EVALUATION OF METHODS FOR GERMINATION INDUCTION IN *Mimosa caesalpiniaefolia* BENTH. SEEDS

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Abstract – Mimosa caesalpiniaefolia seeds have dormancy due to water impermeability of the integument. The aim of this study was to evaluate different treatments for breaking dormancy of seeds of M. caesalpiniaefolia. The seeds were collected at the Experimental Field of Embrapa Rondonia, in Porto Velho. At the Laboratory of Plant Biotechnology, the seeds were subjected to the treatments: mechanical scarification with scalpel; chemical scarification with sulfuric acid; chemical scarification with sodium hypochlorite; stratification; dark storage; lixiviation with running water, immersion in hot water. Subsequently the seeds were placed in Petri dishes with filter paper moistened with distilled water and kept in a growth chamber at 25°C, photoperiod of 16 hours, except for the treatment with storage in the dark. A completely randomized design was used with four replications of 25 seeds per dish. The percentage of germination was evaluated in the 23 subsequent days. The highest percentages were obtained by mechanical scarification and chemical scarification with sulfuric acid, which resulted in 100 and 93% of seed germination, respectively.

Keywords: Dormancy. Scarification. Mimosaceae.

I. INTRODUCTION

Mimosa caesalpiniaefolia Benth. is a native tree to Northeastern Brazil and belongs to the Mimosaceae botanic family (Ribeiro, 1984). Trees are small, usually with prickles on the branches, bipinnate leaves, small flowers in cylindrical spikes, seeds in articulated legume fruits. It is one of the most promising species for the deployment of multiple-use forests and reforestation of degraded areas due to its rapid growth (Araújo Filho *et al*., 1998; Lorenzi, 2002). The leaves are used as a food source for cattle, particularly during the dry season in the semiarid Northeast Brazil (Alves *et al*., 2004). The wood is hard, compact, very durable and can be used in the manufacture of poles and stakes, which allows wide use on farms as hedges (LORENZI, 2000).

Species of the Mimosaceae family often have seed dormancy due to water impermeability of the integument. This kind of dormancy is a process characterized by delayed germination, which only occurs in adequate environmental conditions, favorable to the plants to survive. It should be noted that the dormancy has its importance for the perpetuation of the species, increasing the possibility of establishment of new individuals or colonization of areas by distributing germination in space and time (Carvalho & Nakagawa, 2000). However, from the agricultural point of view, the dormancy delays germination when the seeds are subjected to harsh conditions (BORGES *et al*., 1982) and also decreases the number of cycles per year (BORGHETTI & FERREIRA, 2008).

There are several techniques for breaking seed dormancy caused by water impermeability. A slight scarification is sufficient to permit water to enter so germination can occur. Under natural conditions mechanical scraping can occur inside the gizzard of birds and represents a spreading strategy. One of the simplest artificial methods is mechanical scarification, which can be performed by cutting the seed integument with a blade. This method has already been established with the leguminous tree species *Salpinia ferrea* Mart. ex Tul., *Bauhinia forficata* Link. and *Schizolobium parahyba* (LORENZI, 1992; BORGHETTI & FERREIRA, 2008).

The chemical scarification performed by sulfuric acid allows the seed to perform gas exchange and water absorption (Popinigis, 1985). The natural exposure of seeds to acids occurs inside the animal digestive systems and also is a way to spread seeds. The seeds of leguminous trees such as *Mimosa bimucronata* (DC.) Kuntze and *Dimorphandra mollis* Benth. are examples of seeds whose dormancy can be broken by exposure to sulfuric acid (BORGHETTI & FERREIRA, 2008).

The immersion of seeds in hot or boiling water has also been widely used because this practice removes the waxes present in the integument, thereby decreasing its impermeability (Zaidan & Barbedo, 2004). It is inexpensive and requires less care when compared with treatment with sulfuric acid. This procedure has been successfully used in *Mimosa bimucronata* (DC.) O. Kuntze (RIBAS *et al*., 1996).

The immersion in sodium hypochlorite is mostly used in disinfection procedures in laboratories. Nevertheless, because it is a low-cost product and easy to handle, some researchers have also been using this compound in chemical scarification of *Oryza sativa* L. (Ribeiro *et al*., 2009), *Coffea arabica* L. (Rubim *et al*., 2010) and *Lactuca sativa* L. seeds (RODRIGUES *et al*., 2012).

The physical effect of water in breaking dormancy can be understood when it plays the role of a leaching agent, washing growth inhibitors present in the seed integument. This technique consists of exposing the seeds to running water over a period of time. Under natural conditions, the occurrence of successive rainfalls can end up washing inhibitors from the seed integument, thereby providing germination in an

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environment which provides abundance of water to the plant growth (FERREIRA & BORGHETTI, 2008).

Light is another important factor in breaking dormancy, because the action of different wavelengths on the phytochrome is one of the main factors for germination (Ferreira & Borghetti, 2008). Thus, the germination of some species may be inhibited by light, whereas in other germination can be promoted. The response of seeds to light, or the lack of it, is one of the factors controlling the germination time and can be seen more commonly in small seed species. In some cases, germination with a lack of light can indicate that in a natural environment other plants provide a protection against direct sunlight (PONS, 2000).

Temperature can affect the biochemical reactions that determine the whole germination process. Stratification is a practice to break dormancy in which seeds are exposed to a few days of low temperatures as a pre-germination procedure. This situation occurs in natural conditions during late winter. Seeds of some species of the genus *Pinus, Pyrus, Rosa* and the cereals *Avena sativa* L. and *Vitis vinifera* L. depend on the cold to germinate (FERREIRA & BORGHETTI, 2008).

There is a need for studies in laboratory conditions to understand the process of breaking dormancy of seeds of the species *M. caesalpiniaefolia* taking into account its social and economic value. Some studies have been conducted with their seeds (Novembre *et al*., 2007; Alves *et al*., 2004; Garcia *et al*., 2002; Torres *et al*., 1994), but there are few studies that determine the best methods to break seed dormancy. The aim of this study was to evaluate the efficiency of different treatments in breaking dormancy of *M. caesalpiniaefolia* seeds.

II. PROCEDURES

Seeds of *M. caesalpiniaefolia* were collected from trees in the experimental field of Embrapa Rondonia, Porto Velho. The experimental field is located at 08˚48'N and 63˚51'W, with an elevation of approximately 88 meters and according to Köppen classification the climate is Aw, tropical rainy. The treatments were applied at the Laboratory of Plant Biotechnology of Embrapa Rondonia. Seeds were subjected to the following treatments: mechanical scarification by cutting with scalpel in the seed integument; chemical scarification by immersion in concentrated sulfuric acid for 10 minutes followed by washing with running water; chemical scarification by immersion in 2% sodium hypochlorite for 10 minutes followed by washing with running water; stratification by storage at 8°C for 24 hours; dark storage; washing on a sieve with running water for 24 hours; immersion in water at 80°C for 10 minutes; and control: intact seeds without pre-germination treatment.

After that, the seeds were placed in Petri dishes with filter paper moistened with 10 mL of distilled water and kept in a growth chamber at 25°C. A completely randomized design was used with four replications, each consisting of 25 seeds on a plate, totaling 100 seeds per treatment.

To evaluate the treatment's effect, the variable used during 23 days was the germination percentage followed by effective conversion into normal seedlings, i.e., those who had all the essential perfect structures (Brasil, 1992). The results were submitted to analysis of variance and averages were compared by Tukey test at 5%.

III. RESULTS AND DISCUSSION

The percentages of seed germination in relation to the treatments are shown in the Figure 1. In the experimental control group, there was only 2% germination, indicating that most of the seeds were dormant.

Mechanical scarification resulted in 100% germination. The effectiveness of this method has been proven in seeds of several species: *Leucaena diversifolia* (Schlecht.) Bentham K 156 (Bertalot & Nakagawa, 1998), *Bauhinia ungulata* L. (Alves *et al*., 2000), *Bixa orellana* L. (Custódio *et al*., 2002), *Operculina macrocarpa* (L.) Farwel (Medeiros Filho *et al*., 2002), *Lotus subbflorus* L. (Jacob Jr. *et al*., 2004), *Ormosia nitida* Vog. (Lopes *et al*., 2006), and *Senna siamea* (Lam.) H.S. Irwin E Barneby (DUTRA *et al*., 2007).

The germination percentage of chemical scarification with sulfuric acid reached 93% and did not differ significantly from the treatment with mechanical scarification. Work carried out with *Parkia platycephala* Benth. seeds also confirmed the efficiency of mechanical scarification by cutting the integument and also chemical scarification by immersion in concentrated sulfuric acid (GARCIA *et al*., 2002; NASCIMENTO *et al*., 2009).

The chemical scarification with sulfuric acid was the most effective in studies with seeds of *Bowdichia virgilioides* Kunth (Smiderle & Souza, 2003), *Brachiaria dictyoneura* cv. Llanero (Almeida & Silva, 2004), *Zizyphus joazeiro* Mart. (Alves *et al*., 2008), *Senna siamea* (Lam.) H.S. Irwin & Barneby (Dutra *et al*., 2007), *Caesalpinia leiostachya* (Benth.) Ducke (Biruel *et al*., 2007), *Stryphnodendron adstringens* (Mart.) Coville (Martins & Nakagawa, 2008), *Brachiaria brizantha* cv. marandu (Hochst. ex A. Rich.) Stapf (Gaspar-Oliveira *et al*., 2008), *Dinizia excelsa* Ducke (Cruz *et al*., 2009), *Adenanthera pavonina* L. (Rodrigues *et al*., 2009), *Myracrodruon urundeuva* Freire Allemão (Guedes *et al*., 2009), *Piptadenia moniliformis* Benth. (Azeredo *et al*., 2010), *Centrosema plumieri* Benth. (Gama *et al*., 2011), *Colubrina glandulosa* Perk. (Brancalion *et al*., 2011), *Senna macranthera* (Collad.) Irwin et Barn. (Pozitano & Rocha, 2011), *Parkia panurensis* Benth. ex H.C. Hopkins e *Parkia velutina* Benoist (MELO *et al*., 2011).

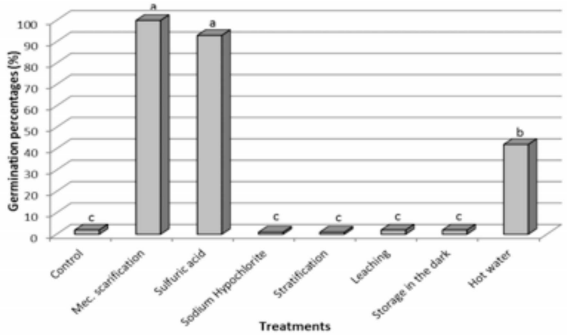

Figure 1- Germination of *M. caesalpiniaefolia* seeds 23 days after incubation, in relation to the methods used to break dormancy
Letters indicate significance by Tukey test at 5% probability

The chemical scarification with sodium hypochlorite and stratification at low temperature showed the lowest results, only 1%, and did not differ significantly from experimental control. Likewise, Franco *et al*. (2009) found

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no significant germination from pre-chilling (stratification) applied to seeds of *Oryza sativa* L. However, Meneghello *et al.* (2002) showed that pre-chilling is an efficient method to overcome seed dormancy in *Melissa officinalis* L.

Washing in running water for 24 hours resulted in only 2% germination. Different results were obtained from Brasileiro *et al.* (2010), who observed that submitting *Talinum triangulare* (Jacq.) Willd seeds to running water for 24 hours was effective in breaking dormancy. Borghetti & Ferreira (2004) recommend this procedure to overcome dormancy in seeds of some species which have difficulty to germinate.

Incubation in the dark results only in 2% germination. Amato *et al.* (2007) also observed that the absence of light was not a positive factor for the germination of *Arachis pintoi* Krapov. & WC Gregory seeds.

Soaking in hot water at 80°C for 10 minutes resulted in 42% germination. The use of the hot water method is considered advantageous and cost effective. Similar results have shown effectiveness, at 70°C for three minutes in *Zizyphus joazeiro* Mart. (Alves *et al.*, 2008), at 100°C for 10 seconds in *Bowdichia virgilioides* Kunth (Smiderle & Schwengber, 2011), at 100°C for 1 minute in *Acacia mangium* Wild (Smiderle *et al.*, 2005), at 80°C for 10 minutes in *Caesalpinia pyramidalis* Tul. (Alves *et al.*, 2007), and at 95°C keeping in the same water for the subsequent 24 hours in *Peltophorum dubium* (Sprengel) Taubert.

IV. CONCLUSION

The mechanical scarification and chemical scarification with concentrated sulfuric acid are effective treatments to overcome dormancy in *Mimosa caesalpiniaefolia* Benth. seeds.

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