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EFFECT OF PRE-GERMINATION TREATMENTS ON THE DORMANCY BREAKING AND EARLY GROWTH PERFORMANCE OF BITTER KOLA (*Garcinia kola*- (Heckel) IN SOUTH SOUTHERN NIGERIA

[1]Ajayi, S. and Echi, A. A.

[1]Department of Forestry and Wildlife management,
Cross River University of Technology (CRUTECH)
Obubra campus), P.M.B 102, Obubra,
Cross River State, Nigeria

E-mail: *samayodora@yahoo.com* Phone: +2348038368014; +2348059456270

ABSTRACT

The demand for bitter kola (Garcinia kola) is high in Nigeria market but the population of the species is low both in the wild and home gardens. Rapid deforestation, heavy exploitation in the natural forest and difficulties associated with its germination occasioned by seed dormancy have been blamed. The study on enhancing germination and early growth of Garcinia kola was conducted using Complete Randomized Design (CRD) with three treatments and a control. The control was made of untreated seeds (T_1) while the treatments included nicked seeds soaked in water for 24 hours (T_2), seeds from fermented pods (T_3), and seeds from fresh pods (T_4). Seed germination tests were carried out after pre-treatment using 16 seeds for each treatment anf the control in the nursery site of the Cross River University of Technology (CRUTECH, Obubra campus) in South southern Nigeria.. The result showed that cutting seeds at the opposite end to the radicle (nicking) was the most suitable pre-sowing treatment to increase seed germination and early growth performance of Garcinia kola. Treating the seeds with mechanical scarification (nicking) significantly enhanced germination ($P<0.001$) and significantly influenced seedlings growth ($P<0.05$). The highest mean values of 8, 14.65 cm and 5 were obtained for germination count, plant height and leaf number respectively from nicked seeds soaked in water for 24 hours. Dormancy in Garcinia kola seeds can be removed by nicking the seeds and soaking in cold water for a day.

Keywords: Germination, growth, seed nicking, pre-treatment, dormancy

INTRODUCTION

Garcinia kola (Heckel) commonly known as 'bitter kola' is a medium size tropical tree which often grow to a height of 12-15m belonging to the family Clusiaceae and sub-family guttiferal. *Garcinia kola* is one of the

non-timber forest products that are of high socio-economic importance in Nigeria. It is endemic to the humid lowland rainforest vegetation of the west and central African sub regions. It is found in coastal areas and lowland plains up to 300m above sea level with an average of 2000mm – 2500mm rainfall per annum and temperature ranges from 32.150^{o}c to 21.40^{o}c and minimum relative humidity of 76.34% (Raven *et al*, (2005).

Garcinia kola enhances the flavor of some local beverages, and plays a prominent masticatory role in traditional hospitality, cultural and social ceremonies in southern part of Nigeria. The seeds of *Garcinia kola* have pharmacological uses in treating cough throat infections, bronchitis and hepatitis (inflammation of the liver) and liver disorder (Farombi, *et al*, 2005). According to Adegoke et al., (1998), the seeds have inhibitory effect on lipid peroxidation in rat liver homogenates. Other medicinal uses include purgative, antiparasitic, and antimicrobial. They are also used for prevention and relief of colic, head or chest colds as they contain biflaviods, xanthones and benzophenones, which the microbial properties of the plant have been attributed to; it has also shown bronchodilator effect, anti-inflammatory, anti-microbial (Akoachere *et al*, 2002). Compounds from the plant have also proved effective against some strains of flu, a contagious respiratory disease known as influenza (Cheek, 2004). The seeds serves as bitter stimulant and a snake repellant when placed around compound (Daily Champion, 2004). Extract of various part of the plants are thought to have some medicinal properties used for the treatment of laryngitis, mouth infections, cough, heart burn, liver disorder and other inflammatory diseases.

Apart from food and medicinal values, the fruits and seeds of *Garcinia kola* are gather and sold by people mostly in rural areas to generate income for sustainable livelihood. *Garcinia kola* has agroforestry potentials as wind break because of its good canopy. In addition, its hard wood is suitable for timber and tools handle making. The wood is excellent for fuel wood, its dense round crowns makes it

an ideal tree for shade around homes; the branches, stem and roots are used as chewing stick because of the antibacterial activities of its extracts. Its commercialization in both the domestic and national market raises the standard of living of those involved in its trading activities both in the rural and urban centre (Adebisi, 2004).

Despite its socio-economic importance, the cultivation of this plant is very much limited. The demand for bitter kola (*Garcinia kola*) is high in Nigeria market but the population of the species is low both in the wild and home gardens due to rapid deforestation and heavy exploitation in the natural forest coupled with the difficulty of the species to germinate due to seed dormancy. Hence, when untreated, the seed may not germinate or take longer period of about six to twelve months to germinate (Adebisi, 2004; Anegbeh, *et al.*, 2008). It is therefore a challenge to research institutions to help overcome this problem and to respond to priorities of farmer especially in areas of conserving highly endangered and valued species.

This study is therefore aimed at determining the best germination pre-treatment that will enhance the early germination and growth performance of *Garcinia kola.*

MATERIALS AND METHODS

The study was carried out in the nursery site of the Department of Forestry and Wildlife, Cross River University of Technology (CRUTECH) Obubra Campus. Obubra lies between Latitude 6° 05′ and 8° 20′N and Longitude 6° 08′ and 8° 33′E. The climate is characterized by wet and dry seasons with fairy uniform temperature of mean monthly average of about 27 ^{0}c and annual rainfall between 2000-2500mm per annum (CRADP, 1992). The relative humidity varies from 60-70% in January to 70 – 80% in July (Bulk Trade and Investment Company Limited, 1998).

Seeds were collected from trees growing in home garden at Adun-beach village in Obubra Local Government Area of Cross River State. Ripe fruits were collected from all parts of the crown since they might have been

pollinated by different pollen sources. Collecting fallen fruits and seeds was avoided because of uncertainty and greater risk of contamination with soil-borne pathogenic fungi. After collecting the fruits, the seeds were extracted, washed in clean water and air dried for one week to ensure viability. Also, some of the seeds were sown directly from the fresh fruits while some of the fruits were allowed to decay with the seeds left inside for the period of two weeks interval after which seeds were extracted from decayed fruits, washed in clean water and sown immediately after washing.

Complete Randomized Design (CRD) with three treatments and a control was used. A total of 64 seeds were evenly allocated to all the treatments. Treatment 1 had 16 untreated seeds used as control; treatment 2 was allocated 16 nicked seeds (seeds cut at the opposite end of the radicle) soaked in clean water at an average temperature of 28^0c for the period of 24 hours; treatment 3 had 16 seeds from fresh fruits while treatment 4 was assigned another 16 seeds from fruits that were allowed for the period of one week to ferment. Poly-pots of 12cm diameter, and 24cm depth were filled with top soil and arranged on the ground in four replications of four (4) poly-pots for each treatment. Planting was done to a uniform depth of 2cm. Water was applied daily so that the medium is kept moist at all time without getting water -logged.

The source of data from the research was based on observation and counting and the criterion for germination was the visible protrusion of the shoot epicotyls on the surface of the soil. Data on weekly germination, percentage germination and complete dormancy period (the number of days from sowing to start of the germination) were collected over four months. Also, growth parameters; (plant height and leave number) were measured after four months.

Descriptive statistics (mean, percentage) and analysis of variance (ANOVA) were used to summarize and analyze the data. Mean separation was done using Least significant difference (LSD).

RESULTS

Seed germination and plant growth

Hypogeal germination was observed in seeds of *Garcinia kola*. Pre-germination treatments studied had profound effects on dormancy period and early growth of *Garcinia kola*. Results revealed that germination count and growth parameters (leaf count and plant height) were significantly ($p<0.001$) among the treatments and the control (Table 1).

Table 2 indicates a reduction in dormancy periods of nicked seed as 8 seeds on the average germinated within 10 weeks. It can be explained by the fact that seed nicking enhanced their ability to imbibe water necessary for hydrolyzing substances stored in the dormant embryos. The dormancy in *Garcinia kola* contributed to the longest periods observed in the untreated seeds of the control. It appeared that seeds coat of *Garcinia kola* restricted water supply and gaseous exchange into the embryos and thus inhibited germination in the control treatment. Very few seeds germinated in the control experiment. Clearly, nicked seed recorded an impressive 96% germination (Figure.1) in the seeds of this highly endangered tree species within 10 weeks.

Table 1. Analysis of variance (ANOVA) for seed germination and plant growth parameters of G*arcinia cola*

Germination count

Source	Sum of Squares	Df	Mean Square	F	Sig.
Treatments	117.500	3	39.167	28.485	***
Error	16.500	12	1.375		
Total	134.00	15			

***=significant (p<0.001)

Leaf count

Source	Sum of Squares	Df	Mean Square	F	Sig.
Treatments	36.848	3	12.283	6.582	* *
Error	54.121	29	1.866		
Total	90.900	32			

** significant (p<0.01)

Plant height

Source	Sum of Squares	Df	Mean Square	F	Sig.
Treatments	273.877	3	91.292	16.260	* * *
Error	162.825	29	5.615		
Total	436.702	32			

***= significant (p<0.001)

Table. 2. Mean separation result for the effect of different pre-treatment on germination and growth performance in *G. kola.*

Treatment	Germination count	Leave count	Plant height (cm)
T_1	0.50 ± 0.58^{c}	2.33 ± 0.58^{b}	4.90 ± 1.95^{c}
T_2	7.75 ± 0.50^{a}	5.36 ± 1.29^{a}	14.65 ± 2.50^{a}
T_3	3.75 ± 2.06^{b}	3.91 ± 1.70^{ab}	9.91 ± 2.05^{b}
T_4	2.00 ± 0.82^{bc}	3.00 ± 1.10^{b}	10.39 ± 2.69^{b}

T_1= Control; T_2=Nicked seeds; T_3= Seeds from fermented pods; T_4 = Fresh seeds
(Mean ± SD with same superscript under the same roll are not significant - $p>0.05$)

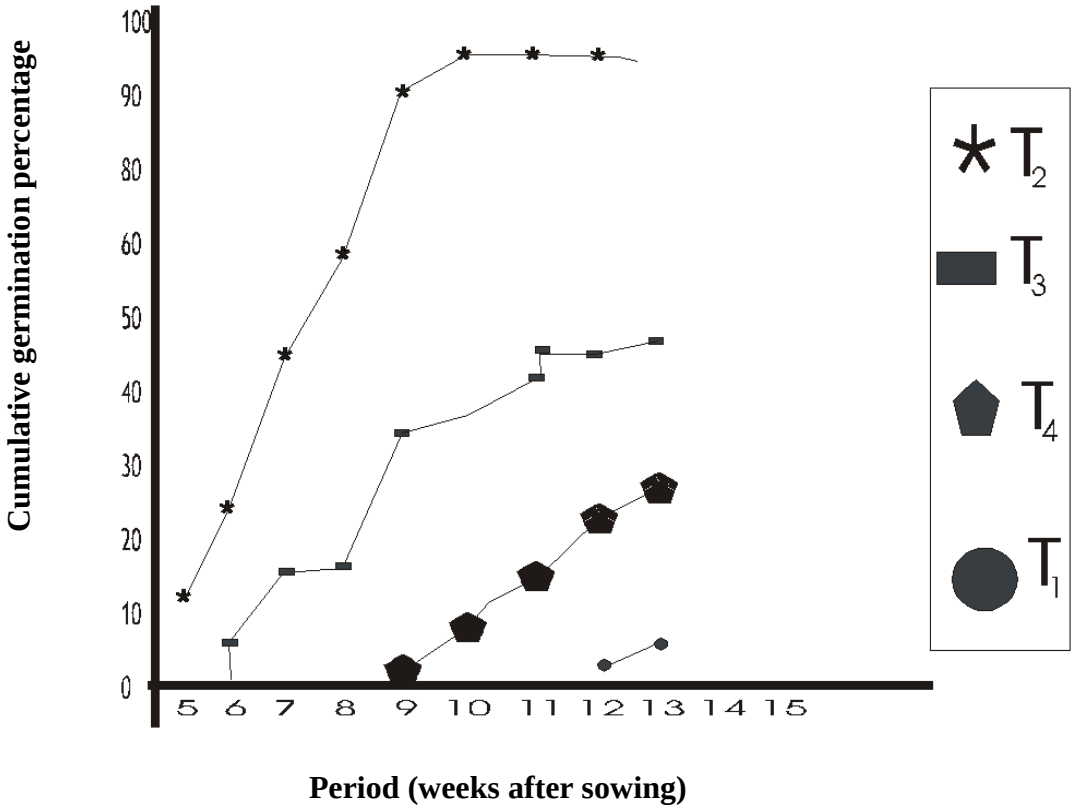

Figure 1: Mean percentage germination of *G.kola* under different treatments.
T_1 = Control; T_2 = Nicked seeds; T_3=Seeds from fermented pod; T_4 = Fresh seeds

The result in table 2 shows that an average leave count of 5 was recorded under treatment 2 (nicked seeds) and was significantly ($P<0.05$) higher than those of T_1, and T_4. However, the mean value of T_3 and T_2 showed no significant changes ($p>0.05$). The mean values for plant height shows that significant ($p<0.05$) difference exist among the various treatments, but treatments 3 and treatment 4 did not show any significant difference ($P>0.05$). The highest mean plant height of 14.65 cm was recorded in treatment 2

DISCUSSION

Different approaches of breaking seed dormancy in order to enhance germination rate and to increase germination process were argued by many authors (Alamgir and Hossain, 2005a, b; Azad *et al*., 2010a; b). Among the methods used in breaking seed coat dormancy include physical scarification of seed coat by nicking; filling with needles, knife and or abrasion paper (Schmidt, 2000). In addition, Hossain *et al.,* (2005) noted that seed with hard, solid, impermeable seed coat established germination after pre-sowing treatments. However, breaking of seed dormancy varies from one species to another.

The investigation revealed that nicked seed soaked in cold water for 24 hours was very effective in enhancing the germination of *Garcinia kola*. It could then be said that germination percentage was low for *Garcinia kola* because of its dormancy and impenetrable seed coat as it appears that embryos in the seeds have in-built dormancy mechanism. Oboho and Urughu (2010) reported that *Garcinia kola* has both seed coat dormancy and physiological dormancy imposed by chemicals in the seed. Water absorption through stomatal opening in *Garcinia kola* seeds allowed the enzymes (protein) to assume an active conformation and state of catalytic activity. Earlier work has shown that scarification and water are features that enhance germination in seeds of tropical trees (Awodola, 1994; Anegbeh, *et al.,* 2008).

From this study, it is observed that early germination probably contributed to the significant number of leaves produced by

seedlings in nicked seeds (treatment 2), and also, found to have contributed to the significant height advantage of the treatment. This is in agreement with the findings of Oboho and Urughu (2010) that earlier germination probably contributed to the significant height advantage of decoated seed of *Garcinia kola*. Hence, cutting seed of *Garcinia kola* prior to sowing is most suitable pre-treatment to be used in improving its germination.

CONCLUSION AND RECOMMENDATION

The result of this study has established an effective approach for breaking seed dormancy in *Garcinia kola* through soaking of nicked seeds in water prior to sowing. It was deduced from this investigation that *Garcinia kola* seed exhibit seed coat chemical imposed dormancy which was broken by nicking (cutting). The treatment studied had positive influence on germination and early growth performance of *Garcinia kola*. Since large scale planting require efficient, economical and knowledge of reliable practice for raising the planting stock, the result of this study will therefore greatly help to focus on the species domestication in order to specifically address the needs of farmers who would want to go into *Garcinia kola* farming.

These findings have significant implications on dormancy breaking in *Garcinia kola* and it is therefore recommended that soaking nicked seed in water for 24 hours prior to sowing is the most reliable treatment to adopt in enhancing the germination of *Garcinia kola.*

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