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Storage of seeds *of* *Cnidosculus phyllacanthus* Pax & K. Hoffm*.*

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Abstract: This work aimed to determine the best environment for conservation of physiological quality of seeds of *Cnidosculus phyllacanthus* during storage. Seeds with 8.5% moisture content and 86% germinative capacity were filled in containers of different permeability, and storaged at different conditions during 360 days. Seeds packed in permeable container (paper bag) were stored at ordinary room temperature (18 to 25 °C and 55 to 78% RH), and dry chamber (18 °C and 60% RH) while those packed in semipermeable (polyethylene bag) and impermeable (glass) containers were stored in cold chamber (10 °C and 75% RH). Seed moisture content, germinative capacity and germination speed were evaluated each 90 days interval. For all the tested storage conditions, seed germination speed was reduced at first evaluation and stabilized up to 360 days. Great deterioration in seeds stored at ordinary room condition was observed, while those stored in dry chamber maintained its germinative capacity for 270 days. The seed germinative capacity was better retained in cold storage, packaged either in semipemeable or impermeable containers. During storage, the seeds had a behavior classified as orthodox.

Key words: conservation, forestry seed, physiological quality

Armazenamento de sementes de *Cnidosculus phyllacanthus* Pax & K. *Hoffm*

Resumo: Este trabalho foi desenvolvido com o objetivo de se verificar o melhor ambiente para conservação da qualidade fisiológica das sementes de *Cnidosculus phyllacanthus* (faveleira) durante o armazenamento. Sementes com 8,5% de água e 86% de capacidade germinativa foram acondicionadas em embalagens de diferentes permeabilidades e armazenadas em ambientes diversos, por 360 dias. As sementes acondicionadas em embalagem permeável (saco de papel) foram armazenadas nos ambientes natural de laboratório (18 a 25 °C e 55 a 78% de umidade relativa-UR) e de câmara seca (18 °C e 60% UR), enquanto as acondicionadas em embalagens semipermeável (saco de polietileno) e impermeável (recipiente de vidro) foram armazenadas na câmara fria (10 °C e 75% UR). O teor de água, a capacidade germinativa e a velocidade de germinação das sementes foram avaliados a cada 90 dias. Em todas as condições de armazenamento, o vigor das sementes foi reduzido já na primeira avaliação e se manteve estável até o final do período de armazenamento. As sementes armazenadas no ambiente natural de laboratório se deterioraram acentuadamente, enquanto as armazenadas na câmara seca mantiveram a capacidade germinativa, por 270 dias. As sementes armazenadas na câmara fria, independente da embalagem, mantiveram a capacidade germinativa durante todo o período de armazenamento. As sementes de faveleira tiveram, durante o armazenamento, comportamento similar ao das classificadas como ortodoxas.

Palavras-chave: conservação, sementes florestais, qualidade fisiológica, faveleira

INTRODUCTION

The storage of forest seeds is of great importance due to the unfavorable climatic conditions prevailing in certain year, to the man intervention eliminating producing areas or yet to the fructification periodicity of certain species (Souza et al., 1980a). Many native woody species produce seeds of natural short longevity, restraining their utilization (Zannon & Ramos, 1986).

In the study of seed conservation, one must take into account its physiological behavior in relation to storage (Medeiros & Zanon, 1998a, b). So, Eira (1996) considers seed classification in orthodox, recalcitrant or intermediary, of extreme importance to the definition of conservation strategy. The orthodox seeds, which resists to drying up to values of 5 and 7% of water, are capable to maintain their viability in temperatures below zero (-20 ºC) and generally are of small size. Recalcitrant seeds do not support drying bellow relatively high levels (40 to 50%) of moisture, without loss of its viability and, in general, they are big seeds (Roberts, 1973). Intermediary seeds may be dry to the levels of 10 to 15% moisture, without loss of viability, but may suffer physiological damages if submitted to drying to lower values (Ellis et al., 1990).

Several studies have been performed aiming to evaluate storage and storage environment influence in the conservation of forest seeds released or extracted from dry fruits. The most researched genus is *Tabebuia,* which encloses several ipe species; the results of these researches have shown the orthodox behavior of the seeds, which are better conserved when stored having low water content in an environment with low levels of temperature and relative humidity of air (Degan et al., 2001).

Species from other genus have also largely been studied. Souza et al. (1980b) packed *Astronium urundeuva* seeds in permeable, semipermeable and impermeable containers, and stored them during thirteen years in natural environment of laboratory and cold/dry chamber; larger deterioration for seed packed in permeable containers and stored in natural environment of laboratory was found. Other conditions were effective to conserve seed quality. Vianna (1983) tested permeable and impermeable containers in packing of *Swietenia macrophylla* seeds followed by storage in natural environment of laboratory, dry chamber and cold chamber. After seven months, seeds stored in dry chamber, regardless the container, and the ones packed in semipermeable containers and stored in cold chamber have presented germinative capacity similar to the initial one, while under the other storage conditions there was complete deterioration of seeds.

Works with some species were developed in the National Center Forestry Research of EMBRAPA, in Colombo/Brazil, and published in 1998. In all the experiments, the seeds were stored, for one year, under the following conditions; (a) packed in permeable containers and stored in the natural environments of laboratory and of dry chamber, (b) packed in semipermeable container and stored in natural environments of laboratory and of cold chamber. The seeds of some species such as *Parapiptadenia rigida* (Fowler & Carpanezzi, 1998), *Rhammus sphaerosperma* (Medeiros & Zanon, 1998b) and *Podocarpus lambertii* (Medeiros & Zanon, 1998c), conserved better when packed in semipermeable container and stored in cold chamber. For *Schimus terebinthifolius*, however, better conservation was obtained for seed packed in permeable containers and stored in dry chamber (Medeiros & Zanon, 1998a). On the other hand, seeds of *Sebastiania commersoniana* were conserved with the same efficacy in both conditions (Medeiros & Zanon, 1998a).

More recently, Medeiros & Zanon (2000) have stored seeds of *Machaerium stipitatum* in natural environments of laboratory and of cold chamber, packed in semipermeable and impermeable containers. The better results, after one year of storage, were obtained for seeds packed in the semipermeable container and stored in cold chamber.

Figliolia et al. (2000), studying the behavior of *Cariniana estrellensis* seeds packed in different containers and stored under different conditions, verified that when the seeds were stored in normal environments of laboratory and of dry chamber they maintained the physiological quality for 60 days. In cold chamber, on the other hand, they maintained its physiological quality for 20 days when packed in impermeable container and, for 480 days, when packed in permeable and semipermeable container.

C*cnidosculus phyllacanthus* is a tree of natural occurrence in the semi-arid region of Brazil (Gomes, 1982), and shows great resistance to drought and has been largely utilized for reforestation of degraded areas. It produces dry and dehiscent fruits, giving seeds with relatively low water content, probably orthodox. In the region of natural occurrence, C*cnidosculus phyllacanthus* flowers and frutifies practically during the entire year in moist areas. The current study was performed aiming to verify the best way to conserve the physiological quality of *Cnidosculus phyllacanthus* seeds during storage.

MATERIAL AND METHODS

Cnidosculus phyllacanthus seeds were collected from mature fruits, next to dehiscence process, harvested in Patos, Paraiba state, Brazil, between August 14 and 16, 2000. After removing the seeds from the fruits, they were dried in shade for seven days.

In the beginning of September 2000, after drying again in shade, the seeds were packed in different permeability containers: permeable (Kraft paper bag), semipermeable (20 μ thickness transparent polyetilene bag) and impermeable (transparent glass container). Seeds packed in permeable container were stored in natural environment of laboratory (monthly mean varying from 18 to 25 ºC and 55 to 78% relative humidity, RH), while the ones packed in semipermeable and impermeable containers were stored in cold chamber (10 ºC and 75% RH) and dry chamber (18 ºC and 60% RH).

Before storage, a sample of 100 seeds was removed in order to determine the initial physiological quality (germination percentage and speed) and three samples of 20 seeds to determine water content. Both determinations were repeated each 90 days, until 360 days of storage. In each evaluation period, a container with a seed quantity needed to perform the germination and water content tests was taken from each storage condition.

Storage and tests were performed in the Seed Analysis Laboratory of the Vegetal Production Department of the Faculdade de Ciências Agrárias e Veterinárias, in Jaboticabal, São Paulo state. The water content of seeds was established by stove method at 105 ± 3 ºC for 24 h, as previously recommended in Brasil, (1992).

Germination test was carried out in BOD germinator, adjusted for alternated temperature of 20–35 ºC, with 8 h photoperiod in the higher temperature. Before the test the seeds were immersed in water at 30 ºC during 4 h to make uniform and to accelerate the germination (Silva et al., 1999). Then, seeds were disinfected in 4% sodium hypochloride solution for 10 minutes and after that, they were washed with abundance of distilled water. Four replications of 20 seeds were used in each treatment, placed on vermiculite moistened with 0.2% nistatina solution, in 11 x 11 x 4 cm transparent plastic box, with cover.

Daily counts were performed and the seeds that presented main root equal or larger than 1 cm were considered germinated. Percentage and germination speed of the seeds were established under Labouriau & Agudo (1987).

The experimental design was entirely randomized, in a subdivided plots in time. Percentage data were transformed in to arcsin√P/100 for statistical analyses. In order to verify seed's behavior as a function of storage time, a polynomial regression analysis was done.

RESULTS AND DISCUSSION

At the initial package time, *Cnidosculus phyllacanthus* seeds had 8.5% of water content, 8.6 of germinative capacity and germination speed equals to 1.0 (germination day^{-1}). For the water content, the linear regression adjusted better to the observed values of seeds packed in impermeable container and stored in cold chamber (Figure 1A). However, for the other storage conditions, the water content (Figure 1B, C and D) as well percentage and speed germination values (Figure 2) adjusted better to the quadratic regression.

Seeds packed in impermeable and semipermeable containers and stored in cold chamber, had little reduction in its germinative capacity during storage, showing 78 and 72% of germination, respectively, after 360 days (Figure 2). In glass containers, considered impermeable, several studies have shown that moisture did not change between the seeds and the environment, while in the polyetilene container, considered semipermeable, there was only a slight change in water vapor between the seeds and the environment (Zanon & Ramos, 1986; Carneiro & Aguiar, 1993; Carvalho & Nakagawa, 2000). In impermeable containers, the initial water content of seeds had very little change during the storage period (Figure 1A), favoring its conservation. In semipermeable container, the occurrence of a small change in moisture did not significantly affect the seed germination capacity (Figure 1B). This fact together with low temperature of the cold chamber favored the conservation of *Cnidosculus phyllacanthus* seeds.

Seeds that had been packed in permeable container stored in dry chamber had only a slight reduction in germination until 270 days of storage (Figure 2). After this period, the deterioration was more pronounced and at 360 days of treatment, germination (65%) being significantly lower than the initial one (100%).

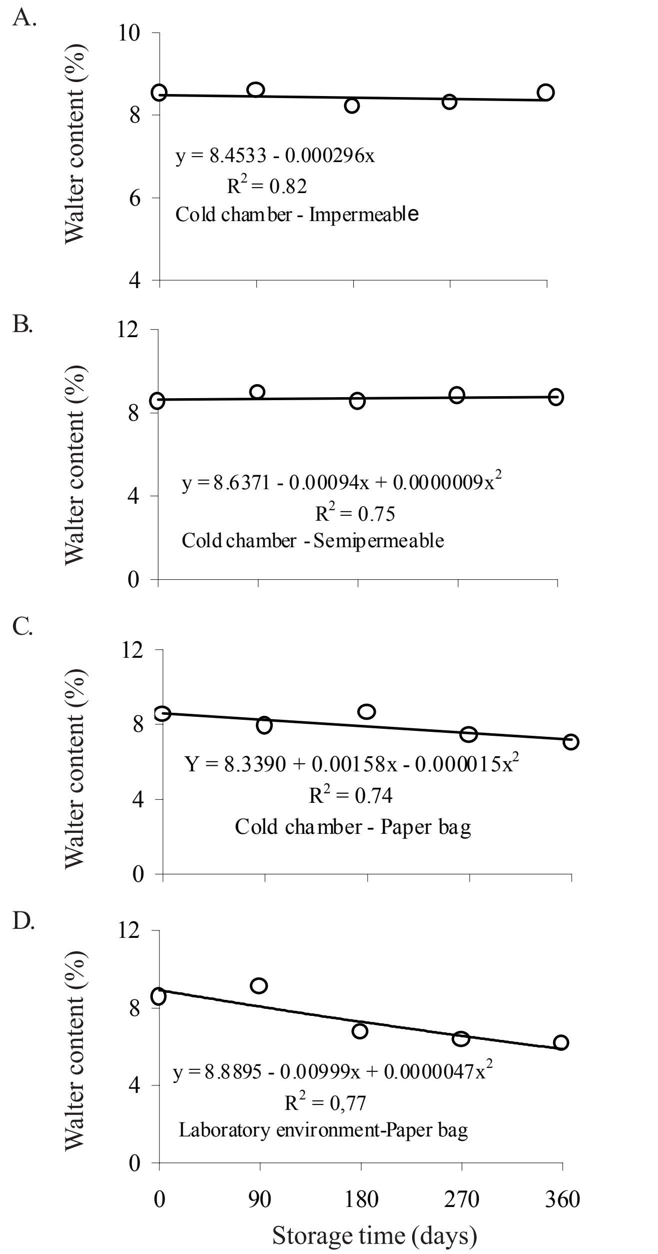

Figure 1. Water content of *Cnidosculus phyllacanthus* seeds during 360 days of storage under different environments

It is possible that decrease in percentage of germination was due to reduction in water content of seed observed at 180 days of storage, once the permeable container permitted change of water vapor with dry chamber environment. At 270 days of storage, the seed water content reduced by 7.0% and remained at a similar level until the end of storage period (Figure 1C).

Medeiros & Zanon (1998b) observed that *Podocarpus lambertii* seeds, packed in permeable containers and stored in cold chamber, had its initial content of water reduced from 8.0 to 6.5%. According to the authors this reduction caused progressive loss of germinability and they suggested a more detailed study to accurately determine the critical level of seed moisture. For the same container and storage environment conditions, Fowler & Carpanezzi (1998) reported decrease in

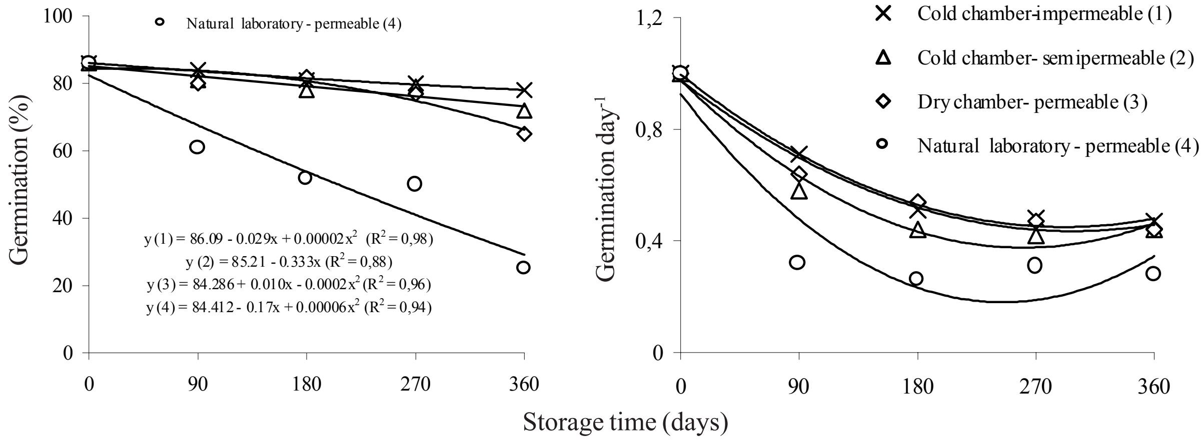

Figure 2. Germination percentage and speed of *Cnidosculus phyllacanthus* seeds during 360 days of storage under different environments

germinability of *Parapiptadenia rigida* seeds when its initial content of water decreased from 15.5 to 10.5%. The authors suggested that the seeds of this species are sensitive to desiccation until value for orthodox seeds is accepted, suggesting that they could be considered as intermediary.

Therefone, the results obtained with *Cnidosculus phyllacanthus* seeds suggest that the physiological phenomenon linked to the tolerance level of dehidration needs to be studied in more detail in further research. However, it is likely that smaller efficiency of dry chamber to conserve seeds is at least explained by the highest tempe-rature of this environment (18 ºC) compared to the cold chamber (10 ºC).

The results presented in the Figure 2 show that the germinative capacity of seeds decreased greater following storage on natural environment of laboratory, in all times. There, larger changes in water content of seeds take place (Figure 1D). Indeed, after a small increase at 90 days, the water content of seeds stored on natural environment of laboratory reduced to 6.7 and 6.1% at 180 and 360 days of storage, respectively. Such large variations in the seed water content reflect container permeability that allows a rather high moist replace to the laboratory environment. The *Cnidosculus phyllacanthus* seeds absorbed and lost water due to fluctuation of both temperature and air relative moist, settling different levels of hygroscopic balance (Harrington, 1972).

Natural environment of laboratory was also harmful for conservation of seeds for the most plant species quoted in the introduction of this work. This environment was favorable only for *Bertolethia excelsa* (Figueiredo et al., 1990) and *Campomanesia rufa* (Arrigoni-Blank, 1997) seeds packed in semipermeable containers.

The fast deterioration of *Cniodosculus phyllacanthus* seeds in natural environment of laboratory may be confirmed by the smallest values of germination speed found in this environment (Figure 2). Thus, for all storage conditions, the seed strength was reduced already from 90 days but it tended to stabilize by the end of the storage period. According to Delouche & Baskin (1973), deterioration processes begin with deterioration and loss of membrane permeability, reducing strength and seed germinative capacity.

Strength of the seeds packed in permeable container and stored in dry chamber was similar to the ones packed in permeable container and stored in cold chamber, during the entire storage period. This behavior emphasizes the effectiveness of dry chamber to conserve, along 270 days, the *Cnidosculus phyllcanthus* seeds packed in permeable container once in this period the seed germinative capacity was high. This condition was also effective to conserve seeds from the other species such as *Swietenia macrophylla* (Vianna, 1983), *Schimus terebinthifolius* (Medeiros & Zanon, 1998a) and *Sebstiania commersoniana* (Medeiros & Zanon, 1998b).

Seeds packed in semipermeable container and stored in dry chamber had less vigor, but the difference compared to the previous conditions was not significant. In this way, dry chamber may be indicated to conserve *Cnidosculus phyllacanthus* seeds for at least 12 months, packed either in semipermeable or impermeable container. In comparison to the other environments, the low temperature of the chamber was favorable to reduce seed deterioration speed and furthermore to increase its conservation.

According to Kramer & Kozlowski (1972), storage in low temperature delays life of most seeds by reducing its metabolic activity. Seeds of other species such as *Astronium urundeuva* (Souza et al., 1980b), *Swietenia macrophylla* (Vianna, 1983), *Cedrela angustifolia* (Piña-Rodrigues & Jesus, 1992), *Kielmeyra coriaceae* (Botelho & Carneiro, 1992), *Paraptadenia rigida* (Fowler & Carpanezzi, 1998), *Rhammus sphaerosperma* (Medeiros & Zanon, 1998a), *Sebastiania commersoniana*, *Podorcarpus lambertii* (Medeiros & Zanon, 1998b) and *Machaerium stipitatum* (Medeiros & Zanon, 2000), were also effectively conserved in environment of cold chamber or cold/dry chamber.

The current results showed that either low temperature of environments or low relative humidity of air are conditions that allowed for conservation of *Cnidosculus phyllacanthus* seeds. These seeds support dehydratation, keeping relatively well with 7.0% of water in dry chamber; they also support low temperature, although the temperature of the cold chamber used (10 ºC) has not been so low. This behavior allows to classify *Cniodosculus phyllcanthus* seeds, in relation to storage, as orthodox.

CONCLUSIONS

1. Pronounced deterioration was observed for seeds packed in permeable containers and stored in natural environment of laboratory.

2. For the other conditions analyzed, seed strength was reduced already in the first evaluation done at 90 days, and remained stable until the end of the storage period.

3. Cold chamber was effective to conserve germinative capacity of seeds for 360 days, packed in semipermeable and impermeable containers.

4. Seeds packed in permeable containers and stored in dry chamber kept its germinative capacity until 270 days of storage.

5. *Cnidosculus phyllacanthus* seeds presented, during storage orthodox behavior.

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