PHYSICAL AND PHYSIOLOGICAL ATTRIBUTES OF NATIVE FOREST SEEDS AND THEIR INFLUENCE ON DIRECT SEEDING FOR RESTORATION OF CILIARY FOREST

Janisson Batista de Jesus[1*], Robério Anastácio Ferreira[2], Dráuzio Correia Gama[3], Maria Fernanda Oliveira Torres[4]

[1]*Universidade Federal do Rio Grande do Sul, Doutorando pelo Programa de Pós-Graduação em Sensoriamento Remoto, Porto Alegre, Rio Grande do Sul, Brasil – janisson.eng@gmail.com*
[2] Universidade Federal de Sergipe, Departamento de Ciências Florestais, São Cristóvão, Sergipe, Brasil - roberioaf@yahoo.com.br
[3] Universidade Estadual do Sudoeste da Bahia, Mestrando pelo Programa de Pós-Graduação em Ciências Florestais, Vitória da Conquista, Bahia, Brasil - drauziogama@hotmail.com
[4] Universidade Federal de Sergipe, Doutoranda pelo Programa de Pós-Graduação em Agricultura e Biodiversidade, São Cristóvão, Sergipe, Brasil - nandatorres7@gmail.com

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Resumo

Atributos físicos e fisiológicos de sementes florestais nativas e sua influência na semeadura direta para restauração de mata ciliar. O conhecimento da relação entre as características físicas e fisiológicas das sementes florestais é essencial para o sucesso dos projetos de recuperação das matas ciliares. Sendo assim, o trabalho foi realizado com o objetivo de analisar parâmetros físicos e fisiológicos de sementes de espécies florestais, para o uso na restauração de matas ciliares por meio de semeadura direta. Foram realizadas avaliações da qualidade física (teor de água, massa específica, peso de mil sementes e número de sementes por quilograma), morfométricas (comprimento, largura e espessura) e fisiológica em laboratório (viabilidade) de *Cassia grandis* L.f., *Enterolobium contortisiliquum* (Vell.) Morong., *Guazuma ulmifolia* Lam. e *Libidibia ferrea* var. *leiostachya* (Benth.) L.P.Queiroz. O experimento em campo foi implantado em Delineamento em Blocos Casualizados (DBC) com quatro blocos, testando-se as sementes tratadas para superação de dormência de quatro espécies. A semeadura direta foi realizada em 10 linhas de plantio, cada uma composta de 10 covas (30 x 30 x 30 cm), em espaçamento 2,0 x 1,0 m. Sementes de *E. contortisiliquum* apesar de terem os maiores valores para as características físicas e morfométricas e ter alto percentual de germinação, foi a espécie de menor percentual de emergência em campo, ficando abaixo de *G. ulmifolia* que tem sementes de menores tamanho e peso, e *L. ferrea* var. *leiostachya* que, mesmo tendo baixa germinação, foi a segunda de maior percentual de emergência. O estudo permitiu observar que não houve uma relação direta entre os atributos físicos e fisiológicos das sementes florestais e sua capacidade de emergência.
Palavras-chave: Espécies arbóreas; Qualidade de sementes; Germinação; Emergência em Campo Mata Ciliar.

Abstract

Knowing the relationship between the physical and physiological characteristics of native forest seeds is essential for the successful recovery of riparian forests. Thus, the work was carried out to analyze the physical and physiological parameters of seeds of native forest species for use in the recovery of riparian forests by direct seeding. Were evaluated the physical quality (water content, mass, the weight of one thousand seeds, and the number of seeds per kilogram), morphometric characteristics (length, width, and thickness), and physiological quality in the laboratory (viability) of *Cassia grandis* L.f., *Enterolobium contortisiliquum* (Vell.) Morong., *Guazuma ulmifolia* Lam., and *Libidibia ferrea* var. *leiostachya* (Benth.) LPQueiroz. The experiment in the field was implanted in a randomized block design (RBD) with four blocks, testing seeds treated to overcome the four species dormancy. The direct sowing was in 10 planting lines, each composed of 10 pits (30 x 30 x 30 cm), spaced 2.0 x 1.0 m. *E. contortisiliquum* seeds, despite having the highest values for physical and morphometric characteristics, and having a high percentage of germination, was the species with the lowest percentage of emergence in the field, being below *G. ulmifolia*, which has seeds of smaller size and weight, and *L. ferrea* var. *leiostachya* which, despite having low germination, was the second with the highest percentage of emergence. The study allowed us to observe that there was no direct relationship between the physical and physiological attributes of forest seeds and their ability to emerge.
Keywords: Tree species; Seed Quality; Germination; Field Emergence Riparian Forest.

INTRODUCTION

The germination of a seed is the result of metabolic processes, initiated from a greater intensification of the respiratory activity, resulting from the absorption of water, which degrades the reserve substances generating the consequent production of compounds rich in energy that allow the growth of the embryonic axis

(CARVALHO; NAKAGAWA, 2012), therefore, physiological studies are fundamental for understanding this process in different forest species, both in laboratory conditions and in fieldwork.

In Brazil, seed tests, such as the viability for plant species evaluation, occur according to the Seed Analysis Rules (BRASIL, 2009) and Instructions for Analysis of Forest Species Seeds (BRASIL, 2013) recommendations. Besides being fundamental to the physiological potential of the seed's knowledge, these analyzes offer information about the viability and vigor of the vegetative material analyzed (SILVA *et al*., 2014). It is also essential to obtain data on the external characteristics of seeds, such as shape, dimensions, and color, which are relevant factors that can assist in the propagation of different plant species (FLORES *et al*., 2014).

Because of the high need for degraded environments recovery, verified by the increase of these activities in natural ecosystems (SILVA *et al*., 2015), it is essential to understand the factors that interfere in the emergency process in the field, as fundamental for the successful use of sowing direct, as this is a technique widely applied for this purpose, especially when the objective is to reduce costs since it eliminates the entire seedling production phase in a nursery (SANTOS *et al*., 2012).

Therefore, the comparison of data in controlled laboratory conditions with field experiments is necessary, serving as a basis for forest restoration/restoration activities since, in the field, the conditions in which the seeds are in the soil are not always optimal for the emergency. In this sense, studies related to the germinative responses of seeds in artificial conditions should be carried out, making it possible to obtain information on the species ecophysiology and, still, as tools to evaluate the limits of tolerance of survival and adaptation of these species to the conditions of natural stresses (GUEDES *et al.*, 2013).

Considering the reported aspects, this work was carried out to analyze the physical, morphometric, and physiological parameters of seeds of native forest species (*Cassia grandis* Lf, *Enterolobium contortisiliquum* (Vell.) Morong., *Guazuma ulmifolia* Lam. and *Libidibia ferrea* var. *leiostachya* (Benth.) LPQueiroz.) compared to the response via direct seeding for use in the recovery of riparian forests.

MATERIAL AND METHODS

The choice of these species was defined based on their natural occurrence in the riparian forests of the region and reconciliation with the availability of seeds in the cold chamber of the Federal University of Sergipe (UFS)'s Department of Forest Sciences.

The fruits of each species were harvested in the municipalities that make up the Piauitinga River Basin (Lagarto, Salgado, Boquim, and Estância/Sergipe), and in other cities in the state of Sergipe (SE), where these plants occur naturally. The collections were carried out, in 2011, directly in different mother trees previously selected, respecting the minimum distance of 50 m as indicated by Bianchetti (1999). Subsequently, we transported the fruits to the Forest Nursery of the Federal University of Sergipe, where they were dried in the shade and processed. Then, we separated the seeds into lots, composed of different matrices, which were packed in transparent waterproof plastic bags, labeled and stored since 2011, in a cold chamber at the Department of Forest Sciences-UFS, at a temperature of 6-9 ºC and 60 -65% relative air humidity, where they remained until the time of use in this study.

Evaluation of physical and morphometric characteristics of seeds

For the evaluation of the physical quality of the seeds, the morphometry of 100 seeds of each species of the same batch was initially performed, with the aid of a digital caliper (0.01 mm) of the brand Digimess YT202, obtaining values of length, width, and thickness (mm). Also, evaluations of a specific mass, weight of a thousand seeds, and the number of seeds per kilogram (kg) were carried out using a precision 120 g analytical balance with a 0.0001 g BEL brand resolution and calculated according to the recommendations of the Seed Analysis Rules (BRASIL, 2009).

The humidity degree of the seeds of the selected species, using four repetitions of 25 seeds, which were placed in aluminum capsules, weighed, and then dried in an oven at 105 ± 2 ° C, for 24 h. The humidity calculation was performed according to Brasil (2009) through the expression:

$$U\ (\%) = 100.(P - p)/(P - t)$$

Where:
P: initial weight - the weight of the container and its lid, plus the weight of the moist seed;
P: final weight - the weight of the container and its lid, plus the weight of the moist seed;
t: tare - the weight of the container with its lid.

Treatments to overcome dormancy

The species used show integumentary dormancy, and thus, treatment was used to facilitate water absorption and provide maximum germination. Thus, all species were subjected to chemical scarification through concentrated sulfuric acid (PA 95-98%), each with a specific immersion time (Table 1).

Table 1. Recommendations used to overcome seed dormancy for the studied species.
Tabela 1. Recomendações utilizadas para a superação da dormência de sementes das espécies estudadas.

Species	Treatment	Immersion time (min)	Recommendations
Cassia grandis	sulphuric acid	30	Melo and Rodolfo Júnior (2006)
Enterolobium contortisiliquum	sulphuric acid	25	Silva *et al.* (2012)
Guazuma ulmifolia	sulphuric acid	50	Ribeiro *et al.* (2012)
Libidibia ferrea var. *leiostachya*	sulphuric acid	25	Biruel *et al.* (2007)

Soon after immersion, the seeds were washed with distilled water for approximately 10 min to remove the acid. The entire process was carried out at the Forest Seeds Laboratory of the Department of Forest Sciences - UFS.

Evaluation of the physiological quality of seeds

The determination of the initial viability of the seeds was carried out through a germination test, according to the Rules for Seed Analysis (BRASIL, 2009), using four replications of 25 seeds. The seeds were disinfected with 2% sodium hypochlorite for two minutes, followed by washing in distilled water to avoid a microorganism's infestation.

The germination tests were carried out in a germination chamber of the BOD type, with a temperature of 25 ºC, under continuous white light. The substrate was sand (washed, sieved, and sterilized in an oven at 120 ºC for 24 h). The small seeds were sown on a substrate in plastic boxes (11 x 11 x 2.5 cm). The large seeds were sown in plastic trays (26.5 x 17.5 x 5.5 cm). Whenever necessary, the substrate was moistened to keep the seeds in moisture conditions favorable to germination and seedling development. After the assembly of the germination tests, the evaluations were carried out every two days, counting the seeds with root emissions and considering the normal seedlings that had primary root, hypocotyl, cotyledons, epicotyl, and open photophilous to be germinated. The duration of the tests varied for each species studied, as indicated by the Instructions for Analysis of Seeds of Forest Species (BRASIL, 2013), and the species absent in the document was evaluated up to 40 days after the beginning of the test. At the end of the tests, the non-germinated seeds were classified as dormant, hard, or deteriorated seeds (BRASIL, 2009).

Implementation and evaluation of the emergency via direct seeding

The experiment, in the field, was implemented on July 2, 2014, in a stretch on the right and left banks of the Piauitinga River watercourse, in the Brasília village, Lagarto municipality, Sergipe state, between the UTM Sirgas coordinates 2000, South 24 spindle: 657800/8793400 and 658000/8793200. The predominant forms of land use and occupation before the study were pasture and agriculture. In the area, cleaning was carried out using manual weeding, eliminating invasive plants without initial soil preparation. Isolation of the experiment areas selected for planting was carried out through the construction of barbed wire fences to avoid the entry of animals present in the surroundings.

Using the Randomized Block Design (RBD) to test the seeds with the treatment to overcome dormancy in the four species used, in four blocks, with sowing taking place by selecting two stretches of the riparian forest area, at an approximate distance of 300 m, each disposed on each bank of the river and each bank there was a distance of 3 m from one block to the other. Each experimental block had 10 lines, composing 10 pits (30 x 30 x 30 cm, and using this depth dimension to remove possible layers of soil impediment), in 2.0 x 1.0 m spacing, with the factorial scheme distribution done by random drawing for each line.

For *Libidibia ferrea* var. *leiostachya*, 20 seeds per hole were used, and for the other species, 10 seeds per hole. The seeds of *Cassia grandis*, *Enterolobium contortisiliquum*, and *Libidibia ferrea* var. *leiostachya* were sown at 1.5 cm, and *Guazuma ulmifolia* at 1.0 cm, depending on their size. To favor the initial development of the species and reduce the competition for light, water, and nutrients, each pit was crowned with a minimum radius of 50 cm in the to be sown area, with manual cleaning at each evaluation of the seedling emergence in the field. The control of leaf-cutting ants was performed using granulated bait formicide when the need for assessments was verified.

Seedling emergence assessments were carried out weekly during 90 days after sowing, considering seedlings that showed visible protophils emerged, with the results expressed as a percentage and calculated according to the total number of seeds sown by species, considering the percentage according to the number of seeds emerged for each species, at weekly intervals.

Statistical analysis

The results regarding both physical and morphometric evaluations of the seeds and seedling germination (considering normal seedlings), performed in the laboratory, as well as the field emergence, were analyzed for the normality of errors and homogeneity of variances, expressed as a percentage and calculated according to the total number of seeds sown per species. The treatment averages were transformed into a square root sinus of x/100 when necessary. The results were subjected to analysis of variance using the F test and the means compared by Scott-Knott at 5% in the SISVAR® program (FERREIRA, 2011).

FINDINGS

The physical and morphometric characteristics of the studied species are shown in Table 2. Considering the mass of the seeds, it was observed that Gulmifolia had the lowest average (0.0049 g). On the other hand, the other species showed statistically different mass values, with E. contortisiliquum (0.7167 g) with greater mass, respectively, followed by *C. grandis* (0.6862 g) and *L. ferrea* var. *leiostachya* (0.2211 g).

Table 2. Physical and morphometric characteristics of seeds of forest species. M - mass, WTS - weight of a thousand seeds, NS - number of seeds per kilogram, M - moisture, L - length, W – width, and T - thickness.

Tabela 2. Características físicas e morfométricas de sementes de espécies florestais. M – Massa, PMS – peso de mil sementes, NS – número de sementes por quilograma, U – umidade, C – comprimento, L – largura e E – espessura.

Species	**Evaluated parameters**						
	M (g)	**WTS (g)**	**NS/kg**	**M (%)**	**L (mm)**	**W(mm)**	**T (mm)**
Cassia grandis	0.6862c	681,498c	1,461a	16.56c	17,261d	11,325d	4,398b
Enterolobium contortisiliquum	0.7167d	705,051d	1,421a	16.60c	15,965c	10.225c	6,735c
Guazuma ulmifolia	0.0049a	4.963a	201,614c	5.03a	2.606a	1,994a	1,563a
Libidibia ferrea var. *leiostachya*	0.2211b	222.654b	4.521b	6.70b	10,710b	6,825b	4,33b
CV (%)	4,56	1,05	0,59	4,45	1,1	2,62	3,51

Averages followed by the same letter in the columns do not differ by the Scott-Knott cluster test at 5% probability.

Regarding the weight of a thousand seeds, it was observed that all species differed statistically, with emphasis on *Guazuma ulmifolia*, which had the lowest value (4.963 g), due to their small specific mass, thus resulting in the greatest number of seeds per kilo (201,614). The highest weight of a thousand seeds obtained was for *E. contortisiliquum* (705,051 g), the same species that had the highest mass, consequently with the lowest number of seeds per kilo (1,421). However, it is noteworthy that *C. grandis* (681,498 g), despite having a lower weight of a thousand seeds than *C. contortisiliquum*, has a statistically similar number of seeds per kilo (1,461). The species *L. ferrea* var. *leiostachya* and *G. ulmifolia* presented values of seeds per kilo that differ statistically from the other species, with *G. ulmifolia* presenting the second largest number (201,614), followed by *L. ferrea* var. *leiostachya* (4.521).

As for the moisture degree in the studied species seeds, it was found that *G. ulmifolia* had the lowest value (5.03%), and *L. ferrea* var. *leiostachya* also had a low value (6.70%), the species differed in the averages test, while *C. grandis* and *E. contortisiliquum* had the highest moisture content, with 16.56% and 16.59%, respectively, being statistically similar and differing from other species.

Concerning the length and width of the seeds, all species differed statistically, with *C. grandis* presenting the largest length (17.261 cm) and width (11.325 cm). As for the thickness, *E. contortisiliquum* obtained a higher thickness value (6.735 cm), differing from the other species, followed by *C. grandis* (4.398 cm) and *L. ferrea* var. *leiostachya* (4.33 cm) that did not statistically differ from each other. *G. ulmifolia* presented the lowest values of length (2.606 cm), width (1.994 cm), and thickness (1.563 cm), with its mean different from the other species regarding these parameters.

For the analysis of physiological quality, it was observed that in the studied species, the percentage of radicles emission of *C. grandis* (97%) and *E. contortisiliquum* (90%) were higher than the other species, however, being statistically similar to each other (Table 3). *Cassia grandis* was the only species not to have hard seeds, being different from all others, even *L. ferrea* var. *leiostachya* and *E. contortisiliquum* presenting low values, 15 and 9%, respectively, and being statistically similar. *G. ulmifolia* obtained the highest percentages of hard seeds, with 41%. For deteriorated seeds, we observed a high percentage in *L. ferrea* var. *leiostachya* (56%), followed by *G. ulmifolia* (21%), while *C. grandis* and *Enterolobium contortisiliquum* had the lowest values, with 3% and 1%, respectively, similar by the test average and different from other species.

Table 3. Physiological quality (%) of seeds of forest species regarding radicle emission (RE), hard seeds (Ha), deteriorated seeds (De), and normal seedlings (NS) in the laboratory, and the seedling field emergence (SFE).
Tabela 3. Qualidade fisiológica (%) de sementes de espécies florestais quanto à emissão de radícula (ER), sementes duras (Du), sementes deterioradas (De) e plântulas normais (PN) em laboratório, e da emergência em campo das plântulas (EP).

	Laboratory analysis				Field
Species	**RE (%)**	**Ha (%)**	**De (%)**	**NS (%)**	**SFE (%)**
Cassia grandis	97.00b	0,00a	3,00a	79.00cA	69.25cA
Enterolobium contortisiliquum	90.00b	9,00b	1,00a	83,00cB	20.00aA
Guazuma ulmifolia	38.00a	41,00c	21,00b	35.00bA	26,50aA
Libidibia ferrea var. *leiostachya*	29,00a	15,00b	56,00c	22,00aA	44.75bA
Average germination and emergence (%)	-	-	-	51.70A	32,10A
CV (%)	13,29	26,3	25,14	13,01	32,10

Averages followed by the same letter in the columns do not differ by the Scott-Knott cluster test at 5% probability.
Lower case letters compare between species. Capital letters compare germination and emergence in each species.

The percentage of normal seedlings was similar in *C. grandis* and *E. contortisiliquum*, with 79 and 83%, respectively. The lowest value was obtained in *L. ferrea* var. *leiostachya* (22%), following and differing statistically from *G. ulmifolia* with 35%. Concerning field emergence, *C. grandis* had the highest value with 69.25%, differing from all species, followed by *L. ferrea* var. *leiostachya* (44.75%). *G. ulmifolia* and E. *contortisiliquum* with 26.5% and 20% respectively were statistically equal.

Comparing germination in the laboratory with the emergence in the field, statistically, similar averages are observed for the species *C. grandis, G. ulmifolia*, and *L. ferrea* var. *leiostachya*. *E. contortisiliquum* presented statistical difference, emphasizing the difference between the averages of 83% of germination and 20% of emergence.

DISCUSSION

The morphometric characteristics of the seeds are highlighted in the emergence process of the initial parts of the plant this is due to the large seeds having a higher number of accumulated reserves that will be required for the development of the embryonic axis and subsequent establishment of the seedlings (SANTOS *et al*., 2012). According to Carvalho and Nakagawa (2012), the higher the density of the seed, the greater its vigor. Therefore, species belonging to genera and botanical families, as well as different ecological groups, are expected to have different physical and morphometric parameters (BUDOWSKI, 1965). However, although the averages were considered within the same species, the values regarding seed morphometry are variable even within the same species, and this can be seen when comparing the same parameters with other studies, such as *E. contortisiliquum* presented values higher than those seen by Barreto and Ferreira (2011) with 13.5 mm, 9.5 mm and 0.66 mm, as well as for *C. grandis* with values of 15.83 mm, 11.34 mm and 6.39 mm (BEZERRA *et al*., 2012), for length, width, and thickness, respectively, in both comparisons.

As for the size of the seeds, Doust *et al.* (2006) observed that the larger seeds (> 5.0 g), which were categorized based on the weight, showed higher rates of establishment than the small seeds (0.01 g to 0.099 g) and intermediate (0, 1 to 4.99 g), noting that this parameter was one of the factors that influenced the establishment of seedlings of sixteen tree species used to restore tropical forests via direct seeding in Northeast Queensland, Australia. Similar behavior was observed in the field by Ferreira *et al*. (2009) when performing riparian forest recovery activity in the Lower São Francisco-SE with five forest species (*L. ferrea* var. *leiostachya*, *C. grandis*, *E. contortisiliquum*, *Hymenaea courbaril*, and *Schinus terebinthifolia*) also via direct seeding. In this study, the authors found that seeds of greater specific mass and larger size showed a faster emergence and a higher survival rate at 90 days after sowing. Such results can be explained, as the authors themselves mention, by the higher number of accumulated reserves contained in the seeds of larger sizes and weights.

Regarding the weight of the seeds, lower values were observed when compared to other studies, such as 7.6 g for the weight of a thousand seeds of *G. ulmifolia* (PAIVA SOBRINHO; SIQUEIRA, 2008) and 0.867 g of mass-specific to *C. grandis*, observed by Bezerra *et al*. (2012). Such variation is still verified, comparing the results of the present work with those of three species in common to the study by Ferreira *et al.* (2009), where *E. contortisiliquum* and *L. ferrea* var. *leiostachya* presented lower values for all parameters compared to those indicated in the present study. Cassia grandis presented higher values for specific mass (0.753 g). The variation in weight can be conditioned not only to the mass and the reserve content but also to the tree-matrix quality. Besides, this variation may also depend on the water content in the seed, which, in turn, may be related to its drying and storage process.

The relative humidity value can also directly affect the weight of a thousand seeds and the number of seeds per kilo results. This is proven when comparing the results obtained by Santos *et al*. (2012) for *G. ulmifolia*, which in its study had a percentage of 5.37, giving higher values also for the weight of a thousand seeds (5.93 g), and the number of seeds per kilo (168.634), these are the consequence of the specific mass that was probably greater than the seeds of the present study. Additionally, the higher water content may be related to the storage time until the date used, which was lower than the present. Such results are different from those obtained in the present work. Another factor is the variations in the seed's water content, which can influence its germinative capacity, observed in *C. grandis* and *E. contortisiliquum* seeds, which had similar values with a similar response in the laboratory, but, in the field, the answer was not the same. The seeds with lower relative humidity had lower germination values. Besides, the variation in the seeds water content can give different germination percentages when analyzed together with the drying carried out and the form of storage. Nery *et al*. (2014) analyzed two species considered physiologically orthodox (*Casearia sylvestris* and *Eremanthus incanus*), two recalcitrant (*Guarea kunthiana* and *Protium heptaphyllum*), and one intermediate (*Qualea grandifl*). Even though the species used in the present study are orthodox, it was found that the water content in the seed was different between species, which may indicate that the germination percentages in the laboratory may be related to this attribute. In the field, soil moisture may have negatively affected *E. contortisiliquum*, showing its sensitivity to this environmental condition.

The response of the physiological quality of the studied seeds indicated a high root emission of *C. grandis* (97%) and *E. contortisiliquum* (90%), a result of *C. grandis* superior to that obtained by Melo and Rodolfo Júnior (2006), who found 72%. In contrast, Lessa *et al.* (2014) acquired more than 95% germination when studying *E. contortisiliquum*, a percentage also higher than the almost 60% obtained by Silva *et al.* (2012). This variation can be expected considering, as previously mentioned, the other factors that can determine the germination capacity, in addition to its vigor and the quality of the chosen parent trees that make up the lots used. The other species obtained low values of radicle emission, which are statistically similar to each other, with emphasis on *L. ferrea* var. *leiostachya* with the lowest value (29%), a value lower than that found by Biruel *et al*. (2010) that obtained 57% germination, a difference associated with the high value of deteriorated seeds obtained in the present study.

The difference between the sources of variation (germination x field) is also verified by Guedes *et al*. (2015), who, when working on *Amburana cearensis*, observed a higher germination average of this species in the laboratory. However, in one of the used lots, they found a higher percentage for emergence in the field concerning germination. Dutra *et al*. (2016) also obtained higher values of field emergency compared to laboratory results for all treatments on different substrates used. This condition of higher emergence in the species field coincides with that seen in the present study, only for *L. ferrea* var. *leiostachya,* which had a field emergency (44.75%) higher than germination in the laboratory (22%). A higher percentage of emergence is an answer to be expected when compared to germination in a controlled environment, where it allows adequate substrate, temperature, humidity, and luminosity for maximum germination capacity for each species. In the field, environmental factors are adverse, with seedlings emerging that are more tolerant to each natural condition.

The seed size is highlighted by Biruel *et al.* (2010), who affirm that, generally, small seeds present lower values of germination and vigor when compared with those of medium and large size. This may also be related to the present study where the species of smaller seeds (*G. ulmifolia*) had a low emergence in the field, and *C. grandis*, which has greater length and width and presented the highest emergence among species. However, *E. contortisiliquum*, which despite having a higher average mass and thickness of its seeds among the other species, had a low average of emergence, in addition to having the second-best radicle emission rate (90%), and normal seedlings (83%) had the least emergency in the field with only 20%. This condition may be related to seed sensitivity without cutaneous resistance, since it was treated to remove this dormancy, to environmental factors in the riparian region, mainly humidity, causing its embryo deterioration or death.

One factor to be taken into account is the resistance of seeds to high levels of soil moisture and their influence on the emergence in the field of the species used, as an accumulated value of 266.75 mm was recorded in July in the rainy season Boquim-SE, about 28 km from the studied area (nearest data collection point). On the 16th of the same month, the highest rainfall (135.5 mm) was recorded, which increased species mortality, deteriorated seeds, or promoted the displacement of the soil mass.

CONCLUSIONS

- *Cassia grandis*, *Enterolobium contortisiliquum*, and *Libidibia ferrea* var. *leiostachya* have the highest weights, lengths, widths, and thicknesses among the species studied, and *Guazuma ulmifolia* with the lowest mass and, consecutively, the highest number of seeds per kilo.
- *C. grandis* and *E. contortisiliquum* have the highest values of humidity, radicle emission, and normal seedlings, while *Libidibia ferrea* var. *leiostachya* presents a high percentage of deteriorated seeds and *Guazuma ulmifolia* the lowest percentage of normal seedlings.
- The species showed higher percentages of germination under controlled conditions when compared to field emergence, except for *L. ferrea* var. *leiostachya*, which had the highest emergency in the field. *C. grandis* stood out with high percentages both in the laboratory and in the field, while *E. contortisiliquum* even with a higher germination percentage, did not show the same response in the field.

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