



EFFECT OF DIFFERENT ORGANIC SUBSTRATES ON THE INITIAL DEVELOPMENT OF AÇAÍ (*EUTERPE OLERACEA* MART.) SEEDLINGS IN DYSTROPHIC YELLOW LATOSOL

Jessivaldo Rodrigues Galvão¹
Felipe Yuichi Carvalho Iwabuchi²
Kleslie de Carvalho Moraes³
Vanessa Milena Queiroz Lobo⁴
Francisco José Furtado Rendeiro⁵
Erick Alexandre de Oliveira Pontes⁶
Erick Leonardo Reis Dias⁷
Bianca Marques Oliveira⁸
Guilherme Silva Oliveira⁹
Julio Cesar Gomes Costa¹⁰
Esther Aires Costa¹¹
Giselly Carime Diniz Melo¹²

ABSTRACT

Objective: To evaluate the effect of different organic substrates (sheep manure, litter from cultivated area, agroforestry system litter, and native vegetation litter) on the initial growth of açaí seedlings under greenhouse conditions.

Theoretical Framework: The açaí palm (*Euterpe oleracea* Mart.) holds great socioeconomic and environmental importance in the Amazon region, especially in the states of Pará, Amapá, and Amazonas. Although it is a hardy species, it is commonly cultivated in naturally low-fertility soils, such as dystrophic Yellow Latossols, which have high acidity and limit the early growth of seedlings. Organic fertilization has shown promise by improving the physical, chemical, and biological properties of the soil. Among organic materials, litter stands out for supplying nutrients gradually and improving soil structure and microbiology.

¹ Universidade Federal Rural da Amazônia, Belém, PA, Brasil. E-mail: jessigalvao50@gmail.com

Orcid: <https://orcid.org/0000-0003-4242-6555>

² Universidade Federal Rural da Amazônia, Belém, PA, Brasil. E-mail: engflorestalfelipeyuichi@gmail.com

³ Universidade Federal Rural da Amazônia, Belém, PA, Brasil. E-mail: kleslie.moraes.ufra@gmail.com

Orcid: <https://orcid.org/0000-0002-6757-5357>

⁴ Universidade Federal Rural da Amazônia, Belém, PA, Brasil. E-mail: vanessa_lobo@yahoo.com.br

Orcid: <https://orcid.org/0009-0006-1462-8888>

⁵ Instituto Federal do Pará, Belém, PA, Brasil. E-mail: francisco.rendeiro@ifpa.edu.br

Orcid: <https://orcid.org/0009-0009-0421-1810>

⁶ Instituto Federal do Pará, Belém, PA, Brasil. E-mail: erick.fontes@ifpa.edu.br

Orcid: <https://orcid.org/0000-0002-4643-9858>

⁷ Secretaria Municipal de Agricultura - Salinas, Salinas, PA, Brasil. E-mail: rickagronomia@gmail.com

Orcid: <https://orcid.org/0009-0007-5919-1154>

⁸ Instituto Federal de São Paulo, São Paulo, SP, Brasil. E-mail: bianca.marques1@aluno.ifsp.edu.br

Orcid: <https://orcid.org/0009-0005-8288-2426>

⁹ Instituto Federal de São Paulo, São Paulo, SP, Brasil. E-mail: guilherme.fisica.sma@gmail.com

Orcid: <https://orcid.org/0009-0009-6323-4641>

¹⁰ Universidade Federal Rural da Amazônia, Belém, PA, Brasil. E-mail: julio.costa@ufra.edu.br

Orcid: <https://orcid.org/0009-0006-9485-6003>

¹¹ Universidade Federal Rural da Amazônia, Belém, PA, Brasil. E-mail: estheraires.ufra@gmail.com

Orcid: <https://orcid.org/0009-0007-4380-7612>

¹² Universidade Federal Rural da Amazônia, Belém, PA, Brasil. E-mail: gisellydiniz.ufra@gmail.com

Orcid: <https://orcid.org/0009-0006-3308-162X>



Method: A completely randomized design experiment was conducted with four treatments and eight replications (total of 32 seedlings). Açai seedlings were transplanted and grown for 90 days in plastic bags, evaluated every 10 days. Measured variables included plant height, stem diameter, number of leaves, and relative chlorophyll content (SPAD). Data were analyzed by ANOVA and grouped using the Scott-Knott test at 5% probability (Sisvar 5.6).

Results and Discussion: Seedlings treated with agroforestry system litter (LITSAF) and cultivated area litter (LITCULT) showed superior growth in height (33.90 cm and 31.77 cm), stem diameter (50.95 mm and 48.83 mm), and number of leaves (17.75 and 17.63) compared to sheep manure (29.16 cm; 44.90 mm; 15.00 leaves) and native litter (28.18 cm; 41.30 mm; 14.50 leaves). Chlorophyll index remained similar across treatments (37.79–44.39 SPAD). Litter from SAF and cultivated areas favored açai seedling growth, outperforming sheep manure and native litter due to higher nutrient release. Chlorophyll index was stable among treatments. These data indicate that such litters are sustainable and effective alternatives for seedling production.

Research Implications: This study provides support for more sustainable practices in açai seedling production, with potential to reduce chemical fertilizer use, optimize nursery costs, and improve field planting success.

Originality/Value: This research expands knowledge on using organic residues in açai seedling production by addressing little-explored sources. Its relevance lies in valuing local and sustainable substrates with direct application in agroforestry and extractivist systems in the Amazon.

Keywords: *Euterpe Oleracea*, Organic Substrates, Seedling Growth, Agroforestry Systems, Nurseries.

EFEITO DE DIFERENTES SUBSTRATOS ORGÂNICOS NO DESENVOLVIMENTO INICIAL DE MUDAS DE AÇAÍ (*EUTERPE OLERACEA* MART.) EM LATOSSOLO AMARELO DISTRÓFICO

RESUMO

Objetivo: Avaliar o efeito de diferentes substratos orgânicos (esterco ovino, liteira de área cultivada, liteira de SAF e liteira de vegetação nativa) no crescimento inicial de mudas de açai sob condições de casa de vegetação.

Referencial Teórico: O açazeiro (*Euterpe oleracea* Mart.) possui grande importância socioeconômica e ambiental na região amazônica, especialmente nos estados do Pará, Amapá e Amazonas. Apesar de ser uma espécie rústica, é comumente cultivado em solos de baixa fertilidade natural, como os Latossolos Amarelos distróficos, que apresentam alta acidez e limitam o crescimento inicial das plântulas. A adubação orgânica tem se mostrado uma alternativa promissora, melhorando as características físicas, químicas e biológicas do solo. Dentre os materiais orgânicos, a liteira se destaca por fornecer nutrientes de forma gradual e melhorar a estrutura e microbiologia do solo.

Método: Um experimento em delineamento inteiramente casualizado (DIC) foi realizado com quatro tratamentos e oito repetições (total de 32 mudas). As mudas de açai foram transplantadas, cultivadas por 90 dias em sacos plásticos e avaliadas a cada 10 dias. As variáveis medidas foram: altura da planta, diâmetro do coleto, número de folhas e teor relativo de clorofila (SPAD). Os dados foram analisados por ANOVA e agrupados pelo teste de Scott-Knott a 5% de probabilidade (Sisvar 5.6).

Resultados e Discussão: Mudas nos tratamentos com liteira de sistema agroflorestal (LITSAF) e liteira de área cultivada (LITCULT) apresentaram crescimento superior em altura (33,90 cm e 31,77 cm), diâmetro de coleto (50,95 mm e 48,83 mm) e número de folhas (17,75 e 17,63), em comparação a esterco ovino (29,16 cm; 44,90 mm; 15,00 folhas) e liteira nativa (28,18 cm; 41,30 mm; 14,50 folhas). O índice de clorofila permaneceu semelhante entre os tratamentos (37,79–44,39 SPAD). Liteiras de SAF e áreas cultivadas favoreceram o crescimento de mudas de açai, com melhor desempenho que o esterco ovino e a liteira nativa, devido à maior liberação de nutrientes. O índice de clorofila foi estável entre os tratamentos. Os dados indicam que essas liteiras são alternativas sustentáveis e eficazes na produção de mudas.

Implicações da Pesquisa: A pesquisa oferece subsídios para práticas mais sustentáveis na produção de mudas de açai, com potencial para reduzir o uso de fertilizantes químicos, otimizar custos em viveiros e aumentar o sucesso no plantio em campo.



Originalidade/Valor: Este estudo amplia o conhecimento sobre o uso de resíduos orgânicos na produção de mudas de açai, abordando fontes pouco exploradas. Sua relevância está na valorização de substratos locais e sustentáveis, com aplicação direta em sistemas agroflorestais e extrativistas na Amazônia.

Palavras-chave: *Euterpe Oleracea*, Substratos Orgânicos, Crescimento de Mudas, Sistemas Agroflorestais, Viveiros.

EFFECTO DE DIFERENTES SUSTRATOS ORGÁNICOS EN EL DESARROLLO INICIAL DE PLÁNTULAS DE AÇAÍ (*EUTERPE OLERACEA* MART.) EN LATOSOL AMARILLO DISTRÓFICO

RESUMEN

Objetivo: Evaluar el efecto de diferentes sustratos orgánicos (estiércol ovino, hojarasca de área cultivada, hojarasca de sistema agroforestal y hojarasca de vegetación nativa) en el crecimiento inicial de plántulas de açai bajo condiciones de casa de cultivo.

Marco Teórico: El açai (*Euterpe oleracea* Mart.) es socioeconómica y ambientalmente importante en la Amazonía. Crece comúnmente en suelos de baja fertilidad, donde la fertilización orgánica mejora las propiedades del suelo. La hojarasca destaca por liberar nutrientes gradualmente y mejorar la estructura y microbiología del suelo.

Método: Experimento con diseño completamente al azar, cuatro tratamientos, ocho repeticiones (32 plántulas). Las plántulas se cultivaron 90 días y se evaluaron cada 10 días en altura, diámetro del coleto, número de hojas y clorofila relativa (SPAD). Se analizaron datos con ANOVA y prueba Scott-Knott (5%).

Resultados: Plántulas con hojarasca de sistema agroforestal y área cultivada mostraron mayor crecimiento en altura, diámetro y número de hojas que las tratadas con estiércol ovino y hojarasca nativa. El índice de clorofila fue similar entre tratamientos. Las hojarascas favorecen el crecimiento por su mayor liberación de nutrientes, siendo alternativas sostenibles y efectivas para producción de plántulas.

Implicaciones: Los resultados apoyan prácticas sostenibles que pueden reducir el uso de fertilizantes químicos, optimizar costos en viveros y mejorar el éxito en campo.

Originalidad/Valor: Amplía el conocimiento sobre residuos orgánicos poco explorados, valorizando sustratos locales con aplicación directa en sistemas agroforestales y extractivistas amazónicos.

Palabras clave: *Euterpe Oleracea*, Sustratos Orgánicos, Crescimento de Plántulas, Sistemas Agroforestales, Viveros.

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1 INTRODUCTION

The assai palm (*Euterpe oleracea* Mart.), belonging to the Arecaceae family, is a tropical palm native to the floodplains and wetlands of the Amazon region, particularly the Amazon estuary. In recent years, this species has gained prominence not only for its socioeconomic value, but also for its nutritional, cultural and environmental implications. The açai fruit is widely consumed in Brazil and abroad, representing a rapidly expanding production chain. According to data from the Brazilian Institute of Geography and Statistics (IBGE, 2023),



the national production of açai fruits reached approximately 1.7 million tons, moving R\$ 8.06 billion, with a strong productive concentration in the states of Pará, Amapá and Amazonas.

Despite its rusticity and relative adaptation to different soil and climatic conditions, the açai palm is often grown in acid soils and low natural fertility, such as the dystrophic Yellow Latosols of the Amazon. These soils are characterised by low levels of organic matter and high exchangeable aluminium saturation, which limits the initial growth of plants and, consequently, the efficiency of seedling production nurseries (Segovia *et al.*, 2020). Thus, the use of practices that improve the physical, chemical and biological quality of the soil is essential to promote the good development of seedlings and increase the survival rate in the field.

The use of organic matter as a source of fertilisation has been a promising alternative for the sustainable management of these environments. Organic waste, such as animal manure, plant compounds and forest litters, act not only as sources of macro and micronutrients, but also as soil conditioners, improving water retention, aeration, structural aggregation and microbial activity (Zandonadi *et al.*, 2014; Cunha *et al.*, 2006). In addition, they contribute to environmental sustainability by allowing the reuse of agroforestry waste and reducing dependence on chemical inputs.

Among the types of organic matter, there is litter (or litter), composed of leaves, branches, fruits and other plant structures at different stages of decomposition, which accumulate on the soil surface in forests and agroecosystems. Litter composition and litter decomposition rate vary according to the type of vegetation and management adopted, which directly influences its ability to provide nutrients and improve soil attributes. In particular, litters from agroforestry systems (AFS) and intensely managed cultivated areas have shown potential to *increase soil fertility and promote greater growth of plant species, due to their diversity of species and materials* (Fernanda *et al.*, 2021; Andrade *et al.*, 2003).

However, there are still few studies that comparatively evaluate the effect of different sources of organic substrates - such as sheep manure, litter of native vegetation, litter of AFS and litter of cultivated areas - on the initial development of açai seedlings. Understanding how these materials impact the morphological and physiological growth of seedlings is fundamental for the adoption of more sustainable and efficient technologies in the production of nurseries.



2 METHODOLOGY

2.1 STUDY AREA

The experiment was conducted in a greenhouse located in the Soil Science Area of the Federal Rural University of Amazonia (UFRA), in Belém, Pará State. The geographical coordinates of the experimental area are 1°27'12.0" S latitude and 48°26'36.0" W longitude. According to the Köppen climate classification, the region has a humid equatorial climate (Af), characterised by high temperatures and high rainfall throughout the year.

2.2 SOIL CHARACTERISATION AND PREPARATION

The soil used in the experiment was collected at a depth of 0-20 cm, being classified as Dystrophic Yellow Latosol, according to the Embrapa classification (2013). Soil chemical analyses were performed according to the procedures described in the Embrapa Standards (1997).

For the determination of pH, a glass electrode coupled to a pHmeter was used. The soil was previously oven dried, sieved and mixed with 20 mL of distilled water (1:1 ratio). The suspension was shaken for 10 minutes and left to stand for one hour. Then, the pH reading was performed. Figure 1 shows the equipment used in the analysis, and the results of the chemical characterisation are shown in Table 1.

Due to the high acidity of the soil (pH 4.2), the correction was performed using dolomitic limestone with PRNT of 92%. The corrective was incorporated into the soil, which was subsequently incubated for 30 days under controlled environmental conditions.

2.3 EXPERIMENTAL DESIGN AND TREATMENTS

The experimental design was completely randomised (DIC), with four treatments and eight replications, totalling 32 experimental units. The treatments consisted of:

- T1 – Sheep manure;
- T2 – Litre of cultivation area (not recent use);
- T3 – Agroforestry system litter (SAF);
- T4 – Litre of native vegetation.



2.4 IMPLEMENTATION AND CONDUCT OF THE EXPERIMENT

Acai seeds (Figure 2) were sown in Styrofoam trays containing a locally produced organic compound. Germination occurred 13 days after planting. After 30 days, the seedlings were transplanted into plastic bags with a capacity of 3 dm³, filled with substrate formed by the mixture of 2 kg of corrected soil for 1 kg of organic material of each treatment.

Litter substrates were collected in three distinct areas:

- SAF: Agroforestry system with species such as andiroba, taperebá, açai, banana and cocoa.
- Native vegetation: Area of primary forest without anthropic interference.
- Cultivated area: Former cultivated area, unused in the last 20 years.

After transplanting, the experiment was conducted for 90 days, with evaluations performed every 10 days from the first month of germination. The variables analysed were: plant height, stem diameter, number of leaves and relative chlorophyll content. Measurements of height, number of leaves and stem diameter were performed using tape measure and digital calliper in six periods. Leaf chlorophyll content was estimated using a SPAD metre, which provides non-destructive readings. The value of the SPAD index is positively correlated with the chlorophyll content and, consequently, with the leaf nitrogen concentration (PORTO *et al.*, 2011).

2.5 STATISTICAL ANALYSIS

The data regarding the morphological and physiological variables (height, stem diameter, number of leaves and chlorophyll index) were submitted to normality analysis, as a preliminary step of the statistical analysis. Then, the means were submitted to analysis of variance (ANOVA) and, when significant, the Scott-Knott cluster test was applied at the 5% probability level. Statistical analyses were performed with the aid of Sisvar software, version 5.6 (FERREIRA, 2011), ensuring the accuracy and robustness in the interpretation of experimental data.



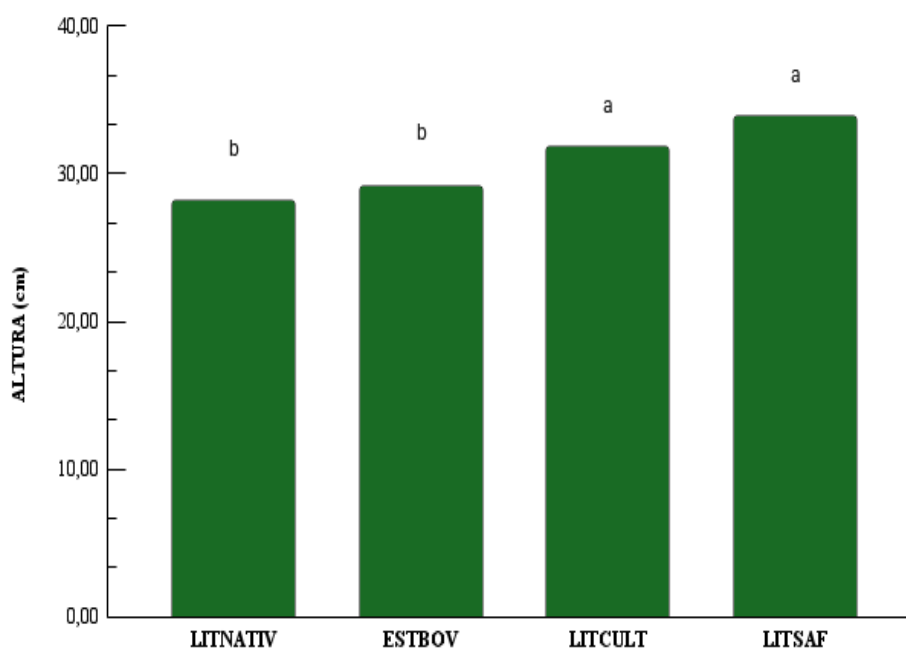
3 RESULTSS AND DISCUSSION

The results obtained show significant differences between the treatments for the morphological parameters evaluated, except for the chlorophyll index. The data were organised and analysed to allow a clear interpretation of the responses of açaí seedlings (*Euterpe oleracea* Mart.) to different sources of organic substrates.

After 90 days, it was observed that seedlings grown on substrates with litter agroforestry systems (LITSAF) had higher average height (33.90 cm), followed by plants in litter cultivated area (LITCULT), with an average of 31.77 cm. These values were significantly higher than those observed in seedlings cultivated with sheep manure (29.16 cm) and litter of native vegetation (28.18 cm), as shown in Figure 1. The growth in height reflects the availability and readiness of nutrients provided by litter LITSAF and LITCULT, which may have favoured cell expansion and elongation of vegetative tissues.

Figure 1

Mean height values for organic substrates.



Source: Research data, 2025

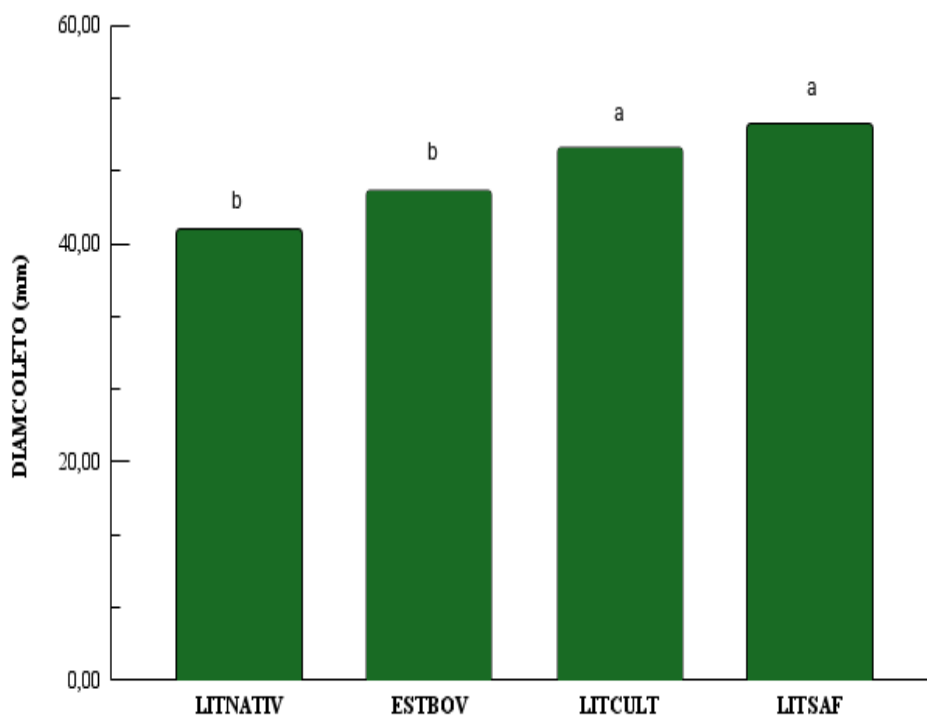
The mean stem diameter was also significantly higher in treatments with LITSAF (50.95 mm) and LITCULT (48.83 mm), compared to sheep manure (44.90 mm) and litter of native vegetation (41.30 mm), as represented in Figure 2. The increase in stem diameter is a direct



indicator of the vigour of the seedling, being related to the mechanical support capacity of the plant and the accumulation of reserves.

Figure 2

Mean values of the stem diameter in relation to the organic substrates.



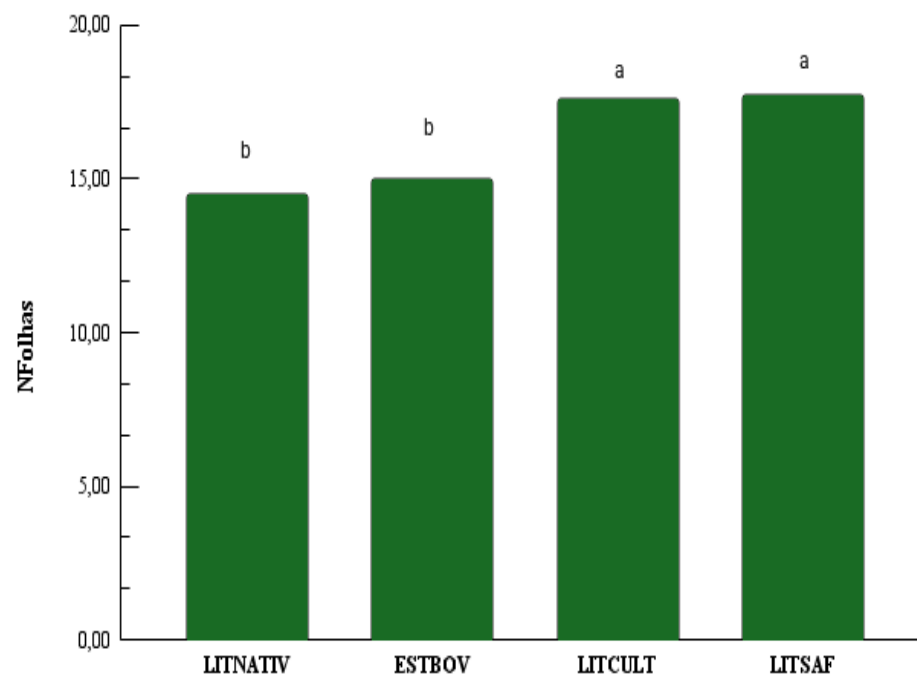
Source: Research data, 2025

The average number of leaves emitted during the experimental period reinforces the previous morphological data, with emphasis on the treatments with LITSAF (17.75 leaves) and LITCULT (17.63 leaves), which presented higher averages in relation to the other treatments, with sheep manure (15.00 leaves) and litter of native vegetation (14.50 leaves) (Figure 3). The largest number of leaves implies a larger photosynthetic area, which enhances carbon assimilation and biomass accumulation.



Figure 3

Mean values of the number of leaves in relation to organic substrates.



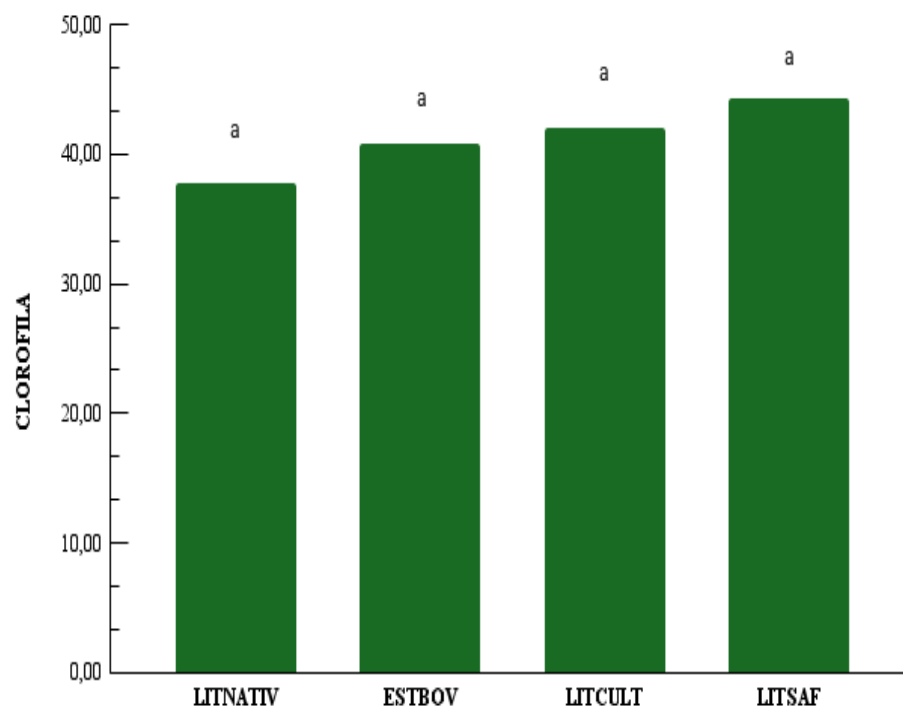
Source: Research data, 2025

Despite the differences observed in the growth parameters, the chlorophyll index ranged between 37.79 and 44.39, without presenting a statistically significant difference between treatments (Figure 4). This suggests that, regardless of the organic source used, leaf nitrogen levels were sufficient to maintain chlorophyll synthesis, reflecting a homeostasis in photosynthetic processes under greenhouse conditions.



Figure 4

Average values of chlorophyll index found in organic substrates.



Source: Research data, 2025

The results show that the organic substrates derived from litters of agroforestry systems and cultivated areas provided better conditions for the initial development of *Euterpe oleracea* Mart. The seedlings treated with these substrates showed significant gains in height, stem diameter and number of leaves when compared to treatments with sheep manure and litter of native vegetation.

This superior performance can be attributed to the higher decomposition efficiency of SAF litters and cultivated areas, which promote the gradual and balanced release of essential nutrients such as nitrogen (N), phosphorus (P) and potassium (K). According to Zandonadi *et al.* (2014), organic matter derived from fresh plant residues stimulates important physiological processes for plant growth, such as nutrient absorption and root development. In addition, plant diversity in agroforestry systems contributes to greater complexity of litter, favouring soil microbial activity. This intensifies the mineralisation of organic matter, increasing the availability of nutrients for plants (FERNANDA *et al.*, 2021). Cunha *et al.* (2006) also highlight that substrates with greater moisture retention capacity and good aeration promote physical conditions favourable to root growth and the emergence of new leaves.



On the other hand, the lower performance observed in the treatments with sheep manure and litter of native vegetation may be related to the slow mineralisation of these materials, mainly due to their high carbon / nitrogen (C / N) ratio, which reduces the immediate release of nutrients (PAVINATO; ROSOLEM, 2008). The native litter, for example, has a more recalcitrant composition and associated low microbial activity, which compromises the efficiency in the availability of nutrients (ANDRADE *et al.*, 2003).

Regarding the chlorophyll index, no statistically significant differences were observed between treatments. This uniformity may indicate that, even in treatments with lower morphological performance, there was sufficient supply of essential elements to chlorophyll synthesis, such as Mg, iron and nitrogen, which are fundamental components of the chlorophyll molecule (STREIT *et al.*, 2005). This result suggests that, under controlled greenhouse conditions, photosynthesis can be maintained even on substrates of lower nutritional quality, as long as there is some level of supply of these elements.

Thus, the data obtained reinforce the potential of SAF litters and cultivated areas as promising organic sources for the production of açai seedlings, promoting greater vegetative growth and possibly greater resistance in later stages of development. The use of such waste is also a sustainable and low-cost strategy, in line with the principles of organic agriculture and the valorisation of local resources.

4 CONCLUSION

Litters of agroforestry systems (SAF) and cultivated areas potentiate the initial growth of açai seedlings, with gains in height, stem diameter and number of leaves. These substrates optimise nutrient release and soil structure, supporting more efficient yields. Sheep manure and native litter showed lower efficacy. It is recommended to prioritise AFS litters in açai nurseries and investigate their effects in advanced stages of development.

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