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Germination of *Corymbia citriodora* on different substracts. Germinação de *Corymbia citriodora* em diferentes substratos.

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Resumo

O objetivo do presente trabalho foi avaliar a germinação de sementes de eucalipto limão (*Corymbia citriodora*) em diferentes substratos. Foram testados: 1) substrato comercial, 2) areia, 3) areia + fibra de coco (2:1), 4) fibra de coco, 5) substrato + fibra de coco (2:1), 6) areia + substrato (2:1) e a testemunha (papel germitest). Com base no experimento, observou-se que a germinação foi abaixo do esperado para a espécie, variando entre 57 e 74%, apesar de não haver diferença significativa entre os tratamentos quanto a este parâmetro. Os tratamentos que levaram a uma maior velocidade de germinação foram a testemunha (papel germitest), seguido pelo substrato comercial, fibra de coco, areia + substrato e substrato + fibra, sem diferença significativa, indicando ser os melhores para a germinação das sementes de *C. citriodora*. O substrato a base de fibra de coco é promissor, pois pode ser considerado um substrato alternativo e de baixo custo.
Palavras-chave: Eucalipto limão. Germinação de sementes. Substratos alternativos. Testes *in vitro*.

Abstract

The objective of the present work was to evaluate the germination of lemon-scented gum (*Corymbia citriodora*) on different substrates. The following were tested: 1) commercial substrate, 2) sand, 3) sand + coconut fiber (2: 1), 4) coconut fiber, 5) substrate + coconut fiber (2: 1), 6) sand + substrate (2: 1) and the control treatment (germitest paper). Based on the experiment, it was observed that germination varied between 57 and 74%, although there was no significant difference between treatments. The treatments that led to a higher germination speed were the control (germitest paper), followed by the commercial substrate, coconut fiber, sand + substrate and substrate + fiber, with no significant difference, indicating that they are the best for the germination of *C. citriodora* seeds. The substrate based on coconut fiber is promising, as it can be considered an alternative and low-cost substrate.
Keywords: Alternative substrates. *In vitro* tests. Lemon-scented gum. Seed germination.

Introduction

Corymbia citriodora (Hook.) K.D. Hill and L.A.S. Johnson, belonging to the Myrtaceae family, is a medium to large tree species, reaching 25 to 50 m in height and 1.2 m in diameter at breast height, and occupying a prominent place in the segment of aromatic plants (BOLAND et al., 1991). Its taxonomy has been the subject of controversy, and it was previously classified as *Eucalyptus*. *C. citriodora* is composed of two subspecies: *C. citriodora* subsp. *citriodora* and *C. citriodora* subsp. *variegata* (HILL; JOHNSON, 1995).

Originating in Australia, *C. citriodora* stands out for its economic value in the production of wood for various purposes, such as in the manufacture of furniture, firewood and charcoal. It is highly sought-after in light and heavy civil construction, in addition to presenting medicinal properties (CUNHA et al., 2019). The tree species is cultivated in more than 90 countries (CABI, 2015).

Eucalyptus species are the most planted trees in Brazil, has and they cover a current area of approximately 6.97 million hectares (IBÁ, 2020). Recent data on the area cultivated with *C. citriodora* in Brazil have not been accessed, but according to Kronka et al. (2002) it was around 85,000 ha, with greater concentration in the states of Minas Gerais and São Paulo.

The essential oil is found mostly in its leaves. The product of the distillation of leaves of *C. citriodora*, with an extremely pleasant odor and known as citronellal or as citronella, is an input of great demand in the market. It is part of the composition of products such as flavorings, soaps, toothpastes, detergents, candies, perfumes, deodorants, disinfectants, waxes, sachets and insecticides, etc. (BOLAND et al., 1991).

C. citriodora is known as lemon-scented gum, citron-scent gum, lemon gum tree or spotted gum. Its cultivation grows in Brazil, due to its characteristics of fast growth and edaphoclimatic adaptation, in addition to the silvicultural characteristics and the quality of its wood. These are other interesting features: good tolerance to pests and diseases (MORAIS et al., 2010), wood that can be applied for civil construction (NOGUEIRA et al., 2021) and calorific value acceptable for energy production (MARCHESAN et al., 2020).

Despite their widespread use, species of the genus *Corymbia* are considered difficult to propagate. With the exception of *C. torelliana*, for which rooting is viable, the other species are difficult to root. Rooting levels are usually below 5%, which has prevented its use in clonal propagation programs. In this way, *C. citriodora* commercial plantations have traditionally been established through seeds (SMITH et al., 2007; REIS et al., 2013). Recent studies showed that *C. citriodora* present genotypes adapted to different soil textures and the low additive genetic variance can limit the development of breeding populations (SOUZA et al., 2020).

According to Pierret and Moran (2011), the substrate is the medium that provides the support for the roots to proliferate. It is, therefore, on the substrate that the initial growth of the seedling will depend, since the root is the connection between it and the aerial part, which will develop in function of its physical, chemical and biological properties, since the conditions of humidity, temperature, light and wind are not limiting. Besides, the choice of substrate can also impact the cost of seedling production (CANTLIFFE, 1993).

Some works have already been carried out in order to verify the most suitable substrate for the production of *C. citriodora* seedlings. Steffen et al. (2011) studied the use of vermicompost as a substrate in the production of *E. grandis* and *C. citriodora* seedlings. Oliveira and co-workers (2014) evaluated the rice husk and coconut fiber. Later, Lopes et al. (2015) evaluated different formulations based on commercial substrate, sugarcane bagasse and coal dust. Ferreira and co-workers (2020) also studied the use of vermicompost and coconut fiber as a sustainable substrate in the production of seedlings of this plant. However, among these works accessed, the only one that evaluated the influence of the substrate on seed germination was that of Ferreira et al. (2020).

Given this context, the present study aimed to evaluate the effect of different substrates on the germination of *Corymbia citriodora* seeds.

Materials and methods

The study was conducted in the Federal District, central Brazil (15.58 ºS, 47.73 ºW), consisting of the Cerrado biome, during the month of September 2020. According to the Köppen classification, the location has a Tropical seasonal climate of megathermic savannah, with an average annual precipitation of 1,400 mm (CARDOSO et al., 2014).

The *Corymbia citriodora* seeds were donated by the IPEF (Forestry Research and Studies Institute). The crop identified by the donor is from 2018 and comes from Rio das Pedras - SP, from an ACS-AS (Altered Seed Collection Area - F1).

In the experiment, seven treatments were evaluated: T1 - Commercial substrate; T2 - Sand; T3 – Sand: coconut fiber (2: 1); T4 - Coconut fiber; T5 - Coconut fiber: substrate (2: 1); T6 – Sand: Substrate (2: 1) and T7 - Control (Germitest paper).

In each gerbox (11 x 11 x 3.5 cm) containing the treatments, 20 seeds were deposited, which were kept at room temperature (24-25 ºC) and light. As the seeds lost moisture, they were moistened. The readings of the experiment took place daily, where the number of seeds that germinated each day was recorded.

The design used was the Completely Randomized Design (CRD) with four replications, composed of 20 seeds each, including the seven treatments mentioned. Based on the germination data, the average germination time (1), the germination speed (2) and the germination index (3) were calculated using the following equations (SANTANA; RANAL, 2004):

- $T = \frac{\sum(fi * xi)}{\sum fi}$ (days) average germination time (1)
- $V = \frac{1}{T}$ (days^{-1}) germination speed (2)
- Germination index (%) = $\frac{germinated\ seeds}{total\ number\ of\ seeds} * 100$ (3)

Where f_i = number of seeds germinated on the i-th day; and x_i = number of days counted from seeding to the day of reading.

The test data were subjected to analysis of variance (ANOVA), using the SISVAR 5.6 program (FERREIRA, 2014). The mean values of the germination and length parameters were compared using the Tukey test, at 5% probability.

Results

Based on the statistical analysis of the results, it was observed that the treatment that took least time to germinate was the one that used the germitest paper (control), followed by the commercial substrate, sand, sand + substrate (2: 1) and substrate + fiber (2: 1), with no significant difference between them (Figure 1). The treatments fiber and sand + fiber (2: 1) did not differ, with the longest germination times.

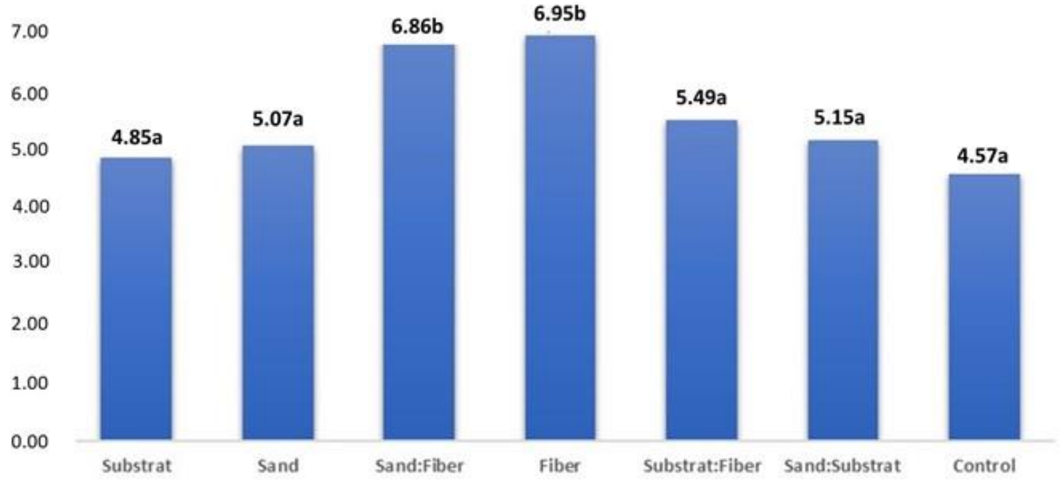

Figure 1 – Average germination time in days (Axis y) of *Corymbia citriodora* seeds on different substrates (Axis x). Means followed by the same letter do not differ statistically by the Tukey test (P <0.05).

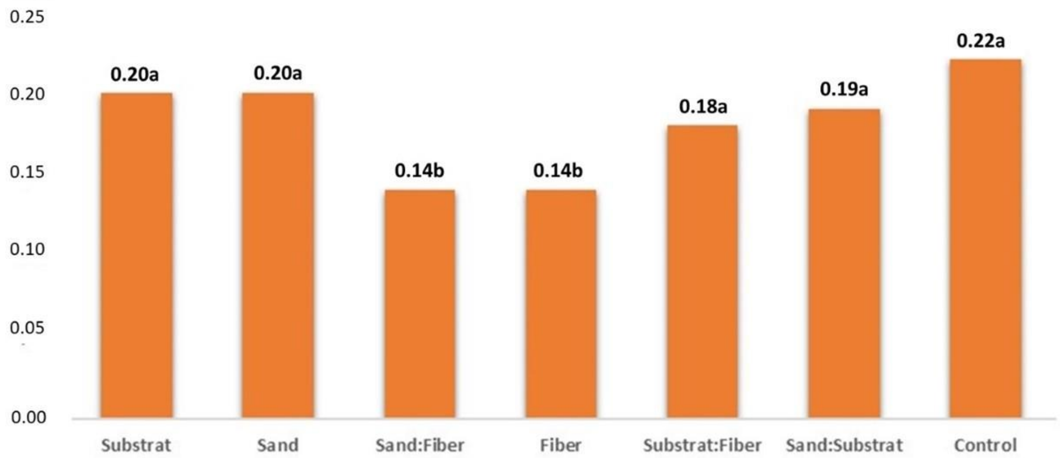

Figure 2 – Germination speed in days^{-1} (Axis y) of *Corymbia citriodora* seeds on different substrates (Axis x). Means followed by the same letter do not differ statistically by the Tukey test (P <0.05).

Regarding the germination speed, which is the inverse of time, it is observed that the highest speed was precisely with the germitest paper (control treatment), followed by the commercial substrate, sand, sand + substrate (2: 1) and substrate + fiber (2: 1), also without significant difference. Following the same reasoning, the substrates on which the seeds germinated most slowly were sand + fiber (2: 1) and pure fiber (Figure 2).

The germination index was below what is expected for the species, and it was observed here at 57 to 74% (Figure 3).

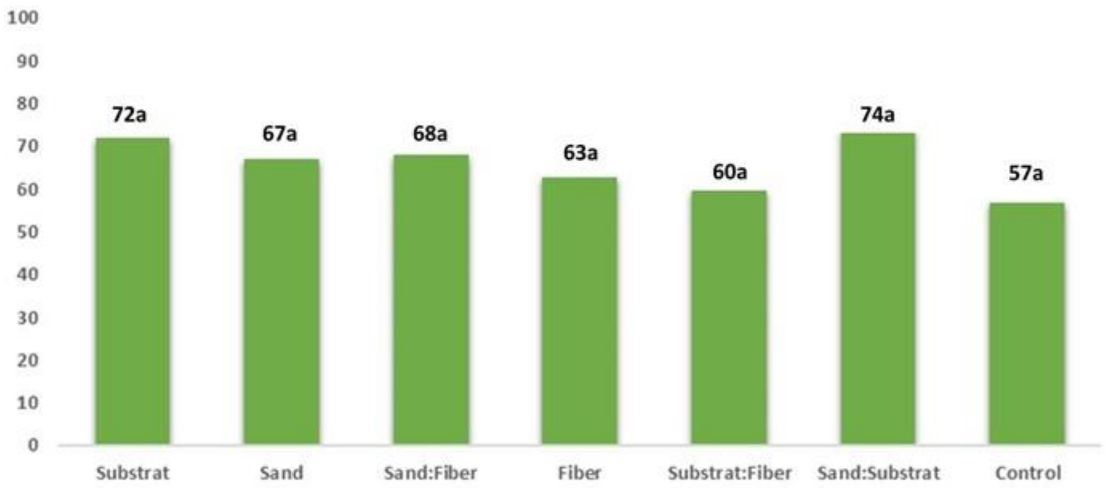

Figure 3 – Germination index (Axis y) of *Corymbia citriodora* seeds on different substrates (Axis x). Means followed by the same letter do not differ statistically by the Tukey test ($P < 0.05$).

The appearance of fungi was observed in all treatments, but mainly on paper and coconut fiber. Although not quantified, the genera observed were: *Alternaria* sp., *Aspergillus* sp., *Fusarium* sp. and *Rhizopus* sp.

Discussion

According to Ferreira and co-workers (2020), treatments with a lower proportion of coconut fiber (75% coconut fiber + 25% vermicompost and 65% coconut fiber + 35% vermicompost) germinated faster, on the fourth day; those with 85% coconut fiber + 15% vermicompost and only commercial substrate germinated on the fifth day, corroborating the results of the present study.

In the current study, low seed germination was observed (< 74%). According to Reis et al. (2013) the average germination of *C. citriodora* is 86%. The treatment in which less germination was observed was that of germitest paper, followed by substrate + fiber, sand, fiber, substrate + fiber and lastly the one with the highest index was sand + substrate, although they did not differ significantly. In a study by Ferreira et al. (2020) substrates with different proportions of vermiculite and substrate, germination was 100%.

The appearance of fungi was observed in all treatments, but mainly on paper (control treatment) and coconut fiber. Fungi may have affected germination. For the present experiment, no superficial disinfestation of the seeds was carried out, nor the sterilization of the substrates, since the intention was to simulate natural sowing conditions. Fungi can originate from the seed itself, since they also appeared in the control treatment (germitest paper). According to Santos et al. (2000), these fungi mentioned are common in the seeds of forest species, such as eucalyptus.

It is worth mentioning that the choice of substrate will be of fundamental importance in the production of seedlings, even interfering in their production cost (CANTLIFFE, 1993). In the germination speed, substrate + coconut fiber (2: 1) also stood out, which can be considered low-cost mixture. The same was observed by Oliveira et al. (2014), where a lower proportion of coconut fiber also stood out in the production of *C. citriodora* seedlings. Following the same reasoning, Ferreira et al. (2020) highlight that the alternative substrate for seedling production, composed of coconut fiber and vermicompost, was the most promising. Thus, in addition to being a good alternative for seedling production, it was also observed here that the coconut fiber substrate mixture is interesting for a better germination of this seed species.

Conclusions

It is concluded that the treatments that stood out with the highest germination speed were commercial substrate, sand, sand + substrate (2: 1) and substrate + fiber (2: 1). The substrate based on coconut fiber is promising, as it can be considered an alternative and low-cost substrate. Knowledge about the best substrate for the germination of *Corymbia citriodora* seeds can contribute significantly to the improvement of seedling production of this species.

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