Effect of various pre-treatments for breaking the dormancy of *Jatropha gossypifolia* Linn.

Mudasir Qadir and Fatima Khan*

Govt College of Science and Commerce Benazeer, Bhopal-462008 (India)

Abstract

In the present investigation, seeds of *Jatropha gossypifolia* were subjected to various treatments to achieve early germination by breaking dormancy.

The highest germination percentage was recorded for the seeds subjected to hot water pretreatment followed by IAA treatment which respectively induced 84 and 78 percent germination on 17th day after sowing. For the same time period, the germination percentage was 21, 38, 20, 58, 33, 32, 30, 24, 32, 60, 27, 49, 30 and 69 respectively in the seeds kept as control, those treated with scarification, stratification, alternating high and low temperature, KNO₃, thiourea, kinetin, GA₃, H₂SO₄, presoaking, electric current, mechanical injury, coumarin and brassinolide. Incidentally, there was no improvement of germination percentage after 17th day of sowing. Thus, the best option for the germination of *J. gossypifolia* seeds is pre-treatment with hot water.

The seeds of some plants easily germinate after sowing in nature but the seeds of a number of plants do not germinate easily and exhibit dormancy for varying period of time. The dormancy may be due to internal factors or may be due to external factors. Certain plants may immediately germinate after the harvest, it can be best exemplified by the seeds of *Pisum sativum*, which sometimes germinate in the fruit itself which is still on the plant, a phenomenon known as vivipary. However, sometimes the dormancy period is very prolonged and can take months together for germination. This is true for the seeds of *Malus domestica* which has a hard seed coat and *Entada gigas* which has a very thick seed coat and do not germinate easily.

*J. gossypifolia* is a flowering plant grown more for the foliage than the flowers. The new growth is a deep purplish-red color. As the leaves mature, they turn green. The plant is always in a state of growth, so the colorful foliage is always present. The growth habit is upright to a height of 5-6 feet. Flowers are small and brick red, appearing in clusters on new growth. One of the most interesting features is that the leaf margins, veins and

* Present address : Govt. College, Nasrullah Ganj-466 331 (India)
petioles are covered with hairs topped by a sticky gland. Sometimes known as Bellyache bush.

This medicinally important plant is native to Central and South America and the Caribbean. It is a tropical plant and does not tolerate a lot of cold. This species has a watery sap but the sap is not a skin irritant like that of other Jatrophas. In fact, the sap has been used for generations in Nigeria as a haemostatic agent to stop bleeding. The fluid is applied directly to bleeding nose, gums or skin.

Because of very thick seed coat, a high degree of seed dormancy prevails in this plant. It is evident from table 1 that only 21% seed germination of *J. gossypifolia* could be achieved after 17 days of sowing in the seeds which served as control, whereas, IAA promoted germination to the extent of 78% during the same time period followed by 69% under the influence of brassinolide. The seeds were subjected to various treatments which are mentioned in table-1.

Germination is a sequential series of morphogenetic events that result in the transformation of an embryo into a seedling. The seeds of every plant have the capability to germinate but their germination is affected due to some factors, such as seed coat, hard seed coat, rudiment embryo, over-ripening, presence of plant growth inhibitors, due to absence of water, oxygen and due to unfavourable conditions. Dormancy of seeds is due to external factors or due to internal factors. When it is caused due to internal factors, it is called as true dormancy or innate dormancy or primary dormancy. And when it is caused due to external factors, it is called as imposed dormancy or quiescent dormancy or secondary dormancy. Both of these primary and secondary dormancy influences are mutually dependent and can not be singled out. True dormant seeds do not germinate even if they are provided with suitable environmental factors. Secondary dormant seeds may germinate immediately after shed off. After some storage, they fail to germinate and thus exhibit secondary dormancy. Some seeds such as *Brassica alba*, *Ambrosia tripolia* and *Xanthium pennsylvanicum* exhibit secondary dormancy. Secondary dormancy is opposite to after ripening. Presence of high carbon dioxide concentration, absence of light and very high or low temperature induce the secondary dormancy.

A number of techniques are available for breaking the dormancy of seeds, such as; scarification, exposure to light, alternating high & low temperatures, stratification, impaction, pressure, electric current, pretreatment with coumarins, kinetin, GA₃, H₂SO₄, thiourea, KNO₃ and hot water.

Chouard,⁵ has investigated vernalization and its relation to dormancy. Experimental induction of dormancy in *Betula pubescens* was investigated by Eagles & Wareing.⁹. Evanari,¹⁰ has studied the physiology of seed dormancy, after ripening and germination. Ribosome and enzyme changes during maturation and germination of the castor bean seeds was investigated by Marre,¹⁵. Effects of light, temperature and their interaction on
the germination of seeds was investigated by Toole\textsuperscript{26}.

Hayes & Klein,\textsuperscript{12} investigated special quality influence of light during development of \textit{Arabidopsis thaliana} plants in regulating seed germination. Bewley and Black,\textsuperscript{2} studied the physiology and biochemistry of seeds. Isoenzymes of sugar phosphate metabolism in endosperm of germinating castor beans were studied by Nishimura,\textsuperscript{20}. Seed germination and dormancy have been studied by Bewley,\textsuperscript{3}. Improvement of seed germination in \textit{Asparagus racemosus} has been reported by Gupta, \textit{et al.},\textsuperscript{11}.

Effect of pre-sowing treatment on seed germination of Babchi (\textit{Psoralea corylifolia}) and Senna (\textit{Cassia angustifolia}) in nursery has been reported by Koppad, and Umarbhadsha,\textsuperscript{14}. Seed germination behaviour of \textit{Asparagus racemosus} (\textit{Shatavari}) under \textit{in-vivo} and \textit{in-vitro} conditions has been investigated by Raghav, and Kasera,\textsuperscript{21}. Siva, \textit{et al.},\textsuperscript{24} have studied the enhanced seed germination of \textit{Psoralea corylifolia} L. by heat treatment. Musara, \textit{et al.},\textsuperscript{18} have investigated the evaluation of different seed dormancy breaking techniques on Okra (\textit{Abelmoschus esculentus} L.) seed germination. Asha, and Illa,\textsuperscript{1} have studied the effect of seed direction and growth media on \textit{in vitro} seed germination and seedling establishment of \textit{Pterocarpus marsupium}.

Cantoro, \textit{et al.},\textsuperscript{4} have reported seed dormancy QTL identification across a \textit{Sorghum bicolor} segregating population. Dave, \textit{et al.},\textsuperscript{6} have investigated the regulation of \textit{Arabidopsis thaliana} seed dormancy and germination by 12-oxo-phytodienoic acid. \textit{Entada phaseoloids} seed dormancy and germination: implications for conservation and restoration has been reported by Deepa, and Shinde,\textsuperscript{7}. The effect of the use of temperature on the breakage of dormancy and the subsequent performance of rice (\textit{Oryza} \textit{spp.}) has been investigated by Doku, \textit{et al.},\textsuperscript{8}. Transcriptome analysis of seed dormancy after rinsing and chilling in ornamental peaches (\textit{Prunus persica}) has been investigated by Kanjana, \textit{et al.},\textsuperscript{13}.

Effect of different pretreatments and seed coat on dormancy and germination of seeds of \textit{Senna obustifolia} has been studied by Mensah, and Ekeke,\textsuperscript{16}. Mishra,\textsuperscript{17} has investigated the effect of temperature and light on the seed germination of \textit{Sida cordifolia}. Redwood, \textit{et al.},\textsuperscript{22} have reported seed longevity and dormancy state in a disturbance-dependent forest herb, Ageratina. Germination pretreatments to break hard-seed dormancy in \textit{Astragalus cicer} L. has been studied by Statwick\textsuperscript{25}.

Effect of various dormancy breaking treatments on seed germination, seedling growth and seed vigour of medicinal plants has investigated by Warghat, \textit{et al.},\textsuperscript{27}. Zohra, \textit{et al.},\textsuperscript{28} have reported the effect of salicylic acid on germination of \textit{Ocimum gratissimum} seeds induced into dormancy by chlormequat. The release of dormancy, a wake-up call for seeds to germinate has reported by Nee, \textit{et al.},\textsuperscript{19}.

Healthy seeds of \textit{Jatropha gossypifolia} were collected from the seed market (Bhopal).
The seeds were washed with running tap water three to four times and once surface sterilized with 0.1% \( \text{H}_{2}\text{Cl}_{2} \) solution for 5 minutes to remove the surface adhering microbes. After surface sterilization, the seeds were again washed with double distilled water. Uniform sized seeds were then transferred to sterilized Petri Plates provided with filter paper pads. Three replicates of treated and control seeds were kept for germination studies. The filter paper pads were moistened as and when needed. The emergence of radical was taken as germination.

The highest germination percentage was recorded for the seeds subjected to hot water pretreatment followed by IAA treatment which respectively induced 84 and 78 percent germination on 17\( ^{th} \) day after sowing. For the same time period, the germination percentage was 21, 38, 20, 32, 30, 24, 32, 60, 27, 49, 30 and 69 respectively in the seeds kept as control, those treated with scarification, stratification, alternating high and low

<table>
<thead>
<tr>
<th>Treatment</th>
<th>3(^{rd}) day</th>
<th>5(^{th}) day</th>
<th>7(^{th}) day</th>
<th>9(^{th}) day</th>
<th>11(^{th}) day</th>
<th>13(^{th}) day</th>
<th>15(^{th}) day</th>
<th>17(^{th}) Day</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>3</td>
<td>8</td>
<td>15</td>
<td>17</td>
<td>20</td>
<td>21</td>
<td>21</td>
<td>21</td>
</tr>
<tr>
<td>Hot water</td>
<td>18</td>
<td>37</td>
<td>45</td>
<td>58</td>
<td>67</td>
<td>81</td>
<td>84</td>
<td>84</td>
</tr>
<tr>
<td>Scarification</td>
<td>8</td>
<td>17</td>
<td>17</td>
<td>26</td>
<td>32</td>
<td>38</td>
<td>38</td>
<td>38</td>
</tr>
<tr>
<td>Stratification</td>
<td>2</td>
<td>5</td>
<td>7</td>
<td>13</td>
<td>13</td>
<td>19</td>
<td>20</td>
<td>20</td>
</tr>
<tr>
<td>Alt. high &amp; low temp.</td>
<td>9</td>
<td>15</td>
<td>18</td>
<td>32</td>
<td>41</td>
<td>55</td>
<td>57</td>
<td>58</td>
</tr>
<tr>
<td>KNO(_3)</td>
<td>5</td>
<td>9</td>
<td>9</td>
<td>17</td>
<td>26</td>
<td>33</td>
<td>33</td>
<td>33</td>
</tr>
<tr>
<td>Thiourea</td>
<td>4</td>
<td>8</td>
<td>17</td>
<td>17</td>
<td>28</td>
<td>31</td>
<td>32</td>
<td>32</td>
</tr>
<tr>
<td>Kinetin</td>
<td>7</td>
<td>12</td>
<td>16</td>
<td>23</td>
<td>23</td>
<td>29</td>
<td>29</td>
<td>30</td>
</tr>
<tr>
<td>GA(_3)</td>
<td>6</td>
<td>11</td>
<td>16</td>
<td>18</td>
<td>21</td>
<td>24</td>
<td>24</td>
<td>24</td>
</tr>
<tr>
<td>(\text{H}<em>{2}\text{SO}</em>{4})</td>
<td>12</td>
<td>19</td>
<td>23</td>
<td>27</td>
<td>32</td>
<td>32</td>
<td>32</td>
<td>32</td>
</tr>
<tr>
<td>Presoaking</td>
<td>13</td>
<td>19</td>
<td>31</td>
<td>39</td>
<td>47</td>
<td>58</td>
<td>59</td>
<td>60</td>
</tr>
<tr>
<td>Coumarin</td>
<td>0</td>
<td>4</td>
<td>10</td>
<td>17</td>
<td>23</td>
<td>29</td>
<td>30</td>
<td>30</td>
</tr>
<tr>
<td>Electric current</td>
<td>8</td>
<td>14</td>
<td>14</td>
<td>20</td>
<td>27</td>
<td>27</td>
<td>27</td>
<td>27</td>
</tr>
<tr>
<td>Brassinolide</td>
<td>11</td>
<td>29</td>
<td>37</td>
<td>46</td>
<td>61</td>
<td>68</td>
<td>68</td>
<td>69</td>
</tr>
<tr>
<td>Mechanical injury</td>
<td>13</td>
<td>18</td>
<td>22</td>
<td>31</td>
<td>38</td>
<td>47</td>
<td>49</td>
<td>49</td>
</tr>
<tr>
<td>IAA</td>
<td>20</td>
<td>33</td>
<td>41</td>
<td>53</td>
<td>69</td>
<td>76</td>
<td>78</td>
<td>78</td>
</tr>
</tbody>
</table>
temperature, KNO₃, thiourea, kinetin, GA₃, H₂SO₄, presoaking, electric current, mechanical injury, coumarin and brassinolide. Incidentally, there was no improvement of germination percentage after 17th day of sowing. It is evident from table-1 that treatment with hot water of J. gossypifolia seeds is the best option for securing higher germination percentage followed by IAA and alternating brassinolide treatment which respectively induced 84, 78 and 69 percent germination. For the same time period, only 21% germination was achieved in the seeds kept as control.

Only 21% seed germination of J. gossypifolia could be achieved after 17 days of sowing in the seeds which served as control, whereas, IAA promoted germination to the extent of 78% during the same time period followed by 69% under the influence of brassinolide.

On the 3rd day, the germination percentage was 3, 18, 20 and 11 in the seeds respectively kept as control, those treated with hot water, IAA and brassinolide. However, pretreatment of the seeds with hot water was found to be the best method to achieve higher germination percentage. It is evident from table 1 that this method resulted in achieving as high as 84% germination on 17th day after sowing. Thus, hot water treatment initially is the best option for the germination of J. gossypifolia seeds.

References: