Evaluation Of Silvicultural Requirements Of Dialium Guineense (Willd), A Neglected Indigenous Fruit In Nigeria

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ABSTRACT

Evaluation of silvicultural requirements of *Dialium guineense* to different potting media and pot sizes were investigated towards efforts in increased domestication and *ex-situ* conservation. Initial seeds viability test was carried out in the laboratory and subsequently 100 seeds were sown in a high humidity propagator and germination monitored for one month. Thereafter, thirty six fairly uniform vigorous seedlings were selected and potted into different pot sizes containing different potting media and growth performance monitored. Findings indicated that highest total plant height (9.54cm) was observed in the small pot size containing topsoil (M_1P_1) and least (8.16cm) in medium pot size with sawdust (M_2P_2. Highest plant diameter (15mm) was attained in the large pot size containing topsoil (M_1P_3) and least (13.00mm) in the medium pot size containing saw dust (M_2P_1). Interactions between potting media and all the growth parameters were significant ($p<0.05$) while interaction between pot sizes and growth parameters were not significant. Interactions between pot sizes and potting media were also not significant. Pot size effect was not particularly stable for most growth variables investigated, rather the type of potting medium used. The present study indicates that topsoil as potting medium was superior irrespective of pot sizes. Although pot size effects was not consistent, however raising the species in small to medium pot size with top soil as potting medium was most preferred. The use of sterilized river sand or saw dust may not be particularly recommended while large pot size appeared not to confer special advantage on early seedlings growth

Key words: *Dialium guineense***,** pot size, potting media, growth parameters, conservation

INTRODUCTION

Nigeria is rich in floristic composition and biodiversity with over 4,600 species out of which 205 are endemic, while another 476 species are threatened (Country Report Nigeria, 1997; FAO, 2000). The forest contributes between 1.3%-3% of the Gross Domestic Product (GDP) and over 10% to the forest food supply of rural population. The forest has productive, protective and social function (Matthew, 1994; Olajide, 2003) however this important resource is undergoing serious genetic depletion arising from both natural and human induced factors (FAO, 2004). The Federal Department of Forestry puts the rate of deforestation in Nigeria at 3% (Oyebo, 2006). *Dialium guineense* (Willd) belongs to the sub-family and family (Caesalpiniaceae, Fabaceae), commonly known as Velvet tamarind. It is a woody perennial species growing in dense Savannah forests (ICRAF, 1996) but has extended to the derived and forest fringe due to forest disturbance. It is a useful legume and it has been suggested for use in agroforestry both as a leguminous tree capable of fixing soil Nitrogen and as fodder for livestock (Larbi *et al*; 1998).

D. guineense has been classified as a multipurpose tree species by many authors (Okeke and Omaliko, 1991, Larbi *et al*; 1998). Its ecological amplitude extends from Senegal to Nigeria, also occurring in the Islands of Principle and Sao Tome but in most cases it is restricted to the Savanna region of Nigeria (Keay, 1989). The fruit which is brownish when dry, contains sweet edible mealy pulp and is consumed locally. According to Okafor (1980) production of alcoholic beverages and high quality Jam and Jelly products were possible. It is commonly known as *Awin* among the 'Yorubas', *Icheku* by 'Ibos' and *tsamiyar kurmi* by the Hausas (Keay 1989). Flowering is a dry season event (October – December) while fruiting often extends to early rains (February -April) (Keay, 1989). Most seeds remain viable for longer periods than normal if they are first dried and then stored at low temperature in a sealed container. The dry wood burns readily and makes splendid firewood while the charcoal is used by blacksmith (Okafor, 1980). Several other domestic uses had been indicated for the wood, the root of the plant is used as a woman's medicine, and when cooked with palm-nut is used for managing stomach ache (Irvine, 1961, Gills, 2001).

Despite these numerous economic potentials in traditional culinary, deliberate domestication and silvicultural efforts had remained very low at the expense of diminishing natural population attributed to deforestation and land degradation. Faboye and Gbadamosi (2007) worked on progenies variation while Oboho *et al*. (2012) worked on the species

germination however their studies used only top soil as potting medium. Developing *ex-situ* conservation programme for any forest tree species requires sound and broad-based knowledge on the species silvicultural requirements including potting media and pot sizes for nursery operations. The present investigation was carried out to provide additional information in this regard to promote more silviculutral studies

MATERIALS AND METHOD

PROCUREMENT OF SEEDLINGS AND MATERIALS

Seeds used for this study were obtained from the (Seed store unit) of Forestry Research Institute of Nigeria (FRIN) Ibadan ((Long. 07°24'N, Lat. 3°54'E). Seed storage information indicated that they were less than three months in the store. Altogether 120 seeds were randomly collected from the batch and 10% of the seeds were subjected to laboratory viability test. For the potting media, Top soil was collected randomly at depths of 0–15cm from a *Gmelina arborea* plantation near the Federal College of Forestry Nigerian Ibadan, the second medium; River sand was collected from a perennial stream at a watershed adjacent the institute, while the third potting medium, sawdust was obtained from the institute saw mill. All the potting media were processed by removing all contaminants and impurities. The Top soil was sieved to remove all coarse particles and other unwanted materials while the river sand was washed and sterilized to remove pathogenic agents and the sawdust was also cleaned and dried. The three potting media were coded as indicated below:

M_1 - Topsoil
M_2 - Saw dust
M_3 - River Sand

Three pot sizes used were coded as indicated:

P_1 - Small pot size (8cm X 15cm)
P_2 - Medium pot size (12cm X 20cm)
P_3 - Large pot size (15cm X 25cm)

The experimental design is simple completely randomized and replicated four times and each replicate made up of 9 treatment units given a total of 36 treatment units. Following 100 percentage (%) laboratory seedlings germination within 2 weeks after sowing, the remaining batch of 100 seeds were sown in five (5) plastic seed trays filled with washed sterilized river sand at the rate of 20 seeds per tray. After sowing, they were watered and placed under a high humidity propagator which was the germination chamber. On a daily basis, light watering was carried out using a knap sprayer and one week after, seedlings emergence were noticed in the different plastic trays. Seedlings emergence and growth were monitored for one month under the high humidity propagator. Ahead of the potting out of the seedlings into the different black polythene pots, 12 of each of the different sizes of the poly pots were obtained and filled respectively with the different potting media based on the experimental design. They were subsequently arranged under a weaning shed as shown below (Table 1). Thereafter 36 most vigorous *Dialium* seedlings which were approximately the same size heights were selected from the five plastic seed trays and one seedling was transplanted per different polythene pot sizes containing different potting media. Thereafter routine operations including watering and rouging were carried out every other day for the next weeks before data collection started. Morphological parameters data collection started 2 weeks after potting for total plant height (cm) number of leaves, stem diameter (mm) at soil mark

EXPERIMENT LAYOUT

R_1	R_2	R_3	R_4
M_1P_1	M_3P_1	M2P3	M3P2
M_1P_2	M_2P_2	M1P2	M1P3
M_1P_3	M_1P_3	M3P1	M2P1
M_2P_1	M_2P^1	M1P3	M1P2
M_2P_2	M_1P_2	M2P1	M2P3
M_2P_3	M_3P_3	M3P2	M3P1
M_3P_1	M_2P_3	M1P1	M2P2
M_3P_2	M_1P_1	M2P2	M3P3
M_3P_3	M_2P_2	M3P3	M1P1

RESULTS

Total Plant height (cm)

Total seedlings plant height showed a gradual increase from 2weeks after potting in the different pot sizes and in the different potting media. However maximum total plant height was attained in treatment (M_3P_1) at the end of the study (10.58cm) followed by (M_1P_1) treatment (10.20cm) and least in (M_2P_2) treatment (8.43cm). However mean total plant height value (9.54cm) was attained in the treatment (M_1P_1) under small pot in the topsoil. Mean plant height in the river sand and small pot size treatment (M_3P_1) also compared favorably with those in topsoil and small pot size with a mean value of 9.50cm (Table 1). However the least mean plant height (8.16cm) was attained in the sawdust in the medium pot size (M_2P_2). Comparison between river sand and saw dust as potting media showed that pot size was effect was more critical compared with potting media. Small pot size supported optimum growth under sawdust whereas with increase in pot size, plant response was better in the river sand as potting medium. Potting media had significant effect on seedlings height however interaction between pot sizes and potting medium was not significant. Analysis of variance for the interactions among the treatments over the period of the experiment was also not significant ($p>0.001$).

Table 2 Effects of potting media and pot sizes on Total seedlings height in *D. guineense*

Treatments	Weeks after potting (WAP)				Mean
	2	4	6	8	
M_1P_1	9.00	9.33	9.63	10.20	9.54
M_1P_2	8.05	8.38	8.60	8.80	8.45
$M1P_3$	8.10	8.50	8.78	8.90	8.57
M_2P_1	7.60	8.30	8.83	9.13	8.46
M_2P_2	7.75	8.13	8.35	8.43	8.16
M_2P_3	8.63	9.00	9.18	9.23	9.01
M_3P_1	8.25	9.13	10.05	10.58	9.50
M_3P_2	7.97	8.23	8.45	8.73	8.34
M_3P_3	8.38	8.60	9.00	9.03	8.75

Effect of pot sizes and potting media on number of leaves per plant

Number of leaves also increased in the same manner like the total plant height parameter from 2 weeks (2WAP) after potting to a maximum of eight leaves per plant at the termination of the experiment. At the initial stage, small pot size containing river sand (M_1P_3 showed higher number of leaves per plant compared with other treatments. However, at the end of the study small pot size containing topsoil (M_1P_1) treatment had the highest mean number of leaves of 6.35 (Table 3). The individual treatments had effect on total number of leaves, however the interactions between potting media and pot sizes had no significant effect on number of leaves ($p>0.001$).

Table 3 Effects of potting media and pot sizes on number of leaves in the *D. guineense* seedlings

Treatments	**Weeks after potting (WAP)**				**Mean**
	2	**4**	**6**	**8**	
M_1P_1	5.0	6.0	7.2	7.2	6.35
M_1P_2	5.0	5.2	5.2	5.5	5.20
M_1P_3	4.7	4.7	5.0	5.0	4.85
M_2P_1	4.5	4.7	6.5	7.2	5.72
M_2P_2	4.7	4.7	4.5	4.7	4.65
M_2P_3	4.2	4.7	5.0	5.0	4.72
M_3P_1	5.0	5.7	7.0	7.7	4.60
M_3P_2	5.0	5.0	5.0	5.0	5.01
M_3P_3	4.5	4.5	4.7	5.2	4.72

Table 4 Analysis of variance (ANOVA) for the number of leaves in the *D. guineense* seedlings

Sources of variation	Df	SS	MS	VR	F pr
Replicate	3	4.25	1.41	3.22	
Week	3	27.80	9.26	21.04	<.001***
Pot size	2	4.38	2.19	4.98	0.009*
Media	2	52.72	26.36	59.85	<.001***
Week x pot size	6	0.61	0.10	0.23	0.96 ns
Week x media	6	26.94	4.49	10.20	<.001***
Pot size x media	4	1.94	0.48	1.10	0.35ns
Week x pot size x media	12	2.38	0.19	0.45	0.93ns
Total	105	46.25	0.44		

*** Highly significant at $p < 0.05$

* Slightly significant at $p<0.05$

NS = Not significant

Effect of pot size and potting media on mean plant seedling diameter (mm)

Mean plant diameter was determined at the end of the study in view of the exceptionally slow growing rate in the species. The seedlings plant diameter showed similar

trends as observed for other growth parameters. Maximum seedlings diameter was observed in large pot size containing top soil (M_1P_3) with a mean value of 15mm (Table 5) while the least mean seedlings plant diameter was obtained in the small pot size containing saw dust (M_2P_2) (Table 5). Generally seedlings growing in top soil as potting medium showed comparatively superior seedlings diameter to those either in saw dust or river sand irrespective of pot sizes. However seedlings in the river sand medium compares favorably with that in topsoil in small pot size treatment. The seedlings diameter in river sand was better compared with that of sawdust medium though values observed for medium and large pot sizes for both potting media were the same. Treatments interaction (potting media and pot sizes) was however not significant ($p>0.001$).

Table 5 Effects of potting medium and pot sizes on seedling total girth in *D. guineense*

Treatments	**Mean seedling diameter (mm) (8 WAP)**
M_1P_1	13.50
M_1P_2	13.75
M_1P_3	15.00
M_2P_1	13.00
M_2P_2	13.50
M_2P_3	13.50
M_3P_1	14.25
M_3P_2	13.50
M_3P_3	13.50

DISCUSSION

From the present investigation *D. guineense* is a slow growing species like it had been reported for several indigenous tree species in Nigeria and West Africa (*Parkia biglobosa* and *Vitellaria paradoxa* (Oni, 2002; Odebiyi *et al*; 2004). This problem makes the various treatments effect not to be fully expressed even at the expiration of the study. Mean plant heights in this study were similar to the works of Faboya and Gbadamosi (2007) and Oboho *et*

al. (2012) who both obtained 14.7cm and 14.66 respectively though their studies lasted for a longer period. From the present study, Top soil as potting medium had the best performance among the various potting media (Top soil, River sand and Sawdust) irrespective of different pot sizes. This perhaps may be attributed to the availability of organic matter and primary elements in form of (NPK) in the soil which had been reported to enhance faster growth by earlier studies (Nwoboshi, 1982; Ginwal *et al;* 1995).

Potting medium is a major factor in any seedling domestication study although top soil had been widely acknowledged by various workers as the best medium for seedling establishment (Faboya and Gbadamosi 2007 and Oboho *et al;* 2012), it was however observed from the present study that washed sterilized river sand equally supported active early seedlings growth in this study and compared favorably with top soil. However, sawdust as potting medium was observed not to compare effectively or favorably with the other potting media. The lower comparative performance may not be unconnected with too much lignin in the material which in most cases had been reported not to support active seedling growth and development due to its poor nutrient reserve (Faboye and Gbadamosi, 2007).

Generally, the bigger the soil volume the more the expected growth for most plants (Oni and Caspa, 2002), however it has been observed that this may not bring about significant effect on overall plant growth as observed in the present study. It was observed that optimum seedlings performance for both total plant height and number of leaves were obtained in small pot size compared with other pot sizes. Potting medium was more critical in plant growth compared to pot size since the initial plant performance is mainly based on available nutrients (Nwoboshi, 1982**).** Oni and Caspa (2002) obtained significant effect on pot sizes in their study however their investigation involved the use of different soils types as compared to the different potting media investigated in the present study. Except for plant diameter where pot size significantly influenced the seedlings performance, pot size effect had no significant effect on other growth parameters. Plant height at four-leaf stage indicated that the best plant height was recorded in the small pot size containing top soil indicating that potting media rather than pot sizes was the major factor.

From the present study it may be concluded that small to medium pot sizes are likely to have more positive effects on early seedling growth in the species while top soil rich in essential mineral elements is recommended for use as potting medium for most silvicultural studies. The

use of large pot size may not be necessary especially if the seedling would be moved to permanent site later. Where good top soil is expensive or not ready available or accessible it may be economical to use small pot size once the soil is rich in essential plant nutrients. Early seedlings establishment favor small to medium pot size using either top soil or river sand. For research purpose however where pathogens control is crucial, sterilized washed river sand is preferred to top soil as potting medium. Except where both soil media (top soil and river sand) become too expensive or inaccessible saw dust may then be used as observed from this study. Generally sawdust performance was least for most of the parameters investigated.

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