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Influence of different conventional and alternative substrates on sombro seed germination

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ABSTRACT
Germination is a factor of great importance in the production of forest seedlings, being correlated, normally, with the type of substrate, as well as the quality of the seed and the climatic conditions to which it is submitted. Thus, the objective was to evaluate the influence of conventional and alternative substrates on the germination of seeds of Clitoria fairchildiana (sombrero). The work was carried out at the Seed Technology Laboratory of the Department of Engineering at the Federal University of Piauí, in the municipality of Bom Jesus - PI. The design used was completely randomized, totaling 10 treatments (T1 - bovine manure; T2 - vermiculite; T3 - washed sand; T4- bioplant ® ; T5 - buriti wood; using 100% of each material; T6 - vermiculite + bioplant ® ; T7 - washed sand + vermiculite; T8 - bioplant ® + washed sand; T9 - bovine manure + buriti wood; using mixtures (50% + 50%); and T10 - washed sand + buriti wood + bovine manure (20% + 40% + 40), with four replicates. Germination (% GERM), first germination count (% PC), germination speed index (IVG), length and dry mass of seedlings were evaluated. The collected data were submitted to the analysis of variance using the ASSISTAT statistical program and the means were compared by the Scott-Knott test, at 5% probability. Treatment T9 promoted a higher percentage of germination and IVG, being indicated for the germination of sombrero seeds. greater initial germination, as well as greater seedling length.

Keywords: Clitoria fairchildiana, tree species, organic materials.

1 INTRODUCTION

Because of the exploitation of tropical forests, knowledge of seedling production techniques is necessary to recompose devastated forests, as a way to guarantee the continuity of this economic potential (Muroyaetal., 1997) and the conservation of genetic resources, soil, water, and fauna. Such techniques are mainly related to the choice of substrate, as it ends up effectively influencing germination and emergence, as well as the vigorous development of seedlings. However, it is not enough to produce seedlings. These seedlings must have the quality and capacity to survive in the field, and one of the items that interfere with the quality of the seedlings is the substrate. According to Siqueira et al. (2018) within this type of production, the composition of the substrate is a factor that influences its quality, because it is responsible for providing physical support to the root system and conditions to adequately supply the water and nutritional demand of the seedling.

Germination is a factor of great importance in the production of seedlings, being correlated, normally, with the type of substrate, as well as the quality of the seed and the climatic conditions to which they are submitted. According to Carvalho and Nakagawa (2012), seed germination is a factor regulated by the interaction of its physiological quality and environmental conditions, and each plant species requires specific requirements regarding the availability of water, temperature, light, and sowing depth for seeding. occurrence of the germination process of its seeds.

The substrate has the function of maintaining the moisture of the seed and providing favorable conditions during the germination process. According to Moraes Neto et al. (2001), organic substrates have greater buffering power, in addition, losses due to cumulative evaporation are much higher in mineral substrates than in organic substrates, which shows the greater retention of water available in organic substrates. Thus, substrates must have physical and chemical characteristics that promote moisture retention and nutrient availability, so that they meet the initial needs of the plant (Cunha et al., 2006). Thus, it is worth remembering that factors such as structure, aeration, water retention capacity, and degree of pathogen infestation may vary from one substrate to another, interfering with the germination process and seedling growth (MORAES et al., 2007).

In Brazil, as a result of the great richness of existing forest species, studies on the potential for reforestation programs are fundamental, whether for economic and/or conservation purposes. Among the various genera that can be used in reforestation, the genus Clitorias stands out (Scalon et al., 2006) mainly because it is widely adapted to different regions of the country. Clitoria fairchildiana also known as C. racemosa Lindl. (LORENZI, 2002), by the scientific class or as palheteira, sombreiro and faveira by the population, is the name of a type of tree native to the Amazon. Widely used for urban afforestation and the restoration of deteriorated places (SOUZA et al., 2007; BLUM et al., 2008; LORENZI, 2012), and also of great value for the medicinal and pharmaceutical areas for presenting antinociceptive, anti-inflammatory activities. inflammatory and antioxidant (LEITE et al., 2012; ANNEGOWDA et al., 2013). Thus, this study aimed to evaluate the influence of conventional and alternative substrates on Clitoria fairchildiana seed germination.

2 MATERIAL AND METHODS

The work was carried out at the Seed Technology Laboratory of the Department of Engineering at the Federal University of Piauí, in the municipality of Bom Jesus - PI. The seeds were obtained by collecting the fruits directly from mother trees, which were inserted on the University Campus, when they were in the beginning of natural dehiscence. After harvesting, the fruits were taken to the laboratory and processed manually, opening the pods to obtain the seeds, and eliminating the malformed ones. After processing, the seeds were homogenized and formed into a single batch and kept in a refrigerator for five days, with a water content of 21%. The statistical design was completely randomized, totaling 10 treatments, in four replications. The substrates used are described in Table 1.

Table 1 – Substrates used for germination test in C. fairchildiana seeds.

Treatments	Substrates	Acronyms *
T_1	Esterco bovino	EB
T_2	Vermiculita®	VERM
T_3	Areia lavada	AR
T_4	Bioplant®	BIO
T_5	Paú de buriti	PBU
T_6	50% Vermiculita® + 50% Bioplant®	VERM+BIO
T_7	50% Areia lavada + 50%Vermiculita®	AR+VERM
T_8	50% Bioplant® + 50% Areia lavada	BIO+AR
T_9	50% Esterco bovino + 50% Paú de buriti	EB+PBU
T_{10}	20% Areia lavada + 40% Paú de buriti + 40%Esterco bovino	AR+PBU+EB

* Abbreviation of treatments

The seeds were evaluated according to the following tests: Germination test - for each treatment, 100 seeds were used, which were divided into four subsamples of 25, using the following substrates: sand, vermiculite, bioplant, buriti wood, bovine manure , using 100% of each material and the mixtures of vermiculite + bioplant; sand + vermiculite and bioplant + sand (50% + 50%), in addition to sand (20%) + buriti wood (40%) + cattle manure (40%) in gerbox plastic boxes with dimensions of 11 cm x 11 cm x 3.5 cm in length, width, and depth respectively.

After distribution on the substrate, the seeds were placed in a Biochemical Oxygen Demand (B.O.D) germinator set at a constant temperature of 25°C and a photoperiod of 12 hours. Humidity was maintained through daily irrigation according to the retention capacity of the substrates. Counts of germinated seeds were performed daily from the 7th day when germination began until the 17th day after the start of the test, whose germination criterion was the epicotyl emission.

For the other tests, the procedure was as follows: First germination count - this test was carried out together with the twinning test, from the seven days when germination began. Germination speed index - for this test, daily counts of normal seedlings were performed, at the same time, from nine days when germination began to 17 days after the beginning of the test. The index was calculated according to the formula proposed by Maguire (1962), whose criterion used in the evaluations was that of normal seedlings, that is, those with perfect essential structures (Brasil, 2009). Length and dry mass of seedlings - after the final count of the germination test, the normal seedlings were removed from the substrate and measured, from the primary root to the shoot apex, with the aid of a ruler graduated in centimeters, with the results expressed in centimeters per seedling. Afterward, these seedlings were placed in brown Kraft paper bags and dried in an oven set at 65 °C for forty-eight hours. After this period, they were weighed on an analytical scale with a precision of 0.001g.

Statistical analysis was performed using the ASSISTAT program, Version 7.6 beta (2012), and means were compared using the Scott - Knott test at 5% probability.

3 RESULTS AND DISCUSSION

The germination percentage averages are shown in Table 2, and it is observed that there was a significant difference ($p<0.05$) between the treatments used. The highest means were reached in treatments T3, T6, T7, and T9. The T9 treatment reached 91% of germination at the end of 17 days, that is, the mixture of alternative substrates, bovine manure + buriti wood, was able to provide almost 100% of germination of the forest species C. fairchildiana. This result probably occurred because these substrates have a light texture that favors oxygenation and luminosity, and have the capacity to retain moisture, which is essential for the germination process to occur. In addition, these substrates appear as an alternative to seedling producers, in addition to providing a reduction in production costs for nurserymen. The promising results of mixing materials can be reinforced by the statements by Minami, (1995), when reporting that the substrate should provide favorable conditions for germination and seedling development (low density, high water retention capacity, freedom from contamination, low cost, adequate amounts of macro and micronutrients). However, these characteristics are rarely present in a single material, which is why mixtures of organic materials provide positive results.

Table 2. Germination (GERM), first count (PC) and germination speed index (IVG) of C. fairchildiana seeds submitted to different substrates.

Treatments	GERM	PC	IVG
	-----------------------%--------------------		
T_1	69 b*	11 e	1,46 c
T_2	75 b	10 e	1,47 c
T_3	81 a	14 d	1,70 b
T_4	67 b	20 b	1,37 c
T_5	77 b	11 e	1,48 c
T_6	88 a	25 a	1,77 b
T_7	87 a	19 b	1, 61c
T_8	61 b	20 b	1,32 c
T_9	91 a	17 c	2,03 a
T_{10}	69 b	15 d	1,45 c
CV (%)	10,7	7,7	12,1

*Means followed by the same letter in the column, do not differ from each other, at 5% probability using the Scott Knott test. T1-bovine manure; T2- vermiculite; T3-washed sand; T4-bioplant®; T5-buriti wood; T6-vermiculite + bioplant® (50% + 50%); T7- washed sand + vermiculite (50% + 50%); T8- bioplant® + washed sand (50% + 50%); T9- bovine manure + buriti wood (50% + 50%); T10- washed sand + buriti wood + cattle manure (20% + 40% + 40).

There was a significant difference ($p<0.05$) for the evaluation of the first germination count (Table 2), in which the highest mean was reached in substrate T6, followed by T4, T7 and T8. Studies carried out by Andrade et al. (1994), evaluating the germination of seeds of forest species under controlled conditions (B.O.D.) attribute this result to the high water retention capacity that vermiculite has. In general, for this evaluation of the first count carried out seven days after sowing, the percentages were low, however, they can be considered good, as normally seeds of forest species delay the beginning of the germination process. According to Alves et al. (2013), C. fairchildiana seeds need very specific conditions to express their maximum vigor, due to the initial energy expenditure required.

The T6 treatment, composed of vermiculite® + bioplant®, has desirable physical characteristics for the initial acceleration of germination. In general, commercial substrates are formulated with materials that favor seed germination, mainly in terms of moisture retention and porosity. However, its use does not indicate certainty in the efficiency of this process, which may vary from species to species.

The lowest averages for the first germination count (Table 2) were observed in treatments T1 (bovine manure) and T2 (vermiculite®). It is important to report that both for the total percentage of germination and for the percentage of germination in the first count, the best results were obtained with mixed substrates, demonstrating that their use in their original form may not be as efficient, and evidence that in the mixed substrates, the physical and chemical properties of the materials complement each other and can, therefore, provide better germination. However, the T3 treatment (washed sand) in the total percentage of germination, presented results statistically equivalent to those found in the mixed substrates.

Data referring to the germination speed index (GVI) of C. fairchildiana seeds submitted to different substrates are shown in Table 2, where it can be seen that, once again, the T9 treatment provided the highest mean (2.03) showing superior to other treatments in promoting germination. Treatments T3 and T6 showed intermediate means in this experiment. The results achieved for the germination speed index (GSI) in the present work differ from the results obtained by Alvino and Rayol (2007), where the highest average was reached when vermiculite was used in the germination of Ochroma pyramidale seeds (pau-de- ferry). Lopes and Pereira (2005) found higher mean values for the germination speed index (GVI) of cubiu seeds (Solanum sessiliflorum) when submitted to 25ºC on sand, and lower mean when the seeds were put to germinate in vermiculite under the same temperature conditions, 4.27 and 0.68, respectively.

In the literature there are studies with the use of substrates that provided better germination speed index (GVI) in forest species. Oliveira et al. (2008), found that at a temperature of 30°C and the paper substrate, in the form of a roll, the highest germination speed of seeds of Peltophorum dubium Spreng (Taubert) is achieved. In Amburana cearenses (Allemão) A. C. Smith seeds, the best results were found in sand and vermiculite substrates (Guedes et al., 2010); for seeds of Tabebuia serratifolia (Vahl) Nicholson, the highest average was reached in the sand substrate (Machado et al., 2002); in the germination test of Spilanthes oleracea seeds carried out by Honório et al. (2011), the authors recommended all substrates used in the test, except soil.

Similar to what happened in the previous variables, for the initial development of seedlings evaluated by length and dry mass (Table 3), there was a significant difference ($p<0.05$) between treatments. These qualitative parameters are excellent indicators of seedling quality, as they demonstrate greater vigor and indicate the best time for transplanting.

Regarding seedling length (Table 3), substrate T6 obtained the highest average (25.36), which can be explained by the fact that the mixture, vermiculite®+bioplant®, has adequate physical characteristics for root growth, such as aeration, luminosity and water retention, in addition to being substrates designed to provide quality for germination and initial growth of seedlings. Alves, et al. (2013) observed similar results for the species C. fairchildiana when germinated on paper towels at 25ºC (24, 07). The lowest averages were observed in substrates T1 (cattle manure) and T2 (vermiculite), demonstrating once again the low efficiency in using the substrate in its original form.

Table 3 shows the highest average dry mass of seedlings in treatment T2, that is, vermiculite enabled greater initial production of the dry mass of seedlings than the other substrates used. This result is attributed to all the physical properties already mentioned in this work for the vermiculite® substrate, which directly favors root and shoot growth.

Table 3. Length and dry mass of C. fairchildiana seedlings submitted to different substrates.

Treatments	Length (cm. plântula^{-1})	Dry mass (g. plântula^{-1})
T_1	11,54 e*	0,139 b
T_2	10,20 e	0,162 a
T_3	14,03 d	0,135 b
T_4	20,00 b	0,069 e
T_5	11,58 e	0,129 b
T_6	25,36 a	0,067 e
T_7	19,00 b	0,088 d
T_8	20,25 b	0,065 e
T_9	17,44 c	0,117 c
T_{10}	15,69 d	0,086 d
CV (%)	7,7	10,4

*Means followed by the same letter in the column, do not differ from each other, at 5% probability by the Scott-Knott test. T1- bovine manure; T2- vermiculite; T3-washed sand; T4-bioplant®; T5-buriti wood; T6-vermiculite + bioplant® (50% + 50%); T7- washed sand + vermiculite (50% + 50%); T8- bioplant® + washed sand (50% + 50%); T9- bovine manure + buriti wood (50% + 50%); T10- washed sand + buriti wood + cattle manure (20% + 40% + 40).

4 CONCLUSION

1. 1. The mixture of the alternative substrate, T9 (bovine manure + buriti wood), was able to promote a higher percentage of germination and a higher germination speed index (IVG), and can be used in the germination of C. fairchildiana seeds.
2. The use of substrates, bovine manure, and buriti wood in isolation (100%), was not efficient in the germination process.
3. The T6 treatment (vermiculite® + bioplant®) promoted greater initial germination, as well as greater seedling length.

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