GERMINATION OF NATIVE CAATINGA SPECIES IN SALT AND WATER STRESS CONDITIONS

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ABSTRACT: The occurrence of saline soils with water restriction were common in several countries, especially those with arid and semi-arid regions, as example as Brazil. Therefore, knowledge about the influence of salt and water stress on the species germination from these regions are extremely relevant. Therefore, the aim of this study was to analyze the effect of saline and water stresses on the germination of two native species with wide occurrence in Caatinga region. The experiment consisted of five treatments, with 8 replicates containing 25 seeds, which were kept in a germination chamber at a temperature of 25 °C and 12/12 h photoperiod, for 12 days. The treatments corresponded to the different osmotic concentrations of NaCl and PEG 6000, simulating the saline and water stresses, respectively. The analyzed variables were percentage of germination (%G), germination speed index (GSI) and mean germination time (MGT). Water stress reduced the germination percentage in both species, in counterparts, the GSI decreased with the increase of osmotic concentrations, in both analysed species and stress conditions. The *P. stipulaceae* shown be more tolerant to saline stress than to water stress, whereas the seeds of *M. caesalpiniaefolia* had their germination severelly affected in both stresses.

KEYWORDS: water stress, tolerant species, salinity

GERMINAÇÃO DE ESPÉCIES NATIVAS DA CAATINGA EM CONDIÇÕES DE ESTRESSE HÍDRICO E SALINO

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RESUMO: A ocorrência de solos salinos e com restrição hídrica ocorrem em diversos países, principalmente aqueles que apresentam regiões áridas e semiáridas, com isso se tornam indispensável o conhecimento a cerca da influência dos estresses salino e hídrico na germinação das espécies oriundas dessas regiões. Diante disso, objetivou-se analisar o efeito dos estresses salino e hídrico na germinação de duas espécies nativas da Caatinga. O experimento foi constituído por cinco tratamentos, com 8 repetições contendo 25 sementes, sendo estas mantidas em câmara de germinação sob temperatura de 25°C e fotoperíodo de 12/12 h. Os tratamentos corresponderam as diferentes concentrações osmóticas de NaCl e PEG 6000, simulando os estresses salino e hídrico. As variáveis analisadas foram percentagem de germinação (%G); índice de velocidade germinação (IVG) e tempo médio de germinação (TMG). O estresse hídrico reduziu a percentagem de germinação nas duas espécies, e o IVG diminuiu à medida que se aumentou as concentrações osmóticas das soluções em ambos os estresses. A sementes de jurema-branca se mostraram mais tolerante ao estresse salino do que ao estresse hídrico, enquanto as sementes de Sabiá tiveram sua germinação significativamente afetada, em ambos os estresses analisados.

PALAVRAS-CHAVE: déficit hídrico, espécies tolerantes, salinidade

INTRODUCTION

Seed germination is crucial for the dissemination of the species and the preservation of its abundance in the ecosystem (Bewley et al. 2013). According to Braga et al. (2009), the germination period is important for the survival of forest species, especially in places where water availability is limited during a period of the year.

Piptadenia stipulacea (Benth.) (Jurema-branca) and *Mimosa caesalpiniaefolia* (Sabiá) are native species of Caatinga, widely distributed in Northeastern Brazil (Fabricante & Andrade, 2007). These species are very suitable for the recovery of degraded areas and forest restoration, used for the production of firewood, coal, carpentry (Lorenzi, 1992), and stand out as fodder for goats and other animals (Maia, 2004).

The occurrence of saline soils with water restriction were common in several countries, especially those with arid and semi-arid regions, as example as Brazil, considering that the salts are responsible for affecting the plants through the osmotic retention of water and the specific ionic effect on the protoplasm. Consequently, the water potential reduction of the soil happens, making it less accessible to plants (Moura et al., 2011), simulating an effect like water deficit (NASR et al., 2012).

The physiological responses of plant species to abiotic stresses, such as water and saline stress, have been widely addressed by several authors (Munns; Tester, 2008; Voigt et al., 2009; Marques et al., 2013; Alencar et al., 2015). The physiological mechanisms of tolerance to these stresses have been extensively studied in plant species during the germination phase (Voigt et al., 2009; Marques et al., 2013; Alencar et al., 2015), but little is known about the mechanisms of germination. adaptation of seeds of native species from the northeastern semiarid to the conditions of water restriction and salinity in the soil, and how these seeds can begin their vegetative development in their natural environment.

In relation to this, it is important to understand how the Caatinga native species can develop in such adverse conditions. Thus, the aim of this study was to evaluate the effects of saline and water stress on *P. stipulacea* (Benth.) and *M. caesalpiniaefolia* germination.

MATERIAL AND METHODS

The experiments occurred between February and September 2017, in the Biology Laboratory do IFCE Campus Crateús, Ceará. Initially, it was selected seeds without injuries. Subsequently, these seeds were disinfected with 0.5% sodium hypochlorite, for 5 minutes, thereafter they were washed with running water. The seeds were pre-germination treatment, which corresponded to their immersion in H_2SO_4 for a period of 30 minutes, which was used with the intention to broken the physical tegument dormancy.

The seeds of *P. stipulacea* and *M. caesalpiniaefolia* were placed to germinate in plastic boxes (gerbox) on germitest paper moistened with NaCl solutions of 0; 40.36; 80.72; 121.09 and 165.41 mM, in first experiment, and PEG 6000 solutions of 119.571; 178,343; 223.664 and 261.948 mM. The salt and osmotic treatments corresponded to osmotic concentrations of 0 (distilled water), -0.2, -0.4, -0.6 and -0.8 MPa. Germination tests were carried out in BOD chambers at 25 °C, in white light and photoperiod of 12 h light /12 h dark conditions.

A completely randomized experimental design was carried out, consisting of five treatments, with 8 replicates containing 25 seeds each. The salt and water treatments corresponded to the different concentrations of NaCl and PEG 6000. Daily, germination seed was recorded, until the number of seedling germinated became constant, which was around 12 days.

After that period, the percentage of germination (%G) (Laboriau, 1983), germination speed index GSI (Maguire, 1962) and mean germination time (TMG) (Laboriau, 1983) of the seeds were estimated. Data were submitted to analysis of variance (ANOVA, p <0.05 and p <0.01). According to the significance, the data were submitted to regression analysis (p <0.01), using the statistical software R (R DEVELOPMENT CORE TEAM, 2013).

RESULTS AND DISCUSSION

P. stipulaceae seeds showed be tolerant to salt stress, maintaining germination independent of the osmotic potential (Figure 1a). There was a linear reduction of this parameter, which was not significant with the osmotic concentration increase. However, in water deficit induced by PEG 600 solutions, it was observed a significant decrease in *P. stipulaceae* in this condition (p <0.01) (Figure 1b). The *P. stipulacea* germination was significant reduced from -0.4 MPa osmotic concentration, and after this period, the germination percentages were reduced gradually (Figure 1b). *M. caesalpiniaefolia* seeds had their germination influenced such as for salt stress (Figure 1c) and as water stress (Figure 1d), induced by NaCl and PEG 6000, respectively. In both stresses, the germination percentage decreased as the osmotic concentrations increased, and the lowest percentages verified at -0.8 MPa osmotic potential. Similarly to our results, Reis (2012) reported that *Erythrina velutina* (Willd.) seeds showed to be tolerant to the salinity, because its germination was not affect negatively when submitted to different NaCl concentrations.

The reduction in germination percentage observed in this study, especially for M. *caesalpiniaefolia*, may be associated with the physiological drought produced by the increase in salinity levels in the germination medium, since the increase of salt concentrations have a reductive effect on the osmotic potential and, consequently, reduces the water potential.

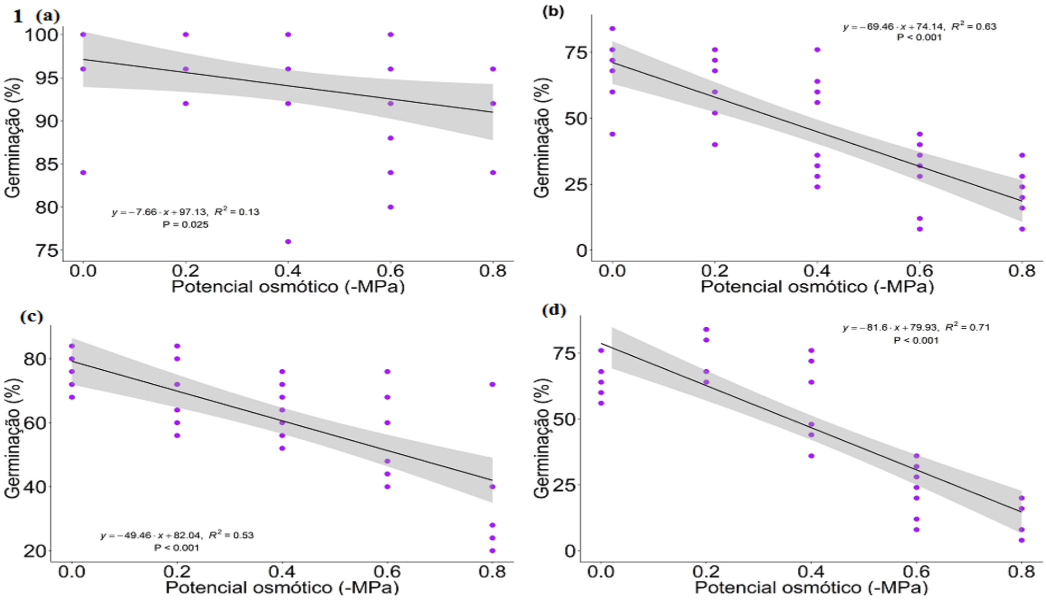

Figure 1. Germination percentage (% G) of *P. stipulaceae* seeds subjected to different osmotic potentials of NaCl (a) and PEG 6000 (b) and *M. caesalpiniaefolia* subjected to different osmotic potentials of NaCl (c) and PEG 6000 (d).

In relation to Germination Speed Index (GSI), there was a significant reduction (*P* <0.01), with a tendency of linear decreasing from the osmotic potential at -0,2 MPa (Figure 2a), which was 25.02, reaching the value of 17.10 for the treatment with the highest concentration of NaCl (-0.8 MPa). Regarding GSI in water stress condition, with the increase of osmotic agent concentration, it was observed a linear decrease in this parameter (Figure 2b). In addition, it was verified that the highest values of IVG were observed in the control treatments, followed by the potential -0,2 MPa, being that in the most negative osmotic potential, the lowest IVG was observed.

In salt stress conditions, *M. caesalpiniaefolia* seed germination showed linear decrease with NaCl concentrations increase (Figure 2c). However, this difference was only verified at highest NaCl stress condition (-0.8 MPa). The reduction in GSI found in this study, it could be associated with the reduction in osmotic potential caused by the increase in salinity, impairing the water absorption by the seeds, and consequently, compromising seed germination.

In water stress condition, these seeds also showed a decreasing linear reduction in PEG 6000 concentrations, which were more prominent at -0.6 and -0.8 MPa osmotic potential (Figure 2d). Similarly, to this study, Santos et al. (2016) verified that the seeds of *Poincianella pyramidalis* (catingueira) and *Anadenanthera colubrina* (angico), submitted to different osmotic potentials induced by NaCl, presented similar GSI results to the present study, with reductions from potential of -0.4 MPa. In addition, also corroborating this study, Matos et al. (2016) also observed higher IVG values in the control treatment (0.0 MPa), with rates of 40.0 in *Enterolobium contortisiliquum*, 26.0 in *Erythrina velutina* and 4.0 in *Ormosia arbórea*.

In general, this IVG reduction was correlated with the progressive reduction in the water potential, which may have been caused because there was a restriction in water absorption; this may have caused a reduction in the speed of some processes, such as biochemical and metabolic processes that contribute to the delay or germination inhibition.

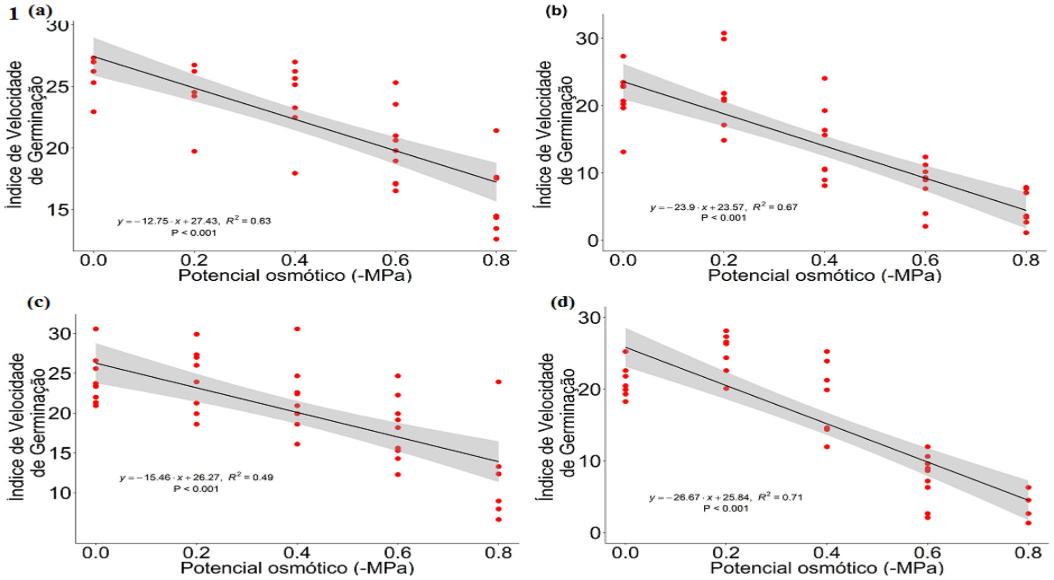

Figure 2. Germination speed index (GSI) of *P. stipulaceae* seeds subjected to different osmotic potentials of NaCl (a) and PEG 6000 (b) and *M. caesalpiniaefolia* subjected to different osmotic potentials of NaCl (c) and PEG 6000 (d).

In this study, it was verified that GMT of *P. stipulaceae* seeds were practically unchanged in salt stress (Figure 3a), with germination occurring around 5 days. Indeed, in water stress conditions, it was verified a linear significant decrease with PEG 6000 increment (Figure 3b). For M. *caesalpiniaefolia* seeds, it was verified a GMT around 6 days, for both treatments (Figure 3c, d), being that it was not verified significant differences between treatments.

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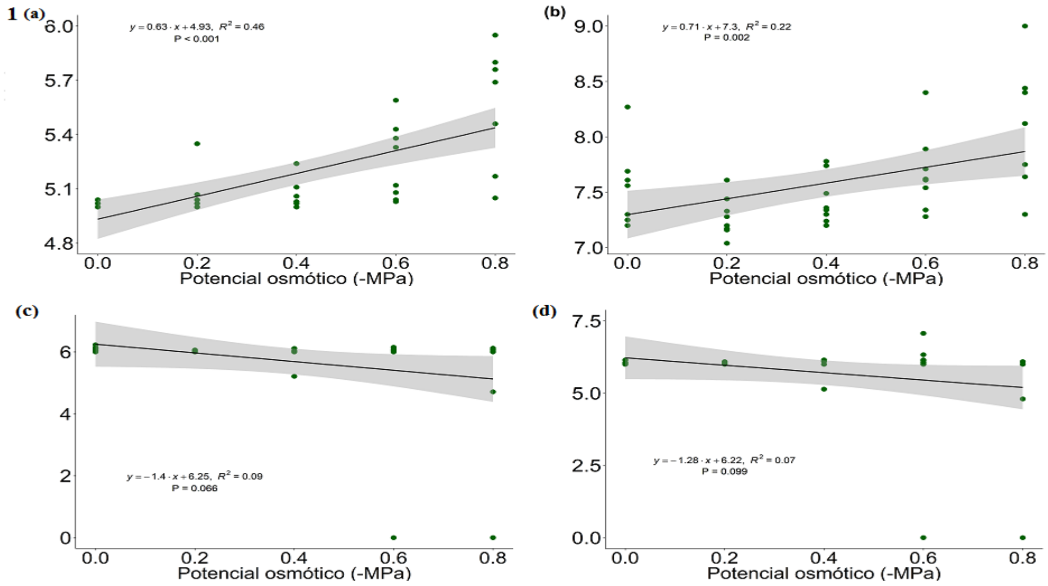

Figure 3. Germination medium time (GMT) of *P. stipulaceae* seeds subjected to different osmotic potentials of NaCl (a) and PEG 6000 (b) and *M. caesalpiniaefolia* subjected to different osmotic potentials of NaCl (c) and PEG 6000 (d).

In this study, GMT values remained pratically unchanged under saline stress condition, for both evaluated species, showing that this germination time combined with high germination rates may represent the tolerance of *P. stipulaceae* and *M. caesalpiniaefolia* seeds in salinity conditions. However, the GMT increase in P. *stipulaceae* seeds subjected to highest negative osmotic potential, may be related to the osmotic stress caused due to the reduction in water absorption. Moreover, when a GMT increase happens under stressful conditions, this may compromise the establishment of seedlings, which need favorable conditions to start their germination.

Similarly, Matos et al. (2016) reported that the species *Enterolobium contortisiliquum*, *Erythrina velutina* and *Ormosia arbórea* need a longer period to complete their germination when subjected to high negative osmotic potentials. Santos et al. (2016) described this same observation, with seeds of *Poincianella pyramidalis* and *Anadenanthera colubrina*.

CONCLUSION

P. stipulacea seeds showed to be tolerant to salt stress during germination stage, whereas *M. caesalpiniaefolia* was not tolerant to salinity.

P. stipulacea and *M. caeasalpiniaefolia* seed germination was severally affect by water stress effects, which could represent that this condition is more limiting for these seeds.

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