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Seeds

Water absorption and physiological responses of hog plum tree diaspores to storage

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Abstract - Hog plum tree seeds (*Spondias mombin* L.) have a complex dormancy mechanism, which causes slow germination and great unevenness. At present, there are no efficient methods to promote seed germination. The objective of the study was to evaluate the effect of storage on overcoming seed dormancy of this Anacardiaceae. Diaspores of two hog plum trees were used, identified as Mother plant 1 and Mother plant 2, established in Tomé-Açu city, PA. Initially, it was investigated whether the structures surrounding the seeds (internal mesocarp and endocarp) prevent water absorption. For this, the diaspores of the two mother plants were sown between blotting paper, with an adequate level of water and, periodically, in the total of 144 hours, the water content of the seeds was computed. The storage studies involved two experiments. In the first, diaspores from both mother plants with a water content of around 5.0% were stored in impermeable packages, for one year, under the following conditions: natural environment of Belém, PA (average temperature of 26.8 °C) and at temperatures of 6 ± 1 ° C and minus 18 ± 2 °. The germinative response of the stored diaspores was compared with those of non-stored diaspores. Prior to storage, selection was made on the diaspores, discarding the small ones. In the second experiment, the germinative response of the diaspores of the two mother plants, stored for zero, one, two, three, four, five and six months, under natural environment conditions of Belém, PA, was evaluated. It was observed that the structures that cover the seeds do not offer restrictions to the water absorption, thus discarding the hypothesis of physical dormancy, without, however, excluding the possibility of mechanical dormancy. The storage of diaspores for one year, regardless of the storage condition, did not affect the germination power of the seeds. On the other hand, responses of great magnitude, in terms of reducing the time required for germination, were obtained when the diaspores were stored under natural conditions and at minus 18±2 °C, indicating that dormancy is naturally overcome by storage . Overcoming dormancy was a little slower when the diaspores were stored at a temperature of 6±1 °C. It was found that the storage of diaspores in an environment with an average temperature of 26.8 °C for three months provides the overcoming dormancy of most of the seeds. The intensity of dormancy varied within and between mother plants.

Index terms: *Spondias mombin* L., germination, dormancy.

Absorção de água e respostas fisiológicas de diásporos de cajazeira ao armazenamento

Resumo - As sementes de cajazeira (*Spondias mombin* L.) apresentam complexo mecanismo de dormência, que condiciona germinação lenta e desuniforme. Presentemente, não existem métodos eficientes para promover a geminação das sementes. O objetivo do trabalho foi avaliar o efeito do armazenamento sobre a superação da dormência de sementes dessa Anacardiaceae. Foram utilizados diásporos de duas cajazeiras, identificadas como Planta matriz 1 e Plant matriz 2, estabelecidas no município de Tomé-Açu-PA. Inicialmente, foi investigado se as estruturas que envolvem as sementes (mesocarpo interno e endocarpo) impedem a absorção de água. Para tanto, diásporos das duas plantas foram semeados entre papel mata-borrão, com nível adequado de água e, periodicamente, no total de 144 horas computou-se o teor de água das sementes. Os estudos de armazenamento envolveram dois experimentos. No primeiro, diásporos de ambas as matrizes, com teor de água em torno de 5,0%, foram armazenados em embalagens impermeáveis, durante um ano, nas seguintes condições: ambiente natural de Belém-PA (temperatura média de 26,8°C) e nas temperaturas de 6±1°C e 18±2°C negativos. A resposta germinativa dos diásporos armazenados foi comparada com as de diásporos não armazenados. Antecedendo ao armazenamento, efetuou-se seleção nos diásporos descartando-se os de tamanho diminuto. No segundo experimento, considerou-se a resposta germinativa dos diásporos das duas plantas matrizes, armazenados nas condições de ambiente natural de Belém-PA, durante seis meses, e avaliados mensalmente. Observou-se que as estruturas que recobrem as sementes não oferecem restrições à absorção de água, descartando, portanto, a hipótese de dormência física, sem, no entanto, excluir a possibilidade de dormência mecânica. O armazenamento dos diásporos, durante um ano, independentemente da condição de armazenamento, não afetou o poder germinativo das sementes. Por outro lado, respostas de grande magnitude, em termos de redução do tempo requerido para germinação, foram obtidas quando os diásporos foram armazenados nas condições de ambiente natural e a 18±2°C negativos, indicando que a dormência é naturalmente superada pelo armazenamento. A superação da dormência foi mais lenta quando os diásporos foram armazenados a 6±1°C. Constatou-se que o armazenamento dos diásporos nas condições de ambiente natural de Belém, durante três meses, proporciona a superação da dormência da maior parte das sementes. A intensidade da dormência variou dentro e entre plantas matrizes.

Termos para indexação: *Spondias mombin* L., germinação, dormência.

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Introduction

The yellow mombin or hog plum tree (*Spondias mombin* L.) is a species that produces edible fruits, native to Tropical America and with a probable center of origin in the Brazilian Amazon. It is widely dispersed in Brazil, occurring, however, with greater frequency and abundance in the North and Northeast regions. In the first region it is popularly known as "taperebazeiro" and in the rest of Brazil as "cajazeira" (CARVALHO, 2006; CARVALHO; ALVES, 2008; CAVALCANTE, 2010).

The hog plum is a fleshy fruit, of the drupid type, coming from a pentacarpellated ovary, each carpel containing one egg (CAVALCANTE, 2010). It is rarely consumed naturally, as it has high acidity (MATIETTO et al., 2010). However, it is widely used in the preparation of soft drinks, sweets, ice cream and mousse. It constitutes food of good nutritional quality and contains in its composition several phenolic and carotenoid compounds, which gives it a great antioxidant capacity, and can therefore be classified in the group of functional foods (TIBURSKI eta al., 20011; CARVALHO et al., 2015).

This Anacardiaceae has strategies for sexual and asexual reproduction, the latter by sprouting from roots that develop horizontally, close to the surface of the soil. For the production of seedlings on a commercial scale, grafting by fork in the top in a full slit is the most used method, with the rootstock being the hog plum tree itself. The major obstacle to the use of this propagation method is associated with the fact that the hog plum seeds have a complex dormancy mechanism, which determines a very slow and uneven germination (SANCHÉZ et al., 2018).

The unit of dispersion and propagation of the hog plum by sexual means is represented by the bulky diaspore, which consists of the pyrene and the internal mesocarp. Depending on the genotype, it has an elliptical, obovoid, ovoid or globose shape, usually with a tapered and a rounded end (AZEVEDO et al., 2004). The endocarp and internal mesocarp have a corneal and spongy consistency, respectively (SILVA, 2003). The seeds are small compared to the size of the diaspore and are located in individualized locules, with a radial arrangement inside the endocarp. The number of seeds per diaspore ranges from zero to five and are elongated, elliptical and of varying length, within the same diaspore. They have a straight embryo, with a short hypocotyl-radicle axis and slightly plane-convex cotyledons (AZEVEDO et al., 2004).

The mechanisms that regulate the germination of hog plum seeds are not properly elucidated, and there are reports that dormancy is due to restrictions imposed by the horny endocarp that surrounds them (SALOMÃO, 2002), while others admit that it is of a physiological nature and can be naturally overcome by storage (SAUTU et al., 2007; AZEVEDO et al., 2004), however, the storage time necessary to overcome dormancy has not been established.

Studies on methods to accelerate germination of hog plum seeds are quite contradictory. For Silva (2003), Oyebamiji et al., (2014) and Fadimu et al. (2014) immersion of diaspores in water or mechanical scarification provide significant increases in the germination percentage and reduction in the time required for seeds to germinate. On the other hand, Martins et al. (2019) found that these pre-germinative treatments have little or no effect on seed germination. In these studies, the authors did not discriminate the time elapsed between the drying of the diaspores and the application of pre-germinative treatments, which is an important factor in overcoming dormancy (AZEVEDO et al., 2004).

This study aimed to verify the effects of diaspore storage of two hog plum tree genotypes on seed germination and dormancy. At the same time, it was evaluated whether the structures that cover the seeds, represented by the internal mesocarp and the endocarp, are permeable to water.

Material and methods

Diaspores from two hog plum trees, established at the Experimental Field of Embrapa Amazônia Oriental, in Tomé-Açu, PA, were used and identified as Mother plant 1 and Mother plant 2. The first mother plant is located at the geographic coordinate 2°35'35.72" south latitude and 48°21'35.26" longitude west of Greenwich and the second at 2°35'27.22" south latitude and 48°21'42.30" longitude west of Greenwich. The local soil is of low natural fertility, classified as a Dystrophic Yellow Latosol, medium texture. The climate is hot and humid and falls under the Köppen classification as the Ami type (VALENTE et al., 2014).

Diaspores came from fully ripe fruits, characterized by yellow color and soft pulp consistency, collected on the day they naturally detached from the mother plant and are biometrically distinguished from each other by the characteristics shown in Table 1.

Table 1. Biometric characteristics of diaspores from two genotypes of hog plum tree (*Spondias mombin* L.) and percentage of diaspores devoid of seeds*

Mother plant	Weight (g)	Length (cm)	Width (cm)	Seedless diaspores (%)
1	1.11(±0.20)	2.43(±0.20)	1.73(±0.17)	19.0(±0.60)
2	0.71(±0.16)	2.43(±0.27)	1.29(±0.13)	5.0(±0.20)

*Values represent means (± standard deviation), n = 100.

Initially, in order to verify whether slow and uneven germination was associated with obstacles to water absorption by the structures surrounding the seeds, diaspores of the two hog plum genotypes were sown on two sheets of blotting paper and covered with two other sheets, previously moistened with water. An 2 mm water layer was always maintained above the level of blotting paper sheets on which the seeds were placed. The following imbibition periods were considered: 0 h, 6 h, 12 h, 18 h, 24 h, 30 h, 36 h, 42 h, 48 h, 72 h, 96 h, 120 h and 144 h. After each imbibition period, samples were taken to determine the water content of the internal mesocarp and endocarp set and of the seeds. When the diaspores were removed from the substrate, they were dried superficially with paper towels, to remove surface water, and then sectioned transversely. The seeds were then separated from the other two structures with the aid of tweezers. Immediately, the water content of the seeds and the internal mesocarp and endocarp set was determined. The water content was determined by the over method at 105°±3° C, for 24 hours and, for each determination, four replications of ten diaspores were used. The results were expressed on a wet basis. It should be noted that the portion represented by the seeds suffered a lot of fragmentation during the extraction operation.

The studies of diaspore physiological responses to storage involved two experiments. In the first, diaspores from the two hog plum trees were mechanically extracted in a fruit pulper and washed under running water until the complete removal of pulp residues. Then, they were superficially dried with cotton cloth and subjected to drying in the sun, from 10 am to 3 pm, for five consecutive days, when they reached a water content of around 8.0%. Subsequently, they were placed in desiccators containing silica gel, in the proportion of 1 kg of silica gel to 1 kg of diaspore. In this situation, they remained for 20 days, at the end of which the water content was reduced to 5.0% and 5.4%, respectively in the diaspores of Mother plant 1 and Mother plant 2. The water content was determined by the over method at 105±3°, for 24 hours, using two repetitions of 20 diaspores for each determination.

Immediately after drying, it was made a selection of the diaspores, discarding the small ones. In Mother plant 1, those with weight equal to or less than 0.95 g were discarded and in Mother plant 2 those with weight equal to or less than 0.59 g. This selection implied discarding 20% within each mother plant and made it possible for 95% (Mother plant 1) and 100% (Mother plant 2) of the diaspores to present at least one seed. Then it was packed in polyethylene terephthalate (PET) containers, coated with aluminum foil and PVC film, and stored for one year under the following conditions: a) natural environment of Belém, PA (average temperature of 26.8° C); b) environment with a temperature of 6±2° C; c) and environment with a temperature of minus 18±2° C. A control treatment represented by non-stored diaspores was used for comparison purposes. Germination tests were carried out before and after storage to evaluate seed quality. These tests were carried out in the natural environment of Belém, in plastic containers 45 cm long, 15 cm wide and 14 cm deep, containing as a substrate the mixture of sand with sawdust powder, in the volumetric proportion of 1: 1. The substrate was previously sterilized for two hours in boiling water.

The number of germinated seeds was computed daily, for the purpose of estimating the mean time to germination and for the elaboration of the germination curves. Only seeds that originated normal seedlings were considered germinated, that is, those that had all essential structures perfectly healthy and developed. In the case of diaspores containing more than one seed, it was computed, both for the purpose of estimating the mean time to germination and for calculating the germination percentage at which it germinated first.

At the end of the germination tests, the diaspores in which no seed germination occurred were removed from the substrate, cross-sectioned and examined with the help of a magnifying glass to check whether the remaining seeds were firm or deteriorated.

The experiment was conducted in a completely randomized design, following the factorial scheme 2 (matrix) x 4 (diaspore condition), with five replications. Each parcel was constituted by 50 diaspores. The diaspore condition was represented by non-stored diaspores and those stored for one year at different temperatures.

The data obtained were subjected to analysis of variance and the averages compared by the Tukey test, at the level of 5% probability. To meet the assumptions of the analysis of variance, the germination percentage data were previously transformed into arc sen $\sqrt{x/100}$ and the mean time to germination into $\sqrt{x}$. The statistical analyzes were performed using the Sisvar software (FERREIRA, 2015).

In the second experiment, processed and packaged diaspores were used in the same way as in the previous experiment, except that no selection was realized. In this experiment, storage was carried out only in the natural environment of Belém, PA, and the following storage periods were considered: zero (control), one, two, three, four, five and six months. The germination tests, carried out at the end of each storage period, followed the same methodology used in the first experiment.

The experiment was conducted in a completely randomized design, in a factorial scheme 2 (mother plant) x 7 (storage period), with four replications. Each portion was represented by 50 diaspores. The response variables analyzed were the percentage and the mean time to germination.

Results and discussion

It was found that, regardless of the genotype of the mother plant, the internal mesocarp and endocarp are permeable to water, allowing the seeds to readily absorb this substance, when sown in a substrate with adequate water availability. The absorption of water by these structures was fast, with full hydration of the tissues 72 hours after sowing, in a purely physical process. On that occasion, the set represented by the internal mesocarp and endocarp had a water content of around 70%. The high increase obtained in such a short period is due, in large part, to the hydration of the internal mesocarp, whose hygroscopicity is greater than of the endocarp, since it consists of spongy fibers, according to Xavier et al. (2000). The greater hygroscopic capacity of the internal mesocarp was previously verified by Silva et al. (2003) when they found that, after 48 hours of imbibition, diaspores in which this structure was removed absorbed 63% less water than intact diaspores. The absorption of water by the seeds was slower and less intense. After 96 hours of imbibition, they reached a water content of around 28%, which remained at that level until 144 hours (Figure 1).

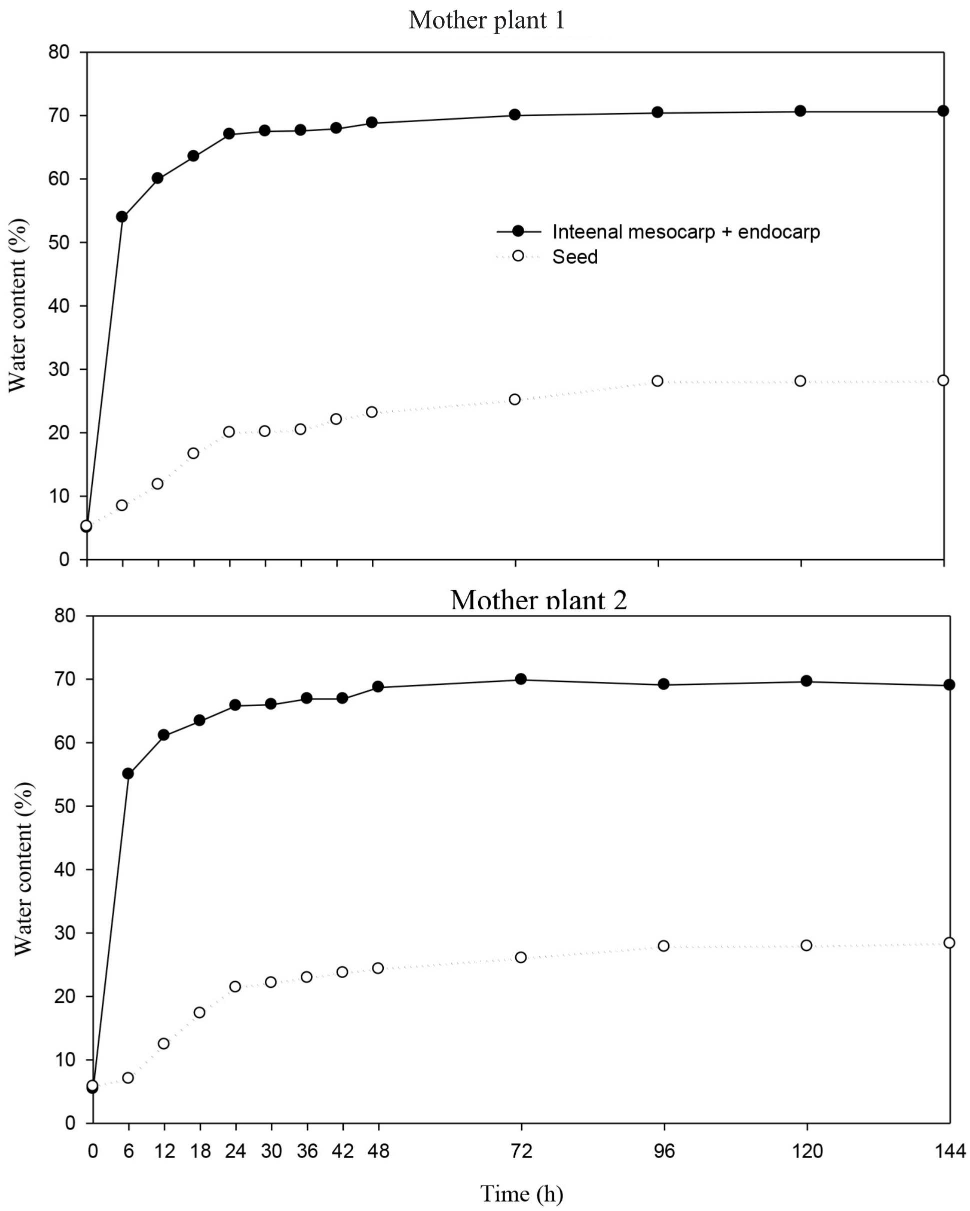

Figure 1. Water content of cover structures (internal mesocarp + endocarp) and seeds in diaspores of two mother plants of hog plum tree (*Spondias mombin* L.), after different periods of imbibition.

Probably, the low water content reached by the seeds, after 144 hours of imbibition, is due to the fact that the hog plum seed has a relatively high lipid content, that is, 31.5%, as found by Eromosele and Paschal (2007). Lipids are hydrophobic substances and their high concentration in the seed tissues reduces the water absorption rate during the initial germination phase, providing that the seeds germinate with a lower water content than seeds with a low oil content (IZQUIERDO et al., 2017). In addition, it should also be considered that seeds with physiological dormancy, when reaching the maximum water content of phase 1 of the three-phase water absorption process, do not immediately enter phase 2, which only occurs when dormancy is overcome, when the water content increases considerably (CARVALHO; NAKAGAWA, 2000).

The demonstration that hog plum seeds, regardless of the mother plant genotype, readily absorb water, after being sown, discard the hypothesis that slow and uneven germination is associated with the impermeability of the structures that cover them, in particular the endocarp whose cornea consistency suggests this possibility. However, the possibility of this structure regulating germination cannot be excluded, imposing mechanical resistance to the growth of the embryo. If this hypothesis prevails, pre-germinative treatments that involve scarification of the endocarp are not efficient to promote the germination of hog plum seeds. Scarification, whether mechanical or chemical, is adequate to overcome dormancy of seeds that have water impermeable integuments. When corneous endocarps restrict seed germination, due to mechanical dormancy, the success in promoting germination occurs only when the seed is extracted from endocarp, as verified by Ferreira and Gentil (2006) in "tucumã-do-amazonas" (*Astrocaryum aculeatum* Meyer) diaspores or when the resistance imposed by this structure is broken, causing fractures in the endocarp by compression or impacts, as observed by Carvalho and Nascimento (2008) and Slator et al. (2013), respectively in diaspores of 'murucizeiro' (*Byrsonima crassifolia* (L.) Kunth) and teak (*Tectona grandis* L.f.). For hog plum diaspores, there are no methodologies that allow the removal of seeds inside the diaspore or that cause ruptures in the endocarp without compromising the germination capacity.

The unconvincing and contradictory results of diaspores scarification to promote germination of hog plum seeds (SILVA, 2003; OYEBAMIJI et al., 2014; FADIMU et al., 2014; MARTINS et al., 2019) are due to the fact that dormancy is not caused by impediments to water absorption. Increases in the percentage and germination speed eventually observed are due, in most cases, to the variation that exists in the mechanical resistance degree of the endocarp among diaspores in the same batch. Therefore, those with a lower resistance degree, which constitute a small portion, may eventually have germination favored by scarification.

In the experiment that considered the diaspores physiological response of the two mother plants to different storage conditions, the analysis of variance revealed, for the germination percentage, significant effect ($p < 0.05$) for the mother plant factor and not significant for the mother plant x diaspore condition interaction and for the diaspore condition factor, indicating that the germinative response of diaspores not stored or stored under different conditions, for one year, does not depend on the genotype of the mother plant and that the final germination percentage was not affected by the storage condition. The better germinative performance was found in the diaspores from Mother plant 1 (Figure 2).

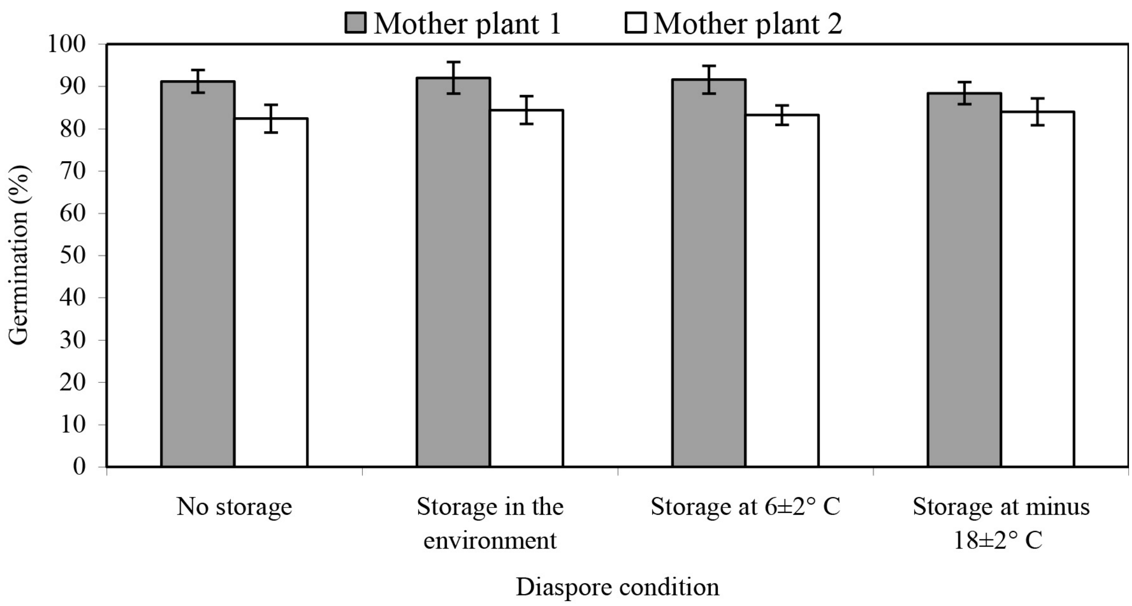

Figure 2. Diaspore germination (%) of two hog plum tree (*Spondias mombin* L.) mother plants not stored and stored during one year, under different conditions.

The diaspores of both mother plants showed a higher germination percentage than that reported in Silva (2003), Oyebamiji et al. (2014), Fadimu et al. (2014) and Quadros et al. (2016) studies. This can be attributed to the following factors: initial quality of the diaspores, previous selection of the diaspores, with elimination of the small ones and the duration of germination tests, which was 630 days, enough for the seeds germinate, even those with high dormancy intensity. By the way, at the end of the germination tests, in the diaspores where there was no germination, the seeds were deteriorated.

Regardless of the mother plant, germination was quite uneven. In Mother plant 1, it started 30 days after sowing and stabilized at 540 days, while in Mother plant 2, the germination process was slower, starting at 60 days, with the germination level reached only after 585 days. On the other hand, when storage was carried out under the natural environment of Belém, PA, germination was faster and more uniform. The first seeds germinated 15 days after sowing, both in Mother plant 1 and in Mother plant 2 with the maximum percentage of germination being reached at 210 days and 360 days, respectively. The storage of diaspores, at a temperature of minus 20±2° C, also favored germination. The germination course was similar to that seeds whose diaspores were stored in the environment. In the diaspores stored at 6±2° C, the germination course was slightly less satisfactory, when compared with the two previous situations, especially in the first 120 days after sowing and assuming, thereafter, similar proportion. For the stored diaspores, regardless of the storage condition, the germination curves showed a simple sigmoidal pattern, while in the non-stored ones there was a tendency of double sigmoidal in the diaspores of Mother plant 1 and triple sigmoidal in those of Mother plant 2. (Figure 3).

The great unevenness in germination indicates that the intensity of dormancy varies markedly among the diaspores of the same mother plant.

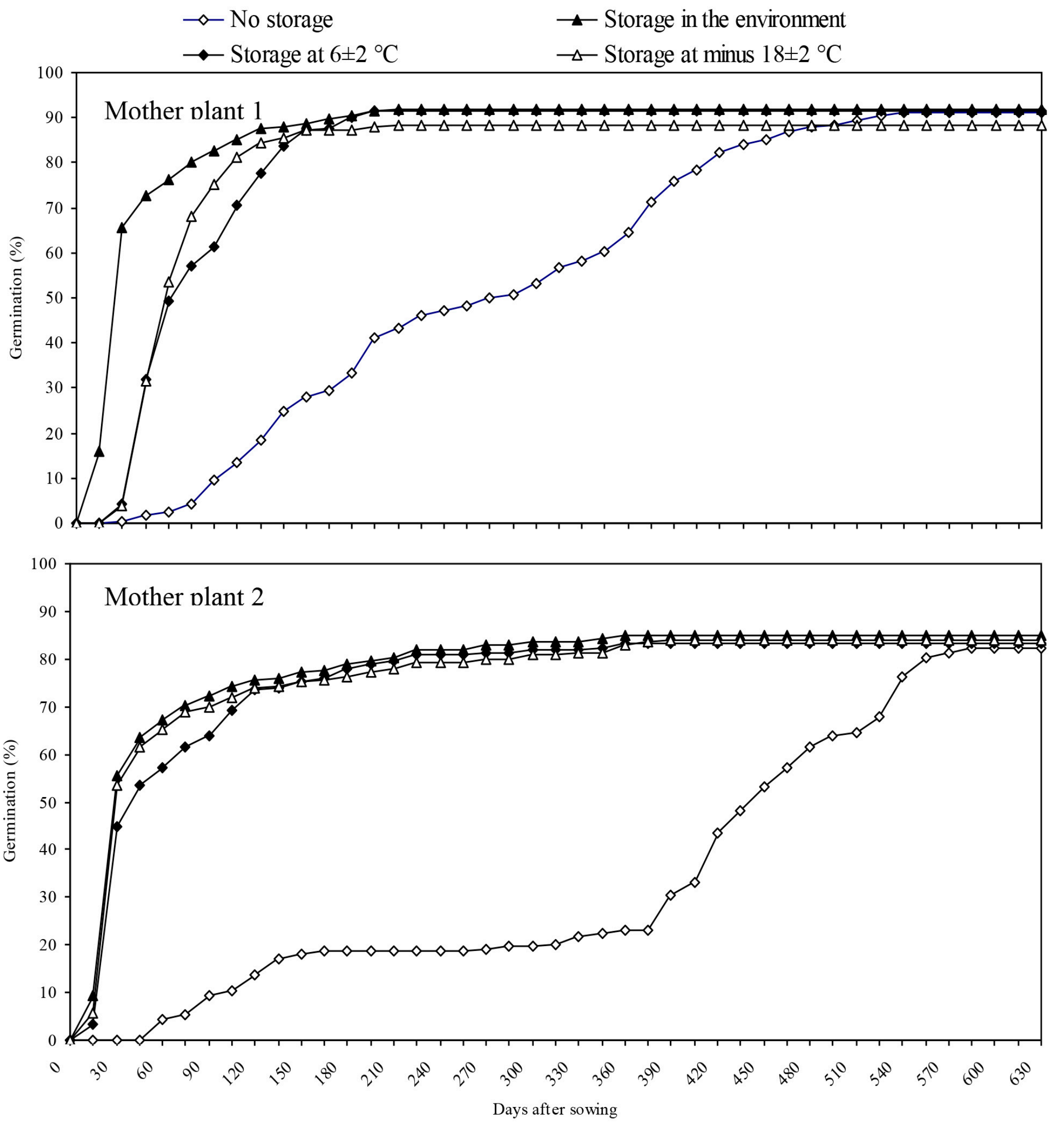

Figure 3. Diaspores germination course of two mother plants of hog plum tree (*Spondias mombin* L.) not stored and stored under different conditions.

Regarding the mean time to germination, significant differences were found (p <0.05) both for the main effects and for the interaction, indicating differential behavior of the diaspores of the two matrices compared to the condition to which they were submitted.

Prior to storage, the diaspores in Mother 1 had a shorter mean time to germination than the diaspores in Mother 2, indicating lower dormancy intensity in those of the first matrix. The same occurred when the diaspores were stored at a temperature of 6±2° C. In the two other storage conditions, the mean time to germination required for seed germination in both matrices was statistically equivalent. When the degrees of freedom unfolded within each matrix, significant differences (p <0.05) were found in both Mother 1 and Mother 2 for the effect of the conditions to which the diaspores were subjected. The diaspores of both mother plants required more time to germinate when not stored. Great magnitude results, in terms of reducing the mean time to germination, were observed after one year of storage, particularly when storage was carried out under natural environment conditions (Figure 4).

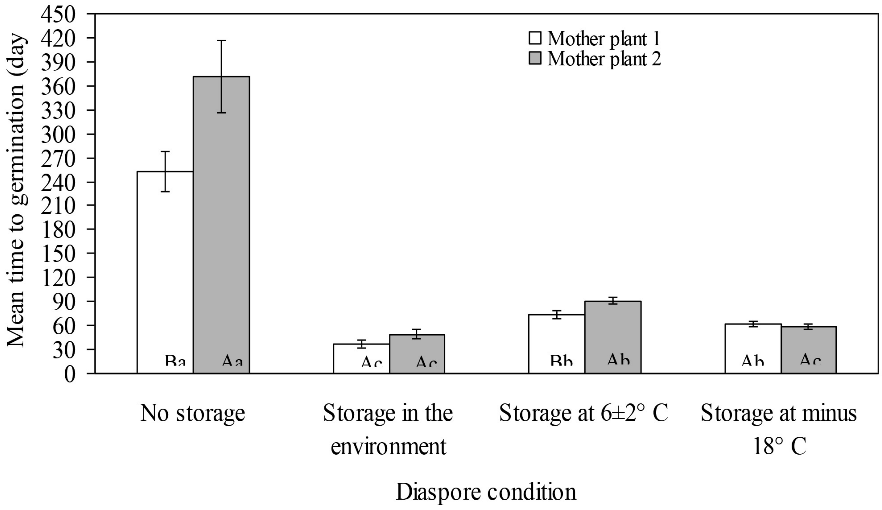

Figure 4. Mean time to germination (day) of diaspores of two mother plants of hog plum tree (*Spondias mombin* L.) not stored and stored for one year under different conditions. (Means with the same uppercase letter, within each storage condition, and with the same lowercase letter, within each mother plant, indicate non-significant differences by the Tukey test, at 0.05 level of probability).

The great unevenness in germination, observed in the diaspores of the two mother plants, especially when they were not stored, allows us to infer that the intensity of dormancy varies markedly among diaspores in the same mother plant. Nevertheless, the hypothesis that within each mother plant there are certain proportions of seeds with similar dormancy degrees is acceptable, which justifies germination curves with tendencies of double sigmoidal (Mother plant1) and triple sigmoidal (Mother plant 2).

The great differences observed in the mean time to germination in the diaspores of the two mother plant suggest that the intensity of dormancy is, at least in part, genetically controlled, therefore, there is the possibility of selecting mother plants whose seeds germinate faster. The fact that most seeds require excessively long time to germinate, especially when they have not been stored, allows us to conjecture that in addition to exogenous dormancy, imposed by the corneous integument, germination is also controlled by dormancy of a physiological nature, in agreement with Azevedo et al. (2004) and Sautu et al. (2007) observations. This hypothesis is supported by the fact that it would be inconsistent for a species of seed with orthodox behavior in storage, according to Lima Jr. et al., (2014), and whose covers are permeable to water to remain viable, with high water content, for periods greater than 300 days, as observed in most diaspores that have not been stored. It is inferred, then, that physiological dormancy allows the embryo, after the initial imbibition phase, to remain with active metabolism, but at low intensity, without differentiation and growth, until the endocarp is fragile, allowing the continuity of the germination process, which culminates with the emergence of the seedling, as in the case of 'murucizeiro' pyrenes (*Byrsonima crassifolia* (L.) Kunth) (CARVALHO; NASCIMENTO, 2008).

In the experiment in which the diaspores of the two mother plants were stored for zero (control), one, two, three, four, five and six months, in the natural environment conditions of Belém, PA, it was observed that the storage had no effect on the final percentage of germination. However, as the storage period increased, the diaspores of both mother plants germinated faster and with greater uniformity, indicating that seed dormancy is naturally overcome. The acceleration in germination was more pronounced after the third month of storage, when significant increases in the germination percentage were observed 30 days after sowing, regardless of the genotype of the mother plant. The maximum germination percentage was reached 180 days after sowing. (Figure 5).

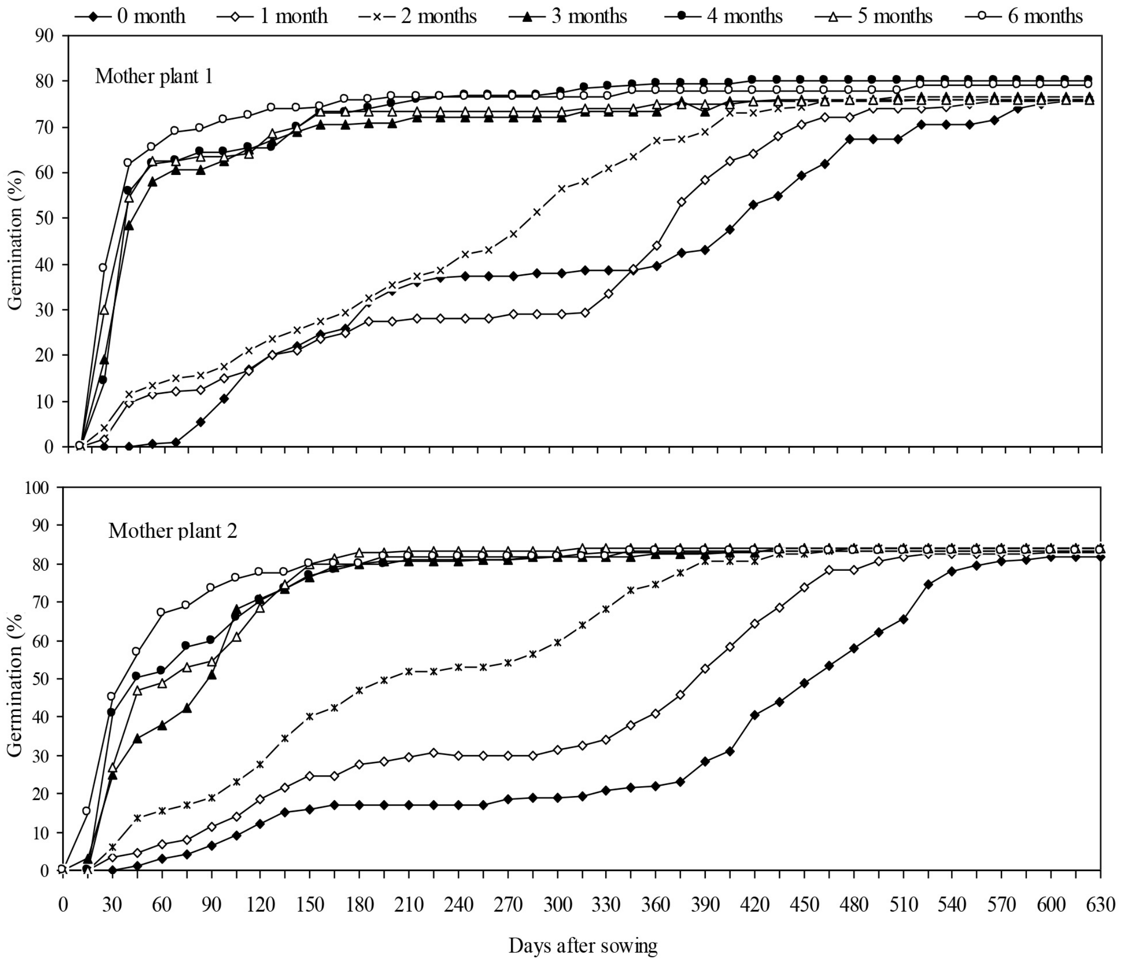

Figure 5. Diaspores germination (%) of two mother plants of hog plum tree (*Spondias mombin* L.) stored for different periods, as a function of time.

In non-stored diaspores or in those stored for one and two months, the germination course showed a curve with a tendency of double or triple sigmoidal, while in those stored for a period equal to or greater than three months, the trend was of a single sigmoidal, which allows us to infer that up to two months of storage, there are groups of diaspores with the same intensity of dormancy, which conditions germination curves with two or three peaks of germination, similar to what was verified previously.

Comparing the percentage data of final germination of the non-stored diaspores in the two experiments, it appears that the final percentage of germination of Mother plant 1 was higher in the first experiment, with an average of 91.2%, while in the second it was only 75.5%. On the other hand, in Mother plant 2, the observed values were practically the same, with averages of 82.4% and 82.0%, respectively. This can be attributed to the fact that the previous selection of the diaspores, in which those with less weight were discarded, was more efficient in Mother plant 2. In this mother plant, the diaspores have less weight (Table 1).

Regarding the mean time to germination, significant reductions ($p < 0.05$) were observed with the increase of the storage period, that is, the diaspores germinated more quickly as they remained longer stored. These reductions were of great magnitude after the third month of storage (Figure 6). Therefore, it is recommended as a method to overcome dormancy of hog plum seed, storage under natural environment conditions for at least three months. This procedure is an efficient, simple and low cost method. As the seeds show orthodox behavior in storage (LIMA JÚNIOR et al. (2014), which was confirmed in this study, the seedling producer can accurately plan the sowing period, in such a way that the seedlings are ready for planting at the beginning the rainy season that, in most of the Amazon and the Northeast of Brazil, takes place in January.

The overcome dormancy by storage, in several species of seed, has been reported since the middle of the last century. However, the mechanisms that regulate this phenomenon, up to the present time, are not properly elucidated. In the case of hog plum seeds, it was observed that when the diaspores were stored in the natural environment of Belém, PA, the dormancy was efficiently overcome, which can be attributed to the higher storage temperature. Paradoxically, storage at a temperature of minus 20±2° C was also quite satisfactory, in terms of stimulating germination, being much higher than storage at a temperature of 6±2° C. It is likely that freezing with subsequent thawing has reduced the resistance of the endocarp, but this alone does not convincingly explain the acceleration in germination seen in the diaspores. It is noteworthy that Salomão (2002), when exposing hog plum diaspores to liquid nitrogen, for only three days, obtained 53.0% of germination percentage, a value much higher than that of the control treatment, which was only 11.0%, attributing this fact to cracks caused in the endocarp by freezing.

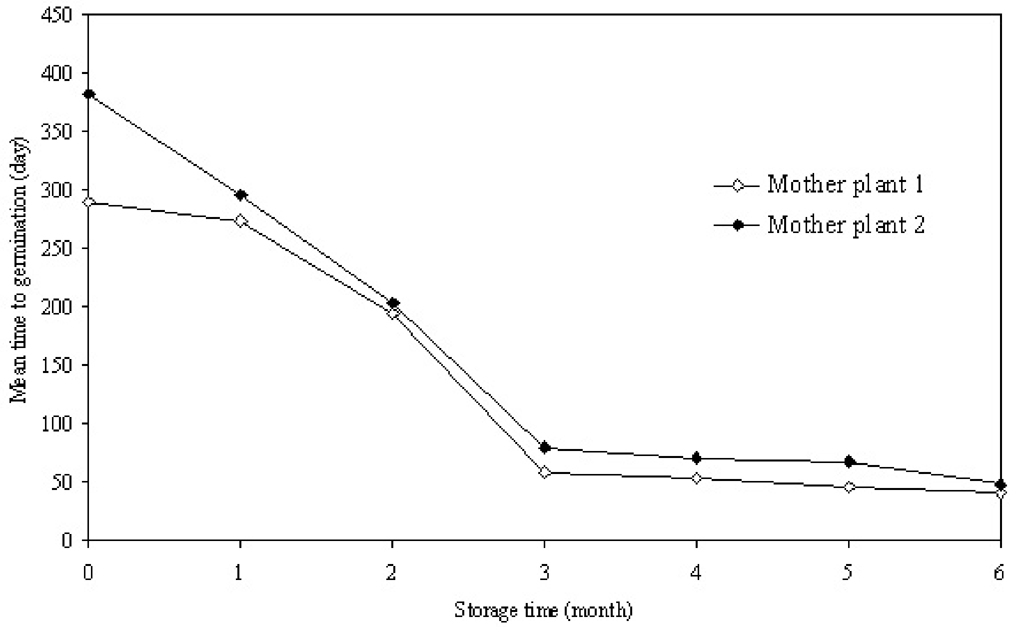

Figure 6. Mean time to germination (day) of diaspores of two mother plants of hog plum tree (*Spondias mombin* L.), depending on the storage time.

Conclusions

The structures that cover the hog plum seeds, represented by the internal mesocarp and the endocarp, are permeable to water;

The storage of hog plum diaspores, regardless of the mother plant genotype and storage temperature, provides the overcoming dormancy.

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