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GERMINATION AND INITIAL GROWTH OF *Albizia niopoides* Benth. SEEDLINGS UNDER DIFFERENT PHOTOPERIODS

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ABSTRACT

This research aimed to evaluate the seed germination and the initial growth of *Albizia niopoides* Benth. seedlings under different photoperiods. The experimental design was completely randomized with four replicates, each one containing 25 seeds. The seeds were sown on the sand substrate; and the experiment was carried out under B.O.D (Biochemical Oxigen Demand) conditions, regulated at alternating 20-30 ºC temperature, under photoperiods of continuous dark, continuous light, 8, 12, and 16h light. The analyzed variables were germination percentage, germination speed index (GSI), shoot length and primary root, and shoot dry mass and seedling root system. There was a significant effect ($p \leq 0.01$) for all analyzed variables in response to photoperiods. A. niopoides seeds germinated both in the light presence and absence; however, the photoperiod conditions of 12 and 16 h light favor the seedling germination and performance of the studied species. The highest germination values, GSI, primary root length, and dry mass of the root system were obtained when the seeds were submitted to the 12h light photoperiod. The 12h light photoperiod favors the seed germination and initial growth of *Albizia niopoides* seedlings under the conditions established by this study.

Keywords: Light. Native forest species. Seed ecophysiology.

1. INTRODUCTION

Popularly known as white angico, *Albizia niopoides* Benth. is a native forest species classified as pioneer, initial and/or late secondary, usually found in clearings, forest edges, and open vegetation areas (Carvalho, 2009). In accordance with this author, it is a species with great potential to be used in reforestation programs and/or recovery of degraded areas, and can contribute to recover fertility on these soils, since the species is able to nodulate and fix

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atmospheric nitrogen, and this is a fact of extreme importance, among its ecological characteristics.

Considering that seed germination is a fundamental factor for the species' perpetuation and its maintenance in the ecosystem (Holanda et al., 2015), it is emphasized that studies are important relating the seed germination process with abiotic factors, since such information is useful for seed technology, as well as because it contributes to understanding the ecophysiological needs of plant species (Borghetti & Ferreira, 2004), which may facilitate to select species that will be used in/or forest restoration (Holanda et al., 2015).

In general, inadequate supply of biotic and abiotic factors required by plant species can drastically reduce seedling performance and limit its development (Scalon et al., 2001). Considering the above exposed, the relevance of these studies is noteworthy, especially in relation to forest species, mainly some native species such as *A. noiopoides*, when compared to agricultural species.

The light factor stands out among those studied and pointed out as greatly important for the plant development, either by its direct or indirect action on its metabolism regulation (Erig & Schuch, 2005). Light provides favorable actions on seeds, such as stimulation of hormone and enzyme synthesis, control of respiratory rate and integuments' permeability to oxygen, and lipid metabolism (Taiz & Zeiger, 2013).

For some native species, such as *Dalbergia cearensis* Ducke. (Nogueira et al., 2014), *Cochlospermum vitifolium* (Will.) Sprengel. (Pereira et al., 2013), *Passiflora cincinnata* Mast. (Zucareli et al., 2009), *Mimosa caesalpiniifolia* Benth. (Holanda et al., 2015), *Calliandra viscidula* Benth. and *Calliandra hygrophila* Mackinder and Lewis. (Rezende et al., 2011) the best light conditions for germination tests have already been defined. However, for the species under this study, such information is still unknown.

In this context, the objective of this research was to evaluate the seed germination and initial growth of *Albizia niopoides* seedlings, under different photoperiod conditions.

2. METHODOLOGY

The experiment was carried out at the Laboratory of Forest Ecophysiology of the Federal University of Piauí, Professora Cinobelina Elvas Campus, Bom Jesus City, Piauí State (PI), Brazil (9º 4' 28'' S, 44º 21' 31'' W, and 277 m ALT).

To obtain the seeds, fruits were collected from 15 matrices (100 m minimum distance among trees), located in remaining forest in the municipality of Bom Jesus, PI, in transition vegetation

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areas of cerrado-caatinga (a kind of savannah). After the collection, fruits were taken to the laboratory for manually extracting and processing the seeds.

The experimental design was completely randomized with four replicates, each one composed by 25 seeds, totaling 100 seeds per treatment. The treatments consisted of photoperiods of continuous light, 12, 8, 16h light, and continuous darkness.

Before sowing, the seeds were submitted to the pre-germinative treatment of chemical scarification by immersion in sulfuric acid for one minute to overcome the integumentary dormancy, as recommended by Carvalho (2009). Seeds were disinfested using the 5% Sodium Hypochlorite solution, in which the seeds were immersed for five minutes, and then, they were washed with distilled water.

The sowing was carried out in transparent plastic "gerbox-type" boxes, with washed and autoclaved sand substrate, moistened with 0.2% nystatin solution, following the recommendations of the Rules for Seed Analysis (RSA) (Brazil, 2009). The boxes were sealed and placed in a B.O.D. (Biochemical Oxygen Demand) germination chamber type, with four fluorescent white light (4 x 20W), regulated at alternating 20-30 ºC temperature (conditions defined in previous studies - unpublished data) and tested photoperiods. The continuous darkness was simulated by covering the gerbox-type boxes with black plastic bags, and the germinative behavior was evaluated in a dark room.

The analyzed variables were: (1) Percentage of germination, corresponding to the total germinated normal seedlings, from sowing until the end of the experiment, about 15 days after sowing. The germinated seeds were evaluated daily, using as germination criterion the hypocotyl's emergence with the consequent cotyledons and protophilus' emergence; (2) Germination speed index (GSI) - it was performed together with the germination test; and normal seedling was daily counted at the same time from the first count until the value becoming constant and until to obtain the index by the formula proposed by Maguire (1962); (3) Length of primary root and aerial part - at the end of the germination test, the aerial part and the primary root of the normal seedlings of each replicate were measured with a ruler graduated in centimeters, and the results were expressed in cm.seedling-1. Their average length was obtained by summing the measurements of each seedling part (root and aerial) of each replicate, then dividing by the number of normal measured seedlings; (4) Dry mass of root system and aerial part - soon after measurements, the seedlings had their cotyledons removed; the parts were separated with a pair of scissors and packed in Kraft paper bags, previously identified with the treatment type, replicate and parts (aerial and root); then, they were taken to the air circulating greenhouse, set at 60 °C, for 24 hours, to obtain the dry mass weight. After this period, the

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seedlings of each replicate were removed from the oven and bags, and then weighed in an analytical balance with 0.001 g accuracy, and the mean results were expressed in mg.seedling-1.

The data were submitted to the normality test (Lilliefors) and homogeneity of variances (Cochran). Subsequently, they were submitted to analysis of variance (ANOVA) and the means were compared by the Tukey test at 5% probability, when significant effect of the treatments was verified. Statistical analyzes were performed using the SISVAR software (DEX/UFLA) version 5.3 (Ferreira, 2010).

3. RESULTS AND DISCUSSION

There was a significant effect ($p \leq 0.01$) for all analyzed variables in response to the tested photoperiods (Table 1).

Table 1 - Mean squares, effect of different photoperiods on seed germination, and *Albizia niopoides* Benth. seedlings performance

Variation Sources	**Medium Squares**					
	%G	GSI	APL	RL	DMAP	DMRS
Photoperiod	714**	6.551**	4.609**	1.169*	13.111**	1.650**
Error	41.066	0.071	0.222	0.204	0.438	0.289
Coefficient of Variation (%)	7.82	8.26	9.48	13.47	5.89	17.10

** Significant at 1%; and * 5% at 5% probability F test; (%G = germination; GSI = germination speed index; APL = Aerial part length); RL = Primary root length; DMAP = Dry mass of aerial part; and DMRS = Dry mass of root system)

The A. niopodes seeds germinated both in the light presence and absence (Figure 1A); however, the germination was favored under the photoperiod conditions of 12 and 16h light (96%).

As in this study, species such as *Cochlospermum vitifolium* (Will.) Sprengel. (Pereira et al., 2013), *Caesalpinia leiostachya* (Benth.) Ducke. (Biruel et al., 2007), and *Sideroxylon obtusifolium* (Roem. & Schult.) T. D. Penn. (Silva et al., 2014) show a behavior trend of a neutral photoblastic species; in the case of *A. niopoides*, it may be related to the pioneer character of the species. In accordance with Aguiar et al. (2005), these species have great ecological relevance when compared to other plant species, since they do not require specific luminosity conditions

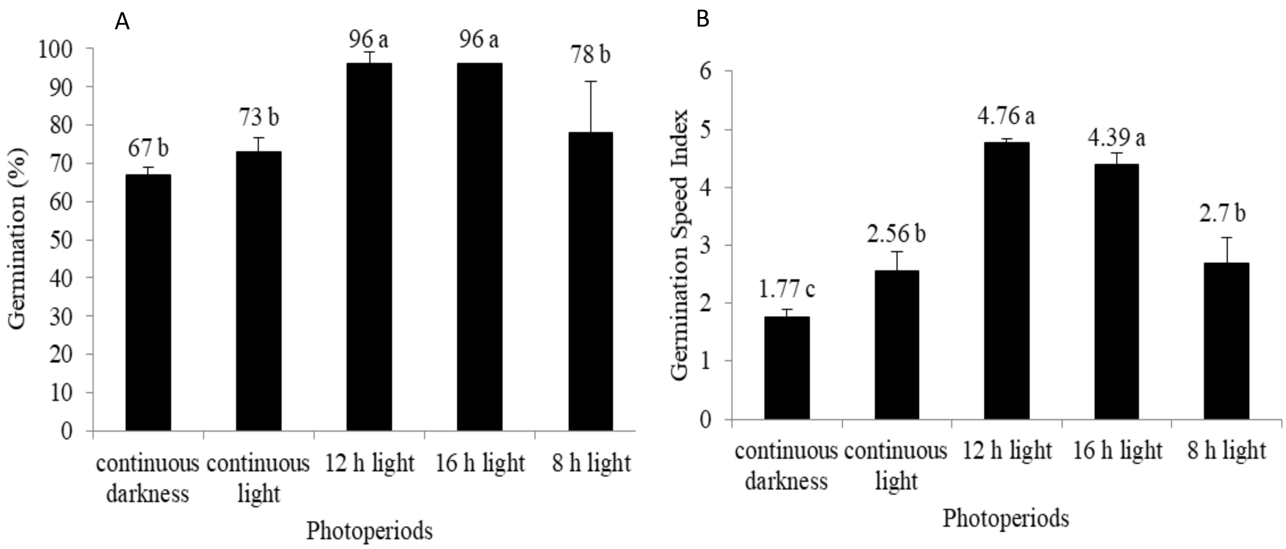

Figure 1 - Germination Percentage (A) and Germination Speed Index (GSI) (B) of *Albizia niopoides* Benth. seeds, under different photoperiods (continuous darkness, continuous light, 12, 16, and 8h light). Coefficient of variation (%) = 7.82 and 8.26, respectively.

Regarding the germination speed index (GSI), as well as the germination, the highest average values were observed when the seeds were under photoperiods of 12 and 16h light (4.77 and 4.39, respectively), thus differing from the other treatments. Reduction in the GSI mean value was also observed when the seeds were exposed to light absence (Figure 1B).

Opposite results were obtained by Zucareli et al. (2009), when evaluating the *Passiflora cincinnata* Mast. seeds germination, submitted to the same conditions of this study, in which, the authors obtained the best results for the GSI, when the seeds were put to germinate under continuous darkness.

Analyzing Figure 2, greatest length of the primary root and aerial part of the seedlings was observed, when the seeds were submitted to light absence (4.09 and 6.77 cm.seedlings^{-1}, respectively). However, when evaluating the length variable individually, it was observed that to aerial part continuous darkness treatment differed from the others ($p \leq 0.01$), whereas for the primary root length it differed only from the treatment with continuous light. However, it is worth mentioning that the variable germination percentage and speed index in the same treatment presented lower results.

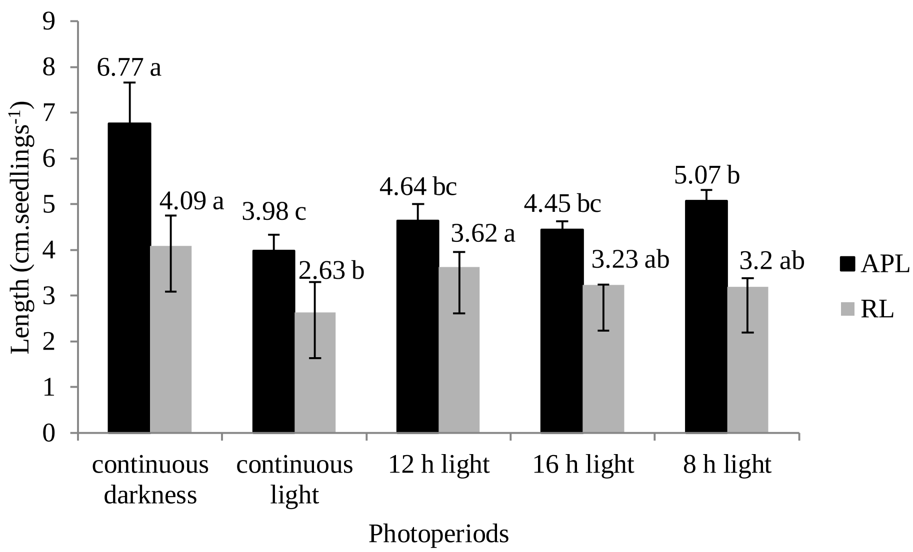

Figure 2 - Length of the main root (RL) and aerial part (APL) (cm.seedlings^{-1}) of *Albizia niopoides* Benth. seedlings under different photoperiods (continuous darkness, continuous light, 12, 16, and 8h light). Coefficient of variation (%) = 13.47 and 9.48, respectively.

Similar results were found for the *Sideroxylon obtusifolium* (Roem. & Schult.) T. D. Penn. (Silva et al., 2014) and *Jatropha curcas* L. species (Silva et al., 2016), which obtained a good initial development of the seedling, when the seeds were submitted to light absence.

The seedlings observed in this treatment were all etiolated; this greater development may be related to some change in their metabolic activity, since the species was exposed to light's lack, and in searching light, they invested in stem growth. In accordance with Silva et al. (2016), the etiolation is a detrimental phenomenon to the initial seedling growth, as it interferes both in its normal development and in the photosynthesis accomplishment. This behavior may also be related to the light influence on seed physiology, since this is an exogenous factor that acts on plant growth hormones (Leite et al., 2000).

On the basis of the results, it can be verified that the dry mass of the root system differed ($p \leq 0.01$) only in the treatments with light absence and 12h light photoperiod (Figure 3). The obtained highest dry mass value of the root system was 3.61 mg.seedlings^{-1}, when the A. niopoides seeds were exposed to the 12h light photoperiod. For the dry mass of aerial part, there was a greater difference among treatments when compared to the dry mass of the root system, and the highest average values were obtained in photoperiods of 16 and 8h light, and continuous light (13.19, 12.09, and 12.02 mg.plantula^{-1}, respectively).

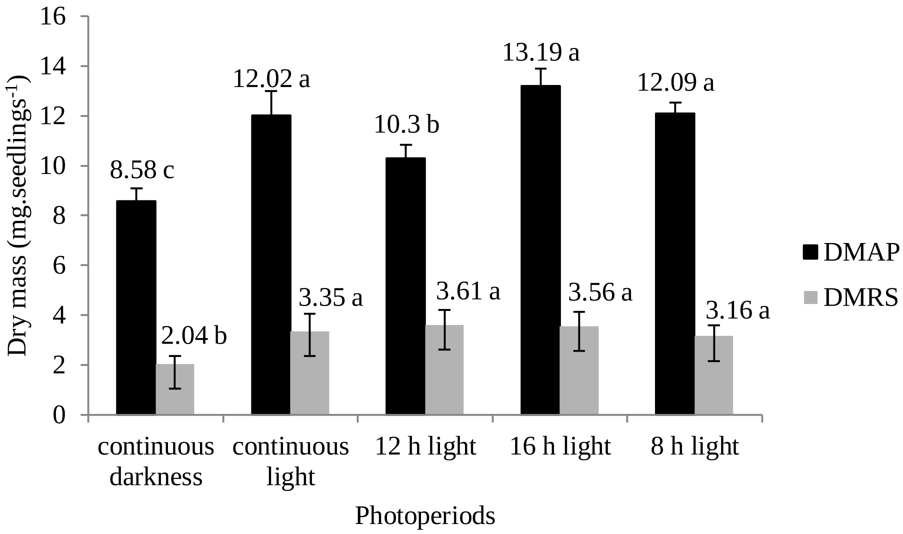

Figure 3 - Dry mass of the root (DMRS) and aerial part (DMAP) (mg.seedling^{-1}) of *Albizia niopoides* Benth. seedlings, under different photoperiods (continuous darkness, continuous light, 12, 16, and 8h light). Coefficient of variation (%) = 17.19 and 5.89, respectively.

In general, continuous darkness treatment with the exception of the length variable (Figure 1 and 3) negatively affected the germinative performance of the studied species. In accordance with the RSA (Brazil, 2009), it is common to species germination, both under the light presence and under the darkness; however, even if light is not indicated as one of the best conditions for germination tests, this is recommended, because it favors the essential seedling structures development.

Seeds of most species germinate both under the light presence and under the darkness. Even when light is not indicated, the illumination during the test, whether natural or artificial, is generally recommended to favor the essential seedling structures development, thus facilitating assessment and reducing the microorganism attack possibility. Seedlings that grow under complete darkness conditions are etiolated and hyaline and often more sensitive to attack by microorganisms. In addition, certain defects such as chlorophyll deficiency cannot be detected.

In accordance with Flores et al. (2011), this sensitivity to light during seed germination is an important strategy used by the species itself to prevent the occurrence of germination events at sites and times unfavorable to the establishment of its seedlings. It is worth mentioning that these differences in seed germination when submitted to different light regimes may also occur among species of the same family (Nogueira et al., 2012; Resende et al., 2011).

4. CONCLUSION

The 12h light photoperiod favors the seed germination and initial growth of *Albizia niopoides* seedlings, under conditions established by his study.

5. ACKNOWLEDGEMENTS

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REFERENCES

Aguiar, F. F. A., Bilia, D. A. C., Kanashiro, S., Tavares, A. R., & Barbedo, C. J. (2005). Germinação de sementes de *Rhapis excelsa* (Thunb.) Henry ex Rehder: efeitos da temperatura, luz e substrato. Hoehnea, 32 (1), 119-126.

Biruel, R. P., Aguiar, I. B., & Paula, R. C. (2007). Germinação de sementes de pau-ferro submetidas a diferentes condições de armazenamento, escarificação química, temperatura e luz. Revista Brasileira de Sementes, 29 (3), 151-159.

Borghetti, F., & Ferreira, A.G. (2004). Interpretação de resultados de germinação. (2004) Pp. 209- 222. In: Ferreira, A.G., & Borghetti, F. (Ed.). Germinação: do básico ao aplicado. Porto Alegre, Artmed.

Brasil. Ministério da Agricultura, Pecuária e Abastecimento. (2009). Regras para análise de sementes. Ministério da Agricultura, Pecuária e Abastecimento. Secretaria de Defesa Agropecuária. Brasília: MAPA/ACS. 395p.

Carvalho, P. E. R. (2009). Farinha-seca *Albizia niopoides*. Embrapa Florestas, Colombo, p. 1-8. (Comunicado técnico 226).

Erig, A. C., & Schuch, M. W. (2005). Tipo de luz na multiplicação in vitro de framboeseira (*Rubus idaeus* L.)'Batum'. Revista Brasileira de Fruticultura, 27 (3), 488-490.

Holanda, A. E. R., Medeiros Filho, S., & Diogo, I. J. S. (2015) Influência da luz e da temperatura na germinação de sementes de sabiá (*Mimosa caesalpiniifolia* Benth.-Fabaceae). Gaia Scientia, 9 (1), p. 22-27.

Ferreira, D. F. Programa computacional Sisvar. Versão 5.3. Lavras, MG: UFLA, 2010.

Flores, J., Jurado, E., Chapa-Vargas, L., Ceroni-Stuva, A., Dávila-Aranda, P., Galíndez, G., Gurvich, D., León-Lobos, P., Ordóñez, C., Ortega-Baes, P., Ramírez-Bullón, N., Sandoval, A., Seal, C.E., Ullian, T., & Pritchard, H.W. (2011). Seeds photoblastism and its relationship with some plant traits in 136 cacti taxa. Environmental and Experimental Botany, 71 (1), 79-88.

Leite, A. I., Almeida, M. A., Oliveira, M. I., Balça, M. J., & Costa, S. L. (2000). Da célula ao organismo. Editora: Areal Editores..

Maguire, J. D.(1962). Speed of germination-aid in selection and evaluation for seedling emergence and vigor. Crop Science, 2 (1), 176-177.

Nogueira, F.C.B., Silva. J.W.L., Bezerra, A.M.E., & Filho, S.M. (2012). Efeito da temperatura e luz na germinação de sementes de *Luetzelburgia auriculata* (Alemão) Ducke–Fabaceae. Acta Botanica Brasilica, 26 (4), 772-778.

Nogueira, F. C. B., Gallão, M. I., Bezerra, A. M. E., & Medeiros Filho, S. (2014). Efeito da temperatura e luz na germinação de sementes de *Dalbergia cearensis* Ducke. Ciência Florestal, 24 (4), 997-1007.

Resende, S. V., Crepaldi, I. C., Pelacani, C.R., & Brito A. L. (2011). Influência da luz e substrato na germinação e desenvolvimento inicial de duas espécies de *Calliandra* Benth. (MIMOSOIDAE – LEGUMINOSAE) endêmicas da Chapada Diamantina, Bahia. Revista Árvore, 35 (1), 107-117.

Scalon, S.P.Q., Scalon Filho, H.; Rigoni, M.R., & Veraldo, F. (2001). Germinação e crescimento de mudas de pitangueira (*Eugenia uniflora* L.) sob condições de sombreamento. Revista Brasileira de Fruticultura, 23 (3), 652-655.

Pereira, D. S., Pereira, M. S., & Bezerra, A. M. E. (2013). Efeito da Luz e da Temperatura na Germinação de Sementes de *Cochlospermum vitifolium* (Will.) Sprengel. Floresta e Ambiente, 20 (3), 391-397.

Silva, K. B., Alves, E. D., Oliveira, A. N. P., Sousa, N. A., & Aguiar, V. A. (2014). Influência da luz e temperatura na germinação de sementes de quixaba. Revista Técnico-Científica Agrícola, 35 (1), 13–22.

Silva, F. J., Hisatugo, E.Y., & Souza, J. P. (2016). Efeito da luz na germinação e desenvolvimento de plântulas de pinhão-manso (*Jatropha curcas* L.) de distintas procedências. Hoehnea, 43(2), 195-202.

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Taiz, L.; & Zeiger, E. (2013). Fisiologia vegetal. (5.ed.). Porto Alegre: Artmed.

Zucareli, V., Ferreira, G., Amaro, A. C. E., & Araújo, F. P. D. (2009). Fotoperíodo, temperatura e reguladores vegetais na germinação de sementes de *Passiflora cincinnata* Mast. Revista Brasileira de Sementes, 31 (3), 106-114.

