INVESTIGATION OF THE EFFECT OF SEED COAT TREATMENT AND OPEN STORAGE TIME ON THE GERMINATION AND SURVIVAL OF *GAMBEYA ALBIDA* G. DON SEEDLINGS.

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Abstract

Indigenous forest fruit trees like Gambeya albida play vital roles in the dietary diversity of the Nigerian people. The ever increasing rate of deforestation means their gradual disappearance, hence the need to examine appropriate seed sowing options for people interested in the crop. The study investigated the germination of Gambeya albida under different seed coat and open storage regimes in the nursery. The seed coat treatments were: decoated (CD), filed at circumference (FC) and untreated (CC). The seed moisture content was carried also out every three days ending in 22 days, while the investigation of seed germination was for 3 (three) months. Experimental layout for the germination study was randomized complete block design (RCBD), data was analysed using percentages, one-way ANOVA and means separation by Duncan Multiple Range test at 50% level of significance. The seed moisture content percentage study showed that fresh seeds of Gambeya albida had 43.21MC% which decline steadily with open storage time to 18.30% (critical moisture content) in 22 days. Time of storage affected the germination. The days of germination were between 11 –19 days for seed coat treatment regimes, was lowest for the (CD) and highest for (CC). The percentage germination was 5% (CD), 14.38% (FC) and 45% for (CC). Survival of emerged embryos that became seedlings was 12.5% (CD) 54.5% (FC) and 70.8% (CC). Seedcoat had significant protective role to play in the germination, early growth and survival of Gambeya albida seedlings. It is recommended that the seeds should be sown without seed coat removal in order to have good germination rate and survival.

Keywords: *Gambeya albida*, germination, moisture content, seed coat, survival.

INTRODUCTION

There is daily decline in the size of Niger to plant more trees to meet the various social, economic and ecological needs of man provided by trees as well as halting the rising trend of global temperatures. At the state and federal government levels, plantations of exotic tree species (specifically, *Tectona grandis*, *Gmelina arborea*, and *Azadirachta indica*) are being established to provide timber, pulp and environmental protection as needed in the various ecological zones of the country. Minimal attention is given to the indigenous species in the afforestation programme of government; but it is these

indigenous non-timber fruit tree species that are more used by the private individuals especially those in rural communities who essentially have their livelihoods intricately wound around these species.

Indigenous fruit trees are very important in the life of every community in Nigeria; playing essential roles in the dietary diversity of the people from month to month and alleviating rural poverty. They also contain variety of amino acids, vitamins and minerals that are essential for

man's growth and development (Okunola and an indigenous woody plants distributed in the forest zone of Nigeria including the derived savanna belt was prepared by Okafor (1979). Some of the edible ones included *Treculia africana, Irvingia gabonensis, Gambeya albida, Spondias mombin, Vitex doniana, Dialium guineenses* and *Ceiba pentandra*. He further indicated that the species were important not only for the supply of various items of food but also for livestock feeds, oils, fats, beverages, farming and household implements, chewing stick, dyes, drugs, timber amongst others. Most people relish indigenous fruit tree crops as evident from the high consumption when they are in season. Unfortunately, this love is not matched by private/individual planting as these crops are still being harvested from the wild/natural forest, Oboho and Ngalum (2014).

Etukudo *et al*. (1994) stating factors which militated against early acceptance of private forestry in Nigeria indicated that forests are seen by many people as God-given, inexhaustible resources. The people still see the forest to be abundant and so do not deem it fit to plant more trees. FORMECU (1998) reporting on the constraints against the cultivation of indigenous fruit trees included poor or lack of extension education on indigenous fruit tree cultivation. In order to give impetus to private and public planting of important fruit tree species, it is worthwhile to know more about the silvicultural requirements for their regeneration. There is presently paucity of knowledge regarding simple ways of raising many of the indigenous fruit tree species by local people, especially for seeds that exhibit some form of

dormancy. It is against this background that this study intends to investigate simple seed coat treatments and allowable open storage time that could be adopted by rural people in the raising of *Gambeya albida.*

Brief description of *Gambeya albida:*

Gambeya albida (G. Don) Aubrev and Pellegr, is plant locally known as cherry in Nigeria and belongs to the family Sapotaceae. It is a lowland rainforest species which is found in villages and market squares, and home gardens. The tree grows up to 40m in height, bole is sometimes long and straight but often branched low down, deeply fluted, with small buttress at the base. Bark is pale grayish brown. Slash is pale brown, exudating copious white latex. Leaves are simple, reaching 30cm long and 9cm broad, *lanceolate*, tapering rather rapidly to acuminate apex and wedge-shaped base; lower surface densely covered with silvery-white or slightly yellowish hairs. The flowers are cream yellow, in dense clusters in the leaf axils.

The fruit is a berry and can be found between January –April. It is orange-red or brownish yellow when ripe. It is glabrous, ovoid to subglobose, pointed at the apex, up to 6cm long (Plate 1a). The fruit contains 3-5 seeds. The seed coat is hard, bony, dark brown and shining and has a scar at the base or on one side (Plate 1b). Wood is brownish-white, soft, coarse and open grain, very perishable in contact with the ground. This plant is of great cultural and economic value. Egharevba (2008) stated that African cherry has future potentials which is enormous ranging from production of delicious fruits high in vitamin C, contain moderate amount of minerals, sugar and protein. Fruits contain anacardic acid used industrially to protect wood and as source of resin. Fruits pulp for jelly, jam, wine, syrup and chewing gum. The bark, leaves and seeds are traditionally used in medicines for the cure of bronchitis and mental disorder. Bark used in the treatment of yellow and malaria fever. The seed contains oil used in the manufacture of candle. Seeds rich in lindeic and oleic acids. The broken shells of the seeds are strung together and used as rattle and worn

by dancers (Keay *et al*., 1964).

Plate 1a: Fruits of *Gambeya albida*

Plate 1b: Seeds of *Gambeya albida*

MATERIALS AND METHODS

Study Area

The study was carried out at the nursery of the Department of Forestry and Wildlife, University of Benin, Edo State, Nigeria. The location as indicated by GPS is on Latitude 6^0 24'0.3.8" N and Longitude 005^0 37'24.0"E and on an altitude of 106m above sea level. Benin City has a temperature range of between 27^0C to 32^0C for most of the year and atmospheric humidity of 75% at noon and 95% at 6.00am. During the harmattan which occurs from the month of December to February, cold and dusty North-Easterly winds bring a considerable drop in the relative humidity. The main rainy season predominantly with South-West wind is from the month of May to October and the annual rainfall is 2,078mm, Master Plan (1993). **Method:**

The study was carried out in two concurrent phases namely:

a) Investigation of the seed moisture content in relation to time of open storage in the laboratory. Seed moisture content being an important parameter of seed that could alter with time was taken as a base line data.

Investigation of the germination and seedling survival under different seed coat treatments in the nursery of the Department of Forestry and Wildlife, University of Benin, Benin City

Plate 2a: Nursery site for the investigation of *Gambeya albida* germination.

For (a): Fresh seeds of *Gambeya albida* were extracted from the fruits, rinsed with water to remove all pulp, dried with absorbent tissue, and then cleaned and open air stored in a basket. Twenty (20) seeds were taken from the seed lot for moisture content percent determination each time seeds were taken for sowing to test for germination. These times were day 1, 4, 7, 10, 13, 16, 19 and 22 days respectively. The last date being when the seed lot from the basket gave no further germination. The seed moisture content was determined by drying seeds in an oven for 24 hours at 80^{o}C-105^{o}C until constant weight was attained. The loss in weight was taken as the moisture content (MC) expressed as the percentage of the initial seedlot weight (Olomu, 1995).

For (b): At each time of moisture content determination (every three days), a second batch of seeds was taken for seed germination using three different seed coat treatments. The treatments were Completely decoated (CD), filed at circumference (FC) with a nail filer and untreated (CC) which was the control (Plate 3a-3c). There were three replications per treatment and twenty (20) seeds used in each replicate. The germination testing continued up till when there was no further germination for each seed coat treatment regime under investigation. Two months after emergence, the surviving seedlings under each treatment were counted, recorded and inferences deduced. Randomize complete block design was used in the germination experiment/survival experiment.

Plate 3a: Germinating seedlings of *Gambeya albida* (untreated seeds)

Plate 3b: Germinating seedlings of *Gambeya albida* (filed seeds)

Plate 3b: Germinating of seedlings of *Gambeya albida* (completely decoated seeds)

STATISTICAL ANALYSIS

The germination and survival values were subjected to descriptive statistics using percentages as well as analysis of variance (ANOVA) and the means were separated using the Duncan Multiple Range Test at 5% level of probability.

RESULTS

The fresh seeds of *Gambeya albida* are fleshy, had moisture content of 43.21%. This value declined steadily with increasing duration of open storage (Figure 1). By the 22nd day, the moisture content had reduced to 18.30%. This means that there was 24.91% drop in the moisture content in the said period, or approximately 1.13% drop in moisture content per day. Germination of the seeds was intermittent, with the peak value at the beginning. Completely decoated (CD) seeds commenced emergence/germination in 11days, filed seeds (FC) took 15.4days and the untreated (CC) seeds took 18.8days. The duration of open storage time did not significantly affect the germination date. Knowledge of open storage time would give an insight into the allowable time the seeds could be kept where germination was expected.

The seeds whose moisture content percent (mc%) had dropped below 34.20% did not germinate when seed coat was removed.

Filed seeds (FC) did not germinate below 26.74% mc while the untreated seeds (CC) were still able to germinate up to a level of 18.30% moisture content. From the result, the critical moisture content of undecoated (untreated) seeds of *Gambeya albida* seeds was $\geq$ 18.30% moisture content, this being the point below which no further germination could take place.

There was 5% germination for decoated (CD) seeds, 14.38% for filed (FC) seeds and 45.6% for untreated (CC) seeds (Table 1). The germination percent declined with increasing duration of storage for all treatments. The decoated seeds stopped germination by the 7^{th} day of storage, the filed seeds reached 13^{th} day while the untreated seeds reached 22days after which there was no further germination (Table 2). There was significant effect of seed coat treatment and duration of storage on germination. Also the interaction effect was significant (Table 3). Not all emerged cotyledon survived the first two months (8 weeks) after emergence. Decoated (CD) seeds had 12.5%, filed seeds (SC) 54.5% and untreated (CC) seeds had 70.8% survivors becoming seedlings. The seed coat treatment significantly affected the seed germination percentage and survival of emerged seedlings (Table 4).

RESULTS AND DISCUSSION

The steady decline of seed moisture content with duration of storage indicates that the seed is recalcitrant. This agrees with the findings of Oboho and Ngalum (2014) who observed a similar result with open stored seeds of *Treculia africana*.The duration of open storage (hence moisture content decrease) only caused numerical but not significant differences in dates of emergence. Apart from environmental factors of moisture, temperature and oxygen (air), a primary factor in seed germination is the life of the embryo which controls its viability. Reduced moisture content is able to reduce metabolic activity and make the embryo be in a temporary resting or quiescent state which is non-dormant. If other germination factors are available, the seed soon gets activated and germinates. It therefore follows that within certain thresholds and when seed moisture content decline does not endanger the life

of the embryo, germination is able to commence. The numerical differences observed in germination dates in relation to duration of open storage probably indicate the time needed to activate enzymatic activity and transfer the hydrolysed nutrients to embryo and stimulate emergence/germination.

The emergence and post emergence survival of seedlings observed in this study indicated that seed coat removal was detrimental to *Gambeya albida* seed germination. Oboho and Urughu (2010) observed that decoated seeds of *Garcinia kola* gave the highest germination percentages (83%). The difference observed in this study could be due among other factors to the fact that *Garcinia kola* exhibited hypogeal germination. *Gambeya albida* on the other hand exhibits epigeal germination. At emergence, the cotyledons are raised above the soil making germination discernable. In some species like *Gambeya albida*, *Terminalia ivorensis*, *Hunteria umbelata* and *Terminalia superba*, these cotyledons do not fall off but become the first proper leaves of the seedlings (Oboho, 2014). The seeds are foliaceous and because it takes between 2-3weeks for the *Gambeya albida* cotyledons to acquire the photosynthetic status and ability, the seed coat removal becomes a disadvantage. From this study, the fate of the emerged cotyledons could have been determined by all or any of the following factors:

1) Dessication: uncovered cotyledons easily dry up and once dessication takes place, they become unable to attain the photosynthetic status and soon wither off.
2) The fleshy nature of the cotyledon makes them susceptible to attack by herbivorous animals.
3) Fungus and other micro-organism could also destroy the exposed cotyledons.

The aspect of survival of seedling after germination was supported by Woods and Elliot (2004) who opinioned that protecting seeds against predation, permitting them to reach seedling stage is an important goal of tropical restoration programs..

This study has shown that for some species, especially with albuminous and foliaceous seeds, the seed coat (testa) is a natural protection for the emerging embryo against the vagaries of the environment and its retention aids the early growth and survival processes of the young seedlings.

CONCLUSION

The seed of *Gambeya albida* is recalcitrant, as seen from the steady rate of seed moisture content loss (desiccation) with time. The investigation has revealed that seed coat treatment affected germination date completely decoated seeds were the earliest to germinate but had the least germination percentage and survival of seedlings while the untreated seeds gave the best results. It is evident therefore that for this type of species which has recalcitrant seeds, epigeal germination and foliaceous seedlings, the seed coat (testa) plays a very crucial protective role during the germination, early growth and survival of the seedlings. It is hereby recommended that such seeds be raised without removing the seed coat in order to obtain the best results. This method could also be easily practised by interested planter of the crop. The study is therefore an asset to domestication and regeneration of *Gambeya albida*.

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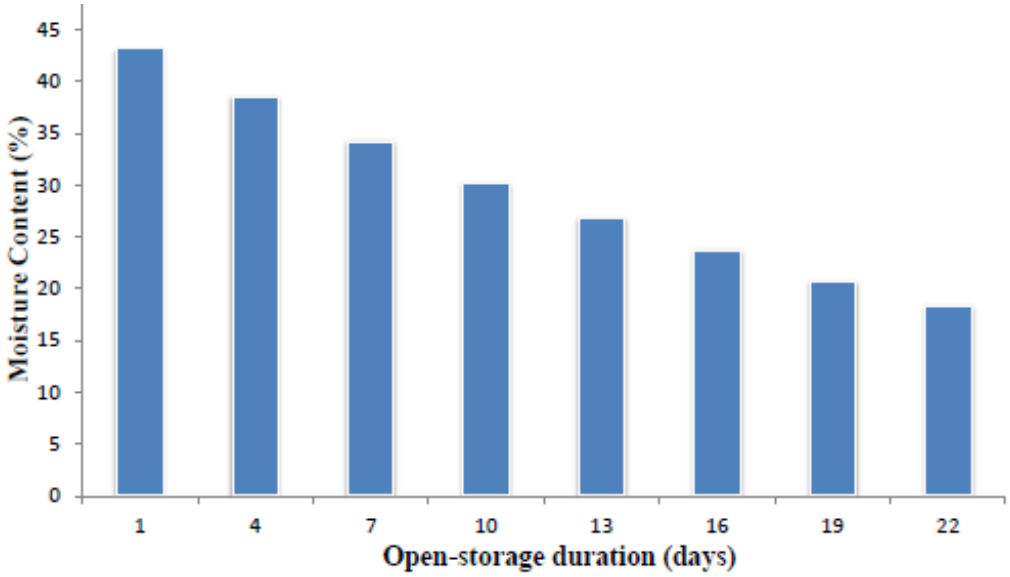

Figure 1. Moisture content of *Gambeya albida* seed in relation to storage time

TABLE 1: Germination of seedlings of *Gambeya albida* in relation to open storage time and seed coat treatment.

Open storage time (days)	Seed coat treatment		
	CD	**FC**	**CC**
1	4	9	12
4	2	3	12
7	2	4	11
10	0	5	11
13	0	2	10
16	0	0	9
19	0	0	6
22	0	0	2
$\bar{x}$	8	23	73
Percentage (%)	0.05	14.38	45.63

** CD = Completely decoated seeds FC = Filed seeds
CC = Untreated seeds (Control)

TABLE 2: Mean Germination values of *Gambeya albida* in relation to seed coat treatment and storage duration.

Seed Coat	**Open-Storage duration (days)**								
Treatment	**1**	**4**	**7**	**10**	**13**	**16**	**19**	**22**	**Mean LSD = 0.536**
CD	2.00	0.67	0.67	0	0	0	0	0	**0.42**
FC	3.00	1.00	1.33	1.67	0	0	0	0	**0.96**
CC	4.00	4.00	3.67	3.67	3.33	3.00	2.00	0.67	**3.04**
Mean	3.00	1.89	1.89	1.78	1.33	1.00	0.67	0.22	**Interaction LSD = 1.515**

LSD = 0.875

TABLE 3: Anova table for germination of *Gambeya albida* under different seed coat treatment and storage time

Sources of Variation	DF	SS	MS	F ratio
Replication	2	28.7778	14.3889	
Scarification	2	92.1944	46.3889	51.44**
Time of Keeping	7	47.1944	6.7222	7.50**
Interaction (S x T)	14	14.6944	1.0496	1.17*
Error	46	41.2223	0.8961	
Total	71	223.944		

** Significant at 5% and 1% levels respectively.

TABLE 4: Germination (%) and survival (%) of *Gambeya albida* in relation to seed coat treatment.

Treatment	Germination Rate (%)	Survival Rate (%)
CD (T_1)	5.0^{x}	12.5^{a}
FC (T_2	14.4^{y}	52.2^{b}
CC (T_3)	45.6^{z}	75.3^{bc}
LSD 5%	17.1	31.7