Full Length Research Paper

Effect of Dry-Heat Treatment on the Germination and Seedling Emergence of Corchorus olitorius Seed

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ABSTRACT

The aim of the study was to determine the effect of temperature on the seed germination and seedling emergence of Corchorus olitorius. About 2.5kg seed were subjected to seven temperature regimes (40°C, 50°C, 60°C, 70°C, 80°C and 90°C) for 5minutes and 10minutes to break the seed dormancy. The seed germination test was carried out in petri-dishes following the oven heat treatments, while the seedling emergence test was carried out in a concrete trough and trays filled with sterilized soil. The germination was initiated at 40°C and seedling emergence initiated from the control while optimum germination was obtained by treating seeds at 90°C for 5 and 10mins exposure. The dry heat treatments of 40°C, 50°C and 60°C are not significantly (P<0.05) different, however, those of 70°C, 80°C and 90°C heat treatments are significantly different at (P <0.05). The experiment showed that C. olitorius seed can tolerate high dry oven heat treatment and still remain viable at temperature as high as 90°C.

Keywords: Seed germination, Seedling emergence, Seed dormancy, Dry-heat treatment.

INTRODUCTION

Corchorus olitorius is an annual dicotyledonous flowering herb belonging to the family of Malvaceae. A native to most tropical and sub-tropical regions of the world (Carter and Varina, 2001), it is used as ingredient for mucilaginous potherb preparation called molokiyiwa. C. olitorius is extensively cultivated in India as a fibre crop since ancient times and usually referred to as Jew's mallow, tossa jute or wild okra. This Jew's mallow is also widely cultivated in the Caribbeans, Brazil, Bangladesh, China, Japan, Egypt and Middle East (Fox and Norwood, 1982; Van Wyk and Gericke, 2000; Voster et al., 2002). C. olitorius is a remarkable vegetable food to many families in Africa, Asia and in the Middle East. The edible leaves are rich sources of vitamins and minerals including: iron, calcium, thiamine, riboflavin, niacin, foliate, dietary fibre and protein balance (Leong et al., 1968). It is highly rated leafy vegetable soup ingredient in Cote d'Ivoire, Benin, Nigeria, Cameroon, Sudan, Kenya, Uganda and Zimbabwe. The vegetable soup is cheap, easy to cook and highly digestible due to the nature of its dietary fibre content, making this vegetable the favourite of many household especially when other vegetables are scarce and expensive (Denton, 1997). Root scrapping of Jew's mallow is used to treat toothache in Kenya, a root decoction is used as a local tonic, the leafy twigs in Congo where is used to suppress heart beat irregularities, an infusion from the leaves is taken against constipation in Tanzania and the young shoot is used as purgative in Nigeria (Grubben and Denton, 2004). C. olitorius is usually cultivated by broadcasting. Farmers indiscriminately scatter the seeds on prepared seed beds without spacing of the planning seeds. The plant has a short growing duration provided there is adequate moisture and rich loamy soil.
Early germination and plant establishment on the field is essential for timely harvesting and marketing of the vegetable. The seed often has a period of dormancy which may prevent and delay early germination, therefore seed dormancy constitute a major barrier in predicting the germination potential of \textit{C. olitorius} seeds. Denton (1997) recommended a solution to the incidence of seed dormancy through the application of seed parboiling process. The seed dormancy syndrome may partly be as a result of condition outside the embryo which can be: physical, chemical, mechanical or even morphological in nature. Seed dormancy may arise when seed coats are impermeable to water and gaseous exchange, especially when the endocarps of the seed coats are hardened thereby preventing the permeability of water and gases necessary during the last development stages of seed germination. Farmers often by accidental practice subject garden seeds to heat fire condition through bush burning practice that eventually breaks seed dormancy. This fire treatment power is not accurately predictable because the amount and duration of heat treatment reaching the seed coats is governed by several factors (Emery, 1987). Thus a rapid, reliable dormancy breaking process is required to ensure better germination of \textit{C. olitorius} seeds in the field. Present study, therefore concentrated on finding a suitable dormancy breaking treatment in \textit{C. olitorius}.

**MATERIALS AND METHODS**

A total of 2.5kg of oniyaya variety was acquired from the experimental fields of National Institute of Horticulture (NIHORT) in Ibadan, Oyo state, Nigeria. The seeds were cleaned of debris, stones, shafts and straws by winnowing the rough seeds in a perforated aluminum screening bowl of (4 x 4 x 3) mesh size screen. This was followed by seed floatation process in which 100g of cleaned seeds were added to 500ml beaker containing 350ml of distilled water. The seeds were separated based on density profile of the seeds. Healthy containing 350ml of distilled water. The seeds were 100g of cleaned seeds were added to 500ml beaker while damaged insect perforated seeds and other light weight impurities found floating was discarded. Seed recovery was done using the aluminum screening mesh size bowl to separate and discard the liquid portion. The seeds were spread in 3 laboratory trays and left to dry under the ambient room temperature (tempering) for 2days. Five grams (5 g) of cleaned seeds were placed in seven glass heat resistant petri-dishes each representing different temperature regimen of: 40°C, 50°C, 60°C, 70°C, 80°C, and 90°C, including a control (untreated seed). Each petri-dish was put in the oven pre-heated to desired temperature for the dry heat treatment for 5min and 10min oven heat exposure respectively. The dry heat treated seeds were cooled to room temperature in a laboratory shade drying cubicles and preserved for seed germination test. The control remained untreated being the index of comparison.

Seed germination test was conducted in the seed processing laboratory using 2x7 (time by temperature) in triplicate for each experimental trial. A hundred (100) seeds were counted and placed in a petri-dish lined with a role of Whatman No. 1, filter paper saturated with distilled water. Each petri-dish containing the seeds was observed for germination within a period of ten days. A seed is said to germinate when the radical is visible sprouting out of the embryonic tissue. The seedling emergence test in soil was carried out at the horticultural unit of the department using 2x7 (time and temperature) regime. A total of one hundred and fifty treated seeds were sown into twenty one planting rows in triplicate. A total of 450 selected and treated seeds were sown on concrete trough of (80 x 30x 7) cm$^3$ that was divided into three equal rows per plot. Each planting trough was filled with sterilized soil leveled with iron rake. A hole of 2.5 cm depth was drilled into the soil with spacing of 8cm between each planting row. Each trough containing the planted seeds was watered slightly to ensure adequate moisture was provided for germination. A seed is said to emerge when the cotyledons break through to the surface of the soil. Each plot containing planted seeds was under observation for seed emergence within a period of 10 days, after which a pair of forceps was employed to remove the sprouting seedling to a permanent field plot for plant establishment into maturity.

Data were collected on seed germination culture from the laboratory perit-dishes as well as from the seed emergence trial of concrete trough culture at the horticultural unit of the department. Statistical Analysis Statistical significance was assessed for data collected by two-way (ANOVA) at 95% confidence level using SAS, version 9.1 (SAS, 1999). Also analysis of variance was used to test the data and the difference among the means was compared using Duncan Multiple Range test (Duncan, 1955).

**RESULTS AND DISCUSSION**

Traditional vegetable farmers are known to prefer upland and lowland farming during this growing season. During the raining and wet season time there is sufficient moisture to support the rapidly growing nature of this vegetable to full maturity. Also \textit{C. olitorious} vegetable is known to have short growing duration therefore the wet season time period facilitates this rapid emergence of embryonic tissue of coleorhiza, coleoptiles and the epiblast shoots to sprout out of the germ in response to
Table 1. Analysis of variance for the percentage seed germination and seedling emergence.

<table>
<thead>
<tr>
<th>Source</th>
<th>df</th>
<th>% seed germination</th>
<th>% seedling emergence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time</td>
<td>1</td>
<td>564.67**</td>
<td>5239.40**</td>
</tr>
<tr>
<td>Temperature</td>
<td>6</td>
<td>5241.00**</td>
<td>892.08**</td>
</tr>
<tr>
<td>Time*temp</td>
<td>6</td>
<td>168.56**</td>
<td>121.40 ns</td>
</tr>
<tr>
<td>Replication</td>
<td>2</td>
<td>9.74 ns</td>
<td>21.37 ns</td>
</tr>
<tr>
<td>Error</td>
<td>26</td>
<td>30.61</td>
<td>215.72</td>
</tr>
<tr>
<td>Total</td>
<td>41</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Key: Values are means ± SE of 3 replicates.

*= significant at 0.05 (5%)

**= significant at 0.01 (1%)

Table 2. Percentage germination and percentage seedling emergence for *Corchorus olitorius* seeds under two time regimes of dry-heat treatment.

<table>
<thead>
<tr>
<th>Time (min)</th>
<th>% seed germination</th>
<th>% seedling emergence</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>22.33a</td>
<td>39.32a</td>
</tr>
<tr>
<td>10</td>
<td>15.00b</td>
<td>16.99b</td>
</tr>
</tbody>
</table>

Key: Values are means ± SE of 3 replicates.

Mean differences were tested by Duncan Multiple Range test at P<0.05).
Means with the same letters in column and row are not significantly (P<0.05) different.

Table 3. Percent germination and seedling emergence for temperature regimes of dry-heat treatment.

<table>
<thead>
<tr>
<th>Temperature</th>
<th>% seed germination</th>
<th>% seedling emergence</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0.00d</td>
<td>8.62d</td>
</tr>
<tr>
<td>40</td>
<td>0.83d</td>
<td>23.42bcd</td>
</tr>
<tr>
<td>50</td>
<td>1.17d</td>
<td>17.95cd</td>
</tr>
<tr>
<td>60</td>
<td>1.33d</td>
<td>32.63abc</td>
</tr>
<tr>
<td>70</td>
<td>14.83c</td>
<td>38.65ab</td>
</tr>
<tr>
<td>80</td>
<td>32.50b</td>
<td>32.83abc</td>
</tr>
<tr>
<td>90</td>
<td>80.00a</td>
<td>43.53a</td>
</tr>
</tbody>
</table>

Key: Values are means ± SE of 3 replicates.

Mean differences were tested by Duncan Multiple Range test at P<0.05).
Means with the same letters in column and row are not significantly (P<0.05) different.

the favorable environmental condition. However, the reverse is the case during dry season farming when moisture is scarce, farmers depend on lowland fadama farming system carried out along the river and stream.
shore lines where moisture is available to this rapidly growing vegetable. The result of analysis of variance on seed germination and emergence test is presented in Table 1. Significant difference was observed between the time periods (5 min and 10 min) of exposure to high temperature. Temperature is highly significant at (P<0.05) for percentage seed germination and percentage seedling emergence. High temperature is an ideal source of heat to the dry seed. The vegetable seed is known to have a period of seed dormancy when the germination and seed emergence potential is at minima. Heat treatment is necessary to prevent the incidence of seed dormancy that may delay early germination and rapid seed emergence of the embryonic tissue.

The percentage seed germination and percentage seedling emergence under dry heat treatment is presented in Table 2. The heat treatment exposure of seeds for 5min indicates that there is no difference in the percentage of seed germination and seed emergence suggesting that 5min of heat treatment exposure of the seed may prevent and delay the incidence of seed dormancy syndrome. Also there is no significant (P<0.05) difference in heat treatment given to the seed for 10min exposure, suggesting that such exposure is ideal in reducing incidence of seed dormancy to minima.

Table 3 shows the percent germination and seedling emergence under various temperature regimens on dry heat treatments. The mean values of percent seed germination for the six temperature regimes and control were significantly different from each other. However, control treatment and treatment at 40°C, 50°C and 60°C did not differ significantly from each other, while treatment at 70°C, 80°C and 90°C were significantly (P<0.05) different from control. The mean values of percentage seedling emergence for the six temperature regimes and control differed significantly (P<0.05) in this case, the control treatment and treatment at 50°C were not significantly different while treatment at 60°C, 70°C, 80°C and 90°C were significantly (P<0.05) different from control. The analysis of variance shows that optimum seed germination and seedling emergence may be obtained at 90°C. Dry heat treatment at 90°C is observed to have generated sufficient and effective heat that overcome the seed dormancy syndrome by translating into 80% of seed germination and higher percentage of seedling emergence. The results indicate that seed germination and seedling emergence of *Corchorus olitorius* increase with dormancy breaking treatment at high temperature and maximum performance was recorded at 90°C. Hot water treatments have been reported to enhance germination of hard coated seeds by increasing water and O₂ permeability of the testa (Msanga and Maghembe, 1986; Teketay, 1998).

This study has demonstrated that dry heat treatment is a viable and possible technique of breaking seed dormancy of *Corchorus olitorius*. The optimum seed germination is at 90°C after the seeds had been exposed to the dry heat treatment for 5 min and 10 min in the oven. The optimum temperature obtained at 90°C for both 5 and 10mins for seed germination and seedling emergence must have generated sufficient and effective dry heat treatment capable of preventing the incidence of seed dormancy. This result also explains the high germinability of *C. olitorius* seeds collected by bush burning practice of farmers. Also it was observed that as the time of exposure increases the dry heat generated gradually overcome the incidence by breaking the seed dormancy. Simmering hot water was reported earlier to have also broken seed dormancy of *Corchorus tridens* but not as effective as concentrated sulphuric acid solution. The length of exposure for more than 10 min caused reduction in the germination of *Corchorus* seed in the simmering hot water (Emongor *et al.*, 2004) Similarly in this current trial it is observed that the length of exposure of *Corchorus* seeds to dry heat treatment for more than 10 minutes cause reduction in the seed germination.

REFERENCES


Teketay D (1998). Germination of *Acacia origena*, *A. pilispina* and *Pterolobium stellatum* response to different pre-sowing