

## Initial development of *Euterpe oleracea* Mart. in function containers used in the production of seedlings

*Desenvolvimento inicial de Euterpe oleracea Mart. em função de recipientes usados na produção de mudas*

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### ABSTRACT

The açazeiro (*Euterpe oleracea* Mart.) is a natural species of the lowland areas of the Amazon region, with the state of Pará as the largest center of natural dispersion of this palm. Much of its production comes from extractivism and has the potential to increase fruit production by projecting the scenario for the advancement of the species' cultivation to the mainland, but it needs to be framed in market standards, therefore, improvement must occur. of seedling production techniques. Thus, this work aimed to evaluate the initial development in açai plants, produced in containers with different volumes and substrates, during 360 days in the field. The test was carried out in the experimental field of Embrapa Amazônia Oriental, in Belém, PA. Açazeiro seedlings of the cultivar BRS Pará, produced in two types of substrates (commercial and conventional) were used. For the production of seedlings, the following types of containers were used: plastic bag with dimensions of 18 x 24 cm (1900 cm<sup>3</sup>), which is recommended for the production of açai seedlings and other fruit trees and tubes with volumes of 280, 175 and 95 cm<sup>3</sup>. The experiment was installed in a completely randomized block design, using four replications and five plants per plot. Field evaluations took place every 60 days after planting. The variables measured were: plant height, stem diameter and number of leaves. It was observed that the treatments in polyethylene bag had greater development in the analyzed variables, regardless of the substrate used. It was found that there was no significant difference between treatments resulting from seedlings produced in tubes. Therefore, it is concluded that the plants of *E. oleracea* Mart, cultivar BRS Pará, presented greater initial development when coming from seedlings produced in polyethylene bags in relation to the other containers.

**KEYWORDS:** field establishment; seedling production; volume of container.

### RESUMO

O açazeiro (*Euterpe oleracea* Mart.) é uma espécie natural das áreas de várzea da região amazônica, sendo o estado do Pará como o maior centro de dispersão natural dessa palmeira. Grande parte de sua produção provém do extrativismo e possui potencial de incremento da produção de frutos ao projetar o cenário para o avanço do cultivo da espécie para a terra firme, mas necessita estar enquadrado nos padrões de mercado, portanto, deve-se ocorrer o aperfeiçoamento das técnicas de produção de mudas. Assim, o trabalho teve como objetivo avaliar o desenvolvimento inicial em plantas de açazeiro, produzidas em recipientes com diferentes volumes e substratos, durante 360 dias em campo. O ensaio foi realizado no campo experimental da Embrapa Amazônia Oriental, em Belém, PA. Foram utilizadas mudas de açazeiro da cultivar BRS Pará, produzidas em dois tipos de substratos (comercial e o convencional). Para a produção de mudas foram usados os seguintes tipos de recipientes: saco de plástico com as dimensões de 18 x 24 cm (1900 cm<sup>3</sup>), a qual é recomendada para a produção de mudas de açazeiro e outras fruteiras e tubetes com volumes de 280, 175 e 95 cm<sup>3</sup>. O experimento foi instalado no delineamento experimental em blocos inteiramente casualizados, utilizando-se quatro repetições e cinco plantas por parcela. As avaliações em campo ocorreram a cada 60 dias após o plantio. As variáveis mensuradas foram: altura da planta, diâmetro do coleto e número de folhas. Observou-se que os tratamentos em saco de polietileno houve maior desenvolvimento nas variáveis analisadas, independente do substrato usado. Verificou-se que não houve diferença significativa entre os tratamentos resultantes de mudas produzidas em tubete. Portanto, concluiu-se que as plantas de *E. oleracea* Mart, da cultivar BRS Pará, apresentaram maior desenvolvimento inicial quando oriundas de mudas produzidas em sacos de polietileno em relação aos demais recipientes.

**PALAVRAS-CHAVE:** estabelecimento em campo; produção de mudas; volume de recipiente.

## INTRODUCTION

*Euterpe oleracea* Mart, known all over the world as açai, is a palm tree, native to the Brazilian Amazon, belonging to the *Arecaceae* Family (OLIVEIRA et al. 2019). It has Pará as the largest center of natural dispersion. Its cultivation is aimed at fruit production, to extract the pulp that generates açai wine for fresh consumption that is characteristic of the region's population. According to HONÓRIO et al. (2017), the açazeiro is considered a species with multiple uses, however, its potential is mainly related to the commercialization of fruit and stem, origin of the palm heart.

Due to the nutritional attributes and caloric value of açai, its demand has increased in recent years since the fruit is consecrated for being a food abundant in proteins, lipids, fibers, and vitamin E, besides being a source of minerals such as manganese, copper, boron and *chromium* (SILVA et al. 2017).

Much of this production comes from extractivism and has the potential to increase fruit production by designing the scenario for the advancement of the cultivation of the species to the land. For the açazeiro, the best container choice should consider the substrate used and the desired age for the production and/or commercialization of seedlings. Interestingly, both planting and maintenance of homogeneous plantings of açazeiros require the acquisition of vigorous seedlings to ensure the return on investment and success in the establishment of the plantation; for this, it is necessary to improve the techniques of production açai seedlings of a high commercial standard (SILVA et al. 2017).

Smaller containers have advantages for nurseries in the production of açazeiro seedlings, such as lower amount of substrate demanded, ease of transport, lower production costs and better operating yield at the time of planting (LIMA FILHO et al. 2019). Thus, it is extremely important to analyze the impact that this form of production has on the quality of açai seedlings.

In studies developed by NASCIMENTO & GATTI (2020), it was possible to affirm that the production of açazeiro seedlings, regardless of the type of substrate used, is more indicated in containers with a volume of 1,900 cm<sup>3</sup>, allowing seedlings suitable for planting in the field from 180 days. While for seedlings produced in tube should remain for another 120 days in nursery.

Thus, the objective of this work was to verify the effect of different substrates and container volumes on the initial development of açazeiro (*Euterpe oleracea* Mart) seedlings.

## MATERIAL AND METHODS

The assay was conducted in the experimental field of Embrapa Eastern Amazon, in Belém, PA. The local soil is Yellow Latosol with light texture and the climatic type Af<sub>i</sub> according to the Köppen classification, which corresponds to the humid tropical, with monthly temperature higher than 18 °C, rainfall in the two seasons precipitation always above 60mm (CARVALHO SILVA 2016).

Characterized as a tropical climate area, with an average rainfall of 2,537 mm.year<sup>-1</sup> and an average temperature of 26.8 °C. The test was conducted in a location with geographic coordinates: 1° 26' 09.1", south latitude and 48°26'34.6" west longitude, from August 2018 to August 2019.

We used açazeiro seedlings of the cultivar BRS Pará, with eight months of age (240 days in a nursery), produced in two types of substrates, the first consisting of 60% of soil + 40% of aviary bed (conventional substrate), while the second type of substrate applied was the recommendation used by the Institute of Forest Development and Biodiversity of the State of Pará (Ideflor-Bio), for the production of forest and fruit seedlings in tubes (commercial substrate). The recommendation was formulated for the production of 200 liters, consisting of the mixture of 160 liters of coconut fiber, 20 liters of carbonized rice straw, 20 liters of clay, 1 kg of castor bean pie, 1 kg bone flour, 500 grams of dolomitic limestone, 500 grams of phosphorus and controlled release osmicate fertilizer (15% Nitrogen, 9% Phosphorus and 12% Potassium).

For the production of seedlings, the following types of containers were used: plastic bag with dimensions of 18 x 24 cm (1900 cm<sup>3</sup>) and tubes with volumes of 280, 175 and 95 cm<sup>3</sup> (Figure 1).

The fertilization in the pit at the time of planting consisted of the following composition: 10 liters of manure, 200 g of phosphorus and 40 g of dolomitic limestone. In the period of lower rainfall (August to November), in the metropolitan region of Belém, water supplementation was performed (Figure 2).

The experiment was installed in an experimental design in completely randomized blocks, with açazeiro seedlings aged eight months in a nursery, produced in different containers, with four replications of five plants per plot. Thus, a total of 100 açazeiro plants were arranged in the spacing of 1 m x 1 m. Fertilization was made every three months using the chemical fertilizer NPK in formulation 18-18-18. In the first six months of the

experiment, 50 grams per plant were applied, using the technique in "half-moon", and after this period 100 grams were applied per plant of the same formulation.

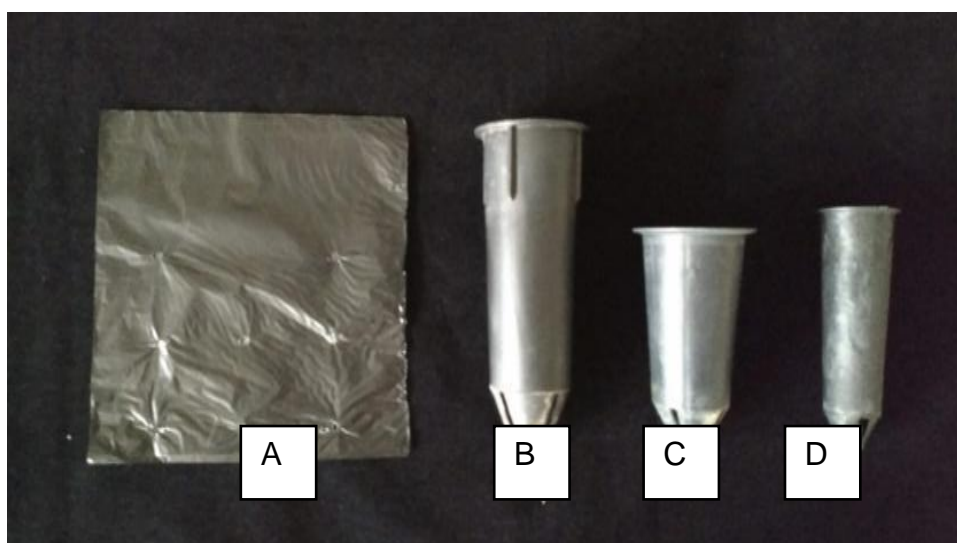


Figure 1. (A) Plastic bag 18 x 24 cm. (B) Tube of 280 cm<sup>3</sup>. (C) 175 cm<sup>3</sup> tube. (D) 95 cm tube<sup>3</sup>.



Photo: Walnice Nascimento.

Figure 2. Detail of the plants of *Euterpe oleracea* Mart., after six months of field deployment.

The treatments used in the assay were as follows: 1. plastic bag with conventional substrate; 2. Plastic bag with commercial substrate; 3. tube of 280 cm<sup>3</sup>; 4. 175 cm<sup>3</sup> tube; and 5. 95 cm<sup>3</sup> tube, both containing commercial substrate (Table 1).

Table 1. Containers used for the production of *euterpe oleracea* Mart., with their volumes and type of substrate.

Container	Volume	Type of substrate
1. Plastic bag with conventional substrate	1900 cm <sup>3</sup>	conventional
2. Plastic bag with commercial substrate	1900 cm <sup>3</sup>	commercial
3. Tube	280 cm <sup>3</sup>	commercial
4. Tube	175 cm <sup>3</sup>	commercial
5. Tube	95 cm <sup>3</sup>	commercial

Field evaluations occurred every 60 days after planting, starting in August 2018 and ending in August 2019, and the evaluations at 120, 240 and 360 days were used for statistical analysis. The data obtained underwent statistical treatment in the Software SAS Studio (2018), where the Tukey test compared the means with a significance level of 5%.

The variables measured were: plant height (H cm), obtained using a graduated ruler, measuring from the base of the plant (stem region) to the tip of the upper open leaf; diameter of the stake (D mm), measured by means of a digital caliper, and number of leaves (NF), measured by the count of open and non-senescent leaves of each plant. At the end of the 360 days after the beginning of the experiment, plants were collected to determine the fresh mass (FFM) and dry mass (MSF) of the leaves. The three central plants of each plot were used.

## RESULTS AND DISCUSSION

The means for height of the açazeiro plants in the three periods evaluated are presented in Table 2. It is observed that the treatments in plastic bags stood out significantly from the other types of containers, regardless of the substrate used. There was no significant difference between treatments with seedlings produced in tube during the evaluation period. This result may be related to the low volume of substrate in the tubes, since they limit the development of the roots and, consequently, the growth of the plant. On evaluation in the nursery with the seedlings of *Euterpe oleracea Mart.* produced in the same containers NASCIMENTO & GATTI (2020), obtained similar results with the development of seedlings in nursery.

Table 2. Height (H cm) of *Euterpe oleracea Mart* plants., between treatments at each time evaluated.

Recipiente x substrato	Número de dias		
	120	240	360
	H (cm)	H (cm)	H (cm)
Saco plástico (18x24 cm) - sub. convencional	63,50 a*	127,88 a	203,02 a
Saco plástico (18x24 cm) - sub. comercial	63,25 a	122,55 a	195,05 a
Tubete 280 cm <sup>3</sup> - sub. comercial	42,00 b	67,50 b	125,46 b
Tubete 175 cm <sup>3</sup> - sub. comercial	40,05 b	58,70 b	108,04 b
Tubete 95 cm <sup>3</sup> - sub. comercial	35,15 b	55,30 b	101,16 b

\*Followed means of the same letter in the column do not differ statistically from each other by the Tukey test at 5% probability.

The açazeiro seedlings resulting from the treatments with plastic bag in conventional substrate and the commercial substrate were the only ones that presented at the time of planting, a height compatible with the indication made by the State Commission of Seeds and Seedlings of Pará (BRASIL 1997). Therefore, this committee recommends the marketing of seedlings sized from 40 to 60 cm in height, measured from the neck of the plant at six to eight months of age in nursery. However, it was possible to observe that at the end of the evaluated period 360 days, regardless of the type of container used for seedling formation, all açazeiro plants presented height greater than one meter.

The highest averages for plant height were obtained in treatments with seedlings produced in plastic bag and with a conventional and commercial substrate, at 360 days in the field, with heights of 203.02 and 195.05 cm, respectively. This fact can be justified by the volume of substrate available for the development of the root system of the seedling in its process of formation still in a nursery, which ends up ensuring the greatest growth, besides providing greater chances of adaptation in the field. The same result found by NASCIMENTO & GATTI (2019), who found in their experiment higher average height in açazeiro seedlings from polyethylene bags, açai seedlings produced in a container with dimensions of 18 cm x 24 cm are able to be taken to the field from 180 days (six months).

The superiority in the growth of açazeiro plants produced in a polyethylene bag container was verified in relation to the other containers used, results convergent with the present work.

The seedlings that were produced in plastic bags had the highest averages for the diameter of the stake in the evaluated periods and differed significantly from the seedlings produced in tubes (Table 3). Results different from those found by SANTOS & OLIVEIRA (2021), in which the diameter of the stake (DC), did not have significant differences between the açazeiro seedlings produced in plastic bags and those of the tubes, indicating that the seedlings responded positively to the cultivation in containers with different volumes up to 120 days.

Similar data were found by NASCIMENTO & GATTI (2019) when analyzing the effect of the size of containers on the production of seedlings of *Euterpe oleracea Mart.* In their study, the authors used polyethylene bags with a dimension of 12 x 15 cm and tubes of dimensions of 8 x 10 cm. The reported results indicated the use of polyethylene bags, as more advantageous for developing açazeiro plants.

Table 3. Stem diameter in *Euterpe oleracea* Mart. plants, between treatments and in three evaluation times.

Container x substrate	Number of days		
	120	240	360
	D (mm)	D (mm)	D (mm)
Bag (18x24 cm) - conventional sub.	21.67 a	36.98 a	53.90 a
Bag (18x24 cm) - commercial sub.	21.89 a	36.54 a	52.42 a
Tube 280 cm <sup>3</sup> - commercial sub.	13.22 b	18.88 b	32.78 b
Tube 175 cm <sup>3</sup> - commercial sub.	11.49 b	17.34 b	30.07 b
Tube 95 cm <sup>3</sup> - commercial sub.	10.38 b	15.65 b	28.23 b

Followed means of the same letter in the column do not differ statistically from each other by the Tukey test at 5% probability.

From 240 days on, no significant difference existed between treatments for the number of leaves (Table 4). The justification for this behavior throughout the evaluation period is in the phenological stage of development of açazeiro plants when it refers to the number of leaves maintained by them, since, as described in the methodology, leaf counting was made only of those already open and non-senescent. SANTOS & OLIVEIRA (2021) obtained similar results, with no significant difference between seedlings in tube and plastic bag, considering that the number of leaves indicates vigorous seedlings reflected in the field (MENDES et al. 2018).

Table 4. Number of leaves of *Euterpe oleracea* Mart. plants, depending on treatments and evaluation times.

Containers x substrate	Number of days		
	120	240	360
	NF	NF	NF
Bag (18x24 cm)- conventional sub.	6.50 a*	7.25 a	7.20 a
Bag (18x24 cm) - commercial sub.	6.35 a	6.55 ab	6.90 a
Tube 280 cm <sup>3</sup> - commercial sub.	5.20 ab	5.25 bc	6.30 a
Tube 175 cm <sup>3</sup> - commercial sub.	4.95 ab	4.90 bc	5.75 a
Tube 95 cm <sup>3</sup> - commercial sub.	4.70 b	4.55 c	5.50 a

\*Means followed by the same letter in the column do not differ statistically from each other, by the Tukey test at 5% probability.

To compare the average scans of fresh and dry leaves at twelve months after planting in the field, a similar behavior was observed for the variable height and diameter of the stem of the açazeiro plants, where the treatments with the use of larger containers for seedling formation were made, with average dry masses of the leaves of 219.8 and 211.8 grams, respectively (Table 5).

Table 5. Fresh and dry mass of leaves, in *Euterpe oleracea* Mart. plants, after 360 days in the field.

Container x substrate	MFF (g)	MSF (g)
Bag (18x24 cm) - conventional sub.	575.5 a*	219.8 a
Bag (18x24 cm) - commercial sub.	561.0 a	211.8 a
Tube 280 cm <sup>3</sup> - commercial sub.	270.4 b	101.6 b
Tube 175 cm <sup>3</sup> - commercial sub.	209.4 b	81.3 b
Tube 95 cm <sup>3</sup> - commercial sub.	192.6 b	77.5 b

\*Averages followed by the same letter in the column do not differ statistically from each other, by the Tukey test at 5% probability.

Correlated results are described by SANTOS & OLIVEIRA (2021), in which the seedlings produced in a plastic bag presented significantly higher average fresh mass values than those from tubes, revealing that the volume of the container is directly related to the higher performance of these parameters.

Higher averages for the green and dry mass of shoots were also observed in the work of NASCIMENTO & GATTI (2020), which studying the use of containers for the production of seedlings of *Euterpe oleracea* Mart. In their research, using 18 x 24 cm polyethylene bags and two substrate types showed to be the most promising for this variable, 240 days of age of seedlings.

Therefore, containers with the highest volume allow better root system development. However, reductions in height, leaf area, and biomass production are limitations to development imposed by root system restriction.

The performance in the initial development of the açazeiro plants in the field was directly proportional to the volume of substrate used for seedling production.

Among the tubes of 95 cm<sup>3</sup>, 175 cm<sup>3</sup>, and 280 cm<sup>3</sup>, the 280 cm<sup>3</sup> tube presented a better result that is similar to the results found by NASCIMENTO & GATTI (2019), working with seedlings of *Euterpe oleracea* Mart., found that tubes with a volume of 280 cm<sup>3</sup> are the most suitable for the species. The açazeiro plants of the cultivar BRS Pará that resulted from seedlings produced in plastic bags with capacity for 1,900 cm<sup>3</sup> of substrate had the best vegetative development at 360 days after planting in the field, regardless of the type of substrate used and considering the variables analyzed.

## CONCLUSION

The use of polyethylene bags with a capacity of 1900 cm<sup>3</sup> result in greater development of height, stem diameter and dry and fresh mass of leaves at 120, 240 and 360 days in *seedlings of Euterpe oleracea* Mart., from cultivar BRS Pará. However, the type of substrate does not present significant differences for the development of açai seedlings.

## REFERENCES

- CARVALHO SILVA C et al. 2016. Experiências de estudos e pesquisas a partir de indicadores sociais: o caso da Coordenadoria de Estudos Sociais da Fundação Amazônia de Amparo a Estudos e Pesquisas (Fapespa). *Inclusão Social* 9.
- HONÓRIO ABM et al. 2017. Germinação de sementes de *Euterpe oleraceae* (Mart.) em diferentes substratos. *Agrarian Academy* 4: 280-288.
- LIMA FILHO P et al. 2019. Produção de mudas de *Ceiba speciosa* em diferentes volumes de tubetes utilizando o biossólido como substrato. *Ciência Florestal* 29: 27-39.
- MENDES NVB et al. 2018. Emergência e desenvolvimento inicial do açazeiro em diferentes substratos e ambientes. *Acta Iguazu* 7: 84-96.
- NASCIMENTO WMO & GATTI LAP. 2019. Recipientes para produção de mudas de *Euterpe oleracea*. In: Embrapa Amazônia Oriental-Artigo em anais de congresso (ALICE). In: CONGRESSO BRASILEIRO DE FRUTICULTURA, Anais... Juazeiro: Sociedade Brasileira de Fruticultura.
- NASCIMENTO WMO & GATTI LAP. 2020. Produção de mudas de açazeiro em recipientes de diferentes volumes. Embrapa Amazônia Oriental. *Boletim de Pesquisa e Desenvolvimento (INFOTECA-E)*.
- OLIVEIRA HO et al. 2019. Coupling physiological analysis with proteomic profile to understand the photosynthetic responses of young *Euterpe oleracea* palms to drought. *Photosynthesis Research* 140: 189-205.
- SANTOS JA & OLIVEIRA IV. 2021. Diferentes recipientes na produção de mudas de açazeiro. *Research, Society and Development* 10: e33810414174.
- SAS INSTITUTE INC. 2018. SAS University Edition: installation guide for windows. Cary: SAS Institute.
- SILVA ACD et al. 2017. Tamanho da semente e substratos na produção de mudas de açai. *Advances in Forestry Science* 4: 151-156.