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GUABIJU TREE PROPAGATION BY MINI-CUTTING: ONTOGENY OF THE MATRIX, CUTTING LENGTH AND INDOLE-BUTYRIC ACID

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ABSTRACT - Guabiju tree is usually propagated by seeds, although this method presents disadvantages, such as a long juvenile period and great genetic variability, resulting in uneven plants which makes management and the establishment of commercial orchards difficult, in addition to the delay in the production entry. The objective of this work was to test the propagation technique by mini-cutting in guabiju tree. The experimental design used was completely randomized, with a 2 x 2 x 3 factorial (ontogeny of the matrix plant x cut length x IBA concentration), with four replications and 20 mini-cuttings per experimental unit. A hundred and twenty days after the implantation of the experiment, the rooting percentage and callogenesis of the mini-cuttings, the secondary root total length, the aerial part and number of leaves were evaluated. The rooted mini-cuttings were transplanted into larger containers with substrate, and after 60 days of transplantation, their survival percentage was analyzed. The highest rooting percentage was obtained with 0 mg L^{-1} of IBA with an 57.69% average. Mini-cuttings had a high percentage of survival, with 87.5% being the lowest, presenting a satisfactory result. For the guabiju tree propagation by mini-cutting, it is recommended not to use IBA and adopt a length of four centimeters, using a juvenile matrix plant.
Keywords: *Myrcianthes pungens* (O. Berg) D. Legrand, native species, mini-cut, *Myrtaceae*.

PROPAGAÇÃO DE GUABIJUZEIRO POR MINIESTAQUIA: ONTOGENIA DO MATRIZEIRO, COMPRIMENTO DE ESTACA E ÁCIDO INDOLBUTÍRICO

RESUMO - O guabijuzeiro geralmente é propagado por sementes, porém este método apresenta desvantagens, como longo período juvenil, grande variabilidade genética, resultando em plantas desuniformes, dificultando o manejo, a implantação de pomares comerciais, além do atraso de entrada de produção. O objetivo deste trabalho foi testar a técnica de propagação por miniestaquia em guabijuzeiro. O delineamento experimental utilizado foi inteiramente casualizado, com fatorial 2 x 2 x 3 (ontogenia da planta matriz x comprimento de estaca x concentração de AIB), com quatro repetições e 20 miniestacas por unidade experimental. Após 120 dias da implantação do experimento, avaliou-se o percentual de enraizamento e de calogênese das miniestacas, o comprimento total, de radicela, da parte aérea e número de folhas. As miniestacas enraizadas foram transplantadas em recipientes maiores com substrato e após 60 dias foi analisada a porcentagem de sobrevivência. A maior porcentagem de enraizamento foi obtida com 0 mg L^{-1} de AIB com média de 57,69%. As miniestacas tiveram alto percentual de sobrevivência, sendo 87,5% o mais baixo, mostrando resultado satisfatório. Para a propagação de guabijuzeiro por miniestaquia recomenda-se não utilizar AIB e adotar o comprimento de quatro centímetros, utilizando planta matriz jovem.
Palavras-chaves: *Myrcianthes pungens* (O. Berg) D. Legrand, espécies nativas, miniestaca, Myrtaceae.

INTRODUCTION

In all Brazilian territory native species can be found (SOUZA et al., 2020), many of which belong to the *Myrtaceae* family. Most of the species in this family have edible fruits, which can be eaten fresh or in industrialized form, serving food segments (jellies, yogurts, ice cream, juices), cosmetics and pharmaceuticals (CASSOL et al., 2020), for having a high content of antioxidant substances. Among the native fruit trees of the Atlantic Forest of this family with economic potential is the guabiju tree (*Myrcianthes pungens*) (GRIEBELER et al., 2019), which is still little explored and studied, requiring basic information for its cultivation (HOSSEL et al., 2011).

This fruit tree is usually propagated by seeds, which results in a long juvenile period and uneven plants due to genetic variability caused by gene recombination, which is not desirable in an orchard because it makes management difficult (SILVA et al., 2011). In order to reverse this problem, it is ideal to obtain seedlings from some technique derived from the asexual method, once it reduces the juvenile period, anticipating the fruit production and allowing to obtain the desired uniformity in the orchards, in addition to fixing a superior genotype of interest (HOSSEL et al., 2018).

However, not all techniques of the asexual method have only advantages, since they depend on the need for

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labor and realization time, in addition to the production of few seedlings per matrix plant, which can harm it, in this specific case if layering is used on a large scale. In grafting it is necessary to have compatibility between rootstock and graft and, even so, low survival may occur, as the technique requires a lot of practical grafting, in addition to other necessary care (FACHINELLO et al., 2005). Given this, a possible solution to be tested would be the mini-cutting, a vegetative propagation technique where the juvenile potential of the propagules is used to induce rooting, using shoots of propagated vegetatively plants or by seeds (FERRIANI et al., 2010).

This technique is commonly applied in the multiplication of *Eucalyptus* sp. clones, a species also from the Myrtaceae family (ALFENAS et al., 2004) and which can be promising for guabiju tree, since both species belong to the same family and present the same problem when other techniques were used. In addition to eucalyptus, Hossel et al. (2018) had successful with jaboticaba tree, with the same difficulties of rhizogenesis. However, to achieve the desirable results with mini-cutting, factors such as time of year, growth regulators usage, condition and nutritional status of the matrix plant must be considered (MARINHO et al., 2009).

In the mini-cutting process, auxins can be used, which act in the process of accelerating adventitious rooting, acting on meristematic differentiation, usually common in species that have difficulty in rooting. Indole-butyric acid (IBA) is one of the most widely used synthetic auxins, presenting the best results in the rooting process (VALMORBIDA et al., 2008). In addition to auxin, another factor in which can influence the results concerns on the mini-cut length, once such conditions have an influence on the amount of carbohydrates and auxins present, in which they can favor for rapid differentiation and consequent secondary root formation (MAYER et al., 2002). However, as mini-cuttings involve using material with herbaceous tissue, the longer length can favor faster water loss.

Adult matrices, due to their physiological characteristics, increase the levels of inhibition and decrease the rooting cofactors, having less capacity to form adventitious roots. The present work aimed to evaluate the propagation technique by mini-cutting in guabiju tree, testing different concentrations of IBA, as well as the length of cuttings and ontogeny of the matrix plant.

MATERIAL AND METHODS

The experiment was carried out at the Unidade de Ensino e Pesquisa Viveiro de Produção de Mudas Hortícolas, da Universidade Tecnológica Federal do Paraná (UTFPR), *Campus* Dois Vizinhos (Paraná State, Brazil), from January to August 2018. The area is located in the ecoclimatic region of Southwest Paraná, with geographic coordinates: latitude 25°41’32” S, longitude 53°05’42” O and altitude of 526 m. The region's climate is classified, according to Köppen, as *Cfa*: Subtropical climate (ALVARES et al., 2013).

As matrices, 50 seedlings from guabiju tree seeds were used, with about 3 years old, kept in a pot, on a 50% shade screen and an adult plant with 15 years old. The potted and field plants were pruned in February 2018 to stimulate the growth of new shoots, in which were used to make the mini-cuttings. When the matrices had sprouts about 10 cm long, the material was collected (April 2018), kept in a container with water, in order to prevent their oxidation (HOSSEL, 2016). The mini-cuttings were prepared with lengths of 4 and 6 cm, having a pair of leaves, reduced to 25% of their original size in the apical portion.

After making, the mini-cuttings were immersed in the solution of indole-butyric acid (IBA) 2 cm of the base for 10 seconds, in concentrations of 0, 1000 and 2000 mg L^{-1} (HOSSEL, 2016). While preparing the IBA solution, it was diluted with absolute ethyl alcohol PA (99.5%) and then distilled water was added until the desired final concentration was obtained. Then, the mini-cuttings were placed in tubes containing commercial Plantmax® substrate, buried about 2/3 of its size. The mini-cuttings were kept in a greenhouse, with controlled temperature (25°C) and relative humidity (85%) (variation of +/- 2°C) (HOSSEL et al., 2018).

The experimental design used was completely randomized, with a factorial 2 x 2 x 3 (ontogeny of the matrix plant x length of mini-cuttings x IBA concentration), (ontogeny refers to the age of the matrix plants) with four replications and 20 mini-cuttings per experimental unit.

After 120 days of the experiment implementation, (August 2018) the rooting percentage and callogenesis of the mini-cuttings, the total length, length of the three largest secondary roots, the aerial part and total, the number of leaves were evaluated, and they were counted manually. For the evaluations, the mini-cuttings were washed with water for the excessive removal of the substrate, and with the aid of a millimeter ruler, the total length, root and aerial part in (cm) was obtained.

The rooted mini-cuttings were transplanted in larger containers with substrate containing latosoil, sand and compost (coming plant waste from the Unidade de Ensino e Pesquisa Compostagem of the referred Campus) (2:1:1 v/v) (Table 1), with two daily 30 min. of sprinkler irrigation shifts, on a 50% screen. After 60 days of transplanting (October 2018), the percentage of survival was evaluated. The variables data were submitted to the Lilliefors normality test, in the GENES® program. The data were subjected to analysis of variance, then an average comparison was performed using the Duncan test ($\alpha = 0.05$), in the GENES® program.

TABLE 1 - Chemical analysis of the substrate containing the oxisol, fine sand and compost mixture (2:1:1, v/v).

Substrate	pH*	P	K	Ca^{2+}	Mg^{2+}	Al^{3+}	H+Al	SB	V	MO
	H_2O	-------- mg dm^{-3} --------		------------------------- $cmol_c$ dm^{-3} -------------------------					(%)	gdm^{-3}
LCOA	6.70	323.82	1.00	4.90	3.40	0.00	2.36	9.30	79.76	42.89

*pH in water, KCl and $CaCl_2$ = ratio 1:2,5; P, Na, K, Fe, Zn, Mn and Cu = $Mehlich^{-1}$ extractor; Ca, Mg, Al = extractor: KCl $1molL^{-1}$; H + Al = 0.5 $molL^{-1}$ calcium acetate extractor; pH = 7.0; B = hot water extractor; S = monocalcium phosphate extractor in acetic acid; SB = sum of bases and V = base saturation index.

RESULTS AND DISCUSSION

According to the results obtained, in the root length and rooting percentage, it was not necessary to perform data transformation. For the total length, the data were transformed by square root of x+1, for the number of roots and leaves per root of x, and for the percentage of callus and survival by arc sine $\sqrt{x}$ / 100. Mini-cuttings from adult plants did not survive during the experiment, causing intense and rapid dehydration.

In plants, the physiological condition may present a greater number of inhibitors and a decrease in rooting cofactors, having less capacity to form adventitious roots (HARTMANN et al., 2011). Such fact may have occurred in the present work with material from adult plants, even though being in both situations' herbaceous material propagules. Thus, the ontogeny of the plant had a direct influence on the adventitious root's formation of the guabiju, being of great importance, aiming at obtaining propagules and consequent formation of seedlings. According to the results obtained, there was no significant effect on the variables evaluated regarding the factors of mini-cuttings length and IBA concentrations analyzed separately.

Significant interaction was obtained for IBA concentration x mini-cut length in terms of rooting percentage (Table 2) and post-transplant survival. In the other variables, the interaction was not significant, obtaining average of 5.99% for callogenesis, 2.07 cm of total length, number of secondary roots 1.36, length of the three largest roots of 1.62 cm, and 1.35 number of leaves.

TABLE 2 - Guabiju tree (*Myrcianthes pungens*) mini-cutting rooting (%), according to the IBA concentration (mg L^{-1}) and length (cm).

IBA concentration (mg L^{-1})	Mini-cutting length (cm)	
	4	6
0	57.69 aA*	30.55 aB
1000	38.46 aA	44.44 aA
2000	9.62 bA	32.50 aA
CV(%)	47.13	

*Averages followed by the same uppercase letters in the row and lowercase letters in the column do not differ statistically from each other, using the Duncan test (α = 0.05). CV = coefficient of variation.

As for rooting, the highest averages occurred in the 4 cm mini-cuttings using 0 and 1000 mg L^{-1} of IBA, the same did not occur in the 6 cm, once the IBA concentrations did not differ significantly in the analyzed averages. Without the IBA usage, the greatest rooting occurred in 4 cm mini-cuttings compared to 6 cm. Even this combination was the only one that presented rhizogenesis greater than 50%. In the other IBA concentrations (1000 and 2000 mg L^{-1}) the averages between both mini-cut lengths did not differ significantly.

It is believed that phytotoxicity may have occurred in the 4 cm mini-cuttings, when the highest exogenous concentration of auxins was used, reducing rooting. This confirms what was described by Ramos et al. (2003), who stated that the exogenous supply of auxin, in certain quantities, can promote changes in the hormonal balance, favoring or not the rooting of cuttings. In addition, it is believed that the shorter mini-cuttings provided greater rhizogenesis, due to the smaller specific surface area, causing less water loss, which is so necessary for the processes of cell division and differentiation, for later rhizogenesis.

It was observed that once rooted, mini-cuttings have a high percentage of post-transplant survival, obtaining statistically lower averages only in those with 6 cm and using 2000 mg L^{-1} (Table 3). According to Peña et al. (2015), Surinan cherry mini-cuttings (*Eugenia uniflora*) from juvenile plants of semi-mineral origin with 226 days, showed a high survival rate, with about 99.28%. Altoé et al. (2011), also obtained high survival rates of guava (*Psidium guajava*) and Araça tree (*Psidium cattleianum*) mini-cuttings with 4.68 and 2.94 cm in length, in which obtained averages of 100 and 95.8%, respectively.

TABLE 3 - Guabiju tree (*Myrcianthes pungens*) mini-cuttings survival (%) after transplantation, according to the IBA concentration (mg L^{-1}) and the length (cm).

IBA concentration (mg L^{-1})	Mini-cutting length (cm)	
	4	6
0	100.00 aA*	100.00 aA
1000	92.71 aA	100.00 aA
2000	100.00 aA	87.50 bB
CV(%)	7.18	

*Averages followed by the same uppercase letters in the row and lowercase letters in the column do not differ statistically from each other, using the Duncan test (α = 0.05). CV = coefficient of variation.

The rooted juvenile matrices mini-cuttings of the Myrtaceae family, in general, showed good ability to survive after transplantation, if the environment conditions and management are adequate, thus allowing, in addition to the rhizogenesis, seedlings obtention.

CONCLUSION

For the guabiju tree propagation by mini-cuttings it is not necessary to use IBA, but one must adopt a length of 4.0 cm and the collection of material from juvenile matrix plants.

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