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Physico-viable Properties of Some *Eucalyptus* Species Seeds

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ABSTRACT

Some physico-viable properties of *Eucalyptus citriodora*, *Eucalyptus camaldulensis* and *Eucalyptus cloeziana* were determined using their seeds in order to provide a suitable test measure for their viability. The bulk densities of *E. citriodora*, *E. camaldulensis* and *E. cloeziana* were found to be 1.18, 1.13 and 1.14 g cm^{-3} while their germination capacity on volume basis were 25, 94 and 64 seedlings cm^{-3}, respectively. These could be used in calibration of devices for testing of the viability of these seeds as well as predicting their germination. The light transmissivity of *E. citriodora*, *E. camaldulensis* and *E. cloeziana* were found to be 12.17, 2.00 and 2.66 lux, respectively. This property could be applied in identification of viable seeds of *Eucalyptus* species.

Key words: Physico-viable properties, bulk densities, germination capacity, light transmissivity

INTRODUCTION

The identification of most granular seeds depends so much on their physical properties. *Eucalyptus* is one of the world's most important and most widely planted genera. It includes more than 700 species and belongs to the family of Myrtaceae which has about 100 genera (Maciel *et al.*, 2010). Many researchers have worked on the on some other aspect of *Eucalyptus* seedling to reduce its susceptibility to environmental hazards (Khosla and Reddy, 2008). In Nigeria there are various species of *Eucalyptus* which are *E. citriodora*, *E. camaldulensis*, *E. cloeziana*, *E. globules* amongst other. One of the trial afforestation located in Kaduna, Nigeria based its research on some *Eucalyptus* species because of their good provenance (FAO, 1981). In the northern part of Nigeria there has been promulgation for rapid tree planting in order to combat adverse of effect of climate change and environmental degradation such as desertification. Some species of *Eucalyptus* are also grown in other part of Nigeria due to its resistance to adverse soil and environmental condition. Also, other researchers have worked on several aspects of *Eucalyptus* which include the chemical composition of their essential oils, their insecticidal and fungicide effects, seed size effects on growth, their interaction with other plants, their interaction with other plants, their strength characteristics (Maciel *et al.*, 2010; Cheng *et al.*, 2009; Somda *et al.*, 2007; Batisha *et al.*, 2008; Kidanu *et al.*, 2004; Olufemi and Malami, 2011). There are various ways of identifying various species of *Eucalyptus* seeds as well as enabling their uniformity in germination and growth rate in multiple planting. Kumar *et al.* (2006) applied electrical properties to determine the viability of poppy seeds. Naidu and Jones (2007) showed the effect of seed size of *Eucalyptus grandis* on its field performance. McRae (2005) also reported the influence of grading on the growth and germination rate of some *Eucalyptus* species and how it can be applied to precision sowing. The larger seeds were found to have better germination rate due to their greater amount of endosperm reserves that are available during the germination process (Schmidt, 2000). However, some of these seeds are very small; thus it is very difficult to determine their viability without planting. The objective of this study was to determine some physico-viable properties of the seeds of *E. citriodora*, *E. camaldulensis* and *E. cloeziana* as a way of testing their viability before planting.

MATERIALS AND METHODS

Seed preparation: Some seeds of *Eucalyptus* species (viz., *E. citriodora*, *E. camaldulensis* and *E. cloeziana*) were obtained from Forestry Research Institute of Nigeria/JICA Kaduna house station as shown in Fig. 1-3. The seeds were thoroughly cleaned and screened before conducting the experiment. The seeds were kept under normal room temperature before the experiment. All experiments were carried out under laboratory condition.

Determination of seed bulk density: The bulk densities of the three species of *Eucalyptus* (i.e., *E. citriodora*, *E. camaldulensis* and *E. cloeziana*) were found by filling a container of specific

Fig. 1: *Eucalyptus citriodora* seeds

Fig. 2: *Eucalyptus camaldulensis* seeds

Fig. 3: *Eucalyptus cloeziana* seeds

Fig. 4: Light transmissivity set up

volume with the seeds after which it was tapped and leveled. The mass of the seeds inside the container was weighed using a digital weigh balance (Denver Instrument XP-300) reading to 0.01 g as conducted by Aremu and Fadele (2011). The ratio of the seed mass to the volume of the container gives the bulk density of the seed as reported by Sugri *et al.* (2011) in Eq. 1. This was replicated fourteen times for each of the species while their average values were calculated:

$$\text{Bulk density} = \frac{\text{Mass of seeds}}{\text{Volume occupied by seeds}} \quad (1)$$

Determination of light transmissivity: Light transmissivity is used to indicate the quantity of light that can pass through a material. The set up for the experiment included a light source, a Lux meter and a small transparent container as shown in Fig. 4. The light source was focused at a distance of 9.0 cm from the light receptor with the transparent container being placed on it. The container was loaded with the *Eucalyptus* species (*E. citriodora*, *E. camaldulensis* and *E. cloeziana*) to 11.60 cm^3 of its capacity and leveled; after which the light intensity value was read from the Lux meter. This was replicated for six times for each of the *Eucalyptus* species. Before this, the radius of the container was measured as 2.80 cm and the seed dept was calculated as 0.471 cm. The experiment was carried in a dark environment to prevent light interference from other source.

Determination of germination capacity: Some seeds of the three *Eucalyptus* species (viz., *E. citriodora, E. camaldulensis* and *E. cloeziana*) were collected from the whole bulk and made to fill up a container having a specific volume of 5.80 cm^3, after which it was planted in boxes filled with sharp sand (Franks *et al*., 1995). This was wet periodically until all the seeds have germinated. The seedlings were subsequently harvested and counted after 11 days. The germination capacity of each *Eucalyptus* species were found on volume basis by calculating the ratio of the seedling harvested to the seed volume planted respectively for each of the species as given in Eq. 2:

$$\text{Germination capacity} = \frac{\text{No. of seedlings emerged}}{\text{Bulk volume of seeds planted}} \tag{2}$$

RESULTS AND DISCUSSION

Bulk density of *Eucalyptus* seeds: The bulk densities mean values of some *Eucalyptus* seeds namely, *E. citriodora, E. camaldulensis* and *E. cloeziana* were found to be 1.18, 1.13 and 1.14 g cm^{-3} with ranges of 1.16-1.24, 1.10-1.17 and 1.12-1.16 g cm^{-3}, respectively. The value obtained for *Eucalyptus* species indicated that good portion of their seeds would not float in water and this asserts that their true densities are more than that of water. Most researchers have conducted experiment involving both true and bulk densities with the true density having greater value than the bulk density (Aremu and Fadele, 2011; Balasubramanian, 2001; Baryeh, 2001; Isik and Izli, 2007). This shows that water could be used to for the viability of the seed by dropping them in it. The bulk densities values of each of the *Eucalyptus* species were subjected to paired sample t-test statistics using SPSS 15 version, by comparing them with one another to determine their level of discrepancy. *Eucalyptus camaldulensis* compares favourably with *E. cloeziana* with a significance value greater than 0.05; thus indicating that there is a little difference in their bulk densities. However, the significance values obtained when the bulk density of *E. citriodora* was compared to that of *E. camaldulensis* and *E. cloeziana* were much more less than 0.05; indicating a significant difference in their bulk densities. Figure 5 shows the bulk densities of some *Eucalyptus* species.

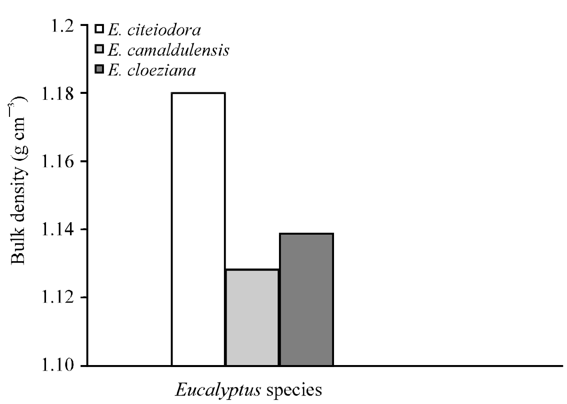

Fig. 5: Bulk densities of some *Eucalyptus* species

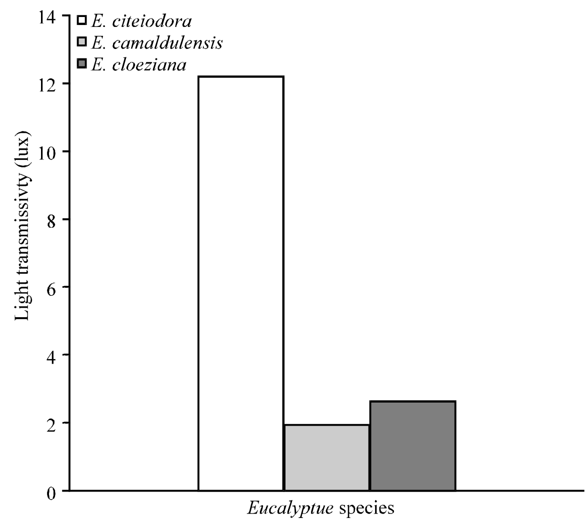

Fig. 6: Light transmissivity of some *Eucalyptus* species

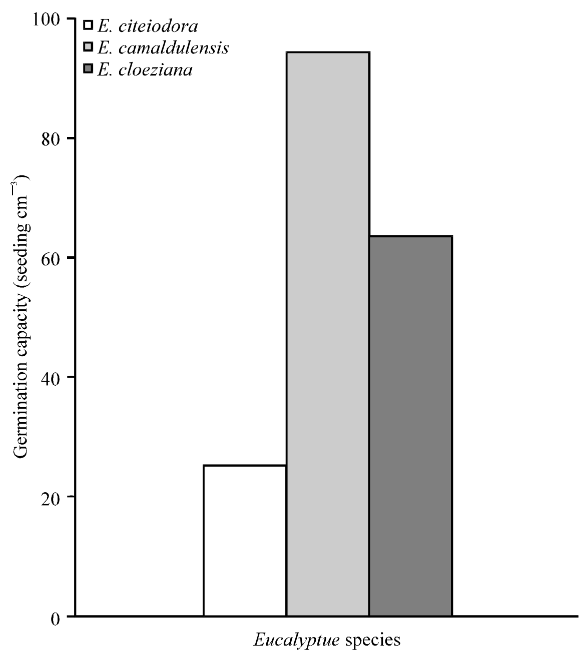

Fig. 7: Germination capacity of some *Eucalyptus* species

Light transmissivity of *Eucalyptus* seeds: The light transmissivity of *Eucalyptus* seeds namely *E. citriodora*, *E. camaldulensis* and *E. cloeziana* were found to have mean values of 12.17, 2.00 and 2.66 lux, respectively as shown in Fig. 6. The light source was also found to have a value of 2380 lux; indicating that the *Eucalyptus* seeds are opaque in nature and will allow little or no amount of light to pass through it. *E. citriodora* has the highest value of light transmissivity because of its seed size which creates pore spaces for light to pass. This was also observed in *E. cloeziana* seed which is larger than *E. camaldulensis* and also having higher light transmissivity, even though not as high as that of *E. citriodora*. This property could be applied in developing a device that can be used to identify viable seed of *Eucalyptus*.

Germination capacity of *Eucalyptus* seeds: The mean values of germination capacity for some *Eucalyptus* seeds (viz., *E. citriodora*, *E. camaldulensis* and *E. cloeziana*) were found to be 25, 94 and 64 seedlings cm^{-3} with ranges of 23-28, 88-104 and 56-73 seedlings cm^{-3}, respectively. *Eucalyptus camaldulensis* obviously has the highest value of germination capacity as shown in Fig. 7. It was observed at germination stage that the seedlings of *Eucalyptus* camaldulensis densely covered the planting area while seedlings of *Eucalyptus citriodora* sparsely spread over the planting area. Moreover, germination rate of *E. camaldulensis* was much higher than that of *E. citriodora* and *E. cloeziana* while the stalk of *E. citriodora* is stronger than that of *E. camaldulensis* and *E. cloeziana*; and able to withstand water droplet impact during wetting unlike the other two species. The fewer number of seedlings of *E. citriodora* that germinated could be due its larger volume occupied by its seeds, when compared to *E. camaldulensis* and *E. cloeziana*. The circumscribing radius of *E. citriodora* seed was found to be more than 2.00 mm greater than the other two species and similar to that obtained by Beltrati (1978).

CONCLUSION

Some physico-viable properties of *E. citriodora*, *E. camaldulensis* and *E. cloeziana* seeds were investigated. The results obtained revealed that the bulk densities and germination capacity of *E. citriodora*, *E. camaldulensis* and *E. cloeziana* seeds have ranges of 1.16-1.24, 1.10-1.17 and 1.12-1.16 g cm^{-3} and 23-28, 88-104 and 56-73 seedlings cm^{-3} with their light transmissivity having mean values of 12.17, 2.00 and 2.66 lux, respectively. All these data could be useful testing for the viability of these seeds. However, further research should be conducted on non-viable seeds of these eucalypts for comparison.

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