EFFECT OF WATER TEMPERATURES AND SEED WEIGHTS ON THE GERMINATION OF BLACK PLUM (VITEX DONIANA SWEET) SEEDS

*Adelani, D.O. and Suleiman, R.

Federal College of Forestry Mechanisation, P.M.B 2273, Afaka, Kaduna State, Nigeria

*Correspondence author: adelani.olusegun@yahoo.com; 07038953146

ABSTRACT

Vitex doniana is an underexploited indigenous tree species with enormous potentials. Investigation was conducted in Federal College of Forestry Mechanization, Afaka, Kaduna during dry season of 2018 to overcome problems associated with germination of Vitex doniana seeds. Effect of temperatures of water (27, 56, 73 and 96 °C) and seed weights (3.3, 1.4 and 1.2 g) on the germination of V. doniana was laid down in a split-plot experimental design with five replications. Interaction of temperatures of water and seed weights significantly (P<0.05) enhanced the germination of V. doniana seeds. A significant germination percentage of 46.67 % was recorded in seeds soaked in 56 °C water. Germination percentage among the seed weights were not significantly (P<0.05) different. The least mean germination time of 12 days was recorded in 1.2 g seeds soaked in 73 °C water for 45 minutes. A significant germination percentage value of 80 % was recorded in 3.3 g seeds soaked in 96 °C water. Soaking of 3.3 g seeds in 96 °C water enhanced the germination of V. doniana. The study therefore recommends soaking of 3.3 g seeds in 96 °C water for 45 minutes.

Key words: Temperature of water, Seed weights, Germination, Indigenous fruit tree species.

INTRODUCTION

The local people tend to make use of edible fruits, vegetables and medicine from tree/shrubs and herbs of forests and compounds to meet their day to day needs (Erhabor and Oboho, 2017). Erhabor and Oboho (2017) stated that different indigenous species produce fruits and other edible products and nutrient supplements at different times of the year to complement the staple foods such as grains, tubers and pulses that are the buck of their diets. Okafor (2010) reported that wild fruits, nuts, seeds, vegetables and other classes of edible forest products contributed enormously to overcome or ameliorate prevailing food problems of rural dwellers in developing countries.

There are around 3000 species of wild fruits in Africa representing enormous important and largely untapped natural resources (Pye-Smith 2010). Vitex doniana is one of such indigenous fruit tree species of immense potentials. Vitex doniana is called Black plum; Dinya; Ucha koro and Oori-nla in English, Hausa, Igbo and Yoruba respectively (Orwa et al., 2009). The blackish pulp of the matured fruits is sweet and edible, and is eaten fresh. This pulp also serves in jam preparation. A beverage is made from the fruit juice, whereas boiled fruits are the basis for an alcoholic liquor and wine (Ky, 2008).

Hounkpèvi et al. (2018) stated that its leaves are used as fodder for livestock and the young leaves as leafy vegetables in sauces preparation. The blackish pulp of its ripened fruits is edible and used in preparation of some sweet drinks (Hounkpèvi et al., 2018). The V. doniana is an important indigenous fruit or leafy vegetable in Africa (Burkill, 2000; Maundu et al., 2009) for food, medicine and other purposes (Dadjo et al., 2012). In traditional medicine V. doniana have several applications (Ladeji et al., 2005; Ky, 2008; Padmalatha et al., 2009). For instance the leaf, the bark, dried and fresh fruit serve as ingredients in many preparations to treat or heal diseases including conjunctivitis, headache, stiffness, measles, rash, fever, chicken pox, hemiplegia, respiratory diseases, ankylostomiasis, rachitis, gastro-intestinal disorders,
jaundice, kidney troubles, leprosy, liver diseases, bleeding after childbirth and diarrhoea (Achigan-Dako et al., 2014).

The species has proved difficult to germinate from fresh seeds while existing trees are aging. The V. doniana seeds present a combination of physical (PY) and physiological dormancy (PD), based on classification by Baskin and Baskin (2004) and Silveira (2013). However, little is known about dormancy breaking requirements and no reliable technique is available yet. Germination trials usually produce low success rates (Ky, 2008). Various pre-treatments reported by Yarou (2007) lead to only 20 % germination when seeds are involved. Imbibition tests revealed that V. doniana seeds are physically dormant (N’Danikou et al., 2014) but different treatments tested so far resulted in germination rates below 60 % after six months (Mapongmetsem, 2006; Ky, 2008; Ahoton et al., 2011). Ahoton et al. (2011) and Chamshama et al. (2001) have respectively reached 58 % and 61 % (the highest rates reported so far) when stones are broken with physical shock prior to sowing.

To propagate more of this species for biodiversity conservation, dormancy associated with the seeds of this species need to be overcome. Developing ex-situ conservation programme for any forest tree species requires sound and broad based knowledge of the species silvicultural requirements (Oni, 2013). Little information is available on the effect of temperatures of water and seed weights on the germination of V. doniana seeds. Seeds of the same tree species, with different seed weights need to be pre-treated differently. Seed weights and seed sizes are directly proportional (Adelani et al., 2013). Ajiboye et al. (2016) stated that a lot of attributes including seed sizes affect the germination of seeds and growth of seedlings, in many of the tropical tree species especially leguminosae tree species of the savanna. Seed weight has been reported to be a very important factor in the evaluation of seed germination and seedling vigour (Adetiloye, 2005).

De et al. (2003) reported that the use of large seed in wheat proved much better for germinability and productivity than medium and small size seeds. Upadhaya et al. (2007) in Prunus jenkinsii stated that seedlings from heavy seeds survived maximally and had greater height number of leaves, leaf area and dry matter yield than seedlings from intermediate and light weight seeds. In order to ascertain appropriate temperature of water for treatment of particular seed weight, investigation was conducted into effect of temperatures of water and seed weights on the germination of V. doniana.

MATERIALS AND METHODS

Study Area
The research was conducted in the screen house of the Federal College of Forestry Mechanization, Afaka, Kaduna. The college is located in the Northern Guinea Savannah Ecological zones of Nigeria. It is situated in Igabi Local Government Area of Kaduna State, Nigeria. It lies between Latitude 10° 35’ and 10° 34’ and Longitude 7° 21’ and 7° 20’ (Adelani, 2015). The mean annual rainfall is approximately 1000 mm. The vegetation is open woodland with tall broad leaved trees (Otegbeye et al., 2001).

Fruit collection and seed extraction
The fruits of V.doniana were sourced from mother tree from Buruku forest in Kaduna State. The seeds were extracted from the fruits and air dried for thirty minutes. The viability of the randomly selected seed samples was assessed using the cutting method (Schmidt, 2000). The river sand used for the experiment was collected from the floor of the college dam, sieved through 2 mm sieve and then sterilized in the laboratory oven at 160 °C for 24 hours. The polythene pots used was 20 x 10 x 10 cm³ in dimension and filled with the sterilized river sand and arranged in the screen house.

Effect of different water temperatures and seed weights on the germination of V.doniana seeds
The experiment of the effect of different water temperatures and seed weights on the germination of V. doniana seeds was laid down in a split-plot experimental design with five replications. Seeds were soaked in different water temperatures for forty-five (45) minutes. Four different water temperatures regime (27, 50, 73 and 96 °C) and three seed weights (1.2, 1.4 and 3.3 g) constituted the main and sub-plot treatments respectively. The water at room temperature (27 °C) served as the control. The sum of one hundred and twenty seeds was used for the experiment.
Two seeds represented a replicate. The weight of the samples of seeds was determined by weighing the seeds on Mettler Top Loading Weighing Balance (Model-Mettler PM 11-K). The ten (10) seeds of different weights 1.2, 1.4 and 3.3 g were soaked in 27, 50, 73 and 96 °C water. The seeds were removed, washed and air dried. Ten (10) seeds each of different seed weight were planted in 4 cm depth of sterilized river sand and 70 mL of water per seed was administered daily.

**Data analysis**
The germination count data collected on the effect of the different water temperatures and seed weights were converted to percentage germination. Germination percentage was calculated as suggested by Cicek and Tilki (2007). Germination percentage was subjected to two-way analysis of variance (ANOVA) using SAS (2003) software. Comparisons of significant means were accomplished using Fischer’s Least Significant Difference (LSD) at 5% level of significance.

**RESULTS**

**Effect of temperatures of water and seed weights on the germination of Vitex doniana seeds**
The result of the effect of temperatures of water and seed weights on the germination of *V. doniana* seeds is presented in Table 1. A significant germination percentage of 46.67 % was recorded in seeds soaked in 56 °C water. Germination percentages among the seed weight treated were not significantly (P<0.05) different.

**Interactive effect of temperatures of water and seed weights on the germination of *V. doniana* seeds**
The result of interactive effect temperatures of water and seed weights on the germination of *V. doniana* seeds is presented in Table 2. A significant germination percentage value of 80 % was recorded in 3.3 g seeds soaked in 96 °C water.

### Table 1: Effect of temperatures of water and seed weights on the germination of *V. doniana* seeds

<table>
<thead>
<tr>
<th>Temp (°C)</th>
<th>Effect of Temperature on germ</th>
<th>Effect of Seed Weight on germ</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>% germ</td>
<td>MGT (day)</td>
</tr>
<tr>
<td>27</td>
<td>13.30a</td>
<td>13.30a</td>
</tr>
<tr>
<td>56</td>
<td>46.67a</td>
<td>46.67a</td>
</tr>
<tr>
<td>73</td>
<td>26.67a</td>
<td>26.67a</td>
</tr>
<tr>
<td>96</td>
<td>40.00a</td>
<td>40.00a</td>
</tr>
<tr>
<td>SE</td>
<td>19.44</td>
<td>19.44</td>
</tr>
</tbody>
</table>

*Means on the same column having different superscripts are significantly different (P<0.05) vertically*

**Key** : Temp- Temperature, % germ- Percentage germination, SW- Seed weight, MGT- Mean germination time

### Table 2: Interactive effect of temperatures of water and seed weights on the germination of *V. doniana* seeds

<table>
<thead>
<tr>
<th>Temperature (°C)</th>
<th>3.3</th>
<th>1.4</th>
<th>1.2</th>
</tr>
</thead>
<tbody>
<tr>
<td>27</td>
<td>0.00a</td>
<td>0.00a</td>
<td>40.00a</td>
</tr>
<tr>
<td>56</td>
<td>60.00a</td>
<td>40.00a</td>
<td>40.00a</td>
</tr>
<tr>
<td>73</td>
<td>0.00b</td>
<td>60.00a</td>
<td>20.00ab</td>
</tr>
<tr>
<td>96</td>
<td>80.00a</td>
<td>0.00b</td>
<td>40.00a</td>
</tr>
<tr>
<td>SE</td>
<td>18.75</td>
<td>18.75</td>
<td>18.75</td>
</tr>
</tbody>
</table>

*Means on the same row having different superscripts are significantly different (P<0.05) horizontally*
Interactive effect of temperatures of water and seed weights on the mean germination time of *V. doniana* seeds

The result of the interactive effect of temperatures of water and seed weights on mean germination time of *V. doniana* seeds is presented in Table 3. The mean germination time among the treatments were not significantly (P<0.05) different. The least mean germination time of 12 days was recorded in 3.3 and 1.4 g seeds not soaked. The least mean germination time of 12 days was recorded in 1.2 g seeds soaked in 73 °C water for 45 minutes.

<table>
<thead>
<tr>
<th>Temperature (°C)</th>
<th>Seed Weight (g)</th>
<th>3.3</th>
<th>1.4</th>
<th>1.2</th>
</tr>
</thead>
<tbody>
<tr>
<td>27</td>
<td></td>
<td>12.00a</td>
<td>12.00a</td>
<td>20.00a</td>
</tr>
<tr>
<td>56</td>
<td></td>
<td>32.00a</td>
<td>24.00a</td>
<td>24.00a</td>
</tr>
<tr>
<td>73</td>
<td></td>
<td>0.00a</td>
<td>36.00a</td>
<td>12.00a</td>
</tr>
<tr>
<td>96</td>
<td></td>
<td>0.00a</td>
<td>24.00b</td>
<td>16.00a</td>
</tr>
<tr>
<td>SE</td>
<td></td>
<td>18.75</td>
<td>18.75</td>
<td>18.75</td>
</tr>
</tbody>
</table>

*Means on the same row having different superscripts are significantly different (P<0.05) horizontally.

DISCUSSION

It could be inferred that 56 °C is average, moderate and appropriate temperature of water for breaking the dormancy of *V. doniana* seeds. Appropriate temperature for seed germination varies within and between species. Similar observations have been reported by investigators such as Mackay et al. (2001) (*Lupinus arboreus*), Tigabu and Oden (2001) (*Abizia species*), Aydin and Uzuu. (2001) (*Trifolium meneghianum*), Rincon-Rosales et al. (2003) (*Acacia angustissima*), Agboola et al. (2006) (*Tithonia diversifolia*) and Wang et al. (2006) (*Krascheninnikovia lanata*), Afrasyab and Reza (2007) (*Ferula gummosa*), Truong and Hans (2007) (*Sesbania sesban*), Michael et al., (2008) (*Terminalia sericea*), Nour-El-Din (2010) (*Balanites aegyptiaca*), Okunomo (2010) (*Tetrapleura tetraptera*), Amira and Mohammed (2013) (*Cassia fistula*), Sikiratu, (2014) (*Acacia senegalensis*), Adelani et al. (2014) (*Tamarindus indica*) and Adelani, (2015) (*Sesbania sesban*). It can be inferred that soaking the seeds in appropriate temperature softened the seed coat to absorb water for imbibition that resulted in germination. This is in line with the reports of Oboho and Ogana (2012). Germination percentages among the seed weights treated were not different. The result of this trial is contrary to those of Ajiboye (2016) and Ibeawuchi *et al.* (2012) who recorded highest germination percentage in large seeds. They attributed the excellent performance of large seeds to the presence of large food reserves that gave energy for higher germination percentage. The excellent performance of heaviest seeds in the presence of highest temperature of water can be attributable to the availability of the compatibility between heaviest seeds and highest temperature of water, which help to degrade the seed coat without damaging the embryo and equally enhanced germination. This is in consonance with the reports of Adelani *et al.* (2013) and Adelani *et al.* (2018).

The least mean germination time of 12 days recorded in small seeds revealed that small seeds germinated faster compared to other treated seed weight. Similar observation has been reported by Ajiboye *et al.* (2016).

CONCLUSION

Investigation conducted into effect of temperatures of water and seed weights on germination of *V. doniana* seeds revealed that highest germination of seeds was recorded when soaked in 56 °C water. To have maximum germination percentage, 3.3 g *V. doniana* seeds need to be soaked in 96 °C water for 45 minutes. The least mean germination time was recorded in 1.2 g seeds soaked in 73 °C water for 45 minutes. Seedlings of high vigour were obtained by adopting appropriate temperature of water for pre-
sowing treatment and selecting the best seed weight of this indigenous priority species for biodiversity conservation. Breaking the dormancy of the appropriate seed weight will enhance robust germplasm conservation programmes.

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