Brazilian Journal of Development

Germination of piriquiti (*Adenanthera pavonina* L.) under saline stress conditions

Germinação de piriquiti (Adenanthera pavonina L.) sob condições de estresse salinas

DOI:10.34117/bjdv5n11-014

Recebimento dos originais: 07/10/2019
Aceitação para publicação: 01/11/2019

Elisson Teixeira da Silva
Agronomy course student at Federal University of Alagoas (UFAL), Center of Agrarian Sciences (CECA), Rodovia Br 104, s/n – km 85, Rio Largo, AL, CEP: 57072-97, Brazil.
E-mail: elisson.teixeira@gmail.com

Natália Tavares Santos Ferreira
Agronomy course student at Federal University of Alagoas (UFAL), Center of Agrarian Sciences (CECA), Rodovia Br 104, s/n – km 85, Rio Largo, AL, CEP: 57072-97, Brazil.
E-mail: nataliatavaressf@gmail.com

Patrícia da Silva Santos
Agronomy course student at Federal University of Alagoas (UFAL), Center of Agrarian Sciences (CECA), Rodovia Br 104, s/n – km 85, Rio Largo, AL, CEP: 57072-97, Brazil.
E-mail: p.fera.pp@gmail.com

Rafaela Ferreira da Silva
Agronomy course student at Federal University of Alagoas (UFAL), Center of Agrarian Sciences (CECA), Rodovia Br 104, s/n – km 85, Rio Largo, AL, CEP: 57072-97, Brazil.
E-mail: rafaela.ferreirads@gmail.com

Tiago da Paz
Agronomy course student at Federal University of Alagoas (UFAL), Center of Agrarian Sciences (CECA), Rodovia Br 104, s/n – km 85, Rio Largo, AL, CEP: 57072-97, Brazil.
E-mail: tiago_da_paz20@hotmail.com

Maria José de Holanda Leite
Teacher of Federal University of Alagoas (UFAL), Center of Agrarian Sciences (CECA), Rodovia Br 104, s/n – km 85, Rio Largo, AL, CEP: 57072-97, Brazil.
E-mail: maryholanda@gmail.com

Roberta Patrícia de Sousa Silva
Postgraduate student in Forest Sciences, Federal University of Campina Grande (UFCG), Rural health and Technology Center (CSTR), Av. universitária, s/n, Bairro – Santa Cecília, Patos-PB, CEP:58708-110, Brazil.
E-mail: robertapatriciasousa1@hotmail.com

Brazilian Journal of Development

José Lenildo Barbosa Leite da Silva
Postgraduate student in Forest Sciences, Federal University of Campina Grande (UFCG), Rural health and Technology Center (CSTR), Av. universitária, s/n, Bairro – Santa Cecília, Patos-PB, CEP:58708-110, Brazil.
E-mail: lelbarbosa@outlook.com

Luan da Silva Figueroa
Graduated in Forest Engineering, Federal University of Campina Grande (UFCG), Rural health and Technology Center (CSTR), Av. universitária, s/n, Bairro – Santa Cecília, Patos-PB, CEP:58708-110, Brazil.
E-mail: luan.figueroa@hotmail.com

ABSTRACT

Adenanthera pavonina L. (Piriquiti) is a pioneer Brazilian forest species belonging to the botanical family Fabaceae of characteristics that make it of important economic interest both for its high timber potential, as for ecology and uses as Ornamental plant. Some factors may be limiting to the germination of plant seeds, especially forest, conditions of salt stress can be one of the factors. The present study aimed to show the germination behavior of A. Pavonina when placed under conditions of saline stress, in different levels of NaCl salt, to point to future studies other possibilities of use for the species. The maximum limiting saline concentration found was 2.0% of sodium chloride, below this concentration does not hear statistical difference in the percentage of germination, however, the increase in the saline concentration up to the maximum limit, negatively affected the Germination velocity, levels above 2.0% were not observed germination.

Keywords: sodium chloride, reforestation, arboreal species.

RESUMO

Adenanthera pavonina L. (Piriquiti) é uma espécie florestal brasileira pioneira, pertencente à família botânica Fabaceae, de características que o tornam de importante interesse econômico, tanto pelo seu alto potencial madeireiro, quanto pela ecologia e usos como planta ornamental. Alguns fatores podem estar limitando a germinação de sementes de plantas, principalmente florestas, condições de estresse salino podem ser um dos fatores. O presente estudo teve como objetivo mostrar o comportamento germinativo de A. Pavonina quando submetido a condições de estresse salino, em diferentes níveis de sal NaCl, para apontar para estudos futuros outras possibilidades de uso para a espécie. A concentração salina limitante máxima encontrada foi de 2,0% de cloreto de sódio, abaixo dessa concentração não ouve diferença estatística na porcentagem de germinação, no entanto, o aumento da concentração salina até o limite máximo afetou negativamente a velocidade de germinação, níveis acima de 2,0 % não foram observadas germinação.

Palavras-chave: cloreto de sódio, reflorestamento, espécies arbóreas.

1 INTRODUCTION

Among the many arboreal plants existing in Brazil, there is the Piriquiti species (Adenanthera pavonina L) belonging to the Fabaceae family, the third largest group in the plant kingdom, consisting mostly of tropical trees (SPRENT 2001). The trees of this species can present 15 to 20 m high (FANTI; PEREZ, 2003). This species can be found in regions of northeastern Brazil and presents

seeds of red and showful coloration that are used in various forms, such as handicrafts, dyes, jewellery and according to Olajide et al. (2004) These are also used for medicinal purposes due to its anti-inflammatory and analgesic effects, besides containing antimicrobial proteins (SANTOS; MORAL MATOS, 2004).

Regarding the species of the Brazilian biome, this has important characteristics, such as abundance and thickness. It is a pioneer species, which presents rapid growth, which contributes to the development, under its canopy, of arboreal plants, shrubs and vines, which do not tolerate high luminous intensities (FONSECA et al. 2003). The tree of Piriquiti has high importance both in the economic area because it presents great timber potential, as for the ecology being used as an ornamental plant (AKKASAENG; GUTTERIDGE WANAPAT, 1989; LORENZI et al., 2003).

In nature it is possible to find all the resources necessary for plants to germinate naturally, thus guaranteeing the perpetuation of the species. However, even with all the favorable conditions for the plant to germinate, some species cannot perform the radicle emission because it has a high degree of dormancy, this phenomenon occurs in many legumes (OLIVEIRA et al., 2003).

The seeds of the species evaluated have a high degree of dormancy. This phenomenon despite being an important tool for them to germinate at different times, increasing their chances of survival and decreasing the risk of extinction of the species, is a negative feature for use in reforestation and use Agronomic (CARVALHO; NAKAGAWA, 1983). In addition, other factors may diminish or even inhibit the germinative power of seeds.

Among the factors of greatest concern in agriculture, soil salinity, mainly in irrigated areas, in addition to causing damage to the physical and chemical properties of the soil, causes the reduction of plant growth, bringing great losses (CAVALCANTE et al., 2010).

One of the most widespread procedures for investigating the tolerance of plants to excess salts is the observation of the percentage of germination in saline growth medium (LIMA; TORRES, 2009). Thus, with the reduction of germinative power, compared to the control treatment, this serves as an indicator of the tolerance index of the species to salinity (GÓIS et al., 2008). According to Taiz & Zeiger (2009), the evaluation of germinative capacity using this method also indicates the tolerance of plants to salts at subsequent stages of plant development.

In view of the above, the present study aimed to evaluate the germination of *Adenanthera pavonina* L. In saline stress conditions using NaCl at different concentrations.

2 MATERIALS AND METHODS

The experiment was carried out in the seed laboratory of Embrapa Tabuleiros Costeiros UEP Rio Largo, located at the center of Agrarian Sciences-CECA of the Federal University of Alagoas in

Brazilian Journal of Development

the municipality of Rio Largo-AL The margins of BR 104, latitude S 09 º 28 ' 02 ", Longitude W 35 º 49 ' 43 ", in the months of July and August of the year 2019.

The seeds of *Adenanthera pavonina* were collected from trees located within the ECSC that were fruit at the same time of the experiment.

For the break of dormancy, concentrated sulfuric acid 98% (Costa et al., 2010) was used. Since seeds may present different dormancy levels within the same species due to the effect of provenance (Marcos Filho, 2005), and thus may find different responses for the same treatment in the dormancy break, a test was performed Preliminary dormancy break using concentrated sulfuric acid 98% to determine the immersion time of seeds in sulfuric acid ideal for the characteristics of the seeds collected. The seeds had then broken tegumentary numbness with the chemical method of immersion of the seeds in sulfuric acid for 20 minutes then washed in running water for 10 minutes to remove all the acid residues.

To verify the effect of different saline concentrations on the germination of A. Pavonina, NaCl was used, and saline solutions were prepared from concentrations 0.25%, 0.5% 1%, 2% and 4% of salt and distilled water.

Four replications were used with 25 seeds in a completely randomized design containing five saline solutions of distilled water plus NaCl and a control treatment containing only distilled water, totaling six treatments with four Repetitions, with the comparison of averages performed by the Tukey test at 5% probability.

Each repetition was placed to germinate in paper Rolls "germitest type" soaked in its respective saline solution with the equivalent of 2.5 times the weight of the dry filter paper, where each treatment was packaged in airtight plastic bags to prevent loss of moisture. The experiment was submitted to germination in a BOD incubator greenhouse, with temperature of 25 º C and photoperiod of 12h and evaluated daily for 12 days.

The germination reading was performed based on the parameter that is considered to germinate the seed that has protrusion of the radicle equal to or greater than 2 mm (REHMAN et al., 1996).

It was then determined the germination percentages, germination velocity according to Labouriau and Valadares (1976) and Maguire (1962) respectively, germination speed coefficient Nichols & Heydecker (1968), and average germination time proposed by Labouriau (1983).

$$G = \frac{f}{A} * 100$$

Where:

G = Percentage of germinated seeds (%);

f = Number of germinated seeds;

A = Total number of seeds placed to germinate.

$$VG = \sum_{i=1}^{k} \frac{f_i}{D_i}$$

Where:

VG = Germination speed;

f_i = Seed numbers germinated on the ith day;

D_i = Number of days counted from sowing until the day of reading (i);

k = Last day of the count.

$$CVG = \frac{\sum_{i=1}^{k} f_i}{\sum_{i=1}^{k} f_i D_i} * 100$$

Where:

CVG = Germination speed coefficient (%);

f_i = Number of seeds germinated on the ith day;

D_i = Number of days counted from sowing until the day of reading (i);

k = Last day of evaluation.

$$TMG = \frac{\sum_{i=1}^{k} f_i D_i}{\sum_{i=1}^{k} f_i}$$

Where:

TMG = Average germination time (days);

f_i = Number of seeds germinated on the ith day;

D_i = Number of days counted from sowing until the day of reading (i);

k = Last day of evaluation.

3 RESULTS

The percentage of seed germination (table 1) submitted to different saline concentrations differed statistically from the control only in saline concentrations with 2.0% and 4.0% NaCl.

Brazilian Journal of Development

Table 1. Germination percentage of *Adenanthera pavonina* seeds of different saline stress conditions.

Germination percentage (%)		
Saline solution (%)	Salt Stress Agent	
	NaCl	
0	92,000	a
0,25	92,000	a
0,5	91,000	a
1,0	97,000	a
2,0	43,000	b
4,0	0,000	c
C.V. (%) = 12,06%		

Averages followed by the same letter do not differ from each other.

With regard to the germination velocity, the increase of the salt concentration reduced the germination speed of the seeds in all solutions saturated with sodium chloride significantly, but statistically had similar behavior, and the Solutions with 2.0% and 4.0% differed statistically from the others, but did not differ from each other (table 2). The germination velocity curve (Figure 1) represents the typical behavior of the effect of saline stress induced with NaCl, where there is the peak speed of germination in the lowest salt concentrations and decreasing as the concentration increases, being such Behavior explained by the quadratic equation with 96.57% certainty.

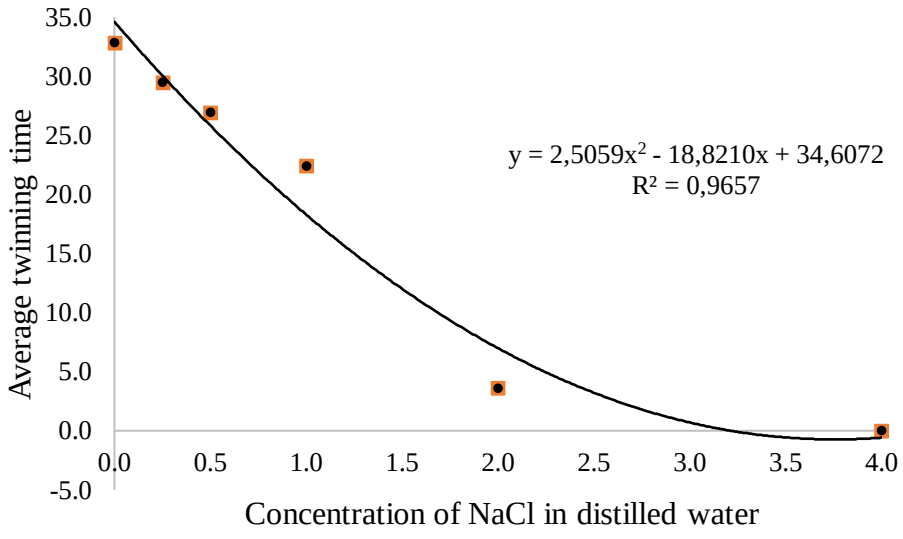

Figure 1. Twinning speed curve of Adenanthera pavonina seeds as a function of NaCl concentration in distilled water.

Brazilian Journal of Development

Table 2. Germination velocity of Adenanthera pavonina seeds of different saline stress conditions.

Germination speed		
Saline solution (%)	Salt Stress Agent	
	NaCl	
0	32,844	a
0,25	29,469	ab
0,5	26,902	bc
1,0	22,392	c
2,0	3,579	d
4,0	0,000	d
C.V. (%) = 10,88%		

Averages followed by the same letter do not differ from each other.

As the germination velocity was negatively affected by the increase of salt in the water, the germination speed coefficient (table 3) showed that the increase in the NaCl concentration in the solutions affected negatively, statistically all the averages differed from each other.

Table 3. Germination speed coefficient of *Adenanthera pavonina* seeds of different saline stress conditions.

Germination speed coefficient		
Saline solution(%)	Salt Stress Agent	
	NaCl	
0	12,900	a
0,25	12,528	b
0,5	12,260	c
1,0	11,527	d
2,0	9,490	e
4,0	0,000	f
C.V. (%) = 0,68%		

Averages followed by the same letter do not differ from each other.

As for the average germination time of the seeds, the increase in the saline concentration negatively affected the average time that the seeds led to germinate, and statistically, the averages presented with similar behavior, and the solutions with Sodium chloride concentration of 2.0% and 4.0% did not differ between yes, but differed from the others. The mean germination time curve (Figure 2) represents how long it took the seeds to germinated in each of their respective treatments with salt saturated solution.

Brazilian Journal of Development

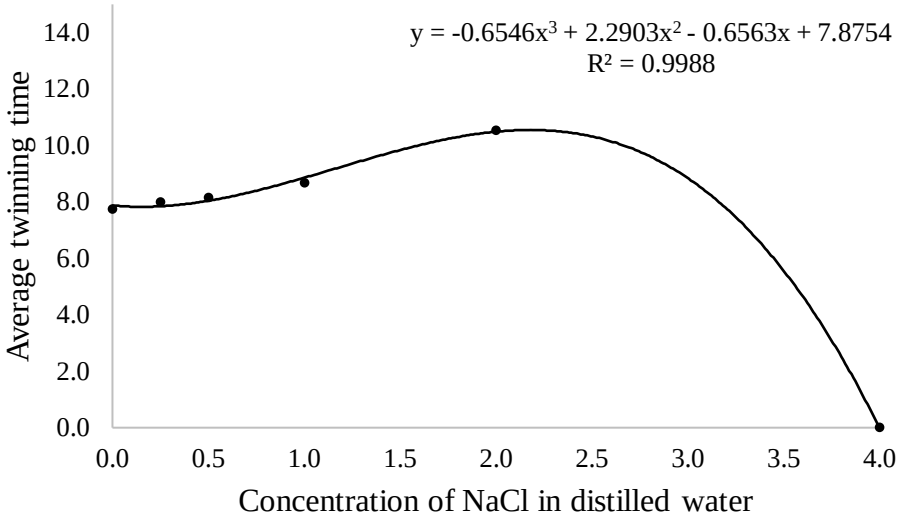

Figure 2. Mean twinning time curve of Adenanthera pavonina seeds as a function of NaCl concentration in distilled water.

Table 4. Average germination time of *Adenanthera pavonina* seeds of different saline stress conditions.

Average germination time		
Saline solution(%)	Salt Stress Agent	
	NaCl	
0	7,751	a
0,25	7,982	ab
0,5	8,156	bc
1,0	8,670	c
2,0	10,537	d
4,0	0,000	d
C.V. (%) = 0,78%		

Averages followed by the same letter do not differ from each other.

4 DISCUSSION

The lowest germination values occurred when the addition of sodium chloride is equal to or higher than 2.0%, although germination with 2.0%, statistically, does not differ when the salt concentration increases. Fanti and Perez (1998) found that the maximum tolerance limits to salinity for Adenanthera Pavonina is -1, 4MPa and -1, 2MPa, although the differences of methodologies do not corroborate the results. Germination speed results reduced significantly, confirming what was observed by Fanti and Perez (1998).

Brazilian Journal of Development

5 CONCLUSIONS

With the present study, it can be concluded that: saline stress with sodium chloride salt reduces the germination percentage and speed of Adenanthera pavonina seeds. Saline stress affects more negatively the germination speed than the germination percentage. The maximum limit of saline concentration is between 1.0% and 2.0%.

REFERENCES

AKKASAENG, R.; GUTTERIDGE, R. C.; WANAPAT, M. Evaluation of trees and shrubs for forage and fuelwood in Northeast Thailand. International Tree Crops Journal, v.5, n.4, p.209-220, 1989.

CARVALHO, N. M.; NAKAGAWA, J. Sementes: ciência, tecnologia e produção. Campinas: Fundação Cargill, 1993.

CAVALCANTE, L. F. et al. Fontes e níveis da salinidade da água na formação de mudas de mamoeiro cv. Sunrise solo. Semina: Ciências Agrárias, v.31, p.1281-1290, 2010.

COSTA, P. A.; LIMA, A. L. S.; ZANELLA, F.; FREITAS, H. QUEBRA DA DORMÊNCIA EM SEMENTES DE *Adenanthera pavonina* L. Pesquisa Agropecuária Tropical, v.40, n.1, p.83-88, 2010.

FANTI, S. C.; PEREZ, S. C. J. G. A. Efeitos do estresse hídrico, salino e térmico no processo germinativo de sementes de Adenanthera pavonina L. Revista Brasileira de Sementes, v.20, n.1, p.167-177, 1998.

FANTI, S. C.; PEREZ, S. C. J. G. A. Influência do sombreamento artificial e da adubação química na produção de mudas de *Adenanthera pavonina* L. Ciência Florestal, Santa Maria, v. 13, n. 1, p. 49-56, 2003.

FONSECA, S. C. L.; PEREZ, S. C. J. G. A. Ação do polietileno glicol na germinação de sementes de *Adenanthera pavonina* L. e o uso de poliaminas na atenuação do estresse hídrico sob diferentes temperaturas. Revista Brasileira de Sementes, Brasília, DF, v. 25, n. 1, p. 1-6, 2003.

GÓIS, V. A.; TORRES, S. B.; PEREIRA, R. A. Germinação de sementes de maxixe submetidas a estresse salino. Revista Caatinga, v. 21, n. 4, p. 64-67. 2008.

LABOURIAU, L. G. A germinação das sementes. Série de Biologia, Monografia 24. Organização dos Estados Americanos. Programa Regional de Desenvolvimento Científico e Tecnológico.

LABOURIAU, L. G.; VALADARES, M. E. B. On the germination of seeds Calatropis procera (Ait.). Anais da Academia Brasileira de Ciências, v.48, n.2, p.263-284, 1976.

LIMA, B.; TORRES, S. Estresses hídrico e salino na germinação de sementes de Zizyphus joazeiro Mart. (Rhamnaceae). Revista Caatinga, Mossoró, v. 22, n. 4, p. 93-99, 2009.

LORENZI, H. et. al. Árvores exóticas no Brasil: madeireiras, ornamentais e aromáticas. Nova Odessa: Instituto Plantarum, 2003. 384P.

MAGUIRE, J. D. Speed of germination and in selection and evaluation for seedling emergence and vigor. Crop Science, v.2, n.1, p.176-177, 1962.

MARCOS FILHO, JULIO. Fisiologia de Plantas Cultivadas / Julio Marcos Filho. – Piracicaba: Fealq, 2005.

NICHOLS, M. A. & HEYDECKER, W. Two approaches to the study of germination data. Proc. Intern. Seed Testing Association, 33:531-540, 1968.

OLAJIDE, O. A et. al. Anti-inflammatory studies on *Adenanthera pavonina* seed extract. Inflammopharmacology, Leiden, v. 12, n. 2, p. 196-202, 2004.
OLIVEIRA, A. B.; et al. O problema da salinidade na agricultura e as adaptações das plantas ao estresse salino. Enciclopédia Biosfera, Centro Científico Conhecer - Goiânia, v.6, n.11, 2010.

REHMAN, S. et al. The effect of sodium chloride on germination and the potassium and calcium contents of Acacia seeds. Seed Science and Technology, v.25, n.1, p.45-57, 1996.

SANTOS, T. O.; MORAIS, T. G. de O.; MATOS, V. P. Escarificação mecânica em sementes de Chichá (*Sterculia foetida* L.). Revista Árvore, Viçosa-MG, v. 28, n. 1, p. 1-6, 2004.

SPRENT, J. I. *Nodulation in legume*. London: Royal Botanic Kew Gardens, 2001.

TAIZ, L.; ZEIGER, E. Fisiologia vegetal. 3.ed. Porto Alegre: Artmed, 2004. 719p.