Original Research Article

Overcoming seed dormancy of *Enterolobium contortisiliquum* (Vell.) Morong.

ABSTRACT

The use of new methods may facilitate the production of seedlings for reforestation since the seed market is scarce and seedlings take time to be produced. The Earpod tree is a native species that can be used for the floristic recomposition of the biome and with the possibility of using wood for commercial purposes. In this sense, the present work aimed to evaluate different methods of overcoming dormancy of the *Enterolobium contortisiliquum* (Vell.) Morong. Seven treatments were performed with 5 replications: T0: control, T1: mechanical scarification with a rasp, T2: mechanical scarification with welding electric appliance, T3: mechanical scarification with cutting pliers, T4 y T5: chemical scarification with sodium hydroxide 30% for 25 minutes and 30 minutes, respectively, and T6: immersion in 100 °C water for 7 minutes. The following variables were evaluated: percentage of emergence, emergence speed index (ESI), the height of seedlings, number of leaves per seedling, stem diameter, and length of a root system. The mechanical scarification method with cutting pliers was the most efficient, with an emergence percentage of 96% and plant emergence speed indexes of 9.79. The treatments, chemical scarification with sodium hydroxide 30% for 30 and 25 minutes, and control showed low efficiency in overcoming dormancy, with an emergence percentage of 2, 6, and 4% and emergence rates of 0.14, 0.37 and 0.24.

Keywords: *Germination, Emergence, Growth, Seedlings.*

1. INTRODUCTION

The Earpod tree (*Enterolobium contortisiliquum* (Vell.) Morong.) belongs to the family Fabaceae and can be found in several regions of Brazil. Its height can reach up to 35 m presenting loss of leaves during winter in dry regions. This species can be indicated even for the recovery of degraded areas because it provides greater efficacy in the use of water and soil nutrients by biological nitrogen fixation [1].

Earpod tree seeds show behavior with 90% germination when stored from 3º C to 5º C and 92% RH (relative humidity) and 50% germination after nine years of storage [2]. In addition, they present dormancy, which is a characteristic that causes seeds to germin eat in the period more appropriate to their development, allowing plant species to survive conditions that hinder or prevent their vegetative growth. Dormancy is considered a strategy for perpetuation of the species, especially those in the early stage of ecological succession. However, it becomes a hindrance outside the natural environment, because this mechanism causes germination to occur in an uneven way, which can subject the seed to fungal attacks, making them unfeasible [3].

The dormancy mechanism presents particularities, making it difficult to generalize its causes, as there are variations depending on the cultivated species, edaphoclimatic conditions, seed processing, and storage conditions. Thus, the choices of efficient treatments for the overcoming of dormancy also vary, being the most used treatments: chemical, thermal, and mechanical [4].

Earpod tree seeds have tegumentary numbness, a type of numbness that can be interrupted by mechanical or chemical scarification [2]. This is the result of the impermeability of the integuments of the seed or fruit to water.The use of methods to overcome dormancy when performed properly can facilitate the germination of seeds of species that present impediments in germination. The understanding of germination processes, especially those seeds with tegumentary dormancy can offer support for seedling production [5].

For each species, there is a more effective dormancy overcoming treatment, because the thickness of the waterproof layer influences the dormancy and efficiencies of pre-germinative treatments. Among the methods, there is scarification, immersion in water or acids, pre-cooling, and stratification. For the treatment used integumentary dormancy, chemical and mechanical scarifications stand out, using sulfuric acid (H_2SO_4) and sandpaper, respectively, because they often present the best results regarding the high percentage of germination [4].

Besides providing a higher germination rate, these scarification modalities also induce an increase in germination speed. This is because it is directly associated with the speed with which the water that enters is absorbed, due to the integumentary wear caused by scarifications, accelerating the stages of the embrasure, activation of metabolic processes, and germination [6].

Thus, the use of new methods can facilitate the production of seedlings for reforestation, since the seed market is scarce, seedlings take time to be produced and the Earpod tree is a native species that can be used for the floristic recomposition of the biome and with the possibility of using wood for commercial purposes. In this sense, the present work aimed to evaluate different methods of overcoming dormancy of the species *Enterolobium contortisiliquum* (Vell.) Morong.

2. MATERIAL AND METHODS

The experiment was conducted in the municipality of Alexânia – GO (Brazil), carried out in protected but uncontrolled cultivation, in a space of 15 m², being five meters long and three meters wide (Figure 1).

Fig. 1. – Experimental area for seedling cultivation. Source: (author himself, 2021).

The seeds were acquired in the Nursery Seed of Brazil. Soil (dystrophic Red Latosol) was used for the substrate composition. Seeds underwent different forms of scarification (Table 1).

Table 1. Treatments for overcoming dormancy in Earpod tree seeds (*Enterolobium contortisiliquum*) and their respective identifications.

Treatments	Identification
T0	Control
T1	Mechanical scarification with rasp
T2	Mechanical scarification with electric welding apparatus
T3	Mechanical scarification with cutting pliers
T4	Chemical scarification with sodium hydroxide 30% for 25 minutes
T5	Chemical scarification with sodium hydroxide 30% for 30 minutes

T6	Immersion in water at 100 °C for 7 minutes

Seven treatments were performed with 5 replications. In each scarification treatment distributed 100 seeds of Earpod tree, being separated into five replicates, each repetition containing 10 containers (perforated bags of polyethylene with dimensions of 15x28, is 15 cm in diameter, and 28cm deep; in each container was hold 2 seeds to the depth of 1 cm). Two waterings were performed daily, one in the morning and one at the end of the day, due to the need for water for the initial development of the seedling.

After 30 days, when the seedling was more developed, the watering was reduced to only once a day until the seedlings reached the point of going to the field after being done a thinning, leaving in each container only the most vigorous seedling, in search of reaching a batch of seedlings with higher quality, enabling better results in the characteristics to be evaluated.

2.1 Seedling reviews

All evaluations on morphological characteristics of the seedlings were evaluated 105 days after sowing, except for the variable's emergence time and emergence speed index. The observation of the emergency time started from the first day after sowing and extended to the twenty-fourth day, being observed every day.

- **Emergence (%)** – Observation of the emergency time started from the first day and lasted until 24 days after sowing (Fig. 2A). The criterion used was that of normal seedlings that presented the perfect essential structures [7].

Fig. 2. Seedling emergence assessment (A), Monitoring seedling growth for emergence speed index calculations (B). Source: (Author Himself, 2021).

- **Emergence speed index (ESI)** – after the seedlings emerged, daily observation was carried out until the twenty-fourth day (Fig. 2B), obtained using the formula, suggested by [8]. ESI = E1/N1 + E2/N2 + ... En/Nn. Where: E1, E2, ... En = number of normal seedlings computed at the first count, up to the last count. N1, N2, ... Nn. = the number of days from sowing to the first, until the last count.
- **Plant height**– plant height was considered, the distance between the base of the plant and the apical gem with a millimeter ruler (Fig. 3A).

Fig. 3. - Plant height assessment (A) and the number of leaves seedling (B). Source: (Author Himself, 2021).

- **Number of leaves seedling**– counting the number of leaves present in each seedling of each treatment (Figure 3B).
- **Stem diameter**– with the aid of a caliper, the diameter of the stem was measured in the region of the plant neck (Fig.4A).

Fig. 4. - Evaluation of seedling stem diameter (A) and length of the root seedling system (B). Source: (Author Himself, 2021).

- **Length of root system** - Due to the root system of the plant being pivoting type, the maximum depth that its root will reach 105 days after sowing was evaluated, with the use of a ruler (Fig. 4B).

2.2. Statistical Analysis

The results obtained were submitted to analysis of variance (ANOVA) and the means compared by the Tukey test (*P*≤0.05), using the software Sisvar version 5.6 [9]. The graphics were plotted using sigmaplot software version 10® [10].

3. RESULTS AND DISCUSSION

The use of different dormancy breaking methods in the Earpod tree (Enterolobium contortisiliquum Vell. Morong.) promoted significant effects (p≤0.05) with an increase in crop emergence speed, but did not reflect on plant development. Thus, about these evaluated characteristics, there was a difference in the characteristics of emergence percentage, emergence speed index, and length of the root system.

The emergence of Earpod tree seeds had a lower percentage in the methods T5, T4, and T0 (Fig. 5A). T3 shows an average superiority of 92% over the others, other methods that may be considered are T1, T2, and T6.

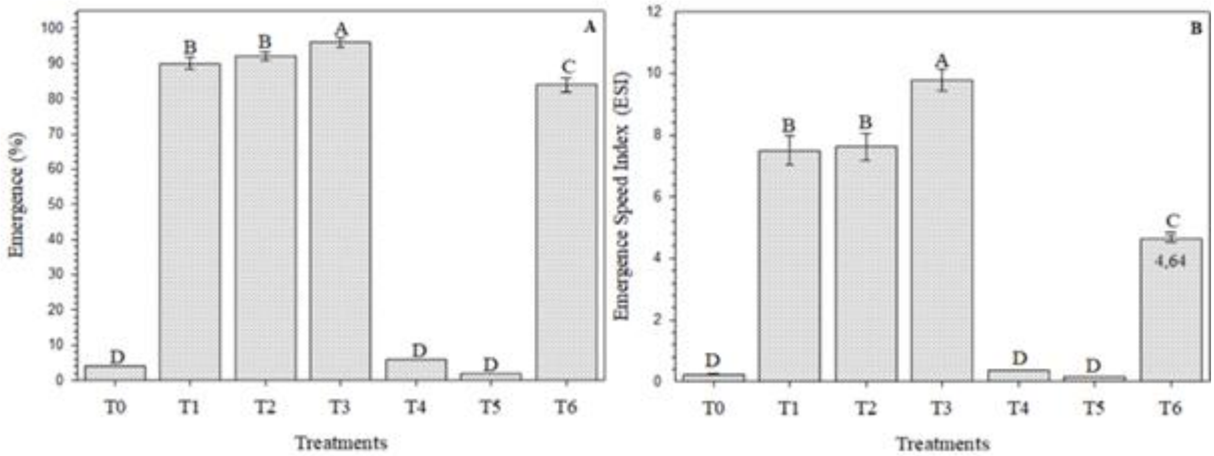

Fig. 5. - Emergence percentage (A) and Emergence Speed Index (B) (24 days after sowing) of Earpod tree seeds (*E. contortisiliquum*) with different dormancy overcoming methods. T0: Control; T1: Mechanical scarification with a rasp; T2: Mechanical scarification with electric welding apparatus, T3: Mechanical scarification with cutting pliers; T4: Chemical scarification with sodium hydroxide 30% for 25 minutes; T5: Chemical scarification with sodium hydroxide 30% for 30 minutes; T6: Immersion in water 100 °C for 7 minutes.

Performed mechanical scarification techniques using water sandpaper n°120 and puncture on the opposite side of the primary root protrusion with pyrograph and stated that such methods promoted a higher rate of emergence of Earpod tree seedlings, recommending both types of mechanical scarification because they are less costly [11].

Regarding the emergence speed index, the results differed statistically (Fig. 5B). The highest ESI values were observed in scarified seeds using the T3 with a total of about 3833.49% higher than the means of the lowest results. This corroborates the results of [12] who found a better response from ESI with the mechanical scarification method, being more efficient in overcoming the dormancy *of Hymenaea stigonocarpa*, with plant emergence rates ranging from 92.31 to 100%, surpassing the other methods.

T0, T4, and T5 treatments showed the lowest ESI values. In studies conducted by [13] chemical scarifying with sodium hydroxide in a period of 20 and 40 minutes has negative effects on emergence speed indices in species of the Fabaceae family, resulting in about 900% lower treatments with mechanical scarification.

In general, the height of the seedlings plant height was not a significant difference between the treatments evaluated, being that the treatment T0 (control) has the highest height with 44 cm, but given the fact that this was the one that was obtained the lowest amounts of plants making the competition for space was lower about the other treatments that obtained an average of 42 cm in height when analyzing the final results, this variable was not influenced, being statistically similar ($P \leq 0.05$).

What may explain the results of plant height is the fact that the amounts of plants present in the treatments, ends up resulting in competition by space, thus being able to suppress the growth of plants when in larger amounts, so even the variables with the lowest germination rates have sizes like the most germinated ones. In a study conducted by [14] with *E. contortisiliquum*, defined the ideal number of 24 plants for better development of plant height, mainly due to competition for space in its development.

Regarding the number of leaves per Earpod tree plant, there was no statistical difference (*P*≤0.05) between treatments for this variable, which demonstrates that regardless of the method used is a variable that will not be negatively affected, with average values of 10 leaves/plant. Even without variation between treatments it is important to highlight the importance of the number of leaves that is a factor entirely linked to the development of the plant since they are the main place where photosynthesis occurs, and because they are the reserve center, auxin source, and rooting cofactors are transferred to the base, so they also help to form new tissues, such as the roots, so they are more important than the stems [15].

The means of the variable diameter of the Earpod tree seedling stem did not obtain a statistical difference (P≤0.05) between treatments, with an average value of 5 mm. The stem diameter is an important item to evaluate the survival and growth potential of seedlings of forest species after planting, plants with larger diameters in the same species have a higher survival rate, as they can form and develop new roots. Although the results have not differed between treatments, it is an extremely important variable, because the thickness of the stem is a good indicator of the quality of the seedlings and has a strong correlation with the survival rate of the seedlings [16].

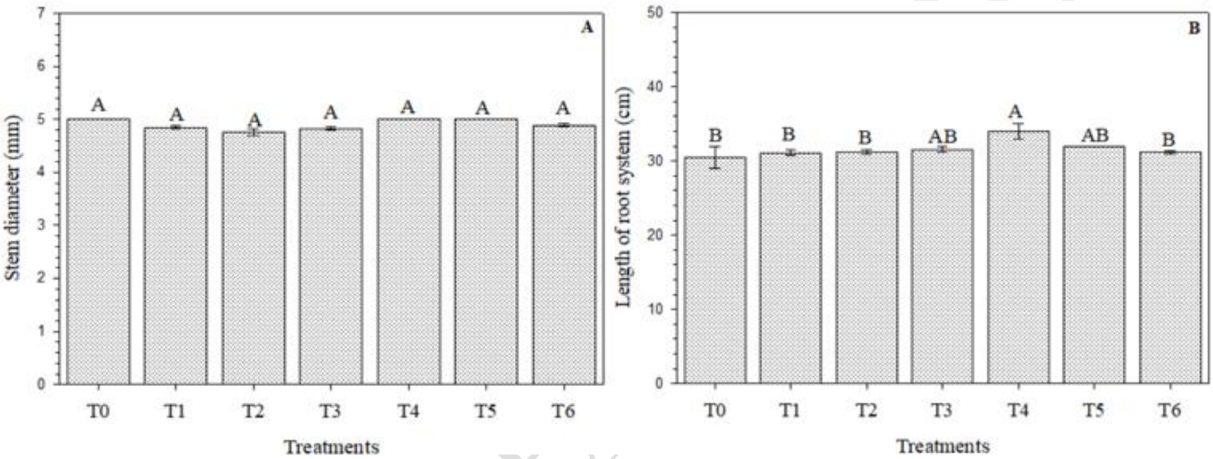

Fig. 7. - Length of the root system (*E*. *contortisiliquum*) at 105 days of age, in different methods of overcoming dormancy. T0: Control; T1: Mechanical scarification with a rasp; T2: Mechanical scarification with electric welding apparatus, T3: Mechanical scarification with cutting pliers; T4: Chemical scarification with sodium hydroxide 30% for 25 minutes; T5: Chemical scarification with sodium hydroxide 30% for 30 minutes; T6: Immersion in water 100 °C for 7 minutes.

The characteristic length of the root system showed statistical differences between treatments, being T4 11.47% higher than control (Fig. 7).

In this study, we see the treatments with the worst results in germination with the smallest number of plants in the area, demonstrated equality between treatments in root growth, and it is also important to highlight that the higher the volume of soil exploited by the roots, the greater its development and the greater the amount of water absorbed by the plant in addition to that the deeper the root system and the thinner and branched the roots [17].

It is noted that the specie *E*. *contortisiliquum* responded in different ways to treatments, as well as verified in the same family in kind by [18]. What may explain the results are the characteristics of the seed integument, such as the structure or conformation of the inhibitory tegumentary layer, as well as the level of dormancy that may vary depending on the situation in which is the seed [19]. Therefore, the time required to break the integument and make it permeable varies with the seed lot and the evaluated species [20]. State that the success of dormancy breakage treatment depends on the degree of numbness, which varies according to each species [21].

4. CONCLUSIONS

Considering all the data collected, it was verified that the different methods of overcoming dormancy are effective in what is proposed, but only the Method T3: Mechanical scarification with cutting pliers, was superior to the others, being the most effective for the initial development of the culture. However, we emphasize the need for further research that investigates beyond the aspects observed and correlated in this study, aiming to guide the use of these methods in Earpod tree culture, presenting the effects promoted in plants and their advantages.

The variables seedling height, stem diameter, and the number of leaves were not influenced by treatments, not differing statistically from each other.

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