Comparative study of three seed germination methods on King Palm (*Archontophoenix cunninghamiana*)

Ubara, U.E.¹, Yusuf, A.O.², Yakubu, M.¹, Aye, A.I.¹, Odewale, J.O.², Eke, C.R.¹, and Emenike C.J.¹

¹ Plant Physiology Division, Nigerian Institute for Oil palm Research, P.M.B. 1030 Benin City, Edo state Nigeria.
² Plant Breeding Division, Nigerian Institute for Oil palm Research, P.M.B. 1030 Benin City, Edo state Nigeria.

Abstract

The King palm or Alexandra palm is a popular ornamental palm used as a decorative plants in the environment indoor and outdoor. It belongs to the family Arecaceae and native to Australia and coastal region of North America. The palm is one of the most popular trees in tropical and subtropical climate used for landscaping and beautification. This sun-loving palm is mostly used outdoors, but it also makes an excellent house plant if given the right environment. The objective of the study was to mass produce King palm planting material in an attempt to prevent the palm from extinction within the NIFOR Palmetum, through comparing different methods of seed germination. Harvested seeds were divided into three groups of fifty seeds each (A, B and C). Group A were subjected to heat treatment in the germinator at a control temperature of 39±1°C for the duration of 1-5 weeks. The second group B after treatment with benlate solution and scarified using surgical blade to remove the operculum were subjected to incubator at a reduced temperature of 30°C. The last group C were soaked in water for 24 hours to regain moisture content, two seeds were planted directly into twenty five polythene bags and kept outside the laboratory and watered daily for the period of five weeks. The result of the present study shows that seeds planted direct and the one given one week heat treatment had highest germination percentage within ten days (100%) respectively. The heat treatment later, drastically dropped to 98%, 26%, 22% and 12% for 2, 3, 4 and 5 weeks with increase in time of heating. The scarification method had the lowest germination count given 28% as the highest and 5% after five weeks storage. From there it was concluded that king palm seeds germination does not require pre-treatment as best result could be achieved by direct sowing and when given one week heat treatment in the germinator for mass production and sales.

Keywords: Germination, Ornamental, King Palm, Scarification, Heat treatment, Arecaceae,

INTRODUCTION

The germination of most palm seeds of the family Arecaceae is triggered by seed coat or testa which causes difficulty and presenting physical dormancy. The seeds of the King palm were introduced to Nigeria through the Nigerian Institute for Oil palm Research (NIFOR) in the year 1964. It was germinated and planted on the NIFOR Palmetum same year (NIFOR, 1964). Some of the trees were also planted as homestead within the campus of NIFOR.

NIFOR Palmetum is a botanical garden featuring one family of the plants Arecaceae. It is a repository of different species of indigenous and exotic palms. The Palmetum act as a live germplasm for the various exotic, native, and wild species and serve as a source of high quality propagation materials. The Palmetum currently occupies about 6 hectares at Field 21 of the NIFOR Main Station, Benin City.

The Palmetum was first established in the late 50s and as in the late 80s had a collections of 429 palms of over 97 species which was reduced currently to less than 100 palm trees of 25 different species of the Arecaceae (Palm) family collected mainly from South East Asia and America (WAIFOR,1964 and NIFOR, 1972). The palms were raised in the nursery and field planted on the Palmetum at the NIFOR main station.
between 50s and 90s.

Since most of the palms species in the Palmetum are ageing with narrow genetic base, there is a need to reproduce some of these palms at the same time collect and introduce other palm species within and outside NIFOR in order to save the remaining palms from extinction and also enrich the palms genetic resources of the institute.

The king Palm tree also known as Alexandra Palm is a native to Australia. The palm is one of the most popular trees in tropical and subtropical climate used for landscaping and beautification. It is propagated from seed. The plant has high ecological value of preventing erosion and desertification (Brooks, 1993). This sun-loving palm is mostly used outdoors, but it also makes an excellent house plant if given the right environment. While King Palm is young, it can be kept inside in the container to avoid cold exposure. It has a single smooth grey brownish trunk ringed by the scars from the fallen frond. Trunk is a little wider at the base, about 1 ft in diameter with beautiful crown shaft at the top. Crown shaft is generally green, but occasionally can be brownish. The King Palm has about 15-20 arching evergreen fronds that emerge from the crownshaft forming a graceful crown. The leaves are bright green above and below, although there can also be brown scales on the paler green undersides. They have about 100 to 150 leaflets that are 6-12 inches long. In midsummer, the King Palm produces pink flowers that are held by 2-3 ft long branched inflorescence, growing from below the crown shaft. Male and female flowers are on the same inflorescence (Brooks, 1993). Flowers are followed by attractive berry-like green fruits that turn red when ripe. Fruits are round, about 1/2 inches in diameter and hang in clusters. The king palms shows some distinct features; such as cold tolerance, moderate moist and water requirement, partial shade to full sun and easy maintenance. There are no reports in the literature about germination of this palm seeds (Plate A and B).

**MATERIALS AND METHOD**

The experiment was carried out in the Plant Physiology Division laboratory of the Nigerian Institute for Oil palm Research (NIFOR). Fruits were harvested and collected in February 2015 at the NIFOR Palms Botanical Garden (Palmetum). The fruits were detached from the stalk, pre-soaked in water to facilitate the removal of seeds from pulp and washed thoroughly to remove the epicarp and mesocarp by changing of the water daily for 3 days, in order to obtain clean seeds (Merlo et al., 1993; Piotto and Noi, 2003). During this period, physical viability test was carried out by soaking the seeds in water; in this test, good quality seeds tend to sink in water, while seeds which are not fully developed or are pest-infected floated. The floating seeds were removed and discarded. The seeds were then air dried at ambient temperature for 3 day. Fifty seeds were counted into each of the ten white polythene bags of heat treatment and scarification. Three seeds were also planted into ten different polythene bags outside the lab (Direct sowing), the heat treatment, Scarification and direct sowing method are described below.

**Heat treatment**

At this point, the most important factor in seed germination is proper hydration followed by constant high heat (Jeff Marcus and Ken Banks, 1999). The seeds were kept in the germination chamber at a temperature of 39±1°C for weekly periods of heating time; 1, 2, 3, 4 and 5 weeks. A bag was brought out at weekly interval, soaked in water to raise the moisture content, air dried, re-bagged and kept at ambient temperature. The seed sprouting were observed daily and recorded weekly for the period of 5 weeks. The result was calculated and tabulated using the formula below:

Germination % = No. of sprouted seeds X 100
No. of seeds in the polythene bag

**Scarification**

Scarification of palm seed involves thinning the bony endocarp of palm seeds, which may inhibit water imbibitions or an attempt to reduce the thickness of the testa of palm seeds using either heat (Rutar et al., 2001), acid (Pandraghi et al., 2003, Alderete-chavez et al., 2011), freeze (Stout 1990, Hall et al., 1993) or mechanical (Baes et al., 2002 and Dittus and Mujr, 2010). Scarification has increase the number of germination of a palm species with hard, water impermeable seed coats (Odetola, 1987; Nagao et al., 1980). This was done by scraping the top of the seeds to remove the operculum and view the embryonic position, a mechanical scarification (deoperculation) using surgical blade. The seeds were then soaked in water to raise the moisture content, later it was air dried and subjected to incubator temperature of 30°C for different periods of heating time; i.e. 1, 2, 3, 4 and 5 weeks respectively.

One bag was brought out at weekly interval soaked in water for twenty four hours. It was then removed air dried, re-bagged and kept at ambient temperature to observe the germination process. Few seeds showed a sign of fungal contamination and were treated with 5% benlate solution, while those that were found to have lost their viability were removed as discards.

**Direct sowing**

The king palm seed were soaked in water for twenty four
hours before planting, to raise the moisture contents, this is in conformity with (NIFOR, 1974; 1975).

Two king palm seeds planted into twenty five polybags arranged in five different lines making a total of fifty seeds. They were laid on its side and pressed into the polybags with one finger until the seeds were partially under the soil with the top of the seed still viable above the soil. Twenty five polythene bag containing soil rich in required nutrients were used for the experiment in front of the division. The watering was done gently, because too harshly can cause them to be buried too deeply or washed away. The King Palm was noticed to have started sprouting ten days after planting.

**RESULT**

The results of the final germination percentage of king palm seeds are presented in tables 1, 2, 3 and figure 1,2.

It was observed that the seeds given one and two week’s heat treatment had the highest germination percentage of 100% and 98% respectively. The number drastically dropped as it was recorded for three, four and five weeks to 23%, 21% and 12%. This states that for King palm the longer the heating period, the lower the germination percentage (Table 1).

According to the findings; the king palm germination
Table 1. Weekly germination count from the day of initial sprouting and final percentage % (Heat Treatment)

<table>
<thead>
<tr>
<th>Duration of heat treatment</th>
<th>Day of initial sprouting</th>
<th>No. of seeds in the bag</th>
<th>No. of seeds germinated</th>
<th>Week 1</th>
<th>Week 2</th>
<th>Week 3</th>
<th>Week 4</th>
<th>Week 5</th>
<th>Final %</th>
</tr>
</thead>
<tbody>
<tr>
<td>HTW₁</td>
<td>Day 10</td>
<td>50</td>
<td>25</td>
<td>30</td>
<td>39</td>
<td>41</td>
<td>47</td>
<td>50</td>
<td>100%</td>
</tr>
<tr>
<td>HTW₂</td>
<td>Day 17</td>
<td>50</td>
<td>20</td>
<td>26</td>
<td>35</td>
<td>39</td>
<td>45</td>
<td>49</td>
<td>98%</td>
</tr>
<tr>
<td>HTW₃</td>
<td>Day 24</td>
<td>50</td>
<td>08</td>
<td>10</td>
<td>12</td>
<td>12</td>
<td>13</td>
<td>13</td>
<td>26%</td>
</tr>
<tr>
<td>HTW₄</td>
<td>Day 35</td>
<td>50</td>
<td>02</td>
<td>06</td>
<td>08</td>
<td>10</td>
<td>11</td>
<td>11</td>
<td>22%</td>
</tr>
<tr>
<td>HTW₅</td>
<td>Day 43</td>
<td>50</td>
<td>02</td>
<td>04</td>
<td>05</td>
<td>06</td>
<td>06</td>
<td>06</td>
<td>12%</td>
</tr>
</tbody>
</table>

Table 2. Weekly germination count from the day of initial sprouting and final percentage % (Scarification).

<table>
<thead>
<tr>
<th>Duration of scarification treatment</th>
<th>Day of initial sprouting</th>
<th>No. of seeds in the bag</th>
<th>No. of seed germinated</th>
<th>Week 1</th>
<th>Week 2</th>
<th>Week 3</th>
<th>Week 4</th>
<th>Week 5</th>
<th>Final %</th>
</tr>
</thead>
<tbody>
<tr>
<td>SSW₁</td>
<td>Day 12</td>
<td>50</td>
<td>5</td>
<td>5</td>
<td>10</td>
<td>12</td>
<td>14</td>
<td>14</td>
<td>28%</td>
</tr>
<tr>
<td>SSW₂</td>
<td>Day 20</td>
<td>50</td>
<td>6</td>
<td>03</td>
<td>04</td>
<td>04</td>
<td>05</td>
<td>06</td>
<td>12%</td>
</tr>
<tr>
<td>SSW₃</td>
<td>Day 27</td>
<td>50</td>
<td>2</td>
<td>2</td>
<td>4</td>
<td>6</td>
<td>7</td>
<td>8</td>
<td>10%</td>
</tr>
<tr>
<td>SSW₄</td>
<td>Day 36</td>
<td>50</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>5</td>
<td>7%</td>
</tr>
<tr>
<td>SSW₅</td>
<td>Day 45</td>
<td>50</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>5%</td>
</tr>
</tbody>
</table>

Table 3. Germination in the bag from the day of initial sprouting (Direct sowing)

<table>
<thead>
<tr>
<th>No of bags</th>
<th>polythene bags</th>
<th>Number of seed Planted</th>
<th>Days of initial sprouting</th>
<th>Number of seed germinated</th>
</tr>
</thead>
<tbody>
<tr>
<td>Line 1 = 5</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>Line 2 = 5</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>Line 3 = 5</td>
<td>10</td>
<td>12</td>
<td>12</td>
<td>10</td>
</tr>
<tr>
<td>Line 4 = 5</td>
<td>10</td>
<td>12</td>
<td>12</td>
<td>10</td>
</tr>
<tr>
<td>Line 5 = 5</td>
<td>10</td>
<td>12</td>
<td>12</td>
<td>10</td>
</tr>
</tbody>
</table>

Figure 1. Weekly percentage germination using heat treatment.
using scarification method had lowest count given less than 30% and showed contamination (table 2). The first week recorded 28% as the highest and 5% as the lowest count recorded for week five.

Meanwhile the direct sowing was the best method that gave uniform germination of hundred percent with no contamination.

**DISCUSSION**

Direct sowing method of king palm seed had 100% germination and was achieved and appeared to be more promising and efficient as shown in table 3. These results agreed with that of NIFOR 1974, 1975 who reported that though, different palm species respond to various germination treatments heat treatment not exceeding two weeks in the germinator and direct sowing has given the best germination rate of most palm species. For instance, germination of *Phoenix acaulis* was enhanced when given heat treatment at 40°C for 2 weeks and when soaked in running water, while seeds of *Dictyosperma aureum* were reported to achieve 100% germination when the endocarp was removed, then placed in running water for a day and placed in polythene bag at ambient temperature. *Acanthophoenix alexandreae* seeds achieved the same 100% germination when soaked in water and placed in polythene bag at ambient temperature.

Heating the seeds for one week also gave good result, and is as well important in providing good aseptic environment for germination.

**CONCLUSION**

The direct sowing method appeared to be the most efficient and promising for mass production of King Palm planting materials.

**REFERENCE**


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