Effects of Seed Weights on Germination Rate and Seedling Vigor of Cashew (*Anacardium occidentale* L.)

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ABSTRACT

Seed weight has been noted to have a plastic trait that could directly influence seed germination and seedling vigor parameters. This study investigated the effect of seed weight on germination and seedling vigor performance of *Anacardium occidentale* L. Seed lots were hand mixed to improve the homogeneity and graded into weight classes as small (3.00 g-5.99 g), medium (6.00 g-8.99 g) and large (9.00 g-11.99 g). From each weight class, 40 seeds were randomly selected, their weights were recorded, and each was planted in polythene pots measuring 10 cm x 15 cm filled with garden soil.

Observations on Germination Percentage (GP) and Mean Daily Germination (MDG) were recorded. Germination values were calculated and seedling growth characters which included plant height (cm), number of leaves, stem girth (cm), leaf width (cm) and seedling vigor index were measured from the 6th to 11th weeks after sowing. The study was laid out in a completely randomized designed and replicated 4 times. Data was analyzed using SPSS and the Least Significant Difference (LSD) test was used as the post hoc test for mean comparison.

Results revealed that germination percentage and germination value of medium weight class were significantly differed from other seed classes. The medium class seeds had the highest germination percentage (100%) and was followed by small (87.50 %) and large (50 %). Similarly, the germination value of the medium class seeds was higher than (10.83), values recorded for the small class (10.00) and large class seeds (8.05). The present study concluded that the highest germination characteristics is obtainable with medium seed weight, while seed weight had no effect on the vigor of *Anacardium occidentale* seedlings. Thus, seed weight of medium class can be considered for its germination efficiency.

(Keywords: cashew seed, weight, germination rate, seedling vigor)

INTRODUCTION

Cashew (*Anacardium occidentale* L.) is a native of South America with center of origin in central Brazil (Mitchell and Mori, 1987). It was introduced into Africa by Portuguese adventurers in the 16th century (Johnson, 1973 and Frankel, 1991). Cashew is produced in about 32 counties of the world. Padmanaban (2010) estimated that the world production figure for cashew is around 2.7 million tons per annum. The major raw cashew producing counties with their production figures in 2005 (as per the United Nation's Food and Agriculture Organization) are Vietnam (960,800 tons), Nigeria (594,000 tons), India (460,000 ton), Brazil (147, 629 tons) and Indonesia (1200,000 tons) (Padmanaban, 2010). World's total area under the cultivation of cashew is around 13,100 km^2.

India ranks first in area utilized for cashew production, though its yields are relatively low. The world's average yield is 700 pounds per acre (780 kg/hectare) of land. Currently, Nigeria has about 600,000 surviving cashew trees spread across the country, with an average yield of about 200 kg per hectare (FAO, 2011).

The total land under cashew tree cultivation in Nigeria by 1995 was estimated at about 40,000 hectares, of which about 60% of the holdings were owned by peasant farmers (Oyedele *et al*., 2011). Total land area under cashew cultivation increased to 320,000 hectares in 2007 (FAO, 2007) and cashew nut production has been on steady increase from 30,000 metric tonnes in 1990 to 636,000 metric tonnes in the year 2006

(FAO, 2007). This significant increase has been due mainly to the involvement of private entrepreneurs, Federal and State Governments, Cooperative societies and affluent farmers in cashew cultivation (Aliyu and Hammed, 2008).

High germination and vigorous seedling are major important factors in the establishment of good cashew orchard (Anjusha *et al*., 2015), it is therefore imperative that selecting seedling with high vigor is quintessential and must always be considered in any breeding program designed to improve any crop species (Anjusha *et al*., 2015). Many of the cashew plantations in the major producing counties today produce poor yield probably because of low vegetative vigor of the seedlings used in the establishment of such farms (Ohler, 1979; Martin and Kasuge, 1995; Topper *et al*., 2001; Aliyu, 2004). One of the major production constraints in the country is that most of the plantations are senile and unproductive which has to be replaced with clones of high yielding variety (Huballi, 2009).

To boost the cashew production and become self-sufficient there is a need to produce quality planting materials since it is presumed that large planting materials are needed for area expansion and replanting of senile and unproductive cashew orchards (Anjusha *et al*., 2015). Sowing of mixed or ungraded seeds gives rise to non-uniform density of nursery stock (Anjusha *et al*., 2015). One of the reasons for the heterogeneity in the nursery stock is the high amount of variation in seed size and weight (Anjusha *et al*., 2015). Variation in the seedling size could be avoided to a great extent if seed of uniform grade are recast. Grading of the seeds will also help in reducing the waste of seeds in the nursery, if the influence of seed size on germination and vigor and seedling are established. Grading of seeds based on size and weight is a common practice in a majority of plant species as it has been found to regulate the germination and subsequent seeding growth in many species (Ajeesh *et al*., 2014. Vidyasagran *et al*., 2014). Hence, the study was undertaken to evaluate the effect of different seed weights of *Anacardium occidentale* on the initial nursery performance of seedlings.

MATERIALS AND METHODS

The experiment was carried out at nursery garden of the Department of Crop, Soil and Pest Management, Federal University of Technology Akure, Ondo State Nigeria, during the period of March to August 2011. A soil media was used which was the top layer of the garden soil, collected at crop type museum of Crop, Soil and Pest Management department and sieved with 2mm diameter mesh sieve. Materials used for the experiment were polythene pot of 10 cm x 15 cm filled with garden soil, while mature seeds were collected from a pure stand of mature cashew trees in a home stead garden at Ilara Mokin, Ondo state, Nigeria. The seeds were washed, air dried and stored in a cool dried place. The seeds viability was tested by pouring the seed in water, the floated ones were discarded and regarded as non-viable while the unfloated ones are regarded as viable for germination.

Seed lots were hand mixed to improve the homogeneity and graded into weight classes as small (3.00 - 5.99 g), medium (6.00 - 8.99 g) and large (9.00 - 11.99 g). From each weight class, 40 seeds were randomly selected to record weight. These seeds were then planted according to different weight classes and each plant were wet with water every day. From these observations, Germination Percentage (GP), Mean Daily Germination (MDG) and Germination Value were calculated (Czabator, 1962).

Seedling growth characters measured were plant height (cm), number of leaves, stem girth (cm), leaf width (cm) and seedling vigor index. Plant height was measured with a meter rule at the distance from soil level to the top of the terminal bud, the number of leaves was determined by visual counting of the leaves, leaf length and weight of leaf following the procedures of Agbogidi and Ejemete (2005) and Agbogidi and Ofuoku (2005). Stem girth at 3 cm above soil level was measured using Vernier calipers and seedling vigor Index (SVI) (Kharb *et al*., 1994). The seed belonging to each weight class were subjected to observation of the height, girth and number of leaves between 6^{th} to 11^{th} weeks after sowing in completely randomized designed (CRD) replicated 4 times.

Statistical Analysis

Data were analyzed using SPSS data package and the Least Significant Difference (LSD) test was used for detecting significant difference between means at 5% level of possibility.

RESULTS

Table 1: Germination Parameter of *Anacardium occidentale* Seeds as Affected by Weight.

Seeds Classes	Germination percentage (%)	Mean Daily Germination	Germination Value
Small	87.5	0.25	10.00
Medium	100	0.23	10.83
Large	50	0.13	8.05
LSD	7.70	0.02	0.30

a-c: means with same letter along same column are not significantly different (P>0.05)
LSD: Least Significant Difference

Table 2: Summary of Mean Values of Growth Parameter of Seedlings of *Anacradum occidentale* as Affected by Seed Weight.

Seed Classes	Plant Height (cm)	Number of Leaves	Stem Girth (cm)	Leaf Width (cm)	Seedling Vigor Index
Small	28.70	10.00	0.50	15.60	0.16
Medium	27.90	12.00	0.60	14.30	0.13
Large	28.70	10.00	0.50	15.60	0.15
LSD	0.60	5.00	0.40	0.58	0.02

a-c: means with same letter along same column are not significantly different (P>0.05);
LSD: Least Significant Difference.

Seed germination parameters were significantly influenced by the seed weight which are graded into weight classes small, medium and large at the 0.05 level of probability.

The medium seed class reflects a significantly highest germination of 100% compared with small weight 87.5% and large weight 50% (Table 1).

The small seed class mirrored a significantly high mean daily germination (MDG) while the large seed class was the lowest significantly as regards Mean daily germination in all the tree classes of seed weight (Table 1).

Again, the germination value for the medium seed class was significantly the highest while that of the large seed weight was significantly the lowest (Table 1).

Evidently from the data, plant height for both small seed class and large class show no significant difference while the medium seed class was significantly low compared with the other two (Table 2). Number of leaves were of no significant influence as far as the 3 categories of seed weight were concerned as well as the stem girth.

There was no significant difference in leaf width of plants sown with both the small and large seed weights while the medium seed weight gave significant difference. It is evident that medium seed weight was significantly different compared with small and large seed weights although statistically lower compared with the large and small.

The large seed category which shows 5.40 cm leaf width which was significantly higher compared with small seed weight of 5.39 cm and medium seed weight reflects 4.67 cm which is significantly lowest statistically.

Seedling vigor index was 0.153 from large seed class while 0.163 was from small seed class weight though not significant different but are relatively higher than the medium seed weight of 0.134 which is significantly lower than the two others.

DISCUSSION

In *Anacardium occidentale* L. the germination percentage was higher in medium seeds with 100%, small seeds 87.5% and followed by large seed 50%. This was in line with what was reported by Sujith *et al.* (1994) that seed size and weight did not have any influence on germination of *Ceiba pentandra*. Jatasankar *et al*. (1999), reported that seed size/weight characteristic had no or weak correlation with germination percentage of teak seeds. This is contrary to the assertion that more quality of store food materials in the heavy seeds will contribute for early and better germination according to Banik (1978) who studied on the seedlings of *Leucaema leucocephala* from larger, medium and small seeds showed higher initial field emergence and growth rate for seedling from larger seeds.

Ponnammal *et al.* (1993) grouped *Hardwickia binnate* seeds into small, medium and heavy category based on seed sizes and weight and reported that seed germination, seedling growth and biomass of seedlings increased with increase in size and weight. It is evident from this research that the medium seeds category reflects a better performance in respects to germination percentage and seed germination value which could be due to a moderate amount of stored food and slightly thinner seeds coat compared with large seeds which may require longer period to imbibe water and overcome seed domancy (Anjusha, 2015).

Seed weights significantly affect the performance of germination performance with respect to mean daily germination the small weight has highest performance 0.25 cm, followed by medium 0.23 cm and the large seed 0.13 cm. This is in agreement with Beniger *et al.* (1998) who reported that small seeds of *Copaifera langsdorffi* are more permeable and germinate faster than large seeds. In general seed size and weight are directly related with seed coat thickness and inversely related to water intake (Beniger *et al.*, 1998).

The increase in seed size and weight also implies decrease in the surface volume ratio resulting in lower relative ability to absorb water and initiate the process of germination (Fowler and Bianchett, 2000). Thereby, small seeds have thinner coat and highest relative surface. This seed trait ensures greater permeability in the small seeds and consequently high mean daily germination (Dolan, 1984).

With reference to plant height, leaf number, stem girth and seed vigor index, the seed weight obviously has no effect on the seedling growth parameters in the large seeds and small seeds. This can be related to the findings of Schall (1980) and Howell (1981) who stated that sometimes large seedlings have performance and sometimes they do not. Dreissch (1965) and Hendrix (1984) are of the opinion that genetic attributes and conditions for germination in the field may produce substantial effect of seed size/weight difference within and among plant species. Contrary to Gonzalez (1993) who stated that seed size/weight affects plant vigor as seeds with greater mass produce vigorous plants. Seed in the large seed weight had the highest value of seedling height, collar diameter and number of leaves (Owoh *et al*., 2011). However, the difference weight of seed did not significantly affect in the biomass production of the seedlings.

CONCLUSION

Result clearly indicate that the highest germination characteristics were attained with medium seed weight of 6.00 g-8.99 g. While the seed weight has no effect on the vigor of the seedlings of *Anacardium occidentale.*

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