Determination of Phenology, Seed Germination and Development of *Hura crepitans* using ChemicalScarifications

1M. Idu, 2A.C. Omonhinmin and 3H.I. Onyibe
1Department of Botany, University of Benin, Benin City, P.M.B. 1154, 2Department of Biological Sciences, Igbinedion University, Okada, P.M.B. 0006, Benin City, Nigeria 3Department of Botany, Ambrose Alli University, P.M.B. 14, Ekpoma, Nigeria

**Abstract:** The phenology, seed germination, seedling development and evaluation were carried out on the seeds of *Hura crepitans*. The phenological data describes *Hura crepitans* seeds as 0.94 g in weight, 2.3x2.2x.48 cm in size, 3.6 cm mean volume, of 78% moisture level. The capsule of length 8 cm contains 7-16 seeds. The seeds are circular in shape, smooth, glabrous and glossy in texture with a capsule depth of 2.5 cm and a brownish testa. The plant flowers and fruits from the end of October to the end of June. To break dormancy, investigations on the stimulatory effect of chemical scarifications were analyzed. Methanol pre-treatment recorded the highest of 70% germination. Comparatively, some of the pretreatments showed better germination energy and vigour than the control. Such pretreatments are good for germination and nursery establishment of the species.

**Key words:** *Hura crepitans*, phenology, seed germination, seedling development, chemical scarification

**INTRODUCTION**

Germination studies are fundamental to any plant multiplication scheme. More so where such plant does not do well by vegetative propagation methods (Eze and Orole, 1987). Such studies are primarily carried out to obtain information on the field, planting value of seeds and comparable values for different seed lots (ISTA, 1996) *Hura crepitans* (sand box) is of the family Euphorbiaceae. It produces purple flowers (spike) and fruits are large, flattened and fluted making it distinct. The mature tree grows up to 16 m high with a wide spreading crown branching down (Keay, 1989).

Seed germination and development cannot be isolated from the process of dormancy as it is a crucial factor determining the survival and hence continuity of any seed bearing plant species. The process itself is influenced by the parents and embryo in relation to the prevailing environmental conditions. Simpson (1990) and Hendrick and Taylorson (1972) reported that treating seeds with chemicals, which are not growth regulators could promote metabolic activity and induce germination.

Crocker (1906) first reported the use of acid to weaken the seed coat of hard seeds to improve the seed coat permeability to water (Crocker and Davies, 1914; Idu and Omonhinmin, 2000, 2001; Idu and Omoregbe, 2002; Idu et al., 2002). In the present study, phenological, observations, seed germination, seedling development and evaluation were carried out on the seeds of *Hura crepitans*.

**MATERIALS AND METHODS**

**Seed source:** Seeds of *Hura crepitans* for this study were collected from Benin City, Edo State, Nigeria during the month of March 2004. Ripe pods were collected and seeds were stored at ambient temperature in kilner jars, before commencement of study in April 2004.

**Seed test:** Seed germination tests were carried out, following the techniques outlined by Idu and Omonhinmin (2000, 2001).

Seed were surface sterilized with 0.1% mercuric chloride solution for 1 min and rinsed thereafter with several changes of distilled water. Seeds were soaked afterward in solutions of concentrated sulphuric acid, hydrochloride acid, nitric acid, boric acid, acetic acid as well as ethanol, benzene, xylene, methanol for 5, 15 and 25 min, respectively.

The treated seeds were washed thoroughly after the various time lapses. Set of ten seeds with five replicates per treatment was allowed, to imbibe water on Whatman No. 1 filter papers, saturated with distilled water in 9 cm diameter Petri-dishes at room temperature (28°C). A set of

**Corresponding Author:** Dr. Idu MacDonald, Department of Botany, University of Benin, Benin City, PMB 1154, Benin City, Nigeria
untreated seeds served as control. The experimental setup was placed under continuous fluorescent light at bench level.

Emergence of 2 mm of the radicle was used as a criterion of germination. Results were grouped into vigour categories based on speed of germination, germination energy (Maguire, 1962), vigour index (Abdul-Baki and Anderson, 1973), germination value (Czabator, 1962) abnormal seedlings (Idu and Ogidoh, 2002), high vigour and low vigour (Idu and Omonhinmin, 2001).

Comparison of treatment mean height was performed using the Least Significant Difference (LSD) multiple range test. Standard Error and critical difference at 5% were statistically evaluated for the various germination parameters.

RESULTS AND DISCUSSION

The phenology, seed germination, seedling development and evaluation were carried out on the seeds of *Hura crepitans*. The phenological data (Table 1) describes *Hura crepinats* seeds as 0.94 g in weight, 2.3×2.2×48 cm in size; 3.6 cm³ mean volume, of 78% moisture level. The capsule of length 8 cm contains 7-16 seeds. The seeds are circular in shape, smooth glabrous and glossy in texture with a capsule depth of 2.5 cm and a brownish testa. The plant flowers and fruits from the end of October to the end of June. High cumulative germination of germinated seeds 85% for 25 min, 60% for 5 min treatments were recorded for Boric acid and Hydrochloric acid, respectively. Germination energy of 75% was recorded for 5 min (Boric acid) (Table 2).

Seed treated with sulphuric acid and acetic acid recorded low germination percentages and energies. Nitric acid recorded 0% germination. Germination speed of 8.37 for boric acid (15 min) and 6.27 for hydrochloric acid (25 min) were quite high for both. The highest vigour index was recorded for sulphuric acid (Table 3). Idu (1994) recorded 60% germination for *Bixa orellana* seed treated with 36% hydrochloric acid for 5 min. Further, research by Idu and Omonhinmin (2001) reported 62% germination for *Tamarindus indica* using acid under continuous light condition.

Seed coat dormancy eliminated by acid scarification is linked to the corrosive removal of the waxy seed coat thereby directly increasing the water uptake of the seeds, permeability to gases and change in sensitivity to light or temperature and/or probably of inhibitors (Noel and Van Stalen, 1976).

Benzene and methanol recorded high cumulative percentage germination of 65% (15 min) for benzene and

<table>
<thead>
<tr>
<th>Table 1: Phenological data of Hura crepitans</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
</tr>
<tr>
<td>---</td>
</tr>
<tr>
<td>Beginning and end of rainy season</td>
</tr>
<tr>
<td>Flowering period</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Table 2: Percentage germination and germination energy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pretreatment (min)</td>
</tr>
<tr>
<td>---------------------</td>
</tr>
<tr>
<td>5</td>
</tr>
<tr>
<td>15</td>
</tr>
<tr>
<td>25</td>
</tr>
<tr>
<td>Control</td>
</tr>
<tr>
<td>SE (%)</td>
</tr>
<tr>
<td>CV (%)</td>
</tr>
<tr>
<td>CD at 5%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Table 3: Germination speed, seed vigour and abnormal seedling percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pretreatment (min)</td>
</tr>
<tr>
<td>---------------------</td>
</tr>
<tr>
<td>5</td>
</tr>
<tr>
<td>15</td>
</tr>
<tr>
<td>25</td>
</tr>
<tr>
<td>Control</td>
</tr>
<tr>
<td>SE (%)</td>
</tr>
<tr>
<td>CV (%)</td>
</tr>
<tr>
<td>CD at 5%</td>
</tr>
</tbody>
</table>
Table 4: Percentage germination and germination energy

<table>
<thead>
<tr>
<th>Pretreatment (min)</th>
<th>Germination (%)</th>
<th>Germination energy (%)</th>
<th>High vigour</th>
<th>Low vigour</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Benzene</td>
<td>Methanol</td>
<td>Benzene</td>
<td>Methanol</td>
</tr>
<tr>
<td>5</td>
<td>55</td>
<td>70</td>
<td>15</td>
<td>50</td>
</tr>
<tr>
<td>15</td>
<td>65</td>
<td>55</td>
<td>40</td>
<td>45</td>
</tr>
<tr>
<td>25</td>
<td>35</td>
<td>20</td>
<td>20</td>
<td>10</td>
</tr>
<tr>
<td>Control</td>
<td>80</td>
<td></td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>Nicking</td>
<td>35</td>
<td></td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>SE (%)</td>
<td>8.82</td>
<td>14.81</td>
<td>7.64</td>
<td>12.58</td>
</tr>
<tr>
<td>CV (%)</td>
<td>30.00</td>
<td>65.30</td>
<td>53.00</td>
<td>62.00</td>
</tr>
<tr>
<td>OD at 5%</td>
<td>27.19</td>
<td>045.67</td>
<td>23.54</td>
<td>38.80</td>
</tr>
</tbody>
</table>

Table 5: Germination speed, germination vigour and percentage abnormal seedling

<table>
<thead>
<tr>
<th>Pretreatment (min)</th>
<th>Speed of germination</th>
<th>Vigor index</th>
<th>Germination value</th>
<th>Abnormal seedling (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Benzene</td>
<td>Methanol</td>
<td>Benzene</td>
<td>Methanol</td>
</tr>
<tr>
<td>5</td>
<td>5.28</td>
<td>8.83</td>
<td>1055.45</td>
<td>147</td>
</tr>
<tr>
<td>15</td>
<td>4.90</td>
<td>5.50</td>
<td>1162.20</td>
<td>1342</td>
</tr>
<tr>
<td>25</td>
<td>1.62</td>
<td>2.83</td>
<td>630.00</td>
<td>322.6</td>
</tr>
<tr>
<td>Control</td>
<td>6.50</td>
<td></td>
<td>1620.00</td>
<td></td>
</tr>
<tr>
<td>Nicking</td>
<td>3.17</td>
<td></td>
<td>0390.95</td>
<td></td>
</tr>
<tr>
<td>SE (%)</td>
<td>1.16</td>
<td>1.74</td>
<td>162.56</td>
<td>353.34</td>
</tr>
<tr>
<td>CV (%)</td>
<td>51.00</td>
<td>53.00</td>
<td>36.00</td>
<td>62.00</td>
</tr>
<tr>
<td>OD at 5%</td>
<td>3.38</td>
<td>5.07</td>
<td>473.57</td>
<td>976.95</td>
</tr>
</tbody>
</table>

Table 6: Ranked mean of alcohol pretreatment

<table>
<thead>
<tr>
<th>Pre-treatment (Alcohol)*</th>
<th>Ranked mean*</th>
<th>LSD (H)+mean*</th>
<th>Pre-treatment (Alcohol)**</th>
<th>Ranked mean**</th>
<th>LSD(H)+mean**</th>
</tr>
</thead>
<tbody>
<tr>
<td>HCl 25 min</td>
<td>8.8a</td>
<td>11.88</td>
<td>Control</td>
<td>12.25a</td>
<td>15.67</td>
</tr>
<tr>
<td>H2SO4 15 min</td>
<td>9.7ab</td>
<td>12.83</td>
<td>Methanol 25 min</td>
<td>16.13b</td>
<td>19.55</td>
</tr>
<tr>
<td>Acetic acid 25 min</td>
<td>10b</td>
<td>13.08</td>
<td>Benzene 15 min</td>
<td>17.86b</td>
<td>21.30</td>
</tr>
<tr>
<td>H2SO4 25 min</td>
<td>10.1b</td>
<td>13.18</td>
<td>Benzene 25 min</td>
<td>18.0c</td>
<td>21.42</td>
</tr>
<tr>
<td>Acetic acid 15 min</td>
<td>11bc</td>
<td>14.08</td>
<td>Methanol 15 min</td>
<td>18.46c</td>
<td>21.82</td>
</tr>
<tr>
<td>HCl 15 min</td>
<td>12c</td>
<td>15.08</td>
<td>Benzene 5 min</td>
<td>19.19d</td>
<td>22.61</td>
</tr>
<tr>
<td>Control</td>
<td>12.25c</td>
<td>15.33</td>
<td>Methanol 5 min</td>
<td>21.13e</td>
<td>-</td>
</tr>
<tr>
<td>Boric acid 15 min</td>
<td>12.5c</td>
<td>15.58</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Boric acid 25 min</td>
<td>15.64d</td>
<td>18.72</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Boric acid 5 min</td>
<td>16.3d</td>
<td>19.38</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Acetic acid 5 min</td>
<td>18e</td>
<td>21.08</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>HCl 5 min</td>
<td>19.13e</td>
<td>22.21</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>H2SO4 5 min</td>
<td>20.20f</td>
<td></td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

*F = Ratio = 4.49, **F = Ratio = 1.81, Mean followed by the same letter(s) are not significantly different at 5% (LSD)

Table 7: Ranked mean of hormone pretreatment

<table>
<thead>
<tr>
<th>Pre-treatment (Cormarin)*</th>
<th>Ranked mean*</th>
<th>LSD (H)+mean*</th>
<th>Pre-treatment (Thiouracil)**</th>
<th>Ranked mean**</th>
<th>LSD (H)+mean**</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>12.25a</td>
<td>17.15</td>
<td>Control</td>
<td>12.25a</td>
<td>14.97</td>
</tr>
<tr>
<td>10 mg L⁻¹ 5 min</td>
<td>14.03a</td>
<td>18.93</td>
<td>0.1 mg L⁻¹ 5 min</td>
<td>14.89ab</td>
<td>17.95</td>
</tr>
<tr>
<td>0.01 mg L⁻¹ 5 min</td>
<td>14.3a</td>
<td>19.20</td>
<td>0.1 mg L⁻¹ 15 min</td>
<td>15.48c</td>
<td>18.54</td>
</tr>
<tr>
<td>0.1 mg L⁻¹ 25 min</td>
<td>16.88b</td>
<td>21.38</td>
<td>0.1 mg L⁻¹ 5 min</td>
<td>15.56e</td>
<td>18.62</td>
</tr>
<tr>
<td>1 mg L⁻¹ 15 min</td>
<td>17.86b</td>
<td>22.77</td>
<td>10 mg L⁻¹ 15 min</td>
<td>16.40c</td>
<td>19.46</td>
</tr>
<tr>
<td>10 mg L⁻¹ 15 min</td>
<td>18.1b</td>
<td>23.09</td>
<td>0.001 mg L⁻¹ 25 min</td>
<td>16.75e</td>
<td>19.81</td>
</tr>
<tr>
<td>0.01 mg L⁻¹ 15 min</td>
<td>18.2b</td>
<td>23.10</td>
<td>1 mg L⁻¹ 25 min</td>
<td>17.44d</td>
<td>20.50</td>
</tr>
<tr>
<td>10 mg L⁻¹ 25 min</td>
<td>18.33b</td>
<td>23.23</td>
<td>1 mg L⁻¹ 15 min</td>
<td>17.53d</td>
<td>20.59</td>
</tr>
<tr>
<td>1 mg L⁻¹ 25 min</td>
<td>19.25c</td>
<td>23.55</td>
<td>10 mg L⁻¹ 15 min</td>
<td>17.55d</td>
<td>20.61</td>
</tr>
<tr>
<td>1 mg L⁻¹ 5 min</td>
<td>19.60c</td>
<td>24.30</td>
<td>10 mg L⁻¹ 25 min</td>
<td>17.75d</td>
<td>20.81</td>
</tr>
<tr>
<td>0.001 mg L⁻¹ 5 min</td>
<td>19.88b</td>
<td>24.78</td>
<td>0.001 mg L⁻¹ 15 min</td>
<td>17.96d</td>
<td>21.02</td>
</tr>
<tr>
<td>0.1 mg L⁻¹ 5 min</td>
<td>19.88b</td>
<td>24.78</td>
<td>1 mg L⁻¹ 15 min</td>
<td>17.96d</td>
<td>21.02</td>
</tr>
<tr>
<td>0.001 mg L⁻¹ 25 min</td>
<td>20.53c</td>
<td></td>
<td>0.1 mg L⁻¹ 25 min</td>
<td>17.96e</td>
<td>21.22</td>
</tr>
<tr>
<td>0.001 mg L⁻¹ 5 min</td>
<td>20.74c</td>
<td></td>
<td>0.1 mg L⁻¹ 25 min</td>
<td>19.50e</td>
<td>-</td>
</tr>
<tr>
<td>0.1 mg L⁻¹ 25 min</td>
<td>20.89d</td>
<td></td>
<td>0.01 mg L⁻¹ 5 min</td>
<td>21.02f</td>
<td>-</td>
</tr>
<tr>
<td>0.1 mg L⁻¹ 15 min</td>
<td>20.90e</td>
<td></td>
<td>0.1 mg L⁻¹ 15 min</td>
<td>20.54f</td>
<td>-</td>
</tr>
</tbody>
</table>

*F = Ratio = 0.75, **F = Ratio = 3.33, ***F = Ratio = 2.71, Mean followed by the same letter(s) are not significantly different at 9% (LSD)

70% (5 min) for methanol (Table 4). Higher germination vigour (8.83) at 5 min treatment was recorded for methanol. Similarly, higher vigour index was recorded for methanol pretreatment (Table 5).

Ethanol and xylene showed 0% germination. The stimulatory role of alcohol solvents on seeds might be due to the interaction with cellular membrane of the seeds or the chemical erosion of the outer waxy layer of the seed.
coat (Taylorson, 1982). Hence alcohol solvent though less corrosive than acids, showed good abrasive properties.

Boric acid pretreatment (25 min) recorded high percentage of abnormal seedling, an index of poor establishment in the nursery of boric acid pretreated seedlings. Alcohol pre-treatments were not significantly different. However, those of the acid scarification were significant (Table 5).

Analysis of variance for a complete randomized design was carried out on the height data for seedlings raised from various acid, alcohol and hormonal pre-treated seeds, to test for the effect of the pre-treatments. The acid and alcohol were associated with an F-ratio of 4.49 and 1.81, respectively, while the hormone pre-treatments of coumarin had 0.73, 3.33 and 2.71, respectively, suggesting treatments difference at 5% level of significance for acid, thiourea and GA$_3$. Comparison of mean heights, performed using the Least Significance Difference (LSD) multiple range test (Table 6 and 7), showed that sulphuric acid and methanol treated seeds for 5 min and those treated with coumarin at 0.001 mg L$^{-1}$ for 15 min 0.001 mg L$^{-1}$ for 25 min and 0.01 mg L$^{-1}$ for 25 min 0.1 mg L$^{-1}$ for 15 min, thiourea at 0.001 mg L$^{-1}$ for 5 min and GA$_3$ at 1 mg for 25 min 1 mg L$^{-1}$ for 5 min and 0.1 mg L$^{-1}$ for 5 min produced seedlings of higher vigour than other pre-treatments in their category.

CONCLUSIONS

Conclusively, scarification with methanol is promising. Its use in seed germination and seedling development of _H. crepitans_ especially at a tolerable timing of 5 min would be ideal.

REFERENCES


