STORAGE POTENTIALS AND INFLUENCE OF MOISTURE CONTENTS ON THE GERMINATION OF Vitellaria paradoxa C.F. GAERTN

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ABSTRACT
Viability of seeds of many tropical tree crops during storage is influenced by several factors among which are moisture content. However, the maintenance of Vitellaria paradoxa seed viability in storage has always been a concern. This study therefore investigated the potentials and influence of moisture content on germination of seeds of the species. Two hundred (200) seeds were selected and weighed. Ten (10) seeds were thereafter selected and oven dried at 60°C for 17 hours until they attained constant dry weight so as to determine moisture content (MC). Another seed lot of 10 was selected and sown in perforated germination trays containing washed and sterilized river sand as treatment 1 (T1) replicated 4 times. The remaining 150 seeds were spread on a platform at ambient temperature (25 ± 2°C). At 2nd week, the moisture content was determined and 10 seed lot replicated 4 times were sown (T2). The procedure was repeated at 4th week (T3) and 6th week. Germination Percentage (GP), Germination Energy (GE), Mean Daily Germination (MDG), Peak Value (PV) and Germination value (GV) were determined. Data were subjected to analysis of variance (ANOVA) and Duncan Multiple Range Test (DMRT) was used in means separation. The highest germination percentage (95%) was recorded for T1 (MC = 23.33%) followed by T2 (MC = 20.93%) with (67.5%) while T4 (MC = 10.87%) had the least (40%). The freshly depulped sown seeds (T1) had the highest MDG (1.85), PV (2.26), GV (3.82) and GE (52.2%) while T4 had least values of 0.42, 0.71, 0.50 and 25% for MDG, PV, GV and GE respectively. There were significant differences among the treatments at P<0.05 and T1 had the highest means (9.50± 0.13) while T4 had the least (5.21± 0.81). The progressive decrease in moisture content with increased storage period intensified the loss of viability of the seeds. It is therefore recommended that seeds of V. paradoxa should be stored at the temperature where their moisture content will be conserved and should not be stored beyond 4 weeks at ambient temperature for average germination percentage.

Keywords: Viability, Vitellaria paradoxa, ambient temperature, moisture content.

INTRODUCTION
Maintenance of Vitellaria paradoxa seed viability in storage has always been a serious concern in the tropics as retention of high viability over a long period is necessary for the reproduction of this fruit tree crop. Longevity of seeds of many tropical tree crops during storage are influenced by several factors such as moisture content, temperature, relative humidity, initial viability and state of maturity at harvest. (Tatipata, 2009, Nagel and Borner, 2012).

The Knowledge about seed biology and the germination process of tree crops is very crucial in understanding natural regeneration, plantation establishment and their survival (Izquierdo et al., 2017). Germination is a vital process in plant metabolism, responsible for embryo growth and development into a complete plant (Bewley et al., 2012). This process comprises of water imbibition, cell stretching, cell division and cell differentiation into tissues. In consideration of germination process of a seed, knowledge about the mechanisms related to seed dormancy is very germane...
Seeds of *Vitellaria paradoxa* are desiccation sensitive; this means that they are recalcitrant in nature and thereby difficult to be successfully stored. (Bonkoungou, 2005). This study therefore looked into storage potentials and influence of moisture contents on the germination of *Vitellaria paradoxa* with a view to ascertaining the extent with which seeds can be stored and which moisture content enhances optimum germination.

**MATERIALS AND METHODS**

Fresh mature fruits of *Vitellaria paradoxa* were collected from Igboho in Oorelope Local Government Area of Oyo State in May 2018. The fruits were depulped for seed extraction. Two hundred (200) seeds of equal weight were selected. The weight of each seed was determined by weighing on a sensitive weighing balance. Ten (10) seeds were thereafter selected and oven dried at 60°C for 17 hours until they attained constant dry weight so as to determine moisture content. Another seed lot of 10 was selected and sown in perforated germination trays containing washed and sterilized river sand as treatment 1 (T1) replicated 4 times. The remaining 150 seeds were spread on a platform at ambient temperature (25 ± 2°C). At 2nd week, the moisture content was determined and seed lot of 10 replicated 4 times was sown (T2). The procedure was repeated at 4th week (T3) and 6th week (T4).

Germination trays were arranged in a mist propagator chamber and watered daily. The study was laid out in Completely Randomized Design. The germination counts were taken daily after the first emergence of each treatment for 12 weeks. The plumule up to 1 cm in length were considered as new emergent and marked each time with permanent marker on the germination tray to avoid double counting.

Germination Percentage (GP), Germination Energy (GE), Mean Daily Germination (MDG), Peak Value (PV) and Germination value (GV) were determined with the use of the following equations according to Schelin *et al.* (2003):

\[
\text{Germination Percentage (GP)} = \frac{\text{Total Seeds Germinated}}{\text{Total Seeds Sown}} \times 100 \quad \ldots \ldots \ldots 1
\]
Germination Energy (GE) is the percentage total of highest germination counts from the day it begins till when it starts diminishing divided by total seeds sown

\[ GE = \frac{x+y+z}{\text{Total Seeds Sown}} \times 100 \quad \text{...2} \]

Where: \( x \) = the first highest germination count, \( y \) = higher germination count, \( z \) = high germination count

Mean Daily Germination percentage (MDG): This is cumulative total percentage of germinated seeds divided by exact germination days.

\[ \text{MDG} = \frac{\text{Cumulative Total Percentage of Seeds Sown}}{x} \quad \text{...3} \]

Where: \( x \) = Exact germination day

Peak Value (PV) is the highest value calculated as MDG

Germination Value (GV) is the product of the last day MDG and PV

\[ \text{GV} = \text{Last day MDG} \times \text{PV} \quad \text{...4} \]

Moisture content (MC) percentage was determined by the equation:

\[ \text{MC} = \frac{W_1 - W_2}{W_1} \times 100 \quad \text{...5} \]

Where: \( W_1 \) = Fresh weight of seeds and \( W_2 \) = Dry weight of seeds.

The treatments were therefore as follows:

- \( T_1 \) = Fresh seeds sown at of MC (23.33%)
- \( T_2 \) = Seeds sown after 2 weeks at of MC (20.93%)
- \( T_3 \) = Seeds sown after 4 weeks at of MC (15.02%)
- \( T_4 \) = Seeds sown after 6 weeks at of MC (10.87%)

**Data Analysis**

Data were subjected to analysis of variance (ANOVA) and Duncan Multiple Range Test (DMRT) was used in means separation.

**RESULTS**

Table 1 shows influence of storage period and moisture contents on germination percentage, MDG, PV, GV and GE of *Vitellaria paradoxa* seed. The highest germination percentage (95%) was recorded for \( T_1 \), followed by \( T_2 \) (67.5%) while \( T_4 \) had the least (40%).

The freshly depulped sown seed (\( T_1 \)) at 23.3% moisture content had the highest MDG (1.85), PV (2.26), GV (3.82) and GE (52.2%) while \( T_4 \) had least values of 0.42, 0.71, 0.50 and 25% for MDG, PV, GV and GE respectively (Table 1).

The period of storage significantly influenced the moisture contents. At the end of 2\(^{nd}\), 4\(^{th}\) and 6\(^{th}\) week of storage, the moisture contents of the seeds of *V. paradoxa* reduced to 20.93%, 15.02%, and 10.87% respectively. Table 2 shows that there were significant differences among the treatments at \( P<0.05 \) and \( T_1 \) had the highest means (9.50 ± 0.13) while \( T_4 \) had the least (5.21 ± 0.81) (Table, 3). As shown in figure 1, \( T_1 \) had the highest germinated seeds (38) followed by \( T_2 \) (27) and the least was \( T_4 \) (16).

**Table 1: Influence of Storage Period and Moisture Contents on Germination Percentage (%), MDG, PV, GV and GE (%) of *Vitellaria paradoxa* Seeds.**

<table>
<thead>
<tr>
<th>Treatments (MC)</th>
<th>Germination Percentage (%)</th>
<th>Mean Daily Germination (MDG)</th>
<th>Peak Value (PV)</th>
<th>MDG (Final)</th>
<th>Germination Value (GV)</th>
<th>Germination Energy (GE) (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>( T_1 )</td>
<td>95</td>
<td>1.85</td>
<td>2.26</td>
<td>1.69</td>
<td>3.82</td>
<td>52.2</td>
</tr>
<tr>
<td>( T_2 )</td>
<td>67.5</td>
<td>0.82</td>
<td>1.38</td>
<td>1.38</td>
<td>1.90</td>
<td>32.5</td>
</tr>
<tr>
<td>( T_3 )</td>
<td>52.5</td>
<td>0.67</td>
<td>0.97</td>
<td>0.93</td>
<td>0.90</td>
<td>30</td>
</tr>
<tr>
<td>( T_4 )</td>
<td>40</td>
<td>0.42</td>
<td>0.71</td>
<td>0.71</td>
<td>0.50</td>
<td>25</td>
</tr>
</tbody>
</table>
Table 2: Analysis of variance on Storage Potentials and Influence of Moisture Contents on the Germination of *Vitellaria paradoxa*

<table>
<thead>
<tr>
<th>SV</th>
<th>df</th>
<th>SS</th>
<th>MS</th>
<th>F-cal</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Treatments</td>
<td>3</td>
<td>48.19</td>
<td>16.06</td>
<td>59.31</td>
<td>0.000*</td>
</tr>
<tr>
<td>Error</td>
<td>12</td>
<td>3.25</td>
<td>0.271</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>15</td>
<td>51.44</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*=significant at P<0.05

Table 3: Means separation for Storage Potentials and Influence of Moisture Contents on the Germination of *Vitellaria paradoxa*

<table>
<thead>
<tr>
<th>Treatments</th>
<th>Means</th>
</tr>
</thead>
<tbody>
<tr>
<td>T1</td>
<td>9.50±0.13a</td>
</tr>
<tr>
<td>T2</td>
<td>6.75±0.11b</td>
</tr>
<tr>
<td>T3</td>
<td>5.25±0.90c</td>
</tr>
<tr>
<td>T4</td>
<td>5.21±0.81c</td>
</tr>
</tbody>
</table>

Means with the same subscript are not significantly different at 5% level of probability by DMRT

**DISCUSSION**

The seed moisture content which is usually expressed in percentage is the most important parameter that influences the seed quality and its storage life (McDonald, 1999). The highest percentage of fresh seeds sown at of MC (23.33%) implies that moisture content plays major roles in the germination of seeds of *V. paradoxa*. According to Cibele *et al.* (2013) moisture content is a key factor in preservation of recalcitrant seed quality. Cellular water in the seeds has a strong relationship with macromolecular surfaces which enhances the stability of membranes and macromolecules. During the drying process of seeds, water gets loose and causes a myriad of metabolic modification (Berjak and Pammenter, 1997; Vargheese and Naithai, 2000). As a result of this process, growth regulators, quantity and types of proteins, cellulose, presence of free radicals, physical water status, among others are been affected (Cibele, *et al.*, 20013). The moisture contents of the seeds of *V. paradoxa* at highest germination percentage could therefore be considered as critical moisture content since significant reduction in germination percentage was observed with decrease in moisture content (Berjak and Pammenter, 1997).
The Germination Energy (GE) of seeds (function of the product of MDG and PV) establishes the quality of seeds which is the main goal of seed production of high quality with good physiological, biochemical, and psychopathological characteristics (McDonald, 1999; Tomic et al., 1998). The higher value of MDG, PV, GV and GE of $T_1$ could be ascribed to the moisture content of the seeds. This corroborate the assertion of Cibele, et al., (20013) that a recalcitrant seed with optimum moisture is one of the most important factors determining the viability and germinability of a plant. This therefore implies that the use of good-quality, healthy and viable seeds are of utmost importance in the maintenance of an optimum plant density in a tree crop plantation. According to Ahmad, (2001), indicators of seed vitality (germination energy and germinability as well as emergence under normal environmental conditions) play a direct role and are the key factor in determining plant number per hectare, which is one of the three main components of yield. Seed quality also affects the rate and uniformity of emergence as well as the rate of initial plant growth.

Seed germination drastically reduced as moisture content decreased with increase in storage period. This is in line with the findings of kazeem et al. (2016) who observed that there was a gradual reduction in moisture content of seeds of Ceasalpinia bonduc when subjected them to different storage periods and storage temperatures where fresh seeds had highest germination percentage (100 %). This implies that the period by which seed maintains its ability to germinate after procurement depends on moisture content and can be used to determine the appropriate sowing period whether to sow immediately or dry to attain the desired moisture content. Reduction in the germination of seeds of V. paradox with elongating storage period and decreased moisture contents indicates that metabolism activities in the seed had been affected due to distorted biochemical events, leading to membrane degradation and decreased biosynthetic reactions. This eventually results in losses of several performance attributes, such as germination values, germination energy, increase of abnormal seedlings and loss of the germination potentials (Walters et al., 2005; Spears, 1995).

**CONCLUSION**

The progressive decrease in moisture content with increase storage period intensify the loss of viability of the seed as indicated by final germination. This established the recalcitrant nature of the seeds of V. paradox. It is shown that moisture content play key roles in the germination of V. paradox seeds. The moisture content of the fresh seeds enhances optimum germination values and germination energy of the seeds. It is evident that metabolic activities that aid germination were being inhibited as storage period of seeds increases and outwardly affect germination parentage.

**Recommendations**

It is therefore recommended from the findings of this study that seeds of V. paradox should be stored at temperature (lesser than room temperature) where their moisture content will be conserved. Then seeds should not be stored beyond 4 weeks at ambient temperature for average germination percentage.

**REFERENCES**


