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CAN THE COLORING OF INTERNAL TISSUES OF AMBURANA-DE-CHEIRO SEEDS BE AN INDICATIVE OF VIGOR?

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ABSTRACT - *Amburana cearensis* (Allemão) A. C. Sm. is a forest species with multiple uses, whether landscape, timber, or medicinal, however, with the advance of the destruction of the Caatinga and the predatory exploitation of this species, it is necessary to guarantee greater production of seedlings in quality and quantity, in order to avoid the exclusion of seed lots with low germination content, thus, we aimed to analyze the emergence of different groups of scarified seeds with light and dark colored cotyledons. The seeds came from the region of Guanambi/BA, and were sown in sand, with daily irrigation. The design used was completely randomized, with 4 replications of 20 seeds each, distributed in three treatments, being: intact seeds, scarified seeds with light cotyledons, and scarified seeds with dark cotyledons. At the end of the test, using the daily data of the number of emerged seeds, the following variables were calculated: percentage of emergence, emergence speed index (ESI), average emergence time, and average speed. Seeds with light cotyledons were viable for seedling production, with 86% emergence, in addition to presenting the highest ESI value, on the other hand, seeds with dark cotyledons had 100% losses. *A. cearensis* seeds present higher germination potential when submitted to the mechanical scarification process. In addition, analysis by means of the coloring of the internal tissues of the seed is an effective method for indicating the vigor of the seeds, generating greater efficiency in the yield of seed lots.
Keywords: *Amburana cearensis* (Allemão) A. C. Sm., storage, emergence, viability.

A COLORAÇÃO DOS TECIDOS INTERNOS DE SEMENTES DE AMBURANA-DE-CHEIRO PODE SER UM INDICATIVO DE VIGOR?

RESUMO - A *Amburana cearensis* (Allemão) A. C. Sm. é uma espécie florestal com múltiplos usos, seja paisagístico, madeireiro e medicinal, porém, com o avanço da destruição da Caatinga e pela exploração predatória dessa espécie, é necessário garantir maior produção de mudas em qualidade e quantidade, a fim de evitar a exclusão de lotes de sementes com baixo teor de germinação, assim, objetivamos analisar a emergência de diferentes grupos de sementes escarificadas com cotilédones de coloração clara e escura. As sementes procederam da região de Guanambi/BA, sendo semeadas em areia, com irrigação diária e o delineamento utilizado foi o inteiramente casualizado, com 4 repetições de 20 sementes cada, distribuídos em três tratamentos, sendo: sementes intactas, sementes escarificadas com cotilédones claros e sementes escarificadas com cotilédones escuros. Ao final do teste, com os dados diários do número de sementes emergidas, foram calculadas as variáveis: porcentagem de emergência, índice de velocidade de emergência (IVE), tempo médio de emergência e velocidade média. As sementes com cotilédones claros mostraram-se viáveis para produção de mudas, com 86% de emergência, além de apresentar o maior valor de IVE, por outro lado, sementes com cotilédones de coloração escura tiveram 100% de perdas. Sementes de *A. cearensis* possuem maior potencial germinativo quando submetidas ao processo de escarificação mecânica, promovendo aumento no percentual de emergência e do índice de velocidade de emergência e a análise por meio da coloração dos tecidos internos da semente é um método eficaz para indicação do vigor das sementes, gerando facilidade e agilidade para a formação de plântulas e maior eficiência no rendimento de lotes de sementes.
Palavras-chave: *Amburana cearenses* (Allemão) A. C. Sm., armazenamento, emergência, viabilidade.

INTRODUCTION

Amburana cearensis (Allemão) A. C. Sm. is a native species, although not endemic to the Caatinga, occurring in the Atlantic Forest and Cerrado. It is well distributed in the semi-arid regions of Brazil (SILVEIRA et al., 2022), occurring in the Northeast region (Alagoas, Bahia, Ceará, Paraíba, Pernambuco, Piauí, Rio Grande do Norte), North (Tocantins), Midwest (Goiás, Mato Grosso do Sul) and Southeast (Espírito Santo, Minas Gerais, Rio de Janeiro, and São Paulo) (ARAÚJO and DANTAS, 2019).

It presents itself as a leafy tree, which can reach up to 15 m in height, with white flowers, flattened pods, and brownish-red stem bark whose pleasant odor is conferred by coumarin. Its seeds are black, winged, orthodox and exude a strong coumarin scent, similar to vanilla (MENDES et al., 2019). It is a heliophilous species, a selective halophyte, deciduous, with a mellitophily pollination system, and

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anemochory dispersal syndrome, it develops in the shade in some situations of regeneration under the forest canopy, is drought tolerant and not frost tolerant (FERREIRA et al., 2020).

The wood has diverse uses, especially for carpentry, fine furniture, sculptures, crates, civil construction, wainscoting, ceilings, frames, carpentry, planking, and for the manufacture of barrels for storing and aging beverages, in addition to having medicinal properties. such as anticoagulant and anti-inflammatory (FERRAZ et al., 2020). The seeds have a high germination potential, above 90% (VASCONCELOS et al., 2019) when freshly collected, with up to three months of longevity. However, with physiological maturity, there tends to be a progressive decrease in quality due to the deterioration process, drastically reducing germination, especially when stored at room temperature (CORADIN et al., 2018).

It is known that storage can promote cellular damage, such as loss of permeability and degradation of seed membranes (DUTRA et al., 2019), increases in the specific activities of peroxide, superoxide dismutase, and catalase enzymes, darkening of seed structures, and degradation of total soluble sugars (SILVA et al., 2018). Possibly, this may be an indication of loss of seed germination potential. In this sense, with the aim of ensuring greater production of seedlings in terms of quality and quantity from stored seeds of *A. cearensis* and to avoid the exclusion of seed lots with low germination content, the objective was to analyze the emergence of different groups of scarified seeds with light and dark colored cotyledons.

MATERIAL AND METHODS

The amburana-de-cheiro fruits were collected from 20 matrices from the municipality of Guanambi/BA (Latitude 14º13'01" S, Longitude 42º46'40" W) and all research was conducted at the Seed Analysis Laboratory of the Center for Agricultural Sciences at the State University of Londrina, in Londrina/PR.

The fruits were collected manually with the aid of a ladder and aerial pruning shears and all the seeds were removed from the fruits manually. Badly formed, discolored, necrotic, stained, or irregularly shaped seeds were classified and duly discarded. The seeds were then stored for 12 months in PET bottles kept at room temperature.

The experimental design used was completely randomized, containing three treatments: T1 - intact seeds, T2 - scarified seeds with light cotyledons, and T3 - scarified seeds with dark cotyledons (Figure 1), with four replications with 20 seeds each. The emergence tests were conducted in greenhouses at room temperature, where the seeds were disinfected by immersion in a sodium hypochlorite solution with 1% active chlorine for 3 minutes, followed by washing in distilled water. The seeds were sown in sand, with daily irrigation by a micro-sprinkler system.

The experiment was carried out for 12 days and the seeds were considered germinated when the plumular hook emerged on the sand. At the end of the test, from the daily data on the number of emerged seeds, the following variables were calculated, as suggested by Ferreira et al. (2022), in Equations 1, 2, 3, and 4:

$$E = \left(\frac{N}{A}\right) \times 100 \quad \text{(Equation 1)}$$

In which:
E = emergence (%),
N = number of seeds emerged at the end of the test and
A = total number of seeds planted to emerge.

$$ESI = E1/N1 + E2/N2 + \cdots + En/Nn \quad \text{(Equation 2)}$$

In which:
ESI = emergence speed index,
E1, E2, En = number of seeds emerged at the first, second, and final count and
N1, N2, Nn = number of sowing days at the first, second, and final count.

$$t = \sum niti / \sum ni \quad \text{(Equation 3)}$$

In which:
t = average time to emergence (days),
ni = number of seeds emerged per day and
ti = incubation time.

$$v = 1/t \quad \text{(Equation 4)}$$

In which:
v = average speed (days) and
t = average emergence time.

Data were subjected to analysis of variance and, if significant, means were compared using Tukey's test ($p \leq 0.05$). The assumptions of normality of errors and homogeneity of variances were tested by Shapiro-Wilk and Levene tests, respectively. The analyses were performed with the aid of the R software (R CORE TEAM, 2021), using the AgroR package (SHIMIZU et al., 2022).

RESULTS AND DISCUSSION

The *Amburana cearensis* seeds with dark colored internal structures presented totally unsatisfactory emergence, with 100% losses (Figure 1). During storage, the seeds underwent processes that affected their vigor, culminating in deterioration, which is an irreversible and continuous process, presenting a progressive rhythm, resulting in a drop in quality and the death of the seed (SILVA et al., 2019). At this point, in order to obtain a seed lot with a high percentage of emergence, it is important to highlight the importance of evaluating the germination behavior, which should not only consider the results of germination tests, but also information on the condition of the internal tissues of the seed.

FIGURE 1 - Intact seed (T1), scarified seed with light cotyledons (T2), and scarified seed with dark cotyledons (T3).

On the other hand, manually scarified seeds with light colored cotyledons achieved an emergence percentage of 86% (Figure 2A). The seeds were scarified by breaking the tegument on the opposite side to the hilum with a small cutting mechanical device, consisting of two removable parts, a lever and a blade. Intact seeds demonstrated a lower percentage of emergence (44%), demonstrating that storage significantly reduced their viability, contrary to what was reported by Lorenzi (2002), who found greater viability after 3 months of storage. Vasconcelos et al. (2019), also concluded that *A. cearensis* seeds had low viability and germination vigor when stored, characterizing losses of almost 50% of viability.

Araújo et al. (2017) report that it is not advisable to store *A. cearensis* seeds in a laboratory environment without an airtight container, in addition, these seeds can be kept in a refrigerated environment, without loss of viability, for at least two years. According to Silva et al. (2019), for forest species, in general, the germination test is the most commonly used parameter to evaluate the physiological quality of seeds, since it is a reliable and reproducible test; however, as this test is carried out under favorable conditions, it has several limitations.

In addition to not allowing the precise identification of factors that affect quality, this test also does not detect subtle alterations in seed deterioration, and does not predict the result of seed performance under general field conditions, or the storage potential. Thus, as we have shown the need of mechanical scarification, the identification of the color of the internal tissues (cotyledons) is an important tool for vigor analysis and consequently for achieving a high percentage of seedling formation, with quality and agility (SILVA et al., 2019).

Several studies report the percentage of unsatisfactory germination of intact *A. cearensis* seeds, such as Ferraz et al. (2020), who showed only 5% emergence in sand, Guedes et al. (2010), after 270 days of storage, showed 68% germination, Almeida et al. (2014) observed a germination percentage of 43%, Guedes et al. (2013) 66%, and Vasconcelos et al. (2019), showed 55% germination.

The fact that the emergence of intact seeds was 22% lower than the treatment with scarified seeds can be understood in terms of anatomical aspects, since according to Loureiro et al. (2013), macrosclereids, osteosclereids, and phenolic compounds cause a certain degree of impermeability of the tegument, which hinders the absorption of water, leading to primary seed dormancy. Also according to the authors, scarification facilitated the absorption of water, allowing stand uniformity of germination. Guedes et al. (2010) also found a significant reduction in moisture absorption in intact seeds when compared to mechanically scarified seeds of *A. cearensis*.

The ESI values differed statistically between the analyzed treatments (Figure 2A), with the best results verified for scarified seeds with light internal tissues, being approximately 50% higher. As pointed out by Guedes et al. (2013), different ESI values were found for seeds collected from different matrices, ranging from 0.9 to 2.01, values lower than those established for scarified seeds with a light tegument (3.69) as seen in the ESI values found by Guedes et al. (2015), whose highest value for a given matrix was 2.941. The same authors also point out that seed quality is the sum of several attributes, that contribute to obtaining more vigorous seedlings, with faster germination and emergence.

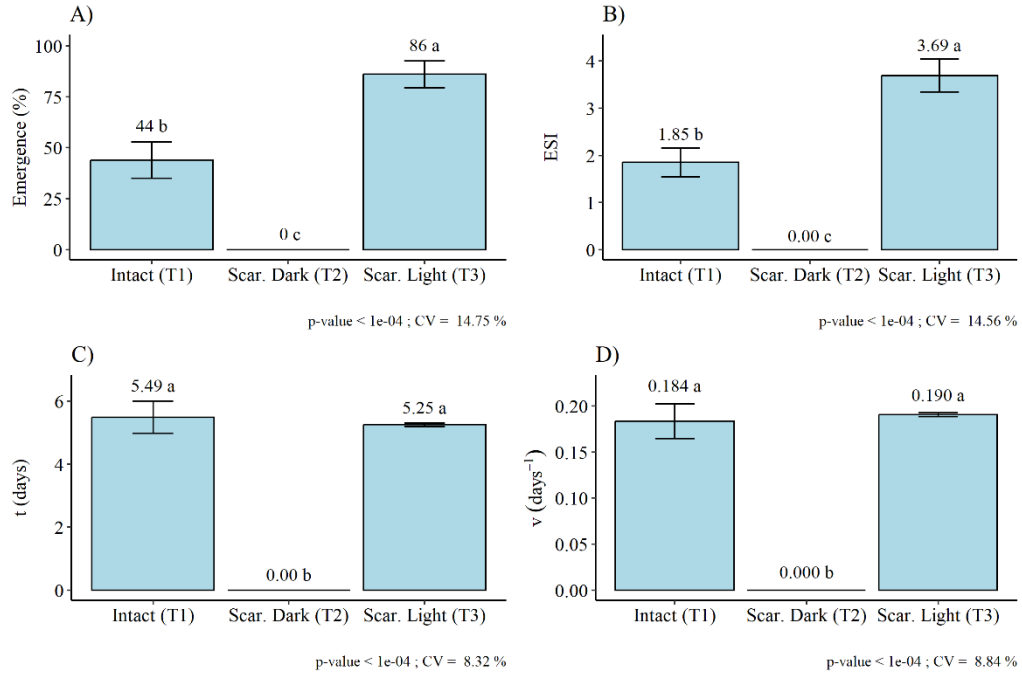

FIGURE 2 - Germination behavior of intact *A. cearensis* seeds with distinct cotyledon color. Means followed by the same letter between columns do not differ by Tukey's test (p≤0.05).

Although the differences in ESI values showed discrepant value, the same was not observed for t values (Figure 2C). Although the intact seeds obtained a higher value (5.49 days) when compared to scarified seeds with light tissues (5.25 days), the treatments did not differ from each other, maintaining the same behavior for v, varying between 0.184 and 0.190 (Figure 2D).

Work with native forest seeds is essential to guarantee satisfactory production of seedlings, with proper management of seed lots, through indications of vigor and storage characteristics.

CONCLUSIONS

Amburana cearensis seeds have greater germination potential when subjected to the mechanical scarification process, promoting an increase in the percentage of emergence and the emergence speed index.

Analysis through the coloration of the internal tissues of the seed is an effective method for indicating the vigor of the seed, generating ease and agility for the formation of seedlings and greater efficiency in the yield of seed lots.

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