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Rooting of stem segments from fig tree cultivars

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ABSTRACT. Although Brazil is the largest fig (*Ficus carica* L.) producer in the Southern Hemisphere, it mainly uses only one cultivar, 'Roxo de Valinhos'. In addition, propagation is almost entirely through hardwood cuttings. Therefore, the aim of this study was to establish a propagation method that provides more successful rooting of stem segments of fig cultivars for the purpose of expanding the genetic base of the fig tree. The cultivars used were 'Brunswick', 'Calabacita', 'Negro de Bursa', 'Mini Figo', 'Lampa Preta', 'Lemon', 'Troiano',' Nazaré', 'Três num Prato', 'Princesa', 'Colo de Dama', 'Montes', 'Bêbera Branca', 'Pingo de Mel', and 'Roxo de Valinhos'. The propagation methods used were layering, hardwood cuttings, nodal segments, herbaceous cuttings originating from the removal of sprouts, and herbaceous cuttings obtained during growth. We found that the propagation method influences the rooting of stem segments, and cultivars differ in their rooting potential.

Keywords: *Ficus carica* L., air layering, herbaceous cuttings, vegetative propagation, woody cuttings.

Enraizamento de segmentos caulinares de cultivares de figueira

RESUMO. O Brasil, apesar de ser o maior produtor de figo do Hemisfério Sul, na sua maioria utiliza somente uma cultivar, a Roxo de Valinhos. Além disso, a propagação, quase na sua totalidade, é feita através da estaquia lenhosa. Portanto, objetivou-se com o presente trabalho foi estabelecer um método de propagação propicia de maior enraizamento de segmentos caulinares de cultivares de figueira, visando a ampliação da base genética da figueira. As cultivares utilizadas foram: 'Brunswick', 'Calabacita', 'Negro de Bursa', 'Mini Figo', 'Lampa Preta', 'Lemon', 'Troiano', ' Nazaré', 'Três num Prato', 'Princesa', 'Colo de Dama', 'Montes', 'Bêbara Branca', 'Pingo de Mel' e 'Roxo de Valinhos'. Os métodos de propagação utilizados foram: alporquia, estacas lenhosas, segmentos nodais, estacas herbáceas oriundas da desbrota e estacas herbáceas retiradas durante o período de vegetação. Concluiu-se que o método de propagação influencia no enraizamento dos segmentos caulinares. As cultivares diferem quanto ao potencial rizogênico.

Palavras-chave: *Ficus carica* L., alporquia, estacas herbáceas, propagação vegetativa, estacas lenhosas.

Introduction

The fig tree, considered to be a rustic plant, is a fruit species of great economic importance and in expansion worldwide, with good adaptation to different climates and soil types (Rodrigues et al., 2012).

Hundreds of cultivars of the *Ficus carica* L. species, with several pomological and agronomic characteristics, are listed in the literature (Mars, 2003). Fig breeding studies for the development of new fig tree selections are costly since the pomological characteristics of the flowers are located within a closed receptacle (syconium) that has a small opening, making pollination difficult. Thus, the genetic diversity of most *F. carica* species is based on spontaneous mutations that are only multiplied through cuttings (Kotz, Campagnolo, Chagas, & Dalastra, 2011).

Brazil is the largest fig producer in the Southern Hemisphere. 'Roxo de Valinhos' is the only cultivar that is grown commercially (Sousa, Busquet, Vasconcellos, & Miranda, 2013), and it is currently subject to severe disease problems. Ceratocystis canker and the incidence of nematodes are the main problems responsible for a major decline in growing areas in the states of São Paulo and Minas Gerais (Figueira, Berbara, & Pimentel, 2011). The introduction of new cultivars or the use of new cultivars as rootstock for 'Roxo de Valinhos' could solve the current phytosanitary problems.

The fig tree is usually propagated by hardwood cuttings that are collected from the basal and median portions of the branches at the time of winter pruning, undertaken during the period of dormancy (Karadeniz, 2003; Sousa et al., 2013). Some cultivars have low rooting potential. Şirin, Ertan and Ertan

(2010) observed the emergence of around five roots in cuttings of the cultivar 'Sarilop'.

Low rooting of hardwood cuttings may be related to factors intrinsic to the plant material, such as age of the tissue, time of collection of cuttings, and phytohormone concentration, or exogenous factors, such as the growing conditions of the cutting (Han, Zhang, & Sun, 2009). However, variation in the rooting potential of cuttings is a characteristic intrinsic to genetic potential.

In this context, the adoption of alternative methods for vegetative propagation from fig tree cuttings (using other stem cuttings), such as layering (Pio et al., 2007; Daneluz et al., 2009), nodal segments (Pauletti, Barbosa, Chagas, & Kotz, 2010), hardwood cuttings of the apical portion of the branches (Ohland et al., 2009a), herbaceous cuttings originating from sprout removal (Pio et al., 2005), and herbaceous cuttings obtained during the growing season (Nogueira, Chalfun, Dutra, & Villa, 2007) could provide high rooting in cuttings that have low rooting when propagated by the current method of hardwood cuttings.

This study aimed to establish a propagation method that provides for more successful rooting of stem segments from fig cultivars for the purpose of expanding the genetic base of the fig tree.

Material and methods

The experiments were conducted at the Department of Agriculture (DAG) of the Universidade Federal de Lavras [Federal University of Lavras] (UFLA) in Lavras, Minas Gerais, Brazil, in a highland tropical region (Cwb) at 21°14' S and 45°00' W, and average altitude of 918 meters. Five sequences of experiments were performed from April to November 2014.

To carry out the experiments, stem cuttings were collected from four-year-old fig trees of 15 fig cultivars arranged at a spacing of 2.5 x 1.5 m in an experimental area of the Federal University of Lavras. The cultivars used were 'Brunswick', 'Calabacita', 'Negro de Bursa', 'Mini Figo', 'Lampa Preta', 'Lemon', 'Troiano',' Nazaré', 'Três num Prato', 'Princesa', 'Colo de Dama', 'Montes', 'Bêbera Branca', 'Pingo de Mel', and 'Roxo de Valinhos'.

In the experiment of rooting cuttings by layering, air layering was performed in the middle portion of woody branches with an average length of 150 cm at the end of April, following the methodology of Daneluz et al. (2009). The air layers were made without any wounding, and 1.000 mg L^{-1} IBA was brushed on a two-cm portion of the branch to stimulate rooting. Then, pine bark and moistened vermiculite (2:1) substrate was placed in the area treated with IBA and was wrapped with transparent plastic tied at both ends to prevent moisture loss. After 60 days, the air layering was removed to evaluate the percentage of air layering callus, rooting, and the average number of roots from air layering.

The callus and/or rooted air layers were transferred to 2.5 L plastic bags containing pine bark substrate. The bags were placed on stands suspended in nursery conditions with 50% brightness and were systematically moistened. After 60 days, a single sprout per seedling was selected, and after an additional 60 days, the percentage of sprouting and the average length of sprouts were measured.

In June, during winter pruning, hardwood cuttings of fig cultivars were collected to carry out the experiment of rooting of hardwood cuttings. Cuttings from the apical portion of the branches were used, which were standardized at 15 cm length and seven mm diameter. The base of the cuttings was treated with a concentration of 2000 mg L^{-1} of IBA for 10 seconds, following the methodology of Bastos et al. (2009) and Ohland et al. (2009a). The cuttings were buried to 2/3 of their length in a moist sand bed under nursery conditions with 50% brightness. The rooting bed was systematically moistened and, after 60 days, hardwood cuttings were removed to evaluate the percentage of sprouting and rooting, and average number of roots per cutting.

In the same period, the experiment of rooting of segmented hardwood cuttings was carried out, in which cuttings from the middle portion of the branches of all the fig cultivars were collected and standardized at 20 cm length and 12 mm diameter, with five nodes. A wound was made between nodes (square cuts with dimensions of 1 cm). The cuttings were treated with IBA at 2000 mg L^{-1} using a fine-bristle brush between the nodes of the cuttings, according to the methodology of Pauletti et al. (2010), to stimulate rooting of the cuttings.

The cuttings were buried horizontally at a depth of five cm and remained fully immersed in a moist sand bed under nursery conditions with 50% brightness. The rooting bed was systematically moistened, and after 120 days, the nodal segments were removed to evaluate the average percentage of nodes rooted per cutting, the average number of roots per cutting and per rooted node, the average percentage of nodes sprouted per cutting, the average number of sprouts per cutting, and the seedling yield (average number of nodes rooted and sprouted simultaneously, per cutting).

For the experiment of rooting of herbaceous cuttings originating from sprout removal, herbaceous cuttings of fig cultivars were collected at the time of sprouting of the fig trees, which occurred in August, about 60 days after winter pruning. The cuttings were standardized at 10 cm length, preserving only two leaves and removing the apical bud. They were stored in polypropylene trays in pine bark substrates, according to the methodology of Pio et al. (2005). The trays were placed in an intermittent mist chamber at a temperature of 25 ± 5°C, average RH of 72%, and spraying time of 20 seconds at 10-minute intervals. After 45 days, the percentage of sprouting and rooting and number of roots per cutting were evaluated.

The experiment of rooting of herbaceous cuttings collected during the vegetative period was carried out in October. The cuttings were standardized at 20 cm length and diameter of approximately 7 mm, without leaves, according to the method of Nogueira et al. (2007). The cuttings were buried to 2/3 of their length in plastic boxes filled with moist sand and placed in an intermittent mist chamber, with a spraying time of 60 seconds at 1-hour intervals. After 60 days, the herbaceous cuttings were removed to assess the percentage of sprouting and rooting and number of roots per cutting.

In all experiments (layering, hardwood cuttings, nodal segments, herbaceous cuttings originating from sprouting, and herbaceous cuttings obtained during the vegetative period), a completely randomized design was used with four replicates and 10 cuttings per experimental unit. The results were subjected to analysis of variance with a 5% probability through the Scott-Knott test. Analyses were performed using the System for Analysis of Variance - SISVAR software.

Results and discussion

Layering was observed to be a good technique for plant propagation because the cutting in air layering is not separated from the mother plant and continuously receives water and nutrients through the xylem (Hartmann et al., 2011). This enables the synthesis of substances that assist in induction of adventitious roots (Sanjay, Kumar, Mandal, & Ansari, 2004).

In fig propagation by layering, callus formation was high, at over 70%, except for the cultivar 'Pingo de Mel'. There was also high rooting in the cultivars 'Calabacita', 'Três num Prato' and 'Bêbera Branca' (Table 1). Root emergence in 'Roxo de Valinhos' was similar to that found in the study of Daneluz et al. (2009), but the cultivar 'Três num Prato' put forth the greatest number of roots, an average of 32.8.

The cultivars 'Brunswick', 'Nazareth' and 'Montes', which had high callus formation, did not root. After being transferred to plastic bags, they exhibited sprout emergence in an intermediate range, just below 'Roxo de Valinhos' and 'Bêbera Branca', cultivars which registered the highest rates in general in the rooting of stem segments by layering, although their sprout length was in an intermediate range (Table 1).

The use of layering is a viable technique for species that have difficulty rooting (Entelmann, Scarpare Filho, Pio, Silva, & Souza, 2014), an option for fig cultivars, which exhibit low rooting capacity for woody cuttings. Daneluz et al. (2009) likewise claim that layering is a viable methodology for production of 'Roxo de Valinhos' fig tree seedlings. Layering should be carried out in the middle portion of the branches, without the application of any wounds. Pine bark substrate and the concentration of 1000 mg L^{-1} IBA provided the best rooting results from air layering.

Table 1. Percentage of air layering callus, rooted and the average number of roots per air layering, percentage of sprouting and average length of sprouts from different cultivars of fig tree.

Cultivars of fig trees	Callus air layering callus (%)[1]	Rooting air layerings (%)	Number of roots	Sprouting air layering (%)	Length of sprouting (cm)
Bruswick	100.0 a	0.0 d	0.0 e	60.0 b	5.0 c
Calabacita	100.0 a	79.2 a	23.7 b	50.0 b	11.8 b
Negro de Bursa	100.0 a	10.0 d	10.0 d	55.0 b	13.6 b
Mini Figo	70.0 b	0.0 d	0.0 e	15.0 e	12.5 b
Lampa Preta	75.0 b	0.0 d	0.0 e	40.0 c	14.0 b
Lemon	100.0 a	0.0 d	0.0 e	30.0 c	18.4 a
Troiano	100.0 a	31.2 c	16.8 c	40.0 c	12.1 b
Nazaré	95.0 a	0.0 d	0.0 e	55.0 b	16.5 a
Três num Prato	100.0 a	95.0 a	32.8 a	35.0 c	17.8 a
Princesa	100.0 a	65.0 b	21.5 b	40.0 c	7.7 c
Colo de Dama	100.0 a	45.0 b	5.1 e	35.0 c	14.4 b
Montes	95.0 a	0.0 d	0.0 e	50.0 b	16.3 a
Bêbara Branca	100.0 a	95.0 a	16.9 c	70.0 a	13.4 b
Pingo de Mel	50.0 b	0.0 d	0.0 e	35.0 c	11.4 b
Roxo de Valinhos	100.0 a	53.3 b	20.4 b	80.0 a	15.0 b
C.V. (%)	11.7	21.1	18.6	19.3	16.5

[1] Means followed by the same letter in the column do not differ by the Scott-Knott test ($p \leq 0.05$).

In general, this propagation method provided a high rate of callus induction in the fig tree cuttings; however, rooting was low. This was also observed by Singh and Ansari (2014) when working with layering in some tropical species; they concluded that the callus may or may not result in adventitious roots in air layering. They also stated that callus induction and rooting are independent phenomena that occupy the same place at the same time, competing for similar form of carbohydrates. Therefore, callus can inhibit the formation of adventitious roots in layering. This was observed in the 'Lemon' cultivar, which showed a high incidence of callus layers without rooting, and low sprouting of the cuttings propagated by layering after transplant to plastic bags.

In the layering method, the cultivars that showed the best results for rooting of cuttings were 'Bêbera Branca', 'Calabacita' and 'Três num Prato'.

In the experimental results of hardwood cuttings, there was great variation in sprout and root emergence in fig cultivars. The 'Brunswick' cultivar had the highest percentage of sprouting (95%) and rooting (100%) and the highest average number of roots (45.5 roots) (Table 2). The results for percentage of sprouted and rooted cuttings in this experiment were higher than those found by Ohland et al. (2009b), who found 81.7 and 77.4 % of sprouted and rooted hardwood cuttings, respectively, in working with the cultivar 'Roxo de Valinhos'. However, the result found by the same authors for average number of roots was 94 roots per cutting, almost twice the number observed in this experiment. Hardwood cuttings for the fig cultivars 'Três num Prato' and 'Pingo de Mel' did not achieve good results for the parameters evaluated. From the results, it may be seen that the cuttings collected from the apical portion of the branches have high rhizogenic potential, agreeing with Pio et al. (2006).

Ohland et al. (2009b), working with rooting hardwood cuttings from 'Roxo de Valinhos', observed a 6.6% increase in the survival of cuttings and 27.4% increase in rooting with the use of 2,000 mg L^{-1} IBA at the base of the cuttings. The same was observed by Pio et al. (2006), who managed to increase the rooting of fig tree apical cuttings with the use of 2,000 mg L^{-1} IBA compared to cuttings that did not receive treatment with this concentration of auxin. Ohland et al. (2009a) furthermore affirm that the fig tree apical cutting should be collected in June and subsequently treated with 2000 mg L^{-1} IBA.

An increase in the number of roots per cutting contributes to the operation of transplanting cuttings in plastic bags, minimizing losses from possible root breakage in transplanting and, in addition, has a positive effect on development of the sprouting and root system (Ohland et al., 2009b).

In general, the propagation method through woody cuttings showed superior rooting results in relation to the other methods used. The cultivars that stood out in this method were 'Brunswick', 'Calabacita', 'Colo de Dama', 'Lampa Preta', 'Mini Figo', 'Montes', 'Negro de Bursa' and 'Princesa'.

In the experiment using herbaceous cuttings obtained during the vegetative period, the 'Lampa Preta' and 'Lemon' cultivars stood out in the three evaluations conducted, with more than 22 roots per cutting, on average, rooting percentage above 92%, and sprouting of 100% (Table 2). These results were higher than those found by Nogueira et al. (2007), who worked with herbaceous cuttings from vegetative branches. Their best results exhibited a 77.46% rooting rate for cuttings, showing that this method is also effective for producing seedlings of some fig tree cultivars, as also observed in this study. The cultivars with a high percentage of rooting by the herbaceous cutting method were 'Bêbera Branca', 'Lampa Preta' and 'Lemon'.

Table 2. Percentage of sprouted, rooting, number of roots in hardwood and herbaceous cuttings from different cultivars of fig tree.

Cultivars of fig tree	Sprouting cuttings (%)[1]		Rooting cuttings (%)		Number of roots	
	Hardwood	Herbaceous	Hardwood	Herbaceous	Hardwood	Herbaceous
Bruswick	95.0 a	100.0 a	100.0 a	60.7 c	45.5 a	12.2 b
Calabacita	100.0 a	73.81 b	91.7 a	26.79 d	27.7 b	0.46 c
Negro de Bursa	78.7 b	100.0 a	100.0 a	50.0 c	43.1 a	3.0 c
Mini Figo	80.7 b	100.0 a	83.0 a	28.6 d	37.1 a	1.5 c
Lampa Preta	93.0 a	100.0 a	93.0 a	92.5 a	27.5 b	22.8 a
Lemon	74.5 b	100.0 a	64.2 b	100.0 a	37.2 a	22.9 a
Troiano	64.5 b	92.8 b	70.5 b	3.6 e	11.2 c	0.5 c
Nazaré	67.5 b	100.0 a	76.5 b	71.4 b	39.6 a	8.7 c
Três num Prato	46.4 c	96.4 b	49.3 c	39.3 d	12.7 c	3.4 c
Princesa	77.0 b	96.4 b	87.3 a	56.4 c	37.7 a	5.7 c
Colo de Dama	66.5 b	100.0 a	85.7 a	71.4 b	14.4 c	2.8 c
Montes	95.8 a	100.0 a	91.5 a	64.2 c	16.7 c	11.1 b
Bêbara Branca	39.7 c	100.0 a	73.0 b	96.4 a	41.3 a	12.2 b
Pingo de Mel	37.5 c	100.0 a	56.1 c	82.1 b	18.2 c	4.9 c
Roxo de Valinhos	72.7 b	100.0 a	69.3 b	52.3 c	27.0 b	15.8 b
C.V. (%)	22.7	3.7	16.6	14.3	33.8	20.9

[1] Means followed by the same letter in the column do not differ by the Scott-Knott test ($p \leq 0.05$).

In the experiment for rooting of segmented hardwood cuttings, the cultivars ‘Bruswick’, ‘Troiano’, ‘Nazaré’, ‘Colo de Dama’, ‘Pingo de Mel’ and ‘Roxo de Valinhos’ had the highest rooting percentage (Table 3). However, in this method of propagation, the main advantage was root emergence in the cuttings, especially in the ‘Pingo de Mel’ cultivar (176.1 roots per cutting), a cultivar that had not shown good rooting of stem segments in the techniques discussed above (Tables 1 and 2).

Increased root growth was observed at the edges of the wounds made in the cuttings. According to Hartmann et al. (2011), in cuttings with wounds, there is an increase in respiration rate, and in auxin, carbohydrate, and ethylene content, resulting in the formation of roots at the edges of the lesion; That wounding the cutting may promote root formation in species that have some type of mechanical barrier to root emergence, especially the cuttings that have more lignified tissues at their bases.

The ‘Colo de Dama’ cultivar had the highest seedling yield (77%), followed by the 'Lemon' cultivar (60.5%), calculated by the average number of nodes rooted and sprouted simultaneously per cutting. In a practical sense, this means that adoption of the nodal technique for rooting quadruples the seedling yield for the ‘Colo de Dama’ cultivar and triples seedling yield for the 'Lemon' cultivar. These results are useful and applicable for efficient multiplication of new cultivars, as reported by Pauletti et al. (2010), assisting fig breeding programs in the introduction and large-scale multiplication of cuttings coming from other countries for diversification of fig trees.

It was observed that the sprouting percentage was lower than the other methods, with the exception of the alporquia method. This may have occurred because of the use of wounding and treatment with IBA. These results corroborate those found by Pauletti et al. (2010), who also noted reduction in sprout emergence when working with segmented cuttings from the ‘Roxo de Valinhos’ cultivar.

The cultivars ‘Brunswick’, ‘Colo de Dama’, ‘Nazaré’, ‘Pingo de Mel’, ‘Roxo de Valinhos’ and ‘Troiano’ showed excellent rooting when the segmented hardwood cutting method was used.

In the experiment with herbaceous cuttings collected at the time of sprout removal, the ‘Três num Prato’ cultivar showed the best results in evaluations of the percentages of sprouted cuttings, rooting, and average number of roots (Table 4), in contrast with the results from hardwood cuttings of this cultivar. It is noteworthy that the herbaceous cuttings originating from removal of sprouts from the cultivars ‘Calabacita’, ‘Bêbera Branca’, and ‘Três num Prato’ put forth more than 32 roots, on average, in agreement with Pio et al. (2005), who pointed out that this stem segment has high capacity for putting forth roots.

The cultivars ‘Bêbera Branca’, ‘Calabacita’ and ‘Três num Prato’ showed rooting percentages superior to those found by Pio et al. (2005) in working with cuttings originating from sprout removal from the ‘Roxo de Valinhos’ cultivar, in which he obtained a rooting percentage close to 90%. In the present propagation method, the cultivars that showed the highest rooting of cuttings were ‘Bêbera Branca’, ‘Calabacita’ and ‘Três num Prato’.

Table 3. Average percentage of node rooted per cuttings, average number of roots per cutting and per rooted node, average percentage of node sprouted per cutting, average number of sprout per cutting and yield of seedling in hardwood cuttings, from different cultivars of fig tree propagation by nodal segments.

Cultivars of fig tree	Node rooted (%)[1]	Number of root per cuttings	Number of root per node	Number of sprout node per cutting (%)	Number of sprout per cutting	Yield of seedling (%)
Bruswick	99.0 a	146.7 b	32.0 a	7.0 c	0.3 c	7.0 e
Calabacita	47.0 c	57.9 e	22.3 c	19.0 c	0.9 c	19.0 e
Negro de Bursa	44.0 c	40.3 f	18.3 d	42.0 b	2.1 b	25.0 d
Mini Figo	67.0 c	24.2 f	7.3 e	40.0 b	2.0 b	18.0 e
Lampa Preta	68.0 c	50.0 f	12.5 e	32.0 c	1.6 c	26.0 d
Lemon	87.0 b	138.3 c	28.0 b	60.5 a	3.0 a	60.5 b
Troiano	92.0 a	57.9 d	12.3 e	68.0 a	3.4 a	49.0 c
Nazaré	96.0 a	108.2 d	20.9 c	47.0 b	2.3 b	43.0 c
Três num Prato	61.0 b	63.4 e	22.4 c	53.0 b	2.6 b	31.0 d
Princesa	82.6 b	73.2 e	18.1 d	52.0 b	2.6 b	35.8 d
Colo de Dama	95.0 a	129.5 c	26.6 b	80.0 a	4.0 a	77.0 a
Montes	79.2 b	74.0 e	18.4 d	44.0 b	2.2 b	34.0 d
Bêbara Branca	89.0 b	156.9 b	33.2 a	15.2 c	0.7 c	15.2 e
Pingo de Mel	97.0 a	176.1 a	36.4 a	25.0 c	1.2 c	25.0 d
Roxo de Valinhos	92.0 a	74.3 e	15.9 d	72.0 a	3.6 a	44.0 c
C.V. (%)	8.9	17.1	13.5	29.9	30.1	32.8

(1) Means followed by the same letter in the column do not differ by the Scott-Knott test ($p \leq 0.05$).

Table 4. Percentage of sprouting, rooting and number of roots per cutting in herbaceous cuttings by the sprout removal from diferentes cultivars of fig tree.

Cultivars of fig tree	Sprouting cuttings (%)(1)	Hardwood cuttings (%)	Number of roots
Bruswick	92.5 a	20.0 e	1.6 d
Calabacita	65.0 b	92.5 a	35.4 a
Negro de Bursa	57.5 b	82.5 b	14.1 c
Mini Figo	87.0 a	19.2 d	2.5 d
Lampa Preta	71.2 b	29.0 d	9.1 d
Lemon	68.7 b	78.7 b	29.5 b
Troiano	90.0 a	42.5 c	12.3 c
Nazaré	81.7 a	28.2 d	24.2 b
Três num Prato	87.5 a	95.0 a	32.4 a
Princesa	65.0 b	52.5 c	14.3 c
Colo de Dama	60.7 b	14.0 d	2.0 d
Montes	27.7 c	32.1 d	12.3 c
Bêbara Branca	60.0 b	100.0 a	32.5 a
Pingo de Mel	65.0 b	55.0 c	5.2 d
Roxo de Valinhos	90.0 a	13.3 d	6.6 d
C.V. (%)	18.7	20.6	28.1

(1) Means followed by the same letter in the column do not differ by the Scott-Knott test ($p \leq 0.05$).

Conclusion

The propagation method has an influence on the rooting of stem segments of fig tree cultivars. Fig tree cultivars differ in rooting potential.

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References

Bastos, D. C., Scarpare Filho, J. A., Libardi, M. N., & Pio, R. (2009). Estiolamento, incisão na base da estaca e uso de ácido indolbutírico na propagação da caramboleira por estacas lenhosas. *Ciência e Agrotecnologia, 33*(1), 313-318.

Daneluz, S., Pio, R., Chagas, E. A., Barbosa, W., Ohland, T., & Kotz, T. E. (2009). Propagação da figueira 'Roxo de Valinhos' por alporquia. *Revista Brasileira de Fruticultura, 31*(1), 285-290.

Entelmann, F. A., Scarpare Filho, J. A., Pio, R., Silva, S. R., & Souza, F. M. (2014). Emergência de plântulas e enraizamento de estacas e alporques de porta-enxertos de nogueira-macadâmia. *Revista Brasileira de Fruticultura, 36*(1), 237-242.

Figueira, A. F., Berbara, R. L. L., & Pimentel, J. P. (2011). Estrutura da população de nematoides do solo em uma unidade de produção agroecológica no estado do Rio de Janeiro, Brasil. *Acta Scientiarum. Agronomy, 33*(2), 223-229.

Han, H., Zhang, S., & Sun, X. (2009). A review on the molecular mechanism of plants rooting modulated by auxin. *African Journal of Biotechnology, 8*(3), 348-353.

Hartmann, H. T., Hudson, T., Kester, D. E., Dale, E. K., Davies Junior, F. T., & Geneve, R. L. (2011). *Plant propagation: principles e practices* (8th ed). Boston, MA: Prentice Hall.

Karadeniz, T. (2003). A study on some fruit characteristics and propagations of these by hardwood cuttings of local fig cultivars grown in ordu (Turkey). *Acta Horticulturae*, *605*(1), 107-112.

Kotz, T. E., Pio, R., Campagnolo, M. A., Chagas, E. A., & Dalastra, I. M. (2011). Enxertia em figueira 'Roxo de Valinhos' por borbulhia e garfagem. *Bragantia, 70*(2), 344-348.

Mars, M. (2003). Fig (Ficus carica L.) genetic resources and breeding. *Acta Horticulturae*, *605*(1), 19-27.

Nogueira, A. M., Chalfun, N. N. J., Dutra, L. F., & Villa, F. (2007). Propagação de figueira (*Ficus carica* L.) por meio de estacas retiradas durante o período de vegetação. *Ciência e Agrotecnologia, 31*(3), 914-920.

Ohland, T., Pio, R., Chagas, E. A., Barbosa, W., Kotz, T. E., & Daneluz, S. (2009a). Enraizamento de estacas apicais de figueira 'Roxo de Valinhos' em função de época de coleta e AIB. *Ciência e Agrotecnologia, 33*(1), 74-78.

Ohland, T., Pio, R., Chagas, E. A., Barbosa, W., Dalastra, I. M., & Kotz, T. E. (2009b). Enraizamento de estacas apicais lenhosas de figueira 'Roxo de Valinhos' com aplicação de AIB e cianamida hidrogenada. *Revista Brasileira de Fruticultura, 31*(1), 273-279.

Pauletti, D. R., Pio, R., Barbosa, W., Chagas, E. A., & Kotz, T. E. (2010). Enraizamento de segmentos nodais caulinares de figueira. *Bragantia, 69*(4), 877-882.

Pio, R., Araújo, J. P. C., Bastos, D. C., Siqueira, A. A., Entelmann, F. A., Scarpare Filho, J. A., & Mourão Filho, F. A. A. (2005). Substratos no enraizamento de estacas herbáceas de figueira oriundas da desbrota. *Ciência e Agrotecnologia, 29*(3), 604-609.

Pio, R., Dall'Orto, F. A. C., Alvarenga, A. A., Abraão, E., Chagas, E. A., & Signorini, G. (2007). Propagação do marmeleiro 'Japonês' por estaquia e alporquia realizadas em diferentes épocas. *Ciência e Agrotecnologia, 31*(2), 570-574.

Pio, R., Ramos, J. D., Chalfun, N. N. J., Gontijo, T. C. A., Mendonça, V., Carrijo, E. P., & Chagas, E. A. (2006).

Propagação de estacas apicais de figueira: diferentes ambientes, ácido indolbutírico e tipo de estaca. *Ciência e Agrotecnologia, 30*(5), 1021-1026.

Rodrigues, D. N. B., Viana, T. V. A., Marinho, A. B., Ferreira, T. T. S., Azevedo, B. M., & Gomes Filho, R. R. (2012). Fertirrigação potássica na cultura da figueira no semiárido Cearence. *Revista Brasileira de Agricultura Irrigada, 6*(3), 176-183.

Singh, S., & Ansari, A. S. (2014). Callus formation impedes adventitious rhizogenesis. *Annals of Forest Research, 57*(1), 47-54.

Sanjay, S., Kumar, P., Mandal, A. K., & Ansari, S. A. (2004). Air-layering of trees with differential adventitious rooting response. *Indian Forester, 130*(3), 318-322.

Şirin, U., Ertan, E., & Ertan, B. (2010). Growth substrates and fig nursery tree production. *Scientia Agricola, 67*(6), 633-638.

Sousa, C. M., Busquet, R. N., Vasconcellos, M. A. S., & Miranda, R. M. (2013). Effects of auxin and misting on the rooting of herbaceous and hardwood cuttings from the fig tree. *Revista Ciência Agronômica, 44*(2), 334-338.

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