Diversitas Journal

ISSN 2525-5215
DOI: 10.17648/diversitas-journal-v6i1-1186

Volume 6, Número 1 (jan./mar. 2021) pp: 89-98.
https://periodicos.ifal.edu.br/diversitas_journal/

Efficiency of cinnamon extract (*Cinnamomum zeylanicum* Blume) in the treatment of seeds of braúna (*Schinopsis brasiliensis* Engl.)

Eficiência do extrato de canela (*Cinnamomum zeylanicum* Blume) no tratamento de sementes de braúna (*Schinopsis brasiliensis* Engl.)

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Recebido em: 19 de abril de 2020; Aceito em: 21 de janeiro de 2021; publicado em 31 de 01 de 2021. Copyright© Autor, 2021.

ABTRACT: For decades, chemical products have shown efficiency in inhibiting pathogens associated with forest seeds, but due to the high cost and environmental impact caused by it, research to find more viable and sustainable alternatives has been Held. The objective of this work was to evaluate the efficiency of *Cinnamomum zeylanicum* Blume extract in the treatment of seeds of *Schinopsis brasiliensis* Engl. And to indicate the use of plant extracts as an alternative for the control of pathogens associated with Forest seeds. For the sanity test, 500 seeds collected in 2010 and 500 seeds collected in the year 2014 submitted to treatments with cinnamon extract were used in the following concentrations: T1: solution containing 100% sterile water (control); T2: Solution containing 25% of cinnamon extract and 75% of sterile water; T3: Solution containing 50% cinnamon extract and 50% of sterile water; T4: Solution containing 75% of cinnamon extract and 25% of sterile water; T5: Solution containing 100% of cinnamon extract. The health test lasted 10 days and after this period, the pathogen was evaluated, associated with the seeds of *S. Brasiliensis*, through the observations of the fungal structures through a stereoscopic and optic microscope, and the help of the literature Specialized. The means were analyzed by the Tukey test at the level of 5% probability and the percentage values for the purposes of statistical analysis were transformed into arcsen$\sqrt{x}/100$.The treatment with solution containing 100% of cinnamon extract presented as the most efficient being the most suitable for the inhibition of pathogens associated with the forest seeds. Considering the results, we recommend the advancement of researches around the use of plant extracts as a solution for the treatment of forest seeds so that it becomes a viable alternative in the forestry sector.
KEYWORDS: seeds, pathogens.

RESUMO: Por décadas, os produtos químicos têm apresentado eficiência na inibição de patógenos associados às sementes florestais, mas devido ao alto custo e impacto ambiental causados pelo mesmo, pesquisas a fim de encontrar alternativas mais viáveis e sustentáveis tem se realizado. O presente trabalho teve como objetivo avaliar a eficiência do extrato de *Cinnamomum zeylanicum* Blume no tratamento de sementes de *Schinopsis brasiliensis* Engl. e indicar o uso de extratos vegetais como uma alternativa para o controle de patógenos associados às sementes florestais. Para o teste de sanidade, foram utilizadas 500 sementes coletadas no ano de 2010 e 500 sementes coletados no ano de 2014 submetidas aos tratamentos com extrato de canela nas seguintes concentrações: : T1: solução contendo 100% água estéril (Testemunha); T2: solução contendo 25% de extrato de canela e 75% de água estéril; T3: solução contendo 50% extrato de canela e 50% de água estéril; T4: solução contendo 75% de extrato de canela e 25% de água estéril; T5: solução contendo 100% de extrato de canela. O teste de sanidade teve duração de 10 dias e após esse período realizou-se a avaliação dos patógenos associados as sementes de *S. brasiliensiss* por meio das observações das estruturas fúngicas através de microscópio estereoscópico e ótico, e auxilio da literatura especializada. O tratamento com solução contendo 100% de extrato de canela apresentou-se como o mais eficiente sendo o mais indicado para a inibição de patógenos associados às sementes florestais. Considerando os resultados, é recomendável o avanço de pesquisas em torno do uso de extratos vegetais como solução para o tratamento de sementes florestais de modo que se torne uma alternativa viável no ramo da silvicultura.
PALAVRAS-CHAVE: sementes, patógenos.

INTRODUCTION

The growing demand for seeds of native forest species in order to recover degraded areas as well as for the installation of commercial areas, requires each day, a greater supply of seeds. In recent years, the interest in the propagation of native forest species has intensified due mainly to environmental problems resulting from inadequate exploitation without forest management.

The use of chemicals, despite the high cost and risks to the environment and to those who handle it, has been the most frequently used method in plant health control of seeds, because in addition to presenting an immediate response, it does not require the Knowledge of the biology of the pathogen involved. CAMPANHOLA; BETIOL, 2003).

Treatments based on plant extracts may eventually constitute an alternative for the control of pathogens associated with seeds, with advantage reducing the expenditures for the producer and reduction of environmental impact caused by the chemical products (COUTINHO et al.,1999).

Schinopsis brasiliensis Engler belongs to the family Anacardiaceae, popularly known as (Braúna or Baraúna) is native species of the Caatinga biome, is distributed in almost all areas of this biome, is secondary species and reaches height of 10-20 m (LORENZI, 2014), and presents ornamental potential, (CALVACANTE et al., 2017). Its wood has several utilities, for example, the manufacture of slats, caibros, lines, Beams (MAIA, 2004).

The production of seedlings of forest species has become fundamental both for the recomposition of these unduly exploited areas, as well as for the development of the forestry sector. However, this production faces a number of difficulties, since several factors can compromise it, among them, the factor of sanitary and physiological origin due to the high incidence of fungi associated with seeds and consequently in the resulting seedlings (SILVA, et al., 2013).

Factors such as collection time, processing and adequate storage determine the quality of seeds, these when not considered increase their susceptibility to attacks by pathogens (COSTA et al., 2019). According to Oliveira (2012) seeds can suffer damage before germination, and after the germination process when already in the seedling

phase, such attacks can result in vital damage and thus decrease the quality and production of seedlings.

This is because the association of phytopathogens with seeds is considered the main potential route for transmission and possible establishment of diseases in forest seedlings, and consequently, dissemination in the field if these pathogens meet conditions that allow their development (MARINO et al., 2008).The sanitary control of seeds through secondary products by chemical products and/or plant extracts has become increasingly usual (ARAÚJO et al., 2019; BRESSAN et al., 2018; FANTINEL et al 2017; FONSECA et al., 2014; MEDEIROS et al., 2013).

In laboratories, synthetic products are usually used in the control of pathogens associated with seeds, however in many cases the sanitary control performed exposes the technician or researcher to chemical substances, in addition to the costly costs thereof. Alternatives that lead to an increasingly ecological production is essential for ensuring an increasingly sustainable environment.

Thus, this research aimed to evaluate the efficiency of cinnamon extract (*Cynamomum zeylanicum* Blume) in the treatment of pathogens associated with the seeds of Braúna (*Schinopsis brasiliensis* Engl.) collected in two different eras.

MATERIAL AND METHODS

The present research was conducted in April 2015 at the Laboratory of Forest Pathology, of the academic unit of forestry engineering, of the Federal University of Campina Grande, Campus Patos-PB.

The seeds of *Schinopsis brasiliensis* Engl. Were collected in the years 2010 and 2014 in the city of São João do Cariri-PB and stored at room temperature (27 ± 2 °C).

The sanity test was performed using the filter paper method "Blotter Test" and 500 seeds collected in the year 2010 and other 500 seeds collected in the year of 2014 were used, which underwent a pre-selection, with the objective of selecting the Seeds free from visible damage to the naked eye.

Five treatments with different percentages of cinnamon extract were used to evaluate the reduction of the incidence of fungi in the seeds of *S. brasiliensis*: T1: Solution

containing 100% sterile water (control); T2: Solution containing 25% of cinnamon extract and 75% of sterile water; T3: Solution containing 50% cinnamon extract and 50% of sterile water; T4: Solution containing 75% of cinnamon extract and 25% of sterile water; T5: Solution containing 100% of cinnamon extract.

The extract used was prepared at the Animal Nutrition Laboratory of the academic unit of veterinary Medicine of the Federal University of Campina Grande, Campus Patos – PB. In order to obtain the extract of *Cinnamomum zeylanicum* Blume, 1000 grams of dry cinnamon submitted to drying in a greenhouse during 48 hours were used to remove the maximum moisture.

The hydroalcoholic extract, where the solution presents 70% of water and 30% of cereal alcohol, was prepared in proportion 1:4 in a plastic container where 250 grams of cinnamon in a stick were used for 1 liter of solution consisting of 700 mL of distilled water and 300 mL of alkali Cereal ol. The container was wrapped with aluminum foil to avoid luminosity and stored at room temperature for 72 hours. Then, the material was subjected to simple filtration, using a filter paper, tube and pipette, obtaining 720 mL of pure cinnamon extract.

The seeds of each treatment remained submerged in each solution for one minute and soon after they were plated and taken to the fungus incubation chamber at ambient temperature of 27 ± 2 ºC.

The health test lasted 10 days and after this period, the pathogen was evaluated, associated with the seeds of *S. Brasiliensis*, through the observations of the fungal structures through a stereoscopic and optic microscope, and the help of the literature Expert (BARNETT; UNTER, 1992).

The statistical design used was completely randomized (DIC) in a 2 x 5 factorial scheme, with two levels of factor A (collection Time 2010 and 2014) and five levels in factor B (control and four concentrations of extract). The averages were analyzed by the Tukey test at 5% probability level and the percentage values for statistical analysis were transformed into Arcsen $\sqrt{x/100}$.

RESULTS AND DISCUSSIONS

Table 1. Table 1 shows the results for the fungi microflora associated with S. *brasiliensis* seeds collected treated with Cinnamomum zeylanicum Blume extract.

Incidence of fungi associated with forest seeds (%)

Species	Treatments				
	T1=Witness	T2	T3	T4	T5
Aspergillus flavus sp.	15	3	12	3	0
Aspergillus glaucous sp	13	8	4	10	2
Aspergillus niger sp.	74	75	88	83	68
Curvularia sp.	4	0	0	0	0
Nigrospora sp.	0	2	0	0	2

The microflora found associated with the seeds of *S. brasiliensis* collected in 2010 is composed of fungi of the genus *Aspergillus* and the *A. niger* occurred in a higher incidence, followed by a fungus of the genus *A. flavus* and *A. glaucous*. Other genera such as *Curvularia* and Niger were also found, but in lower incidence.

The same genera were found by Araújo (2019) when evaluating the sanitary quality of seeds of *Chorisia glaziovii*, with plant extracts, where fungi of the genera *Aspergillus* sp., *Aspergillus flavus*, *Cladosporium sp*, *Curvularia*, *Fusarium*, *Niger* and *Rhizopus*.

Fungi of the genus *Aspergillus* are commonly found in research with forest seeds, because according to Silva (2003), fungi of the genus *Aspergillus* sp., and *Penicillium* sp. are considered storage fungi and their incidence may increase According to the storage period and conditions.

None of the concentrations of cinnamon extract were able to reduce the incidence of *A. niger* in Braúna seeds. Carli (2010) assumes that the aqueous extract of cinnamon has no expected effect due to the low concentration of essential oil and according to Matias et al. (2014) found that some factors such as harvesting, beneficiation and adequate storage affect the quality of the seeds. These factors susceptibilize the seeds to the attack of pathogens, affecting longevity and even in the deterioration of propagative material (VICENTE et al., 2016). Different results were obtained in a research conducted by Gomes (2013), in which the treatments with

cinnamon and basil oils were efficient in the control of *Aspergillus niger* and in reducing the incidence of *Rhizopus* sp. in Seeds of *Bauhinia variegata* recently collected. Table 2 shows the results for the fungi microflora associated with *S. brasiliensis* seeds…discutir aqui o 'achado' com outros trabalhos…

Table 2. Percentage of the incidence of fungi by genera and species by treatment in seeds collected in the year 2014.

Incidence of fungi associated with forest seeds (%)

Species	Treatments				
	T1	T2	T3	T4	T5
Aspergillus alutaceous	15	3	12	3	0
Aspergillus candidus	13	8	4	10	2
Aspergillus flavus	74	75	88	83	68
Bipolaris sp.	1	2	0	0	0
Colletotrichum sp.	4	0	0	0	0
Trichoderma sp.	0	2	0	0	2

The microflora associated with the seeds of *S. brasiliensis* collected in 2014 is composed of fungi of the genus *Aspergillus*, being found in a higher incidence and variety of species, being the *A. flavus* (of higher occurrence, followed by *A. candidus and A . alutaceous.*

It is possible to perceive that both for the seeds of *S. brasiliensis* collected in 2010 and for the seeds collected in 2014, the *A. niger* presented in all treatments. The genus *Aspergillus* is often found in stored grains and seeds and develops well where the water content is in equilibrium with relative humidities between 65-90%, corresponding to 13-14% moist bulb (b. u) and adapt in environments with low humidity Relative and rarely attack products with a moisture content greater than 25% B.U., it is noteworthy that species of the genera *Aspergillus* sp. and *Penicillium* sp. are among the main agents deteriorators of seeds (SOUSA et al., 2012).

Santos et al. (1997), when performing the seed sanity test of *Dipteryx alata* (Baru) detected fungi of the genera *Aspergillus* sp.; *A. niger; A. flavus;.; Penicillium* sp.; *Phomopsis* sp.; *Chaetomium* sp.; *Fusarium oxysporum*; *Fusarium* sp.; *Rhizopus* sp.; *Pestalotia* sp.; and *Trichoderma* sp.

In the seeds collected in the year 2010 and 2014, both witnesses (T1) presented the highest indices of diversity and richness of the observed genera. Similar results were found by Leite et al. (2012) who, working with seeds of Sabiá (*Mimosa caesalpiniaefolia*), observed a higher incidence of fungi in the germination of seeds treated with the control (T1), but treatments with oil of Sweet Herb, São Caetano melon and Allamanda extracts reduced the incidence of fungi of the genus *Aspergillus* sp., *Penicillium* sp, *Rhizopus* sp and *Pestalotia* sp. In this way, treatments with plant extracts become a viable alternative for the control of Incidence of fungi associated with forest seeds.

In the analysis of variance of the interaction between all fungi genera found in common in the seeds collected in 2010 and 2014, in order to observe significance (5%) between the means, it was possible to evaluate the interaction only for A. niger, since there was a significant difference for this fungus. By statistical analysis, it was found that there was a significant difference in the interaction between the two seed collection times (2010 and 2014).

Table 3. Means in percentage of the incidence of fungi of the genus A. niger in seeds collected in 2010 and 2014 submitted to different concentrations of cinnamon extract

Collection Time	Extracts (%)				
	0	25	50	75	100
2010	74 **aA**	75 **aA**	88 **aA**	83 **aA**	68 **aA**
2014	83 **aA**	91 **aA**	82 **aA**	31**bB**	65 **aA**

* Averages followed by the same lowercase letter in the column and capitalized in the line, do not differ from each other by the Tukey test, at a significance level of 5% (P > 0.05)

From the analysis of the means in Table 3, it can be observed that there was a significant difference between the seeds collected in 2010 and 2014 in T4 (75%) to A. niger. In relation to the other concentrations, there was no significant difference between the seeds collected in 2010 and 2014.

CONCLUSIONS

Treatment 4 was the most efficient in the inhibition of *A. niger* for the seeds collected in 2014, while treatment 5 proved to be more effective, in a general way, in relation to the different fungi genera. Treatment 2 was ineffective for the two years of collection.

It is recommended the study of essences oils in the treatment of forest seeds in order to find efficient results for the objective of the research, since the plant extracts indicate an efficiency for the inhibition of pathogens, in addition to presenting lower Cost and environmental impact thus being a sustainable and effective option for the forestry sector.

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