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EFFECTS OF WATER SOAKING AND LIGHT ON THE DORMANCY OF *GARCINIA KOLA* (HECKEL) SEEDS

Yakubu, F.B., *Bolanle – Ojo, O.T, Ogunade, O.J. and Yahaya, D.K.
Department of Sustainable Forest Management
Forestry Research Institute of Nigeria, P.M.B. 5054, Ibadan, Oyo State, Nigeria

ABSTRACT: *Freshly collected fruits were extracted for the seeds and air dried for 3 days. The coat of the seeds were removed and subjected to 5 treatments namely: no soaking (T_1), soaking for 24 hours (T_2), 48 hours (T_3), 72 hours (T_4) and 96 hours (T_5). The experiment was laid out in a Completely Randomized Design (CRD) with 10 seeds per treatment inside polythene bags. Germination commenced on the 2nd week for seeds soaked for 72 hours (T_4) and 96 hours (T_5) respectively. Germination was delayed and scanty in T_1 and T_2 compared to other treatments. The germination period ranged between 12 to 62 days. Duration of soaking significantly affected the cumulative germination, complete dormancy period, number of radicle, length of radicle, height of plumule and number of primary leaves at ($p \leq 0.05$). Germination of G. kola seeds can be done based on the information given in this study.*

KEYWORDS: Garcinia Kola, Seed, Soaking Period, Light, Dormancy Breaking, Germination

INTRODUCTION

The delay to embryonic growth in many seeds is overcome by subjecting the seeds in an appropriate environmental requirement. The major environmental conditions necessary are access to moisture and air, a suitable range of temperature, freedom from high concentration of inorganic salts, poisons and inhibitors; and for some seeds, exposure to a proper sequence of light and dark (Noggle and Fritz, 1986). There is however, a more numerous group of plants where seeds do not readily germinated even though they are placed under favourable conditions of moisture, air, temperature and light. Germination may be delayed for days, weeks, months or even years. The seeds of such plants are said to be dormant (Noggle and Fritz, 1986).

Garcinia kola (Heckel) Fam. Guttiferae is a medium size tree that grows up to 12 m high and found in moist forest throughout West and Central Africa (Isawumi, 1993). The seed is commonly known as bitter kola in Nigeria which is a Non-Timber Forest Products (NTFPs) with high consumption rate (Okafor, 1980). It plays a vital role in the socio-economic and medicinal value of the Eastern and South-western parts of Nigeria respectively. There is high demand globally for direct consumption, confectioneries and pharmaceutical industries which in turn increases the level of exploitation of the crop in

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the wild. Its regeneration is low and seedlings are uncommon and slow growing (Abbiw, 1990).

Despite its socio-economic importance, the cultivation of the plant is very much limited. Factors that have discouraged farmers from growing *Garcinia kola* include difficulties encountered in the germination which reduces the availability of seedlings in the nurseries for possible plantation establishment. Most of the productive trees are those which were left in the wild when farm plots were cut out of the forest (Adebisi, 2004).

Because of its high interest resulting in its overexploitation, *G. kola* is extinction-threatened in several West and Central African countries. Considering its importance and to prevent genetic erosion, appropriate strategy should be developed to promote its sustainable use. It is there useful to undertake on farm conservation by farmers through agroforestry systems which will help decrease the pressure on wild individuals. However, an accurate and reliable methods of its propagation is required. The major difficulty in *G. kola* propagation as for several species of *Garcinia* genus is related to seeds germination. Due to its dormancy, *G. kola* seeds can take up to 18 months to germinated (Aduse-Poku *et al.*, 2003). It is necessary to find out adequate solutions to overcome seed dormancy.

Researchers have studied the germination problems of *G. kola* seeds and suggested various means of breaking its dormancy (Gyimah, 2000, Anegbeh *et al.*, 2006, Kanmegne and Ndoumou, 2007, Oboho and Urughu, 2010, Oboho and Ogana, 2011). But there is still a great need to investigate more simple and practicable methods that could be easily adopted by the farmers with low technological input.

MATERIALS AND METHODS

Experimental Site

The study was carried out at Forestry Research Institute of Nigeria (FRIN), Jericho hill Ibadan, Oyo State, Nigeria. FRIN is located on the latitude $07^0$23'N and longitude $03^0$51'E with the main total rainfall of 1548.9 mm, falling in approximately 90 days. The mean maximum temperature is 31.9^0C, minimum 24.2^0C and the relative humidity is 71.9% (FRIN, 2013).

Seed Collection and Processing

Matured fruits of *Garcinia kola* were collected from the mother tree at Uromi Esan North East Local Government Area (LGA) in Edo State of Nigeria. The seeds were extracted from the pulp, washed and air dried at room temperature for three (3) days.

Experimental Design and Pre-germination Treatments

Fifty (50) seeds of uniform sizes were selected from the processed seeds collected and replicated five (5) times with each containing ten (10) seeds. The seeds were decoated and subjected to different water soaking regimes;
No soaking (Control) (T_1)
Soaking for 24 hours (T_2)

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Soaking for 48 hours (T_3)
Soaking for 72 hours (T_4)
Soaking for 96 hours (T_5)
The seeds were soaked for a period of 24, 48, 72 and 96 hours respectively but the control experiment was not soaked. During the soaking period, water was decanted and renewed after 24 hours until the duration of the soaking is reached in other to remove and wash off possible inhibitors. At the end, each treatment was packed into a transparent polythene bags and moist occasionally to avoid dryness. The polythene bags were always kept closed to maintain the humidity. The experiment was laid in a Completely Randomized Design (CRD) and there were 10 seeds in each of the five treatments. This was laid close to the glass window to allow the reception of sunlight during the day.

Data collection and analysis
In this experiment, the criterion for germination is the emergence of either the plumule or the radicle from the seeds in the polythene bag. Germination was recorded weekly until no further germination was observed for four consecutive weeks. Data on cumulative germination percentage (CGP) and Complete dormancy period (number of days from sowing to start of germination) CDP were collected. Germination data were analyzed using Table and figures. Phenology of germination {Number of Radicle (NR), Length of Radicle (LR) and length of plumule (LP)} were observed and measured every 2 weeks. Data collected on NR, LR and LP were subjected to Analysis of Variance (ANOVA). Treatment means were separated by the use of Duncan Multiple Range Test (DMRT).

RESULTS AND DISCUSSION

Results

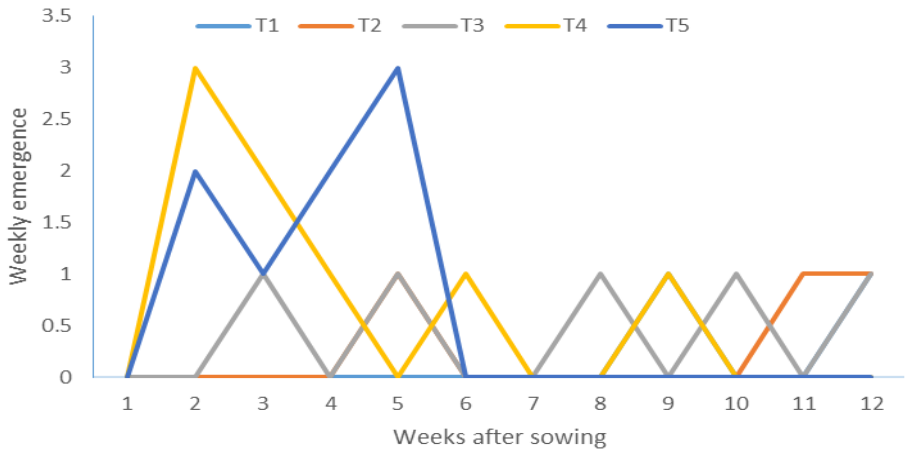

Figure 1: Effect of soaking treatments on the germination trends of *G. kola* seeds

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Table 1: Germination trend of *G. kola* seeds under different duration of soaking in water at room temperature

	Weeks													
Treatment	1	2	3	4	5	6	7	8	9	10	11	12	Total	Mean
T1	0	0	0	0	0	0	0	0	1	0	0	1	2	0.17[a]
T2	0	0	0	0	1	0	0	0	0	0	1	1	3	0.25[b]
T3	0	0	1	0	1	0	0	1	0	1	0	1	5	0.42[c]
T4	0	3	2	1	0	1	0	0	1	0	0	0	8	0.67[d]
T5	0	2	1	2	3	0	0	0	0	0	0	0	8	0.67[d]

Means followed by the same superscripts in column are not significantly difference ($p>0.05$)

Table 2: Effect of the different soaking regimes on CGP (%) and CDP (days) of *G. kola* seeds

Treatment	CGP %	CDP (days)
T1	20[a]	62[a]
T2	30[b]	30[b]
T3	50[c]	21[c]
T4	80[d]	12[d]
T5	80[d]	13[d]

Mean followed by the same superscripts in column are not significantly difference ($p>0.05$)

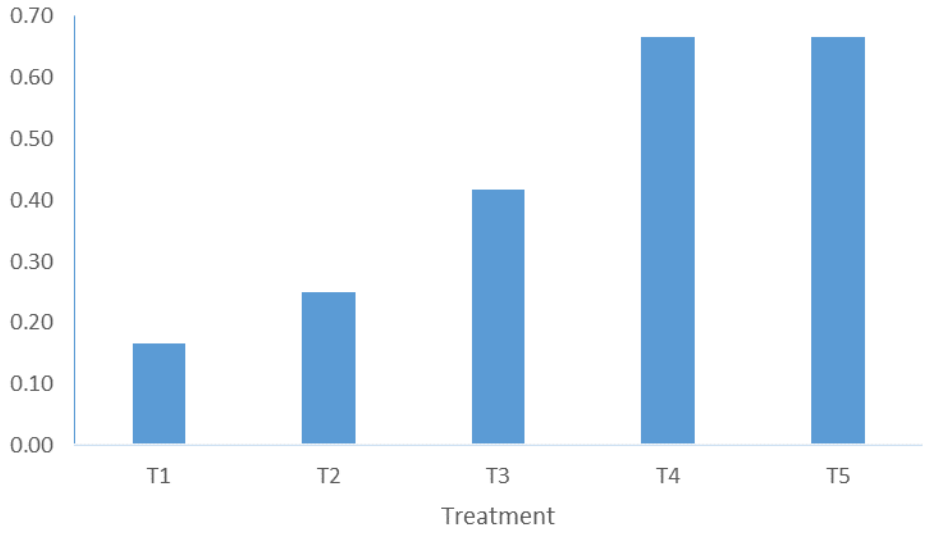

Figure 2: Mean germination value for the different treatments

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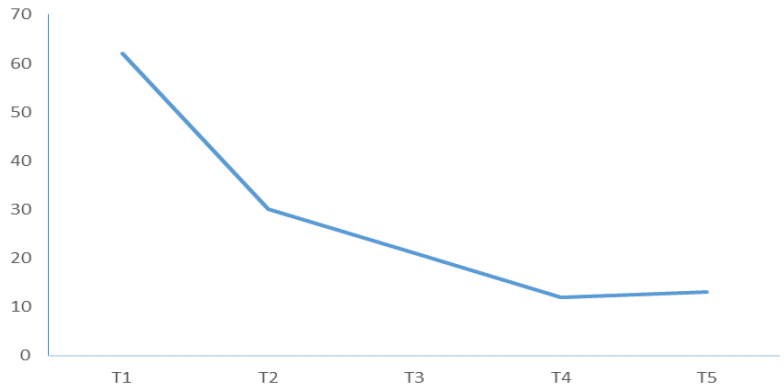

Figure 3: Complete Dormancy Period (CDP) value for different treatments.

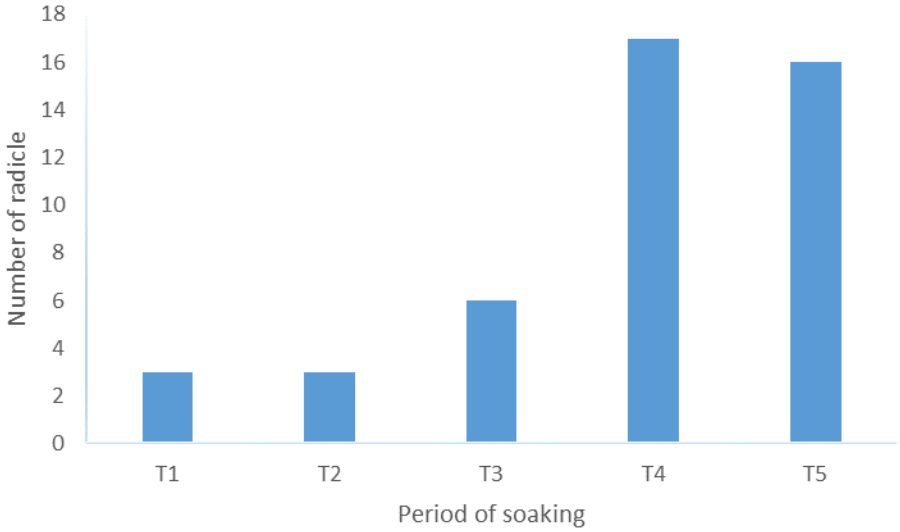

Figure 4: Effect of different soaking period on the number of radicle.

Table 3: ANOVA result for the effect of varying soaking period on the Number of Radicle

Source of variation	df	Sum of Squares	Mean Square	F	Sig.
Period of soaking	4	10.84	2.71	7.10	0.00*
Error	45	17.16	0.38		
Total	49	27.99			

*- significant ($p \leq 0.05$)

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Table 4: ANOVA result for the effect of varying soaking period on the Length of Radicle

Source of variation	df	Sum of Squares	Mean Square	F	Sig.
Period of soaking	4	56.81	14.20	4.74	0.00*
Error	45	134.85	3.00		
Total	49	191.66			

*- significant (p≤0.05)

Table 5: ANOVA result for the effect of varying soaking period on the Length of Plumule

Source of variation	df	Sum of Squares	Mean Square	F	Sig.
Period of soaking	4	20.61	5.15	3.26	0.02*
Error	45	71.05	1.58		
Total	49	91.67			

*- significant (p≤0.05)

Table 6: Mean separation result for the effect of varying soaking period on the NR, LR and LP

Period Soaking (hrs)	Number of Radicle (NR)	Length of Radicle (LR)	Length of Plumule (LP)
T1	0.08±0.21[a]	0.10±0.30a	0.04±0.10a
T2	0.18±0.47[a]	0.34±0.90a	0.26±0.78a
T3	0.32±0.55[a]	0.74±1.44ab	0.42±1.15a
T4	1.25±0.97[b]	2.84±3.08bc	1.74±2.07b
T5	0.98±0.63[b]	2.11±1.59c	1.22±1.27ab

Mean±SD followed by the same superscripts in column are not significantly difference (p>0.05)

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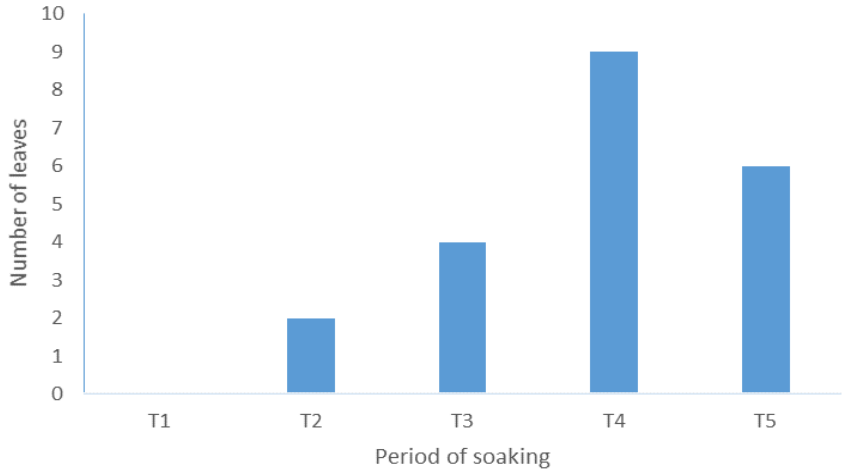

Figure 5: Effect of different soaking period on the number of leaves produced

Discussion

The investigation revealed that the duration of soaking of fresh decoated *Garcinia kola* seeds and packing in transparent polythene bag to allow light influenced the rate of germination and primary growth of development. Conversely to this approach, (Munjuga *et al.*, 2008) made a removal of the whole testa from the seeds of Allanblackia species and subsequently placing the seeds in a moisturized black polythene bag triggered fast germination in three months. Decoated seeds soaked for 96 hours (T_5) gave good results but 72 hours soaking was the best and soaking below this did not enhance the rate of germination. Water is an important factor that enhances germination in seeds of tropical trees (Awodola, 1994).

The complete dormancy period obtained in this investigation ranged from 12 to 62 days. These values were lower than the 70 to 109 days obtained by Oboho and Ogana, (2011) in the germination of *G. kola* and 30 to 180 days reported for the germination of Allanblackia species using black polythene bag by Munjuga, (2008). The difference in the result could have been due to the sowing container that was used which is the transparent polythene bag which allowed the penetration of light reaching the seeds. T_4 and T_5 exhibited similar trends in responses, with T_4 being better. This indicates that Decoated seeds soaked for 96 hours would perform well but it is better not to exceed soaking for 72 hours since it gave the best performance.

G. kola seeds has both seeds coat dormancy and physiological dormancy probably imposed by the chemicals in the seed (Oboho and Urughu 2010). *G. kola* seed coat dormancy was broken by removing the coat before soaking the seeds in water. Soaking for 72 hours (T_4) was adequate for leaching out the inhibitory chemicals, hydrolyzing the stored food in the embryos and stimulating germination in the presence of light. This shows that longer period of soaking should be adopted but not more than 72 hours of soaking since the treatment gave the best performance. Since T_1 was decoated and not

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soaked, it means that only the seed coat dormancy was removed, while the chemically imposed dormancy still remained.

Water absorption through stomata opening in *G. kola* seeds allowed the enzymes (protein) to assume an active conformation and state of catalytic activity. The exposure of *G. kola* seeds to light of appropriate wavelength was sufficient to induce the formation of chlorophyll a. A large number of photomorphogenetic events, including changes in the major chlorophyll absorption maxima, follow protochlorophyll transformation, eventually led to the green colour of *G. kola* seeds

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The presence of green colour was due to an organic molecule, chlorophyll, and the general consensus was that chlorophyll absorbed radiant energy (Noggle and Fritz, 1986). This shows that *Garcinia kola* seeds was able to utilize radiant energy through photomorphogenesis processes to trigger reactions that led to early germination. The green colour of the leaves produced by *G. kola* seeds from germination showed that the leaves respond to photosynthesis and were able to make use to the food in the seed for growth despite not been planted in the soil. This shows that the food in the embryo of *G. kola* seed is adequate to sustain cell division and new tissue and organ formation.

Early germination probably contributed to the significant numbers and length of radicle produced by seeds in T_4. Early germination is also found to have contributed to the length of plumule of *G. kola* seeds in T_4 which concurred with the findings of Oboho and Urughu, (2010) that earlier germination probably contributed to the significant height advantage of decoated seeds of *G. kola*. The high number of leaves produced by T_4 was also probably due to early germination.

CONCLUSION

The present work has establish an effective approach for breaking seed dormancy of *Garcinia kola* through soaking of decoated seeds in water and reception of light. Soaking decoated seeds in water for 72 hours and exposure to light through transparent medium is essential treatment in order to achieving early germination. It was deduced from this experiment that *G. kola* seeds exhibit seed coat dormancy and chemically imposed dormancy which was broken by the removal of the seed covering and soaking in water. The presence of light hasten the rate of germination. Germination of *G. kola* seeds can be done based on the information given in this study. The treatment adopted in this study can be easily utilized by the farmers in the cultivation of *G. kola* which will make the species to be readily available. It is possible to commercialize this technology as sprouted seeds of G. kola will be made available to farmers within a short period of time.

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REFERENCES

Abbiw, D.K. (990) Useful plant of Ghana. Intermediate Technology Publications and Royal Botanic Gardens, Kew, London. Pp. 225-226.

Adebisi, A.A. (2004): A case study of *Garcinia kola* nut production-toconsumption system in J4 area of Omo forest reserve, South-west Nigeria. – In: Sunderland, T. and Ndoye, O. (eds): Forest Products, Livelihood and Conservation (Case study of Non-Timber Forest Product Systems), Volume 2 Africa, pp. 115-132.

Aduse-Poku, K. Nyinaku, F., Atiase, V. Y., Awuah, R., Mensah, E. O., Nyantakyi, D., Owusu, H. K. & Agyenim-Boateng, B. (2003): Improving rural livelihoods within the context of sustainable development: case study of Goaso forest district. Tropenbos International Ghana, University of Amsterdam & Institute of Renewable Natural Resources, 50 pp.

Anegbeh, P. O, Iruka, C and Nkirika, C. (2006): Enhancing germination of Bitter kola (*Garcinia kola*) Heckel: Prospects for agroforestry farmers in the Niger Delta. Scientia Africana. 1SSN 1118-1931 Vol. 5. No.

Awodola, A. M. (1994). Aspects of germination in seeds of locust bean *Parkia biglobosa* (Jacq) Berth. *Journal of Tropical Resources* 9&10: 82-91.

FRIN (2013). Forestry Research Institute of Nigeria, Annual Meteorological Report.

Gyimah A. 2000. Effect of pre-treatment methods on germination of *Garcinia kola* Heckel seeds. *Ghana Journal of Forestry*, **9**: 39-44.

Isawumi AM. 1993. The common edible fruits of Nigeria, Part II. *The Nigerian Field,* 58: 1-2.

Kanmegne G and Ndoumou Omokolo D. (2007) Effects of hormones application on the germination of six populations of *Garcinia kola* Heckel (Guttiferae) seeds. *International Journal of Biological and Chemical Sciences.* ISSN 1991-8631 Vol 1(3): 255-261

Noggle G.R. and Fritz G.J. (1986). Introduction to Plant Physiology, 2nd Ed. Prentice-Hall of India Private Limited, New Delhi-110001

Munjuga M., Ofori D., Sawe C., Asaah E., Anegbeh P., Peprah T., Mpanda M., Mwaura L., Mtui E., Sirito C., Atangana A., Henneh S., Tchoundjeu Z., Jamndaass R. and Simons A.J. (2008). Allanblackia Propagation Protocol. Editor, Ian Dawson, PhD. World Agroforestry Center Publication. Pp 1-44.

Oboho E.G. and Ogana F.N. (2011). Effects of varying water soaking duration on the germination of *Garcinia kola* (Heckel) seeds. *Nigerian Journal of Agriculture, Food and Environment.* Vol. 7(2): 57-62

Oboho E.G. and Urughu J.A. (2010). Effects of pre-germination treatments on the germination and early growth of *Garcinia kola* (Heckel). *African Journal of General Agriculture.* Vol. 6, No. 4.

Okafor, J.C. (1980): Edible indigenous woody plants in the rural economy of the Nigerian Forest Zone. Forest Ecol.Management, 3:15-24.

Experimental pictures

Plate 1: *Garcinia kola* seeds arranged in transparent polythene bags

Plate 2: *G. kola* seed showing the purple colour of the plumule and the dark green colour of the seed.

Plate 3: Phenological features in germinated *G. kola* seeds.

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