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Effects of Acid Pre-Treatment on the Germination and Seedling Growth of African Pear (*Dacryodes edulis* Don. G. Lam. H.J.)

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Abstract: Studies were conducted at the nursery site of the Department of Forestry and Wildlife, Delta State University, Asaba Campus. Asaba, Nigeria in 2006 to evaluate the effects of acid pre-treatment on the germination and seedling growth of African pear (*Dacryodes edulis*) with a view to stimulating farmers' interest in the planting, utilisation, establishment as well as enlightening and encouraging them towards its domestication to arrest the steady disappearance of this multipurpose forest fruit species. Viable seeds of *D. edulis* were pre-soaked in 5% dilute tetraoxosulphate VI acid (H_2SO_4) for 0, 5, 10, 20 and 40 min and thoroughly washed with distilled water before they were planted in poly pots. The experiment was arranged in a Randomized Complete Block Design (RCBD) with four replications. The results showed that germination percentage and days to germination differed significantly ($p \leq 0.05$) with increasing period of seed soaking in the acid until the maximum of 20 min after which there was a significant reduction ($p \geq 0.05$). The results also indicated that acid treatment of *D. edulis* seeds significantly ($p \leq 0.05$) improved the performance of the seedling as regards plant height, number of leaves, leaf area and collar diameter as the period of soaking increased. At 40 min of seed soaking in acid, significant reductions ($p \geq 0.05$) were recorded in all the growth characters assessed. This study has demonstrated that acid pre-treatment of *Dacryodes edulis* has a highly significant effect of improving seed viability and enhances seedling emergence and seedling growth. Based on the findings, acid pre-treatment of seeds for 20 min is recommended to farmers to ensure continuous seedling emergence and improve seedling growth in *Dacryodes edulis*.

Key words: Acid treatment, seeds, seedling emergence, seedling performance, *Dacryodes edulis*

INTRODUCTION

Most fruits have difficulty in germination (Mayer and Potjakoff-Mayber, 1963) hence their propagation is adversely affected by seed coat dormancy resulting in poor imbibitions and germination potential (Ibikunle and Komolafe, 1973; Singh, 1987; Bradbeer, 1988). Various authors have employed different methods of breaking or reducing dormancy and improving germination rate in different forest seeds including cold water (Adeola and Dada, 1983; Eze and Orole, 1987), hot water (Awodola, 1994; Adewusi and Ladipo, 2000; Otegbeye and Momodu, 2002; Aduradola and Adejomo, 2005; Oni *et al*., 2005) and acid treatment (Ibrahim and Otegbeye, 2004; Aduradola and Adejomo, 2005; Owonubi *et al*., 2005; Dachung and Verinumbe, 2006; Isikhuemen and Kalu, 2006). These treatments according to Umar (2005) are aimed at making the seed coat permeable either naturally or artificially and hence enhance germination.

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Dacryodes edulis species are established economic trees that have multi-purpose uses such as providing nutritious fruits for human consumption and timber (Agbogidi and Eshegbeyi, 2006). It is a low-cost fruit liked by all persons of all ages. Tree crops such as *D. edulis* are important to humanity in many ways (Leakey and Newton, 1994). The edible forest products constitute important and cheap sources of vitamins, minerals, proteins, carbohydrate and fats and their contribution to diets of the rural populace is tremendous (Keay, 1989; Agbogidi and Ofuoku, 2006). The dietary contribution of forest trees to improve nutritional status of mankind is further enhanced by the timing of their availability, which often falls at strategic periods of general food shortage (Oni and Gbadamosi, 1998). *D. edulis* falls under the group of forest trees, which produces edible fruits when the conventional staple foods are scarce. *Dacryodes edulis* is a member of the family Burseraceae (Youmbi *et al*., 1998). The tree is an evergreen tree with medium sized spreading canopy whose species are either cultivated or wild (Okigbo, 1980). *D. edulis* is a tropical fruit tree. The bark is thin and the leaves pinnate with leaflets. The immature fruits vary from orange to red in colour but turn blue purple or black at maturity. The fruit, oblong in shape, consists of a large seed surrounded by a thin monocarp. The plant flowers between the months of May and October; and fruits between 5-6 years after planting (Dalziel, 1987). The kernel has some prospects in animal feed formulation (Opeke, 1987).

Despite the numerous benefits derived from *D. edulis*, attempts to domesticate it have yielded little or no positive results. Oluwalana (1997) noted that no conscious effort has been made to domesticate this valuable species. Besides, adequate information about pre-germination treatments that will ensure rapid and uniform germination of high quality seedling of *D. edulis* is lacking. Studies by researches on germination are scanty and not comprehensive enough. The need to domesticate this vital species cannot be over emphasized. It was against this background that the study was embanked upon to ensure the continuous derivation of the benefits of this multi-purpose indigenous fruit tree. Specifically, the objective of this study was to evaluate the effects of acid pre-treatment on the germination and seedling growth of *Dacryodes edulis* seeds with a view to stimulating farmers' interest in the planting and consumption as well as utilisation and establishment of this species. This study also has the advantage of enlightening and encouraging local farmers towards its domestication with a view to arresting the steady disappearance of this multipurpose forest fruit species.

MATERIALS AND METHODS

The study was carried out at the nursery site of the Department of Forestry and Wildlife, Delta State University, Asaba Campus, Delta State, in 2006. Asaba is located at latitude 06°14 N, longitude 06°49 E of the equator (Anonymous, 2006). Asaba lies in the tropical rainfall zone. The rainy season is usually between April and October, with an annual rainfall range of 1505-1849.3 mm. The mean temperature is 28±6°C. The relative humidity is 69-8% and the monthly sunshine is 4.8 bars (Anonymous, 2006).

Matured fruits of *D. edulis* were procured from Ugbolu market in Oshimili-North Local Government Area of Delta State. The seller insisted that the fruits were from one tree. Healthy seeds were sorted out by simple flotation technique following the procedure of Agbogidi and Eshegbeyi (2006). The fruits were mechanically depulped to expose the seeds, which were used for the study. Bottom perforated poly-pots of dimensions 24×14 cm were filled with garden soil (2 kg) rich in organic matter.

Five percent tetraoxosulphate Vl acid (H_2SO_4) was poured into a beaker and the viable seeds were soaked for 0, 5, 10, 20 and 40 min. The acid-treated seeds were removed from the beakers and placed on clean containers thoroughly washed with distilled water after which, the seeds were planted in poly-pots. Seeds were uniformly sown to an approximate depth of 3 cm. Four seeds were planted in each poly-pot. The experiment was laid out in a Randomized Complete Block Design with four replications.

Each experiment comprised 7 poly-pots. The poly-pots were irrigated with water to field capacity every other day till the end of the sampling period. The poly-pots were kept in the Departmental nursery for germination and subsequent examination. The poly-pots were kept weed free throughout the experimental period. Seedling emergence was taken to have occurred once the plumule attained a height of at least 1 cm above the surface of the soil following the procedure of Ibikunle (1975) and Ugese *et al*. (2007). Seedling emergence started about 9 days after sowing (DAS). Germination percentage was taken on the 19th day after sowing while days to germination were taken when about 60% of the seeds planted had germinated. The seedlings were monitored for 10 weeks after germination percentage was taken while parameters were measured forth nightly starting from 2 weeks after germination percentage was taken. Growth characters measured were plant height (cm), number of leaves, leaf area (cm^2) and collar diameter (cm). Plant height was measured with a meter rule at the distance from soil level to the top of the terminal bud, the number of leaves was determined by visual counting of the leaves, leaf area was determined by multiplying the length and breath measurements of a leaf multiplied by the number of leaves in the plant and finally by a correction factor of 0.75 following the procedures of Agbogidi and Ejemete (2005) and Agbogidi and Ofuoku (2005). Collar diameter at 3 cm above soil level was measured using veneer callipers. Data colleted were subjected to analysis of variance while th significant means were separated with the Duncan's Multiple Range Test (DMRT) using SAS (1996).

RESULTS AND DISCUSSION

Seedling emergence differed significantly ($p \leq 0.05$) with increasing period of soaking the seeds in dilute H_2SO_4 up to the maximum of 20 min after which there was a significant reduction ($p \geq 0.05$) in the germination percentage (Table 1). Highest germination percentage from acid treatment was 90 when soaked for 20 min while the lowest percentage (42%) was recorded when seeds were pre-soaked in the acid for 40 min.

The longer the period of seed soaking in the acid: the shorter the days to germination up to 20 min. For example, *D. edulis* seeds pre-soaked in dilute H_2SO_4 for 20 min germinated on the 9th day after sowing, while seeds soaked in the acid for 5 min before sowing took 11 days before germination. Seeds treated with the acid for 40 min before planting germinated on the 18th day after sowing i.e., about 5 days later than the control seeds (Table 2).

The results also indicated that acid treatment of *D. edulis* seeds significantly ($p \leq 0.05$) improved the performance of the seedlings as regards plant height, number of leaves, leaf area and collar diameter (Table 3-6), respectively with increasing time of seed soaking in the acid. Significant reductions ($p \geq 0.05$) were however observed for seedlings from seeds that were soaked in the acid for 40 min before planting (Table 3-6).

Table 1: Effect of acid treatment on the germination percentage of *Dacryodes edulis* seeds

Period of seed (min)	Germination (%)
0	70^{d}
5	78^{c}
10	83^{b}
20	90^{a}
40	42^{e}

Means with different superscript letter(s) are significantly different ($p \leq 0.05$) using Duncan's multiples range test

Table 2: Days to germination of *D. edulis* seeds as influenced by time of soaking in dilute H_2SO_4

Period of seed (min)	Days to germination
0	13^{b}
5	11^{c}
10	10^{c}
20	9^{d}
40	18^{a}

Means with different superscript letter(s) significantly different at ($p \leq 0.05$) using the Duncan's multiple range tests

Table 3: Plant height (cm) of *D. edulis* seedlings as influenced by seed soaking in dilute H_2SO_4

	Plant height/WAG					
Period of seed (min)	2	4	6	8	10	Means
0	8.6	10.8	13.8	22.0	24.5	15.9[d]
5	8.0	12.4	15.4	22.6	25.8	17.0[c]
10	9.6	13.9	16.7	23.8	27.5	18.3[b]
20	10.8	14.8	19.0	24.9	28.7	19.6[a]
40	7.2	9.6	12.3	21.7	24.2	15.0[e]
Means	9.0	12.3	15.4	23.0	26.1	

Means in same column with different superscript and within the same WAG are significantly different ($p \leq 0.05$) using Duncan's multiple range tests. WAG = Week after germination percentage was taken

Table 4: Number of leaves of *D. edulis* seeds as influenced by seed soaking in dilute H_2SO_4

	No. of leaves/WAG					
Period of seed (min)	2	4	6	8	10	Means
0	2.0	2.4	33	4.0	4.4	3.2[d]
5	2.4	3.0	3.5	4.3	4.7	3.6[c]
10	2.5	3.2	3.7	4.8	5.0	3.8[b]
20	2.7	3.6	4.0	5.1	5.6	4.2[a]
40	1.9	2.2	3.2	3.8	4.2	3.1[d]
Means	2.3	2.9	3.5	4.4	4.8	

Means in same column with different superscript and within the same WAG are significantly different ($p \leq 0.05$) using Duncan's multiple range test. WAG = Week after germination percentage was taken

Table 5: Leaf area (cm^2) of *D. edulis* seedlings as affected by seed soaking in dilute H_2SO_4

	Leaf area/WAG					
Period of seed (min)	2	4	6	8	10	Means
0	8.1	8.4	1.7	15.7	17.8	12.3[d]
5	8.4	9.0	12.6	15.3	19.2	12.9[c]
10	8.9	9.5	15.9	18.6	22.4	15.1[b]
20	9.3	10.8	19.4	24.3	28.0	18.4[a]
40	7.0	8.3	10.8	14.6	16.5	11.4[e]
Means	8.3	9.2	14.1	17.7	20.8	

Means in same column with different superscript and within the same WAG are significantly different ($p \leq 0.05$) using Duncan's multiple range test. WAG = Week after germination percentage was taken

Table 6. Collar diameter (cm) of *D. edulis* seedlings as affected by seed soaking in dilute H_2SO_4

	Collar diameter/WAG					
Period of seed (min)	2	4	6	8	10	Means
0	0.5	0.7	0.9	1.2	1.4	0.9[d]
5	0.7	0.9	1.1	1.3	1.7	1.1[c]
10	0.8	1.0	1.3	1.5	1.9	1.3[b]
20	1.0	1.1	1.5	1.8	2.1	1.5[a]
40	0.4	0.5	0.8	1.1	1.3	0.8[d]
Means	0.7	0.8	1.1	1.4	1.7	

Means in same column with different superscript and within the same WAG are significantly different ($p \leq 0.05$) using Duncan's multiple range test. WAG = Week after germination percentage was taken

The observed significant differences are suggestive of the fact that acid treatment of seeds stimulated prompt and uniform germination. This finding is similar to prior reports of Mayer and Potjakoft-Mayber (1963) and Dachung and Verinumbe (2006) that acid treatment of the seed removes the waxy layer of the seed coat by chemical decomposition of the seed coat components as that similar to breakdown processes occurring during microbial attack. This observation also supports the findings of Duguma *et al.* (1988) who noted that acid scarification is the most effective way of improving seed coat permeability in seeds of *Leucaena leucocephala.* Umar *et al.* (2005) noted that soaking of *Phoenix dectilyfera* seeds in concentrated H_2SO_4 for 20 min reduced the germination period

considerably and concluded that it was the best method even though dangerous to handling. Similarly, Adeola and Dada (1983) observed that seeds of many leguminous plants including *Acacia decurens, Acacia mearnsil* and *Acacia arabic* with extreme tough coat that delays germination for months or years have been able to germinate quickly by using either hot water at boiling point (100°C) or acid treatment. The reduction recorded for *D. edulis* seeds pre-soaked in the acid for 40 min could be attributed to the soft or delicate nature of the seed coat for which the acid could have negatively affected the embryo. Toxicity of acid when it comes in contact with seed embryo is a well-acknowledged phenomenon. Aduradola and Adejomo (2005) reported reduced germination percentage for *Erythronphleum suaveolens* seeds soaked in concentrated H_2SO_4 and attributed it to probable destruction of the embryo by the acid.

This study has established that acid treatment of *D. edulis* seeds can improve seed viability and enhance seedling emergence and seedling growth. When pre-soaking is done for more than 20 min, the acid may be detrimental to the seeds. Soaking of seeds in 5% dilute H_2SO_4 for at most 20 min is therefore recommended as it could aid to break dormancy and enhance germination in *D. edulis* seeds. This will help to improve upon using afforestation programmes, forest production as well as ensuring sustainable management. In situations where H_2SO_4 is scare or its use is at risk, ordinary water can be used to soak the seeds to improve germination. Seed pre-soaking of *D. edulis* in H_2SO_4 for periods more than 20 min could have adverse effects on both the emergence and seedling growth and development of *Dacryodes edulis*. Based on the findings, acid treatment of seeds for 20 min is recommended to farmers to ensure continuous seedling emergence and improve seedling growth in *Dacryodes edulis*.

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