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Effect of Soil Media on Seedling Growth of an endangered Bio-diversity species Gnetumafricanum(Okazi)

Nnadi ,P.C

Forestry Department, Rivers State University,Port Harcourt, Nigeria

Abstract

This Study was concerned with the Effects of Soil Media on Seedling growth of okazi (GnetumafricanumWelw).The general objective was to determine the effect of soil media on growth rate of okazi (G. africanum). The experiment was conducted at the Arboretum of Forestry and Environment Department, Rivers State University, Nkpolu-Oroworukwo Port Harcourt. The experiment were laid in a Completely Randomized Design which was (CRD) replicated four times. Top soil alone, Top soil + River sand, Top soil +River sand + Clay, River sand alone were used as planting media. Data collected were subjected to analysis of variance (ANOVA) and the mean separation was done using Duncan Multiple Range Test (DMRT) at the probability of 5%. Soil samples of 0. 15cm depth were collected using soil auger at different positions in Rivers State University. The soil samples were air dried, ground and passed through 2mm sieve for laboratory analysis. Generally, therewere significant (P< 0.05) increase in the total nitrogen, available phosphorus and exchange potassium present in the soil sample. Results indicate that Top Soil had 0.05% of Total Nitrogen, Available Phosphorus 42.11mg/Kg and Exchangeable potassium 0.02mol/kg. Results showed that height, leaf area, number of leaves increased (P<0.05) with the type of soil Media used. A mixture of Top soil + River Sand had 22.39± 8.71 was found to be best that supported the growth of okazi(Gnetumafricanum) followed by Top Soil alone. The number of leaves for the four soil media is 2.00 ± 0.00cm^2 each showed no significant difference (P>0.05). Result showed that the highest height was seen in Top Soil + River Sand with 9.50 ± 1.78cm and the least was in Rivers sand alone with 2.60±0.89cm. It is therefore recommended that farmers who grow Gnetumafricanumare advised to prepare media using Top soil + River sand for a better performance of G. africanumin Rivers State, Nigeria.

KEYWORDS: Bio-Diversity , Conservation, Gnetumafricanum, Soil Media, Seedling growth

INTRODUCTION

Gnetumafricanum is a gymnosperm vine found only in the humid tropical forest of Africa where it can tolerate a range of habitat and environmental conditions. *G. africanum* is similar with *G. buchholzianum*, the only two species found in the family of *Gnetaceae* of the African *Gnetum* plant. *Gnetumafricanum* species is a Climber plantand is well known to the local community as a useful plant because of its edible leaves and the Socio- Economic importance. The leaves of *Gnetumafricanum* have very high nutritional value and constitute an important article of trade in the growing regions where they are harvested on daily basis and sold in local, regional and international market (USA and Europe). In Cameroon, harvesters of*Gnetum*africanumcan generate substantial income averaging US $2630 per annum (Fondoun and Tiki-Manga 2000). In addition to the nutritional and economic values(Isong et al 1999), leaves of*Gnetumafricanum* plants are also important for several medicinal uses (Ali et

al 2011). Despite being socio-economically valuable,*Gnetum*africanumare mostly harvested in the wild stocks. The over-all rate of harvesting appears to be increasing.

Gnetumafricanum (okazi) is a traditional vegetable consumed by many Nigerians. Currently it grows in the wild with only limited domestication. Due to its social, cultural, medicinal, nutritive and economic values, this forest vegetable plays a key role in the livelihood of most rural and even urban communities of south-eastern Nigeria. It is a non-timber-forest product commonly known in south eastern Nigeria as "Okazi" by the Igbo and Afang by the Efik/Ibiobio tribes. *Gnetumafricanum* is one of the several edible indigenous non-woody vegetable plants that could be taken in raw state as salad or cooked as the major vegetable of soups (Okafor, 1983). Presently, consumer demand for *Gnetumafricanum* is high in our local markets and outstrips supply. It is hoped that any investment tailored towards improving its production will be highly rewarding.*Gnetumafricanum* plants are Climbers that need a supporting plant to grow in the forest. So, the vines are destroyed during deforestation. In spite of farmers 'indigenous practices of conserving*Gnetumafricanum* (Fondoun and Tiki-Manga 2000), the combination of increased demand, destructive harvesting practices, over-exploitation and the gradual replacement of the habitat in which the species thrive for other purposes resulted in the decline of the population in certain countries. For instance, in Nigeria many populations of*Gnetumafricanum* extinct from their natural habitats, and in Cameroon there is need to travel further into the forest in search of this valuable vegetable.

Despite their large range of distribution across tropical Africa , the extensive exploitation of Gnetum*africanum* from the forest is considered a major threat and the species was listed as near- threatened in the 2011 IUCN red list (Lakeman and Bachman 2011; Baloch 2011).To avoid a drastic reduction in the population that could lead*Gnetum*africanumto the threshold of threatened category, serious efforts linked to the management of the increased harvesting , domestication and conservation are needed. As high-value and shade tolerant indigenous species, Leakey(1998) and Duguma*et al.*(2001) proposed*Gnetum*africanumas appropriate for domestication and for inclusion into cacao-based or other multi-strata agro forests in order to enhance the system's diversity and Profitability.

The possibility of cultivating *Gnetum*africanumindicates some potential to alleviate pressure on wild populations which due to deforestation activities is one of the indeginousplant species with enormous Socio –economic value (Udofia et al, 2019) and Potential for Plantation Establishment like Chrysophyllumalbidum that is going into extinction (Nnadi and Anyanwu,2018)

The conservation approach that is currently adopted for*Gnetumafricanum*is that of "conservation through cultivation" (Ndam*et al.* 2001). However, due to the lack of planting materials, sustainable cultivation of *Gnetumafricanum* is limited. *Gnetumafricanum*produce seeds, but the ripe fruits are often difficult to find, as birds, bats and rodents often eat them before Maturity (Shiembo 1997).

Seed germination under nursery has not been successful. There is therefore a need to develop successful propagation methodology that will not require the use of seeds. In this light, research programs have been oriented on the development of propagation method of *Gnetum*africanumusing vine cuttings.

Studies on the propagation of*Gnetum*africanumthrough cuttings started in the 1990s in *Gnetumafricanum* through cuttings have been carried out only on *Gnetum.africanum* (Shiembo*et al.* 1996.), or on G. spp. In bulk not determining the species (Bongjo*et al.* 2010). AlthoughGnetumafricanum is composed of at least two distinct species: *Gnetum. africanum* and G. *buchholzianum* that are clearly delimited by morphological and molecular characters (Biye*et al.* 2013). Therefore, there is a need to improve and define the propagation method of each*Gnetum*africanumspecies.

Justification

The Benefits of *Gnetumafricanum*(Okazi) ranging from the Nutritional value to its medicinal and socio-economic value cannot be over-emphasised. The scarcity and extinction of these indigenous species in the wild due to over-exploitation and deforestation of the forest has resulted to the conservation of this species through cultivation to avoid drastic reduction in the population that could lead*Gnetumafricanum* to the threshold of threatened category.

General objective

The General objective of the study is to determine the effect of soil media on growth rate of okazi (*Gnetumafricanum)*

Specific objectives

Specific objectives :

1. determine the Physcio- Chemical properties of the soil media (NPK) used during the experiment.

2. determine the effects of soil media on growth parameters of *Gnetumafricanum*.

Materials and Methods

Study Area

The study was conducted in April 2019, in the Teaching and Research Arboretum of Forestry and Environment department , Faculty of Agriculture, Rivers State University, Nkpolu – Oroworukwo, in situated in Latitude 4.51 N and Longitude 7.01 E at an Altitude of 223 above sea level (Tariah*et al.*1991).

Sources of Planting Materials

The planting Materials were obtained in the nursery site of Forestry and Environment Arboretumdepartment in the Faculty of Agriculture Research farm, Rivers State University, NkpoluOroworukwo, Port-Harcourt.

A uniform height (10cm) of seedlings were obtained.

Methods

Sample Collection

Soil samples were collected in different positions in River State University. The top and clay soil were collected in the nursery site of Forestry Arboretum, River sand was collected from Centre for Continuing Education site around the school back gate. Soil samples were collected at a depth 0.15cm using Soil auger.

The soil samples collected were bagged and transported to the laboratory for physcio-chemical analysis.

Determination of the Effects of Soil media on growth of *G. africanum*

Seedling collection

This method was carried out by the collection of the seedlings of *Gnetumafricanum* from the parent tree and transplanted into poly-bags containing different soil media (Top soil alone, River sand alone, Top soil + River sand and Top soil + River sand + Clay soil using 500g each) in order to determine the effect of soil

media on their growth rate. The seedlings were shaded under trees with large canopy to reduce moisture loss and excess sun scotching of young seedlings.

Watering Methods

Watering was done three times in a week in the morning at every other day except on rainy days.

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Parameters

Plant Height – The plant height of *Gnetumafricanum* was measured with a ruler at two weeks interval starting from 4 weeks after the planting. This was taken from the base to the tip of the leaf.

Leaf Area – The leaf area (cm^2) was obtained by measuring of leaves from each seedlings in each poly-bag from the base of the petiole to the apex of the leaf to obtain the length and at the middle where the leaf was broadest to obtain the width. Thereafter, the length and width from the leaves were multiplied to obtain the mean leaf area (cm^2).

Number of Leaves-The number of leaves was obtained by visual countingof the leaves per seedling on each plant in the poly – bags.

Soil Analysis: Nitrogen, phosphorus and potassium (NPK) was analyzed. The physcio-chemical soil analysis were carried out in the Soil Science laboratory of Rivers State University, Port Harcourt. It was air – dried for some days, ground and filtered into various bags of identification which were used for physio-chemical analysis (FAO, 2016,).

The Physcio-Chemical Properties are as follows:-

Total Nitrogen: Total Nitrogen was determined using the regular micro Kjeldahl method (Bremner and Mulvaney, 1982). In this method, a representative air-dried soil was ground to pass through 0.5mm sieve. 1gram of the air-dried soil was weighed into tubes and mixed with catalyst (Se, $CuSO_4$) + concentrated H_2SO_4.

This was digested on a tecator block until the digest cleared. The digest was distilled and titrated with 0.01N standard sulphuric acid. The present total nitrogen was then determined by calculation using the formular.

$$\%TN = \frac{N\ (T - B) x\ 14\ x\ 100}{1000\ x\ W}$$

Where: N = Normality of acid, T = (ml) for samples

B = Blank reading (ml), W = Weight of soil used.

Available Phosphorus: This was determined using Bray and Kurtz No. 1 method and modified by Oslen and Sommers (1982). In this method, the absorbance of the prepared sample was measured on spectrophotometer at 880µ wavelength. The procedure includes taking 2.85g of samples with the aid of light weight balance, which were added to a 50ml flask with 4ml of reagent B (solution of ascorbic acid, ammonium mollybdade, antimony potassium titrate and tetraoxosulphate (vi) acid all in their right proportion was added to the samples in the flask and then filled to the 50ml mark with distilled water.

Phosphorus determining machine was set at 8-80m and distillation factor taken at 50/2.

Available Potassium: Available potassium was determined using Lamotte garden soil test kit model Em, code 5934. The soil sample was measured into the test tube, it wasanalyzed and the available potassium was determined.

Experimental Design

The experiment was laid in a completely Randomized design (CRD) and four treatments replicated four times to give a total of sixteen (16). Each of the poly-bags represented individual replications. The polybags were kept in the Arboretum of Forestry and Environment throughout the period of the research.

Data Analysis

Data collected was analyzed by analysis of variance (ANOVA) using SPSS Genstat software as described by Steel and Torrie (1980). Duncan Multiple Range Test at probability of 5% (DMRT) to separate the means.

Results

Physcio-Chemical properties of the soil media

The result indicated that Top soil +River Sand + Clay Soil had a higher 0.05% of Total Nitrogen, Available phosphorus 42.11 mg/kg and exchangeable Potassium 0.02 mol/kg as compared to other Soil Media as shown on table 1, below.

Table 1: Physcio- Chemical Analysis of the Soil Media.

	% Total Nitrogen	Avail. P mg/kg	Exch. K (mol/Kg)
Top soil	0.02	20.35	0.02
River sand	0.01	9.83	0.01
Top soil + River sand + clay soil	0.05	42.11	0.02
Top soil + River sand	0.02	28.07	0.01

Result of analysis of four (4) soil sample

Results :Plant Height

The results of the mixture of the three soil media Showed that Top soil + River sand + clay was significantly different from the other Soil media and had the highest height of 9.50±2.16(cm), followed by Top soil + River sand with 8.50±3.34cm,while Top Soil alone have 6.75±3.40(cm) and the least height was observed in Rivers sand alone with 2.60±0.89cm as shown on table 2 below.

Leaf area The result shows that there was significant ($P<0.05$) difference betweenTop soil + River sand + clay with 22.39±8.71cm^2 followed by Top soil + River sand with 11.00±3.59cm^2 , Top soil with 9.58 ± 4.60cm^2 and River sand with 4.00±0.89cm as shown on table 2 below.

Number of leaves: The number of leaves for the four soil media Top soil ,Top soil + River soil, Top soil + River sand + clay and River sand were not significantly different from each otherall had the same number of leaves 2.00±0.00cm^2, ($P>0.05$) .

Table 2: Effects of Soil Media on Growth Parameters (Mean±Standard Dev.)

Soil Media	Height (cm)	Leaf Area (cm^2)	Number of Leaves

Top Soil	6.75+3.40	9.58±4.60[c]	1.75±0.50[a]
Top Soil + River Sand	8.50±3.34[a]	11.00±3.59[b]	2.00±0.82[a]
Top Soil + River Sand+Clay	9.50±1.78b	22.39.±8.71[a]	2.00±0.00[a]
River Sand	5.13±3.61[a]	4.00±.0.89	1.50±0.57[a]

Means with different letter are significantly different (P≤0.05) using DMR

DISCUSSION

Growth medium have effect on growth and Seedling development of plants (Vendrame*et al.;* 2005) and plays an important role in germination rate and many other physiological parameters including plant height, number of leaves, leaf area and subsequently affects the yield, etc (Vendrame*et al;* 2005). The best growing media should have proper aeration, water holding capacity and adequate nutrient supply which may include soil amendement with some organic materials such as Palm ash (Nwaonuala and Nnadi, 2013), Litter decomposition (Nnadi, 2019) and decomposed papers(Eremrena and Nnadi, 2015) to enhance Soil nutrients Status which plants can absorb for their Metabolism

It does appear from the result of this study that Top soil + River sand Clay Soil may be most ideal media for the seedling establishment of *Gnetumafricanum*. This was in full agreement with Dickens (2011) who had suggested that Top soil + River sand + Clay soil as a suitable media was good for the seedling growth and sprouting in *Irvingiagabonensis*. Top soil + River sand + Clay soil gave the highest height, leaf area and Number of leaves and this might be due to the fact that the media was non- toxic and had adequate aeration and moisture for sprouting of cuttings (Dawid*et al;* 2014). In agreement with our findings (Dawid*et al;* 2014; Essien*et al;* 2014) suggested that soil media needs to be non-toxic, free of moulds, with adequate aeration and moisture for seedlings growth.

The possible differences noticed among the plant growth on the different soil media could be as a result of the difference in their organic component. This is similar to an observation by Peter-Onoh*et al;* (2014) on *Monodoramystica* species on different soil media.

There were proper watering, weeding around the seedlings and the protection against big herbivores to enhance seedling growth. This agreed with (Bali *et al*; 2013).

CONCLUSION AND RECOMMENDATION

From the results, it was observed that Top soil + River sand + Clay Soil was Significantly different from the other Soil Media and had a higher plant Height of 9.50±1.78, Leaf Area of 22.39±8.71 and total number of Leaves 2.00±0.00 followed by Top Soil+ River Soil which had Plant Height 8.50±3.34, Leaf Area 11.00±3.59, and Total number of Leaves 2.00±0.82 and the least was in River Sand which had Plant Height 5.13±3.61, Leaf Area 4.00±0.89 and Total number of Leaves 1.50±0.57.

Recommendations

Farmers who grow okazi (*Gnetumafricanum)* are advised to prepare media using Top soil + river sand +Clay Soil for a better performance of okazi (*G. africanum)* in Rivers State, Nigeria Also due to the benefits of *G. africanum*ranging from the Nutritional to its medicinal and socio-economic value, farmers or people are advised to establish Plantation of Gnetumafracanum plant okazi (*G. africanum)* in their nursery farms, backyard and gardens ,Further research using a total

different media for the seedling growth of okazi (*G. africanum)* should be introduced.

Also due deforestation activities , the plant is endangered and may result into Extinction if not conserved by Plantation Establishment. (Ndah et al 2001).

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