European Journal of Agriculture and Food Sciences
www.ejfood.org

Effect of Seed Size and Source Variation on Germination Potentials *of Anacardium occidentale* (Linnaeus) Seeds

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ABSTRACT

Size is one of seed quality that determines the rate of seed germination while seed source presents the best genetic materials carried by the mother tree and transferable to the offspring. This study investigated the effects of seed size and seed source on germination percentage of *Anacardium occidentale*. 81 viable seeds of different seed sizes (large, medium, and small) collected from mother trees at three different sources (Funaab, Camp and Obantoko) in Abeokuta, Ogun State were sown in polythene pots. Seeds of the same size were sown at the rate of 3 seeds per pot with 3 replicates for each of the sizes sown. The experiment was laid out in 3 x 3 factorial in Completely Randomized Design (CRD). Daily record of new sprouts was taken, and the germination percentage was calculated, collected data was analyzed using Analysis of Variance (ANOVA) in SAS. Germination percentage (98%) was significantly (*P<0.*05) higher in Small sized seeds which was not different from medium sizes seed (92.67%) while seeds sourced from Camp had the highest germination (98%) at (*P<0.05*). Highly significant interactions (*p<0.05*) were recorded between seed size and seed source. The smaller the size of *Anarcadium occendalis* seeds the higher the germination within different sources of collection.

Keywords: *Anacardium occidentale*, Germination percentage, Seed size, Seed source.

Submitted : March 20, 2023

Published : May 10, 2023

ISSN: 2684-1827

DOI: 10.24018/ejfood.2023.5.3.671

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I. Introduction

Size is one of seed qualities that determines the rate of seed germination. The evolution of seed size is believed to involve a trade-off between generating numerous smaller seeds, each with restricted resources, and fewer larger seeds, each with a greater amount of resources [1]. This is important because larger seeds often have larger volume of resources that enhances germination than small sized seeds [2]. Seed size represents a significant factor in determining the continued existence, flexibility, and success of any plant propagules [3]. Seed size has exhibited potential to affect the rate of germination of any plant [4]-[6]. Several studies have shown the adaptability of seed size difference to various hazardous conditions, with reference to larger seed size species to be more adaptive according to Westoby, Jurado and Leishman [1]. In relation to water stress, larger seeds have shown a greater survival rate under intense water stress conditions than smaller seeds [7].

Further studies also showed that soil depth does not have any major disadvantage on large seeded species. According to Pearson *et al.* [8] and Ghersa *et al*. [9], large, seeded plant species react to fluctuating temperatures, even buried within the soil, they are able to germinate within those large fluctuating soil temperatures. In contrast, small seed size may have some adaptive germination approach that guarantees germination when the seeds are close to soil surface [10], [11]. In relations to soil depth, Leishman *et al*. [12] and Thompson *et al*. [13] reported that species with small seeds have a greater chance of persisting in the soil seed bank, but they may also be more likely to become buried and unable to emerge from deeper soil layers or under litter [14]-[16]. At this point, seed germination depends more on light with decreasing seed size in both temperate herbaceous species and tropical pioneer tree species [8], [17]-[20].

Many researchers have observed that compared to small seeds, large seeds typically offer numerous advantages and often exhibit a higher percentage of germination [21]. This high germination rates in large seeds may be due to the larger amount of reserves available in larger seeds compared to medium or small seeds. [2]. The rate of seeds germination does not only depend on its size alone, but germination is also controlled by the amount of food reserve, glucose levels in the different seed size, the ability of the seed to utilize its food reserve [22]-[24] and, the mobilization of the seed reserve [25], [26]. Also, seed size was also related to the season of fruiting [22].

A seed source refers to the naturally occurring basis for any planting program. The seed source presents the best genetic materials carried by the mother tree and transferable to the offspring [27]. Furthermore, higher planting productivity and future breeding work can be accomplished through the screening process and testing the for variation in native species. This will necessitate the selection of the best seed

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source and suitable genotypes for a given location for the achievement of maximum plantation production (Takuathing, Pipatwattanakul and Behumibhamon [28], [29], Mamo *et al.* [30]. As reported by Esor, Idiege and Maiguru [31], numerous factors contribute to the variation observed in these native species. Factors such as the longitudinal location of the mother tree, the ability of the seeds to utilize the available food reserve and mobilization of these reserves for seed germination and seed provenance Loha *et al.* [32].

Studies have shown that these variations affect germination potentials of any plant species. According to Loha *et al.* [32], [33], germination performance and capacity in most plant species are influenced by seed locations or provenance effect. Further studies also show that seed germination varies based on its genetic origin and local environment where seed maturity occurred Gush *et al.* [34], [33], Benowiez *et al.* [34], Benowiez *et al.* [35], Gera, Gera and Ginwal [36], Mkonda *et al.* [37]. This varying germination rate can be attributed to the effect of environmental factors on seed production bringing ripple effect on germination Aref *et al.* [38]. These environmental factors affect the production of pollen which prevents the mother trees from siring seeds.

Conducting such an investigation could also aid in the early assessment of criteria for selecting certain prominent traits under both laboratory and nursery conditions, which may be linked to the future performance of these traits in the field Ginwal *et al.* [39]. This necessitated the investigation of seed size and source on the germination potentials of *Anacardium occidentale.*

II. Materials and Methods

A. Location

The experiment was carried out at Forest Nursery of the Federal University of Agriculture Abeokuta, Ogun State latitude 7° 10'N and 7° 58' N and longitude 3° 20' E and 3° 37'E.

B. Source of Seed

One hundred and Sixty-two (162) mature seeds of *Anacardium occidentale* were collected from mother trees at three locations namely:

Funaab (Alabata) latitude 7.2273 N 7°13'38.298" and longitude 3.43422 E 3°26' 3.18444"

Apakila (Camp) latitude 7.18455 N 7°11'4.38756" and longitude 3.43925 E 3°26' 21.28776"

Somorin (Obantoko) latitude 7.1852 N 7°11' 6.72684" and longitude 3.424972 E 3°25' 29.89956"

The different sizes of seeds collected were extracted from fruits and tested for viability by soaking seeds in water at room temperature for 48 hours [40]. Viable seeds were separated according to their sizes vis-a-vis Large, Medium and Small sizes according to their different locations.

C. Planting Procedure

Eighty-one (81) polythene bags were acquired and filled with top soil (sandy loam). The selected viable seeds were planted in the polythene bags at the rate of three (3) seeds of the same size class per polythene bags in three (3) replicates. Sown seeds were watered daily and monitored for eighteen (18) days with a daily record of new sprouts.

Germination percentage was calculated using the formula:

$$GP = \frac{No\ of\ seeds\ germinated}{Total\ number\ of\ seeds\ sown} \times 100\%$$

D. Experimental Design and Statistical Analysis

The experiment was laid out in a 3 x 3 Factorial in a Completely Randomized Design (CRD). Data collected was subjected to Analysis of Variance (ANOVA) in SAS Statistical package.

III. Results

A. Effect of Seed Size on the Germination Percentage of Anacardium occidentale Seeds

Germination potentials of *Anacardium occidentale* was significantly influenced ($P<0.05$) by seed size. Small sized seeds had the highest germination percentage (98%) with mean germination of 2.94. This was followed by medium sized seeds (92.67) while the least germination percentage (72%) was obtained in the large seeds with mean germination at 2.17 (Table I).

TABLE I: Effect of Seed Size on the Germination of *A. occidentale* Seeds

Size	No of germinated seeds per hole	Germination Percentage (%)
F1	2.17 [b]	72.33 [b]
F2	2.78 [a]	92.67 [a]
F3	2.94 [a]	98.00 [a]

Means values with the same subscripts in each column are not significantly different (p>0.05).
F1: Large seed size; F2: Medium seed size; F3: Small seed size.

B. Effect of Seed Source on the Germination Percentage of Anacardium occidentale Seeds

Seeds' location had significant effect ($P<0.05$) on the germination potentials of *Anacardium occidentale* seeds. Seeds sourced at Camp location had the highest germination percentage (98%) with its mean value at 2.94. Seeds collected at FUNAAB resulted in 83.33% while the least germination (81.33%) was obtained in seeds sourced at Obantoko with mean germination of 2.44 (Table II).

TABLE II: Effect of Seed Source on the Germination of *A. occidentale* Seeds

Size	No of germinated seeds per hole	Germination Percentage (%)
S1	2.50 [b]	83.33 [b]
S2	2.94 [a]	98.00 [a]
S3	2.44 [b]	81.33 [b]

Means values with the same subscripts in each column are not significantly different (p>0.05).
S1: Funaab seed source; S2: Camp seed source; S3: Obantoko seed source.

C. Combined Effect of Seed Size and Seed Source on the Germination Percentage of Anacardium occidentale Seeds

The combined effect of seed size and seed source significantly (*P<0.05*) influenced the germination of *Anacardium occidentale* seeds. Results showed that Large, medium, and small sized seeds, sourced at Camp had the highest germination percentage 94.33%, 100%, 100% and 100%, respectively. The effect was not significantly different (*P>0.05*) from medium and small sized seeds sourced at Obantoko with germination rate 94.33%, 100% respectively. The least germination (50%) was recorded in Small sized seeds sources from FUNAAB (Table III).

TABLE III: INTERACTION OF SEED SIZE AND SOURCE ON THE GERMINATION OF *A. OCCIDENTALE* SEEDS

Size * Source	No of germinated seeds per hole	Germination Percentage (%)
S1F1	2.16 b	72 b
S1F2	2.50 b	83.33 b
S1F3	2.83 a	94.33 a
S2F1	2.83 a	94.33 a
S2F2	3.00 a	100 a
S2F3	3.00 a	100 a
S3F1	1.50 c	50 c
S3F2	2.83 a	94.33 a
S3F3	3.00 a	100 a

Means values with the same subscripts in each column are not significantly different (p>0.05).
S1F1: Funaab large seed, S1F2: Funaab medium seed, S1F3: Funaab small seed.
S2F1: Camp large seed, S2F2: Camp medium seed, S2F3: Camp small seed.
S3F1: Obantoko large seed, S3F2: Obantoko medium sized seed, S3F3: Obantoko small seed.

IV. DISCUSSION

Seed size and seed source on the germination potentials of *Anacardium occidentale* seeds. It was shown that seed size had potentials to determine the rate of germination in *Anacardium occidentale* seeds. From the study, small sized seeds had the highest germination percentage compared to medium and large sized seeds. Fredick *et al.* [41] had similar observation where highest mean germination percentage was recorded in small sized seeds of *Dennettia tripetala* which, was followed by the medium seed size and the large size. [42] worked on effect of seed size on germination of three tropical tree species found that small seeds had the highest germination percentage on *Gmelina arborea* while there was no significant effect on *Terminalia superba and Terminalia ivorensis*. In certain tropical tree species in Southern India, smaller seeds were observed to germinate at a faster rate compared to larger seeds [22]. This view was found to contrast [2], [43] and [44] who related increase in germination rate with larger seeds. According to [2], in each of the germination trials of Hairy vetch, it was repeatedly observed that larger seeds had a higher germination rate compared to medium and small-sized seeds. Mtambalika *et al.* [45] considered the effect of seed size of *Afzelia quanzensis* on germination and reported the non-significant effect of seed size on its germination percentage but discovered that larger seeds had the highest germination percentage. Also, [46] observed that large seed size exhibited a significant effect on seed germination and emergence percentage in *Senna occidentale* seeds. Khera *et al.* [47] also observed that the germination performance of small seeds in A. catechu, A. nilotica, A. lebbek, and D. sissoo was poor.

In many studies, compared to small seeds, large seeds typically offer numerous advantages and often exhibit a higher percentage of germination. [21]. The increased germination rates in large seeds may be due to the larger amount of reserves available in larger seeds compared to medium or small seeds. [2].

The seed size often controls the germination and it depends on the ability of seeds to utilize food reserve. The food reserve and glucose levels occur differently in different seed size and may be one of the factors affecting seed germination [22]-[24]. According to Penning de Vries *et al.* [25] as reported by Shahi *et al.* [26], seed germination also depends on the mobilization of the seed reserve.

Seed source had a significant influence on the germination percentage with Camp location emerging as the location with much more germination percentage. According to Loha *et al.* [32] and [33], germination performance and capacity in most plant species are influenced by seed locations or provenance effect. This variation in the germination percentage might attributed to environmental factors. According to Aref *et al.* [38], environmental effect on seed production might bring a ripple effect on germination. These environmental effects affect the production of pollen which prevents the mother trees from siring seeds. Also, these variations can be phenotypic variation which is caused by the local environment and attributed to the longitudinal locations of the mother tree [31]. In contrast to this study however, seed source variation did not affect germination rate of *Chukrasia velutina* [48].

Seed source and seed size interacted with significant influence on germination percentage in seeds investigated. Several factors may have contributed to the variation observed in the germination percentage. Factors such as variations in the longitudinal location of the mother tree, the ability of the seeds to utilize the available food reserve and mobilization of these reserves for germination. According to [32] germination capacity in seeds is influenced seed provenance, [33] observed that germination performance in most plant species is affected by its location. Further studies showed that seed germination varies based on genetic origin and local environment where seed maturity occurred [34]-[37].

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