ISSN: 2456-6527

sjrabeditor@scischolars.com Online Publication Date: December 12, 2016 Volume 1, No. 1

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Scholars Journal of Research in Agriculture and Biology

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Seed Germination and Early Growth of Dacryodes Edulis as Influenced by Some Nursery Techniques

Okunomo, K.[1], Jacob, D. E.[2], Ekpo, I. T.[3]

[1]Department of Forestry and Wildlife, Delta State University, Asaba Campus. Asaba, Nigeria.
[2]Department of Forestry and Natural Environmental Management, University of Uyo, Nigeria.
[3] Department of Forestry and Natural Environmental Management, University of Uyo, Nigeria

Abstract

This study was aimed at assessing the effect of some nursery operations such as soil amendment, growing medium, soaking time for both cold and warm water and sowing depth on seed germination of Dacryodes edulis. The parameters assessed were germination rate, leaf area (cm), number of leaves, collar diameter (cm) and height (cm). The experiments were carried out using complete randomized design (CRD) with three replication and data obtained were analyzed using a two-way analysis (ANOVA) at 5% probability level. The result obtained indicated that top soil had the highest germination rate (64%) for soil amendment, while sawdust was the best growing medium with 80% germination rate. Soaking in warm water for 30 minutes produced the best germination rate (56%) for warm water and soaking for 24hrs gave the best germination rate (40%) for cold water. In terms of depth of planting, 4cm depth had the highest rate (50%) for germination. For growth parameters, wood ash had the highest collar diameter (0.39cm), top soil had the highest leaf area (68.23cm), pig manure had the highest leaves number (10.83), while poultry dropping had the highest plant height (982.85cm). This study recommend planting Dacryodes edulis should be grown on topsoil without any pretreatment as this provides an optimum growth for the species at a lesser cost to the farmer.

Keywords: Dacryodes edulis; Growth rate; Pregermination treatment; Multipurpose tree.

1. Introduction

Forest are central to all human life because they provide a diverse range of resources, they store carbon dioxide which aid in regulating climate, purify water and mitigate natural hazards such as food (FAO, 2005). Throughout the humid tropics they are numerous perennials woody species that have provided indigenous people with many of their needs for millennia (Leakey; 1998; Okafor and Lamb; 1994; Abbiw, 1990). With the rapid population growth, these resources are being depleted owing to the increasing demand for productive land for agriculture, which is met by clearing more forest. Deforestation reduces species diversity and erodes the genetic base of tropical trees, including these vital for the survival of the population of the region. The rain forest environment is rich in diverse as it is also known to be extremely fragile. As a result, the region forest land cleared for crop cultivation (based on shifting cultivation) remains productive for less than three years (Nwoboshi, 1982). It requires a fallow or resting period of over 20 years before can again be strong under cultivation. Traditionally, agroforestry systems are part and parcel of the cropping system of the humid tropics of Africa. In addition to their economy and nutritional are very important, these systems are also biologically diverse and environmentally residents. In response to both environmental concerns and need to ensure the sustenance of the livelihood of the population of the region, agroforestry is advocated as a potential solution (Leakey, 1998). To the early man, forest provided not the shelter but all the tangible products that could subsists the survival of the nation, but due to the increase in human population, the rate of deforestation of the natural forest was increase. This resulted to the disappearing of many plant species including Dacryodes edulis which is a multi-purpose tree species and prominent indigenous fruits seasoning to support livelihood.

2. Materials and Methods

2.1 Study Area

The experiment was carried out in the Research Farm of Forestry and Natural Environment Management Department, University of Uyo, Akwa Ibom State, Nigeria. It lies within the tropical rainforest of Nigeria between latitude 4^{o} 58^{1} and $50^{o}5^{1}$ N and longitude 7^{o} $54^{'}$ and 8^{o} $00^{'}$ E. It comprises of twenty one villages and a total land area of 15,750 hectares

(Akpabio and Chukukereke, 2004). The relief of Uyo urban is that of a relatively gentle slope. Rainfall ranges from 800-3,200mm per annum. It begins in March and continues till October with peaks in June and September (Akpabio and Chukukereke, 2004).

2.2 Materials

The materials used for the experiment included, sharp sand, clay soil, forest top soil, sandy soil, saw dust, poultry dropping, cow dung, pig manure, wood ash, Dacryodes edulis seeds, weighing balance, thermometer, venire calipers, measuring rule (30cm), soaking boxes, polythene pots, labeling tags, field note book, wheel barrow, pen, pencil, cutlass, spade, head pan, soil ogre, sieve, filter paper and oven.

2.3 Soil Analysis

Soil pH was determined in water 1:2 (soil water ratio) using glass electrode ph meters. Electrical conductivity was measured in the extract obtained from 1:2:5 soil water suspension using Conductivity Bridge. Organic carbon was determined by wet oxidation methods of Walkey and Black (1958). Organic matter was determined by multiplying organic value by Van Bremmelen factor of 1:724. Total Nitrogen was determined by Macro-Kjeldah procedures as described by Jackson (1958). Available Phosphorus was determined using Bray P – 1 method as described by Bray and Kurtz (1945). Exchangeable cat ions (Na^+, K^+, Ca^+, Mg^{2+}) were extracted with 1 in neutral ammonium eltranoate acetate. K and Na in the filtrate was determined using flame photo meter. Ca and Mg were determined by EDTA filtration method total exchangeable bases were estimated by summation of exchangeable basic cat ions. Effective cat ions exchange capacity (ECEC) was obtained by summation of total exchangeable bases and exchangeable acidity.

$$\% B.S = TEB / ECEC \times 100 \quad - - - - - - - - \quad (1)$$

Where;

B.S = base saturation

TEB = total exchangeable bases

ECEC = effective cat ions exchangeable capacity

2.4 Seed Collection and Processing

Matured fruits of Dacryodes edulis were collected from the mother tree in Etinan Local Government Area, Akwa Ibom State, Nigeria. The seeds were processed by depulping them and subsequently, washed, sorted and sundried for 2 hours to enhance germination.

2.5 Parameters Assessment

Height (cm)**:** Plant heights were determined by measuring the height of the plant using a ruler (30 cm) calibrated in centimeter. Measurement was conducted every two weeks for five consecutive times.

Stem Diameter (cm): Stem diameter were determined by measuring the diameter of the plant using vernier caliper, calibrated in centimeters (cm). Measurement was also conducted every two weeks for five consecutive times.

Number of Leaves: Number of leaves was determined by visual counting in every two weeks for five consecutive times.

Leaf Area (cm): Leaf Area (cm) was determined every two weeks using the graph method. One of biggest leaf were pluck out and placed in a graph, map out the full boxes and smallest boxes and then dividing full boxes by small boxes and multiple by one hundred to get total leaf area in centimeter (cm).

2.6 Detail of treatment

2.6.1 Experiment One: Various Growing Media*:* This trial was carried out to assess the effect of various growing media on germination of Dacroyodes edulis seeds. The growing media were sharp sand, clay soil, sandy soil, saw dust and top soil (control treatment). All these were obtained at different location in Uyo Local Government Area, 150 seeds each of Dacryodes edulis. The trial was carried out using randomized complete design with three replications. Watering was carried out daily. The experiment was monitored on a daily basis to assertion the time of emergence.

2.6.2 Experiment Two: Water Treatment: This trail was carried out to assess the effect of different soaking duration in warm water on germination of Dacryodes edulis seeds. 50 seeds were place in a thermometer and keep in a constant temperature water bath at 50^o c. Time effectively and removed 10 seeds at the end of 5miuntes – T_1, T_2 – 10 minutes, T_4 – 30 minutes, and control treatment (no soaking). They were later transferred to an already polythene pots containing top soil for sowing. The seeds were sown at a depth of 1cm each. The polythene pots were watered twice daily and the experiment were carried out using a Complete Randomized Design (CRD).

2.6.3 Experiment Three: **Cold Water Treatment:** Seeds of Dacryodes edulis (150) were soaked in cold water with the temperature of 28°c. There were 30 seeds in each treatment including control. The seeds were immediately removed at the end of each duration. The duration was 24 hours, 48 hours, 72 hours, 96 hours and control treatment (no soaking). The seeds were sown in already prepared perforated polythene pots containing 5kg of top soil. The seed were sown at a depth of 1cm each according to treatment and replicates. This experiment was watered daily and was laid in Complete Randomized Design (CRD) with three replications.

2.6.4 Experiment Four: Effect of Soil Depth: The trails were carried out to assess the different soil depth on germination of Dacryodes edulis. 150 seeds were sown in perforated polythene pots containing 5kg of top soil for sowing. Thirty seeds were sown in each treatment and replicates using calibrated round peg to measure the depth of 2cm - T_1, T_2 – 3cm, T_3 - 4cm depth, T_4 – 5cm depth, and T_5 – 1cm (control) depth to enhance germination. The experiments were watered twice daily. The experiments were laid in Complete Randomized Design(CRD) with three replications.

2.6.5 Experiment Five: Growth Assessment: The aim of this experiment was to determine the best soil amendment for raising Dacryodes edulis seeds. The soil amendment utilized were cow dung, poultry droppings, pig manure, wood ash and top soil (control treatment). Perforated polythene bags were filled with top soil (10kg) and 2g of organic manure were added and thoroughly mixed together. A total of 150 seeds were planted into all of them. There were five treatments in all replicated three times using a Complete Randomized Design (CRD). Watering was done daily

2.7 Data Analysis

Data collected from growth parameters were subjected to a two-way analysis of variance at 5% probability level (Akindele, 1996).

3. Results

3.1 Soil Analysis

Data on particles size distribution is shown on (table 4.1), in top soil, the mean value of sand was 94.81%, silt had the mean value of 4.16% and mean value of clay was 1.03%. The soil is generally sandy. The soil ph are generally acidic. This suggests that the soils have a negative change on the exchange complex (DHC) consult (1994) and therefore have exchange acidity (Aghimien et al, 1985). Organic matter content of the five manure sample were as follows; top soil was 0.00%, cow dung was 48.00%, pig manure was 43.36% ; wood ash was 44.84% and poultry dropping gave the highest mean of 64.144%. This shows that organic matter was higher in the poultry dropping than all others manures. Generally, percent available phosphorus was higher in the poultry dropping i.e. mixture of top soil and poultry dropping with the mean of 600.00mg/kg $^{-1}$, and mixture of top soil and pig manure had 4050.00mg/kg $^{-1}$, and the mixture of top soil and wood ash had the mean valve of 2475.00mg/kg $^{-1}$ while mixture of top soil and cow dung had 2325.00mg/kg $^{-1}$. While top soil had 0.32mg/kg $^{-1}$. Also, the soils had low contents of exchangeable basic cations Ca, Ma, K and Na and a high content of acidic cations (Exchangeable (Al and H). Percentage base saturation ranged with a mean of 98.04% for poultry dropping, 87.75% for top soil and 83.30% for mixture of top soil and wood ash while mixture of cow dung and top soil had 79.14%, mixture of top soil and pig manure had 78.03%. The base saturation valves are high indicating that the soils are fertile. The mean of the soils in relation to manures samples were; for forest top soil it was 1.00cmol/kg, mixture of top soil and cow dung having 1.06cmol/kg, mixture of top soil and wood ash had 1.43cmol/kg. It was higher in mixture of top soil and poultry dropping with ECEC OF 80.00cmol/kg compared to wood ash which had 0.51cmol/kg and mixture of top soil and poultry dropping having 4.81cmol/kg. The valves are generally high suitability of the soil for crop production reported by FAO (1996).

Table 1: **Physiochemical Properties of the Soil**

Identity	Ph	Ec $^{ds}/_{m}$	Org.c %	Av.p $^{mg}/_{kg}$ $^{-1}$	Ca $^{mg}/_{kg}$ $^{-1}$	Mg $^{mg}/_{kg}$ $^{-1}$	Na $^{cmd}/_{kg}$	K	Ea	Cec	Bas.sa %	Sand %	Silt %	Clay %
Top Soil	-	0.039	0.00	0.32	5.60	1.41	0.07	0.08	1.00	8.16	87.75	94.81	4.16	1.05
Cow dung	9.20	-	48.00	2325.00	9000.00	1800.00	1980.00	6761.25	1.06	8.16	79.14	90.00	7.005	1.03
Pig manure	9.20	-	43.36	4050.00	3000.00	600.00	1881.0	5861.25	1.06	5.08	78.03	80.00	5.00	15.00
Wood ash	9.10	-	44.84	2475.00	1800.00	3600.00	2153.25	6300.00	1.43	0.51	83.30	91.00	6.50	14.20
Poultry dropping	9.80	-	64.144	600.00	1199.9	2004.75	6243.75	1.87	4.81	80.00	98.04	10.76	4.05	2.00

3.2 Effect of Soil Amendments on Seed Germination

The result in table 2 indicates that Dacryodes edulis seeds planted on the soil treated with the cow dung germinated first with a mean germination days of 25 days after sowing followed by seeds treated with wood ash 26 mean days.

Dacryodes edulis seeds planted in the control had 29 mean germination days, followed by soil treated with poultry dropping (30 mean germination days while seeds), while deeds planted on soil treated with pig manure had the longest mean germination days of 34 days. As regards percentage germination, the Dacryodes edulis seeds planted in the control gave the highest percentage of germination (64%) while the least percentage germination (50%) was obtained in soil treated with wood ash.

Table 1: Mean Days after sowing and Germination as influenced by soil amendments

Treatments	Days after Sowing	Percentage Germination
Cow dung	25 b	56 c
Poultry dropping	30 a	62 a
Pig manure	34 a	58 b
Wood ash	26 b	50 b
Control	29 b	64 a

3.3 Effect of Various Growing Media on Germination

Effect of various soil media on germination of Dacryodes edulis seed is show in table 3. The result shows that seeds sown on sharp sand germinated first with a mean germination days of 10 days after sowing. This was followed by the saw dust with 19 mean days after sowing. Loamy soil treatment had 21 mean days after sowing while control treatment had 23 mean days and lastly clay soil (25 days after sowing). As regards to percentage of germination, significant difference was observed among the treatments at 5% level of significance. The saw dust treatment gave the height of (80%) and the least percentage germination (24%) was obtained in loamy soil treatment.

Table 2: Mean days after sowing and germination as influenced by growing media

Treatments	Days after Sowing	Percentage Germination
Sharp Sand	10 a	40 c
Clay soil	25 a	70 a
Loamy soil	21 b	24 b
Saw dust	19 c	80 c
Control	23 b	60 a

3.4 Soaking in Warm Water

The results of the effect of warm water on germination of Dacryodes edulis seed is show in Table 3. The results showed that 5 minutes treatment germinated first with 11 mean days after sowing, this was followed by control treatment 16 mean days. Seed soaked for 10 minutes germinated 17 days after sowing. Seed soaked 30 minutes germinated 20 days after sowing while those soaked for 20 minutes took 22 days after sowing. The percentage germination result followed the same trend. The 30 minutes treatment gave the highest percentage germination of 56% while the least percentage germination of 18% was given by seeds soaked for 10 minutes. The treatments were significantly different.

Table 3: Mean days after sowing and germination as affected by pre-treatment in water at 50°c

Treatments	Days after Sowing	Percentage Germination
5 minutes	11 a	50 c
10 minutes	17 a	18 c
20 minutes	22 b	32 b
30 minutes	20 c	56 c
Control	16 a	40 a

3.5 Soaking in Cold Water

The results of the effect of cold water on germination the Dacryodes edulis in presented in Table 4. The result indicated that the 96 hours experiment germinated first with a mean days after sowing of 16. This was followed by seeds soaked

for 72 hours with a mean days after sowing of 18, 48 hours had 20 days after sowing, control had 21 days and lastly 24 hours had mean days of 22. The percentage germination result was also highest in 24 hours treatment while the least was given by those soaked for 96 hours had 18. These were significant difference among the treatment.

Table 4: **Mean days after Sowing and percentage germination as influenced by pre-treatment in Cold Water (28°C)**

Treatments	Days after Sowing	Percentage Germination
24 hours	22 b	40 a
48 hours	20 b	24 b
72 hours	18 a	20 b
96 hours	16 a	18 c
Control	21 b	28 a

3.6 Sowing Soil Depth

The result indicated that 2cm depth treatment germinated first with 15 mean days after sowing, 6cm depth treatment had 19 mean days after sowing. 3cm depth treatment had 20 mean days and lastly 4cm depth treatment had 23 mean days after sowing. The treatment differ significantly at $p<0.05$.Percentage germination was highest for seed sown in 4cm depth treatment of 50% and the lowest germination was given under control treatment.

Table 5: **Mean days after sowing and Percentage Germination as influenced by soil depth**

Treatments	Days after Sowing	Percentage Germination
2cm depth	15 b	36 c
3cm depth	20 a	40 b
4cm depth	23 a	50 a
6cm depth	19 b	40 b
Control	17 b	32 c

3.7 Plant Height (cm)

In week 2, the mean highest value for height was recorded under wood ash of (27.06cm). There was significant different among the treatments (Table 6). Week 4 shows that the mean highest value for height was recorded under wood ash (26.96cm) and there was significant different among the treatment (Table 6). In week 6, it indicated that the mean highest value for height was recorded under wood ash (27.83cm) and there was significant different among the treatment and in the 8th week, the mean highest value for height was recorded under wood ash (28.16cm). There were significant different among the treatment (Table6). In week 10, wood ash had the highest mean value for height of (28.25cm) and there was significant different among the treatment (Table 6).

Table 6: Mean height of Dacryodes edulis seedlings under different soil amendment

Treatment	Week after transplanting				
	2	4	6	8	10
Poultry dropping	20.84 cd	22.29 b	23.32 c	23.73 c	24.53 b
Wood ash	27.06 a	26.96 a	27.83 a	28.16 a	28.25 a
Cow dung	19.79 cd	21.42 c	22.43 d	22.95 c	23.81 c
Pig manure	21.5 c	21.98 c	22.99 c	22.87 c	23.89 c
Top soil	24.94 b	25.95 a	27.15 b	27.69 b	27.87 b

3.8 Collar Diameter (cm)

In week 2, the mean highest value for stem diameter was recorded under wood ash of (0.27). There were significant different among the treatment (Table 7). Week 4 shows the mean highest value for stem diameter was obtained under

wood ash (0.30). There were significant different among the treatment (Table 7). In week 6, the results indicated that the mean highest value for stem diameter produced under wood ash (0.34) and there is no significant different among the treatments (Table 7). In week 8, wood ash attained a maximum value for stem diameter of (0.35). There is no significant different among the treatment (Table 7). Week 10 shows that there was different among the treatment and that wood ash had the mean highest value for stem diameter of (0.39cm) (Table 7).

Table 7: Mean Collar Diameter of Dacryodes edulis seedlings under different Soil amendment

Treatment	Week after transplanting				
	2	4	6	8	10
Poultry dropping	0.22 b	0.27 b	0.32 a	0.35 a	0.38 a
Wood Ash	0.27 a	0.30 a	0.34 a	0.36 a	0.37 b
Cow dung	0.18 c	0.20 c	0.24 b	0.28 b	0.29 c
Pig manure	0.17 c	0.21 b	0.26 b	0.29 b	0.30 b
Top soil	0.22 b	0.26 b	0.33 a	0.34 a	0.38 a

3.9 Leaf Area (cm)

In week 2, the mean highest value for leaf was recorded under top soil (30.77cm). There was significant different among the treatment (Table 8). Week 4 shows that Top soil attained the maximum value for leaf area of (31.99cm) and there was significant different among the treatment (Table 8). In week 6, Top soil produced the mean highest value for leaf area of (48.65 cm). There was significant different among the treatment (Table 8). In week 8, the mean highest value for leaf area was recorded under Top soil (55.49cm). There were significant different among the treatment (Table 8). In week 10, the mean highest value was obtained under Top soil (68.23cm). There was significant different among the treatments (Table 8).

Table 8: Mean Leaf area of Dacryodes edulis seedlings under different soil amendment

Treatment	Weeks after transplanting				
	2	4	6	8	10
Poultry dropping	17.51 d	17.05 c	19.89 c	26.02 c	26.32 c
Wood Ash	24.23 b	21.00b	25.03 b	27.34 c	28.43 c
Cow dung	14.89 e	13.37 d	27.73 b	36.26 b	36.89 b
Pig manure	19.40 c	21.40 b	24.00 b	21.65 d	22.02 c
Top soil	30.77a	31.99 a	48.65a	55.49 a	68.23 a

3.10 Number of Leaves

In week 2, the mean highest value for number of leaves was recorded under pig manure (6. 4). There were significant different among the treatment (Table 9). In week 4, results indicated that the mean highest value for number of leaves produced was obtained under pig manure (8.03). There were significant different among the treatment (Table 9). Week 6 shows that there was significant different among the treatments and the mean highest value for number of leaves was recorded under pig manure of (9.27) (Table 9). In week 8, the mean value for number of leaves shows the highest under pig manure of (10.33) and there was significant different among the treatment (Table 9). In week 10, the results shows the mean highest value for number of leaves (10.83) that as recorded in pig manure and there is no significant different among the treatment (Table 9).

ISSN: 2456-6527
sjrabeditor@scischolars.com Online Publication Date: December 12, 2016 Volume 1, No. 1

Table 9: Mean number of leaves of Dacryodes edulis seedlings under different Soil amendment

Treatment	Weeks after Planting				
	2	4	6	8	10
Poultry dropping	5.50d	6..83c	7.53c	8.70c	9.21b
Wood ash	6.23b	7.13b	8.33b	9.37b	10.3a
Cow dung	4.73e	5.53c	6.43d	8.10c	9.02b
Pig manure	6.40a	8.03a	9.27a	10.33a	10.83a
Top soil	6.03c	6.57d	7.87c	9.27b	10.10a

4. Discussion

The result indicated that application of soil amendment is not necessary for germination of Dacryodes edulis seeds due to the fact the control treatment (without application of organic manure) gave the best result. This finding agrees with Opeke (1992) that soils of nurseries should be chemically and physically fertile which is true in this case since top soil contains required nutrients in this for germination. As regards the soil amendments experiment, control treatment produced the highest percentage germination of 64%. This indicated that control treatment was best for sowing Dacryodes edulis seeds. This result however differs with the study by Giwa and Ojeniyi (2004) who observer that control treatment significantly increased the plant height, number of leaves, root growth and fruit yield of tomatoes.

Under the growing media experiment it was discovered that seeds sown on sawdust performed better than the rest. Earlier studies on the use of sawdust as a germination media has proven it to be better than other planting medium (Opeke, 1992). This study also shows the pretreatment of Dacryodes edulis seeds with warm water found that soaking in warm water for 30 minutes enhanced the germination of the species. Sowing in cold water for 24 hours gave the best germination. This however contracted sharply with the study by Okunomo et al (1997) on Dacryodes edulis. This study also revealed that pretreatment of Dacryodes edulis seed with soil depth was discovered that seeds sown on 4cm depth performed better than the rest. This was however corroborated by Oni et al (2002), in their coloning of the popular West African chewing stick Masularia accumulate.

As regard to soil amendment based on the study of growth assessment, plant height were observed, wood ash discovered the best for growth of Dacryodes edulis species. This study however differs with the study by Thomas et al (2004) where they reported a positive influence of poultry manure on growth of Terminalia superba. On stem diameter the observation was confirmed that wood ash gave the best result for Dacryodes edulis species. Under leaf area the study however showed that top soil found to be the best result among the treatments of the species. Based on this study, the best numbers of leaves were obtained from pig manure as it significantly increased and found as the best result.

5. Conclusion

Natural forest provides tangible and intangible benefits to the people, it has long been regarded as an in exhaustible resources and was treated casually and thoughtlessly. The natural forests, particularly the rainforests are fast disappearing due to the upsurge in human population: The rate of deforestation of the natural forest is for sundry needs and is now on the increase. This has resulted in the disappearance of many forest and forest resources including Dacryodes edulis which is a multi- purpose tree species and a prominent indigenous fruit tree. In order to raise sturdy and vigorous, seedlings of Dacryodes edulis and also to ensure fast growth rate, the seeds should be sown on good sawdust without any mixture of top soil and without any pregermination treatment. Watering regimes must be such that seedlings are not subjected to water stress. Aggressive planting of this species in the home garden and recreational centers should be intensified to meet the increasing demand for the fruits.

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