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Effects of Different Temperatures and Duration of Storage on the Viability of Dioscoreophyllum Cumminsil

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ABSTRACT

Germination of Dioscoreophyllum cumminsii seeds stored under different temperatures in cold room, refrigerator, air conditioned room and laboratory temperature was examined. The seeds are collected for germination every month for six months. The seeds stored in cold room and laboratory had zero germination throughout the storage period while the seeds stored in the refrigerator had 10% and 40% germination after storing for three and four months respectively. The seeds stored in the air conditioned room germinated but the germination reduced with the increase in the duration of storage. While 60% of the seeds germinated after one month of storage, 40% and 30% germinated after two and three months of storage respectively. The seeds collected after four and five months of storage had the same germination percentage of 10% while there was zero germination when planted after six months of storage.

Keywords: Dioscoreophyllum cumminsii, Temperature, Storage, Germination.

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1. INTRODUCTION

The seed biology of most tropical tree species is today unknown. Since seed handling and storage requirements are very variable, lack of information is a hindrance for seed propagation of many important and potentially important plant species [14]. Most agricultural crops have seeds that can be dried and stored at low temperatures for years without losing their ability to germinate, these seeds have been labeled 'orthodox seeds', which reflects that they are considered the most usual and widespread type of seed [16]. However, many tree species, particularly in the tropics, have seeds that do not follow the rules of the orthodox seeds, they are difficult to store because they do not tolerate drying, and have therefore been termed 'recalcitrant seeds' [18]. Other seeds do not seem to fit into either of these two categories, and are therefore called 'intermediate seeds' [14].

The main problems with recalcitrant/intermediate seeds are associated with seed quality and storage [14]. Storage may be defined as the preservation of viable seeds from the time of collection until they are required for sowing [7]. The possibility of storing seeds without reducing the number of living seeds is very important in seedling production of a species. Recalcitrant/intermediate seeds are sensitive to moisture loss and low temperatures, but vary a lot according to how much drying and which temperatures they tolerate; it is therefore important to know the critical and optimal moisture contents and temperatures for each species.

The two most critical necessities for storing seeds are constant temperature and low humidity. LBJWC, [10] observed that fluctuating temperature and humidity harms seeds more than slightly higher constant values of each. Similarly, Strelec et. al, [13] stated that environmental temperature and relative humidity are two most important factors influencing seed viability and longevity during the storage. Under ideal conditions, long-term storage lowers viability percentages (since some seeds die) and also lowers the vigor of seedlings produced by the stored seeds. Also, as the length of time in storage increases, the number and percentage of seedlings with damaging mutations or tissue degeneration also increases. Roots in particular are adversely affected by long-term storage [8]. However, observation made by LBJWC, [10] revealed that seed storage longevity varies from species to species.

Fluctuation in temperature or moisture levels of stored seeds lowers the seeds' longevity significantly, causing loss of viability and vigor or even seed death. Rapid moisture fluctuations are particularly damaging to seeds. High moisture or temperatures encourage mutation of seed tissues especially in root tips, which remain more active than other seed tissues. Cellular mutations affecting metabolism or root tissue structure are a common cause of seed failure upon germination [8]. According to Gupta, [6] the main constraints in seed storage are high temperature and moisture which affect the maintenance of seed quality in storage. High temperature and moisture favour the development of insects, bacteria and fungi. Storage structures and practices should also protect the seed against damage by rodents. Storage structures for food are often designed for the same purpose.

Seed deterioration during storage is a gradual and inevitable process causing considerable losses. Seed deterioration physiology and dynamics of seed mortality during storage have been reviewed by a number of authors [1, 2, 3, 11, 16]. However, much less is known about the influence of storage temperature on the germination of *Dioscorephyllum cumminsii.* Therefore, the aim of this study was to assess the germination of *D. cumminssii* seeds stored under different temperatures.

2. MATERIALS AND METHODS

Seeds were extracted from freshly harvested fruits of *Dioscoreophyllum cumminsii*, the seeds were tied inside black polythene nylon for two days for the gelatinous membrane to decompose and expose the real seeds which were later air dried.

240 of the air-dried seeds were divided into four groups, each consisting of 60 seeds. One group each was stored in cold room, refrigerator, air conditioned room and laboratory temperature as control. The seeds were stored in the Gene bank at National Centre for Genetic Resources and Biotechnology (NACGRAB), Ibadan, Nigeria. 10 seeds each of stored seeds at the different temperatures treatments were collected and planted to

test for the viability on monthly basis for six months. Planting was done in polythene nylons filled with top-soil and watered daily. The experiments were replicated three times.

The temperatures in the different treatment environment used during the period of storage were recorded. The number of seeds that germinate in each treatment was recorded and the percentage germination calculated.

3. RESULTS AND DISCUSSION

The minimum temperature of the seed stored in the cold room varied from -18 to -22 °C, the refrigerator varied from -1.1 to -2..5 for the month (4^{th}) with the least temperature and the month with maximum temperature varied from 10.0 to -2.2 °C. Air conditioned room varied from 16.2 to 24.6^{0}C for the month with the least temperature and from 18.1 –27.40^{0}C for the month with the maximum temperature. There was relatively stable temperature during the fourth month (18.0-18.1^{0}C, Table 1). The laboratory temperature was 28±2^{0}C.

Table 2 shows that the seeds stored in the cold room and those under laboratory temperature did not germinate throughout the period of experiment, seeds stored in the refrigerator did not respond for the first two months and also in the fifth and sixth collections, but at the third month of collection, there was 10% germination while the fourth month had 40% germination. The fourth month also had the most stable temperature with the closest temperature range of -1.1– -2.5^{0}C (Table 1).

Seeds stored in the air conditioned room had the best germination. Seeds collected and planted after one month of storage had 60% germination. Decrease in germination percentage was observed in the second collection (40% germination, Table 2), 30% in the third collection while the fourth and fifth collections had 10% seed germination each.

Most indigenous fruit species produced flower and fruit once in a year while some do every other year. Indeed, Vertucci et al. [15] observed that seed production, both in quality and quantity, in most species is not stable from year to year. Many factors influencing this include: genetic, climatic, pest and diseases, animal, human interference and forest fires. Consideration must therefore be given to processing and appropriate storage of seeds collected. Thus seed storage is an important factor in the preservation of viable seeds from the time of collection until they are required for sowing. The results obtained in this study revealed that seeds stored in temperature range of 16-26 ºC had the best % germination (Table 1). This finding was contrary to the findings of Ojo, [12]; Ellis and Hong, [4] on orthodox species. Ojo, [12] recorded the highest mean germination percentage for seeds of *Bombax costatum* stored at 5ºC. Probable reason for the observation could be attributed to the fact that orthodox seeds tolerate high desiccation and low temperature for viability [9].

Also in this study, the best % germination was attained in seeds stored for short period (Table 2). Gamene et al. [5] reported that recalcitrant seeds will not keep for long under any storage condition. *Dioscoreophyllum cumminsii* as a recalcitrant species exhibits low tolerance to drying and cooling thus loosing viability when dried or stored at low temperatures leading to short physiological storability and viability status. Previous observation by Gupta, [6] revealed that storage conditions, storage containers and seed treatments prior to storage are important factors responsible for retaining seed longevity. But ideal storage environment are seldom available for the precious seeds, especially under tropical conditions. Longevity of storage does not

favour the viability of *Dioscoreophyllum cumminsii*. Therefore, the provision of cold storage for the seeds is not required.

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Table-1. Temperature Readings for the Period of Storage in the Four Different Temperatures

Months	**Storage Gene Bank Temperature (^{0}C)**			
	Cold room	Refrigerator	Air conditioned room	Laboratory
1st	-18– -22	-0.2 – -1.2	16.6– 26.2	28±2
2nd	-18– -22	-0.2 – -1.2	16.2 – 24.6	28±2
3rd	-18– -22	4.5 – 0.2	18.1– 27.4	28±2
4th	-18– -22	-1.1– -2.5	18.0 –18.1	28±2
5th	-18– -22	9.6 – -2.2	18.0 –24.0	28±2
6th	-18– -22	10.0 – -2.5	18.0 – 24.0	28±2

Table-2. % Germination of *A.cummunis* seeds stored under different temperatures

Months	**Percentage Germination (%)**			
	Cold room	Refrigerator	Air conditioned room	Laboratory
1st	–	–	60	–
2nd	–	–	40	–
3rd	–	10	30	–
4th	–	40	10	–
5th	–	–	10	–
6th	–	–	–	–