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AVALIAÇÃO DE MUDAS DE *Copernicia prunifera* (Mill.) H.E. Moore SUBMETIDAS À APLICAÇÃO DE FERTILIZANTE FOLIAR

EVALUATION OF SEEDLINGS OF Copernicia prunifera (Mill.) H.E. Moore SUBJECTED TO FOLIAR FERTILIZER APPLICATION

Víctor Brito dos Santos
Student in Agronomy, Federal University of Ceará.
wictorbrito18@hotmail.com
https://orcid.org/0009-0000-2275-0265

Elves Mardonio Pereira Costa
Agricultural Engineer, Federal University of Ceará
elves.costa.ce@gmail.com
https://orcid.org/0009-0007-8449-8107

Lailla Sabrina Queiroz Nazareno
PhD in Agronomy/Phytotechnics, Federal University of Ceará.
queirozlailla@gmail.com
https://orcid.org/0000-0002-3499-1338

Lamartine Soares Cardoso de Oliveira
Prof. Deputy Agronomy/Forestry
lamartine@ufc.br
https://orcid.org/0000-0001-7411-4498

RESUMO
Objetivou-se verificar o efeito de diferentes substratos em combinação com a adubação foliar no crescimento final de mudas de carnaúba. O experimento em fatorial 3x3+1 foi instalado com doze tratamentos variando os substratos, as proporções e dias de aplicação do adubo foliar. Aos 45 dias, avaliou-se: diâmetro do coleto, altura do olho, número de folhas, comprimento da primeira folha totalmente aberta e sua largura. A estratégia de controle aplicada ao longo do período é eficaz.

ABSTRACT
The objective was to verify the effect of different substrates in combination with foliar fertilization on the final growth of carnauba seedlings. The 3x3+1 factorial experiment was installed with twelve treatments varying the substrates, proportions, and days of application of foliar fertilizer. At 45 days, the following were evaluated: collar diameter, eye height, number of leaves, length of the first fully opened leaf and its width. The control strategy applied throughout the period is effective.

INTRODUCTION

The Caatinga biome covers 11% of the territory and is exclusively Brazilian. Located in a large area of the Northeastern semiarid region, it is rich in biodiversity, adapts to different temperature conditions and water scarcity, and is an important cradle of endemic species

(EMBRAPA, 2022). Among some species, the Carnauba palm, Copernicia prunifera (Mill.) H. E. Moore, is a palm tree of the Arecaceae family, endemic to Brazil, mainly found in the Northeastern states, and shows high tolerance to saline and poorly drained soils (Arruda; Calbo, 2004; Viana et al., 2022). Among its uses, wax stands out as a high-value product for the industry. Despite its adaptability and good development in different environments and soils, Carnauba has historically been used in extractive systems with little concern for environmental protection, which has allowed the establishment of invasive species. Among them, Cryptostegia madagascariensis Bojer Ex Decne, commonly known as Devil's Claw, native to the African island of Madagascar, has gained attention as a real threat to Carnauba palm groves. An alternative to reduce the establishment of these invasives would be to invest in fertilizing seedlings while still in the nursery. However, studies of this nature are scarce, and when it comes to Carnauba seedling production, they are mainly limited to emergence, germination, and early stages of these seedlings. Therefore, the aim of this study was to verify the effect of incorporating different substrates in combination with foliar fertilization on the final growth of Carnauba seedlings.

MATERIALS AND METHODS

The experiment was conducted from May to June 2023 in the greenhouse of the Research and Extension Group in Silviculture (GEPS) at the Department of Crop Science of the Federal University of Ceará, Campus do Pici, Fortaleza, State of Ceará. The Carnauba seedlings were obtained through donation from the Domingos Pontes Forest Nursery, belonging to Pontes Carnauba Wax Industry, at a developmental stage (± 5 months), grown with bagasse and sand (2:1), and housed in polyethylene bags with a capacity of 0.35 L. Upon receipt, they were transplanted into containers with an approximate capacity of 3.43 L, made of the same material and filled according to the treatments (Table 1).

Table 1 – Description of the treatments to which the carnauba seedlings were subjected

Treatment	Substrate	Foliar fertilization
T1	Skittish + Bagana (1:1)	7 days
T2		15 days
T3		30 days
T4	Skittish + Bagana (1:1) + 10% of organic compound	7 days
T5		15 days
T6		30 days
T7	Skittish + Bagana (1:1) + 30% of organic compound	7 days
T8		15 days
T9		30 days
T10	Skittish + Bagana (1:1) + 10% of organic compound	No application
T11	Skittish + Bagana (1:1) + 30% of organic compound	No application
T12*	0	No application

* The T12 treatment corresponds to the control.

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After three days, the following measurements were taken: collar diameter [DC], eye height (apical meristem) [Ho], number of leaves [NF], length of the first fully opened leaf [CPF], and its width [LPF].

At 45 days, DC was evaluated using a caliper graduated in millimeters, along with the quantity of new eyes emerged during the period. Ho (from the collar to the apex of the apical meristem), CPF, and LPF were assessed using a graduated metallic tape measure in centimeters.

Foliar application of NPK (10:10:10) was conducted in cycles of 7, 15, and 30 days, except for T10, T11, and T12; these were administered according to the manufacturer's recommendations. The solution was prepared and applied using a spray bottle after 5:00 PM. Physical plastic barriers were used between treatments to prevent contamination.

The experiment was set up in a completely randomized design with four repetitions per treatment, two plants per plot, totaling 96 plants in a 3x3+1 factorial scheme, with different substrate sources at different fertilization periods and one control.

Data analysis was conducted descriptively based on minimum, maximum, mean, and standard deviation from day 0 to day 45. The results were tabulated and obtained using Microsoft Excel software.

RESULTS AND DISCUSSION

In terms of diameter, treatments T8 to T9 showed the best results, while T10 presented the lowest value (8.94 mm). The control treatment was considered average (10.63 mm). Matias et al. (2019) also obtained good results in Myracrodruon urundeuva for the same variables in substrates of Soil + Manure with weekly fertilization (Table 2).

Table 2 – Collar diameter and height (mean ± standard error) of carnauba seedlings subjected to different proportions of substrates

Trat.	Collection diameter (mm)						Height (cm)					
	0		45		Média		0		45		Média	
	Mi	Mx	Mi	Mx	0	45	Mi	Mx	Mi	Mx	0	45
T1	6	12	8	14	9.75 ± 2.5	11 ± 1.9	7	25	15	31	16 ± 6.5	23 ± 6.1
T2	8	12	9	15	10.38 ± 1.4	11.88 ± 1.9	5.6	21	14	24	16 ± 4.8	19 ± 3.3
T3	5	12	6	14	9.25 ± 2.7	10.88 ± 2.4	2	19	10	25	14 ± 6.8	18 ± 5.1
T4	9	14	10	15	11.13 ± 1.7	12.25 ± 1.9	6.5	20	13	33	13 ± 4.2	24 ± 6.7
T5	10	11	10	12	11.5 ± 0	12.38 ± 1.3	5	22	17	28	14 ± 6.7	24 ± 3.9
T6	9	13	12	16	10.63 ± 0	12.75 ± 3.1	7.5	20	16	29	16 ± 4.4	23 ± 5
T7	9	12	11	15	11 ± 1.3	13 ± 1.7	7	27	19	32	14 ± 6.3	24 ± 3.8
T8	9	17	9	17	11.63 ± 0	13.13 ± 3.1	3.5	20	17	26	14 ± 5.5	22 ± 3.4
T9	9	12	10	15	11.13 ± 1	13.25 ± 1.7	10	16	15	24	13 ± 2	19 ± 3
T10	6	6	6	11	7.63 ± 1.1	8.94 ± 1.6	1	20	9.5	25	9.1 ± 6.1	18 ± 5.1
T11	6	11	11	14	9.06 ± 1.8	12 ± 1.1	3.5	18	13	26	11 ± 5	20 ± 4.3
T12	5	10	10	12	8.25 ± 0	10.63 ± 0.9	8	23	21	31	16 ± 4.7	25 ± 3.3

It reads: Treat. – Treatments; Mi – Minimum; Mx – Maximum.

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In terms of height, T12 at 25 cm was the best. However, the composition of sand + bagasse with 10% organic compost also proved significant, except for application after 30 days (T6).

Regarding the number of leaves, T9 showed the highest mean (3.25), while T10 (1.63) was inferior. In the length of the newest fully expanded leaf, treatments T2, T5, T6, and T10 achieved higher averages (30 cm), but still did not exceed the control (31 cm) (Table 3).

Table 3 – Number of leaves and leaf length (mean ± standard error) of carnauba seedlings subjected to different proportions of substrates

Trat.	Number of sheets						Sheet length (cm)					
	0		45		Average		0		45		Average	
	Mi	Mx	Mi	Mx	0	45	Mi	Mx	Mi	Mx	0	45
T1	2	3	2	3	2.13 ± 0.4	2.5 ± 0.5	25	32	25	32	28 ± 2.4	29 ± 2.5
T2	2	4	2	4	2.75 ± 0.7	3 ± 0.8	28	34	28	34	30 ± 2.1	30 ± 2
T3	0	4	0	4	2.13 ± 1.3	2.38 ± 1.2	0	34	35	34	25 ± 11	25 ± 11
T4	2	3	2	4	2.63 ± 0.5	3 ± 0.9	22	35	23	35	28 ± 4.2	29 ± 4
T5	2	3	3	4	2.63 ± 0.5	3.13 ± 0.4	25	33	25	33	30 ± 2.7	30 ± 2.7
T6	2	4	2	4	2.5 ± 0.8	2.75 ± 0.7	26	36	27	37	29 ± 3.6	30 ± 3.3
T7	1	4	2	5	2.75 ± 1	3 ± 1.1	22	29	22	32	25 ± 2.8	28 ± 3.5
T8	2	4	2	5	2.88 ± 0.8	3 ± 1.1	25	31	25	32	28 ± 1.7	29 ± 0.3
T9	2	5	2	6	3.15 ± 1.3	3.25 ± 1.5	20	35	20	35	26 ± 5.8	27 ± 5.8
T10	1	2	1	2	1.75 ± 0.5	1.63 ± 0.5	26	34	27	35	29 ± 2.7	30 ± 2.6
T11	2	2	2	3	2 ± 0	2.25 ± 0.7	25	28	27	28	27 ± 1	28 ± 0.6
T12	1	2	1	3	1.63 ± 0.7	1.88 ± 0.7	21	37	21	38	30 ± 4.8	31 ± 5

It reads: Treat. – Treatments; Mi – Minimum; Mx – Maximum.

For the leaf width variable, among the different substrate proportions, T7 and T8 obtained the best averages (3.8 cm); however, the control still stood out (4.3 cm). Regarding the development of new apical meristems, T3, T6, and T9 stood out with a higher quantity (8 cm) (Table 4).

Table 4 – Leaf width (mean ± standard error) of carnauba seedlings subjected to different proportions of substrates

Trat.	Sheet width (cm)						Apical meristem (cm)
	0		45		Média		Média
	Mi	Mx	Mi	Mx	0	45	
T1	2	5	2	5.5	3.4 ± 0.9	3.5 ± 1.1	5
T2	2.1	4.4	2.1	4.4	3.33 ± 0.9	3.41 ± 0.8	4
T3	0	4.6	0	4.6	2.46 ± 1.4	2.59 ± 1.4	8
T4	2.5	4.2	2.5	4.5	3.35 ± 0.6	3.49 ± 0.7	4
T5	3	4.5	3.2	4.6	3.59 ± 0.6	3.8 ± 0.5	7
T6	2.7	4	2.9	4.3	3.38 ± 0.5	3.64 ± 0.5	8
T7	3	4.5	3	4.7	3.74 ± 0.5	3.85 ± 0.5	6
T8	2.5	4.5	2.6	4.6	3.63 ± 0.6	3.81 ± 0.6	6
T9	2	4	2.1	4.5	3.29 ± 0.7	3.64 ± 0.8	8
T10	2	4	2.5	4	3.28 ± 0.6	3.43 ± 0.5	6
T11	2.9	4.4	3	4.5	3.44 ± 0.5	3.7 ± 0.5	6
T12	2.8	8.8	2.9	8.9	4.15 ± 1.9	4.35 ± 1.9	6

It reads: Treat. – Treatments; Mi – Minimum; Mx – Maximum.

The consistent increase in leaf width across different substrate compositions can be attributed to the fact that, generally, palms initially invest more in the root system and diameter, which negatively impacts vegetative growth, thus explaining the results obtained in this study.

The control group also demonstrated good results in terms of leaf width, surpassing the maximum average values of the treatments slightly. Additionally, the parameter of leaf number showed higher values compared to most treatments, except for T1 and T5. This behavior is based on the rationale that the control treatment requires the necessary nutrients for normal development; therefore, the plant had to compensate by increasing the photosynthesis rate, enabling this species to withstand adverse conditions. Seedlings receiving both soil and foliar fertilization showed promising responses with recorded growth and height.

The treatments with foliar fertilization every 7 days did not yield good results compared to the other two application periods, which is likely due to nutrient excess in the plants and fertilizer phytotoxicity. According to Faquin (2002), this high nutrient content can cause imbalance in physiological and biochemical processes, impairing root structures, and consequently hindering plant growth and development

CONCLUSIONS

The information collected shows the uniformity of the plots and confirmed that the control strategy applied throughout the period is effective, however, further studies are needed with a minimum period of 120 days.

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