Non-Wood Forest Products of Central Africa: Current Research Issues and Prospects for Conservation and Development. FAO.*

Srivastava, L. M. (2002). Plant Growth and Development: Hormones and Environment. Academic Press., PP. 140.

Sunday, G. E. (2003). The Evaluation of Growth Performance of *Gnetum africanum* (Welw Afrank) Treated with N. P. K. Fertilizer in a Homestead Farm in Akwa Ibom State. An Unpublished *B.Sc Project, University of Uyo, Uyo, Nigeria.* Pp 3-4.

Sunday, S. (2011) Types of Plant Hormones and their function. By www. google.com. 11/6/2011.

Swarup , R. Perry, P. and Hagenbeek, D. (2007). Ethylene upregulates auxin biosynthesis in Arabiddopsis seedlings to enhance inhibition of root cell elongation. Plant Cell, 19 (7):2186-2196.

Udah, I. A. I. and Echeiri, T. O. (1997). Evaluation of Growth Performance of *Gnetum africanum* (Welw) (Ukasi) Treated with N. P. K (20:10:10) Fertilizer in Home stead Farm. Imo State. pp

Udoh, A. J., Eboh, L. and Etuk, I. (2011). Cultivation, food values and adoption of technology for sustainable production of *Gnetum africanum. Libyan Agriculture Research Centre Journal International,* 2(1):1-8.

Umah, M. A. (2002). Marketing of *Gnetum africanum* Leaves in Akwa Ibom State. A project An Unpublished *B.Sc Project, University of Uyo, Uyo, Nigeria.* Pp 1-23.

Wahua T. A. T. (2010). Applied Statistics for Scientific Studies Africa-link Books Nigeria Limited , Port Harcourt, Nigeria. Pp 109-160.

World Bank (1996). Nigeria Poverty in the Most of Plenty: The Challenge of Growth with inclusion. *World Bank Washington D. C.* Pp 129.

Young R. A. and Giese R. L. (2003). Forest Ecosystem Science and Management. Third Edition Pp 1-2.