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Phisiological quality and tolerance of *Genipa americana* L. seed submetted to drying

Qualidade fisiológica e tolerância de sementes de *Genipa americana* L. à secagem

M. N. Cardoso[1]; A. N. R. Soares[1]; L. A. R. Oliveira[1]; L. H. A. Nascimento[1]; A. S. Ledo[2]; A. V. C. Silva[2]*

[1]*Programa de Pós-graduação em Agricultura e Biodiversidade (PPGAGRI), Universidade Federal de Sergipe, 49100-000, São Cristovão-SE, Brasil*
[2]*Embrapa Tabuleiros Costeiros, 49025-040, Aracaju-SE, Brasil*

**ana.veruska@embrapa.br*
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The jenipapo (*Genipa americana,* L.) is a Neotropical fruit tree that ranges from northern South America to Argentina. It is used in urban afforestation, and has characteristics that aid degraded area restoration, while its fruit are economically important in the manufacture of confectionary, jams, wines and spirits. The propagation of the species occurs by seeds, but with slow and uneven germination. Therefore, understanding the germination processes in a species sensitive to desiccation is an important factor in solving jenipapo seed storage problems. This work aimed to evaluate the influence of seed drying on jenipapo emergency and initial growth. Seeds were from the municipality of Umbaúba, Sergipe state, Brazil, and after cleaning, were submitted to different drying periods (0; 24; 48; 72; 96 and 120 hours) at a temperature of 28 ºC ± 2 ºC. Sowing was carried out in polyethylene bags containing soil and washed coir in 2:1 (v/v) proportions. Evaluated variables were: water content, emergence of seeds, emergence speed index, seedling length, leaf number, leaf size and seedling fresh and dry weight. The seeds are classified as identical and lose their moisture content as measured. There was a reduction in the quality of the configuration and in the growth of seedlings after 48 hours of drying.
Keywords: jenipapo, initial growth, propagation.

O jenipapeiro (*Genipa americana* L.) é uma árvore frutífera neotropical que se estende do norte da América do Sul à Argentina. É utilizado na arborização urbana e possui características que auxiliam na restauração de áreas degradadas, enquanto seus frutos são economicamente importantes na fabricação de doces, geleias, vinhos e destilados. A propagação da espécie ocorre por sementes, mas com germinação lenta e desigual. Portanto, compreender os processos de germinação em uma espécie sensível à dessecação é um fator importante na resolução de problemas de armazenamento das sementes. O objetivo do presente estudo foi avaliar a influência da secagem das sementes na emergência e crescimento inicial do jenipapeiro. As sementes foram provenientes do município de Umbaúba, Sergipe, Brasil, e após a limpeza, foram submetidas a diferentes períodos de secagem (0; 24; 48; 72; 96 e 120 horas) à temperatura de 28 ºC ± 2 ºC. A semeadura foi realizada em sacos de polietileno contendo solo + fibra de coco, na proporção 2:1 (v/v). As variáveis analisadas foram: teor de água, porcentagem de emergência, índice de velocidade de emergência, comprimento de plântulas, número de folhas, tamanho de folhas e massa fresca e seca de plântulas. As sementes são classificadas como intermediárias, e perdem sua viabilidade à Medida que o teor de água é reduzido. Houve redução da qualidade fisiológica e crescimento de plântulas das sementes a partir de 48 horas de secagem.
Palavras-chave: jenipapo, crescimento inicial, propagação.

1. INTRODUCTION

Jenipapo (*Genipa americana* L.) belongs to the Rubiaceae family and has ecological and economic [1], social and cultural importance. It occurs in almost all Brazilian biomes, with the exception of the Pampas [2]. Practically all parts of the tree are used [3]: the fruits as food and a source of dye; bark and fruits as medicinal; trunk for wood and whole plant as an ornamental [4], in addition to being recommended for reforestation and recovery of degraded areas.

Native fruit species are a reality from an economic point of view, with production chains, other gaps in their existing production systems (other gaps in their existing production systems) are numerous in many species [5]. As for forest production, the advance of changes is directly associated with the quality of the physical environment, such as water and nutrients in the soil [6].

Due to the high levels of iron, vitamins B1, B2, B5 and C, as well as the presence of calcium and carbohydrates, the fruit can be used in the cosmetics industry, notably for the manufacture of products used in hair and skin products [7].

The result of agricultural expansion and anthropic factors in native species such as jenipapo is the loss of genetic variability not yet measured, which has caused concern among scientists [8]. This point justifies the need for research on the characterization of jenipapo, such as genetic diversity [9], chemical-physical properties [10] and forms of propagation [11].

Jenipapo propagation usually involves seeds. These are classified as intermediate as they tolerate drying up to 30% These are classified as intermediate because they tolerate drying up to 30% RH, unlike the orthodox seeds (tolerate between 5% and 7%) and recalcitrant (between 15 and 50%) [12]. Jenipapo have slow and uneven germination, which begins 8 to 13 days after planting [13]. Understanding germination processes and establishing plants of dessication-sensitive species (intermediate and recalcitrant) is important for resolving potential storage problems [14] since incorrect storage can promote changes in the membrane phospholipid composition [15] as well as the loss of ability of seeds to prevent or repair free radical attacks [16]. The resulting decrease in seed functionality is considered highly damaging to overall crop viability [17].

Clearly studies of the impact of reduced water content and storage conditions, on seed are important as these factors influence strongly the physiological viability of seeds. Indeed, maintaining seed viability is still one of the greatest challenges faced by researchers working with conservation using germplasm banks [18].

In addition to the initial quality of the seeds, efficient drying can avoid physiological compromises and favor later storage under correct conditions [19]. Alternatively, such actions may have a negative impact on the quality of non-tolerant seeds, causing immediate impacts on seed germination and vigor [20].

Advances in knowledge concering jenipapo propagation are important in the adoption of technologies to increase seedling production. These can be used in breeding programs and also in the development of biodiversity conservation strategies [21].

Studies involving the behavior of plants and stored seeds submitted to artificial stresses provide a better understanding of their survival and adaptation capacity under conditions of natural stresses, such as drought and growing in salinized soils. This factor makes them valuable for genetic improvement programs [22].

Propagation of undomesticated fruit species with unknown cultivation requirements, like the jenipapo, remains a bottleneck for the production and conservation of their genetic resources. Accordingly, the current study was developed with the objective of to analyze the tolerance of seeds of jenipapo when submitted to drying.

2. MATERIAL AND METHODS

The experiment was conducted in Embrapa Tabuleiros Costeiros, Aracaju, Sergipe State, Brazil, from February to July, 2018. The plants used originally came from a natural population located in the municipality of Umbaúba, Sergipe. According to Köppen classification regional climate is Am, and is characterized by being warm (24.4 ºC annual average), with short-duration dry season, and an average annual precipitation of 1291mm.

To obtain seeds, fruits were collected when mature enough for in natura consumption, packed in plastic bags and taken to the laboratory where they were manually pulped using a plastic sieve. Seeds were washed in tap water for mucilage removal, then dried for different periods: 0 (control treatment); 24; 48; 72; 96 and 120 hours. Control seeds were sown soon after initial processing, using as commercial substrate soil + coir (coconut husk fibre) in the proportion 2:1 (v/v). Seeds intended for other treatments were kept in a forced circulation oven at a temperature of 28 ºC [23]. At pre-established intervals (0, 24, 48, 72, 96 and 120 hours), seed samples were taken from the initial lot for tests and determinations described below:

a) Water content*:* Water content was determined in an oven (105 ± 3 °C) for 24 hours as set by the Brazilian national Seed Analysis Rules (RAS) [23], using four replicates of 15 seeds for each drying period;

b) Emergency percentage (EP): was carried out in a greenhouse. Counting began on Day 11 after sowing, with emergency percentage calculated on day 34 after sowing when seedling emergence stabilized. Counting was performed when the cotyledons had emerged above the substrate. Results were expressed as percentage of total planted seeds;

c) Emergency speed index (ESI): The ESI was evaluated at the same time as the germination test, with daily counts from the eleventh day, continuing until the end of the test (Day 34), with the index calculated according to the formula in [24], presented below: ESI= (E1/N1) + (E2/N02) + ... + (En/Nn). E = number of normal seedlings computed in the counts; N = number of days from sowing to 1^{st}, 2^{nd}... 8^{th} assessment. [24];

d) Seeding length: Seedling length was measured at the end of the experiment (180 days after sowing), using a tape measure, measuring from the end of the longest root to the tip of the apical meristem and expressed in cm;

e) Number of seedling leaves: This was counted at the end of the experiment, at 180 days;

f) Seedling leaf dimensions: Leaf size values were obtained by multiplying the maximum width and length of the largest leaf (Length x Width), at 180 days after planting and the result divided by total seedlings and the value expressed expressed in cm^2;

g) Seedling fresh mass: Seedlings were removed from the growing bag, washed in running water, then weighed together on an analytical balance and the result divided by total seedlings and expressed in grams as a mean;

h) Seedling dry mass: Seedlings were packed in paper bags and placed in an oven at 80 ºC for 24 hours, after which they were weighed on an analytical balance and the result divided by the total seedling and expressed in grams as a mean value [25].

The experimental design was completely randomized, with four replicates of 25 seeds, totaling 100 seeds per treatment. Results were submitted to analysis of variance, with means evaluated by the polynomial regression analysis.

3. RESULTS AND DISCUSSION

At time 0h the mean initial moisture was approximately 51.5%, declining progressively across the initial time intervals (0-24h) to reach 10.24% after 120h of exposure. The sensitivity of recalcitrant seeds and similar biochemicals to desiccation inherent to the species and some factors, such as desiccation speed and temperature [26]. Rapid drying negatively influences the germination of jenipapo seeds below 20% moisture and that 10% humidity can be considered the lethal point for this species [18].

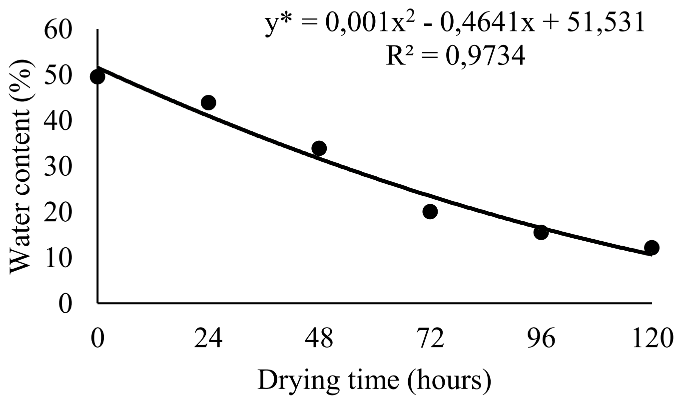

Figure 1. Water content of jenipapo seeds submitted to 0; 24; 48; 72; 96 and 120 hours drying time.

Seedling emergency (Figure 2) was also reduced with increasing seed drying time, reaching 65% in 120 hours. The reduction in the water content of the seeds probably caused physiological damage to the seeds, causing the loss of their germination potential, since the genipap seeds are classified as intermediate, and do not tolerate desiccation below the range of water content between 7 and 10% [18]. Oliveira et al. (2011) [27] confirmed that the drying of genipap seeds caused a reduction in the percentage of seedling emergence. Drying affected the germination parameters of coffee cultivars (Big Coffee and Topaz) when moisture content was lower than 11% [28].

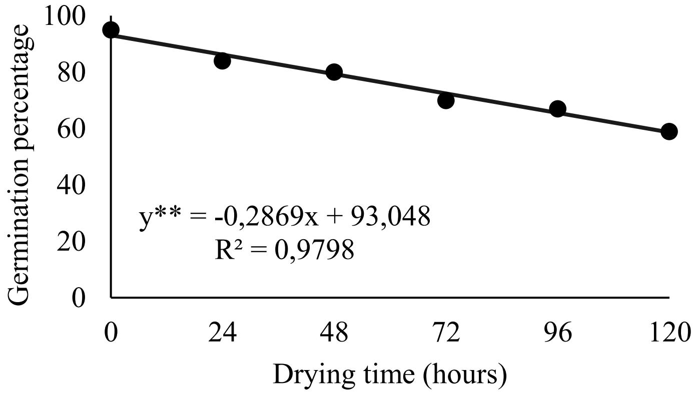

Figure 2. Germination percentage of jenipapo seeds submitted to 0; 24; 48; 72; 96 and 120 hours drying time.

For the emergence speed index, the behavior was similar to that observed for the percentage of emergence (Figure 3). After 48 hours, there was a significant reduction in seed vigor as a function of the drying period. Drying probably caused damage to the embryo, which explains the reduction of seed vigor after a prolonged period of drying. The membranes are disorganized when the seeds reach levels below 25% water, and values close to these can be considered critical for seeds of species sensitive to desiccation. In mangaba (*Hancornia speciosa* Gomes) seeds there was damage to seed vigor after 34 hours of drying [29].

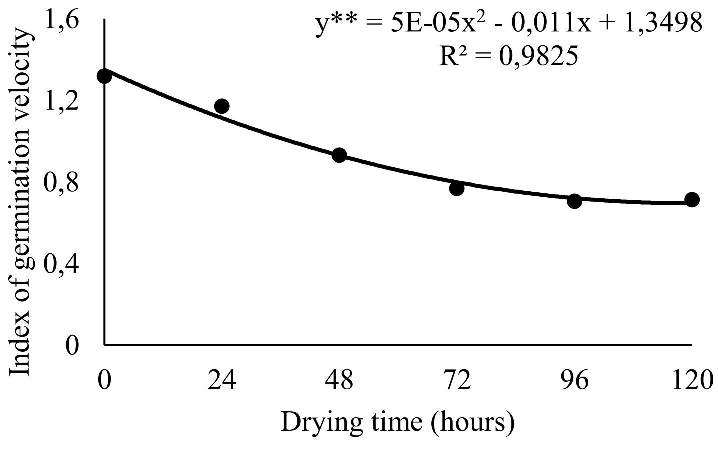

Figure 3. Emergency Velocity Index of jenipapo seeds submitted to 0; 24; 48; 72; 96 and 120 hours drying time.

Initial seedling growth was also affected by seed drying (Figures 4A-E). Drying for 72 hours caused a significant reduction in seedling length (Figure 4A). The dry and fresh mass, the number of leaves and leaf dimensions suffered a marked decrease after 48 hours of drying (Figures 4B-4E).

The drying temperature and storage time affect the mechanisms involved in translocation and transformation of cotyledonary reserves in the embryonic axis, restricting the accumulation of cotyledon-derived dry matter [30]. Consequently, with embryonic nutrition compromised, dry matter accumulation capacity is restricted [31]. In oiticica (*Licania rígida* Benth - Chrysolbalenaceae), physiological quality was impaired after the first few hours of drying with a reduction in root dry mass from 0.26g in the 8h treatment to 0.07 in seedlings from seeds dried for 24h [32]. In Saba nut (*Pachira aquatica* Aubl. - Malvaceae) genotypes [33] reported that the highest values of plant length (8.3 cm) were observed in plants growing from seeds not submitted to drying, and the shortest were those exposed to a 96 h treatment (6.1 cm).

The observed decrease in the growth of jenipapo plants may be a consequence of physiological changes caused by the long exposure to the drying temperature, reducing energy reserve availability for the plants [29]. The reduction in the number and dimensions of leaves may result from damage to meristematic tissues, impairing the synthesis of new cellular material and consequently the production and expansion of leaves.

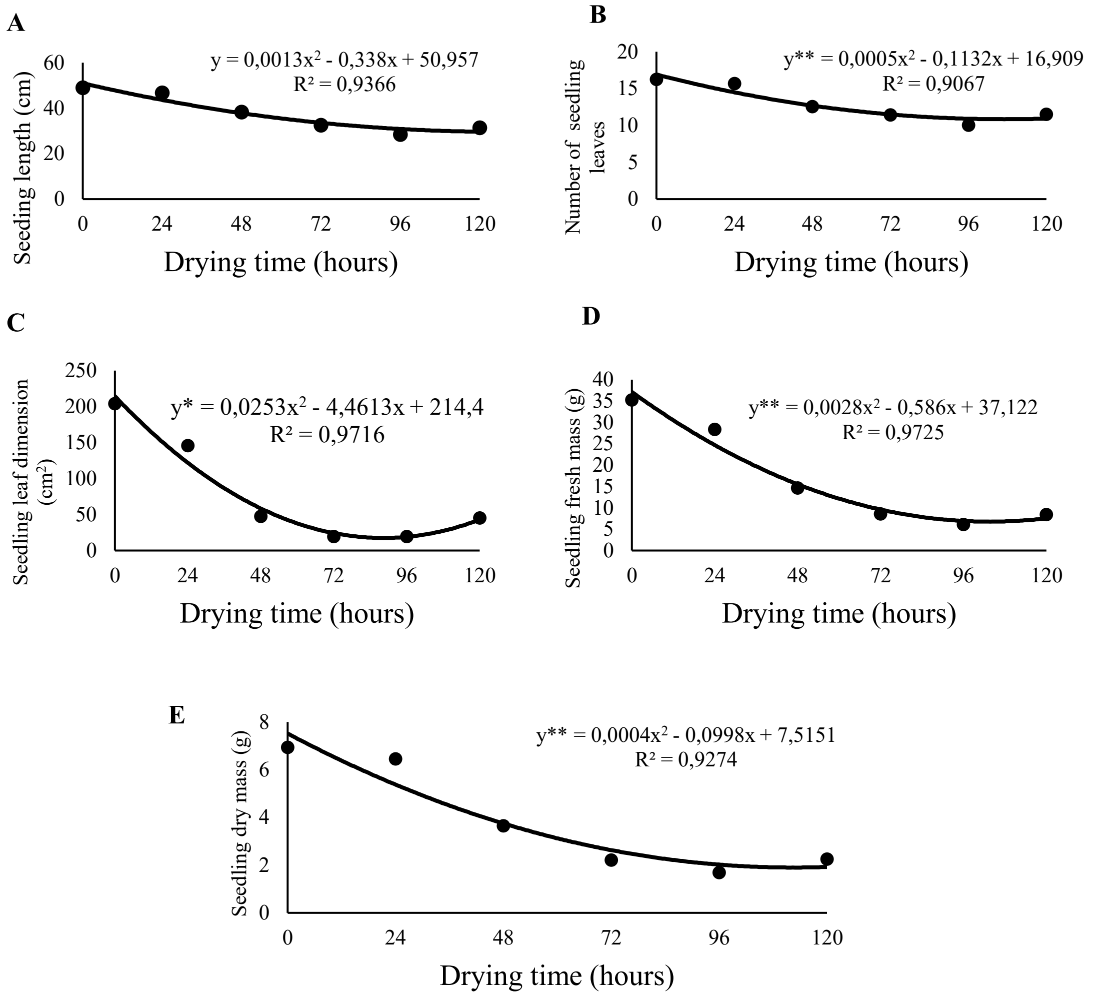

Figure 4. Length (A); leaf dimensions (B); Dry mass (C); Fresh mass (D) and number of leaves (E) of jenipapo seedlings originating from seeds submitted to 0; 24; 48; 72; 96 and 120 hours drying time.

4. CONCLUSION

The drying of jenipapo seeds from 48 onwards compromises the physiological quality of the seeds and seedling growth

The data presented are fundamental for the post-harvest process of jenipapo seeds, effectively contributing to the storage time and the way it should be stored. Such results can be used in commercial plantations and in maintenance and enrichment of Germplasm Banks.

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