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Breaking of Seed Dormancy, Germination and Seedling Growth of *Anacardium occidentale* L

[1]Abdullahi A.A, [2]B.L. Aliero, and [2]A. A. Aliero

[1]Department of Biology, Shehu Shagari College of Education, Sokoto, Nigeria
[2]Department of Biological Science Usmanu Danfodiyo University, Sokoto. Nigeria
Email: adamuabdullahi50@gmail.com/ abdullahi.adamu79@yahoo.com

ABSTRACT
Investigation was carried out on braking of dormancy and subsequent germination of the seeds of cashew (*Anacardium occidentale* L.*)* obtained from three different locations in North-Western Nigeria. Seeds were treated with absolute sulpuric acid (H_2S0_4), hot water, dry heat and mechanical scarification. They were then sown at 1, 3, 6, 9 and 12 cm depth, respectively and watered constantly at 12 hours interval. Emergence of seeds from the various depths was monitored and recorded. The following growth parameter of the emerged seedlings were measured and recorded: height, number of leaves, stem size as well as shoot and root dry matter. Significant differences were not established in all growth parameters. Results of the investigation revealed that sulpuric acids and hot water induce germination better than the other treatments with a maximum of 60% and 40% respectively. Seeds obtained from Gwadabawa that were sown at 1 cm depth performed best in all parameter evaluated for growth. Seeds from Talata Mafara followed and those from Argungu third, respectively. The results of the study may serve as useful information in the production and improvement of the tree species, as knowledge on braking dormancy and germination is critical factor in seedling production.
Key words: Seed dormancy, germination, *Anacardium occidentale*, Savanna.

INTRODUCTION

Anacardium occidenttale L (Cashew) belongs to the family Anacardiaceae, The tree is a native of tropical America, from Mexico and West Indies to Brazil and Peru. The cashew tree is pan tropical, especially in coastal areas. Portuguese adventure dispersed it in the seventeenth century to Africa, India and Far East (James, 1983).

The wood of cashew is reddish brown, moderately hard and termite resistant; it is seldom in large pieces. The bark contains a gum known as cashew gum, bright yellow to dark. It is a mixture of true gum and bassorin and is but soluble to water (James, 1983). The wood is used in boat-building, for boxes, chests, mortars, house and fence- posts and firewood (Burkill, 1985). The oil has considerable industrial beating and clutches, for reinforcing synthetic rubbers, in laminating and impregnating materials to confer oil and acid resistance, in manufacture of typewriter rolls, in oil acid-proof cements and tiles, and as an excellent lubricant in magneto armatures in aeroplanes, and for termite proofing timbers. Bark is used in tanning. Stem exude a clear gum, cashawa gum, used in pharmaceuticals and as substitute for gum Arabic. Juice turns black on exposure to air and provides an indelible ink (Patro and Behera, 1979).

Despite the numerous economic values attached to cashew, its cultivation in this part of Nigeria is neglected. Part of the problems associated with its cultivation is successful seedling establishment due to dormancy associated with the seeds. There is therefore, the need to find ways of breaking the seed dormancy and make planting stock available to farmers. Dormancy in nature serves to protect the seeds from inconsistent weather conditions. It also help to prevent germination

occurring during seed handling (Agbola,1991). A physiologically sound seed may remain quiescent after exposure to all favourable conditions necessary for germination due to dormancy (Kozlowski,1971). Dormancy could be either physical or chemical in nature. Physical dormancy is caused by hard seed coats or pericarps with cutinized layers which are impermeable to water, gases and light, while chemical dormancy may be caused by inhibitory chemicals present in the fruit and seed covering (Fasidi and Olufinboba, 1975, Fasidi *et al*.,1979). Both conditions may however occur simultaneously. Seed with immature embryos may also fail to germinate (Nikolaeva,1980). It is the objective of this work to study the germination of the seeds of *A. occidentale* under different treatments with the aim of breaking the dormancy, and to determine the most appropriate treatment in order to improve germination for easy propagation. This effort would go a long way in encouraging the plantation culture of cashew that is lacking, in the area under study.

MATERIALS AND METHODS

Seed Collection and Viability Test

Seeds of *A. occidentale* were obtained from local inhabitant from Gwadabawa, Sokoto State, (12° 50 'N at 300m above sea level), Talata Mafara, Zamfara State, (12° 38'N) at 300m above the sea level) and Argungu, Kebbi State (12° 18'N at 200m above the sea level). The seeds were dried and were kept in big labeled paper envelope and stored in metal cabinets in the herbarium at 28±2°C.

Chemical viability test for the seeds of the species was carried out using the tetrazolium salt technique in accordance with Adetola and Kozlowski (1979). Pretested (30) seeds were placed separately into three glass beakers containing distilled water and left to stand for 12 hours. Ten seeds each were taken and placed in clean petri dish and dissected longitudinally into two halves through the embryo. The dissected seeds were immersed into 1% tetrazolium solution and allowed to remain for 3 hours. The halved seeds were taken out in petri dish and observed for viability under dissecting microscope.

Field Experiment

Field experiment was conducted at biological garden of Usmanu Danfodiyo University, Sokoto (13°N altitude 300m above the sea level) within the Sudan Savanna ecological zone.

Seeds Sowing and Germination Count

Ten seeds of *A. occidentale* were sown in poly pots containing sterilized soil and animal manure in the ratio 2:1 at a depth of 1,3,6,9 and 12cm. The poly pots were of 35 cm by 25 cm width and 35 cm depth dimension. In all cases, the seeds were placed in standing position with the narrow end (inverted). They were covered with soil and soil saturated with water. Watering was repeated every 12 hours for six weeks.

The number of seeds that germinated in each treatment were counted and recorded on daily basis. Seeds were regarded to have germinated when the radicule protrude from the soil.

Seedling phonological characters study included seedling height, stem diameter and number of leaves per plant.

The *seedling height* was first measured three weeks after sowing (W.A.S) using metre rule and repeated on weekly basis for the rest period of the experiment.

Stem diameter size was measured at 2 cm above soil level with the aid of a vernier slide calipers at weekly interval.

The *number of leaves per plant* was counted from 7 days after emergence (D. A. E.) and then weekly for the rest period of the experiment.

Seedlings were harvested after six weeks. The seedlings were washed and roots separated from the shoot system. Both the shoots and roots were placed in an oven Gallenkamp (Model III — 150) and dried at 70°C for 72 hours. The dried materials were weighed separately on Sartorius (Model P. 163) weighing balance.

Laboratory Investigation

The following experiments were carried out in the physiology laboratory of the Department of Biological Sciences, Usmanu Danfodiyo University, Sokoto.

Chemical Seed Scarification: Seeds of *A. occidentale* were immersed in concentrated sulphuric acid or 3 hours, the seeds were then washed in several changes of distilled water before placing them for germination (Yoursheng and Sziklai, 1985). The treatment was repeated for 6, 9, 12, 15 and 18 hours, respectively. Ten seeds for each treatment were placed in 20 cm dimension petridish, lined with sterile filter paper soaked in distilled water. Each treatment was replicated three times. Untreated seeds serve as control.

Hot Water Seed Treatment: Dried seeds were placed in muslin cloth and dipped in boiling water in a beaker and allowed to stand for 15 mm and then removed. They were thereafter, placed in 20 cm dimension petridish with soaked filter paper for germination. The hot water treatment was repeated for 10, 15, 20, 25, 30 and 35 mm, respectively. Untreated seeds serve as control (Aliero, 2004).

Dry Heat Seed Treatment: Ten seeds of the species contained in petri dishes were subjected to 100°C temperature in an oven Gallenkamp (Model No. LH — 150) for 5 mm. the oven was preset to the temperature before placing the seeds. After heating, the seeds ‘ere allowed to cool. The treatment was repeated for 10, 15, 20, 25, 30, 35, 40 and 45 mm, respectively. Untreated seeds serve as control (Agboola, 1995).

Mechanical Scarification

Eighty (80) seeds of *A. occidentale* were placed in a metal cup containing gravels and shaken vigorously for 5 mm. the seeds were then washed in several changes of distilled water before placing them for germination. The same procedure was repeated at 10, 15, 20, 25, 30, 35, 40 and 45 mm respectively. Untreated seeds serve as control (Aliero, 2004).

Germination Percentage

The percentage germination was determined for each seed batch (3 replicates of 10 seeds) for 28 days. Cumulative percentage (CPG) and Mean Germination Time (MGT) was calculated using the method of Yousheng and Sziklai (1985) as follows:

$$MGT = \sum nidi/n$$

Where n = total number of seeds germinated during 28 days experimental period; ni = number of seeds germinated on day di; di = day during germination period (between 0 and 28).

The germination value (GV) was computed following the method of Dyaranshir and Pourbeik (1976).

$$GV, day—I\text{ -}DGS/NxCPGx10$$

DGS = Daily germination speed computed by dividing CPG by number of days since beginning the test; N = frequency of DGS that are calculated during the test; 10 is a constant.

Data Analysis

The data was subjected to statistical analysis means separation and standard error determined.

RESULTS

Viability test with tetrazolium salt also showed that the collected seeds from the three locations were highly viable in the range of (80 — 90%). The various embryos showed reddish-brown colour in tetrazolium salt solutions.

Seeds of *A. occidentale* started to germinate by 14th day after sowing (D. A. S.) and completed germination by 19th day. Total germination indicated that seeds from Gwadabawa sown at 1 cm depth gave 10.49± 1.7, those at 3 cm 9.32 ± 0.3 and those at 6 cm 9.20 ± 0.5 respectively. Seeds from Talata Mafara gave 9.40 ± 0.5.)20 ± 0.2 and 9.10 ± 0.3 and those from Argungu gave 8.98 ± 0.7, 8.50 ± 0.6 and 7.98 ± 0.5 for six Weeks sown at 1, 3, 6 cm depth respective. The differences between the numbers of seed that germinated from the three locations were not significant (P >0.05) and beyond 6 cm depth no germination was recorded (Table 1).

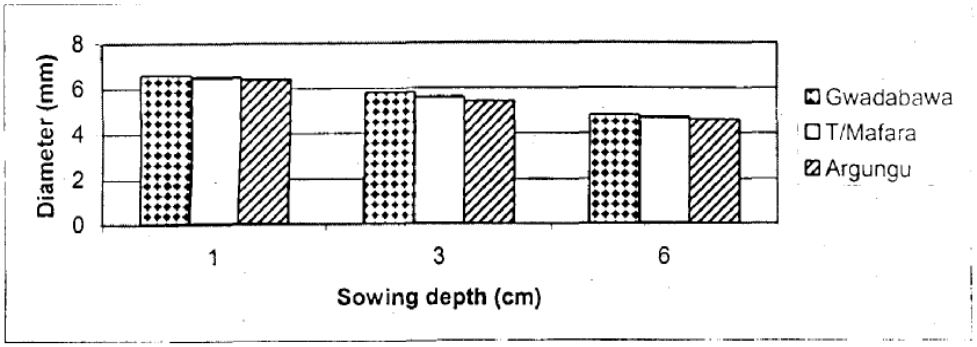

Fig. 3: Mean Diameter of *A. occidentale* seedlings raised with seeds from Gwadabawa, T/Mafara and Argungu sown at different depths. Mean of 3 replicates.

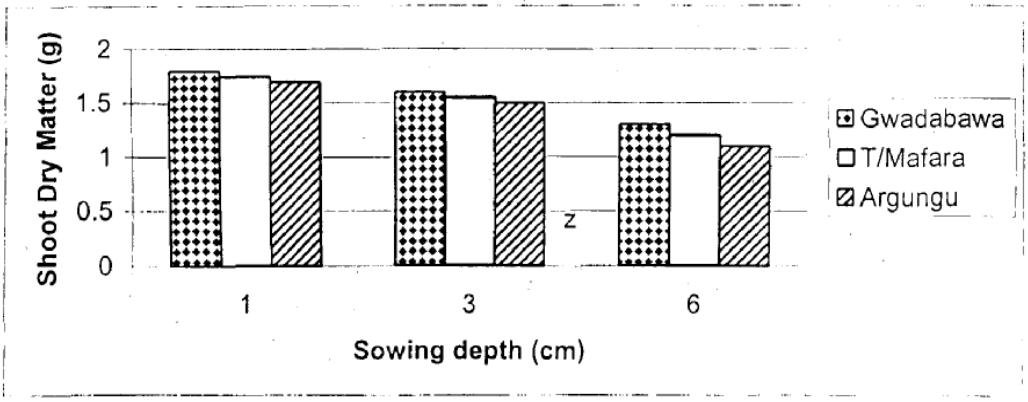

Fig. 4: Mean Shoot Dry Matter of *A. occidentale* seedlings raised with seeds from Gwadabawa, T/Mafara and Argungu sown at different depths. Mean of 3 replicates.

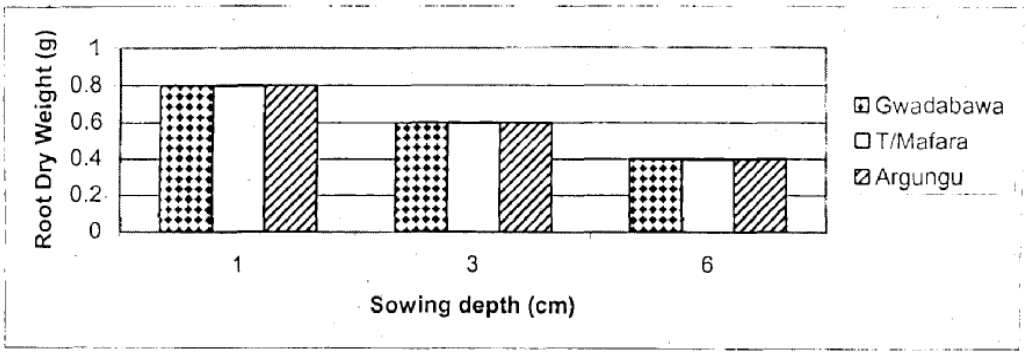

Fig. 5: Mean Values of Root Dry Weight of *A. occidentale* seedlings raised with seeds from Gwadabawa, T/Mafara and Argungu sown at different depths. Mean of 3 replicates.

Treatment with sulphuric acid was effective in breaking seed dormancy and the result is shown in Fig. 6.

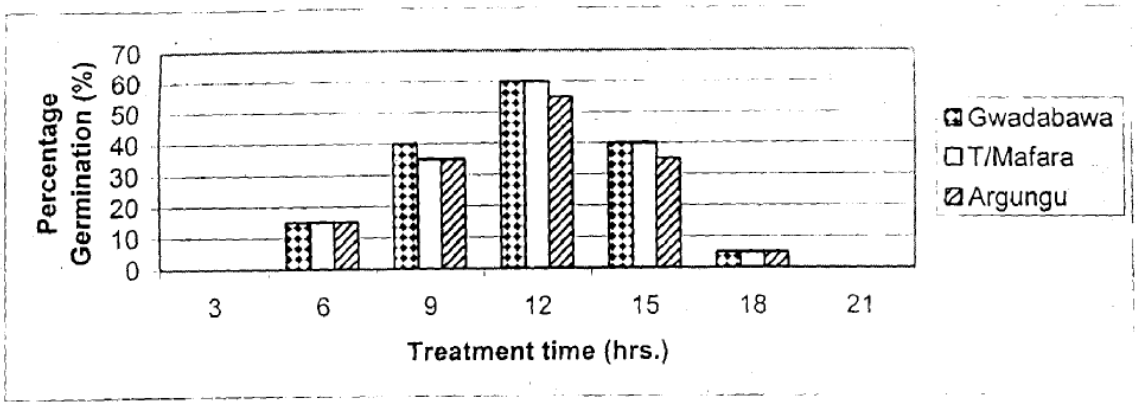

Fig. 6: Percentage Germination in seeds of *A. occidentale* obtained from Gwadabawa, T/Mafara and Argungu treated with Sulphuric acid.

Seeds obtained from the three locations showed that germination rate increased with increase in period of soaking up to 2 hour, after which there was a gradual decline in the germination.

Treatment of seeds for 25 min in hot water gave the highest germination of 30% and the lowest (05%) germination was obtained when immersed in hot water for 35 min (Fig. 7).

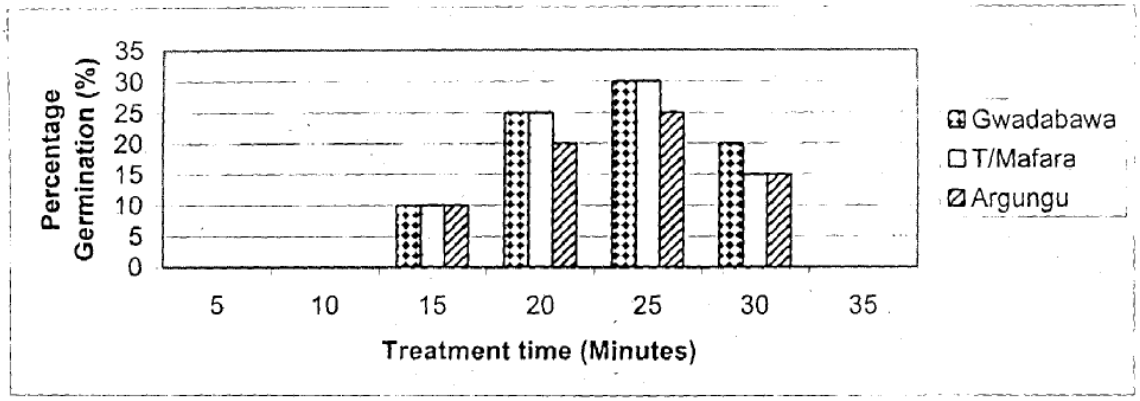

Fig. 7: Percentage Germination in seeds of *A. occidentale* obtained from Gwadabawa, T/Mafara and Argungu treated with Hot water.

Table 1: Mean germination of *A. occidentale* seeds obtained from different locations sown at different depths sowing depths (cm).

Location	Depth of sowing (cm)		
	1	3	6
Gwadabawa	10.49±1.78	9.32 ± 0.3	9.20 ± 0.5
Talata Mafara	9.40 ± 0.5	9.20 ± 0.2	9.10 ± 0.3
Argungu	8.98 ± 0.7	8.50 ± 0.6	7.98 ± 0.5

Values: mean of 3 replicates ± SD

Exposure of seeds to temperature regime of 100°C failed to germinate. Similarly, seeds from the three sources did riot respond in all the treatment when mechanically scarified.

DISCUSSION

Results of germination studies showed that the depth at which seeds are buried in soil influences their emergence as seedlings. The seeds of *A. occidentale* from the three locations examined, germinated best when sown at 1cm depth. These were followed by 3 and 6 cm depth, respectively. All seeds sown at 9 and 12 cm depth failed to germinate irrespective of the location of seed sources. These findings suggest that factors responsible for seed germination within the soil exert greater influence than those acquired due to difference in longitude, latitude and altitude location of the mother plant. Factors such as level of oxygen (02) and carbon dioxide (C02) concentrations vary with the depth of the soil. Where carbon dioxide (C02) concentration is high, it tends to inhibit germination (Brandt, 1992).

Availability of light also diminishes with increase in depth. Since light energy modifies the microclimatic environment of the seeds to trigger germination, where such intensities are low, there may not be sufficient energy to start the process of germination in seeds.

The fact that seeds from Gwadabawa performed best in most of the growth parameters suggests the importance of latitude over altitude. Gwadabawa being at the highest latitude (12° 50'N) compared to Talata Mafara (12° 38'N) and Argungu (12° 18'N) (Abdu, 1982). Altitude appears to have little or no influence on seed germination since Gwadabawa and Talata Mafara are located at the same altitude.

Dormancy in seeds is usually associated with the factors of the protective covering, the seeds coat or the enclosed embryo. From the investigation carried out, such treatment as application of sulphuric acid and hot water were found to induce germination of seeds of *A. occidentale*. From the above one can infer that dormancy of seeds of *A. occidentale* was probably associated with the seeds coat, since the treatment that induce germination were those that can effect disruption of the seed coat. According to Aliero (2004), immersion of seed in concentrated sulphuric acid disrupt the seed coat and prolonged emersion may be injurious to the seeds as acid may rupture vital parts of the embryo. Sulphuric acid is thought to disrupt the seed coat and expose the lumens of the microsciereid cells, permitting imbibition of water (Agboola and Etejaere, 1991), which trigger germination.

Sudden dip of dry seeds in boiling water may lead to the rupture of the coat wall allowing water to permeate the seed tissues causing physiological changes and subsequent germination of the embryo (Agboola and Etejere, 1991, Agboola and Adedire, 1998, Sabon Gari and Aliero, 2004). Plant that pass through their rest period at low temperature may have their rest broken by warm water baths (Leopold and Kreidman, 1975). This also suggests that embryo may get destroyed on contact with boiling water for a prolonged period. The lower germination rate obtained in *A. occidentale* seeds from the three locations may be due to the hard seed coats and presence of inhibitors that may be contained in the kernel. Inhibitors in the seed coats of some desert plants such as absicic acid prevent germination (Noggle and Fritz, 1976). Growth and germination inhibitors; such as coumarin, phenolics, abscissins have been isolated from plants and may have been correlated with dormancy (Mayer and Poijakoff — Mayber, 1975). Many early studies on

the inhibitory effect of pulp of fleshy fruits indicated that inhibitors might be involved in the control of dormancy. Thus, the germination of the seeds of *A. occidentale* also depends on the maintenance of equilibrium in the levels of inhibitors and growth parameters.

The seeds of *A. occidentale* from all the three locations did not respond when the seeds were subjected to dry heat treatment as the seeds failed to germinate. This suggests that the seed coat are hard, dry heat may kill the embryo by dehydrating the moisture contained in the seed. Similarly, the zero (0%) percentage germination recorded in *A. occidentale* seeds when mechanically scarified may be attributed to the hard seed coat which probably required more aggressive treatment to permit ready entry of water into the seed and the seed coat when not properly ruptured may restrain the expansion of the embryo as reported by Odetola and Kozlowski (1979). Under this condition proper mobilization of food and metabolites from the embryo is prevented.

In conclusion, depth of 1-3 cm gave the highest germination and may be Considered useful for raising seedlings of the plant species under nursery conditions which will enhance early, faster and uniform emergence of the seedlings. Sulphuric acid and hot water treatment turned out to be the best in inducing germination of the plant species. Sulphuric acid is dangerous to handle and very expensive. The use of hot water treatment in inducing germination of *A. occidentale* is recommended since it is cheap, less risky and within the reach of the local farmers.

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