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Effect of light periods and substrates in the seed germination of capiron (*Calycophyllum Spruceanum*) in the Colombian Amazon

Efecto de periodos de luz y sustratos en la germinación de semillas de capiron (*Calycophyllum Spruceanum*) en la Amazonia Colombiana

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Abstract

In order to determine the effect of substrates and periods of light on the germination of capirona sedes, (Calycophyllum spruceanum), the speed and germination percentage of these seeds were studied, under controlled conditions, in the department of Putumayo, Colombia, using a 3x3 factorial design (Substrate and light periods), where two variables were analyzed: the germination speed and germination percentage in a 30-day period. The analysis of variance indicated significant differences ($p \leq 0,05$) for the substrates factor, as well as periods of light and the interaction of these on the variables evaluated. The peat substrate presented the highest percentage of germination (22.89 ± 1.14a) and the highest germination rate (0.71 ± 0.03a), while in the 12 daylight hours photoperiod it showed the highest percentage of germination (18.22 ± 1.14a) and the highest germination speed (0.56 ± 0.0290a). The interaction of factors indicated that for both germination percentage and germination rate, peat * 12 daylight hours showed the highest values (44.67 ± 1.98a) and (1.34 ± 0.05a) respectively. It is recommended to include the peat substrate and the 12 daylight hours photoperiod in the germination protocols of seeds of Capiron (Calycophyllum spruceanum) in Amazonian conditions.

Viability, Latency, Physiology

Resumen

Con el objetivo de determinar el efecto de sustratos y periodos de luz sobre la germinación de semillas de capirona, (Calycophyllum spruceanum), se estudiaron la velocidad y el porcentaje de germinación de dichas semillas bajo condiciones controladas en el departamento del Putumayo, Colombia, utilizando un diseño factorial 3x3 (Sustrato y periodos de luz), en donde se analizaron dos variables: la Velocidad de germinación y el porcentaje de germinación en un periodo de 30 días. El análisis de varianza indicó diferencias significativas ($p \leq 0,05$) para el factor sustratos, al igual que periodos de luz y la interacción de estos sobre las variables evaluadas. El sustrato turba presentó el mayor porcentaje de germinación (22,89±1,14a) y la mayor velocidad de germinación (0,71 ± 0,03a), mientras que en el fotoperiodo de 12 horas luz mostró el mayor porcentaje de germinación (18,22 ± 1,14a) y la mayor velocidad de germinación (0,56 ± 0,0290a). La interacción de factores indicó que tanto para el porcentaje de germinación y velocidad de germinación, Turba*12 horas luz mostró los mayores valores (44,67 ± 1,98a) y (1,34 ± 0,05a) respectivamente. Se recomienda incluir el sustrato turba y el fotoperiodo 12 horas luz en los protocolos de germinación de semillas de Capiron (Calycophyllum spruceanum) en condiciones amazónicas.

Viabilidad, Latencia, Fisiología

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Introduction

The capirona (*Calycophyllum spruceanum*) is a native tree of the amazonian region, extending to the south of Brazil and Bolivia, below the 1200 msnm; being common in secondary forest areas, although it is also found in primary forests. It is observed in areas with high and constant rainfall, but also in areas with a marked dry season. It is a species adapted to soils mostly sandy to alluvial, fertile, sometimes temporarily flooded and in riverine areas (Reynel et al., 2003).

In Putumayo, Colombia, the capirona tree species (*Calycophyllum spruceanum*) for its high adaptation to the edaphoclimatic conditions of the area, diversity of uses and acceptance in the markets, is shown as an alternative with great potential for the development of reforestation programs; it is so Corpoamazonia, (2009) in agreement with the communities establish in the last three years 170 hectares on the banks of the Caquetá and Putumayo rivers. According to Bacchetta et al., (2008), light is one of the most important environmental factors in the control of germination, its effect on germination differs in different species, some require it, others do not, its importance is related to the role in photosynthesis that is necessary to fix a daily amount of CO2, which compensates for respiratory loss and that even modifies its structure, which is called etiolation or etching (Vásquez, 2001).

On the other hand, according to Triviño, (2008), a substrate is any solid material other than soil, natural, synthetic or residual, mineral or organic, which, placed in a container, in pure form or in a mixture, allows the anchoring of the root system of the plant, thus playing a supporting role for the plant, its function in germination is restricted to having the ability to maintain adequate humidity, allow oxygen and light to enter the seed and prevent Sun rays directly affect it, the degree of internal variation of each of these factors within each substrate, determine the germination.

The capirona (*Calycophyllum spruceanum*) despite being a native species of the Amazon, there is little information on the propagation processes, and that according to preliminary trials has shown germination percentages lower than 5%, which has hindered the propagation and multiplication of the species in the reforestation programs that have been executed by the CAR Regional.

Methodology to be developed

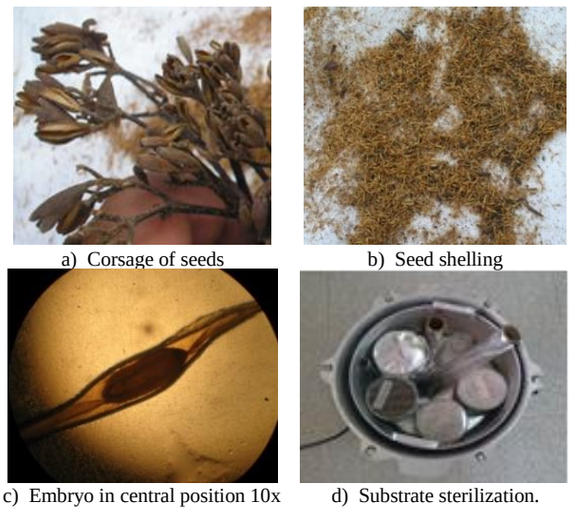
Location:

The present study was carried out in the facilities of the Biology laboratory of the Putumayo Technological Institute in the city of Mocoa, Department of Putumayo, located on the geographic coordinates of 1047355 W, 0619673 N (76 ° 39 ° 05 ° W, 01 ° 09 ° 24 ° N), with average annual temperature of 25 ° C and an average height of 672 msnm.

Preparation of Germplasm

The seeds that were used were collected in the village of the spring, Municipality of Puerto Guzmán, Department of Putumayo; following the methodology proposed by Corpoamazonia (2009), which consisted of extracting seeds from selected trees with superior phenotypic characteristics of the natural forest (Figure.1a). Branches with abundant ripe seeds were selected, fully mature fruits were selected, which showed a light brown color with pubescence on their surface and with the valves beginning to open (Figure1c).

The seeds were dried on fabrics exposed to the sun for 6 days, until a high percentage of opening of the valves and seed shedding was observed (Figure 1c). Subsequently a shatter was made with soft blows on the floor to achieve a greater detachment. This seed was sifted in a sieve to remove foreign particles, observing only the tiny, winged and elongated seeds, with the embryo in the central position (Figure1b); were stored in a paper bag inside a refrigerator at a temperature of 4ºC, to maintain its viability until the time of planting (Beisner, 1989).



a) Corsage of seeds b) Seed shelling

c) Embryo in central position 10x d) Substrate sterilization.

Figure 1 Preparation of germplasm
Source: This research

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The substrates were previously sterilized in an autoclave at a temperature of 254 ºF and a pressure of 1.2kg / cm2 for 40 minutes (Figure1d), according to the methodology described by Jiménez and Guevara, 1996; Mesén 1996) the seeds were treated with the fungicide Ridomil (Mancozeb + Cimoxanil) in a dose of 1 gr / liter, sprayed at the time of sowing.

Preparation of substrates

Paper towel: Three layers were placed directly on the bottom of each petri dish to ensure moisture retention. The seeds were pressed gently on the paper to increase contact (Figure 2a).

Sand + Earth: In each petri box, 9 grams of sand and 9 grams of soil were placed, passed through a 0.8 mm sieve, leveling the substrate (Figure 2b); the seeds were gently pressed to level with the substrate and increase its contact.

Peat: 4 grams were placed in each Petri dish, then the substrate was leveled and the seeds were deposited at the level of the peat, for which it was necessary to apply pressure gently on the plant material.

a) Paper towel substrate

b) Sand + earth

Figure 2 Substrate preparation
Source: This research

Parameter Evaluation

Germination percentage (PG): To determine this, daily observations were made from day 10 after sowing, at which time the plumule emerged from the seeds was observed. Its calculation was obtained by the coefficient of germinated seeds within 30 days after sowing, based on the total number of seeds tested, expressed as a percentage, according to the methodology proposed by Oyola et al., (2008).

Germination speed (VG): the germination was registered daily for 30 days after sowing, considering the seeds germinated when the radicles emerge. Its calculation was obtained by the ratio of germinated seeds with germination time, and were calculated according to the proposed formula Oyola et al. (2008).

Statistic analysis

The statistical tests were performed using the Infostat statistical package. V.2018, under the 2x2 factorial arrangement, the LSD alpha = 0.05 means purchase test was used.

Results

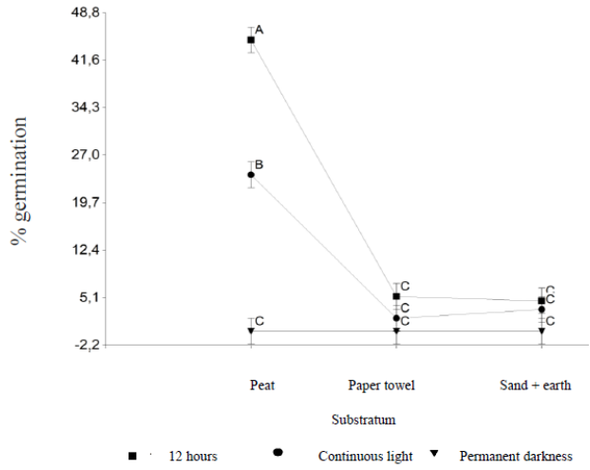
Germination

The assumptions of homoceasticity and normality in the fixed factors (substrates and periods of light) were not validated, a correction of the variance was made by the *Varldent* corrective for the -substrate- factor, allowing to continue with the following tests.

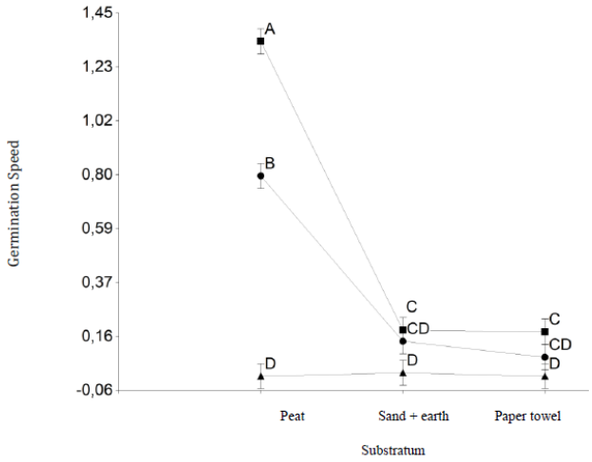
The variance analysis of the germination variable indicated significant differences (P≤0,05) for each of the substrates, as well as in the periods of light, as well as the interaction of these (Table 1).

Germinative parameters.	12 light hours			Continuous light			Permanent Darkness		
	Peat	Sand + Earth	Paper towel.	Peat	Sand + Earth	Paper towel.	Peat	Sand + Earth	Paper towel
% germination	44,67 ± 1,98a	4,67 ± 1,98c	5,33 ± 1,98c	24± 1,98b	3,33 ± 1,98c	2 ± 1,98c	0 ± 1,98c	0 ± 1,98c	0 ± 1,98c
Germination speed	1,34 ± 0,05a	0,18 ± 0,05c	0,18 ± 0,05c	0,8 ± 0,05b	0,14 ± 0,05cd	0,08 ± 0,05cd	0 ± 0,05d	0,01 ± 0,05d	0 ± 0,05d

Table 1 Percentage and speed of germination in seeds of capirona, in three levels of light periods and three substrates. The results show the means ± (E.E). Values with different letters indicate significant differences between light periods and substrates. (post-hoc LSD, Fisher LSD, p <0.05)
Source: This research



Grphic 1 Germination percentage in seeds of capirona, The results show the means ± (E.E). Values with different letters indicate significant differences between light periods and substrates. (post-hoc LSD, Fisher LSD, p <0.05)
Source: This research



Graphic 2 Germination speed in capirona seeds. The results show the means ± (E.E). Values with different letters indicate significant differences between light periods and substrates. (post-hoc LSD, Fisher LSD, p <0.05)
Source: This research.

The test of comparison of means of LSD - Fisher (P≤0.05), in the interaction of the factors indicated that Turba * 12 light hours presented significantly higher values of% of germination, with respect to the other periods of light and substrates, (44.67 ± 1.98a) (Graphic 1).

Germination speed

The variance analysis carried out for the variable Germination speed, showed significant statistical differences (P≤0.05), indicating that, Turba * 12 light hours, the highest germination velocity values were presented (1.34 ± 0.05a), being statistically superior to other periods of light and substrates. (Graphic, 2).

Discussion

The behavior of germination% and the germination rate in peat substrate can be explained since the seeds of species that live in aquatic or flooded environments, where oxygen is scarce, germinate better if the concentration of this gas is low (between 5 and 10%), when considering the capirona a species adapted to temporarily floodable soils and riparian zones (Reynel et al., 2003), the effect tends to be more marked in the more humid substrate since it probably activates with greater intensity physiological response mechanisms of the seed, on the contrary, the paper towel and the mixture of sand + earth with low humidity retentions have an environment that probably decreases the physiological respondents, degún Pérez and Martínez, (1994), the increase of the amount of water available to the seed allows the activation of metabolic processes (Rodríguez and Nieto, 1999), and decreases the amount of oxygen that reaches the embryo (Pérez y Martínez, 1994).

Likewise, the results can be explained as mentioned by Triviño, (2008), indicating that according to the need for light for each species in its germination is regulated by its requirements for its development in the natural state; where tropical low-lying species are generally heliophytes or semiheliophytes, and have high light demands, according to Reynel et al. (2003), capirona is a heliophyte species and therefore explains the increase in% germination and the germination speed obtained in the photoperiod 12 hours, with differences in photoperiod with lower light intensity.

Although for Beisner, (1989), light is not essential for the germination of seeds at rest, but its effect through phytochrome, can break the lethargy by accelerating the germination period. Also, light can promote the increase in the concentration of germination promoting substances or decrease the concentration of inhibitors, or the combination of these two effects (Araya et al., 2000). Tests carried out by Oyola et al., (2008) concluded once the seed has the adequate conditions of humidity, temperature and aeration, the exchange of gases between the substrate and the embryo accelerates the emergence, while lower values in different treatments are associated with the effects of a possible physiological response of defense of the seed when not having an ideal substrate for its germination.

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Conclusions

The best results regarding the percentage and average speed of germination were obtained with the interaction of peat substrate with the period of 12 light hours, exerting one (44.67% ± 1.98a) and (1.34 ± 0.05a) seeds / day.

Significant differences in substrates and light periods on the percentage and average speed of germination of the capirona species, reaffirms the need to use substrates and specific light periods to achieve an optimum in the propagation of the species.

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