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EFFECT OF SEED SIZE AND SOURCE ON EARLY SEEDLING GROWTH OF *TERMINALIA IVORENSIS* (CHEV.)

SUMMARY

A nursery experiment was conducted to study variations in four different sources of *Terminalia ivorensis.* Seeds were collected from Agodi and FRIN, while seeds from Ifon and Owena were collected from Forestry Research Institute of Nigeria seed store. This study was carried out at West African Hardwoods Improvement Project (WAHIP) nursery at the headquarters of the Forestry Research Institute of Nigeria, Ibadan. Assessment of growth parameters such as the seedling height, collar diameter, number of leaves and dry weight in all the sources for sixteen weeks was studied. Agodi seeds had the highest diameter of 7.86mm followed by Ifon seeds with 6.87mm while Owena and FRIN recorded 6.82mm. Ifon had highest height value (21.33cm) followed by 21.22cm in Agodi, 21.09cm in FRIN and Owena had the minimum height (19.40cm). Ifon had highest collar diameter with 3.08mm and Agodi had the minimum collar diameter of 2.83mm out of all. The highest leaf number was also in Ifon with mean 14.98 followed by 13.87 in Owena. FRIN produced the least number of leaves (13.66). Ifon had the highest NAR value of 1.54g/cm^2/wk and the least value was observed in Agodi with 0.06 g/cm^2/wk. Also Agodi had the highest RGR of 2.42g/wk with Ifon having the least value of 0.28g/wk. The average performance of the sources studied with regards to their height and diameter growth, leaf production and leaf area extension showed that seedlings raised from Ifon seedlots performed best. Those from Agodi source ranked second and Owena source was the poorest. In spite of poor performance of Owena in the study, it had resistant against *Eryodiv myth* an insect that attack *T.ivorensis* at early stage.

Keywords: Provenance, seedling, growth and variation

INTRODUCTION

Forest produces goods and services and also provides immense intangible and invaluable environmental services such as control of run-off and prevention of erosion, sustenance of the availability and quality of fresh water, soil conservation, climate change abatement, provision of habitat for wildlife, etc.

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The social functions of the forest are in terms of scenic and aesthetic values they provide. Africa is known to be rich in natural resources in which plant genetic resources cannot be relegated to the background. (9) said that Africa's strength lies in its natural resources including the genetic resources that are the foundation for growth and stability in agriculture, forestry and environment. Africa's wealth of biological resources in general and plant genetic resources in particular, is a critical element in alleviating poverty, ensuring food security, and developing new medicines. According to (4), tropical forests are centres of biological diversity at least at the level of species diversity. However, a study by Ni (8) has shown that approximately half the tropical forests ranging from 780 to 800 million hectares of the original 1.5 to 1.6 billion hectares that precisely covered the earth have been destroyed. This loss is tremendous in South East Asia, the second of the world's great biodiversity hotspots. A lot of what remains today is in the Amazon, Brazil is at present estimated to be losing about 50,000km^2 yearly through agriculture, cattle ranching, logging and mineral exploitation. Deforestation and forest degradation result in a dramatic loss of present biodiversity and future options for use of trees (7).

In many areas of Africa, the lost biodiversity caused by rapid vegetation clearing for agricultural and livestock expansion has resulted in a drastic decline in the supply of traditional medicines. This has increased the demand for medicines as the population is increasing (11). These two factors has prone some of the useful plant species to the risk of becoming extinct. Useful plant such as as *Terminalia ivorensis* which has great difficulty in germination (12) should be prevented from being extinct and improved genetically.

When considering tree improvement, it should be taken into account that not all species are equally suitable for improvement. The suitability of species for improvement depends on factors like regeneration method (e.g. by planting, sprouting or natural seed fall), ease of production of reproductive material and the heritability of the traits to be improved. As natural forests are destroyed, the genepool of *Terminalia ivorensis*, an indigenous tree species is reduced, thus threatening its genetic variability. This species is widely distributed throughout the guinea savannah and the sub – humid (high forest) zones of Nigeria, where demand for farmland and fuel wood is always on the increase. The species is a highly promising multipurpose tree that yields a wide range of useful products such as medicine and fuel wood. It also has potentials for landscaping and the control of large scale soil degradation. Studies on its genetic variability between and within populations are very important to provide very useful guidelines for tree breeders.

Usually, the main objective of any tree breeder is to evolve a tree with desirable traits giving the most valuable forest products at a very cheap rate and in a short time. Therefore, there is need to study the effects of seed source on seedlings early growth of *Terminalia ivorensis* which is an edible aril, also have an edible fruit and produces a beautiful fruit (red) which gives its potential for landscaping.

MATERIAL AND METHODS

The experiment was carried out in Forestry Research Institute of Nigeria (FRIN) nursery which is located in Jericho Hill Ibadan North West Local Government Area of Oyo State, Nigeria. It lies between latitude 7° 24'N and longitude 3° 55'E.

One hundred and sixty (160) seeds per source were sown in seed trays so as to facilitate wide choice of uniformly growing ones. From each location, six vigorous and uniformly growing seedlings were transferred into medium size polythene pots 12x5x5 already filled with topsoil. This was replicated five times. The growth assessment began two weeks after transplanting when the seedlings have stabilized. This was done fortnightly for twenty weeks. Variables such as height, stem diameter, biomass and leaf area were measured at the stated interval.

Biomass assessments were carried out using five seedlings per location making total number of twenty seedlings in all at two weeks interval for sixteen (16) weeks. Seedlings from each source were carefully uprooted by lowering in water and all soil particles carefully removed. The seedlings were then separated into roots, stems and leaves components. The fresh weight of the different seedling components was determined for each seedling using an electronic mettler balance, (H 35). The different components were then oven dried at 60°C for forty eight (48) hours and then weighed to determine the dry weight.

The data collected was used to calculate the Relative Growth Rate and Net assimillation rate.

$$\text{Equation 1: R.G.R } (g^1 week^{-1}) = \frac{LnW_2 - LnW_1}{T_2 - T_1}$$

$$\text{N.A.R } (g/cm^2/week) = \frac{W_2 - W_1}{A_2 - A_1} \times \frac{LnA_2 - LnA_1}{T_2 - T_1}$$

Where:

W_1 = Initial dry matter weight
W_2 = Final dry matter weight
A_1 = Initial fresh leaf weight
A_2 = Final fresh leaf weight
T_1 = Initial harvest time
T_2 = Final harvest time
Ln = Natural logarithm ($\log_e$)

The statistical model for CRD is a linear additive model of the form;

$$Yij = \mu + Tj + Eij$$

Where;

Yij = individual observation
μ = general mean
Tj = effect of the jth treatment
Eij = experimental error

RESULTS

Height Growth

The mean height values across the week from the four sources of Terminalia ivorensis showed differences with seedlings from Agodi having the highest value of 9.96cm in the first three assessment of growth. Seedlings of Owena had the smallest value of 9.01cm among the sources in the first three periods of studying the growth of *T.ivorensis*. From fourth to the eighth assessment, seedlings from Ifon started having highest values ranges from 15.07cm to 21.33cm among the four sources (Table 1). Owena still remain the smallest among the sources by having values ranges from 11.59cm to 19.40cm (Table 1). Effect of source on the height of *T.ivorensis* showed significant differences among them

Table 1. Mean height of seedlings and the collar diameter of Terminalia.ivorensis from four sources across the weeks

Height(cm)	2wks	4wks	6wks	8wks	10wks	12wks	14wks	16wks
Ifon	4.75	7.11	9.45	15.07	16.24	18.55	20.38	21.33
Owena	4.69	6.71	9.01	11.59	14.5	17.2	18.49	19.4
FRIN	5.22	7.78	10.16	12.64	16.14	18.2	19.68	21.09
Agodi	5.58	7.66	9.96	12.22	15.48	17.48	19.3	21.22
p- values	0.008	0.001	0.063	0.335	0.063	0.411	0.242	0.221
Collar(mm)								
Ifon	0.77	1.08	1.36	1.77	2.14	2.62	3.03	3.22
Owena	0.75	0.99	1.27	1.74	2.03	2.45	2.89	3.08
FRIN	0.76	1.03	1.43	1.68	1.95	2.36	2.72	2.91
Agodi	0.82	1.09	1.29	1.72	l.97	2.36	2.60	2.83
p- values	0.255	0.242	0.802	0.740	0.085	0.033	0.002	0.002

Collar Diameter Increment

The best performance in collar diameter increment 1.43mm in the first three assessments among the sources was observed in FRIN closely followed by 1.36mm in Ifon (Table 1). The least collar diameter 1.27mm across the first three assessments was also shown in Owena.

Among the sources, the highest collar diameter was observed in Ifon with the values ranges from 1.77mm to 3.22mm across the week 8 to 16. The lowest collar diameter within these assessments was revealed in FRIN and Agodi (Table 1). Analysis of variance indicated high significant differences in mean collar diameter increment among sources and across the week at 5% probability level.

Number of Leaves

The seedlings in Ifon produced the highest number of leaves ranges from 6 to 10 in the first three assessments. Also, from week 8 to 16, Ifon still produced highest number of leaves across the week and among the sources (Table 2). Analysis of variance (ANOVA) revealed no significant differences in the number of leaves among the sources.

Table 2. Mean Leaf number of seedlings of *Terminalia ivorensis* from four sources per weeks.

Source	***Number of leaves***							
	2wks	4wks	6wks	8wks	10wks	12wks	14wks	16wks
Ifon	6.58	8.22	10.54	11.61	15.78	16.04	15.75	14.98
Owena	6.28	7.94	9.84	11.22	14.24	14.84	14.5	13.87
FRIN	6.32	7.86	9.67	10.77	14.20	14.91	14.12	13.66
Agodi	6.01	7.54	9.42	10.51	13.72	14.18	13.25	13.7
p-values	0.031	0.064	0.210	0.004	0.003	0.085	0.006	0.099

Dry Weight of Seedlings

Based on the last assessment, seedlings in Agodi had the highest mean dry root weight of 0.63g across the assessment period and among the sources. The least mean root weight was observed in Ifon with the value 0.32g. The highest mean number of leaves, 0.94g was observed in Owena while the least mean 0.79g was observed in Ifon. Moreover, among the sources, Agodi produced the highest shoot dry weight across the weeks and the least shoot dry weight 0.38g was in Ifon and Owena. Analysis of variance (ANOVA) showed significant differences in the mean root and leaf production both among the sources and across the assessment week, (Table 3). Duncan test was used to separate the mean that are significantly different.

Table 3. Differences in the Mean of Root and Leaf

	Root		*Leaf*
Source	9	12	3
Ifon	0.20a	0.32a	0.12b
Owena	0.27a	0.40a	0.09a
FRIN	0.30a	0.44a	0.14b
Agodi	0.44b	0.63b	0.11ab

Note: Mean with the same letter are not significantly different from each other at p=0.05.

Net Assimilation Rate (NAR) g/cm^2/wk

The values of NAR for the different sources across the week are given in Figure 1. The data did not follow any definite pattern. In the first assessment, Ifon had the highest NAR value of 1.54g/cm^2/wk and Owena had least with 0.26g/cm^2/wk. In the last assessment, FRIN had the highest value of 0. 1 g/cm^2/wk while Agodi had the least 0.06 g/cm^2/wk. All through the assessment, Ifon had the highest value.

Relative Growth Rate (RGR) g/wk

The data on RGR has a similar trend with those of NAR. In the first and second assessment, Agodi had the highest RGR of 2.42g/wk and 1.05g/wk respectively. All through the assessement, Ifon had the least value of 0.28g/wk (Figure 2).

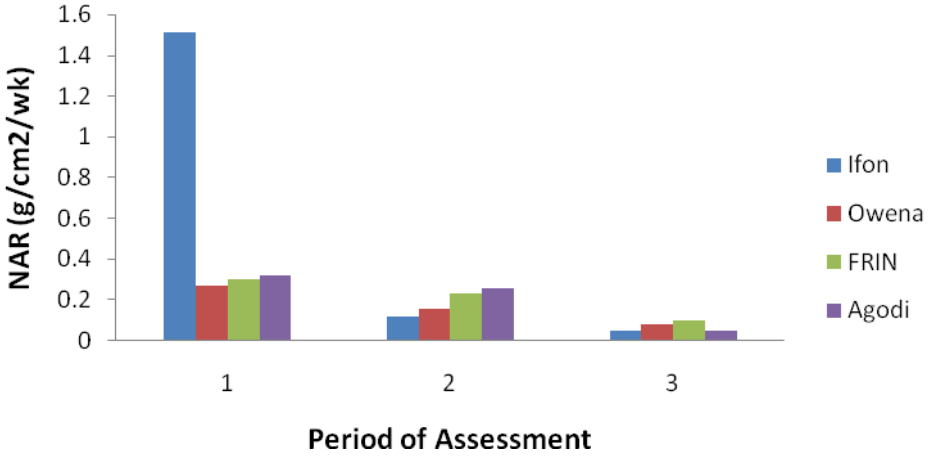

Figure 1. Net Assimilation Rate of *Terminalia ivorensis*

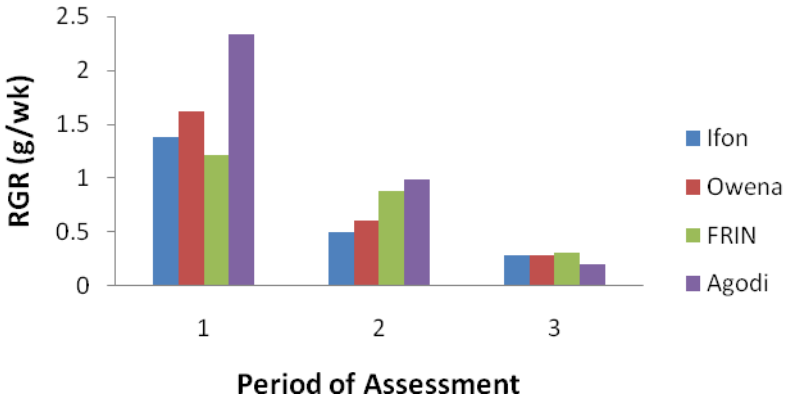

Figure 2. Relative growth rate of *Terminalia ivorensis*

DISCUSSION

Variation occurred in all the growth parameters studied except in the leaf number where no significant difference was noticed. The significant results observed in height and collar diameter among the four sources confirm the existence of variations among the sources. The significant levels of variation obtained in seedling height growth and collar diameter increament agree with the earlier work of (2) who obtained similar result in the seedling height and collar diameter growth of *Dialium guineense.* Also, (3) observed variation in seedling height and collar diameter growth of *Mansonia altissima.* Net assimilation rate (NAR) is a measure of the rate of photosynthesis and growth. NAR has also been defined as the increase in weight per unit of time. The best mean NAR value across the week was obtained in Owena and Agodi which suggest that these two sources may have more photosynthesizing tissue than in both Ifon and FRIN.

Also, Relative growth rate has been defined as the amount of dry matter produced per unit of time.

Figure 3. Variations among the four sources of *Terminalia ivorensis*

CONCLUSIONS

The result obtained showed that Owena had the highest RGR at the first two assessments across the sources while at the last assessment, Agodi then proved best. Ifon had the least RGR across the assessments. The result then suggests that the amount of dry matter produced per unit of time is highest in Owena and slightly high in Agodi than the remaining two sources.

This study has revealed the existence of variation in the seed size and growth parameters of Terminalia ivorensis among the sources studied. Terminalia ivorensis is highly rated for its multipurpose benefits in terms of its contribution to timber industries, its contribution to farming system and protection of environment. It has been observed that lack of seed and seedling has contributed serious constraint for small-holders to fully utilise the benefits of trees (6; 1; 5) and that when planting material is even available, it is often insufficient with regards to choice of species or provenance as well as genetic and physiological quality (10). This study has successfully studied four sources of Terminalia ivorensis on the basis for selection in later use. The significant effects recorded for the sources in these parameters confirm the existence of variations among the sources.

Based on the results of this study it is therefore recommended that for large scale afforestation project or establishment of plantation in Nigeria, seedlings from Ifon can be used as it gave the highest value for most of the growth parameters.

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UTICAJ VELIČINE SJEMENA I IZVORA NA RAST RANIH SADNICA *TERMINALIA IVORENSIS* (CHEV.)

SAŽETAK

Postavljen je rasadnički ogled radi proučavanja varijacija kod četiri različita izvora *Terminalia ivorensis*. Sjemena su prikupljena od Agodi i FRIN, dok su sjemena Ifon i Owena nabavljena u prodavnici sjemena Istraživačkog instituta za šumarstvo Nigerije. Ova studija je sprovedena u okviru rasadnika Projekta poboljšanja tvrdih drveća Zapadne Afrike (WAHIP) u sjedištu Istraživačkog instituta za šumarstvo Nigerije, u Ibadanu. Izvršena je procjena parametara rasta, kao što su visina sadnice, prečnik vrata, broj listova i suva masa u svim izvorima posmatranim tokom šesnaest sedmica. Sjemena Agodi su imala najveći prečnik od 7.86 mm, zatim sjemena Ifona sa 6.87 mm, dok su Owena i FRIN bila 6.82 mm. Kod Ifon je zabilježena najviša vrijednost visine (21.33 cm) zatim 21.22 cm kod Agodi, 21.09 cm kod FRIN i kod Owena najmanja (19.40 cm). Ifon je imao najveći prečnik vrata od 3.08 mm a Agodi je imala prečnik vrata manji od svih 2.83mm. Najveći broj listova bio je kod Ifon, sa srednjom vrijednošću od 14.98, zatim 13.87 kod Owena. FRIN je imala namanji broj listova (13.66). Kod Ifon je zabilježena najviša vrijednost neto asimilacije (NAR) od 1,54g/cm^2/sedmično a najmanja je zabilježena kod Agodi sa 0,06 g/cm^2/sedmično. Agodi je imala i najvišu vrijednost relativne stope rasta (RGR) od 2,42g/sedmično, dok je Ifon imao najmanju vrijednost od 0,28g/sedmično. Prosječne performanse proučavanih izvora u pogledu njihove visine i rasta prečnika, proizvodnje listova i širenja lisne površine pokazale su da su najbolje performanse zabilježene kod sadnica uzgojenih od Ifon sjemena. Sadnice iz Agodi izvora bile su druge po redu, dok su Owena bile najslabije. Uprkos slabim performansama Owena u ovoj studiji, ona je rezistentna na Eryodiv myth, insekt koji napada *T.ivorensis* u ranim fazama razvoja.

Ključne riječi: Provenijencija, sadnica, rast i varijacija