



EFFECT OF SEED SIZE VARIATION AND SOWING MEDIA ON THE GERMINATION PERFORMANCE OF *Caesalpinia bonduc* (L) Roxb.

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ABSTRACT

Varying seed size influences the seedling vigour as germination of seeds is affected by sowing media. Towards optimum production of *C. bonduc*, the study therefore investigated seed size variation and sowing media on the germination potential of the species. The treatments consisted of 3 sowing media (river sand, top soil and decomposed sawdust) and seed size small ($\leq 1.5\text{cm}$), medium ($>1.5\text{cm}$ to $\leq 2.0\text{cm}$) and large ($> 2.0\text{cm}$) to form 9 treatments combination, laid out in Completely Randomized Design and replicated 4 times. Germination counts were taken on daily basis till there was no visible germination. Percentage germination, mean daily germination (MDG), peak value (PV) and germination value (GV) was calculated. Data were subjected to analysis of variance. Large seed size sown in forest top soil (T_8) had the highest germination percentage and GV of 98.3% and 2.46 respectively while small seed size sown in decomposed sawdust (T_3) had the least germination percentage (77.5%). There was no significant difference ($P>0.5$) in all the germination parameters except germination percentage studied on the seed sizes of *C. bonduc*. Both germination value and germination percentage varied significantly ($P< 0.5$) on the sowing media used on seeds of *C. bonduc*. The study showed that large and medium seed sizes responded better than small seed sizes which could be as a result of large food and energy reserves present in the seed.

Keywords: seed size, emergence, sowing media, *Caesalpinia bonduc*, germination

INTRODUCTION

Forest resources include both timber and non-timber or non-wood products. Most timber products are obtainable from natural forests, forest plantations and also from non-forest areas, non wood forest products are mostly generated by the natural forests, except for a few available from forest plantations. Non-wood forest products are quite diverse; they include plants yielding items like medicine, food, fodder, gum, resin, spices, condiments, beverages, fibers, dyes and tannins and few other products of animal origin (Nair, 2000). Non timber forest tree species are mostly found in different habitats across Africa, they contribute immensely to growth and development of the economic status of most developing nations in Africa.

Among the non timber forest tree species is this highly valuable plant, *Caesalpinia bonduc*. The plant is a lesser known forest tree species in Africa, although well known in other tropical parts of the world. The importance of this plant has shown that its seeds and other plant parts are highly medicinal; also the seeds are used locally in socio cultural activities such as the popular outdoor game, “*Ayo Olopon*” in the south-western, Yoruba-speaking part of Nigeria. This plant contributes to the biodiversity of the forests where it grows, helps protect the soil and furnishes cover for wildlife. The effect of seed size on germination and growth performance is considered important for enhancement of the productive capacity of the plant. There are reports that there is a positive relationship between seedling vigour, improved stand establishment and higher productivity in

most plant species (Larsen and Andreasen, 2004; Kaydan and Yagmur, 2008). Seed size is regarded as one of the most important yield component which plays an effective role on species adaptation. It also plays a major role in the seed development duration. Moles *et al.*, (2005a, b) reported that the large range of seed sizes in many terrestrial plant communities supports the assumption that larger seed size increases vigor. According to Gross (1984), seeds that are large in size have traditionally been viewed as advantageous in closed communities, such as forests, whereas small seeds would be more suitable for open successional communities. There has been considerable information published on the effect of seed size on the germination and growth of various species and generally, in forest tree species size of seed and seed germination and seedling growth have been positively correlated (Singh, 1998; Ke and Werger, 1999; Navarro *et al.*, 2006). But in some species large seed did not produce the highest germination and seedling growth (Shepard *et al.*, 1989; Indira *et al.*, 2000; Alptekin and Tilki, 2002). Little information is available on the effect of seed size on germination and seedling growth of *C. bonduc*. Sowing media influence the quality of seedlings produced, which subsequently affect their establishment and productivity in the field (Agbo and Omaliko, 2006; Becker *et al.*, 2001). It has been observed that the effect of sowing media on germination and early seedling development on some selected plant species is crucial as different media have dissimilar aeration and drainage potentials (Ndubuaku and Oyekanmi, 2000).

The over dependence on *Caesalpinia bonduc* as a source of medicine and other benefits among the populace especially rural dwellers has led to pressure on this species. Conservation of this economically-important species is therefore highly recommended in order to prevent it from being going to extinction and enhance its potentials towards environmental amelioration and sustainability. Therefore, for a successful plantation establishment of *Caesalpinia bonduc*, adequate information is needed on its propagation in order to optimize its mass production for ecological and economic sustainability.

MATERIALS AND METHODS

Seed Collection and Extraction

Fruits of *Caesalpinia bonduc* were collected from Pharmacy Flora Garden of the Forestry Research Institute of Nigeria. After careful extraction of seeds from pods—the seeds were separated into three size classes, viz small (≤ 1.5 cm), medium (>1.5 cm to ≤ 2.0 cm) and large (>2.0 cm) (Plate 1).



Plate 1: Three size classes of *Caesalpinia bonduc* seeds

Experimental Design

Thirty seeds were sown in germination trays filled with different sowing media; sterilized river sand, forest top soil and decomposed sawdust. The seed size was measured using veneer caliper. The study consisted of three (3) germinating media and three (3) seed size classes making nine (9) treatments laid out in a Completely Randomized Design replicated 4 times. The treatment combinations were as follows;

T₁- small seed size sown in sterilized and washed river sand

T₂- small seed size sown in forest top soil

T₃- small seed size sown in decomposed sawdust

T₄- medium seed size sown in sterilized washed and river sand

T₅- medium seed size sown in forest top soil

T₆- medium seed size sown in decomposed sawdust

T₇- large seed size sown in sterilized and washed river sand

T₈- large seed size sown in forest top soil

T₉- large seed size sown in decomposed sawdust

Watering was done daily and germination count was taken on a daily basis until there was no visible germination. Germination Percentage (GP), Mean Daily Germination (MDG), Peak Value (PV) and Germination Value (GV) were determined with the

use of the following equations (Schelin *et al.*, 2003):

$$GP = \frac{\text{TotalSeedsGerminated}}{\text{TotalSeedsSown}} \times 100 \dots [1]$$

Where:

Germination Percentage (%)

Germination Energy (GE) is the percentage total of highest germination counts from the day it begins till when it starts diminishing divided by total seed sown

$$GE = \frac{\dots x+y+z}{\text{TotalSeedsSown}} \times 100 \dots [2]$$

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.

$$MDG = \frac{\text{CumulativeTotalPercentageofSeedsSown}}{x} \dots [3]$$

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

$$GV = \text{LastdayMDG} \times \text{PV} \dots (\text{Eqn. 4})$$

Data Analysis

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

Table 1: Mean daily germination (MDG), Germination percentage (%), Peak value (PV) and Germination value (GV) of different sizes of *C. bonduc* seeds sown in different sowing media.

Treatment	Final MDG	Germination %	PV	GV
T ₁	1.11	80	1.08	1.19
T ₂	1.41	95	1.45	2.04
T ₃	1.51	77.5	1.53	2.31
T ₄	1.26	88.3	1.26	1.59
T ₅	1.40	97.5	1.69	2.37
T ₆	1.3	86.7	1.35	1.76
T ₇	1.29	91.7	1.36	1.75
T ₈	1.55	98.3	1.59	2.46
T ₉	1.38	91.7	1.55	2.14

MDG = Mean daily germination; PV = Peak value, GV = Germination value

RESULTS

Variations were observed in germination percentage of different sizes of *C. bonduc* seeds sown in different sowing media. The highest germination percentage was recorded for T₈ (98.3%) followed by T₅ (97.5%). T₅ was followed by T₂ with germination percentage of 95% while T₃ had the least germination percentage of 77.5%.

Table 1 further reveals that the peak value was highest in T₅ (1.69) followed by T₈ (1.59) while T₁ had the least peak value (1.08). Also, T₈ had the highest germination value of 2.46 followed by T₅ (2.37) and the least GV was recorded for T₁ (1.19).

Table 2 shows the mean value of the germination parameters recorded for this study. It was observed that all the seed sizes (small, medium and large) were not significantly different in relation to germination parameters; mean daily germination (MDG), peak value (PV) and germination value (GV). However under percentage germination (GP), small size was significantly different from other seed sizes. From Table 3, the MDG and PV were not significantly different among sowing media while percentage germination and GV were significantly different among river sand, top soil and decomposed sawdust.

Table 2: Effect of seed size on seed germination of *C. bonduc*

Seed size	Mean Germination	Daily Peak Value	Germination Value	Germination Percentage
Small size	0.31±0.48 ^a	0.39±0.02 ^a	0.47±0.04 ^a	25.25±0.85 ^a
Medium size	0.33±0.09 ^a	0.36±0.02 ^a	0.47±0.51 ^a	27.33±0.86 ^b
Large size	0.33±0.02 ^a	0.38±0.11 ^a	0.54±0.03 ^a	28.17±0.55 ^b

Note: Means with the same letter under each column are not significantly different from each other at $\alpha = 0.05$ according to Duncan multiple range of test.

Table 3: Effect of sowing media on seed germination of *C. bonduc*

Sowing medium	Mean Germination	Daily Peak Value	Germination Value	Germination Percentage
River sand	0.31±0.11 ^a	0.36±0.02 ^a	0.39±0.02 ^a	26.08±0.76 ^a
Top soil	0.34±0.15 ^a	0.39±0.20 ^a	0.57±0.05 ^b	29.08±0.48 ^b
Decomposed sawdust	0.34±0.05 ^a	0.37±0.01 ^a	0.52±0.25 ^b	25.58±0.84 ^a

Note: Means with the same letter under each column are not significantly different from each other at $\alpha = 0.05$ according to Duncan multiple range of test.

DISCUSSION

Large seed size of *C. bonduc* as influenced by sowing media performed significantly better than the medium and small seed size in terms of seedling emergence mean daily germination, germination percentage and germination value in this study. The highest impact of top soil on the germination of large sized seeds corroborates the findings of Okunomo, (2010) who observed higher germination percentage in topsoil with *Parkia biglobosa*. Agboola and Adedire (2001) also reported highest germination percentage of *Terminalia ivorensis*; a tropical tree species in topsoil. The germination potentials in large seeds could be attributed to a greater supply of stored energy in the cotyledons which support early seedling growth (Indira *et al.*, 2000; Alptekin and Tilki, 2002). According to Longer *et al.* (1986), the influence of seed size on soybean emergence shows that the higher content of cotyledon reserves provides the advantage that is seen in larger seeds. The large seeds are able to provide energy morerapidly to the growing seedlings. These seeds produced seedlings with a higher growth capacity (Longer *et al.*, 1986). This can be as a result of more food reserves in the seeds. The observation is similar to the findings of Yusuf *et al.* (2014) and Ndor *et al.* (2012) who reported that high germination rate may be attributed to greater food reserves available to the emerging seeds or growing seedlings. Roozrokh *et al.* (2015) also reported that chickpea showed that large seeds had higher germination percentages.

Yusuf *et al.* (2014) explained that large seeds tend to have large embryo, higher food reserves and higher respiration rate that results in greater field emergence than small sized seeds. This can lead to increase in germination percentage of large seeds. Siddig and Abdellatif (2015) also reported that seeds of different sizes have different levels of starch and other food storage that influences the number of germinated seeds. Whereas small sized seeds are often characterised by lower germination percentages, they tend to reduce the number of emerging seedlings and lead to limited survival as reported by Roozrokh *et al.* (2005). Contrary to the findings, Indira *et al.*, (2000) reported that smallest seed sizes absorb water more rapidly compared to large seeds which resulted in increased germination rate.

Seed size has been shown to be a valid measure of seed germination and vigour (Shepard *et al.*, 1989). It is one of the most important characteristics of seed quality of a plant crop. The resources of nutrients at the disposal of the embryo give large seeds the advantage over small seeds of several plant species. (Longer *et al.*, 1986). The increased mass of seeds leads to a higher emergence rate, better plant growth and higher yield (Singn, 1988). Studies have shown that initial seedling size is positively related to seed size and seed mass is the largest influence on a seedling-above and below the ground (Longer *et al.*, 1986).

In contrast, Falemara *et al.*, (2014) reported that sandy soil supports higher germination of seeds than any other sowing media in relation to early emergence, high rate of germination and high germination percentage. Dickens (2011) and Anber (2010) also observed highest germination percentage in sharp river sand with *Irvingia wombolu* and *Delonix regia*. The use of sowing media is thereby necessary for the development and production of quality tree species. Bhardwaj, (2014) explained that a sowing medium would provide sufficient anchorage or support to the plant.

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CONCLUSION

From the results of the study, it is concluded that both factors; seed size and sowing media had varying effect on seeds of *C. bonduc*. Germination percentage increased as seed size increased: this may be due to more food and energy reserves present in large seeds. The top soil recorded the highest germination percentage than other sowing media and this is a confirmation of the water retaining capacity which enhances the quick emergence of seeds, hence top soil is recommended for the sowing of *C. bonduc*. Although the remaining sowing media showed considerable results, this implies that they can also be used when top soil is not readily available.

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