Scientia Agraria Paranaensis – Sci. Agrar. Parana.
ISSN: 1983-1471 – Online

SUBSTRATE IN THE INITIAL DEVELOPMENT OF PAJEU SEEDLINGS

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SAP 22654 Received: 20/06/2019 Accepted: 25/09/2019
Sci. Agrar. Parana, Marechal Cândido Rondon, v. 19, n. 1, jan./mar., p. 72-76, 2020

ABSTRACT - *Triplaris gardneriana* populary know as 'Pajeu' is a tree species with potential for recovery of riparian forests. The aim of this work was to evaluate the emergence and initial development of saplings in different substrates. The experiment was conducted in the didactic garden of the *Campus* Liberdade, from the University of International Integration of Afro-Brazilian Lusophony, in the municipality of Redenção, Ceará State. A completely randomized design with six treatments and four replicates of 25 seeds was used. The substrates used were: soil, soil + humus, soil + compost, soil + manure, soil + humus + cattle manure and soil + humus + compost. Seedling emergence, emergence speed index, plant height and root length were evaluated. The substrate soil + humus + compost provided better seedling quality possibly due to the best physical characteristics, such as aerations and water retention.
Keywords: *Triplaris gardneriana* Wedd, reforestation, production of seedlings, organic fertilizers.

SUBSTRATOS NO DESENVOLVIMENTO INICIAL DE PLÂNTULAS DE PAJEÚ

RESUMO - A *Triplaris gardneriana* conhecida popularmente como Pajeú é uma espécie arbórea com potencial para recuperação de matas ciliares. O trabalho teve como objetivo avaliar a emergência e desenvolvimento inicial de plântulas de Pajéu em diferentes substratos. O experimento foi conduzido em Horta Didática, da Universidade da Integração Internacional da Lusofonia Afro-brasileira, *Campus* Liberdade, no município de Redenção (CE). Utilizou-se o delineamento inteiramente casualizado, com seis tratamentos e quatro repetições de 25 sementes. Os substratos utilizados foram: solo, solo+húmus, solo+composto, solo+esterco, solo+húmus+esterco bovino e solo+húmus+composto. Foram avaliadas a emergência de plântulas (%), índice de velocidade de emergência, altura de plantas e comprimento médio da raiz (cm). O substrato solo+húmus+composto proporcionou melhor qualidade das mudas obtidas, devido as melhores características físicas, como aeração e retenção de água.
Palavras-chave: *Triplaris gardneriana* Wedd, reflorestamento, produção de mudas, adubos orgânicos.

INTRODUCTION

Caatinga is an ecosystem with approximately 1500 species in which a fifth of these species are endemic (CASTRO et al., 2010). However, the exploration of Caatinga resources, in an extractive way, has particularly affected the diversity of flora and fauna (REBOUÇAS, 2009).

One way to repair this advance is to reforest areas in the process of degradation. The use of native species in the reforestation of areas in the process of degradation is recommended for resisting adverse conditions and recovering biodiversity (COSTA e DURIGAN, 2010; JESUS et al., 2016).

Pajeu (*Triplaris gardneriana* Wedd.), is one of the species with potential in the recovery of riparian forests (PEREIRA, 2011), which has a fundamental role in the conservation of biodiversity of flora and fauna and in the preservation of water quality (FERREIRA et al., 2015). Belonging to the Polygonaceae family, *T. gardneriana* is a dioecious tree, with a tortuous and branched trunk, presenting simple and leathery leaves. Its inflorescences are paniculated and its seeds produced annually, these being polygons allowing easy spread by the wind (ARAUJO, 2009).

This species (*Triplaris gardneriana*) is commonly known, in the Northeast, as Pajeú, Pajáu and, in other regions, as coaçu, ant stick, black novice wood. It occurs naturally in the Caatinga and Pantanal region of Mato Grosso, in floodplains and wet slopes (MELO, 2010). It has great importance in home medicine because it

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treats gonorrhea and bloody hemorrhoids with the cooking of the roots and half leaves of the leaves, respectively (CASTRO et al., 2010).

Despite the importance of this species, its seedling production process is not well defined yet. Seedling quality is one of the main factors for the implantation of forest stands. In the production of seedlings the substrate used is important for the supply of water, oxygen and nutrients for the development of the species. In this sense, the substrate constitutes one of the most complex factors in the production of seedlings (ARAÚJO e SOBRINHO, 2011).

In addition to presenting good physical, chemical, biological and sanitary characteristics, in order to obtain quality seedlings, the substrate used must be available for purchase, and must be abundant and available in the long term (COSTA et al., 2012; SANTOS et al., 2017).

The organic waste as a substrate presents itself as a viable economic and environmental alternative, since it reduces the use of commercial substrates and the destination of residues. Several materials can be used, for example: bovine manure, chicken litter, carbonized rice husks, earthworm humus, sawdust, coconut husk fiber, among others (COSTA et al., 2014).

Organic compounds act as a source of organic matter for the substrate, increase the water retention capacity, improve aeration and the aggregation of the substrate to the roots of the plants and increase the availability of nutrients (TRAZZI et al., 2013). Given the above, this study aimed to evaluate the influence of substrates on the initial development of seedlings of *Triplaris gardneriana* Wedd.

MATERIAL E METHODS

The experiment was conduced in the experimental area, at the University of International Integration of Afro-Brazilian Lusophony (UNILAB), *Campus* Liberdade, in the municipality of Redenção, Ceará (CE), during the months of October and November of 2014. The municipality of Redenção is geographically located in the Northeast region of Brazil, at latitude 04º13'33" S and longitude 38º43'50" W, altitude of 88 m. The climate is humid and sub-humid hot tropical and semi-arid hot tropical. The average temperature is between 26 a 28°C and average annual rainfall of 1062 mm (IPECE, 2012).

The seeds of Triplaris gardneriana, were collected on the soil surface of five matrices in the community of Piroás, located in the municipality of Redenção, in October 2014. After collection, the wings were removed from the seeds, and the damaged and intact ones were separated. The selected seeds were treated with bleach solution (5%), for one minute, and then washed and dried on paper towels.

The treatments used were: soil, soil+humus+organic compost (SHC), soil+ humus (SH), soil+compost (SC), soil+manure (SM) e solo+húmus+manure (SHM). The proportion of substrates for three or two items was 1:1:1 e 1:1 (v:v), respectively. The soil was classified, by Donagema et al. (2011) as being Red-Yellow Argisol, collected in the 0-20 layer cm. The chemical composition of the substrates, described in the Table, were analyzed at the Soil and Water Laboratory (DCS/CCA/UFC).

The substrates were arranged in trays according to the principle of a completely randomized design, with four replications of 25 seeds. Polystyrene trays with 200 cells were used, measuring approximately 0.68 m in length and 0.34 m in width.

The water was applied twice a day manually. At 23 days after sowing (DAS), the following variables were evaluated: seedling emergence (%), emergence speed index, plant height and average root length (cm). Emerged seedlings were considered to be those with cotyledons above the substrate surface (BRASIL, 2013). The calculation of the emergency percentage followed the Equation1:

$$E\ (\%) = \frac{N}{A} \times 100 \qquad \text{(Equation1)}$$

Where:

N = number of seedlings emerged, and

A = total number of seeds placed to germinate.

The emergency speed index (ESI) was determined by couting the number os seedlings emerged daily, according to Equation 2 (MAGUIRE, 1962):

$$ESI = \frac{N1}{D1} + \frac{N2}{D2} + \cdots \frac{Nn}{Dn} \qquad \text{(Equation 2)}$$

Where:

N = number of seedlings emerged on the day 1, 2, 3, ...n and

D = days for seedlings to emerge.

The average root length was obtained by measuring the main root and the height of the plant with a graduated ruler (in centimeters). Data were subjected to analysis of variance and Tukey test, at 5% probability of error, using the software ASSISTAT 7.7 Beta (SILVA, 2013). The germination percentage data were transformed to the sine arc x/100.

RESULTS AND DISCUSSION

The emergence of pajeú seeds started from the eighth day after sowing and showed no statistical difference between treatments (Figure 1). This means that the physical conditions of the substrates do not interfere with the availability of oxygen and water, necessary for germination to occur.

The start of seedling emergence differed from the work carried out by Reis et al. (2012), with *Triplaris americana*, where the emergency started on the eighteenth day after sowing, evaluating different substrates based on earth, sand, vermiculite, bovine manure and chicken manure.

In the present study, no significant differences were found for the percentage of emergencies, which ranged from 39.2 to 54%. For *Triplaris surinamensis*, Souza et al. (2008) found a higher percentage of emergence in the substrate soil (86%) and soil + organic compound 3: 1 (82%).

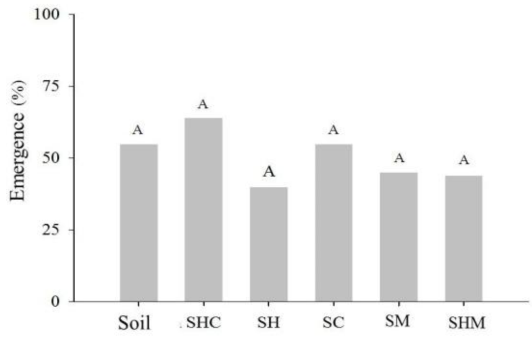

FIGURE 1 - Emergence of pajeu seedlings in different substrates. SHC = soil+humus+compost, SH = soil+humus, SC = soil+compost, SM = solo+manure, SHM = soil+humus+manure). * Averages followed by the same capital letter, do not differ statistically (Tukey, p>0,05).

As for the beginning of seedling emergence, these authors found results similar to those found in this study, with emergence beginning between the 7th and 9th days.

Although it did not affect the emergency, the speed of growth of the embryonic axis was affected. This is because, the substrate soil+humus+compost provided the highest rate of emergence speed (Figure 2), a condition that can result in seedlings with less growth of the aerial part and roots.

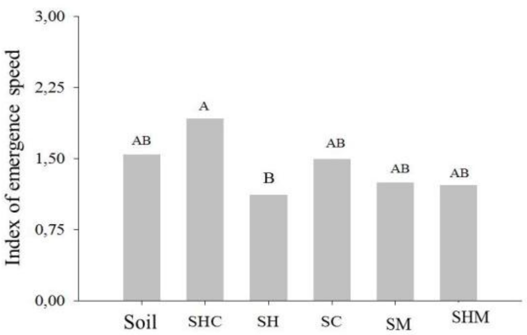

FIGURE 2 - Index of emergence speed of pajeu seedlings in different substrates. SHC = soil+humus+compost, SH = soil+humus, SC = soil+compost, SM = soil+manure, SHM = soil+humus+manure). * Averages followed by the same capital letter, do not differ statistically (Tukey, p>0,05).

The fact of the substrate soil+humus+compost (SHC) have provided greater IES may be related to less water loss through percolation and evaporation by SHC in relation to soil+humus (SH) even applying a similar amount of water between the substrates. This fact suggests that organic matter is fundamental in the aggregation of soil particles. Silva et al. (2014), claim that the stabilization of aggregates presents a positive correlation with the organic matter content of the soil (SOM), in this sense, the higher the content of SOM or even organic material in the soil, the greater aggregation it will have (SILVA et al., 2014).

Rosa et al. (2000), working with Triplaris in the laboratory, germination started on the fifth day after sowing for dark brown seeds considered mature. Ferreira et al. (2015), testing substrates based on sand, soil, composting residues from fruit processing and cattle manure, verified that these did not influence the IES of wood-stick (Platycyamus regnellii). According to the same authors, substrates with organic components, such as banana peel compost, vegetable compost and bovine manure showed greater seedling development.

In percentage terms, the substrate soil+humus+compost presented the highest value for seedling height, differing statistically from the substrate soil+manure that presented the lowest average (Figure 3). The higher growth of seedlings in height in the SHC substrate may be related to the rapid establishment of seedlings, since it presented greater IES. However, this condition was not verified for growth in root length. Generally, root growth in length is related to water condition. The SH substrate may have made less water available during the germination process. This may have stimulated the growth of the root in length to maintain the proper water condition during the germination process on the SH substrate.

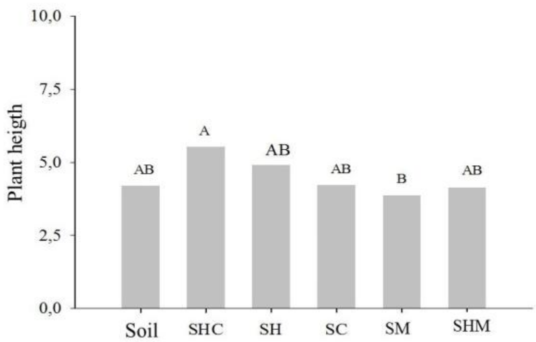

FIGURE 3 - Height of pajeu seedlings on different substrates. SHC = soil+humus+compost, SH = solo+humus, SC = soil+compost, SM = soil+manure, SHM = soil+humus+manure). * Averages followed by the same capital letter, do not differ statistically (Tukey, p>0,05).

Regarding the average root length, only the soil + manure substrate differed statistically from the others (Figure 4).

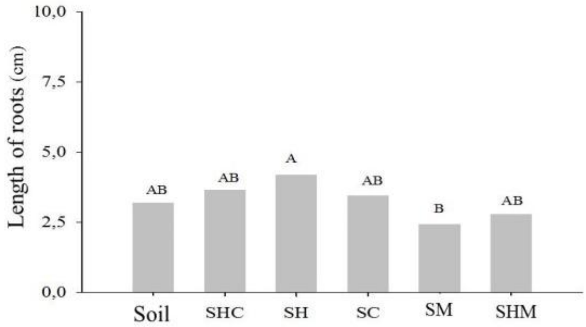

FIGURE 4 - Pajeu root length on different substrates. SHC = soil+humus+compost, SH = soil+humus, SC = soil+compost, SM = soil+manure, SHM = soil+humus+manure). * Averages followed by the same capital letter, do not differ statistically (Tukey, p>0,05).

Lima et al. (2017) did not find a significant difference in root length and collection diameter using the earthworm humus and bovine manure substrates. Lucena et al. (2006), working with leucena (*Leucaena leucocephala*) and flamboyant (*Delonix regia*) found that the growth in height of the aerial part and diameter of the collection was greater in treatments consisting of three organic residues (cattle manure, chicken manure, earthworm manure) in the proportion 1: 1 with subsoil. For Flamboyant, the best averages were verified in the treatments with soil + chicken manure, in the proportions 1: 1 and 1: 2, with subsoil.

Cruz et al. (2016) evaluating different organic substrates for ornamental sunflower growth, obtained better averages for plant height and stem diameter in the soil + humus + manure substrate. In this work, the soil + humus + manure substrate did not show the best results for these variables and also did not show any significant difference in relation to the best averages, even with two sources of organic matter. According Setúbal et al. (2000), organic matter in the seedling production process must be offered in a balanced way, in addition to the other components of the substrate. In addition, the pH of the substrates with manure added values above 7, showing that the availability of nutrients in this pH range is limited (Table 1).

TABLE 1 - Chemical composition of different substrates used in the production of pajeu seedlings. SHC = soil+humus+compost, SH = solo+humus, SC = soil+compost, SM = solo+manure, SHM = soil+humus+manure).

Treatments	P	K	Na	Ca	Mg	pH
	----------------- mg dm^{-3}	-------------------		------- cmo_c dm^{-3} -------		
Soil	94	188	73	2,5	2.5	6,3
SHC	311	689	120	18,2	7,7	6,8
SHM	449	2556	314	8,2	4,3	8,0
SC	141	454	64	10,0	6,4	6,5
SM	463	2495	464	8,0	2,0	7,9
SH	266	235	140	8,2	6,9	6,8

The best results found by the soil + humus + compost substrate can be explained by the fact that this substrate has balanced nutrients and pH in an optimal range (Table 1). Humus, due to its greater chemical stabilization, may have contributed to better nutritional quality of the substrate and the compound favored its physical quality.

Lima et al. (2017) verified a linear pattern when bovine manure was added to the substrate for the production of Mycracroduon urundeuva Allemão seedlings. As the manure concentration increased, the plant responded negatively to height, stem diameter and root length, confirming the phytotoxic action caused by excess of nutrients.

It was found that the soil used as a substrate did not show any significant difference regarding the variables analyzed in relation to the tested substrates. In the production of seedlings it is noted that seedling growth varies depending on the species, the source of nutrients and various physical and chemical factors (FERREIRA et al., 2015). Therefore, it is necessary to carry out future work testing other substrates or yet another species in order to observe and compare the influence of the substrates on the initial development of native species in the region. Still, it is necessary to monitor the seedlings after transplanting to the field, since the results presented refer only to a part of their cycle.

CONCLUSIONS

In general, the substrates used proved to be ideal for the production of seedling quality, and the more varied the source of the substrate used, the better the seedling vigor obtained.

The soil + humus + compost substrate provided better quality of the seedlings obtained, due to the better physical characteristics, such as aeration and water retention.

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