

Effect of Planting Media on the Germination and Early Growth of *Dacryodes Edulis* (G. Don) H. J. Lam

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Abstract: *Dacryodes edulis* (G Don) is an evergreen tree attaining a height of 18-40 m in the forest but not exceeding 12 m in plantations. In Nigeria, it is an important food supplement. The species is a delicacy among the people in several parts of Nigeria where it is consumed in association with other foods such as fresh maize. It is a highly nutritious fruit. Lack of knowledge, especially in propagation techniques for this woody species, inhibits farmers in Africa, including Nigeria, from successfully growing this multipurpose forest fruit tree species. A study was conducted to determine the germination and seedling growth of *Dacryodes edulis* (African pear) as affected by different planting media: top garden soil, river sand, sawdust and a mixture of river sand and sawdust. Sawdust and river sand was mixed in a ratio of 50:50 in the Forestry Nursery of Federal University of Agriculture Makurdi. Seeds were procured and sown in the poly pots filled with various sowing media of sawdust river sand, top soil, and composite mixture of sawdust and river sand. The experiment was laid out in a Completely Randomized Design (CRD) with 3 replicates. The results showed seeds planted in River sand had the highest germination of 100% and was significantly different ($p \leq 0.05$) from those sown in other growth media (river sand and river sand combined with sawdust had 96.67% each while topsoil had 80%). The results also indicated that the performance of the seedlings in terms of height, number of leaves, leaf area and collar diameter planted in the composite mixture of Sawdust and River was better though not significantly different ($p > 0.05$) compared to those in the other growth media except for Top soil medium that had relatively low performance. This study has established that the germination and seedling growth of *D. edulis* are significantly affected by planting media; while river sand recorded better growth performance and is therefore recommended for raising seedlings for plantation establishment.

Keywords: *D. edulis*, Germination, Growth medium, Plantation, Seedlings.

1. INTRODUCTION

Dacryodes edulis (G Don) is a multipurpose plant in Nigeria and Africa at large (Zofou *et al.*, 2013); which grows in the humid tropics. Many households and communities depend on this multipurpose tree for the provision of goods and services that include edible fruits, herbal medicines or fuel wood as well as global service by facilitating carbon sequestration with the potential for climate change mitigation (Albrecht and Kandji, 2003). The gathering of the fruits of *D. edulis* serves as a veritable source of employment and income for rural populace (Agbogidi *et al.*, 2007).

In Nigeria, it is an important food supplement. *D. edulis* is a delicacy among the people in several parts of Nigeria where it is consumed in association with other foods such as fresh maize (Agbogidi and Eshegbeyi, 2006). It is a highly nutritious fruit whose edible pulp contains ash (10.8%), fibre (17.9%), oil (31.9%), protein (25.9%), energy (444.7 kcal/100 g), carbohydrate (13.5%) and moisture content (12.04%) (Agbogidi *et al.*, 2007).

Lack of information on propagation techniques for the woody species inhibits farmers from successfully growing this multipurpose forest fruit tree species (Schreckenber *et al.* 2002; Akinnifesi *et al.* 2008). Due to inadequate research on planting and regeneration of economic woody species in Africa; and most of the work to date has been skewed towards exotic tree species. Consequently, there is an urgent need to study and improve both new and existing methods for propagation and regeneration of the tree species (Nyamukuru *et al.*, 2014).

With increasing population pressure and high demand for this multipurpose forest fruit tree and consequent on the fact that very few farmers domesticate and cultivate *D. edulis* in Nigeria, due to the limited information on the germination of the seeds as well as the seasonality of fruit production and inability of the fruits to store well for a long period of time, the need to develop the best planting medium required for the germination and early seedling growth of *D. edulis* cannot be over emphasized (Agbogidi *et al.*, 2007). *D. edulis* has also been included in the list of endangered forest species (Leakey, 1999; Nwoboshi, 2000). This calls for urgent attempt to domesticate and enhance their acceptability to local farmers, to ensure that the future generation is not deprived of the inherent benefits of this economically important fruit tree species.

The use of suitable growing medium is essential for production of quality plant seedlings. It directly affects the growth, development and maintenance of the functional rooting system. A good growing medium would provide sufficient support to plant; it would also serve as reservoir for nutrients and water, allow oxygen diffusion to the roots and permit gaseous exchange between the roots and atmosphere outside the root substrate (Abad *et al.*, 2002). Nursery potting media influence quality of seedlings produced (Agbo and Omaliko, 2006). The quality of seedling obtained from a nursery influences re-establishment in the field and the eventual productivity of an orchard (Baiyeri, 2006). Thus the aim for this study is to evaluate various planting media to ascertain the most suitable medium for the germination and early seedling growth of *D. edulis* so as to enhance its success in propagation and cultivation in the study area.

2. MATERIALS AND METHODS

2.1. The Study Area

This study was conducted at the Forestry Nursery of the Department of Forestry, Wildlife and Range Management, University of Agriculture Makurdi, Nigeria. The Forestry Nursery lies between Longitude 8° 21' and 9° E and Latitude 7° 21' and 8° N within the southern guinea savanna ecological zone. The climate of the area is tropical sub-humid with high temperatures and high humidity. The maximum temperature is 35 °C while the minimum temperature is 23 °C (Seibert, 2007). The climate is characterized by two distinct seasons namely; rainy and dry seasons with an annual rainfall of 1200mm-1500mm. The vegetation of the area has been described as Southern guinea savanna. The major occupations of the people include; farming, fishing, trading and hunting; the major tribes are Tiv, Idoma and Igede.

2.2. Seed Procurement and Extraction

Fruits of *Dacryodes edulis* were purchased from railway market in Makurdi, Benue state in Nigeria. This market is a well-known market of *D. edulis* and other fruits. This became necessary due to the recalcitrant nature of the seeds and the seasonality in seed production of the tree species (Agbogidi *et al.*, 2007). Viable seeds were sorted out by simple flotation techniques following the procedure of Agbogidi and Eshegbeyi (2006). Seeds are recalcitrant and thus could not be stored for a long time. It loses its viability when subjected to drying or freezing (Walters *et al.*, 2013). Seeds were extracted from the mature fruits of *Dacryodes edulis* in which the fruits were mechanically de-pulped to expose the seeds using a blade. The fruits were split open and deseeded carefully to avoid affecting the anatomical structure of the seed.

2.3. Seed Sowing and Filling of Polythene Pot

Bottom perforated polythene pots were filled with various planting media of top soil (TS), river sand (RS), saw dust (SD) and a mixture of sawdust and river sand (SR); the mixture of river sand and sawdust was done in the ratio 1:1. The extracted seeds of *Dacryodes edulis* were planted directly into the poly pots and each filled with the planting media of top soil (TS), river sand (RS), saw dust (SD) and a mixture of sawdust and river sand (TR), respectively. Watering of the sown seed was done consistently every day after planting to give the seed every condition needed for proper growth.

2.4. Experimental Design

The experiment was laid out in Completely Randomized Design (CRD) at the Forestry nursery in the study area. The study involved the use of four (4) planting media and three (3) replicates. The treatments were: river sand, top soil, sawdust and composite mixture of sawdust and river sand. Total of 120 seeds were planted for the study. This study was observed for the duration of eight (8) weeks while variables were measured forth nightly starting from the 2nd week after planting.

2.5. Data Collection and Analysis

Daily observations were made to determine the effects of the four planting media on the germination of seeds of *D. edulis*. Germination of seeds were discontinued and considered to have been completed when no additional germination took place in two weeks. Data on growth variables were measured; these include: seedling heights were measured from the collar region to the tip of the seedlings by the use of meter rule. Collar diameters were measured using a veneer caliper. Number of leaves was determined by manual counting on the seedlings. Leaf area was measured by tracing three (3) leaves of seedling on a graduated graph sheet. Five seedlings from each treatment were sampled and leaf area assessed fortnightly (Aluko et al., 2014). The growth variables were measured in every two (2) weeks interval for a period of eight (8) weeks.

Data collected on seed germination and growth rate (seedling heights, number of leaves, collar diameter and leaf area) were subjected to descriptive statistics (percentages, mean and standard deviation) and inferential statistics (one-way analysis of variance (ANOVA)) were used to analyze data collected in the study area. Where significant differences occurred between the treatments means, the least significant difference (LSD) method was used to separate the means (William et al., 2012; Imoro et al., 2012; Aluko et al., 2014).

3. RESULTS

The results of these finding on germination rate is presented in Figure 1. There was no germination observed within the first 9 days after the seeds of *D. edulis* were planted in the study area. Germination and emergence of *D. edulis* seeds commenced on the 10th day; top soil had the lowest germination percentage of 45% and composite mixture of sawdust and river sand had the highest germination rate of 82%. There was increase on seeds germination on the 12th day after seeds planting. On the 14th day, river sand planting medium had the highest (100%) level of germination rate as observed. This was followed by sawdust growth medium and composite medium of sawdust and river sand which both had 98% germination on the 14th day. The lowest germination percent was recorded from the top soil planting medium with 80% on the 14th day.

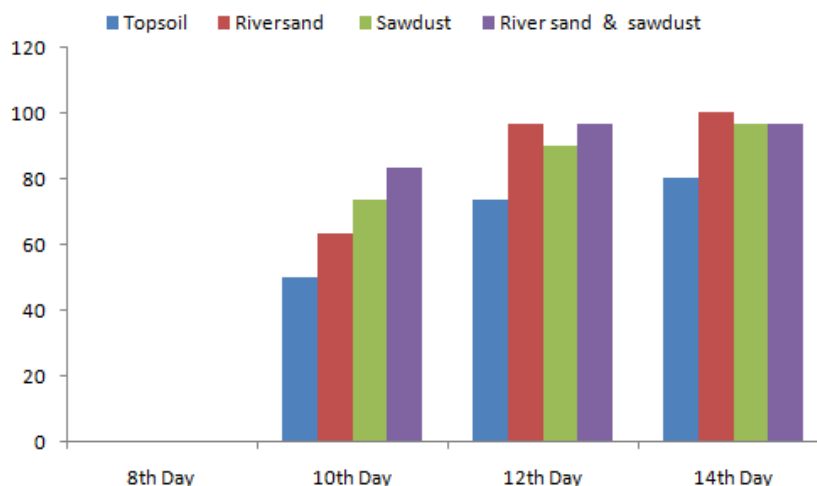


Figure 1. Effects of Different Planting Media on Germination Rate of *Dacryodes edulis* Seeds in the Study Area

The effect of planting media on the seedlings of *D. edulis* is presented on Figure 2. Top soil growth medium had the lowest mean leaf number of 5.14; river sand had mean leaf number of 7.09, sawdust (7.74) and river sand mixed with sawdust had 7.47 mean number of leaves recorded. Seedlings height of *D. edulis* showed river sand mixed with sawdust as had 19.43 cm mean height recorded, followed by sawdust (18.40 cm), river sand had a mean height of 18.21 cm while top soil growth medium had the lowest mean seedling height of 14.01 cm. *D. edulis* seedlings girth was assessed, and sawdust had 0.48 cm with the highest seedling girth, followed by river sand and river sand mixed with sawdust 0.7 cm each while top soil had the lowest mean seedling girth of 0.41 cm (Figure 2).

The leaf area of *D. edulis* seedlings was assessed based on planting media; river sand had the highest mean leaf area of 38.64 cm², followed by river sand; and sawdust (33.13 cm²), top soil (29.57 cm²) while saw dust had the lowest mean leaf area of 27.6 cm² (Figure 3).

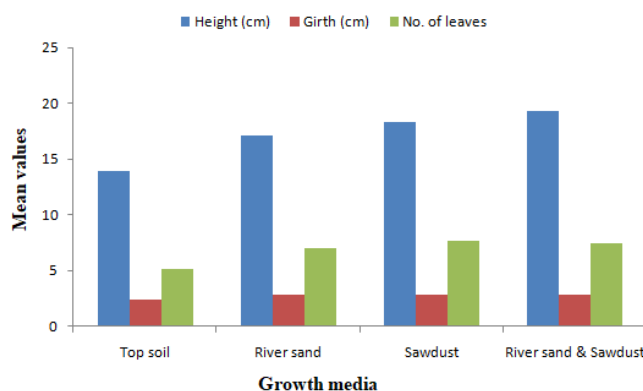


Figure2. Effects of Planting Media on the Mean Height (cm), Girth (cm) and Number of leaves in the Study Area

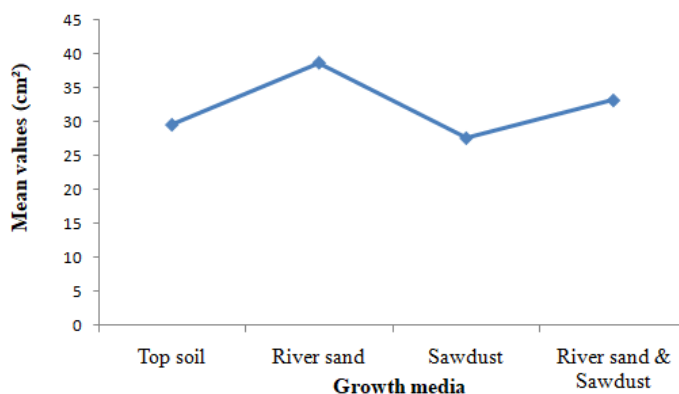


Figure3. Effects of Planting Media on the Mean Leaf Area (cm²) in the Study Area

Table 1 shows the results on the effect of planting media on the growth variables of *D. edulis* seedlings. Based on the result, there was significant difference ($p < 0.05$) on the growth variables from different growing media in the study area. Number of leaves had a significant difference of $p = 0.001$, seedlings height and leaf area which was significantly different ($p = 0.001$) while seedlings girth had $p = 0.002$.

Table1. ANOVA Result on the Comparative Effects of Different Planting Media on *Dacryodes Edulis* Seedlings In The Study Area

Planting media	Variables			
	No. of leaves	Height(cm)	Girth(cm)	Leaf area(cm ²)
Top soil	5.14±4.17 ^b	14.01±4.06 ^c	0.41±0.23 ^b	29.57±9.58 ^{bc}
River sand	7.09±3.82 ^a	17.21±8.63 ^b	0.47±0.13 ^a	38.64±8.93 ^a
Sawdust	7.74±4.06 ^a	18.40±5.60 ^a	0.48±0.14 ^a	27.60±6.64 ^c
River sand & Sawdust	7.47±3.72 ^a	19.43±6.35 ^a	0.47±0.12 ^a	33.13±9.56 ^b
P-value	<0.000	<0.000	0.002	<0.000

Means on the same column with different superscripts are statistically significant ($p < 0.05$)

4. DISCUSSION

4.1. Effect of Planting Media on Germination Rate of *D. Edulis*

This finding showed that the overall germination rate was best recorded under river sand planting medium. This implied that the preferred germination medium for *D. edulis* was river sand in the study area. This could be as a result of high porosity of river sand compare to topsoil and sawdust; as reported by Purwantoro (2016), “the porosity of river sand medium allows imbibitions by the seeds and adequate aeration for seeds to germinate quickly”. River sand has good aeration and drainage, but low water holding capacity (Rivai et al. 2015; Milla et al. 2013). Similarly Agbogidi et al., (2007) observed that the significant higher germination percentage of *D. edulis* seedlings sown in river sand could be attributed in part to the greater porosity when compared to the other media consequent upon

the greater spaces for air and water, which are the basic conditions for seed germination. Although sharp sand is poor in nutrients, Isirimal et al. (2003) maintained that they are ideal for seed germination as the germinating embryos depend on stored nutrients within the seed for their initial growth and other metabolic activities.

This finding is similar to earlier reports by Awodola (2002), on *Parkia biglobosa* seeds who reported higher germination in seeds grown in river soils than in top soils. Similarly, Owonubi et al. (2005) recorded fairly good germination for *Azadirachta indica* seeds planted in river soils. The finding of this study is in contrast with the findings of Okunomo (2000; 2004), who reported a higher germination percentage in topsoil with *D.edulis*.

4.2. Effect of Planting Media on Growth Variables of *D. Edulis* Seedlings

The results on leaf area of *D. edulis* implied that river sand medium is suitable to raise *D. edulis* seedlings for the purpose of plantation establishment in the study area. This agrees with the findings of Okunlola (2016) who recorded highest result in river sand with *A. muricata*.

The result on the height growth of *D. edulis* showed that the highest height was recorded by the composite mixture of river sand and sawdust. This result disagrees with the work Anber (2010) who obtained highest seedling height in topsoil with *D. regia*. It also disagrees with the work of Okunomo (2010) who obtained higher seedling height in poultry droppings than other treatments (topsoil, sharp sand, sawdust, clay soil, cow dung and pig manure) with *P. bicolor*. The result on seedlings diameter growth of *D. edulis* implied that, the best mean collar diameter (girth) was recorded in sawdust. There was no significant difference between river sand, sawdust and composite mixture of sawdust and river sand. The relatively slow growth recorded in topsoil medium is in contrast to the work of Agbogidi et al (2007) who recorded highest seedling performance in top soil with *D. edulis*. This could be attributed to the soil characteristics present which do not favor rapid growth of the species.

5. CONCLUSION

The finding of this study showed that the germination percentage and early growth rate of *D. edulis* was best recorded in river sand. This could be as a result of high porosity of river sand compared to topsoil and sawdust; the porosity of river sand allows imbibitions by the seeds and adequate aeration for seeds to germinate quickly. The relatively slow growth recorded in topsoil medium; this could be as a result of the soil characteristics (such as low porosity) which do not favor rapid growth of the species. Thus, it is recommended that river sand should be utilized as planting medium for raising *D. edulis* seedlings to ensure faster germination. The combination of river sand and sawdust can be an alternative for raising *D. edulis* seedlings especially in the study area.

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APPENDIX

Table 2. Effects of Different Planting Media on the Mean number of leaves, Height and Girth of *Dacryodesedulis* Seedlings in University of Agriculture, Makurdi

Variables	Sources of variation	Sum of Squares	df	Mean Square	F	Sig.
Leaf No	Between Groups	498.206	3	166.069	10.669	.000
	Within Groups	7409.442	476	15.566		
	Total	7907.648	479			
Height	Between Groups	1991.886	3	663.962	15.251	.000
	Within Groups	20722.875	476	43.535		
	Total	22714.761	479			
Girth	Between Groups	.399	3	.133	5.180	.002
	Within Groups	12.224	476	.026		
	Total	12.623	479			
Leaf area	Between Groups	2534.977	3	844.992	11.008	.000
	Within Groups	10746.979	140	76.764		
	Total	13281.957	143			

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