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VEGETATIVE PROPAGATION OF POMEGRANATE 'WONDERFUL' IN SUBSTRATES OF DECOMPOSED BABASSU STEM

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Abstract

The objective of this study was to evaluate different proportions of the regional substratum based on the decomposed babassu stem on the vegetative propagation of the 'Wonderful' pomegranate. The experiment was carried out from April to June of 2017, in a greenhouse with 50% luminosity. Woody stakes of pomegranate were planted approximately 20 cm in length and the diameter ranged from 2.0 to 4.0 mm. The experiment was conducted in a completely randomized design with 6 treatments, 4 replicates, 2 plants per experimental plot. The treatments consisted of 6 different substrate formulations: : i) control (100% soil); ii) 20% decomposed babassu stem + 80% soil and sand mixture (1: 1); iii) 40% decomposed babassu stem + 60% soil and sand mixture (1: 1); iv) 60% decomposed babassu stem + 40% soil and sand mixture (1: 1); v) 80% decomposed babassu stem + 20% soil and sand mixture (1: 1); vi) 100% decomposed babassu stem. It was verified that the use of different proportions of decomposed babassu stem affected the vegetative propagation of the 'Wonderful' pomegranate, with positive effects on rooting mainly root length. For best yields, the substrate is recommended in the proportion of 80% of the babaçu decomposed stem with 20% soil.

Key words: *Attalea speciosa*, cuttings, *Punica granatum* L., substrate.

1. INTRODUCTION

The pomegranate (*Punica granatum* L.) is a woody, branched shrub belonging to the family Punicaceae, of Mediterranean origin, where it was domesticated and later spread by India, the United States, China, Japan, Russia and Brazil. The pomegranate has antioxidant properties [2], [3] through the methanolic extract of pomegranate peel, obtained a beneficial effect for the treatment of malaria, this being attributable to the antiparasitic activities and the inhibition of the pro-inflammatory mechanisms in the appearance of disease.

In Brazilian climatic conditions the pomegranate has good adaptability and its production has been increasing in recent years, reaching 2,03 thousand tons of fresh fruit marketed in the country in 2011[4]. Because of its rusticity, acclimatization to the diverse edaphoclimatic conditions and fruiting throughout the year, the cultivation of the pomegranate grows among the small producers, who seek seedlings of cultivars with good agronomic characteristics. Thus, propagation methods should be studied to improve seedling production techniques, crop management and also for preservation and maintenance of cultivars [5].

In most fruit plants, propagation is carried out by the cutting method, which, in addition to providing seedling quality, fixes desirable agronomic characteristics efficiently [6]. The pomegranate can be propagated via seed, but in this way fruits of quality are not obtained and also a lower productivity occurs [7]. Therefore, vegetative propagation techniques, such as cuttings, can be used to generate a clone from a vegetative segment (stem, leaf or root) [8].

After implantation, the pomegranates may produce some fruit in the second or third year, if propagated by cuttings. They usually reach good commercial production in 5 to 6 years [9]. [10] In addition to the time of year in which the cuttings are collected, other factors may improve the results of adventitious rooting.

In recent years, there has been a marked increase in the volume of pomegranate in Brazil; in 2012 550 fruits were marketed only in Ceagesp [11]. And unlike the various vegetables, the demand for pomegranate has a tendency to increase at a much faster rate. Pomegranate is currently the eighteenth in terms of fruit consumed in the world. It is believed that, with the results of research demonstrating health benefits, it is expected to reach tenth place over the next 10 years [12].

The substrate is very important for obtaining healthy and vigorous seedlings. Generally, their choice depends on the cost of production and regional availability [13]. [14]

the substrate should have a combination of physical and chemical characteristics that promote moisture retention and availability of water and nutrients to meet plant needs. Among the materials that have potential for substrate composition, the decomposed stem of the babaçu palm (*Attalea speciosa* Mart.), Which originates in the northern and northeastern regions of Brazil, stands out [15].

Considering its importance both phytotherapics and economics, the objective was to evaluate different proportions of regional substrate based on the decomposed babassu stem on the vegetative propagation of the 'Wonderful' pomegranate.

2. MATERIAL E MÉTODOS

The experiment was carried out from April to June 2017, with a pomegranate (Punica granatum L.) in a greenhouse with 50% luminosity allocated to the Center for Agrarian and Environmental Sciences, Federal University of Maranhão, Chapadinha-MA (03º44'17 " S and 43º20'29 "W, 100 m above sea level), located 252 km from the capital São Luís. The municipality of Chapadinha-MA has a tropical climate and is classified by Köppen as AW with average rainfall between 1671 mm $year^{-1}$ and average annual temperature of 27 ° C.

48 woody piles of pomegranate were planted approximately 20 cm long and with a mean diameter between 2.0 and 4.0 mm. The experiment was conducted in a completely randomized design with 6 treatments, 4 replicates and 2 cuttings per plot. The treatments consisted of different substrate formulations: i) control (100% soil); ii) 20% decomposed babassu stem + 80% soil and sand mixture (1: 1); iii) 40% decomposed babassu stem + 60% soil and sand mixture (1: 1); iv) 60% decomposed babassu stem + 40% soil and sand mixture (1: 1); v) 80% decomposed babassu stem + 20% soil and sand mixture (1: 1); vi) 100% decomposed babassu stem (DBS).

Irrigation was carried out twice a day using a 5 (five) liter manual irrigator (210 mL / plant / day), and the cuttings were placed in a 12 x 20 cm polyethylene bag. At 60 days after planting the cuttings were measured according to the methodology described by [16].

All the substrates were evaluated physically and chemically before the experiment was installed (Table 1 and 2), and in the soil used as a control, a granulometric analysis was performed: 384 g coarse sand kg^{-1}; 336 g fine sand kg^{-1}; 112g silt kg^{-1}; 168 g of total clay kg^{-1}; 38 g of natural clay kg^{-1}; textural classification sandy loam; and flocculation degree of 77 g / $100g^{-1}$.

Table 1. PH, electrical conductivity (EC) and total (N), phosphorus (P), potassium (K), calcium (Ca) and magnesium (Mg) and sulfur (S) values of the materials used as substrates.

Substrates	pH	CE	N	P	K	Ca	Mg	S
		dS m^{-1}	g kg^{-1}	mg kg^{-1}	———— $cmol_c$ kg^{-1} ————			
T2	4,88	0,61	1,23	14	0,67	1,60	1,00	3,8
T3	5,11	1,36	1,46	13	1,82	3,20	1,70	7,6
T4	4,83	1,79	2,02	13	2,35	4,40	2,80	10,8
T5	5,16	3,00	3,47	27	6,17	10,90	4,60	24,6
T6	5,32	4,34	5,88	33	3,63	20,60	15,20	41,5

T2 = 20% DBS + 80% Soil; T3 = 40% DBS + 60% Soil; T4 = 60% DBS + 40% Soil; T5 = 80% DBS + 20% Soil; T6 = 100% DBS.

Table 2. Overall Density (OD), particle density (PD) and porosity (P) of materials used as substrates.

Substrates	Density (g/cm³)		Porosity (%)
	OD	PD	
T2	1,28	2,64	51,53
T3	1,18	2,57	54,01
T4	0,98	2,24	56,22
T5	0,73	1,88	60,91
T6	0,33	0,97	65,95

T2 = 20% DBS + 80% Soil; T3 = 40% DBS + 60% Soil; T4 = 60% DBS + 40% Soil; T5 = 80% DBS + 20% Soil; T6 = 100% DBS.

The following evaluations were carried out: i) percentage of cutting survival; ii) average number of leaves being counted directly; iii) average number of shoots, direct count of the issued gems; iv) average length of sprouts using a graduated ruler; v) average number of roots, counting directly; vi) length of the largest root, using a graduated ruler; vii) diameter of the largest root, using a digital caliper; viii) fresh and dry mass of shoots and root, after evaluation the cuttings were removed from the polyethylene bags and their roots washed in fine sieve until the substrate was completely cleaned, and the roots separated from the stem. Sprouts and roots were weighed in an analytical balance and then packed in paper sacks and forced to air oven for drying at 75 ° C ± 2 ° C until constant dry matter (about 62 hours). and then weighing the analytical balance.

Data were submitted to analysis of variance and the means were compared by the Tukey test at 5% probability. The analyzes were performed by the Assistat® computer program [17].

3. RESULTS AND DISCUSSION

The use of different proportions of decomposed babassu stem (DBS) in the production of 'Wonderful' pomegranate cuttings provided a significant effect (p <0.01), by the F test, for all variables of both biometry (Table 3) and of biomass (Table 4).

Table 3. Analysis of variance of survival cuttings (SS), number of shoots (NS), number of leaves (NL), number of roots (NR), length of shoots (LS), length of largest root (LLR) and diameter of largest (DL) of 'Wonderful' pomegranate cuttings due to different substrates based on the decomposed babassu stem (DBS).

FV	SC	NS	NL	NR	SL	LLR	DL
	—%—	——————— nº ———————			———— cm ————		
Treatment	4,55**	423,01**	16013,30**	41860,31**	90,35**	221,40**	833,92**
Residue	243,0556	0,08573	0,06995	0,06561	0,08828	0,06561	0,00017
CV%	17,40	2,14	0,53	0,67	8,58	8,00	3,57
MSD	35,00008	0,65734	0,59378	0,57502	0,66705	0,57502	0,02898

** significant at the 1% probability level (p <.01), * significant at the 5% probability level (.01 = <p <.05) and ns not significant (p> = .05). CV% = Coefficient of variation in%. MSD = Minimum significant difference.

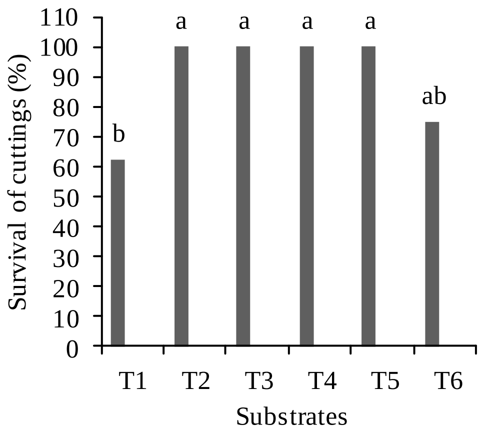
Table 4. Analysis of variance of fresh mass aerial part (FMAP), dry mass of the aerial part (DMAP) and dry mass of the root system (DMRS) of the 'Wonderful' pomegranate cuttings, as a function of different substrates, the base of the decomposed babassu stem (DBS).

FV	FMAP	DMAP	DMRS
	————g————		
Treatment	417453,57**	31729,60**	125,47**
Residue	0	0	0,00004
CV%	0,13	0,60	12,84
MSD	0,00337	0,00337	0,00337

** significant at the 1% probability level (p <.01), * significant at the 5% probability level (.01 = <p <.05) and ns not significant (p> = .05). CV% = Coefficient of variation in%. MSD = Minimum significant difference.

The treatments 2, 3, 4 and 5 stood out in relation to the variable survival of the cuttings (SC), with 100% of rooting (Figure 1). [18] with stakes of three-marias also was observed greater survival when it was used the stem decomposed of babassu like substrate.

***Figure* 1**. Survival of cuttings of pomegranate (*Punica granatum* L.) 'Wonderful' as a



function of different substrates the base of decomposed babassu stem (DBS). T1 = 100% soil; T2 = 20% DBS + 80% Soil; T3 = 40% DBS + 60% Soil; T4 = 60% DBS + 40% Soil; T5 = 80% DBS + 20% Soil; T6 = 100% DBS. Bars with equal letters do not differ as to the composition of the substrate among themselves by the Tukey test at 5% probability.

For the number of shoots (NS), the treatment that stood statistically to the others was the T5, with an average of 17 shoot shoots, as can be seen in Figure 2A, this result can be considered positive when compared to [19] that when using cuttings without leaves, obtained the average of 4.02 shoots per pomegranate cutting.

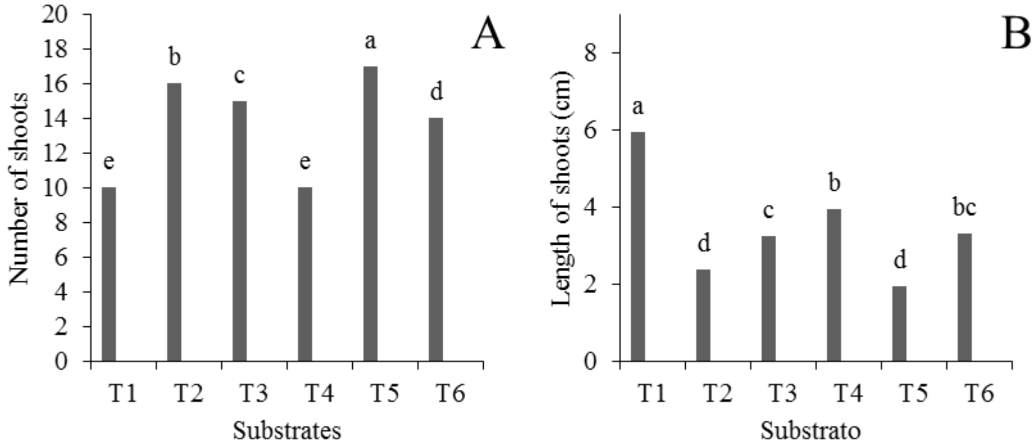


Figure 2. Number of shoots (A) and length of shoots (B), of piles of pomegranate (*Punica granatum* L.) 'Wonderful' as a function of different substrates the base of decomposed babassu stem (CBD).

T1 = 100% soil; T2 = 20% DBS + 80% Soil; T3 = 40% DBS + 60% Soil; T4 = 60% DBS + 40% Soil; T5 = 80% DBS + 20% Soil; T6 = 100% DBS. Bars with equal letters do not differ as to the composition of the substrate among themselves by the Tukey test at 5% probability.

For the variable length of shoots (LS), the T1 reached a higher average, around 5.95 cm (Figure 2B), which is probably due to the fact that as this treatment presented lower fertility and consequently generated few sprouts, the seedlings directed the reserves to the lodging of sprouts. However, this result was well below that reached by [16], which with the use of the Plantmax® substrate, obtained 12.1 cm for the length of shoots of pomegranate seedlings.

As can be seen in Figure 3A, for the variable number of leaves (NL) T3 was the treatment that reached the highest average, with 70.20 leaves. The results were higher than those found by [20], which at their best average using coconut fiber as substrate, obtained 37.64 leaves.

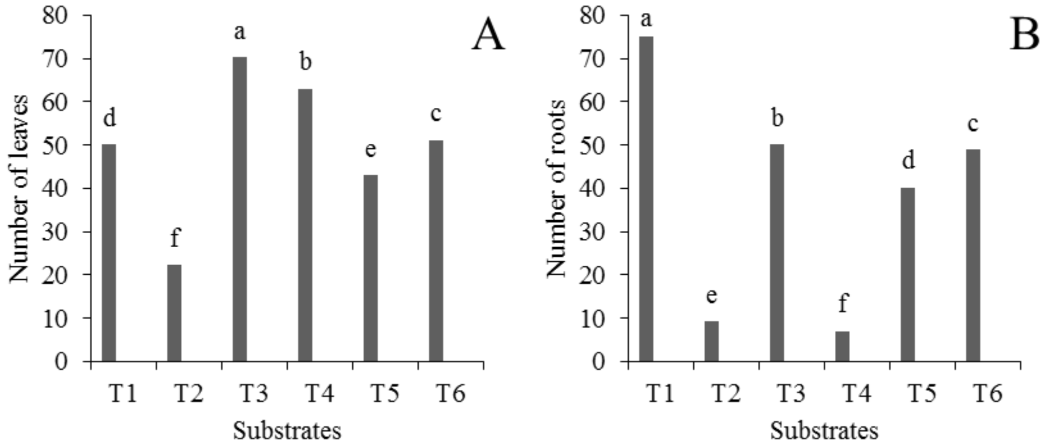


Figure 3. Number of leaves (A) and number of roots (B), of piles of pomegranate (*Punica granatum* L.) 'Wonderful' as a function of different substrates the base of decomposed babassu stem (DBS).

T1= 100% de solo; T2= 20% de CDB + 80% de Solo; T3= 40% de CDB+ 60% de Solo; T4= 60% de CDB + 40% de Solo; T5= 80% de CDB + 20% de Solo; T6= 100% de CDB. Barras com letras iguais não diferem quanto a composição do substrato entre si pelo teste de Tukey a 5% de probabilidade.

The highest number of roots (NR) was observed in T1 with an average of 75 roots per cutting (Figure 3B). In spite of presenting this result in the control of the experiment, such roots were of a length (Figure 4A), which does not indicate a possible good development of cuttings. [5] testing different concentrations of indolebutyric acid, observed stakes with a mean of 12 roots.

The substrate containing 80% of CBD + 20% of soil presented the most developed root system cuttings with the highest root of 5.80 cm as shown in Figure 4A. This is probably due to the characteristic of this substrate having a high porosity, thus providing an environment conducive for the roots to develop more freely. [21] working with cajaraneira obtained the best results with the substrate Tropstrato® providing roots of up to 11 cm.

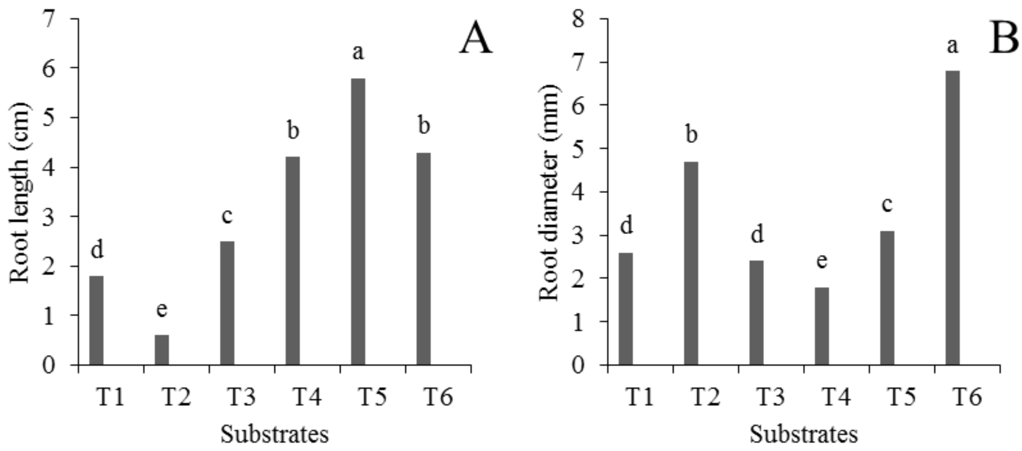


Figure 4. Root length (A) and root diameter (B) of 'Pomegranate' stakes (*'Punica granatum* L.') on the basis of different substrates based on decomposed babassu stem (DBS).

T1 = 100% soil; T2 = 20% DBS + 80% Soil; T3 = 40% DBS + 60% Soil; T4 = 60% DBS + 40% Soil; T5 = 80% DBS + 20% Soil; T6 = 100% DBS. Bars with equal letters do not differ as to the composition of the substrate among themselves by the Tukey test at 5% probability.

As can be seen in Figure 4B, the treatment that provided a larger root diameter (RD) was T6, with 6.8 mm. According to the work of [22], coffee cultivation developed better by propagating by cutting, reaching averages of root diameter around 4 mm.

As shown in Figure 5A, T5 was the best for fresh mass aerial part (FMPA) with 1.71 g, an expected result since the same treatment showed the highest LS according to Figure 2A. According to [23] biomass is the most adequate index to evaluate the growth of plants. [24] when assessing guava cuttings on different substrates obtained 27.62 g of FMPA in their best treatment.

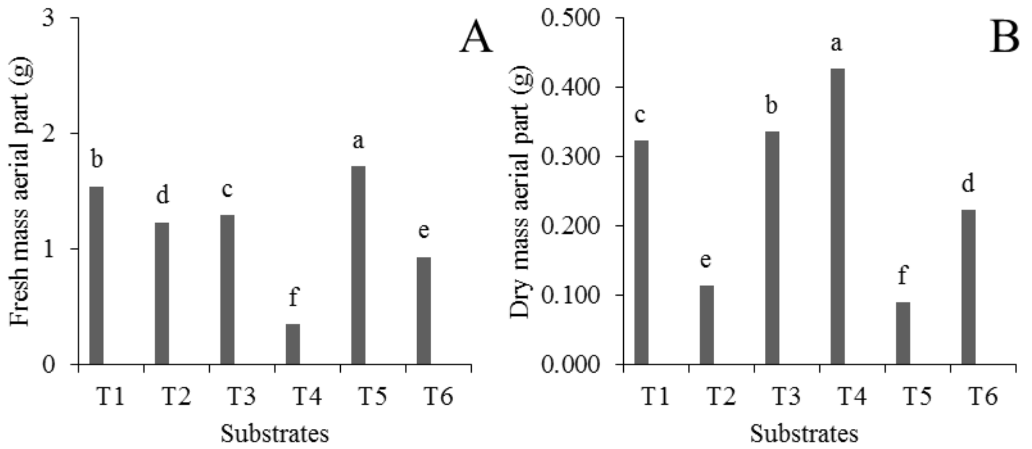
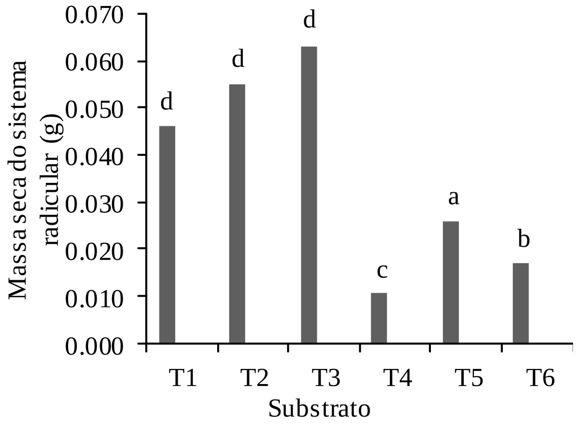


Figure 5. Fresh mass of the aerial part (A) and dry mass of the aerial part (B) of cuttings of pomegranate (*Punica granatum* L.) 'Wonderful' as a function of different substrates the base of decomposed babassu stem (DBS).

T1 = 100% soil; T2 = 20% DBS + 80% Soil; T3 = 40% DBS + 60% Soil; T4 = 60% DBS + 40% Soil; T5 = 80% DBS + 20% Soil; T6 = 100% DBS. Bars with equal letters do not differ as to the composition of the substrate among themselves by the Tukey test at 5% probability.

For the variable dry mass aerial part (DMAP), the treatment that stood statistically out of the others was T4 with 26 g (Figure 5B). [25] say that the best way to evaluate a plant's



growth would be by analyzing its dry mass. [26] when working with acerola, obtained 1.92 g for MSPA.

Figure 6. Dry mass of the root system of pomegranate cuttings (*Punica granatum* L.) 'Wonderful' as a function of different substrates based on the decomposed babassu stem (DBS).

T1 = 100% soil; T2 = 20% DBS + 80% Soil; T3 = 40% DBS + 60% Soil; T4 = 60% DBS + 40% Soil; T5 = 80% DBS + 20% Soil; T6 = 100% DBS. Bars with equal letters do not differ as to the composition of the substrate among themselves by the Tukey test at 5% probability.

The dry mass of the root system (DMRS) the T5 was topped with 0.026 g (Figure 6). [27] when evaluating the rooting of acerola, obtained their best result in the treatment with cuttings presenting two pairs of leaves being 0.028 g. It has been observed that the difficulty in rooting cuttings of some species can be overcome if conditions and optimal factors are provided for their rooting [28].

4. CONCLUSION

The decomposed babassu stem (*Attalea speciosa* Martin.) can be used as an alternative substrate in the production of 'Wonderful' pomegranate (*Punica granatum* L.) seedlings, as it allows better root and shoot development. It is recommended the use of a substrate of decomposed babassu stem in the proportion of 80% of CBD + 20% of soil because it presents the best results for most of the evaluated variables.

5. ACKNOWLEDGEMENTS

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