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Nutritional reserves in seeds of bromeliad species

Natália Aparecida Braconaro de Araujo*
Centro Universitário São Camilo, São Paulo, SP, Brazil.

Flávia Maria Kazue Kurita
Vivian Tamaki
Instituto de Botânica, São Paulo, SP, Brazil.

*Corresponding author: nataliabraconaro@bol.com.br

Workshop Information

I Workshop of Plant Biology (I Workshop de Biologia Vegetal) was held in the Bioscience Institute – UNESP, campus of Rio Claro, Brazil, during August 20 and 21, 2012. Workshop was a scientific event organized by Post-graduate students from that Institute aiming to integrate Post-graduate and Graduate students from different areas related to Plant Biology (Anatomy, Ecology, Evolution, Morphology, Physiology, and transitional areas) from different Universities. Workshop Organization offered a large number of speaking activities, scientific discussions, and extra short-courses to improve the knowledge and formation of students in Plant Biology.

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INTRODUCTION

Bromeliads are plants widely distributed and have different habits, may be terrestrial, lithophytes, saxicol or epiphytes, and have seeds with high morphological diversity, which may be mild, with or without flight apparatus, flat or plump and heavy (Paula and Silva 2004).

The definition of germination is controversial among many authors in the field of botany. Labouriau (1983) considers the criterion of "botanical" germination in which germination is defined when part of the embryo, usually the radicle, emerges through the wrappings. The definition of seedlings is also controversial, some researchers have meaning to the stage after germination of an embryo and it consisting of essential structures and typical of each species (Oliveira 2001), for others to understand the seedling stage from the moment from germination to first leaf expansion (Souza and Válio 2003).

The aim of this research was to study the durability of the seed reserves of some species of Bromeliaceae of different habits, to contribute to a better use of the term seedling in bromeliads.

MATERIAL AND METHODS

The study was conducted at the Laboratory of Research in Ornamental Plants, Institute of Botany, Department of the Environment of the State of Sao Paulo, using seeds of *Nidularium minutum* Mez, *Vriesea gigantea* Mart. ex Schult. f., *Alcantarea imperialis* (Carrière) Harms, *Tillandsia pohliana* Mez, and *Ananas ananassoides* (Baker) LB SM. A hundred seeds of each species were used, whose fruits were opened manually and seeds were placed in brown paper bags and stored in refrigerated conditions at 10 °C.

Seeds passed for a superficial disinfection with 70% alcohol for 5 minutes then solution of sodium hypochlorite at 2% with two drops of Tween 20 for one hour under agitation. Then, in the flow chamber of sterile air, the seeds were rinsed four times with sterile distilled water and placed in Petri dishes with paper filter plates for a total of four for each species, 25 seeds were deposited on each plate. The plates were kept in culture room with 12 h photoperiod, photosynthetically active radiation of 30 μmol m^{-2} s^{-1}, and maintained in an average temperature of 26 ± 2 °C.

Seedlings were watered with distilled water and analyzed every two days during eleven months. Evaluations consisted of analyzing the percentage of germination, the amount of leaves present, and presence of visible signs of nutritional deficiency. Mass were measured of the fresh and dried seeds, in addition to the macronutrient content of the seeds.

Data were subjected to analysis of variance (ANOVA) and means were compared by Tukey test at 5% probability.

RESULTS AND DISCUSSION

Regarding the germination, the seeds of *T. pohliana* did not germinate. One possible explanation for this would be the loss of seed viability, which were collected in January 2010 and were stored in refrigerator under 10 °C until August 2011. The period between the storage of other species and the conduct of this study did not exceed five months, which underlies the statement above.

The germination of other species was considered from the primary root protrusion. Data on seed germination and the length of its reserves were followed until the period of June 1, 2012 and had their averages analyzed and compared (Table 1).

Duration of the reserves was considered, the time between seed germination and the presence of the first signs of chlorosis, which showed a mean duration of 109 days. The species that presented a greater duration of seed reserves was *A. ananassoides* of terrestrial habit. It began to have chlorosis 127 days after seed germination. The remaining species the duration of the reserves range from 85 to 88 days. Regarding the development of leaves, these chlorosis species present between 3 to 5 sheets, without patterns related to the habit species.

The analysis results of macronutrients seeds are shown in Table 2. The species *V. gigantea* showed no amount of dry seed mass enough to be submitted for analysis.

Comparing Tables 1 and 2, there was a direct relationship between the increased presence of nutrients with higher fresh mass and dry mass seeds; however, not in relation to the duration of the reserves (early onset of chlorosis), since *A. imperialis* was the first to show signs of nutritional deficiency, even though it has more nutrients than *N. minutum.*

CONCLUSIONS

Due to the values found, we can conclude that despite the different values on the nutrient content, duration of the seed reserves of the species studied, lasted about 109 days. The storage time also affected seed quality and germination of seeds, showing that work with these species, the optimal period of storage of seeds is up to six months, allowing the embryos to have a good formation without considerable loss of water.

The nutrient content in the seeds did not show a direct relationship with the absolute period of germination of each species and duration of the reserves of the same in the species studied, which suggests that species whose seeds have fewer nutrients will not have a lower specific duration of their reserves.

Regarding the use of the term seedling or plant in the Bromeliaceae, no conclusive results were obtained, which requires further study to attempt to define these terms.

Table 1. Comparison between the duration of germination of the seeds reserve of Bromeliaceae species.

Stage	*Ananas ananasssoides*	*Alcantarea imperialis*	*Nidularium minutum*	*Vriesea gigantea*
Beginning of germination (average time in days)	6	8	13	8
Duration of seeds reserves (days)[1 e 2]	127 ± 1.41	98 ± 1.26	109 ± 2.08	102 ± 3.65
Number of leaves with chlorosis	5 A	4 B	3 C	4 B
Total number of leaves	9	4	3	7
Fresh mass of seed (g /100seeds)	0.72 A	0.21 B	0.020 C	0.04 D
Dry mass of seed (g /100 seeds)	0.65 A	0.11 B	0.017 C	0.01 D
Percentage of germination [3]	92 B	96 A	88 C	96 A

Letters compare values horizontally. The data followed by the same letter do not differ significantly by Tukey test at 5% probability.
[1]The duration of the beginning of germination and presence of chlorosis in 50% of the seedlings of each plate were considered.
[2]Standard deviation shown among the four plates of each species.
[3]Data analyzed by comparison between the four plates of each species.

table 2. Concentrations of nutrients in seeds of different species of Bromeliaceae.

	Macronutrients (mg nutrient g seed^{-1})					
Species	Nitrogen (N)	Phosphorus (P)	Potassium (K)	Calcium (Ca)	Magnesium (Mg)	Sulfur (S)
Alcantarea imperialis	23.34 B	4.04 B	9.43 B	2.77 B	1.37 B	1.80 B
Ananas ananassoides	168.64 A	19.64 A	13.42 A	21.93 A	7.67 A	8.94 A
Nidularium minutum	4.77 C	0.61 C	194 C	0.24 C	0.34 C	0.21 C

Letters comparing the values in vertical and different letters indicate that values are significantly different according to the Tukey test at 5% probability.

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Review process and quality of English writing is responsibility of Workshop Scientific Committee.