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PROPAGAÇÃO DE MACAXEIRA ATRAVÉS DE MINI ESTAQUIA

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RESUMO: A mandioca (*Manihot esculenta* Crantz), planta dicotiledônia da família Euphorbiaceae apresenta pelo menos 5000 variedades principalmente na América do Sul, África, Ásia e México. Por ser uma ótima planta a ser cultivada em locais com solos de baixa fertilidade e índices pluviométricos irregulares, o desenvolvimento de tecnologias com o objetivo de aprimorar sua produção é essencial. Logo, a produção de miniestacas mostra-se uma alternativa viável para minimizar problemas associados a cultura. Objetivou-se com o presente trabalho avaliar a propagação de macaxeira através da miniestaquia. O delineamento utilizado fora o inteiramente casualizado, com dois tratamentos (manivas com duas gemas e manivas com quatro gemas) e quatro repetições. Utilizou-se como substrato terra vegetal e esterco de gado na proporção 2:1. As variáveis analisadas foram o número de brotos, comprimento dos brotos, o número de folhas, o número de nós e o diâmetro do broto. As variáveis comprimento dos brotos, número de folhas, número de nós e diâmetro do broto foram significativas quando submetidas à análise de variância. Os resultados sugerem que estacas com maior diâmetro e maior número de gemas favorecem o desenvolvimento das brotações, promovendo maior comprimento dos brotos e aumento no número de folhas.

Palavras-chave: *Manihot esculenta*, mandioca, miniestaquia, substrato, gemas.

CASSAVA PROPAGATION USING MINI CUTTINGS

ABSTRACT: Cassava (*Manihot esculenta* Crantz), a dicotyledonous plant from the Euphorbiaceae family, has at least 5,000 varieties, mainly in South America, Africa, Asia and Mexico. As it is an excellent plant for growing in places with low-fertility soils and irregular rainfall, the development of technologies to improve its production is essential. Therefore, the production of mini cuttings is a viable alternative for minimizing problems associated with crops. The aim of this study was to evaluate the propagation of cassava via mini-stake cuttings. The design used was completely randomized, with two treatments (maniocs with two buds and maniocs with four buds) and four replications. The substrate used was vegetable soil and cattle manure at a 2:1 ratio. The variables analyzed were the number of shoots, shoot length, number of leaves, number of nodes and shoot diameter. The variables shoot length, number of leaves, number of nodes and shoot diameter were significant when subjected to analysis of variance. The results suggest that cuttings with a larger

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diameter and a greater number of buds favor the development of the sprouts, promoting a greater length of the sprouts and an increase in the number of leaves.

Keywords: *Manihot esculenta*, cassava, mini-stem cuttings, substrate, buds.

1 INTRODUCTION

Cassava (*Manihote sculenta* Crantz) is a dicotyledonous plant of the Euphorbiaceae family and Manihot genus. This genus has at least 5000 varieties of cassava, mainly in South America, Africa, Asia and Mexico (Lehalle *et al*., 2019). Cassava, which was explored in Brazil before the arrival of Europeans, is a plant species capable of storing carbohydrates underground for up to two years without deterioration of its roots, a determining characteristic that makes it an important energy source for human consumption in several countries (Rocha *et al.)*. , 2021).

According to Oliveira *et al*. (2015), cassava, as a plant adapted to low soil fertility and irregular rainfall, has great potential as a safe source of food, as well as a good tool for poverty reduction. Its main form of propagation is commonly carried out vegetatively via parts of the mother plant, also known as cuttings or manivas (Cerqueira *et al.*, 2016). Despite the unquestionable socioeconomic importance of cassava cultivation for all of Brazil and many other countries, there is a great restriction on the planting of new areas due to the low multiplication rate obtained via conventional methods (Rocha *et al.,* 2021).

Vegetative propagation is a method that preserves the characteristics of the mother plant. The main asexual or vegetative multiplication processes include cuttings, grafting, air layering, layering, leaning, propagation by specialized structures and others (Silva, *et al*.). , 2006). One of the most commonly used techniques for plant propagation is cuttings, which allow seedlings to be obtained from a segment of the plant, maintaining the genetic characteristics of the mother plant (Moura, 2022). Propagation by cuttings occurs through cuttings, in which any segment of the plant containing reserves is used, which, when placed in the appropriate substrate, will form adventitious roots, giving rise to a new plant (Costa *et al*., 2016).

In response to the need to offer solutions to these problems, the technique of producing cassava mini-cuttings was developed, a planting material with characteristics distinct from those of traditional materials (Rocha *et al.)*. , 2021). By using mini-cuttings, undesirable aspects such as a low propagation rate, losses due to phytosanitary problems and the limitation of large volumes of planting material can be overcome (Rocha *et al.)*. , 2021). Thus, the objective of this work was to evaluate the propagation of cassava through mini-cuttings.

2 MATERIALS AND METHODS

The experiment was carried out from March to April 2022 at the Federal Institute of Education, Science and Technology of Ceará-IFCE/*Campus* Sobral, in the municipality of Sobral-CE, under the geographic coordinates 3° 41' 01.08" S and 40° 20' 30.76" W, at an altitude of 67 m (Google, 2009). The climate of the region is classified as Aw hot tropical semiarid (IPECE, 2017), with an average rainfall of 821.6 mm.year $^{-1}$, with precipitation concentrated from January--May, and an average temperature of 28°C (FUNCEME, 2023).

The experimental design used was completely randomized (DIC) with two treatments (T1 - cassava with two buds; T2 - cassava with four buds) and four repetitions (six plants per plot). A total of 48 experimental units were used. The cuttings were carried out on March 16, 2022, and the evaluation was carried out on April 19, 2022 (one month after planting). The test was conducted in a protected environment with 70% shade in 200 mL tubes with a substrate composed of topsoil and cattle manure at a 2:1 ratio (Figure 1).

Figure 1. Cassava mini-cuttings were placed in 200 mL tubes under protected cultivation conditions (70% shade).

Source: personal archive (2022).

The variables analyzed were the number of shoots, shoot length, number of leaves, shoot diameter and number of nodes. The data were subjected to analysis of variance via the F test (P <0.05). To compare the means between treatments, the Tukey test was applied. The Pearson correlation test was performed to verify the relationships between the studied variables. Statistical analyses were performed via the *software* R: A Language and Environment for Statistical Computing, R version 4.2.2, with the following packages: AgroR: Experimental Statistics and Graphics for Agricultural Sciences, R package version 1.3.2 (R Core Team, 2024).

3 RESULTS AND DISCUSSION

According to the analysis of variance performed for the variables number of shoots, shoot length, number of leaves, shoot diameter and number of nodes (Table 1), there were significant differences (P <0.05) between treatments for all variables, except for the number of shoots. The values of the coefficients of variation ranged from 15.29% to 27.05%, which, according to Gomes (2000), can be considered medium to high in agricultural trials.

Table 1. Summary of analysis of variance for the variables number of shoots (NB), shoot length (CB), number of leaves (NF), shoot diameter (DB) and number of nodes (NN).

Sources Variation	GL	QM				
		NB	CB	NF	DB	NN
Treatment	1	0.2552^{ns}	31.4442**	9,7800**	6.8882**	22.9172**
Error	10	0.126	0.5493	0.6252	0.2748	1.6255
CV (%)		27.05	15.29	15.22	21.77	18.87

** F value significant at the 1% level; ^{ns} F value not significant (P >0.05); GL - degree of freedom; CV (%) – coefficient of variation.

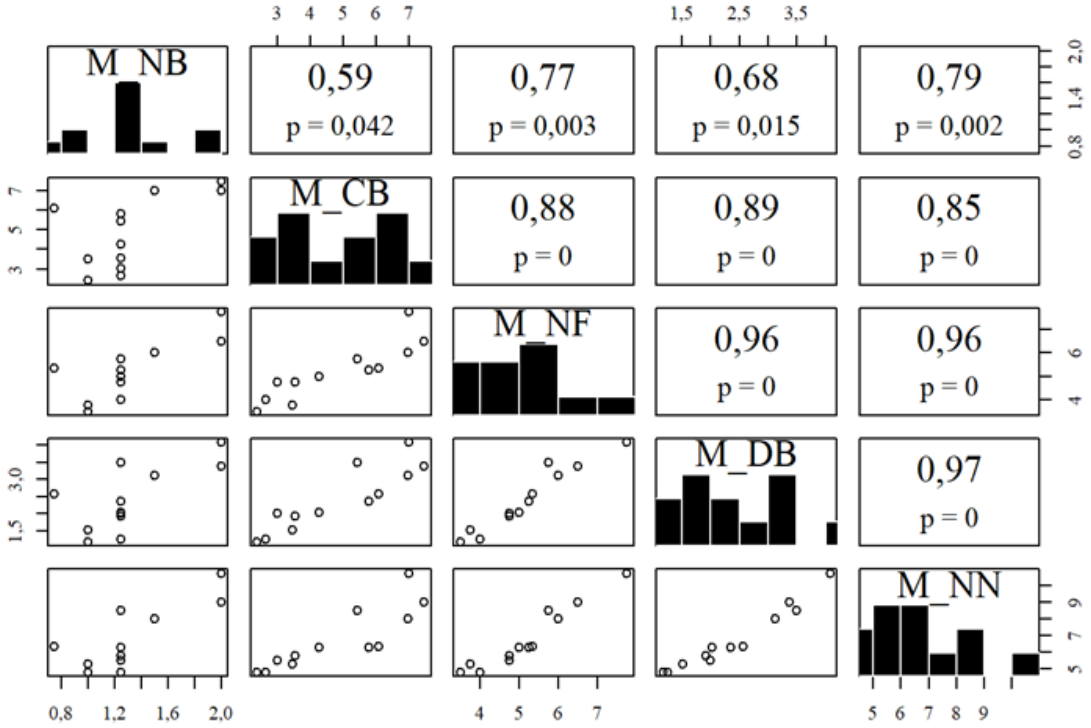
Source: prepared by the authors.

Experiments carried out by Alves *et al*. (2020), which used soil, bovine substrate and washed sand in proportions similar to those used in this study, also did not significantly affect the sprouting index. The reason why the number of sprouts (NB) did not significantly

differ may be related to the length of the cuttings and the number of buds used. According to Fialho, Vieira, Borges (2017), cassava planting should prioritize cuttings of approximately 20 cm, and the number of buds that, according to the authors, should be used is 5 to 8 buds for planting.

According to the correlation analysis (Figure 2), the variables shoot length, number of leaves, shoot diameter and number of nodes presented positive and significant correlations ($P < 0.05$), with an emphasis on the number of nodes, which presented a very strong correlation ($r = 0.97$) with the shoot diameter variable. The number of shoots presented a moderate correlation (r = 0.59) with the shoot length variable.

Figure 2. Pearson correlation for the variables number of shoots (NB), shoot length (CB), number of leaves (NF), shoot diameter (DB) and number of nodes (NN) of cassava mini-cuttings.



Source: prepared by the authors.

The analysis of variance for the variable shoot length (SL) revealed that the treatment with four buds presented a greater number of shoots than did the treatment with two buds. According to Silva *et al*. This greater length of shoots may be related to the greater number of reserves of the vegetative structures of the four-budded cassava plants. These results are also in agreement with those of Ferreira *et al*. (2010), who reported greater shoot lengths in the cassava plants with the greatest diameter.

With respect to the analysis of variance of the variable number of leaves (NF), there was a significant difference for the cassava plants cultivated with four buds compared with those cultivated with two buds. This is in accordance with the research carried out by Ferreira *et al*. (2010), cassava plants with larger diameters in treatment two presented a greater number of leaves, which, according to the authors, was related to the greater number of roots and reserves present in the cassava plants.

According to Muktar *et al*. (2024), the number of nodes also contributes to the greater appearance of leaves, since studies on the rooting of cassava cuttings according to the number of nodes revealed a greater presence of leaves in cuttings that had a greater number of nodes. Schoffel *et al*. (2022) reported that cuttings with a relatively large diameter had a direct relationship with increasing cutting length.

4 CONCLUSIONS

The number of buds in cassava cuttings influences morphological characteristics such as shoot length, number of leaves, shoot diameter and number of nodes.

The use of cuttings with a greater number of buds and larger diameter is recommended when propagating cassava plants.

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