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Overcoming physical dormancy in seeds of *Jatropha mollissima* (Pohl) Baill. (Euphorbiaceae) in the semiarid region of Brazil

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Abstract: *Jatropha mollissima* (Pohl) Baill is a shrub species native of Caatinga biome; it has great medicinal, oleaginous and ornamental potential. Seed dormancy is considered a very common adaptive plant strategy in unpredictable and harsh environments. The aim of this study was to evaluate the effects of different pre-germination treatments on overcoming physical dormancy in seeds of *Jatropha mollissima*. The treatments adopted to overcome dormancy were: T_1 - control; T_2 - mechanical scarification on the opposing extremity to hilum with sandpaper N^o 80; T_3 - mechanical scarification on the lateral region with sandpaper N^o 80; T_4 - immersion in water at 25 ºC for 24 hours; T_5 - water immersion at 25 ºC for 12 hours; T_6 - water immersion at 100 ºC for one minute. The seedling vigor traits evaluated were percentage of emergency, emergency speed index, length of the aerial part and root, dry weight matter of the aerial part and root, steam diameter and number of leaves. The treatment T_6 showed no seedlings emergency. *Jatropha mollissima* seeds have tegumentary dormancy. The results showed that the most efficient treatments to overcome physical dormancy of *Jatropha mollissima* seeds were the mechanical scarification on the opposing extremity to hilum and the lateral region.

Keywords: Pinhão-Bravo, Germplasm, Caatinga.

Superação de dormência física em sementes de *Jatropha mollissima* Baill (Pohl). (Euphorbiaceae) na região semiárida do Brasil

Resumo: *Jatropha mollissima* (Pohl) Baill é uma espécie arbustiva nativa do Bioma Caatinga; apresenta grande potencial medicinal, ornamental e oleaginoso. A dormência de sementes é considerada uma estratégia adaptativa da planta muito comum em ambientes imprevisíveis e adversos. O objetivo deste estudo foi avaliar os efeitos de diferentes tratamentos pré-germinativos na superação da dormência física em sementes de *Jatropha mollissima*. Os tratamentos adotados para superar a dormência foram: T_1 - controle, T_2 - escarificação mecânica na extremidade oposta ao hilo com lixa N^o 80; T_3 - escarificação mecânica na região lateral com lixa N^o 80; T_4 - imersão em água a 25 ºC por 24 horas; T_5 - imersão em água a 25 ºC por 12 horas; T_6 - imersão em água a 100 ºC por 1 minuto. Os caracteres para avaliar o vigor das plântulas foram a porcentagem de emergência, índice de velocidade de emergência, comprimento da parte aérea e da raiz, peso da matéria seca da parte aérea e raiz, diâmetro do caule e número de folhas. O tratamento T_6 não apresentou emergência de plântulas. As sementes de *Jatropha mollissima* apresentam dormência tegumentar. Os resultados mostraram que os tratamentos mais eficientes para superar a dormência física de sementes de *Jatropha mollissima* foram a escarificação mecânica na extremidade oposta ao hilo e na região lateral.

Palavras chave: Pinhão-Bravo, Germoplasma, Caatinga.

Introduction

Seed dormancy is considered to be a very common adaptive plant strategy in unpredictable and harsh environments, such as arid and semiarid landscapes (JURADO and FLORES, 2005; POMPELLI et al., 2010). The numbness provides germination over time or when environmental conditions are favorable for the development of seedling, being beneficial to the survival of the species (MARTINS et al., 2010).

The dormancy caused by a water-impermeable seed coat is called physical dormancy (PD), and it develops during maturation drying of the seed. In seeds with PD, prevention of water uptake causes the seed to remain dormant until some factor (s) render the covering layer (s) permeable to water, like high temperatures, fire, drying and freezing (BASKIN and BASKIN, 2001).

Seeds of some plants in arid and semiarid lands are known to combine physical and physiological dormancy (NASR et al., 2013). This information could also be useful in scientific breeding programs. Local varieties of crop plants constitute genetic resources that are often poorly represented in *ex situ* collections (BRASILEIRO et al., 2012; GHOSH and SINGH, 2011).

The native vegetation in semiarid of Northeastern Brazil is locally known as “Caatinga”, that is dry, tropical and deciduous tree-shrub vegetation. About 800,000 km² of the semiarid region is covered by this vegetation (LIMA, 1996). The genus *Jatropha* L. (Euphorbiaceae), is widely spread in the biome cited, and comprises oleaginous species of high production potential (KUMAR and SHARMA, 2008; ACHTEN et al., 2008; RAO et al., 2008). In spite of the strategic relevance of these plants for the Brazilian economy and agribusiness sector, there is little research on them, including *Jatropha mollissima*.

The *J. mollissima*, popularly known as “Pinhão Bravo”, is a shrub, on average, 2 meters high (LEAL and AGRA, 2005). It is widely used in popular medicine in Northeast of Brazil, possessing therapeutic indications as antiinflammatory (AGRA et al., 2008). The latex is used as snakebites and the seeds are marketed for extraction of fixed oils (AGRA et al., 2007).

One way to help preserve species and others with special conservation value is to understand the processes that promote seed germination (DIGNART et al., 2005; FLORES et al., 2006). The knowledge of the most effective, practical and less costly to overcome dormancy of seeds can lead to the generation of large quantities of seeds germinated for the rapid establishment of this species in the field and for the production of seedlings (AZEREDO et al., 2010).

The aim of this study was to evaluate the effects of different pre-germination treatments on overcoming physical dormancy in seeds of *Jatropha mollissima* (Pohl) Baill.

Material and methods

The fruits were collected in 30 shrubs of *Jatropha mollissima* (Pohl) Baill in the Fazenda Velha/Curral Novo, located in the Caatinga, municipality of Jequié, Bahia, Brazil.

To collect seeds, fruits were harvested at maturation stage and for dry they were put in a closed and constant sunlight place. The seeds were randomly collected and then stored in paper bags for ten days until the beginning of the experiment in the Experimental Genetics Laboratory (LABGENEX) of the Southwest Bahia State University (UESB), Campus Jequié, Bahia. Herbarium vouchers of the studied material was deposited in the Herbarium (HUESB) from the same institution under N^o 4661 and reviewed by specialist.

The treatments adopted to overcoming dormancy were: T_1 - control; T_2 - mechanical scarification on the opposing extremity to hilum with sandpaper N^o 80; T_3 - mechanical scarification on the lateral region with sandpaper N^o 80; T_4 - immersion in water at 25 ºC for 24 hours; T_5 - water immersion at 25 ºC for 12 hours; T_6 - water immersion at 100 ºC for one minute.

The experiment was conducted in a greenhouse with 50% shading from november 9th to december 10th of 2010. The evaluation was done at 31 days. Irrigation was performed daily.

The experiment was completely randomized design with six treatments and four replications of 100 seeds, totaling 24 plots and

600 seeds in the experiment. The plots were arranged in containers (90cm^3) containing as substrate soil, sand and humus in the proportion 3: 2: 1.

The evaluations of the emergence tests were conducted by means of daily counts, by computing the number of seeds with emergence of the young seedlings (root, hypocotyls, epicotyl and eophylls). With this, was determined the Emergence Speed Index, which was calculated using the formula of Maguire (1962) and average emergence was expressed in percentage.

The seedling vigor traits evaluated were:

a) aerial part length - measured from the stem region to the apical meristem, with the aid of a ruler in millimeters and the results expressed in cm / seedling;

b) root length - measured from the stem until the end of the main root, with the aid of a ruler in millimeters and the results expressed in cm / seedling;

c) stem diameter - measured in the middle of the stem with the aid of a digital paquimeter and the results expressed in cm / seedling;

d) dry weight matter of the aerial part and root system - each seedling of the repetition was placed in paper bags, previously identified and placed in a greenhouse ventilation at 70 °C until reach constant weight and then were weighed in a precision balance (± 0,01 g), with the result expressed in g / seedling; e) number of

leaves – total number of leaves on seedlings with length equal or greater than 1 cm.

The data obtained in the experiment were subjected to analysis of variance and summited at F test at 5% probability and means were compared by Tukey test using the statistical program GENES (CRUZ, 2006).

Results and discussion

Emergence began six days after the start of the experiment. At nine days after sowing about 36% and 41% of the seeds submitted to mechanical scarification, at opposing extremity to hilum and the lateral region, had already emerged.

The water immersion at 100ºC for one minute (T_6) showed no seedlings emergency, possibly high water temperature caused serious damage to embryonic tissues, inhibiting the germination of all seeds. Coelho et al. (2010) worked with *Caesalpinia ferrea* Mart seeds and reported significant losses using immersion in water at 80ºC and 100 ºC. On the other hand, Souza et al. (2012) worked with *Schizolobium parahyba* (Vell.) Blake and showed that high constant (30 ºC) and alternating (20/30 ºC) temperatures promoted the breaking of physical dormancy of seeds.

The seeds of *Jatropha mollissima* showed a high degree of physical dormancy, revealed by low emergence (7%) of untreated seeds (control) (T_1) (Figure 1A). This result is similar to Kildisheva et al. (2011) that worked with seed dormancy of *Sphaeralcea munroana* (Douglas) Spach and found that highest germination capacity achieved was by mechanical scarification.

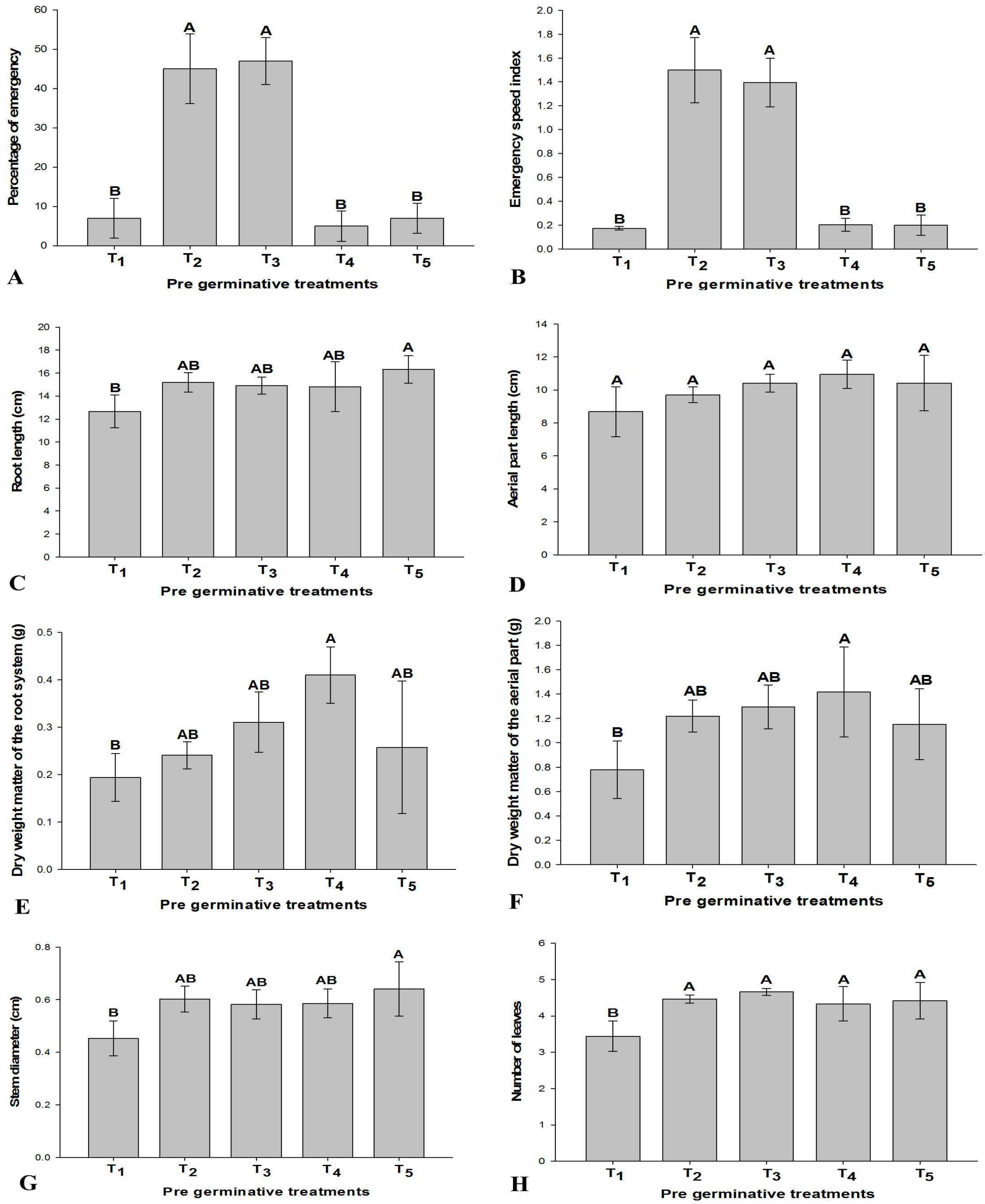
Mechanical scarification in the lateral (47%) (T_3) and on the opposing extremity of hilum (T_2) (45%) provided best results to overcome dormancy of the seeds, which was significantly different at 5% for all treatments (Figure 1A). Thus, it shows the existence of tegumentary dormancy. Possibly, it occurs because when the tegument is perforated the water intake is facilitated, thus allowing the beginning of the germination process with imbibition of the embryo. Our results is similar to Phartyal et al. (2005) who worked with *Dodonaea viscose* L. seeds and indicated that seeds that were mechanically scarified germinated to much higher percentage than did those that were non-scarified.

Several studies have reported the effectiveness of mechanical scarification in some species such as *Hymenaea intermedia* Ducke (CRUZ et al., 2001), *Operculina macrocarpa* L. (MEDEIROS FILHO et al., 2002) and *Ricinus communis* L. (MENDES et al., 2009).

The emergence speed index (ESI) was statistically different in T_2 (1,49) and T_3 (1,39) compared to other treatments (Figure 1B), reflecting in a higher percentage of seedling emergence (Figure 1A). In our study, mechanical scarification was a good method to increase the rate of plant emergence, which has been found in other studies as Matheus et al. (2010) that worked with two *Erythrina* species and obtained better results for *E. velutina* (5,11) and *E. falcata* (3,40). Costa et al. (2013) worked with *Bauhinia forficata* Link and also found high rate of ESI (1,88).

In the present study, we showed that *J. mollissima* seeds might emerge rapidly particularly when treated with mechanical scarification (Figure 1B). In semiarid climate of the

Figure 1 - Different pre-germinative treatments of *J. mollissima* (T_1 - control; T_2 - mechanical scarification on the opposing extremity to hilum with sandpaper Nº 80; T_3 - mechanical scarification on the lateral region with sandpaper Nº 80; T_4 - water immersion at 25ºC for 24 hours; T_5 - water immersion at 25 ºC for 12 hours). Bars indicate standard deviation. Averages followed for the same letter do not differ for the test of Tukey at 5% of probability.



Caatinga, where rainfall is scarce, the seeds may be scarified by mechanical abrasion of the stony endocarp by sand and rocks, mainly in watercourses. Thus, possibly, success in this harsh environment depends on such event, since there is a short period for seed germination and seedling establishment.

The root length (Figure 1C) was statistically different between treatments. The aerial part length was statistically similar, but treatment T_4 showed a tendency to be more vigorous (Figure 1D). Was expected that the treatments with mechanical scarification presented more vigorous seedling growth, since their ESI were higher (Figure 1B). However, this was not observed. An explanation for this fact is that the seedlings of other treatments were able to follow the growth of T_2 and T_3 since existed abundant availability of water, which cannot occur in the natural environment. Similar results was found by Miranda et al. (2011) that worked with *Prosopis juliflora* (Sw) DC seeds and found no significant differences between control and mechanical scarification to shoot height at 30 days.

The analysis of variance indicated that treatments had significantly different impact on dry weight matter of root system (Figure 1E), aerial part (Figure 1F), stem diameter (Figure 1G) and number of leaves (Figure 1H). The treatment T_4 showed a tendency to produce more dry matter of roots and shoots compared to control (T_1). On the other hand, mechanical scarification was statistically similar to the control (Figure 1E and F). In literature it was also evidenced by Menegazzo et al. (2013) that reported for *Annona squamosa* L. seeds that mechanical scarification and control were statistically similar to dry matter of roots and shoots.

Conclusion

The most efficient treatments to overcome physical dormancy of *J. mollissima* seeds were the mechanical scarification on the opposing extremity to hilum and the lateral region.

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