ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/25jun1450

# Effect of Conditions and Duration of Storage on Breaking Dormancy and Enhancing Germination and Emergence in Coconut

Oladapo Olanrewaju ODUFALE[1*]; Musa Ibrahim Koloche[2]; Abimbola Mubo Adeyemi-Ajibulu[3]; Sadiq Abdulrahman Yahaya[4]; Monday Joseph Ahanon[5]; Jane Aniema Imasuen[6]

Corresponding Author: Oladapo Olanrewaju Odufale[*]

[1]NIFOR Coconut substation, Badagry, Nigeria,
[2,3]Nigerian Institute For Oil Palm Research, Coconut substation, Badagry, Nigeria,
[4]Department of Plant Biology, Federal University, Dutse, Nigeria,
[5,6]Plant Breeding Division Nigerian Institute for Oil Palm Research, Benin-City, Nigeria.

Publication Date: 2025/07/09

**Abstract: This study aims to evaluate the effect of storage condition and duration before sowing on coconut emergence. Seednuts of the Tall and Dwarf types were laid out in a randomized complete block design (RCBD) with three replicates. The seednuts were subjected to three storage conditions of direct sunlight (DS), under tree shade (UTS) and seed store (SS) for 21 and 28 days respectively. Data taken were analyzed using ANOVA.**

**There was high variability among the coconut types evaluated for days to attain 50% emergence (ER), days to maximum emergence (DME), percentage germination (PG) and the germination interval (EI) at p < 0.1% level of probability. Conditions of storage had high significant effect on the number of days to emergence (E) (p < 0.1%). The number of weeks before sowing was significant at p < 0.1%. It took the tall 144.44 days after sowing to attain maximum emergence while the dwarf achieved same feat at 110.61 days after sowing. The dwarf had rapid completion of germination of 60.11 days compared with 87.28 days in the tall. Seednuts subjected to DS emerged at 47.92 days and had GI of 64.25 days after sowing while those subjected to UTS and SS emerged at 52.67 and 61.17 days and had GI of 71.92 and 84.92 days respectively. Seed nuts stored for 28 days before sowing emerged earlier at 49.33 days while those sown after 21 days emerged at 58.50 days.**

**This study establish that sunlight can influence days to emergence in coconut. Seednuts should be preferably kept in direct sunlight for about 28 days at 3 – 4 sunshine hours to enhance rapid emergence rate.**

***Key words**: Coconut Germination, Emergence, Storage Condition, Storage Duration, Direct Sunlight, Under-Tree-Shade, Seed-Store.*

**How to Cite:** Oladapo Olanrewaju ODUFALE[*]; Musa Ibrahim Koloche; Abimbola Mubo Adeyemi-Ajibulu; Sadiq Abdulrahman Yahaya; Monday Joseph Ahanon; Jane Aniema Imasuen (2025). Effect of Conditions and Duration of Storage on Breaking Dormancy and Enhancing Germination and Emergence in Coconut. *International Journal of Innovative Science and Research Technology* 10(6), 2866-2870, https://doi.org/10.38124/ijisrt/25jun1450.

## I. INTRODUCTION

Coconut belongs to the family of crop *Arecaceae*. It is very important and resourceful to mankind providing basic necessities of life such as shelter, food, nutritious drink, raw materials for industrial development, among others [1]. Coconut is the second largest seed crop in the world with the seed or fruit as it is often referred to weighing about 1 – 2.5 kg. Only *Laodicea maldivica* (*coco de mer*), another crop species in the family *Arecacea* produces seeds bigger than the coconut [2]. Propagation of coconut is largely through the conventional crop propagation method of seed-based propagules. Hence, it is necessary to improve the seed propagation techniques in coconut to increase the quality and quantity of seedlings produced [3]. Propagation through seed is tasking because of the prolonged juvenile phase, low fruit yield per palm, and elongated period between pollination and maturity of the fertilized seednut [4]. Germination in coconut

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/25jun1450

is highly dependent on the viability and the seed quality [5] thus the need to preserve the quality of the seed by storing in appropriate condition and duration. Seednuts planted immediately after harvest fail to germinate and if kept for long before planting, the seed becomes desiccated and will not germinate as well [6].

Seed dormancy is nature's way of setting an alarm clock on seeds which prevents germination from taking place during unfavourable conditions. The clock ticks, stimulates and initiates germination when the condition is favourable [7]. Dormancy is a trait exhibited by most palms. Habila *et al*., [8] reported that viable Date palm seeds could germinate in 14 to 21 days but Date palm seeds would rather not germinate until about 100 days as a result of seed dormancy. Viable crop seed is expected to germinate in not more than 28 days [9]. However, Odufale *et al.*, [5] reported germination in coconut took place 54 to 80 days after sowing. Delayed germination in coconut is a result of the exhibition of dormancy in coconut seed. Dormancy is enforced as a mechanical barrier imposed by the thickness of the coconut kernel and husk [3]. In nature, seed dormancy is overcome by one or a combination of the seed being rubbed against hard surfaces to make it thinner, passing through the gut of animals, being subjected to changes in atmospheric temperatures or being exposed to fire during bush burning [7]. Over time, man has devised several means such as scarification [8], treatment of seeds with acid or soaking in water to achieve the same purpose in conventional seeds [10]. Coconut have underdeveloped embryo [9] which need to grow and develop properly to maintain viability. Thus, the need to subject it to the curing process that maintain seed viability, break dormancy and enhance germination and seed emergence [11]. Plant hormones aid different processes in plants. Auxins have been found to enhance seed dormancy [12] while the Gibberellins and ethylene supports breaking of seed dormancy and promote germination in crop seed [13]. Ultra violet rays have been found to accelerate ethylene production and therefore activate the expression of ethylene response factor (ERFs) genes which aids in breaking seed dormancy [14].

Awareness of the socioeconomic benefit of coconut products and coconut cultivation in Nigeria is on the rise which thus spur increase in the demand for coconut. Invariably, coconut seedling is in high demand by existing farmers who want to regenerate aged plantation or increase their farm size as well as new entrants into coconut cultivation. However, due to sharp practices by farmers where they now harvest in-completely matured seednuts, the rate of germination of coconut seed nuts intended for seedling production is on the decline. Thus, the urgent need to investigate the process of seedling production and development to ameliorate these challenges. In recent times, losses in the nursery due to ungerminated seed nuts is alarming. This study aims to evaluate the: effect of seed storage conditions and duration of storage on emergence and germination rate of coconut.

## II. MATERIALS AND METHODS

- *Location and Experimental Design:*

The experiment was carried out at the Nigerian Institute for Oil Palm (NIFOR) Coconut Substation Badagry (Lat. 6.49ºN, Long. 2.96ºE). The study was laid out in a randomized complete block design (RCBD) with three replicates. The investigation is a non-destructive type in which the coconut trees from which the seednuts were harvested were not affected. A total of 1,080 seed nuts was used as the study population which comprised 540 seed nuts each from the Tall and Dwarf coconut types, respectively.

- *Experimental Treatments:*

The main treatments to be considered are: (1) Storage condition which comprises of (a) Storage of coconut seednuts under direct sunlight (3 – 4 hrs. day$^{-1}$) (b) storage of coconut seednuts in open air under tree shade (c) Storage of the coconut seednuts in cool and dry seed store at room temperature. (2) Each of the three main treatments will further be subjected to sub-treatments of two different durations of storage periods each which are: (a) Storage period of 21 days (b) Storage period of 28 days

- *Investigation of Seedling Emergence and Other Growth Traits:*

(i) Days to emergence (E): was the number of days it took the coleoptile to break forth from the husk; (ii) Emergence Rate (ER): was the number of days it took for fifty percent of the sown seed nuts to emerge in each set of the sown seed nuts; (iii) Days to Maximum Emergence (DME): the number of days between sowing date and the last emergence count per plot; (iv) Percentage emergence (PE): The number of seed nuts that emerged in each of the sown set of seed nuts were expressed in terms of the total number of seed nuts sown per set and is regarded as the percentage emergence; (v) Emergence interval (EI): was the number of days between the first emergence and the last seed nut emergence in the sown seed nuts.

Percentage emergence :

$$(PE) = \frac{\text{No of seed nuts emerged}}{\text{Total no of seed planted}} \times 100$$

- *Data Analysis*

The data was subjected to Analysis of Variance (ANOVA) using SAS (Statistics Analytical Software version 9). The means of the treatments was separated using LSD.

## III. RESULTS

- *Analysis of Variance of Germination Traits:*

There was high variability among the coconut types evaluated for the number of days to attain 50% emergence (ER), DME, PE and the EI for both of the coconut types (Tall and Dwarf) considered in this study at $p < 0.1\%$ level of probability (Table 1). The number of days the seed nuts were kept before planting was an important factor in order to break dormancy and enhance speed of germination in coconut as it affected the number of days at which germination and

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/25jun1450

emergence took place significantly at $p < 0.1\%$ level of probability. However, other parameters evaluated were not affected by the number of days in storage. This was indicated by the high significance effect of days in storage on DE which was significant at $p < 0.1\%$ level of probability. However, the condition of storage had impact on the days to emergence ($p < 0.1\%$) as well as the duration of germination and emergence of the sown seed nuts at $p < 0.5\%$ level of probabilities respectively (Table 1). The ANOVA General Linear Model (GLM) was sufficient to explaining this result with the coefficient of determination ($R^2$) for the parameters being high with a range of 43 – 58% and coefficient of variability of 13.30 – 25.97% except for the ER whose value was astronomically high (96.41%; Table 1).

The dwarf was distinguishable from the tall for most of the parameters in terms of response to the parameters evaluated. There was significance difference in the emergence rate, DME, PE and EI between the two coconut types except for the days to emergence which was similar in the two coconut types. The dwarf had faster germination rate than the tall. Also, the tall coconut took 144.44 days after sowing to complete and attain maximum emergence while the dwarf achieved same feat at 110.61 days after sowing (Table 2). However, the tall coconut had better emergence percentage of 75% compared with 57% in the dwarf (Table 2). Conversely, the dwarf which had lower emergence percentage had rapidity in completion of emergence (EI) of 60.11 days compared with 87.28 days in the tall (Table 2).

The different conditions of storage before sowing had impact on the days to emergence and speed of emergence. Storing coconut seed nuts under direct sunlight (DS) before sowing impacted on the days to emergence where it attained emergence at 47.92 days after sowing while seed nuts stored under tree shade (UTS) emerged at 52.67 days after planting and those nuts stored in the seed store emerged after 61.17 days after sowing (Table 3). Also, condition of storage had significant impact on the germination interval (GI) otherwise interpreted as the speed of emergence. Seednuts stored in DS completed germination in 64.25days, those stored UTS completed germination in 71.92 days while those stored in the seed store completed germination in 84.92 days (Table 3). Similarly, number of days to germination and emergence was influenced by days spent in storage before planting (curing). The duration in the different experimental storage facilities to ease off the physical dormancy barrier imposed by the hard kernel and the thick spongy mesocarp did not have effect on the germination parameters except for the number of days to emergence. Seed nuts kept in storage for 28 days before sowing emerged faster at 49.33 days after sowing while the seeds sown at 21 days emerged after 58.50 days (Table 4).

## IV. DISCUSSION

There was a lot of dissimilarity in the germination cum emergence pattern between the two coconut types evaluated (Tall and Dwarf) which could be attributed to the diversity [6], selection pressure and domestication intensity [16] of the two types over the years. This was in congruence with the studies conducted by Harries [6]; Odufale *et al.*, [5] who reported that germination rate in coconut is dependent on the types of coconut planted and thus can be used as a means of characterizing coconut. However, contrary to the findings of Fernando *et al.* [11]; Odufale *et al.* [5], there was no significant difference in the days to emergence of the two coconut types. It is practically difficult for palm seeds, including coconut seeds to germinate and emerge if planted immediately after harvest. Germination and subsequence emergence in coconut is affected by the physiological state of the embryo at the time of sowing (Harries, [6]; Baskin and Baskin, [9]. This is as a result of mechanical barrier imposed by the thick shell and the voluminous mesocarp of the seed (Gunn *et al*., [16]; Beveridge *et al*., [17]. Germination *cum* emergence was faster in the Dwarf relative to the Tall and this can be attributed to their smaller fruit size, lesser husk and shell thickness. Before germination can be accomplished in coconut, seed dormancy must be overcome. That means there must have been a considerable shift in the production of hormones that promote dormancy such as abscisic acid (ABA) [13] to those which support germination. Gibberellins and Ethylene are some of the hormones that support germination in seed crops [12]. Seednuts kept in direct sunlight before sowing germinated much earlier than those kept under shade and those kept in the seed store as a result of combination of effects that accompany high sunlight intensity such as high temperature and light intensity which are factors that influence the dynamics of physiological processes in seeds such as electrolyte and water absorption as well as transportation of same in the seeds [10]. Sunlight produces ultraviolet rays (UV-rays) which is a stressor that has the capacity to accelerate ethylene production thus, activating the expression of ethylene response factor (ERFs) genes. This could thus be responsible for rapid change in dormancy state of seeds kept in direct sunlight relative to other seed treatments observed in this study [9]. Similarly, prolonged exposure to sunlight as observed at 28 days seems to enhance faster breakdown of seed dormancy than at 21 days.

## V. CONCLUSION

This study was able to establish that sunlight can influence days to emergence and germination rate in coconut especially when germination rate is poor or prolonged. Seed nuts should be preferably kept in the open under the influence of direct sunlight for about 28 days at a minimum of 3 – 4 sunshine hours to enhance rapid germination irrespective of the type to be sown, be it tall or dwarf.

- *Conflict of Interest:*
  The authors declare there is no conflict of interest

## REFERENCES

[1]. Ahuja, S.C. and Ahuja U. (2014). Coconut – History, Uses, and Folklore. *Asian Agri-History* 18(3): 221–248
[2]. Neema, M.; Veluru A. and Prakash K. (2020). Double Coconut – A Unique Giant Palm from Seychelles. *Indian Journal of Horticulture* pp. 13 – 16
[3]. Foale, M.; Nair M.; Khan H.; Gopalasundaram P.; and Bhaskara R. E., (1993). The Effect of Exposing the

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/25jun1450

Germpore on Germination of coconut in Advances in Coconut Research and Development; *Oxford and IBH*: New Dheli, India, 1993; pp. 247–252.
[4]. Karunaratne, S.; Santha S. and Kovoor A. (1991). An In-vitro Assay for Drought-tolerant coconut Germplasm. *Euphytica* 1991, 53, 25–30.
[5]. Odufale, O. O., Koloche M. I.; Ahanon M. J. Nwite and A. P. (2024). Evaluating the Variability of Germination Pattern of Coconut Types. *Greener Journal of Agricultural Sciences* 14(2), 123-127,
[6]. Harries H.C. (2012). Germination rate is the significant characteristic determining coconut palm diversity. *AoB PLANTS pls045*
[7]. Baskin, J.M. and Baskin C.C. (2004). A Classification System for Seed Dormancy. *Seed Science Research* 14, 1- 16.
*[8]*. Habila, S.; Ali A. D. and Salihu F. H. (2016). Breaking of Dormancy and its Effects on Seedling Establishment of Date Palm (*Phoenix Dactylifera* L.) *Journal of Natural Sciences Research Vol.6, No.12, 2016*
[9]. Baskin, J.M. and Baskin C.C. (2014) What kind of seed dormancy might palms have? *Seed Sci. Res*. 24:17– 22.
[10]. Muhammad, M., Ringim A. S. and Dangora I. I. (2017). Effects of Different Methods of Breaking Dormancy and Seed Germination Rate in Date Palm (*Phoenix dactylifera* L.) *Journal of Research in Forestry, Wildlife & Environment* Vol. 9(4) December, 2017
[11]. Fernando, W. M.U.; Pieris T.S.G. and Wickramaratne M. R. T. (1993). Variation in Seedling Characters of Three Different Coconut Cultivars and Their Use in Identification in the Nursery. *Cocos* 9, 23 – 29
[12]. Liu, X.; Zhang H.; Zhao Y.; Feng Z.; Li Q.; Yang H.; Luan S.; Li J. and He Z. (2013). Auxin Controls Seed Dormancy Through Stimulation of Abscisic Acid Signaling by Inducing ARF-Mediated ABI3 Activation in Arabidopsis. *PNAS* 2013 vol. 110 no. 38. 15485–15490
[13]. Gupta, R. and Chakrabarty S.K. (2013). Gibberellic Acid in Plant Still a Mystery Unresolved. *Plant Signaling & Behavior·* Volume 8 Issue 9 pp e25504-1 to e25504-1
[14]. Chen, H.; Wang L.; Guo S.; Li M.; Tian Z.; Han B.; Tang X. and Liu B., (2023). Effects of Light Intensity on Seedling Emergence and Early Growth of *Liquidambar formosana* Hance. *Forests* 2023, 14, 867.
[15]. Widiawati, H.; Sukirno S.; Purwantoro A.; Koerniati S. and Dewi K. (2024). Effect of seed priming with salicylic acid on germination and early seedling growth of 'Sembada Hitam' black rice subjected to saline conditions. Thai Journal of Agricultural Science Volume 57 Number 4 pp 208 – 223
[16]. Gunn, B. F., L. Baudouin and K. M. Olsen, (2011). Independent Origins of Cultivated Coconut (*Coco nucifera* L.) in the doi: 1371/*journal.pone.0021143*
[17]. Beveridge, F.C., S. Kalaipandian, C. Yang and S.W. Adkins (2022). Fruit Biology of Coconut (*Cocos nucifera* L.) *Plants (Basel).* 11(23): 3293
[18]. Shareefa, M., R. J. Thomas, and C.K. Nampoothiri (2018). Standardization of Seednut Storage for Kalpasree Variety of Coconut. *Indian Journal of Horticulture* 75(4), 726 – 731

## LIST OF TABLES

Table 1Anova Mean Square Table of Emergence Parameters' Response to Storage Conditions and Duration in Tall and Dwarf Coconut Types

| Source of Variation | DE | ER | DME | PE | EI |
|---|---|---|---|---|---|
| **Days in Storage** | 756.25** | 2100.69$^{ns}$ | 1056.25$^{ns}$ | 0.02$^{ns}$ | 30.25$^{ns}$ |
| **Coconut Type** | 420.25$^{ns}$ | 57200.69** | 10302.25** | 0.28** | 6642.25** |
| **Storage Method** | 540.75** | 2913.02$^{ns}$ | 254.36$^{ns}$ | 0.0006$^{ns}$ | 1309.78* |
| **Rep** | 69.75 | 3355.87 | 336.78 | 0.0004 | 720.44 |
| **Error** | 110.39 | 2084.73 | 442.83 | 0.0077 | 366.23 |
| **$R^2$** | 0.43 | 0.54 | 0.49 | 0.58 | 0.50 |
| **CV** | 19.49 | 96.41 | 16.50 | 13.30 | 25.97 |

N.B: *,** indicated significant at $P < 0.05$ and 0.01 levels of probability respectively, ns = not significant

DE = Days to emergence, GR = Germination rate, DME = Days to maximum emergence, PE = Percentage emergence, EI = Emergence interval

Table 2 Mean Separation of Coconut Types and Emergence Parameters

| Source of Variation | DE | ER | DME | PE | EI |
|---|---|---|---|---|---|
| Tall | 57.33a | 87.22a | 144.44a | 0.75a | 87.28a |
| Dwarf | 50.50a | 7.50b | 110.61b | 0.57b | 60.11b |
| LSD (0.05) | 7.16 | 31.13 | 14.35 | 0.06 | 13.05 |

*Different number indicated significant number at $p < 0.05$ level of probability

DE = Days to emergence, GR = Germination rate, DME = Days to maximum emergence, PE = Percentage emergence, EI = Emergence interval.

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/25jun1450

Table 3 Mean Separation of Storage Condition and Germination Traits

| Source of Variation | DE | ER | DME | PE | EI |
|---|---|---|---|---|---|
| **DS** | 47.92b | 37.67a | 124.58a | 65.00a | 64.25b |
| **UTS** | 52.67ab | 39.08a | 125.17a | 66.00a | 71.92ab |
| **SS** | 61.17a | 65.33a | 132.83a | 67.00a | 84.92a |
| **LSD (0.05)** | 8.7726 | 38.12 | 17.57 | 7.00 | 15.98 |

*Different number indicated significant number at $p < 0.05$ level of probability
DS = Direct sunlight, UTS = Tree shade, SS = Seed store.

Table 4 Mean Separation of Duration of Curing and Germination traits

| Source of Variation | DE | ER | DME | PE | EI |
|---|---|---|---|---|---|
| **D1** | 58.50a | 55.00a | 132.94a | 0.68a | 74.61a |
| **D2** | 49.33b | 39.72a | 122.11a | 0.63a | 72.78a |
| **LSD (0.05)** | 7.16 | 31.13 | 14.346 | 0.06 | 13.05 |

*Different number indicated significant number at $p < 0.05$ level of probability
D1 = 21 Days in storage before sowing, D2 = 28 Days in storage before sowing.