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GERMINATION OF CACTUS SEEDS UNDER SALINE STRESS[1]

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ABSTRACT – Cactus seeds in seasonal dry tropical forests are subject to several stressors, such as salt stress which limits imbibition and therefore germination. Thus, this study aimed to compare germination performance of *Cereus jamacaru* subsp. *jamacaru* and *Pilosocereus pachycladus* subsp. *pernambucoensis* seeds under salinity conditions. To this end, NaCl and KCl solutions were used in the following osmotic potentials: 0.0 (control), -0.2, -0.4, -0.6, -0.8, -1.0, and -1.2 MPa. Seeds were placed to germinate at 25 °C and 12-hour photoperiod. The number of germinated seeds was counted daily for 21 days after root protrusion. The variables analyzed were: water content, germination, normal seedlings, germination speed index, and average germination time. The experimental design was completely randomized, following a 2 × 7 factorial scheme (species × osmotic potential) for each saline source. Water restriction and ionic effect caused by salts favored seed germination and vigor in both species at -0.2 and -0.4 MPa. However, from -0.8 MPa onwards, germination decreased significantly for both salts. Seeds of *C. jamacaru* subsp. *jamacaru* and *P. pachycladus* subsp. *pernambucoensis* were tolerant to salt stress since they germinated up to -0.8 MPa (NaCl) and -1.2 MPa (KCl). The latter occurred only for *P. pachycladus* subsp. *pernambucoensis*.

Keywords: Caatinga. *Cereus jamacaru*. *Pilosocereus pachycladus*. Salinity. Vigor.

GERMINAÇÃO DE SEMENTES DE CACTÁCEAS SOB ESTRESSE SALINO

RESUMO – As sementes de cactáceas que ocorrem em florestas tropicais sazonais secas estão sujeitas a múltiplos estresses, a exemplo do estresse salino, que limita a embebição e, consequentemente a germinação. Assim, objetivou-se comparar o desempenho germinativo de sementes de *Cereus jamacaru* subsp. *jamacaru* e *Pilosocereus pachycladus* subsp. *pernambucoensis* em condições de salinidade. Para isso, utilizou-se soluções de NaCl e KCl nos seguintes potenciais osmóticos: 0,0 (controle); -0,2; -0,4; -0,6; -0,8; -1,0 e -1,2 MPa. As sementes foram colocadas para germinar sob a temperatura de 25 °C e fotoperíodo de 12 horas. A contagem do número de sementes germinadas foi realizada diariamente durante 21 dias após a protrusão radicular. As variáveis analisadas foram: teor de água, germinação, plântulas normais, índice de velocidade de germinação e tempo médio de germinação. O delineamento foi inteiramente casualizado seguindo o esquema fatorial de 2 × 7 (espécie × potencial osmótico) para cada fonte salina. A restrição hídrica e o efeito iônico causados pelos sais favoreceram a germinação e o vigor das sementes de ambas as espécies nos potenciais osmóticos de -0,2 e -0,4 MPa, entretanto, a partir de -0,8 MPa houve diminuição expressiva da germinação nos dois sais. As sementes de *C. jamacaru* subsp. *jamacaru* e *P. pachycladus* subsp. *pernambucoensis* foram tolerantes ao estresse salino, pois conseguiram germinar em potenciais de até -0,8 MPa (NaCl) e -1,2 MPa (KCl), este último, apenas no caso do *P. pachycladus* subsp. *pernambucoensis*.

Palavras-chave: Caatinga. *Cereus jamacaru*. *Pilosocereus pachycladus*. Salinidade. Vigor.

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INTRODUCTION

In Brazil, 484 cacti species are found distributed throughout the national territory. Of these, 208 are considered endemic species of Brazilian ecosystems (ZAPPI; TAYLOR, 2020). Mandacaru (*Cereus jamacaru* DC. subsp. *jamacaru)* and facheiro (*Pilosocereus pachycladus* subsp. *pernambucoensis* [Ritter] Zappi) are two columnar cacti widely occurring in the Caatinga biome, and their seeds can germinate in low water availability soils, which are found in arid and semi-arid areas (SILVA; AZERÊDO; TARGINO, 2020). Despite their wide distribution in the Brazilian semi-arid, seeds of these two xerophilic species are subject to several environmental factors that can influence recruitment of new individuals in their original populations.

In semiarid regions, salts tend to accumulate in soil solution due to a set of factors such as climatic, edaphic, and soil management practices. Excess salts cause several disturbances in plant metabolism, the first of which is osmotic effect restricting water transport in plant tissue, affecting germinability, seedling establishment, plant growth, and development, either by an osmotic imbalance or ionic toxicity (IBRAHIM, 2016; TAIZ et al., 2017; SANTOS et al., 2019).

Germination conditioning of Cactaceae seeds to saline stress is one of the most neglected topics, considering all studies in different research lines related to seed germination of this botanical family, with only 14 taxa having been studied on the subject so far (BARRIOS et al., 2020). In Brazil, a few studies have evaluated seed germination response to salinity conditions of some native cactus species such as *Cereus jamacaru* subsp. *jamacaru* (MEIADO et al., 2010), *Pilosocereus arrabidae* (MARTINS et al., 2012), *Pilosocereus catingicola* subsp. *salvadorensis* (LIMA; MEIADO, 2017), *Discocactus bahiensis*, *D. zehntneri* subsp. *petr-halfarii*, *D. zehntneri* subsp. *zehntneri* (NASCIMENTO; MEIADO; SIQUEIRA-FILHO, 2018), and *Pilosocereus gounellei* subsp. *gounellei* (= *Xiquexique gounellei* subsp. *gounellei*) (LIMA; OLIVEIRA; MEIADO, 2020). These studies pointed out important considerations on seed germination conditioning. However, studies comparing saline stress tolerance between species should be portrayed since soil salinization in the Caatinga can negatively affect colonization dynamics of native plant communities, especially in areas at risk of desertification (SANTOS; SOUZA; CASTRO, 2018).

In the laboratory, some compounds have been successfully used in research work to simulate water and saline stress effects on cacti seedlings and seeds, such as polyethylene glycol (PEG 6000), NaCl, KCl, $CaCl_2$, and $MgCl_2$ (SILVA; AZERÊDO; TARGINO, 2020; SILVA et al., 2021). Using saline solutions at different osmotic potentials is necessary to obtain data that could be indicators in defining the species tolerance degree to saline conditions (TAIZ et al., 2017), enabling a broader understanding of plant population establishment and exploitation.

Given the ecological and sociocultural relevance of mandacaru and facheiro, studies on their seed ecophysiology are of major importance for conservation programs to ensure survival and propagation in natural environment. Thus, this study aimed to compare the germinative performance of *C. jamacaru* subsp. *jamacaru* and *P. pachycladus* subsp. *pernambucoensis* seeds under saline stress conditions induced by NaCl and KCl in laboratory.

MATERIAL AND METHODS

Seeds were collected from ripe fruits of *C. jamacaru* subsp. *jamacaru* and *P. pachycladus* subsp. *pernambucoensis* adult individuals from two natural populations. Fruits of *C. jamacaru* subsp. *jamacaru* were collected in an experimental area of the Instituto Nacional do Semiárido (INSA) in the city of Campina Grande, Paraíba State (Brazil), while *P. pachycladus* subsp. *pernambucoensis* fruits were collected at the farm of Umburana, in the city of Bananeiras, Paraíba State (Brazil). Table 1 presents a summary of the main edaphoclimatic characteristics in the fruit collection areas. The phytophysiognomy in both areas is characterized as Caatinga forest formation at different ecological succession levels.

Table 1. Main edaphoclimatic characteristics in the areas of *C. jamacaru* subsp. *jamacaru* and *P. pachycladus* subsp. *pernambucoensis* fruit collection (BDMEP, 2021).

Area	Coordinates	Altitude (m)	Annual average temperature (min-max; °C)	Annual average rainfall (mm)	Soil	Taxon
Campina Grande, PB	7°13'50"S 35°52'52"W	546	23.5 (28.8- 20.2)	777	Litholic Neosol	*C. jamacaru* subsp. *jamacaru*
Bananeiras, PB	06º45'00"S 35º37'00"W	552	22.3 (27.8-18.8)	1.188	Red-yellow Oxisol	*P. pachycladus* subsp. *pernambucoensis*

To identify specimens, plant parts with botanical descriptors were collected, dehydrated in an air circulation oven at 65 °C for 48 hours, and then herborized. Once made, the exsiccates were sent to the Center for Agricultural Sciences (CCA) "*Herbarium Jayme Coelho de Moraes*" (EAN/ UFPB) for identification through comparisons with materials of the herbarium collection and specialized literature. The synonymy and spelling of taxa were updated by consulting the database "*Lista de Espécies da Flora do Brasil*" (REFLORA, 2020).

Fruits were pulped in the Seed Technology Laboratory of the Human, Social and Agrarian Sciences Center of the Federal University of Paraíba, Campus III, Bananeiras, PB. Seeds were separated from funicular pulp by maceration on a sieve, followed by washing in running water. Then, the seeds were left to dry for three days on paper sheets placed on the lab bench. Afterwards, they were kept in paper packaging at room temperature (24 ± 2 °C; 70% RH) in the laboratory until the beginning of the experiment, one week after fruit processing.

Seeds were not previously sterilized. Then, to simulate saline stress, salt solutions of sodium chloride (NaCl) and potassium chloride (KCl) were used, in the following osmotic potentials: 0.0 (distilled water), -0.2, -0.4, -0.6, -0.8, -1.0, and -1.2 MPa, according to the Van't Hoff equation (SALISBURY; ROSS, 1991). Seeds of both species were placed to germinate in transparent acrylic boxes (11 x 11 x 3.5 cm). Previously sterilized blotting paper was used as substrate. The paper was moistened once with saline solutions at 2.5 times its dry weight, placing two sheets under and one on the seeds. Then, the boxes were kept in a germination chamber at 25 °C and 12-hour photoperiod (MEIADO et al., 2010).

The number of germinated seeds was counted daily for 21 days, using as germination criterion the emission of radicle. Seed were considered germinated when the radicle tip protruded ≥ 1 mm out of the operculum opening. The variables analyzed were: seed moisture content, germination percentage, normal seedlings, germination speed index, and average germination time (KRZYZANOWSKI et al., 2020). Seed water content was determined by the oven method at 105 ± 2 °C for 24 hours (BRASIL, 2009). Normal seedlings were considered as those with well-developed and healthy essential structures, without signs of injuries or deformities.

The statistical design used was completely randomized, following a 2 x 7 factorial arrangement (species x osmotic potential) for each salt type, with four 50-seed replications (n = 200 seeds per treatment). Statistical analyses were processed using ESTAT/Jaboticabal® and Microcal Origin® 6.0 software. Data were subjected to variance analysis by the F-test; then, means compared by the Tukey's test ($p \leq 0.05$). As interactions were significant, polynomial equations were adjusted. However, due to the occurrence of negative estimates for some characteristics, data were analyzed using the Origin® 6.0 software by the non-linear logistic model (Pôrto et al., 2006), whose model adopted was Logistics 1 (Equation 1): $y = \frac{a}{1 + e^{-k(x-xc)}}$, where in: y = characteristic value for a given value of x (osmotic potential); a = maximum y characteristic value; k = relative growth rate (in the present case of y reduction); e = neperian logarithm base; xc = x value (osmotic potential) which provides a reduction in the maximum characteristic by 50%, and corresponds to the osmotic potential at curve inflection point.

RESULTS AND DISCUSSION

The variance analysis findings showed a significant interaction effect between factors for all characteristics evaluated ($p \leq 0.01$). The isolated factors also had effects ($p \leq 0.01$) when NaCl was used. Only the factor species had no significant effect on germination (G) and germination speed index (GSI) for seeds under KCl salt stress ($p \geq 0.05$) (Table 2).

During the experiment, *C. jamacaru* subsp. *jamacaru* and *P. pachycladus* subsp. *pernambucoensis* seed water contents were 18 and 12%, respectively, due to recent fruit pulping. According to the literature, water content of freshly collected seeds for some cacti species can range from 6.3 to 23.7% (CHEIB; GARCIA, 2012; CIVATTI; MARCHI; BELLINTANI, 2015).

Seeds of both *C. jamacaru* subsp. *jamacaru* and *P. pachycladus* subsp. *pernambucoensis* obtained high germination percentages up to -0.6 MPa (≥89%) when under saline stress induced by NaCl (Figure 1A). At -0.8 MPa, germination decreased only for *C. jamacaru* subsp. *jamacaru* seeds, whose percentage was 62%, while for *P. pachycladus* subsp. *pernambucoensis* it was 92%. At potential -1.0 MPa, germination was only observed for *P. pachycladus* subsp. *pernambucoensis* seeds, which was equivalent to 2% (Figure 1A). By analyzing the equations obtained by the model Logistics 1, maximum germination was reduced by 50% for *C. jamacaru* subsp. *jamacaru* and *P. pachycladus* subsp. *pernambucoensis* seeds at osmotic potentials of -0.82, and -0.90 MPa, respectively (Figure 1A). In other words, both species were able to produce half of the seedlings with maximum germination value at these potentials; therefore, they could germinate under significant water restriction potentials.

Table 2. Summary of the variance analysis for germination (G), normal seedlings (NS), germination speed index (GSI), and mean germination time (MGT) of *C. jamacaru* subsp. *jamacaru* and *P. pachycladus* subsp. *pernambucoensis* seeds submitted to saline stress induced by NaCl and KCl, following a factorial scheme: species (E) x osmotic potential (P), for each saline source.

Sources of variation	DF	Mean squares			
		G	NS	GSI	MGT
		NaCl			
Species (S)	1	193.1429**	236.1607**	38.4457**	3.2064*
Osmotic potential (Op)	6	16001.4762**	5958.6131**	214.7845**	59.4304**
S × Op	6	272.1429**	301.9940**	11.7607**	85.1227**
Residue	42	6.7619	20.4464	0.7981	0.6051
Average		65.3571	38.3393	6.9571	5.2000
CV (%)		3.97	11.79	12.84	14.95
		KCl			
Species (S)	1	19.4464^{ns}	391.1429**	0.5111^{ns}	181.0802**
Osmotic potential (Op)	6	13526.5774**	4744.9048**	262.4309**	38.9956**
S × Op	6	260.8631**	397.4762**	6.7974**	103.9698**
Residue	42	7.0893	22.9524	0.6549	0.8888
Average		68.3036	40.2857	7.3795	6.2518
CV (%)		3.89	11.89	10.96	15.07

**, * significant at 1% and 5% probability by the F-test, respectively. ^{ns} – non-significant.

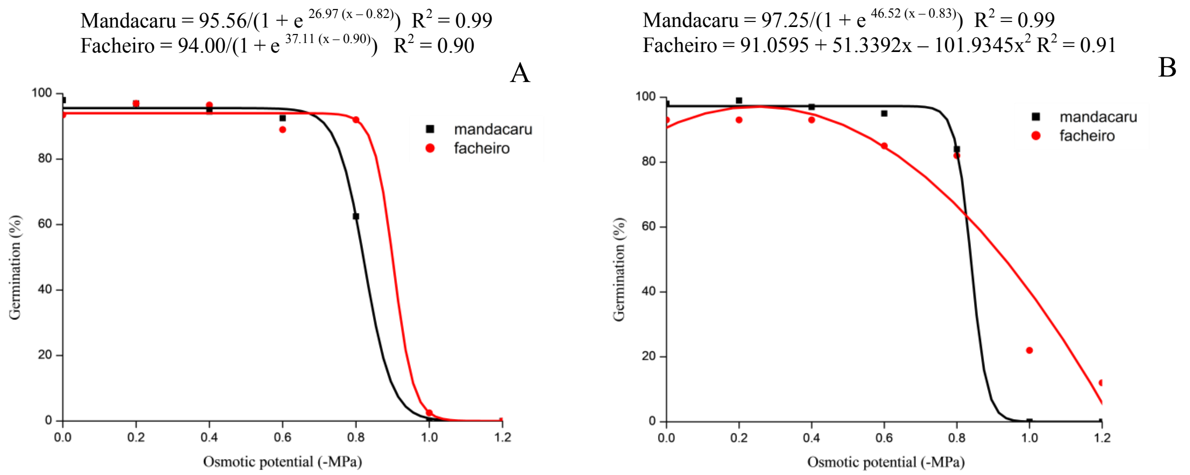

Figure 1. Germination percentage of mandacaru (*Cereus jamacaru* DC. subsp. *jamacaru*) and facheiro [*Pilosocereus pachycladus* subsp. *pernambucoensis* (F. Ritter) Zappi] seeds under saline stress induced by NaCl (A) and KCl (B).

When comparing species in KCl solution, both had germination rates above 80% up to -0.8 MPa. However, at more negative potentials (i.e., -1.0 and -1.2 MPa), only *P. pachycladus* subsp. *pernambucoensis* seeds germinated (about 22 and 12%, respectively), whose data fitted a quadratic model (Figure 1B). However, although *P. pachycladus* subsp. *pernambucoensis* shows higher tolerance to saline stress than does *C. jamacaru* subsp. *jamacaru,* it is not enough to ensure survival of regenerating individuals in natural habitats. Recent studies have pointed out a reduction in the spatial distribution of *P. pachycladus* subsp. *pernambucoensis*, while increases in *C. jamacaru* subsp. *jamacaru* are predicted in future climate change scenarios (CARVALHO et al., 2021).

According to the literature, soil salinity has significant effects on Cactaceae seed germination. High salt levels, mainly sodium chloride (NaCl), are reported to inhibit germination by osmotic potential reduction, harming further germination stages. As in our study, salinity negative effect on germination of native cactus seeds can also be observed in other studies with *Pilosocereus arrabidae* (MARTINS et al., 2012), *Pilosocereus catingicola* subsp. *salvadorensis* (LIMA; MEIADO, 2017), *Discocactus* *bahiensis*, *D. zehntneri* subsp. *petr-halfarii*, *D. zehntneri* subsp. *zehntneri* (NASCIMENTO; MEIADO; SIQUEIRA-FILHO, 2018), and *Pilosocereus gounellei* subsp. *gounellei* (= *Xiquexique gounellei* subsp. *gounellei*) (LIMA; OLIVEIRA; MEIADO, 2020). These studies showed reductions in germination percentage as NaCl concentrations increased in solutions.

In our study, NaCl had more deleterious effects than KCl on germination, mainly for *P. pachycladus* subsp. *pernambucoensis*. For Brown et al. (2016), ease of electron withdrawing from atoms or ions has great impact on chemical behavior of substances due to ionization. This is the minimum amount of energy required to remove an electron from an atom or ion valence shells. In other words, as Na has a higher ionization energy than does K, seeds may have spent more energy for cation absorption during germination (SILVA et al., 2021). Another explanation could be the use of K as a cofactor in more than 40 enzymes, as well as for cell turgor establishment and electroneutrality maintenance (TAIZ et al., 2017).

As for normal seedling percentage (NS), saline stress by NaCl had no significant effect on *C. jamacaru* subsp. *jamacaru* seeds up to -0.4 MPa (68%), decreasing therefrom. Yet for *P. pachycladus* subsp. *pernambucoensis,* the regression equation showed no effect of salt stress up to -0.8 MPa (48%), falling to zero therefrom for both species. The osmotic potentials that provided 50% of the maximum NS were -0.74 MPa for *C. jamacaru* subsp. *jamacaru* and -0.84 MPa for *P. pachycladus* subsp. *pernambucoensis* (Figure 2A).

Conversely, on germination medium containing KCl, the potential providing 50% of the maximum NS was -0.84 MPa for *C. jamacaru* subsp. *jamacaru* and -0.92 MPa for *P. pachycladus* subsp. *pernambucoensis*. NS percentages decreased for *C. jamacaru* subsp. *jamacaru* as potentials reduced, while for *P. pachycladus* subsp. *pernambucoensis,* the highest NS percentages were obtained at -0.4 and -0.6 MPa, which was 67% for both (Figure 2B). Some cacti species may have their germination favored when subjected to -0.2, -0.4 MPa, or even -0.6 MPa, but generally decrease significantly at potentials below -0.6 MPa, and hence the appearance of normal seedlings (BARRIOS et al., 2020).

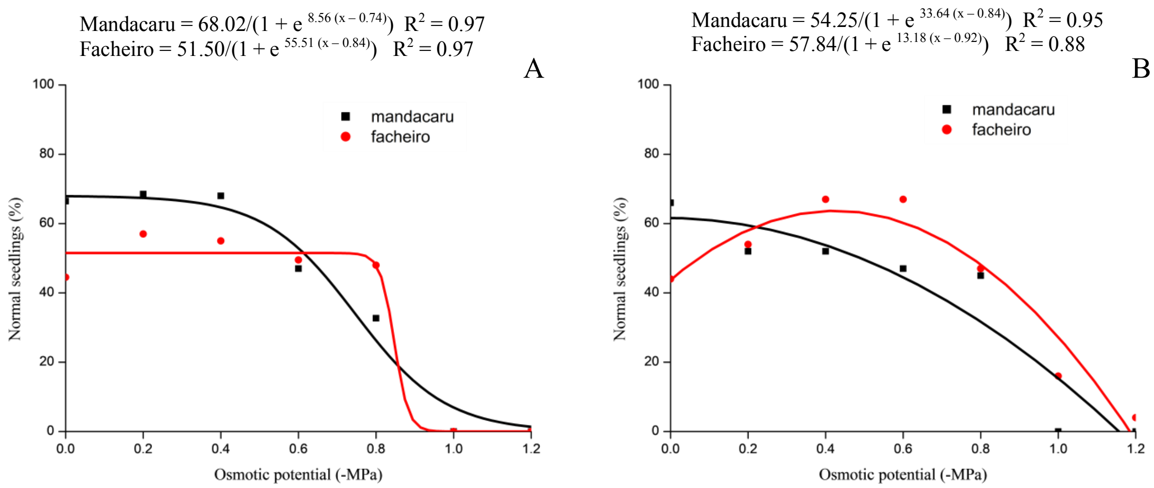

Figure 2. Percentage of normal seedlings of mandacaru (*Cereus jamacaru* DC. subsp. *jamacaru*) and facheiro (*Pilosocereus pachycladus* [F. Ritter] subsp. *pernambucoensis* [F. Ritter] Zappi) under saline stress induced by NaCl (A) and KCl (B).

Our findings showed that more negative osmotic potentials (e.g., -0.8, -1.0, and -1.2 MPa) tend to promote the appearance of abnormal seedlings, whose main characteristics were stunted root systems and tegument attachment to hypocotyl. Silva, Azerêdo, and Targino (2020) also observed the appearance of abnormal seedlings for *C. jamacaru* subsp. *jamacaru* and *P. pachycladus* subsp. *pernambucoensis* seeds subjected to water stress by PEG 6000 solutions, especially at -0.6 and -0.8 MPa. According to these authors, osmotic potential reductions on germination medium decrease the viability and vigor of *C. jamacaru* subsp. *jamacaru* and *P. pachycladus* subsp. *pernambucoensis* seeds.

Salinity delays or prevents seed germination as it reduces potential gradient between soil and seed surface, restricting water uptake reserve mobilization by seeds. However, under high salt concentrations, ions are absorbed and accumulate in seed tissues, causing protein denaturation and membrane destabilization, with Na^+ being a more potent denaturant than K^+ (IBRAHIM, 2016; TAIZ et al., 2017). Thus, the lower the osmotic potential, the lower the respiratory rate and energy production for germination process (FARIAS et al., 2009).

When analyzing germination speed index (GSI), the potentials promoting 50% of the maximum GSI were -0.51 and -0.84 MPa for *C. jamacaru* subsp. *jamacaru* and *P. pachycladus* subsp. *pernambucoensis,* respectively, for seeds under saline stress by NaCl (Figure 3A).

As for saline stress by KCl, 50% of the maximum GSI was observed at -0.60 MPa for *C. jamacaru* subsp. *jamacaru* and -0.74 MPa for *P. pachycladus* subsp. *pernambucoensis* (Figure 3B). Our results showed that *P. pachycladus* subsp. *pernambucoensis* seeds were more tolerant to saline stress when compared to *C. jamacaru* subsp. *jamacaru* seeds on both mediums (Figures 3A and 3B). Furthermore, GSI at -0.2 MPa was similar or even superior to that of control, both for *C. jamacaru* subsp. *jamacaru* and *P. pachycladus* subsp. *pernambucoensis*. Therefore, at low concentrations, salinity can stimulate seed germination of both plant species. Such a germinal response to saline stress may explain, among other factors, wide distribution of both species in Caatinga areas, as these characteristics show an adaptation to semi-arid regions, making them advantageous in these environments.

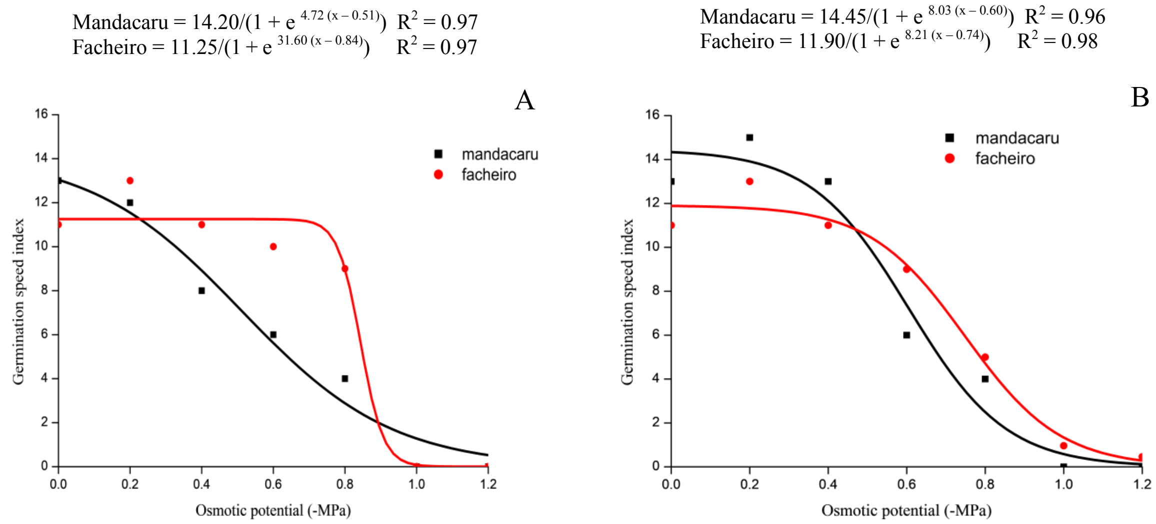

Figure 3. Germination speed index of mandacaru (*Cereus jamacaru* DC. subsp. *jamacaru*) and facheiro (*Pilosocereus pachycladus* [F. Ritter] subsp. *pernambucoensis* [F. Ritter] Zappi) seeds under saline stress induced by NaCl (A) and KCl (B).

Regarding mean germination time (MGT), although estimates were negative for the quadratic equation, except for *P. pachycladus* subsp. *pernambucoensis* in KCl (Figure 4B), data did not fit the Logistics equation 1 adopted for the other variables. Therefore, we opted for the quadratic equation. Seeds of *C. jamacaru* subsp. *jamacaru* and *P. pachycladus* subsp. *pernambucoensis* from the control treatment took about four days to germinate. However, MGT increased as osmotic potentials decreased, except for those potentials at which no germination occurred (Figures 4A and 4B).

Seeds of *C. jamacaru* subsp. *jamacaru* subjected to saline stress by NaCl took from four days (control) to 10 days (-0.8 MPa) to germinate (Figure 4A), while *P. pachycladus* subsp. *pernambucoensis* seeds took on average five days for the radicle to emerge at the same potential (-0.8 MPa). However, *P. pachycladus* subsp. *pernambucoensis* seeds submitted to -1.0 MPa took ±14 days to emit the radicle, that is, about 3.5 times longer than the control (Figure 4A). When analyzing germination performance, *P. pachycladus* subsp. *pernambucoensis* seeds under stress by KCl at -1.0 and -1.2 MPa had the highest MGT values, which were equivalent to 13 and 14 days, respectively (Figure 4B). Yet for *C. jamacaru* subsp. *jamacaru* seeds, the highest MGT values were observed at -0.6 and -0.8 MPa, which were around 8 and 9 days, respectively (Figure 4B). Therefore, under saline stress conditions, MGT lasts longer, hindering the emergence of seedlings.

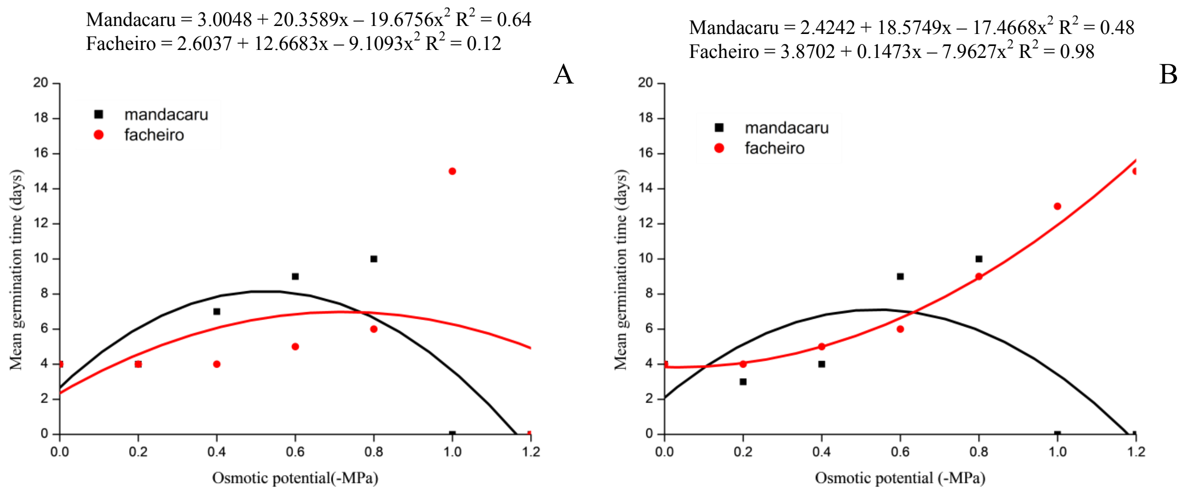

Figure 4. Mean germination time of mandacaru (*Cereus jamacaru* DC. subsp. *jamacaru*) and facheiro (*Pilosocereus pachycladus* [F. Ritter] subsp. *pernambucoensis* [F. Ritter] Zappi) seeds under saline stress induced by NaCl (A) and KCl (B).

Time and space germination distribution is an interesting ecophysiological aspect for plant seeds, as it increases recruitment of regenerating individuals when under favorable environmental conditions (SOUZA, 2020). Although valuable, our findings do not express the real tolerance of *C. jamacaru* subsp. *jamacaru* and *P. pachycladus* subsp. *pernambucoensis* seeds to saline stress in natural environments. This is because, under field conditions, seeds are subject to a cascade of barely perceptible or measurable events, which influence germination and establishment of plant populations in the habitat, such as interaction between one or more abiotic factors, water deficit, light incidence, surface temperature, among others (MEIADO et al., 2016; OLIVEIRA et al., 2017; SILVA; AZERÊDO; TARGINO, 2020). Thus, studies on germination behavior of Cactaceae seeds occurring in the Caatinga, such as *C. jamacaru* subsp. *jamacaru* and *P. pachycladus* subsp. *pernambucoensis,* should be encouraged to understand establishment and chances of survival of these species in their natural environment and, above all, in climate change and anthropic intervention scenarios. In short, conservation programs must take this information into account to ensure resilience and preservation of these populations in their occupation sites.

CONCLUSIONS

Seeds of *C. jamacaru* subsp. *jamacaru* and *P. pachycladus* subsp. *pernambucoensis* are tolerant to saline stress since they can germinate and form normal seedlings under water deficit up to -0.8 MPa (NaCl) and -1.2 MPa (KCl), the latter only for *P. pachycladus* subsp. *pernambucoensis.*

Osmotic potentials equal to or less than -1.0 MPa inhibit *C. jamacaru* subsp. *jamacaru* seed germination of the population studied, either in NaCl or KCl solutions.

Seeds of *P. pachycladus* subsp. *pernambucoensis* are more tolerant to saline stress when compared to *C. jamacaru* subsp. *jamacaru* seeds.

The osmotic effect of both salts can favor germination and vigor of *C. jamacaru* subsp. *jamacaru* and *P. pachycladus* subsp. *pernambucoensis* seeds at potentials such as -0.2 and -0.4 MPa.

NaCl is more deleterious than KCl, especially for *P. pachycladus* subsp. *pernambucoensis*.

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