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Thermal scarification to overcome *Piptadenia moniliformis* seeds dormancy

Elane G. B. de S. Ferreira¹, Valderez P. Matos¹, Romário B. Silva¹,
Helder H. D. Santos¹ & Lúcia H. M. Sena¹

¹ Universidade Federal Rural de Pernambuco, Departamento de Agronomia, Rua Dom Manoel de Medeiros, s/n, Dois Irmãos, CEP 52171-900, Recife-PE, Brasil. E-mail: egbsf@bol.com.br; vpmatoss@ig.com.br; romariobs@gmail.com; helder_hds19@hotmail.com; lumsena@bol.com.br

ABSTRACT

This study aimed to evaluate the performance of different thermal scarification methods to overcome *Piptadenia moniliformis* seeds dormancy. The thermal treatments used were: control (no treatment - T_1); seed immersion in water at 80 and 100 °C for 10 (T_2 and T_6 , respectively), 30 (T_3 and T_7 , respectively) and 60 (T_4 and T_8 , respectively) seconds; seed immersion in water at 80 °C until cooling to room temperature (28 °C) (T_5), and seed immersion in water at 100 °C until cooling to room temperature (28 °C) (T_9). The seeds were placed for germination in boxes with transparent lid, containing the blotting paper substrate, which was moistened with Nystatin solution. Later, they were placed in a Biochemical Oxygen Demand germinator, regulated at 30 °C under continuous light. The following parameters were evaluated: first germination counting; final germination; germination speed index; root and shoot length; and root and shoot dry mass. The thermal scarification using seed immersion in water at 80 °C for 10 and 30 seconds was efficient in overcoming dormancy in *Piptadenia moniliformis* seeds, presenting the highest germination and vigor percentage.

Key words: forest species, germination, vigor

*Escarificação térmica para superação da dormência de sementes de *Piptadenia moniliformis**

RESUMO

O presente trabalho propôs avaliar o desempenho de diferentes métodos de escarificação térmica para superação da dormência de sementes de *Piptadenia moniliformis*. Os tratamentos térmicos utilizados foram: testemunha (sementes intactas - T_1); imersão das sementes em água a 80 e 100°C por 10 (T_2 e T_6 , respectivamente), 30 (T_3 e T_7 , respectivamente) e 60 segundos (T_4 e T_8 , respectivamente), imersão das sementes em água a 80°C até resfriamento em temperatura ambiente (28°C) (T_5) e imersão das sementes em água a 100°C até resfriamento a temperatura ambiente (28°C) (T_9). Para avaliação do efeito dos tratamentos foram determinados a contagem de germinação inicial, germinação final e índice de velocidade de germinação, tal como o comprimento e a massa seca da raiz e parte aérea. A imersão das sementes em água a 80°C por 10 e 30 segundos é eficiente na superação da dormência das sementes de *Piptadenia moniliformis*.

Palavras-chave: espécie florestal, germinação, vigor

Introduction

In Brazil, the occurrence of *Piptadenia moniliformis* Benth. (Leguminosae-Mimosoideae), commonly known as 'quipembé', 'angico de bezerro' and 'muquê', is observed from the states of Maranhão and Piauí up to the state of Bahia, specifically in the Caatinga, Carrasco, Seridó, Cerrado and Agreste regions (Maia, 2004). According to the same author, the species can be used in forest restoration in agroforestry systems, its bark has tannin, which can be harnessed industrially, it is considered apiarian, and its propagation is made by seeds.

The seed dormancy can be defined as a phenomenon in which the seeds of a species even if they are viable and having the appropriate environmental conditions to germinate they do not germinate (Davide & Silva, 2008), for this reason, the use of pre-germinating treatments is necessary to overcome such problem. Most forest species present seed dormancy mechanisms, leading to the need for studies that better explain this process. In order to do so, practical methods for overcoming dormancy, which improve germination and performance of seedlings in the nursery are necessary (Melo & Rodolfo Júnior, 2006).

Pre-germinating treatments are important for speeding and unifying seed germination (Pacheco & Matos, 2009), however, the fast and uniform germination of the seeds, together with vigorous development of plants, is extremely important to subsidize the work of researchers, improvers, seed lab technicians (Medeiros Filho et al., 2005) and nurserymen.

However, on species that have dormancy should be developed more specific studies (Barbosa et al., 2004) as performed by Alencar et al. (2009) with the species *Stylosanthes macrocephala* M. B. Ferreira & S. Costae, where the most effective treatment to break dormancy is to submit seed to oven at 60 °C for 15 hours, while the most recommended seeds of *Stylosanthes capitata* Vogel, the temperature was 70 °C. For seeds *Vachellia farnesiana* (L.) Wight & Arn. mechanical scarification with sandpaper for wood n. 120 provided the best result to break dormancy (Moraes et al., 2012). Treatments mechanical scarification with sandpaper and chemical sulfuric acid for periods between 15 and 45 min were efficient in overcoming coating of the seeds of *Parkia platycephala* Benth. impermeable to water (Nascimento et al., 2009).

This work aimed to evaluate the performance of different thermal scarification methods to overcome *Piptadenia moniliformis* seed dormancy.

Material and Methods

Piptadenia moniliformis seeds were collected in October 2008, in the municipality of Olho d'Água do Casado, in the state of Alagoas, Brazil; the experiments were conducted in the Seeds Laboratory of the Department of Agronomy of the Federal Rural University of Pernambuco (UFRPE), Pernambuco, Brazil.

Seeds presented water content of 9.4%, the thermal treatments with hot water used were: control (no treatment - T_1), seed immersion in water at 80 and 100 °C for 10 (T_2 and

T_6 , respectively), 30 (T_3 and T_7 , respectively) and 60 (T_4 and T_8 , respectively) seconds, seed immersion in water at 80 °C until cooling to room temperature (28 °C) (T_5), and seed immersion in water at 100 °C until cooling to room temperature (28 °C) (T_9). After submission to the pre-germinating treatments, seeds were treated with sodium hypochlorite (2%) for 5 min, and were then washed in deionized water.

Seeds were placed for germination in boxes with transparent lid, containing blotting paper substrate, which was moistened with Nystatin solution at 2%, equivalent to 2,5 times of its weight. Later, they were placed in a *Biochemical Oxygen Demand* (B.O.D) germinator, regulated at constant 30 °C temperature, under continuous light.

The following characteristics were evaluated: first germination counting - corresponding to the germinated seeds percentage on the forth day after sowing; final germination (%) - corresponding to the total germinated seeds percentage until the end of the experiment, which occurred at the fifteenth day after sowing; germination speed index (GSI) - calculated according to the formula presented by Maguire (1962); root and shoot length - at the end of the germination test, primary root and shoot length of the normal seedlings were measured with a ruler graduated in centimeters, and results expressed in centimeters per seedling; root and shoot dry matter; after the conclusion of the germination tests, root and shoot of the normal seedlings in each replication were conditioned in paper bags, identified and led to a forced ventilation oven, regulated at 80 °C, for 24 hours, and further weighed in an analytical scale; results were expressed in mg/seedling (Nakagawa, 1999).

For the study of dormancy overcoming, the experimental design was completely randomized with four replications of 25 seeds each and the means were compared by the Scott-Knott test, at a 5% level of probability.

Results and Discussion

All treatments used to overcome *Piptadenia moniliformis* seed dormancy were efficient in the first germination counting, with no significant difference between them. In all thermal treatments, the germination percentage obtained in the first counting was over 50%, while the seeds that were not submitted to pre-germinating treatments presented only 16% (Figure 1). According to Pacheco & Matos (2009), the thermal stress can be responsible for the seed-coat weakening and cracking, allowing faster water absorption by the seeds so the germination process can be triggered. For the *Arachis pinto* Krapov. & W. C. Greg. species, the healthy fruit heating at 45 °C for 48 and 72 h resulted in germinated seeds reduction.

It can be observed that all pre-germinating treatments used to overcome *Piptadenia moniliformis* seed dormancy favored their germination, with no significant differences between them (Figure 2). Other authors also found positive responses with thermal scarification in studies, such as Barbosa et al. (2004), in which the best treatments for overcoming balsa wood (*Ochroma lagopus* Sw., Bombacaceae) seeds was the immersion in hot water at 80 °C until cooling. Medeiros &

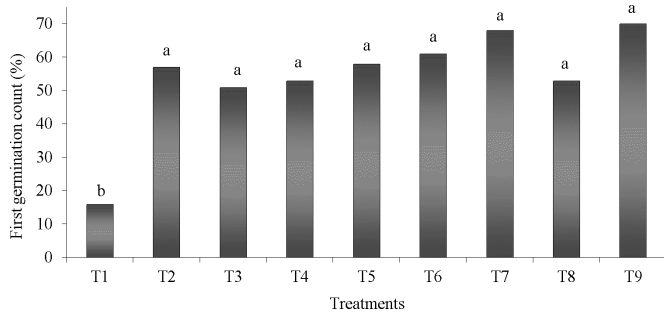


Figure 1. First counting of the germination (%) of *Piptadenia moniliformis* seeds submitted to different treatments to overcome dormancy. Control (T₁); seed immersion in water at 80 °C for 10 (T₂), 30 (T₃), 60 seconds (T₄) and seed immersion in water at 80 °C until cooling to room temperature (28 °C) (T₅); seed immersion in water at 100 °C for 10 (T₆), 30 (T₇), 60 seconds (T₈) and seed immersion in water at 100 °C until cooling to room temperature (28 °C) (T₉). Means followed by the same letter do not differ by the Scott-Knott test at 5% level of probability (CV = 22.54)

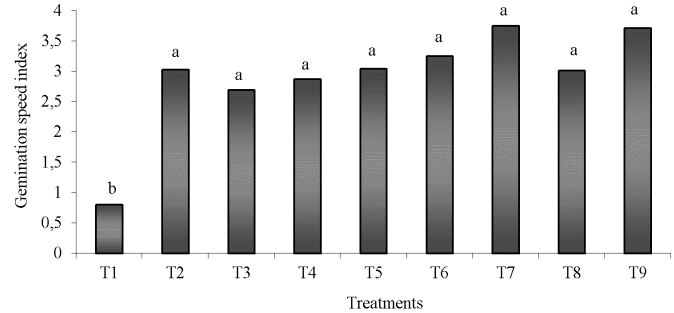


Figure 3. Germination speed index of *Piptadenia moniliformis* seeds submitted to different treatments to overcome dormancy. Control (T₁); seed immersion in water at 80 °C for 10 (T₂), 30 (T₃), 60 seconds (T₄) and seed immersion in water at 80 °C until cooling to room temperature (28 °C) (T₅); seed immersion in water at 100 °C for 10 (T₆), 30 (T₇), 60 seconds (T₈) and seed immersion in water at 100 °C until cooling to room temperature (28 °C) (T₉). Means followed by the same letter do not differ by the Scott-Knott test at 5% level of probability. (CV = 18.76)

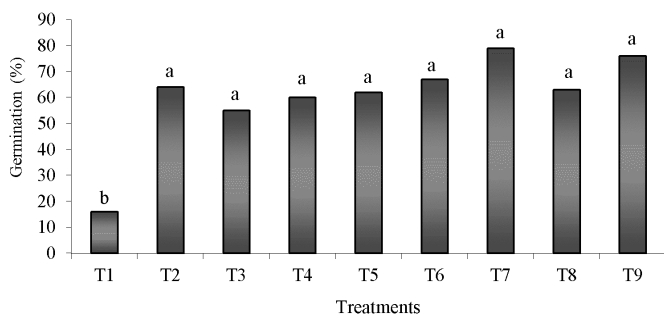


Figure 2. Final germination (%) of *Piptadenia moniliformis* seeds submitted to different treatments to overcome dormancy. Control (T₁); seed immersion in water at 80 °C for 10 (T₂), 30 (T₃), 60 seconds (T₄) and seed immersion in water at 80 °C until cooling to room temperature (28 °C) (T₅); seed immersion in water at 100 °C for 10 (T₆), 30 (T₇), 60 seconds (T₈) and seed immersion in water at 100 °C until cooling to room temperature (28 °C) (T₉). Means followed by the same letter do not differ by the Scott-Knott test at 5% level of probability. (CV = 18.47)

Zanon (1999) also observed that the most efficient treatment in overcoming Sydney Golden Wattle (*Acacia longifolia* (Andr.) Willd.) seeds dormancy was immersion in hot water at 96 °C and resting for 18 h.

The immersion in hot water is a physical treatment quite used in overcoming seed dormancy in legumes, however, despite being a profitable method due to its low cost (Rodrigues et al., 1990; Santarém & Aquila, 1995), it has been observed that it can be efficient only for some species. In a study accomplished by Azeredo et al. (2010) the immersion in sulfuric acid for 20, 25 and 30 min was indicated for the overcoming dormancy of *Piptadenia moniliformis* Benth. seeds.

With regard to germination speed index (GSI), the highest value was observed when the seeds were submitted to the thermal treatments for overcoming dormancy (Figure 3). The results obtained for the GSI were similar to the ones found in the final germination percentage (Figure 2), as opposed to the work carried out by Alencar et al. (2009) with the *Stylosanthes capitata* SW. species, in which the 50 °C temperature had no significant effect on germination and on GSI, and the GSI was 2.33 when seeds were submitted to the 60 °C/10 h temperature and Martins-Corder et al. (1999) also found that immersion in hot water at a temperature of 80 °C

stood out among the others in overcoming numbness seeds of *Acacia mearnsii* De Wild.

Piptadenia moniliformis seedlings primary root growth and roots mass presented superior results, not differing from each other, when seeds were submitted to immersion in water at 80 °C for 10 (T₂), 30 (T₃), 60 seconds (T₄) and until cooling (T₅), including control (without treatment), while the other treatments caused reduction in these parameters (Figures 4 and 5). In a study carried out by Coelho et al. (2010) with *Caesalpinia ferrea* Mart ex Tul seeds, it was observed that the root length of all treatments (mechanical scarification on the opposing extremity to hilum; mechanical scarification on the extremity next to hilum; mechanical scarification on the lateral region; water immersion at 80 °C and water immersion at 100 °C) used led to superior results and was not different from each other when compared to control. Opposite result was obtained with seeds of *Parkia gigantocarpa* Ducke to break dormancy through the use of hot water at 100 °C is not adequate, leading to death of the seeds with partial tear of the integument and extrusion content (Oliveira et al., 2012).

It is worth highlighting that even though the seed immersion treatments in water at 100 °C for 10 (T₆), 30 (T₇), 60 seconds (T₈) and until cooling (T₉) did not make the seeds create vigorous plants regarding root length and dry mass (Figures 4 and 5), they presented more results in parameters like germination percentage and speed. On the other hand, the seeds that were not submitted to the treatments had vigorous plants, but presented low germination percentage and speed, which shows that seeds of this species presented dormancy, as observed by the retardation and disuniformity found in the seeds that were not submitted to any thermal treatment.

According to Figure 4, *Piptadenia moniliformis* seeds submitted to immersion in water at 80 °C for 60 seconds (T₄) and immersion in water at 80 °C until cooling to room temperature (28 °C) (T₅) made the plants create seedling with lower shoot length, while the other treatments resulted in more vigorous seedlings in relation to shoot length, including control.

The ‘pau-de-jangada’ (*Apeiba tibourbou* Aubl) seeds created more vigorous seedlings regarding shoot growth when submitted to all treatments used, including immersion in water

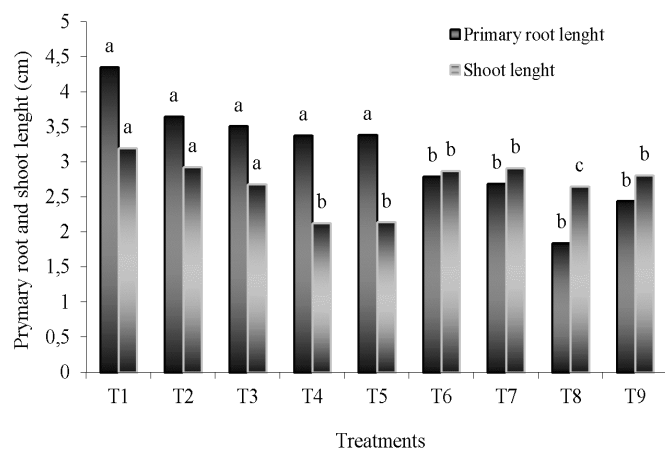


Figure 4. Primary root and shoot length of *Piptadenia moniliformis* seeds submitted to different treatments to overcome dormancy. Control (T₁); seed immersion in water at 80 °C for 10 (T₂), 30 (T₃), 60 seconds (T₄) and seed immersion in water at 80 °C until cooling to room temperature (28 °C) (T₅); seed immersion in water at 100 °C for 10 (T₆), 30 (T₇), 60 seconds (T₈) and seed immersion in water at 100 °C until cooling to room temperature (28 °C) (T₉). Means followed by the same letter do not differ by the Scott-Knott test at 5% probability level (CV = 23.26 and 10.80, respectively)

at 80 °C, except treatment immersion in sulfuric acid for 10 min and control (Pacheco & Matos, 2009).

The shoot dry mass of *Piptadenia moniliformis* seedlings did not present any significant difference when the seeds were submitted to the different treatments for overcoming dormancy (Figure 5).

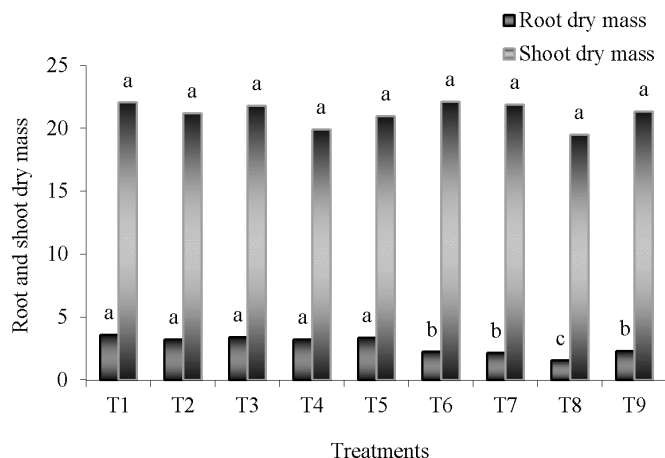


Figure 5. Root and shoot dry mass of *Piptadenia moniliformis* seeds submitted to different treatments to overcome dormancy. Control (T₁); seed immersion in water at 80 °C for 10 (T₂), 30 (T₃), 60 seconds (T₄) and seed immersion in water at 80 °C until cooling to room temperature (28 °C) (T₅); seed immersion in water at 100 °C for 10 (T₆), 30 (T₇), 60 seconds (T₈) and seed immersion in water at 100 °C until cooling to room temperature (28 °C) (T₉). Means followed by the same letter do not differ by the Scott-Knott test at 5% level of probability (CV = 12.30 and 7.23, respectively)

Conclusions

Thermal scarification using seed immersion in water at 80 °C for 10 and 30 seconds was efficient in overcoming dormancy in *Piptadenia moniliformis* seeds, presenting the highest germination and vigor percentage.

The pre-germinating treatment seed immersion in water at 100 °C for periods of 10, 30, 60 seconds and until cooling to room temperature (28 °C) is not indicated for overcoming dormancy of the studied species, due to the low vigorous plants effect.

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