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Scientific Article

INDUCTION OF EPICORMIC SPROUTS OF *Schizolobium parahyba* var. *amazonicum* (PARICÁ): EFFECT OF SEASONALITY AND STUMP HEIGHT

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ABSTRACT

Coppicing technique is recognized as an effective method for inducing epicormic sprouts and promoting reinvigoration in Brazilian native tree species. However, there remains a knowledge gap regarding efficient reinvigoration techniques for vegetative rescue of paricá trees. This study aimed to evaluate the coppicing technique's efficacy in inducing epicormic sprouts in paricá trees, considering different seasons and stump heights. A 2x3 factorial experimental design was employed, encompassing two seasons (rainy and dry) and three stump heights (0 = root collar; 10 cm above root collar; 30 cm above root collar). Stumps were monitored over a 90-day period. Results showed that all stumps remained viable, with significant differences observed in sprouting frequency between the rainy and dry seasons at 15 and 30 days, favoring the former. Furthermore, the number of sprouts per stump varied significantly across seasons at 15, 30, and 45 days, with higher counts recorded during the rainy season. Notably, the high percentage of stumps producing sprouts underscores the species' robust response capacity. Additionally, the occurrence of two sprouts per stump suggests a species-specific trait at these stump heights. Evaluation of sprout length and circumference revealed significant differences between seasons, with greater growth observed during the rainy season. These findings are crucial for informing management decisions related to epicormic sprout development through the coppicing technique in paricá trees. Overall, the results indicate the technique's potential to induce epicormic sprouts across all seasons and stump heights evaluated, with superior outcomes observed during the rainy season.

Keywords: Brazilian native tree species; Coppicing technique; Reinvigoration of forest tree species.

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INDUÇÃO DE BROTAÇÕES EPICÓRMICAS DE *Schizolobium parahyba* var. *amazonicum* (PARICÁ): EFEITO DA SAZONALIDADE E ALTURA DE CEPA

RESUMO – A decepa é reconhecida como um método eficaz para induzir brotações epicórmicas e promover revigoramento em espécies arbóreas do Brasil. No entanto, ainda existe uma lacuna de conhecimento sobre técnicas eficientes de revigoramento para resgate vegetativo de paricá. Este estudo teve como objetivo avaliar a eficácia da decepa na indução de brotações epicórmicas em árvores de paricá, considerando diferentes épocas do ano e alturas de cepa. Foi utilizado delineamento experimental fatorial 2x3, abrangendo duas estações (chuvosa e seca) e três alturas de cepa (0 = nível do colo; 10 cm a partir do colo; 30 cm a partir do colo). As cepas foram monitoradas durante 90 dias. Os resultados mostraram que todas as cepas permaneceram viáveis, com diferenças significativas observadas na frequência de brotação entre as estações chuvosa e seca aos 15 e 30 dias, favorecendo a primeira. Além disso, o número de brotações por cepa variou significativamente entre as estações aos 15, 30 e 45 dias, com contagens mais altas registradas durante a estação chuvosa. Notavelmente, a elevada percentagem de cepas que produzem brotações ressalta a robusta capacidade de resposta da espécie. Além disso, a ocorrência de duas brotações por cepa sugere uma característica da espécie nessas alturas de cepa. A avaliação do comprimento e circunferência das brotações revelou diferenças significativas entre as estações, com maior crescimento observado durante a estação chuvosa. Esses achados são cruciais para informar decisões de manejo relacionadas ao desenvolvimento de brotações epicórmicas através da decepa de árvores de paricá. No geral, os resultados indicam o potencial da técnica para induzir brotações epicórmicas em todas as estações e alturas de cepa avaliadas, com resultados superiores observados durante a estação chuvosa.

Palavras-Chave: Espécies arbóreas do Brasil; Técnica de decepa; Revigoramento de espécies arbóreas.

1. INTRODUCTION

Schizolobium parahyba var. *amazonicum* (Huber ex Ducke) Barneby (Caesalpiniaceae), commonly known as paricá, naturally inhabits the Amazon rainforest and is esteemed as a large tree species (Souza et al. 2003). Widely utilized for timber (Silva et al. 2015; Silveira et al. 2017), it has served as a primary resource for plywood industries, particularly in the Brazilian Amazon (IBÁ, 2019).

Traditionally, paricá has been cultivated in commercial plantations since 1993 through direct seeding or seedlings planting, resulting in significant heterogeneity (Modes et al. 2020; Terezo et al. 2015), low-productivity forests (Silva and Sales 2018) and susceptibility to pests and diseases (Lunz et al. 2010; Tremacoldi et al. 2009). Consequently, there has been a push towards establishing clonal forestry programs.

Presently, cloning of paricá seedlings has been explored at experimental levels, primarily through basic cuttings techniques. However, field trials to evaluate clone performance are lacking (Dias et al. 2015a; Rosa and Pinheiro 2001a; Rosa and Pinheiro 2001b; Souza 2015b). Moreover, studies on in vitro propagation of paricá have been undertaken (Cordeiro et al. 2007; Reis et al. 2007; Souza 2015a).

Despite some exploration of vegetative propagation techniques for paricá trees, efficient protocols for superior material rescue and clonal forestry establishment are still lacking, posing challenges for its management and domestication (Xavier et al. 2021). Critical steps towards establishing clonal forestry programs include the identification of superior trees in commercial or experimental plantations, followed by the induction and rescue of propagules for vegetative propagation (Engel et al. 2019).

Once superior trees (mother-trees) are selected, the next step involves vegetative rescue, which entails collecting juvenile material for adventitious rooting. Based on established knowledge about tree species maturation, juvenile sprouts are preferred for adventitious rooting (Greenwood 1995; Wendling et al. 2014). Inducing basal sprouts is recommended for rejuvenating these materials, involving techniques such as cuttings, girdling, and drastic pruning (Stuepp et al. 2018).

Coppicing technique, applied at various heights based on species/tree capacity to sprout, has been recommended for inducing epicormic sprouts in Brazilian native tree species (Kratz et al. 2016; Sampaio et al. 2007). However, factors such as season, productivity, and stump vigor in the field must be considered (Krainovic et al. 2017; Ohashi et al. 2004). Coppicing has also been utilized for reinvigorating mature trees or initiating sprouts for a new productive forest cycle (Sampaio et al. 2005).

In this context, coppicing technique applied to Brazilian native tree species serves as an efficient method for inducing epicormic sprouts and initiating reinvigoration, rejuvenation, and vegetative rescue. Nevertheless, there remains a gap in knowledge regarding efficient techniques for the vegetative rescue of paricá trees. This study aimed to evaluate the coppicing technique's efficacy in inducing epicormic sprouts in paricá trees at rotation age (five years), considering different seasons and stump heights, with the objective of achieving reinvigoration and vegetative rescue.

2. MATERIAL AND METHODS

2.1 Experimental area

The study was conducted at Fazenda Jaspe (04°0′58″ S and 47°52′32″ W, altitude 160 m), situated in Ulianópolis, State of Pará, Brazil (Figure 1a). The original vegetation of the study areas consisted of Submontane Tropical Rainforest (Veloso et al. 1991) and the predominant type of soil is Yellow Latosol, characterized by a clayey texture and flat to gently undulating relief (Santos et al. 2018). The climate is classified as mesothermal and humid, falling under typology Aw (Dubreuil et al. 2018). The average annual temperature is 27°C, with the average daily relative humidity ranging between 42 and 92%. Annual rainfall averages 2,200 mm, with a rainy season extending December to May (INMET 2021). The temperature, rainfall and water balance data pertaining to the period of this experiment (January 2020 to November 2020) (Figure 1b and c).

2.2 Sprout induction

Before setting up the experiment, soil analysis was conducted following the protocol outlined by Teixeira et al. (2017) (Table 1). Five-year-old paricá trees (with diameter at breast height between 14 and 27 cm and commercial height between 5 and 12 m) were selected from a commercial reforestation area located at Fazenda Jaspe, as detailed by Sales (2018). Each tree received 300 g of NPK fertilizer, formulated as 08-28-16, distributed in two strips measuring 50 cm in length, 15 cm in width, and 10 cm in depth, positioned 50 cm away from the tree base. Trees were felled at predetermined heights 30 days after the onset of each season (Figure 2). A chainsaw was utilized, and the cut was executed in a beveled manner to prevent water accumulation and premature decay.

2.3 Data collection and analysis

The experimental design comprised a randomized complete block with six treatments and four replications, resulting in a total of 24 plots (each with 10 stumps) arranged in a 2x3 factorial design: two seasons (RS = rainy season; DS = dry season) and three stump heights (0 = root collar; 10 cm above root collar and; 30 cm above root collar) (Figure 2). Stump monitoring occurred at 15, 30, 45, 60, 75 and 90 days, involving measurements of: living stumps (%); stumps with sprouts (%); number of sprouts per stump and sprout length (cm) and circumference.

The collected data underwent analysis to verify the homogeneity of variance using

Revista ÁRVORE
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the ONeill-Mathews' test (p<0.05) and to assess the normality of residuals through the Shapiro-Wilk test (p<0.05). Subsequently, the data were submitted to analysis of variance (ANOVA) and regression at a significance level of 5%. Tukey's multiple comparison test (p≤0.05) was utilized when significant differences were detected. Data analysis was performed using RStudio® software (RSTUDIO TEAM, 2022).

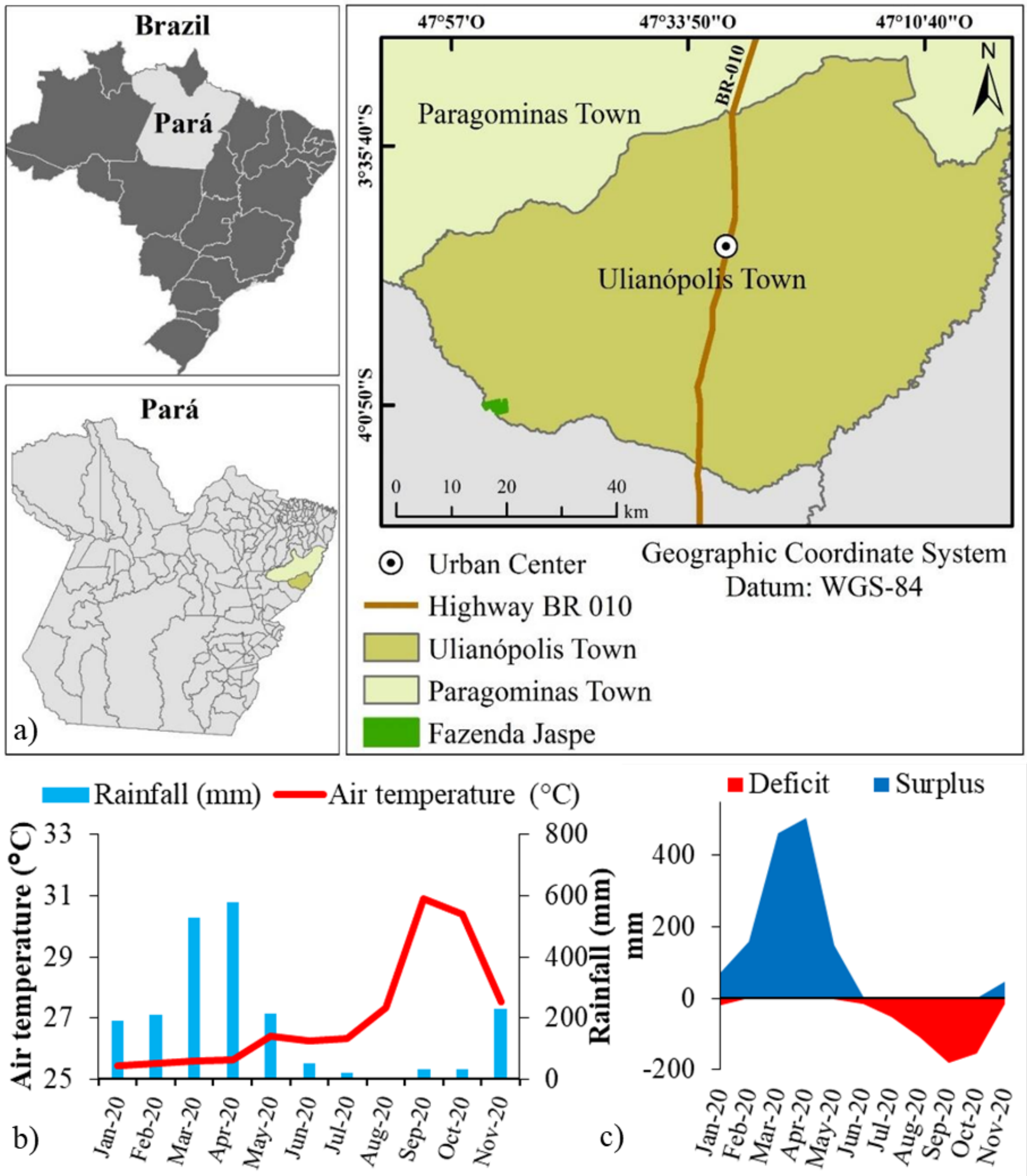

Figure 1 – Location of Fazenda Jaspe (a), average air temperature and rainfall (b), water balance (c), during the period from January/2020 to December/2020, Ulianópolis town, southeastern region of Pará, Brazil.

Figura 1 – Localização da Fazenda Jaspe (a), médias de temperatura e precipitação (b), balanço hídrico (c) durante o período de janeiro/2020 a dezembro/2020, Ulianópolis, região sudeste do Pará, Brasil.

Table 1 – Chemical and physical analyses of soil, depth 0-20 cm, Fazenda Jaspe, Ulianópolis town, Pará, Brazil.

Tabela 1 – Análises químicas e físicas de amostras de solo, profundidade 0-20 cm, Fazenda Jaspe, Ulianópolis, Pará, Brasil.

pH	OM	N	P	K	Ca	Mg	Al	H+Al	Na	SB	t	T
H_2O	dag kg^{-1}	%	mg dm^{-3}		cmolc dm^{-3}							
5.2	2.72	0.56	14.7	74.2	3.2	0.9	0.2	2.83	0.21	4.5	4.7	7.3
Mn	**Fe**	**Zn**	**Cu**	**V**		**m**	**Sand**		**Silt**		**Clay**	
mg dm^{-3}				%			g kg^{-1}					
6.6	98.1	2.1	0.3	61.6		4.6	360		120		520	

Source: Elaborated by the authors. pH = Hydrogen Potential of water; OM = Organic Matter; N = Nitrogen; P = Phosphorus; K = Potassium; Ca = Calcium; Mg = Magnesium; Al = Aluminum; H+Al = Hydrogen + Aluminum. N = Nitrogen; Mn = Manganese; Fe = Iron; Zn = Zinc; Cu = Copper; Na = Sodium; SB = Sum of bases; t = Effective Cation Exchange Capacity; T = Cation Exchange Capacity at pH 7; V = Base saturation; m = Aluminum saturation.

Fonte: Elaborada pelos autores. pH = Potencial Hidrogeniônico; MO = Matéria Orgânica; N = Nitrogênio; P = Fósforo; K = Potássio; Ca = Cálcio; Mg = Magnésio; Al =Alumínio; H+Al = Hidrogênio + Alumínio. N = Nitrogênio; Mn = Manganês; Fe = Ferro; Zn = Zinco; Cu = Cobre; Na = Sódio; SB = Soma de bases; t = Capacidade de Troca de Cátions efetiva; T = Capacidade de Troca de Cátions a pH 7; V = Saturação por bases; m = Saturação por alumínio.

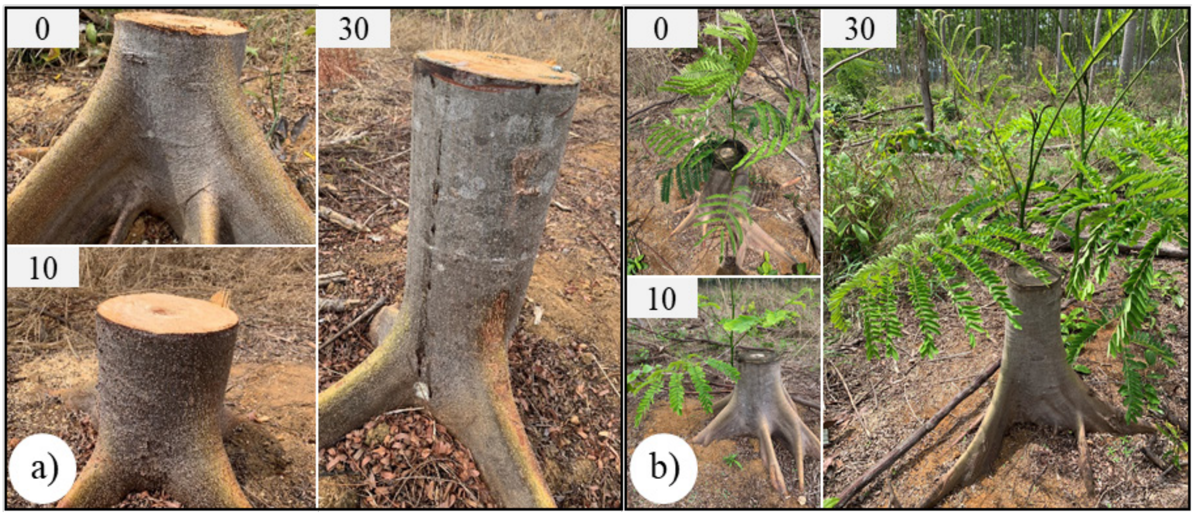

Figure 2 – Coppicing technique applied at different heights (a) and stumps and sprouts at 90 days (b) (0 = root collar; 10 cm above root collar and; 30 cm above root collar) in trees of *S. parahyba* var. *amazonicum* (paricá), Fazenda Jaspe, Ulianópolis town, Pará, Brazil. Source: Elaborated by the authors.

Figura 2 – Técnica de decepa aplicada em diferentes alturas (a) e cepas e brotações após 60 dia (b) (0 = nível do colo; 10 cm a partir do colo; e 30 cm a partir do colo) em árvores selecionadas de *S. parahyba* var. *amazonicum* (paricá), Fazenda Jaspe, Ulianópolis, Pará, Brasil. Fonte: Elaborada pelos autores.

3. RESULTS

Seasons and stump heights do not indicate significant interactions (F>0.05) (Table 2). However, the season factor indicates a significant effect for all the evaluated characteristics, except for stumps with sprouts at 45, 60, 75 and 90 days and the number of sprouts per stump at 60, 75 and 90 days. Stump heights do not exhibit a significant effect.

All stumps remained viable throughout the 90-day evaluation period following application of the coppicing technique (Figure 2a and b). In terms of comparing seasons, stumps with sprouts (%) indicate a significant difference at 15 and 30 days, with better results in the rainy season (Figure 3a). When comparing stump heights, stumps with sprouts (%) and the number of sprouts per stump do not indicate a significant difference, as depicted in the regression plots shown in Figure 3b and c. Number of sprouts per stump in response to seasons indicates a significant difference at 15, 30 and 45 days, with higher numbers observed in the rainy season (Figure 3d).

Table 2 – Summary of analysis of variance of stumps with sprouts (SS%), number of sprouts per stump (NS), sprout length (cm) and circumference (cm) (Circ) as a function of seasons and stump heights at 15, 30, 45, 60, 75 and 90 days, Fazenda Jaspe, Ulianópolis town, Pará, Brazil.

Tabela 2 – Resumo da análise de variância de percentual de cepas com brotações (SS%), número de brotações por cepa (NS), comprimento (cm) e Circunferência (cm) (Circ.) das brotações em função das estações do ano e alturas de cepa aos 15, 30, 45, 60, 75 e 90 dias de avaliação, de árvores selecionadas de paricá na Fazenda Jaspe, em Dom Eliseu, Pará, Brasil.

SV[1]	DF[2]	Mean squares							
		15 days				30 days			
		SS	NS	Length	Circ	SS	NS	Length	Circ
Block	3	0.01	0.36	4.89	0.11	0.01	0.10	13.23	0.11
Seasons[3]	1	3.53*	17.92*	167.75*	1.13*	0.24*	2.63*	412.10*	1.73*
Stump heights[4]	2	0.01[ns]	0.66[ns]	13.99[ns]	0.20[ns]	0.10[ns]	0.07[ns]	15.44[ns]	0.16[ns]
Seasons x Stump heights	2	0.01[ns]	0.08[ns]	9.65[ns]	0.07[ns]	0.01[ns]	0.04[ns]	2.52[ns]	0.02[ns]
Error	15	0.01	0.25	2.34	0.07	0.02	0.06	12.86	0.06
CVexp (%)[5]	-	18.18	34.45	47.73	43.99	23.73	14.52	49.34	23.60

SV[1]	DF[2]	Mean squares							
		45 days				60 days			
		SS	NS	Length	Circ	SS	NS	Length	Circ
Block	3	0.03	0.05	21.75	0.21	0.03	0.21	87.23	0.53
Seasons[3]	1	0.08ns	0.70*	754.54*	2.59*	0.01ns	0.01ns	836.74*	3.60*
Stump heights[4]	2	0.08[ns]	0.08[ns]	47.84[ns]	0.42[ns]	0.04[ns]	0.16[ns]	245.00[ns]	1.36[ns]
Seasons x Stump heights	2	0.01[ns]	0.22[ns]	1.06[ns]	0.01[ns]	0.01[ns]	0.08[ns]	40.51[ns]	0.17[ns]

Cont...

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SV[1]	DF[2]	Mean squares							
		45 days				60 days			
		SS	NS	Length	Circ	SS	NS	Length	Circ
Error	15	0.03	0.05	36.25	0.19	0.04	0.07	86.27	0.35
CVexp (%)[5]	-	25.79	13.52	46.21	31.44	31.90	15.41	41.22	29.83

SV[1]	DF[2]	Mean squares							
		75 days				90 days			
		SS	NS	Length	Circ	SS	NS	Length	Circ
Block	3	0.01	0.55	80.86	0.81	0.02	0.45	82.81	0.75
Seasons[3]	1	0.01^{ns}	0.10^{ns}	1940.94*	5.77*	0.01^{ns}	0.01^{ns}	2445.82*	7.45*
Stump heights[4]	2	0.03^{ns}	0.17^{ns}	252.56^{ns}	1.47^{ns}	0.02^{ns}	0.17^{ns}	272.32^{ns}	1.75^{ns}
Seasons x Stump heights	2	0.01^{ns}	0.09^{ns}	87.38^{ns}	0.47^{ns}	0.02^{ns}	0.08^{ns}	95.91^{ns}	0.58^{ns}
Error	15	0.03	0.08	181.44	0.51	0.04	0.10	233.11	0.64
CVexp (%)[5]	-	27.03	15.78	41.87	27.78	28.47	17.92	36.13	25.19

Source: Elaborated by the authors. "ns" and "*" = non-significant and significant, respectively, at 5% significance level, by F-test. [1]SV = Sources of variation. [2]DF = Degrees of freedom. [3]Seasons (EC = rainy season; ES = dry season). [4]Stump heights (0 = root collar; 10 cm above root collar and; 30 cm above root collar). [5]CVexp (%) = Coefficient of experimental variation.

Fonte: Elaborada pelos autores. "ns" e "*" = não significativo e significativo, respectivamente, a 5 % de probabilidade, pelo teste F. [1]SV = Fontes de variação. [2]DF = Graus de liberdade. [3]Estações do ano (EC = estação chuvosa; ES = estação seca). [4]Alturas de decepa (0 = nível do colo; 10 cm de altura a partir do colo; e 30 cm de altura a partir do colo). [5]CVexp (%) = coeficiente de variação experimental.

Regarding the sprout length and circumference when comparing seasons, a significant difference is observed, with greater length and circumference noted during the rainy season (Figure 3e and h). However, the effect of stump heights does not indicate a significant difference for the sprout length and circumference, as illustrated by the regression plots in Figure 3f and g.

4. DISCUSSION

Stumps with sprouts (%) do not indicate significant differences between seasons and stump heights, a phenomenon possibly stimulated by the absence of competition between trees, owing to the planting arrangement and the harvesting of all trees for growth resources (water, light, nutrients, and temperature), in addition to the species' inherent characteristics (Souza et al. 2003). Despite the genetic heterogeneity of the studied paricá trees, the high percentage of stumps with sprouts underscores the species' robust response to the coppicing technique application at two seasons and stump heights.

For Brazilian native tree species, the application of coppicing technique indicates

Revista
ÁRVORE
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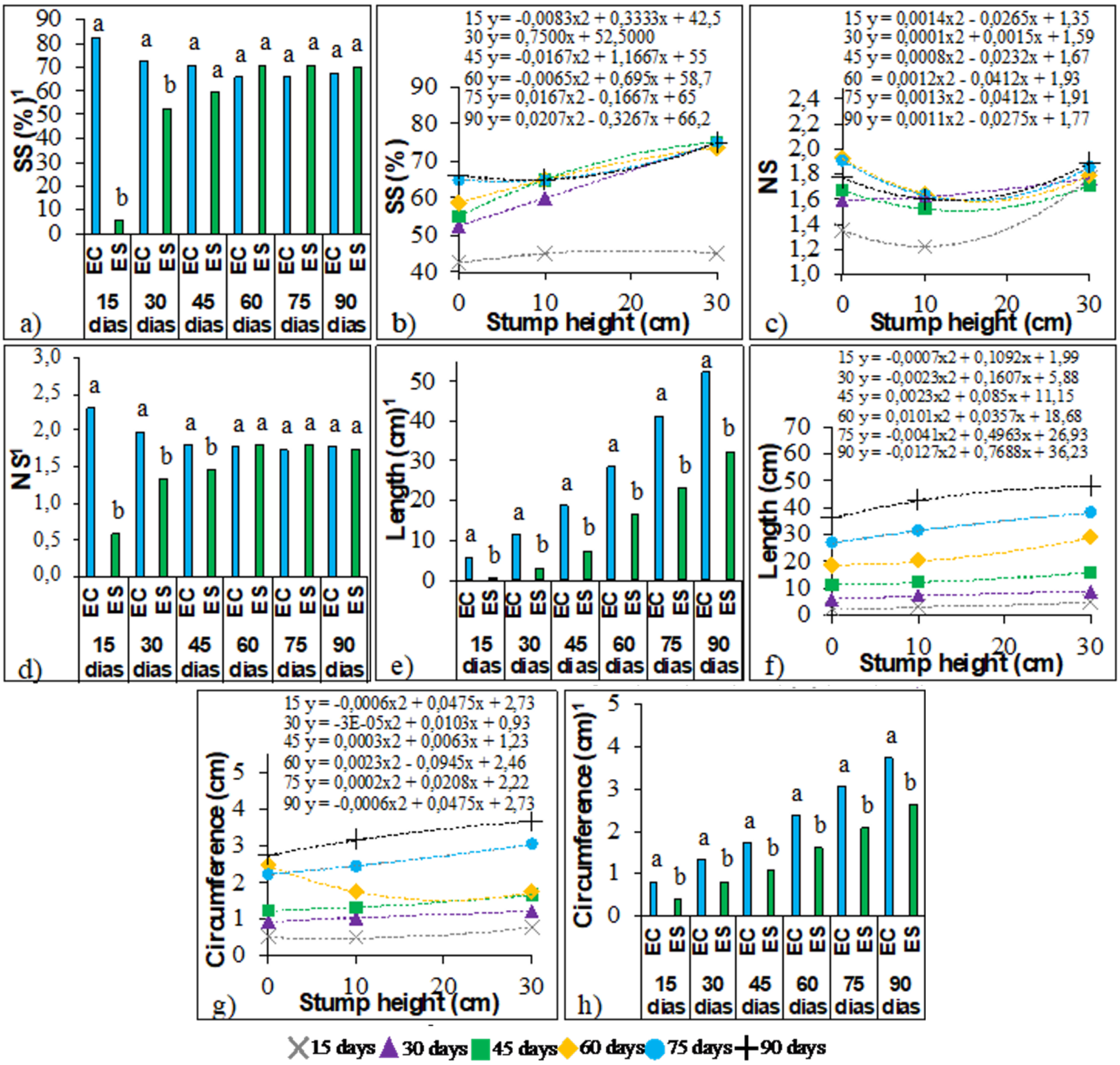

Figure 3 – Stumps with sprouts (SS %) (a and b), number of sprouts per stump (NS) (c and d), sprout length (cm) (e and f) and circumference (cm) (g and h) of *S. parahyba* var. *amazonicum* (paricá) as a function of the seasons (EC = rainy season; ES = dry season) and stump heights (0 = root collar; 10 cm above root collar and; 30 cm above root collar) at 15, 30, 45, 60, 75 and 90 days after coppicing, Fazenda Jaspe, Ulianópolis town, Pará, Brazil. Source: Elaborated by the authors. [1]Means followed by same letter do not differ by F-test at 5% significance level.

Figura 3 - Percentual de cepas com brotações (SS %) (a e b), número de brotações por cepa (NS) (c e d), comprimento (cm) (e e f) e Circunferência (cm) (g e h) das brotações de *S. parahyba* var. *amazonicum* (paricá) em função das estações do ano (EC = estação chuvosa; ES = estação seca) e alturas de cepa (0 = nível do colo; 10 cm a partir do colo; e 30 cm a partir do colo) aos 15, 30, 45, 60, 75 e 90 dias de avaliação, de árvores selecionadas de paricá na Fazenda Jaspe, em Dom Eliseu, Pará, Brasil. Fonte: Elaborada pelos autores. [1]Médias seguidas pela mesma letra minúscula não diferem estatisticamente pelo teste F, a 5% de probabilidade.

yields favorable outcomes for stumps with sprouts (%). For instance, *Anadenanthera macrocarpa* (90%) (Dias et al. 2015b), *Aniba rosaeodora* (100%) (Ohashi et al. 2004), *Araucaria angustifolia* (60%) (Wendling et al. 2009; Wendling and Brondani 2015), *Calophyllum brasiliense* (100%) (Kratz et al. 2016) and *Ilex paraguariensis* (97%) (Stuepp et al. 2016).

The number of sprouts per stump does not indicate significant differences between seasons and stump heights 60 days post-application of the coppicing technique, with an average of approximately two sprouts per stump. This observation may indicate a distinctive characteristic of the species for these stump heights (Xavier et al. 2021). Perrando and Corder (2006) and Stuepp (2016), suggest that greater stump heights (200 and 60 cm, respectively) result in a higher number of sprouts per stump of *Acacia mearnsii* and *Ilex paraguariensis*, respectively. They posit that the increased surface area of the stump enables a greater number of adventitious buds compared to other stump heights.

However, even with a larger stump surface area, a larger number of sprouts may not necessarily ensue. The stump height might not influence the average number of sprouts, illustrating a distinctive species characteristic (Stuepp et al. 2018). Ohashi et al. (2004) provide evidence that stump heights of 15, 30 and 45 cm do not affect the number of sprouts in *Aniba rosaeodora*. Considering paricá timber's primary use in plywood production (IBÁ, 2019), the basal part is best suited for this purpose. Thus, proximity to the root collar is optimal for coppicing application from a timber utilization standpoint.

When conducting coppice sprouting for timber production, a high number of sprouts per stump may not be desirable as it can lead to increased pruning costs to minimize or eliminate competition among sprouts (Souza et al. 2012). Dias et al. (2015b) report the efficient induction of basal sprouting in *Anadenanthera macrocarpa*, through the coppicing technique, yielding an average of 8 sprouts per stump. Peña (2014) reports between 31 and 69 sprouts per stump for *Eugenia uniflora* using the coppicing technique at stump heights of 10 and 30 cm.

Sprout length and circumference are notably higher during the rainy season compared to the dry season across all stump heights. This insight is crucial for aiding decision-making processes regarding the management of epicormic sprouts, whether for collecting propagules with predefined diameters or applying the coppice technique.

If the goal of applying the coppicing technique is to rejuvenate the mother tree and collect propagules, retaining the sprouts for 90 days or longer may not be advantageous. Generally, sprouts become woodier (lignified) over time, which can reduce the chances of successful rooting or survival (Xavier et al. 2021). Additionally, it is worth noting that after 60 days, there are no significant differences between seasons and stump heights in terms of the number of sprouts per stump, which aids in decision-making regarding the maintenance of sprouts on the stumps for extended periods.

Research has evidenced that the sprouting of epicormic buds following the application of coppicing technique is attributed to the mobilization of carbohydrates in conjunction with hormones acting as markers in the process (Mason et al. 2014; Van den Ende 2014). According to this principle, epicormic sprouting occurs only when an adequate amount of carbohydrates is available to support the post-sprouting phases (Van den Ende 2014).

Induction of epicormic sprouts has been linked to environmental factors such as response to solar irradiance on dormant buds, genetic variations between plants, as well as physiological, hormonal, and stress responses (Badilla et al. 2016; Meier et al. 2012). Kratz et al. (2016) attribute the higher supply of epicormic sprouts at the base of *Calophyllum brasiliense* stumps, compared to the girdling technique, to the increased incidence of sunlight at the base of these stumps, resulting in the photo-oxidation of auxins and subsequently breaking bud dormancy. However, solar irradiance alone is not solely responsible for the induction of epicormic sprouts; the stimulation of dormant buds is regulated by genetic and hormonal signals (Meier et al. 2012), including the hormonal imbalance between auxins and cytokinins in the stump.

Techniques for inducing epicormic sprouts for *Eucalyptus* spp. are well-established and consolidated, primarily through the coppicing technique for obtaining juvenile sprouts used in clonal propagation by cuttings (Xavier et al. 2021). Coppicing technique has been effective in altering cytokinin-to-auxin ratios and inducing epicormic sprouts in various Brazilian native tree species, including *Aniba rosaeodora* (Krainovic et al. 2017; Ohashi et al. 2004), *Anadenanthera macrocarpa* (Pereira et al. 2015), *Araucaria angustifolia* (Wendling et al. 2009), *Calophyllum brasiliense* (Kratz et al. 2016), *Cedrela fissilis*, *Cecropia pachystachia*, *Cordia trichotoma*,

Revista ÁRVORE
ISSN 1806 – 9088

Inga marginata, *Peltophorum dubium* (Kammesheidt 1998), *Ilex paraguariensis* (Stuepp et al. 2018) and *Toona ciliata* (Pereira et al. 2015).

For *Hevea brasiliensis*, the application of coppicing technique demonstrates effectiveness when associated with grafting technique (Moraes and Moraes 1998; Prabpree et al. 2018). Similarly, for *Aniba rosaeodora* and *Calophyllum brasiliense*, the application of this technique has proven efficient for managing commercial plantations (Ohashi et al. 2004) and supplying propagules (Kratz et al. 2016), respectively.

The application of coppicing technique to induce basal epicormic sprouts represents a method of simple application and low cost, particularly when combined with harvesting. This study serves as an initial step that provides a new direction for the vegetative rescue of paricá. Despite advancements in paricá silviculture (Sales et al. 2021; Sales 2018; Silva and Sales 2018), there remain knowledge gaps regarding the optimal techniques for vegetative rescue and clonal propagation, particularly under field conditions, highlighting the current status and challenges. Therefore, for successful research progress in paricá rescue and vegetative propagation, it is imperative to clearly understand the challenges and objectives of implementation, as well as the steps and techniques to be applied.

This study showcases the potential for inducing epicormic sprouts through the coppicing technique applied to paricá trees. Future studies should assess aspects related to sprout length and circumference, optimal conditions for their management or removal from the mother tree, and their subsequent management and survival post-transfer to the field or nursery, among other issues pertinent to coppicing.

5. CONCLUSION

Coppicing technique applied to *Schizolobium parahyba* var. *amazonicum* (paricá) indicates potential for inducing epicormic sprouts from rotation-age trees across all seasons and stump heights evaluated. However, the sprout length and circumference are notably greater when the coppicing technique is applied during the rainy season. This insight is crucial for aiding the decision-making process regarding the management of epicormic sprouts resulting from the application of the coppicing technique to paricá trees.

AUTHOR CONTRIBUTIONS

Conceptualization, Agust S. and Aloisio X.; methodology, Agust S., Aloisio X., Haroldo N.P. and Ivar W.; analysis, Agust S., Aloisio X. and Haroldo N.P.; resources, Agust S., Aloisio X. and Marco A.S.; data curation, Agust S., Aloisio X., Haroldo N.P. and Ivar W.; writing—original draft preparation, Agust S., Aloisio X., Haroldo N.P., Ivar W. and Gleison A.S.; writing—review and editing, Agust S., Aloisio X., Haroldo N.P., Ivar W., Gleison A.S., Marco A.S. and Sabrina B.V.

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