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Physiological quality of seeds of *Mimosa bimucronata* (DC) O. KTZE. subjected to different types of drying

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Abstract

Despite its potential, to date, work has not been carried out to identify the ideal drying conditions for *Mimosa bimucronata* (DC) O. Kuntze. Considering the scarcity of information on the drying process of this species, this work was with the objective of evaluating the sensitivity to desiccation by means of drying on activated silica gel (fast) and under laboratory conditions (slow). Rapid drying with silica was performed. For slow drying, the seeds were placed in plastic containers without lids, both at room temperature. Every hour, the seeds were weighed until reaching the pre-established points (30, 25, 20, 15 and 10%). The variables analyzed were: water content, first germination count, germination, germination speed index, dry mass and seedling length. The seeds of *M. bimucronata* (DC) show orthodox behavior, withstanding desiccation at levels below 15%. The desiccation of seeds at very low levels impairs the formation of seedlings, preventing their normal development.

Keywords: germination, orthodox, silica gel.
Abbreviations: GVI_germination speed index.

Introduction

Maricá (*Mimosa bimucronata* (DC) O. Kuntze.) belonging to the Mimosaceae (Leguminosae-Mimosoideae) family, is a medium-sized tree species that is naturally distributed in the Northeast, South and Southeast regions of Brazil, being particularly frequent in the states of Pernambuco, Alagoas and Paraná. It is deciduous, characteristic of the initial stages of ecological succession, however, it is assumed that this species presents different ecotypes and adaptations to different climatic regions (Silva et al., 2020).

Despite its potential, to date, no studies have been conducted to identify the ideal drying conditions for seeds of this species and its name is not included in the Rules for Seed Analysis (Brasil, 2009), the official document that guides the conduct of tests for seed quality analysis in Brazil.

Several factors can interfere with the quality of seeds during the production process, highlighting the prevailing conditions during maturation, harvesting, processing, handling, drying and storage. In this sense, the reduction of the water content of the seeds as a result of drying acts directly on the decrease of metabolism, which can contribute to reduce the rate of deterioration and increase the period in which they can be stored, without loss of physiological quality. Also, the water content of the seeds is directly related to the activity of insects and microorganisms and these with the seeds (Carvalho and Nakagawa, 2012; Marcos Filho, 2015; Moscon et al., 2017).

The drying process can be done naturally or artificially. When choosing the drying method, the volume of seeds is a limiting factor. Moscon (2020) reports that large amounts of seeds, it is essential to use artificial drying, whose operating costs are directly related to the volume, drying speed and air temperature. In artificial drying, the heat source can be variable. What characterizes the method as artificial is the fact that the process is executed with the aid of mechanical, electrical or electronic alternatives and the air is forced through the seed mass (Carvalho and Nakagawa, 2012). Natural drying is based on the actions of wind and sun to remove moisture from the seeds. Such process is limited by the climate, when the conditions of relative humidity of the air and temperature do not allow, or when dealing with larger volumes of seeds (Peske and Villela, 2012).

It is recommended that the drying of seeds be carried out in such a way that their temperature does not exceed 40 ºC, so that there is no marked reduction in their physiological quality. However, the maximum temperature to which seeds can be exposed, during drying, depends on their water content and the exposure time to this condition (Menezes et al., 2012). Despite its advantages, drying is a potentially damaging operation to seed quality and depends on the correct management of initial and final seed water content, temperature, relative humidity, airflow, drying rate, and period of exposure to heated air (Peske et al., 2009). Thermal damage may not manifest immediate effects on germination, however, after a period of storage, seed vigor may suffer considerable reductions (Melo et al., 2018). Considering the scarcity of relevant information about the drying process in

Table 1. Water content (%, wet basis) desired and obtained after drying of seeds of *Mimosa bimucronata* (DC) O. KTZE.

Drying	Desired and obtained water content (%)				
	30	25	20	15	10
Fast	30.3	26.7	21.6	15.9	11.1
Slow	30.3	26.9	22.3	16.5	11.7

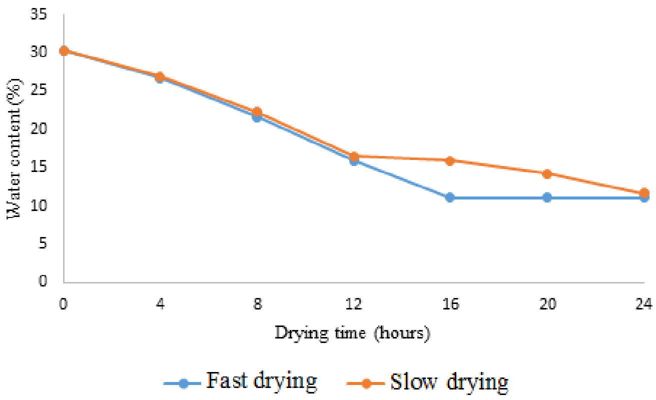

Figure 1. Silica (fast) and environment (slow) drying curve of *Mimosa bimucronata* (DC) O. KTZE seeds.

M. bimucronata seeds, this work was developed with the objective of evaluating the sensitivity to desiccation by means of drying on activated silica gel (fast) and under laboratory conditions (slow).

Results and Discussion

Drying

Slow drying (environment) of *M. bimucronata* seeds took more than 24 hours to reach a water content of 11.7%. However, it was found that the rapid drying (silica gel) occurred in a shorter time, requiring only 14 hours to reach a water content of 11.1% (Table 1 and Figure 1).

First germination count (%) and germination (%)

For the first germination count (PCG) the maximum value of 95% was observed in seeds with a water content of 30% (fast drying) (Figure 2A). For both types of drying, there was a linear reduction in the percentage of PCG as the water contents decreased, evidencing the reduction in the percentage of resumption of embryo growth. These results may have been verified due to the desiccation-sensitive cells, when dried, exhibit metabolic dysfunctions arising from the increase in the concentration of solutes (salts, amino acids, sugars), modifying the ionic strength and pH of the intracellular solution, leading to irreversible denaturation of proteins (Taiz et al., 2017).

Germination was influenced by the seed drying methods, decreasing linearly with water contents, so that at 30% water content they showed survival 100% (fast drying) and 90% (slow drying) (Figure 2B). The drying methods used evidenced different levels of sensitivity to desiccation of the seeds to the water contents hit, with germination values superiors 60% being observed, in the water contents of 10% for fast and slow drying, 65% respectively (Figure 2B). It is noteworthy that the fast and slow drying, little differ, since they provoked little damage in the removal of water at the level of 10%, when compared to species considered recalcitrant. According to Barbedo and Marcos Filho (1998), the critical water content would be reached after the loss of all free cellular water, and in several studies and researched species values from 15 to 38% were obtained, showing that this characteristic is very variable from species to species and even from individual to individual. Results different were observed in seeds *Campomanesia pubescens* (DC.) O. Berg, being that the reduction of water content from 35 to 4% resulted in drastic reduction in germination potential and vigor (Dousseau et al., 2011).

Germination Speed Index

The germination speed index (GVI) (Figure 3) decreased linearly in the two drying methods, accompanying the reduction in water content. The Seeds from fast drying presentend the highest values of IVG, however, there was no difference in water content of 30% (fast drying 5.495 and slow drying 5.421), not evidencing damage caused by the different types of drying. Silva et al. (2014) studying the germination of forest species stated that the germination speed is a good index to evaluate the occupancy of a species in a given environment, since the Rapid germination is characteristic of species whose strategy is to establish themselves in the environment as quickly as possible by taking advantage of favorable environmental conditions. Dresch (2013), working with *Campomanesia adamantium* seeds, obtained a different result from the present work, where seeds from fast drying presented the lowest IVG values, when compared to the slow one, revealing damages caused by fast drying in the germination speed of the seeds.

Seedling length (cm)

Seedling length (Figure 4) was negatively influenced by drying methods. With fast drying, the minimum length was 4.5 cm and slow drying was 4.0 cm, with a water content of 10%, respectively. The desiccation increasing probably intensified the damage caused to the seeds, verified by the shorter length of the seedlings in the water content of 10%. Scalon et al. (2012) performing drying on Eugenia pyriformis seeds, also noticed that the length was negatively influenced by the desiccation of the seeds. It should be noted that the tests that assess the length of seedlings are recommended by the Association of Official Seed Analysts (AOSA) and the International Seed Testing Association (ISTA), presented they

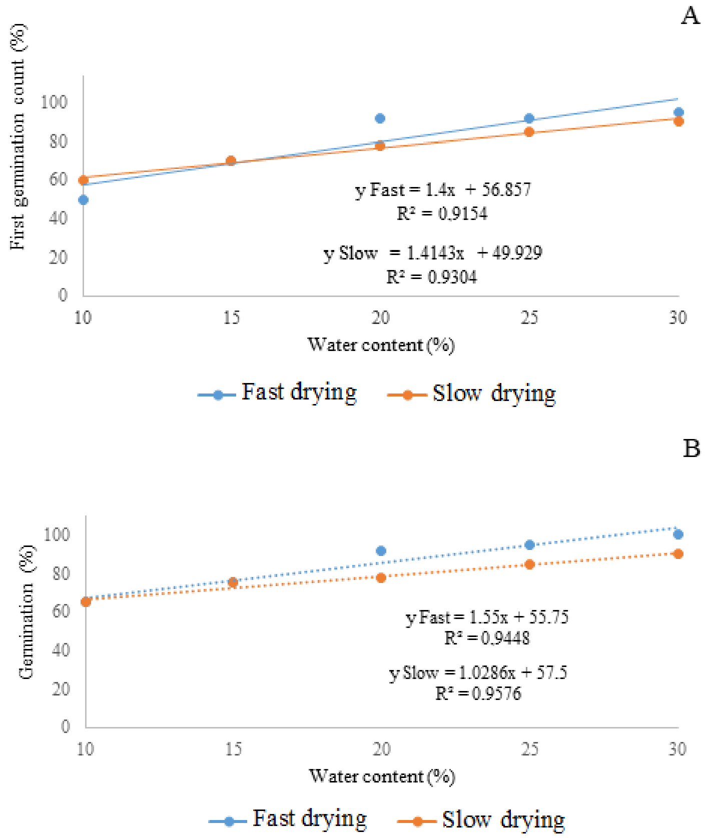

Figure 2. First Germination Count (%) (A) and Germination (%) (B) of *Mimosa bimucronata* (DC) O. KTZE seeds as a function of fast and slow drying at different water contents.

have the advantages of not being expensive, being relatively quick, not need equipment specials nor demand specific training on the technique used (Guedes et al., 2009).

Dry mass (g)

The drying of the seeds committed accumulation of dry mass. The highest values were observed at the water content of 30% (0.120 and 0.100g), for fast and slow drying, respectively (Figure 5). However, the drying showed a drastic reduction in the accumulation of dry mass of the seedlings at the lowest levels of seed hydration, that is, at a water content of 10% (fast drying 0.050g and slow drying 0.040g). Eventually, the reduction in the water content of the seeds impaired the capacity to translocate seedlings reserves. Silva et al. (2012), studying *Cinnamomum zeylanicum* seeds subjected to different levels of drying, found that increasing dehydration negatively affected the length and dry mass of seedlings.
Regression analysis generates an equation to describe the statistical relationship between one or more predictor variables and the response variable, based on that, it is noted that the electrical conductivity variable did not fit any regression model.

Materials and methods

Seed collection location

The pods of *Mimosa bimucronata* (DC) O. KTZE. were collected at the end of July/2021, from 10 matrices located in the city of Anadia - AL. After collection, the fruits were taken to the Laboratory of Phytotechnics of the Federal University of Alagoas, Campus of Engineering and Agricultural Sciences, Rio Largo - AL, discarding the damaged fruits.

Plant materials

Then, the seeds were removed from the pods and placed on Germitest® paper. Before carrying out the tests, the seeds underwent a pre-germination treatment, which consisted of cutting the side opposite the micropyle with the aid of a nail clipper (Melo et al., 2018). Subsequently, the seeds were subjected to rapid drying in activated silica gel and to slow drying in laboratory environment conditions.

Water contente

Drying on silica gel (rapid) was carried out by placing the seeds inside "gerbox" boxes with silica gel at the bottom, changing the silica as soon as the surface layer turns pink and loses the indicative blue color. For slow drying, the seeds were placed inside plastic containers without lids, both at room temperature. Subsequently, every hour, the seeds were weighed until they reached the pre-established points (30, 25, 20, 15 and 10%), according to the formula of Sacandé et. al. (2004). After obtaining the desired degrees of humidity in the two drying conditions, the following characteristics were determined to evaluation the physiological potential:
Water content: determined at 105 ± 3°C for 24 h, by stove method (Brasil, 2009), with three replications of 5 g of seeds each and the results expressed on a wet basis.

Variables analyzed

First germination count: it was performed in Germitest® paper rolls with four repetitions of 25 seeds each and kept in B.O.D. at a temperature of 30°C, under constant white light. The evaluations occurred daily, considering the root protrusion at least 5 mm in length. The results were expressed as a percentage (%).

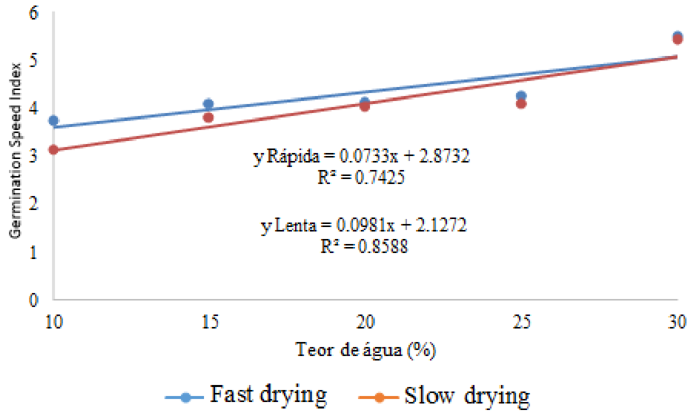

Figure 3. Germination Speed Index of *Mimosa bimucronata* (DC) O. KTZE seeds as a function of fast and slow drying at different water contents.

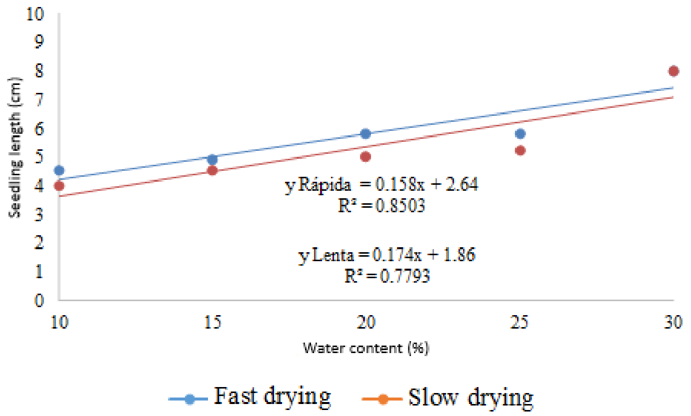

Figure 4. Seedling length (cm) of *Mimosa bimucronata* (DC) O. KTZE as a function of fast and slow drying at different water contentes.

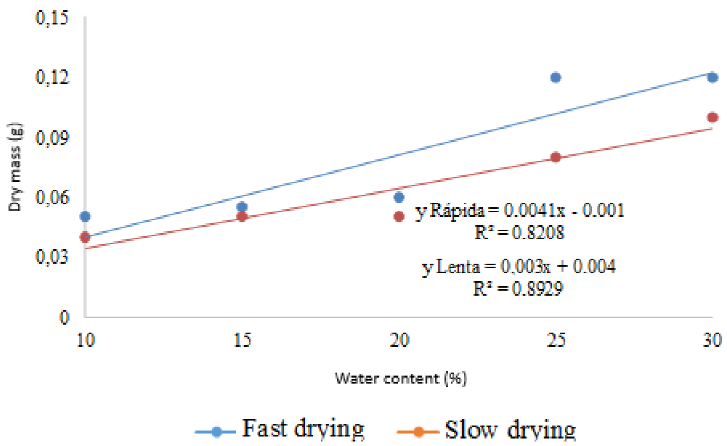

Figure 5. Dry mass of seedlings (g) of *Mimosa bimucronata* (DC) O. KTZE as a function of fast and slow drying at different water contents.

Germination: The evaluations were performed fifteen days after sowing, computing the normal seedlings, using as a criterion the shoot emission and developed root system (Dresch et al., 2012). The results were expressed in percentage (%).

Germination speed index (GVI): calculated by the sum of the number of seeds germinated each day, divided by the number of days elapsed between sowing and germination, according to the formula of Maguire (1962): GVI= (G1/ N1) + (G2/N2) + (G3/N3) + ... + (Gn/Nn), where: GVI = germination speed index, G1, G2, G3,..., Gn = number of seedlings computed in the first, second, third and last counts; N1, N2, N3,..., Nn = number of days from sowing to first, second, third and last count.

Seedling length: obtained by means of measurements, with the aid of a ruler graduated in millimeters, the results were expressed in centimeters (cm).

Total dry mass: obtained from the seedlings dried in an oven regulated at 60ºC for 48 hours, until a constant dry mass is obtained, measured on a precision analytical balance (0.0001g), the results expressed in grams (g).

Statistical analysis

The design used was completely randomized in a factorial scheme (2 dryings x 5 water contents). The data obtained were submitted to analysis of variance and regression analysis was performed at 5% probability, using the SISVAR 5.6 software (Ferreira, 2011).

Conclusions

The seeds of *Mimosa bimucronata* (DC) O. KTZE show orthodox behavior, withstanding desiccation at levels below 15%. The desiccation of seeds at very low levels impairs the formation of seedlings, preventing their normal development.

References

Barbedo CJ, Marcos Filho J (1998) Tolerância à dessecação em sementes. Acta Bot. Brasilica, São Paulo, 12:145-164.

Brasil (2009) Ministério da Agricultura, Pecuária e Abastecimento. Regras para análise de sementes. Ministério da Agricultura, Pecuária e Abastecimento. Secretaria de Defesa Agropecuária. Brasília, DF: MAPA/ACS, 395 p.

Carvalho NM, Nakagawa J (2012) Sementes: ciência, tecnologia e produção. 5. ed. Jaboticabal: FUNEP, 590p.

Dousseaul S, Alvarenga AA, Guimarães RM, Lara TS, Custódio TN, Chaves IS (2011) Ecofisiologia da germinação de sementes de *Campomanesia pubescens*. Ciênc Rural. Santa Maria, 41(8):1362-1368.

Dresch DM (2013) Germinação e redução da sensibilidade à dessecação em sementes de *Campomanesia adamantium* (CAMBESS.) O. BERG (MYRTACEAE). Tese da Universidade Federal da Grande Dourados (Pós-Graduação em Agronomia – Produção Vegetal), 99f.

Dresch DM, Scalon SPQ, Masetto TE, Vieira MC (2012) Germinação de sementes de *Campomanesia adamantium* (Camb.) O. Berg em diferentes temperaturas e umidades do subtrato. Scientia Forestalis, Piracicaba. 40(94):223-229.

Ferreira DF (2011) Sisvar: a computer statistical analysis system. Ciênc Agrote, Lavras. 35(6):1039-1042.

Guedes RS, Alves EU, Gonçalves EP, Viana JS, Medeiros MS, Lima CR (2009) Teste de comprimento de plântula na avaliação da qualidade fisiológica de sementes de *Erythrina velutina* Willd. Semina: Ciênc Agrá, Londrina. 30(4):793-802.

Maguire JD (1962) Speed of germination-aid in selection and evaluation for seedling emergence and vigor. Crop Sci. Madison, 2(1):176-177.

Marcos-Filho J (2015) Fisiologia de sementes de plantas cultivadas. 2.ed. Londrina: ABRATES, 660p.

Melo LDFA, Melo Junior JLA, Araújo Neto JC, Ferreira VM, Silva AC, Silva VSG (2018) Cardinal temperatures for the germination of *Chorisia speciosa* A. St.-Hil. and parameters of the accelerated aging test for determination of vigor. Aust J Crop Sci. 12(6):1653-1659.

Menezes NL, Pasqualli LL, Barbieri APP, Vidal MD, Conceição GM (2012) Temperaturas de secagem na integridade física, qualidade fisiológica e composição química de sementes de arroz. Pes AgropecTropical. 42(4):430-436.

Moscon ES (2020) Influência da secagem e do armazenamento na qualidade de sementes de quinoa. Brasília: Faculdade de Agronomia e Medicina Veterinária, Universidade de Brasília, 117 p. Tese de Doutorado.

Moscon ES, Martin S, Spehar CR, Devilla IA, Rodolfo Junior F (2017). Cinética de secagem de grãos de quinoa (*Chenopodium quinoa* W.). Rev Eng Agri. 25(4):318-328.

Okuhisa D, Sediyama CAZ, Hilst PC, Dias DCFS (2009) Teste de condutividade de elétrica para avaliação da qualidade fisiológica de sementes de mamão (*Carica papaya* L.). Rev Bras Sementes. Londrina. 31(2):137-145.

Peske ST, Villela FA, Labbé-Baudet F (2009) Secagem de sementes de hortaliças. In. Nascimento, W. M. Tecnologia de sementes de hortaliças. Embrapa Hortaliças, Brasília-DF, p. 137-154.

Peske ST, Villela FA (2012) Secagem de sementes. In: Peske ST, Villela FA, Meneghello GE. Sementes: fundamentos científicos e tecnológicos. 2.ed. Pelotas: UFPel, p.371-420.

Sacandé M, Joker D, Dulloo M, Thomsen KA (2004) Comparative storage biology of tropical tree seeds. Roma: International Plant Genetic Resources Institute, 363p.

Scalon SPQ, Neves SEM, Maseto TE, Pereira ZV (2012) Sensibilidade à dessecação e ao armazenamento em sementes de *Eugenia pyriformes* Cambess. (uvaia). Rev Bras Fruticultura. Jaboticabal, 34(1):269-276.

Silva KB, Alves EU, Bruno RLA, Santos SS, Barroso LM (2012) Tolerância à dessecação de sementes de *Cinnamomum zeylanicum* Ness. Semina: Ciên Agrár. Londrina, 33(2):587-594.

Silva LG, Melo LDFA, Melo Junior JLA, Costa JFO, Duarte AG (2020) Potencial fisiológico de sementes de alagadiço obtidas de diferentes localidades sob temperaturas. In: Francisco, Paulo Roberto Megna; Santos, Djail; Ribeiro, George do Nascimento; Medeiros, Paulo da Costa. (Org.). Estudos e Inovações na Engenharia e Agronomia. 1ed.Campina Grande-PB: EPTEC. 5: 6-12.

Silva KB, Alves EU, Oliveira ANP, Sousa NA, Aguiar VA (2014) Influência da luz e temperatura na germinação de sementes de quixaba. Revista AGROTEC. 35(1): 13–22.

Taiz L, Zeiger E, Møller IM, Murphy A (2017) Fisiologia e desenvolvimento vegetal. 6. ed. Porto Alegre: Artmed, 888 p.