

Effect of light and temperature on germination of *Costus arabicus* L., seeds an tropical ornamental species ⁽¹⁾

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ABSTRACT

Costus arabicus L. (Costaceae) is a tropical species native from Brazil. The species has ornamental potential as garden and vase plant, and for flower and stem cutting. The aim of this study was to evaluate the seed germination of *C. arabicus* under different of light and temperature conditions. Seeds subjected to constant temperatures of 20, 25 and 30 °C under photoperiod of 12 h of light or dark. The parameters analyzed were percentage of germination and germination speed index (GSI). The highest germination percentage (70%) was under temperature of 30 °C, both in light or dark. The GSI showed that the germination rate increases as temperature increases, mainly on 30 °C. *C. arabicus* seeds germinated in the presence or absence of light, thus was considered neutral photoblastic and germination on light under 30 °C was more efficient for seed germination.

Keywords: Costaceae, photoperiod, index germination velocity, photoblastic.

RESUMO

Costus arabicus L. (Costaceae) é uma espécie tropical nativa do Brasil, com potencial como planta de jardim, vaso, flor e haste de corte. O objetivo do trabalho foi avaliar o processo germinativo de sementes de *C. arabicus* sob diferentes condições de luz e temperatura. As sementes submetidas às temperaturas constantes de 20, 25 e 30 °C, sob fotoperíodos de 12 horas de luz branca e escuro contínuo. Os parâmetros analisados foram a porcentagem de germinação e o índice de velocidade de germinação. A maior porcentagem de germinação (70%) ocorreu sob a temperatura de 30 °C, tanto no claro como no escuro. Os resultados de IVG mostraram que a velocidade de germinação aumenta com o aumento da temperatura, principalmente a 30 °C. As sementes de *Costus arabicus* germinaram na presença ou ausência de luz, podendo ser consideradas fotoblásticas neutras, sendo a germinação no claro a 30 °C mais eficiente.

Palavras-chave: Costaceae, fotoperíodo, índice de velocidade de germinação, fotoblastismo.

1. INTRODUCTION

The cultivation of tropical flowers in Brazil is increasing, due to favorable environmental conditions, such as land, water and energy that makes its economic competitive in comparison to foreign producers (JUNQUEIRA and PEETZ 2008; LOGES et al., 2005). However, there are limitations to the expansion of new products, among them the lack of information about intensive cultivation conditions of these potential species and their conservation in tropical conditions. The species of the genus *Costus* (Costaceae) have great interest because of its beautiful and exotic ornamental inflorescences and foliage (GONÇALVES et al., 2005). *Costus* are indicated species for landscape design, pot plants, big pot plants and as cut flower and stems (CASTRO et al., 2011). *Costus arabicus* L. is an herbaceous species, with simple leaves without stipules, distributed in spiral arrangement around the stem and has great ornamental interest. Many species with ornamental potential are not used by the lack of adequate information on their propagation and cultivation.

Seed germination studies allows to understand the mechanisms that regulate the longevity of seeds in the soil and the establishment of plants in natural conditions, and

is an essential step to protect the species from the threat of extinction (LABORIAU, 1983) and the conservation of biodiversity (CABRAL et al., 2003). Seed germination is a complex process and depends on various environmental factors such as temperature, light, humidity and substrate (GHERSA et al., 1992). Light and temperature are the main factors that control seed germination (BASKIN and BASKIN, 1988; BEWLEY and BLACK, 1994). Seed germination and its speed are affected by temperature and water absorption rate, as well as the biochemical reactions regulation during seed germination (BEWLEY and BLACK, 1994; CARVALHO and NAKAGAWA, 2000). Light is required for seed germination of various species and the species can be classified as positive photoblastic, which require light to germinate; negative photoblastic that germinate best in the dark or neutral photoblastic that are insensitive to light (LABORIAU, 1983).

C. arabicus is traditionally vegetative propagated by rhizome division, which allows the high pest and disease infestation, thus the deterioration of clonal material within a few generations. The aim of this study was to evaluate the seed germination percentage and germination velocity index of *C. arabicus* L. under different light and temperature conditions.

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2. MATERIAL AND METHODS

C. arabicus fruits were collected from cultivated plants at the Experimental Garden of Núcleo de Pesquisa em Plantas Ornamentais (NPPO), Instituto de Botânica (São Paulo State, Brazil). Fruits were washed in running water over a sieve to remove the pulp. Seeds were dried in a non-controlled environment, not disinfested (seeds weren't submitted to chemical or thermal treatment) and subsequently stored in glass containers under 25 ± 1 °C until initiation of the experiments. The effects of temperature and light on germination were obtained in a germination chamber (Design 347 CDG – FANEM). For germination experiments, 50 mm diameter Petri dishes lined with two sheets of filter paper were used.

Seeds were submitted to the temperatures of 20, 25 and 30 °C and white light or dark were used to evaluate the light effects. The white light was obtained from four fluorescents daylight type 20 W bulbs ($43.8 \mu\text{mol m}^{-2} \text{s}^{-1}$). Petri dishes were inserted inside a transparent gerbox container for the experiments in light and a black gerbox container for those in the dark. The seeds under dark condition were monitored under a green safety light (AMARAL-BAROLI and TAKAKI, 2001). Seeds that presented a primary root with at least 1 mm were considered as germinated. Experiments were monitored daily with counting and removal of germinated seeds. Treatments ended when the germination was not

observed along seven consecutive days. The treatments were conducted in a completely randomized design with treatments arranged in a factorial 3×2 (temperature and light/dark) with three replicates of ten seeds. The results were expressed as percentage of germinated seeds and germination speed index (IVG), calculated according to Maguire formula (1962). The variable germination was transformed into $\text{arc sen}(x/100)^{1/2}$ (STORCK et al., 2000) and a polynomial regression analysis was applied. Analysis of variance (ANOVA) and Tukey test at $\alpha = 0.05$ were conducted when variances were normal and homogeneous. The program Sisvar were used for statistical analysis.

3. RESULTS AND DISCUSSION

Seed germination started on the seventh day after the experiment starts, on seeds subjected to temperatures of 30 °C - Light and on the tenth day for 30 °C - Dark (Figure 1). Seeds exposed to temperatures 25 and 20 °C seed germination started from the 13th day. The highest percentage of seed germination was on treatment 30 °C, in which case the germination stabilization occurred at end of the experimentation on 45th days. The lowest germination rates was 20 °C - Dark which germination starts on 28th days and the stabilization of seed germination occurred on 30th day.

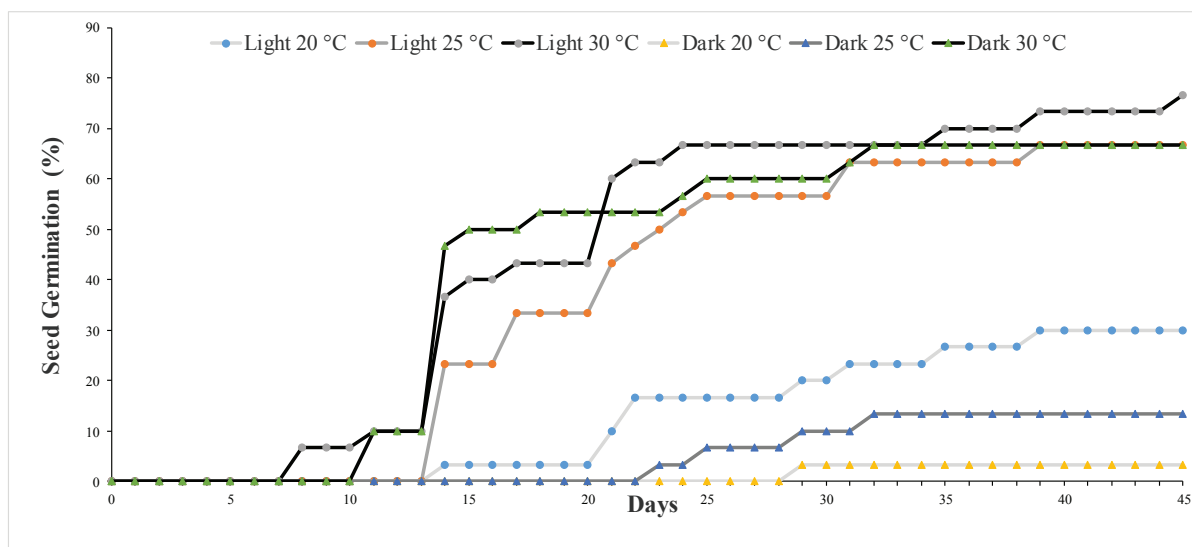


Figure 1. Seed germination (%) of *C. arabicus* on light or dark under 20, 25 or 30 °C during 45 days of experimentation.

Low temperatures delays seed germination of tropical species as for *Hedychium coronarium*, which seeds germination, are delayed, but not decreased, under temperatures that simulated the winter conditions of the tropical region (BRIGITTE et al., 2008).

The Figure 1 shows 30 °C for dark or light, 25 °C on light had the best results for seed germination of *C. arabicus*. High temperature starts seed germination

earlier and maintains the process for a longer time than low temperature, which makes the seeds germination rates on 30 °C higher. A reduction in the rate of metabolic reactions occurs at low a temperature of 20° C, affecting the essential processes that initiate germination, and thus, the establishment of fewer seedlings and a reduction of biomass, particularly among tropical and subtropical species (OLIVEIRA, et al., 2013).

The highest percentage of seed germination of *C. arabicus* on light was reached on 24th day (24.80 days) on temperature of 30 °C on light and 26th day (26.94 days)

on temperature 25 °C (Figure 1). Seed germination on dark reached the highest rate on 22th day (22.39 days) also on 30° C and 36th days (36.54 days) on temperature 25 °C (Figure 2).

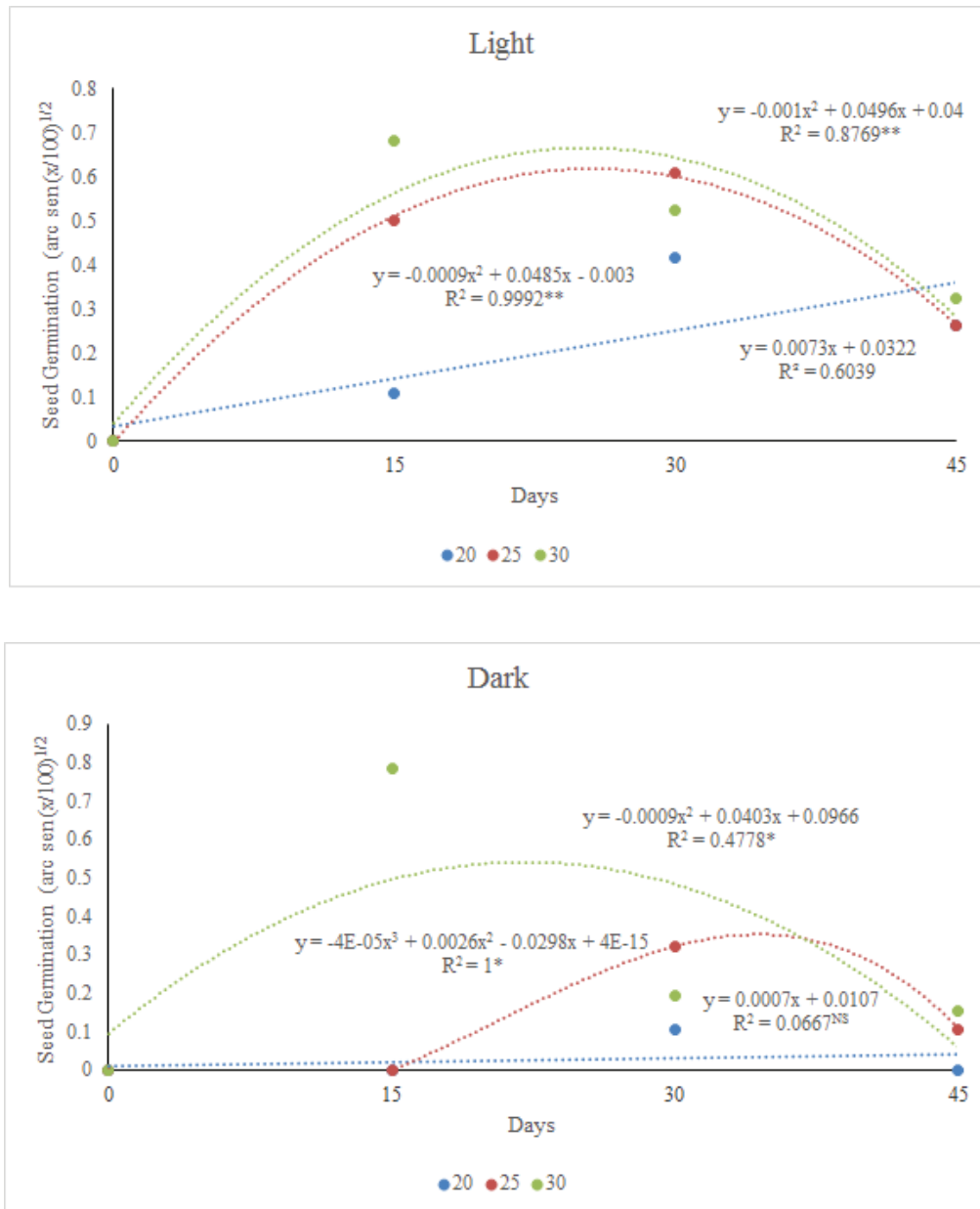


Figure 2. Regression curves of percentage of seed germination (arc sen (x/100)^{1/2}) of *C. arabicus* on light or dark under 20, 25 or 30 oC during 45 days of experimentation.

Germination percentages of *C. arabicus* seeds were higher in light than in darkness on all tested temperatures, indicating that a considerable percentage of the seed population is light sensitive. However, *C. arabicus* seeds can be classified as insensitive or indifferent to the presence

of light (neutral photoblastic), because germinated both in the presence and absence of light (Table 1), but this category can not be stated as definitive, since other factors can alter their photoblastic characteristics (LABORIAU, 1983; BEWLEY and BLACK, 1994; TAKAKI, 2001).

Table 1. Percentage of seed germination (arc sen $(x/100)^{1/2}$) and Index of Germination Velocity (IVG) of *C. arabicus* on light or dark under 20, 25 or 30 oC after 45 days of experimentation.**Tabla 1.** Porcentagem de germinação das sementes (arc sen $(x/100)^{1/2}$) e índice de velocidade de germinação de *C. arabicus* na luz e no escuro sob 20, 25 ou 30 oC durante 45 dias de experimentação.

		Temperature (°C)			
		20	25	30	
		Average % Germination $(x/100)^{1/2}$			
Light		0.542 Ba*	0.813 ABa	0.870 Aa	0.742 a
Dark		0.105 Bb	0.360 Bb	0.806 Aa	0.424 b
	Average	0.324 C	0.586 B	0.838 A	
		IVG			
Light		0.010 Ba	0.289 Ab	0.378 Aa	0.256 a
Dark		0.011 Ba	0.041 Ba	0.381 Aa	0.144 b
	Average	0.056 C	0.165 B	0.380 A	

*Means followed by the same lower case letters in a column and capital letters on the lines do not differ significantly by the Tukey test ($p < 0.05$).

Seeds of some plants maintained under unfavorable conditions may require the presence of light, even those considered neutral photoblastic, or which germinate both in the presence and absence of light (ARAÚJO NETO et al., 2002).

Optimum temperature for seed germination of this species was 30 °C, since there were statistically significant difference among germination percentages at these temperatures. *C. speciosus* showed no germination in low temperature (4 °C) and a high degree of germination after storage for 90 days (TIWARI and DAS, 2014). The highest germination percentage was 66.67% obtained on light with 30 °C. The results are compatible with seed germination of *Cheilocostus speciosus*, which reached from 74.7% 80 days after sowing (SINGH and MEENA, 2013).

Some species in Zingiberales family present dormancy, as *Elettaria* species, which low seed germination percentages, is because of hard seed coat that act as a physical barrier for germination (GOUGH and MOORE-GOUGH, 2011) or the low germination reported for *Musa* seeds due to the degree of maturity of the seed when extracted from the fruit (ELLIS et al., 1985). However, there was not observed any kind of dormancy on *C. arabicus* seeds. The species tolerance to various conditions of temperature, light and shade, as an adaptive condition of the species for recruiting its seedlings in natural environments (SOCOLOWSKI et al., 2010).

The results of the IVG shows that seeds on 30 °C temperature germinated faster in the presence or absence of light indicating to higher temperatures favors the germination speed of this species. Higher temperatures can reduce the germination rate, however, this was not observed, suggesting that seeds of *C. arabicus* as a tropical climate species are well suited to these temperatures. The seeds that germinated in dark under temperatures of 20 or 25 °C had their IVG reduced (81 e 46%, respectively) and

subsequently germinated latter than the other treatments. However, seed germination in both temperature regimes reveals the ability of the species to adapt to the natural thermal fluctuations of the environment. This feature, according to Guedes et al. (2010), provides to *C. arabicus* a higher resistance to environmental adversities.

4. CONCLUSIONS

Costus arabicus seeds are indifferent to light condition and germinate better in temperatures that range from 25 to 30 °C. However, commercial seedling production of *C. arabicus* by seeds is not indicated in lower temperatures.

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