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PROVENANCE VARIATIONS IN *Chrysophyllum albidum* (G. DON) FROM SIX LOCALITIES IN RIVERS STATE, NIGERIA

Oyebade B. A.,[1] Ekeke B. A.[2] and Aigbe H. I.[1]
[1]Department of Forestry and Wildlife Management, University of Port Harcourt, Choba, Port Harcourt, Nigeria
[2]Department of Forestry and Environment, Rivers State University of Science and Technology, Port Harcourt, Nigeria
E-Mail: bukkibadef@yahoo.com

ABSTRACT

The effects of seed sources on early growth of *Chrysophyllum albidum* (G. Don) was evaluated from six localities in Rivers State of Nigeria. Forty (40) seedlings from each location were transplanted into standard size (12 x 5 x 5cm) polythene bags filled with topsoil, and early growth variables of seedlings height, collar diameter, leaf number and leaf area with mortality and germination rates estimated at the interval of two weeks for a period of twelve weeks after sowing (WAS). There were significant variations ($P<0.05$) in all the evaluated growth variables across the locations with increases in time of sowing. Seed source from Bori had the highest germination percentage (53%) and less mortality rate (47%). Seeds from this location also show the highest resistance to collar disease and therefore were regarded as the most promising provenance. However, genetic studies for tree improvement are recommended for further investigation.

Keywords: *Chrysophyllum albidum*, provenance, early growth variables, germination pattern.

INTRODUCTION

The concept of provenance trial remains invaluable in the selection of seeds with desired qualities for propagation. Provenance is the geographical source or place of origin from where a given lot of seed or plants are collected, often restricted to refer to material from a specified race. Trial of provenances of different species for their performance in different agro-climatic regions of the State has been carried out (Lauridsen, 1977; Simons and Leakey, 2004; Indira, 2006). This trial involved mainly the exotics species that are selected for large-scale multiplication in the new region. According to Burley and Wood (1976), tree species with a wide geographical distribution exhibit considerable provenance variation in anatomy, morphology and physiology. He accounted that this provenance variation trails are distinguishable from genetic and ecological studies of tree species which provide information on the pattern and extent of phenotypic and genotypic variations. In this type of variability, there is direct relationship to the distribution of continuous or disjuncture environmental factors such as soil type, altitude, exposure or latitude with their associated factors of precipitation, temperature and photoperiod; and thus making it (genetic and ecological studies) expensive despite its essentiality to a rational programme of afforestation with an untried species. Provenance trials is practically aimed at identifying provenances of seed which will produce well-adapted and productive forests with particular criteria that include survival, resistance to adverse environmental factors and pest, wood quality, seed production as well as establishing local seed production stands.

The studies of Jacobs (1964) and Zobel (1969) however listed the possible risk of using exotic species or provenances when it is uncertain whether they are adapted to local environment. According to them, the supposed tree species may succumb to unusual extremes of the environment, with their growth rate and health declining markedly after good beginning due to unsuspected inadequacies of site. They may also be attacked by insects or pathogen when grown on marginal sites with disappointing wood type and quality.

Though several studies have been carried out on provenance trails with particular reference to some indigenous and exotic species (Dietrichson, 1969; Willan *et al*., 1990; Akinnagbe and Oni, 2007), there is still dearth of information on the provenance variation of important fruit tree species in Nigeria. *Chrysophyllum albidum*, commonly called star apple, is one of such important fruits tree species that are found around household gardens in Sub Saharan Africa (Niez, 1987). It is a large berry containing five large flattened seeds, or sometimes fewer by abortion. It is native of West Indices and Central America and often planted in Nigeria and many West Africa countries for its edible fruits (Okafor, 1979). The tree can grow up to 36m high with bole sometimes long and straight but often branched low down with deeply fluted buttresses at the base.

While many of these compound tree species exist in Nigeria, no serious studies or investigation has been carried out to test for their provenance variations. The quantitative methodology of provenance trial involves the application of suitable statistical model and experimental design technique. According to Burley and Wood (1976), adopting and designing relevant experimental design is to minimize experimental heterogeneity and to increase the precision or correctness of provenance comparisons such that element of experimental error is minimized and separated from every other sources of variability. Lemay and Robinson (2004) reported that in forestry experiments with large experimental units, blocking is often very useful in reducing error variance with only a small reduction in error degrees of freedom, and that blocks (or variables that represent blocks such as provenance trials) are most often random effects. Accordingly, randomized complete block design (RCBD) is the favoured design for provenance

trial. This design is simple, flexible and statistically robust to reduce the variability among experimental units (Singh and Chaudhary 1985).

Therefore, this study was carried out to investigate the effects of seed sources on early growth of *Chrysophyllum albidum* (G. Don) from six localities in Rivers State of Nigeria. The study also considered the effect of appropriate experimental design (RCBD) on the provenance variations of *Chrysophyllum albidum* seedling from the six seed sources.

MATERIALS AND METHODS

Seed collection and silvicultural assessment

Chrysophyllum albidum seeds were collected from six locations in Rivers State, one of the states in the south-south region of Nigeria. The locations are Ahoada, Bonny, Bori, Degema, Ogbakiri and Port Harcourt (Table-1). Six hundred seeds were collected from all the six locations for the study; from which silvicultural assessments, namely germination potentials and growth patterns were assessed.

Experimental design and data analysis

The seed germination assessment was carried out in a Randomized Complete Block Design (RCBD) in five replicates with locations and weeks after sowing (WAS) as major sources of variation. Twenty four (24) germination boxes were set up, where hundred (100) seeds were sown per location were sown. Mechanical method was used on the seed coat of the *species* to enhance the breakage of dormancy and improve germination potential. The seed germination and mortality percentages were determined at interval of two weeks for a period of twelve weeks. Similarly, forty (40) seedlings from each location were transplanted into standard size (12 x 5 x 5cm) polythene bags filled with topsoil, and growth variables notably seedling height, collar diameter, leaves number and leaf area were measured. All the data were subjected to relevant data transformation to conform statistical assumptions (Jayaraman, 1999; Montgomery, 1976) while the data was later analyzed using Statistical Package for Social Sciences (SPSS) for windows (version 17.1). The Randomized Complete Block Design (RCBD) fixed model used in the study is of the order:

$$Y_{ij} = \mu + t_i + \beta_j + \varepsilon_{ij}$$

where

Y_{ij} = the response for the experiment unit with the *i*th treatment in the *j*th individual

μ = overall mean

t_i = the treatment effect

β_j= Block effect (locations)

ε_{ij} = error effect with *i* =1,……..t and j= 1,…….b

Thus, the treatment and block effects in the model are subject to restriction (assumption) such that:

$$\sum_{\bar{i}}^{t} = 1, t_i = 0 \; and \; \sum_{j}^{b} = 1\beta_j = 0$$

Then, the errors are assumed to be independent N $(0, \sigma^2)$.

Table1. Climatic information on *Chrysophyllum albidum* in the study locations.

	Mean annual rainfall (mm)	**Latitude**	**Longitude**
Ahoada	2264	5° 05¹N	6° 39¹E
Degema	1862	4° 43¹N	6° 45¹E
Bori	2488	4° 42¹N	7° 19¹E
Bonny	4698	4° 25¹N	7° 10¹E
Ogbakiri	2363	4° 50¹N	6° 52¹E
Port Harcourt	2805	4° 46¹N	7° 00¹E

RESULTS AND DISCUSSIONS

The results of the assessment of germination pattern and early growth variables of the provenances of *Chrysophyllum albidum* showed significant outcomes. The germination percentages of the seeds across the six locations range between 21- 53% (Table-4); a trend which shows a fairly germination potential across the six locations, and which may be attributed to variability in mechanical force applied to the hard-coated shell in a bid to break the dormancy during the pre-germination treatment. This trend agrees with the work of Willan *et al*., (1990) that reported the incidence of low germination rate with any hard-coated leguminous tree species. The results of DMRT for test of significant differences in the means of seed sources and growth variables revealed a difference among the locations and period of growth (Table-3 and Figures 1 to 4). There was increasing trend among the growth variables across the locations which indicated cumulative growth performances during the period of assessment (Table-2); this observation was in agreement

with the report of Akinnagbe and Oni (2007) which associated such increment growth to characteristics common to biological organisms.

However, the ANOVA results revealed significant differences among all the growth variables (seedling height, collar diameter, leaf number and leaf area) across the locations contrariwise to the submission of Akinnagbe and Oni (2007) that emphasized significant difference in seedling height growth only (Table-3). The result of this study shows the effectiveness of RCBD in comparing presence of significant variation in early seed growth variables in relation to seed sources (the locations) proposed for forestry trials such as provenance trial (Lemay and Robinson, 2004). The results on the mortality and germination percentages also revealed a significant observation in seed sources with Bonny and Degema (riverside communities) having mortality rate of 78.92% and 62.3%, respectively. This may be attributed to the susceptibility of the seeds from these locations (as all other locations are riverside) to incidence of fungi attack such that the germination rate were drastically affected expect the seeds from Bori; an upland area of the State with least mortality (47.40%) and germination rate above the average (Table-4). This consequently make provenance from Bori more promising above all other locations. High mortality due to fungus attack was also reported by some workers in similar studies on some leguminous tropical tree species. They attributed the high mortality rate to fungi attack on collar region of their seedlings (Akinnagbe and Oni, 2007; Partride, 2005). However, critical genetically investigations are recommended for more genetic and ecological studies for the species improvement programme for many Niger Delta communities.

Table 2. *Chrysophyllum albidum* provenances growth performance twelve (12) weeks after sowing (WAS).

Locations	**Growth variables**			
	Seedling height (cm)	**Collar diameter** (cm)	**Leaf number**	**Leaf area** (cm^2)
Ahoada	36.84	0.64	16	346.92
Degema	15.27	0.52	8	261.78
Bori	34.92	0.81	18	347.64
Bonny	12.45	0.485	9	288.84
Ogbakiri	32.56	0.49	16	364.52
Port Harcourt	28.94	0.51	12	276.89

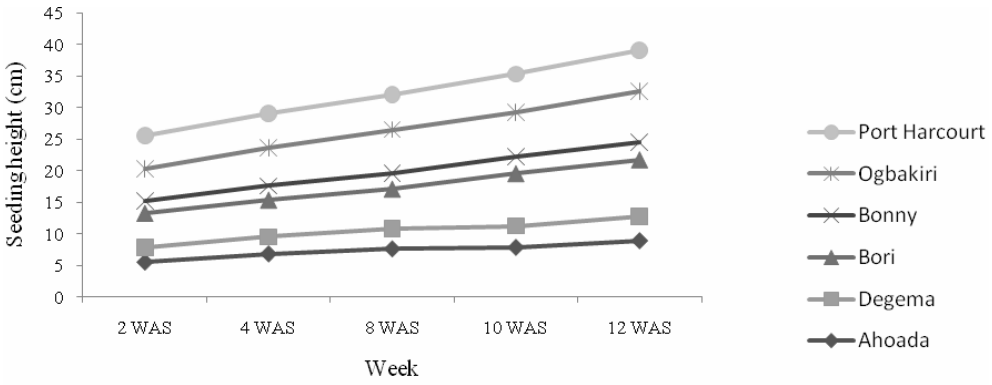

Figure 1 : Mean seedling height growth among the six *Chrysophyllum albidum* seed sources

Table 3. Results of multiple comparisons (DMRT) of seedling heights and weeks of germination in *Chrysophyllum albidum* from the six different locations in Rivers State.

Location	**Seedling height** (cm)	**Collar diameter** (cm)	**Leaf number**	**Leaf area** (cm^2)
Bonny	2.490^{a}	0.097^{a}	2.800^{a}	57.768^{b}
Degema	3.054^{a}	0.104^{ab}	3.600^{bc}	52.356^{a}
Port Harcourt	5.788^{b}	0.102^{ab}	2.800^{a}	55.378^{b}
Ogbakiri	6.512^{c}	0.099^{a}	3.600^{bc}	72.904^{d}
Bori	6.984^{cd}	0.162^{c}	4.000_{c}	69.528^{c}
Ahoada	7.368^{d}	0.128^{b}	3.200^{ab}	69.384^{c}
Week				
2WAS	4.248^{a}	0.093^{a}	2.000^{a}	54.835^{a}
4WAS	4.847^{ab}	0.101^{ab}	3.167^{b}	58.545^{b}
8WAS	5.332^{bc}	0.120^{bc}	3.167^{b}	60.645^{b}
10WAS	5.887^{c}	0.124^{bc}	4.167^{c}	67.653^{c}
12WAS	6.517^{d}	0.140^{c}	4.167^{c}	72.753^{d}

Means with same superscripts are not significantly different from one another along the same column at P>0.05, WAS-(weeks after sowing)

Table 4. *Chrysophyllum albidum* mortality and germination percentage (%) among the seed sources.

	Mortality (%)	**Germination** (%)
Ahoada	50	50
Degema	62.34	38
Bori	47.4	53
Bonny	78.92	21
Ogbakiri	52.9	47
Port Harcourt	56	44

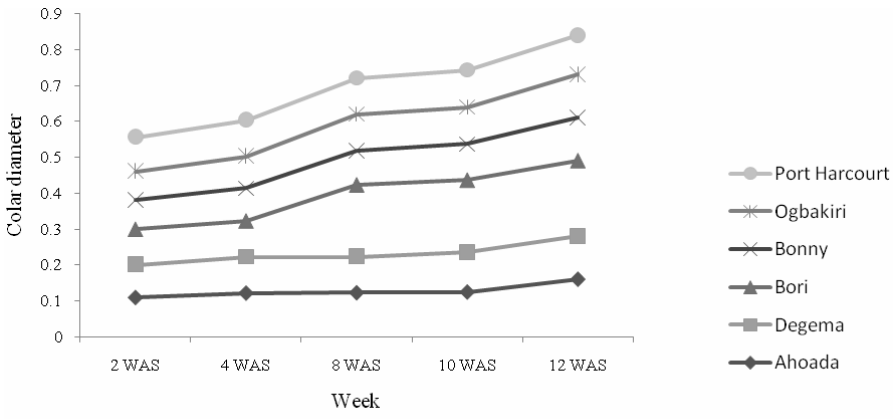

Figure 2: Mean colar diameter growth among the six *Chrysophyllum albidum* seed sources

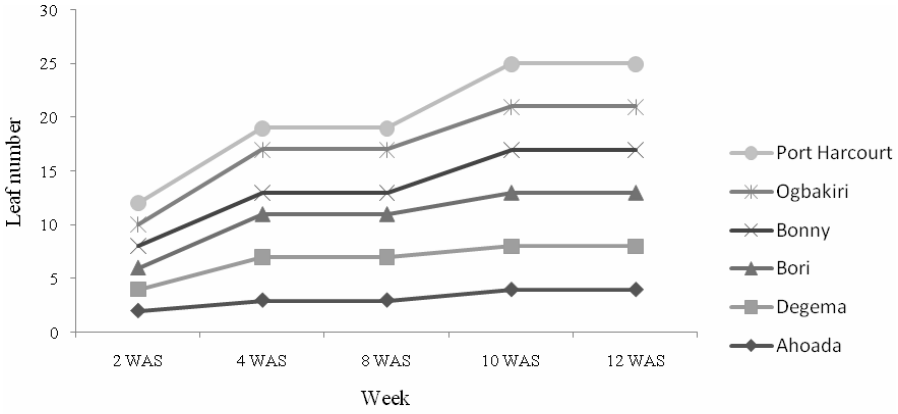

Figure 3: Mean leaf number among the six *Chrysophyllum albidum* seed sources

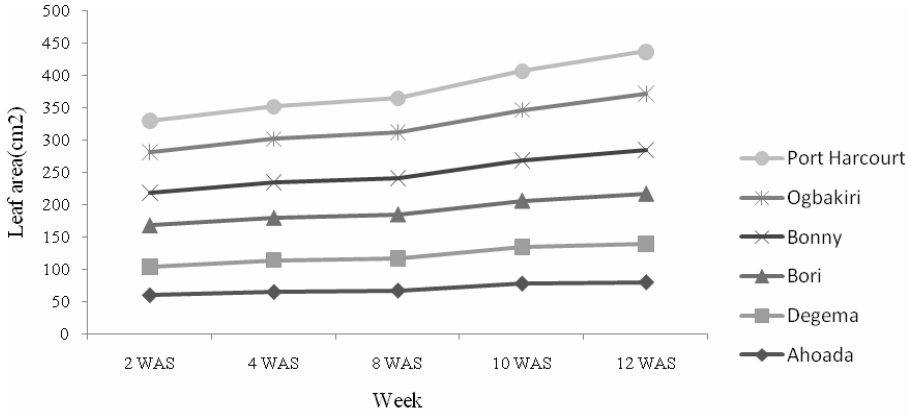

Figure 4: Mean leaf area growth among the six *Chrysophyllum albidum* seed sources

CONCLUSIONS

This study has evaluated variations in the growth *Chrysophyllum albidum* seeds from six provenances in River State, Nigeria. The study revealed significant differences among the growth variables with regard to. There was high mortality across the locations expect in Bori; an upland area, where the highest germination rate was recorded. This shows a promising provenance from this location above all other locations particularly However, genetic and ecological studies on molecular tree improvement of the species are highly recommended.

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