

# BIOMETRY AND DISPERSION OF *JOANNESIA PRINCEPS* (VELL. 1798) IN ZONA DA MATA, MINAS GERAIS, BRAZIL

## BIOMETRIA E DISPERSÃO DE *JOANNESIA PRINCEPS* (VELL. 1798) NA ZONA DA MATA, MINAS GERAIS, BRASIL

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### ABSTRACT

Popularly known as “cutieira”, *Joannesia princeps* Vell. 1798, is a tree species of the family Euphorbiaceae. This work analyzed the biometrics of fruits and seeds and their dispersion processes at a locality in Zona da Mata, state of Minas Gerais, Brazil. The analyzed data came from twenty-four whole fresh fruit collected from an adult tree, and 250 endocarps found on the ground, at Sítio do Tanque located in the rural region of the municipality of São Francisco do Glória, Minas Gerais. Biometry revealed mean values of  $102.2 \pm 8.4$  mm for fruit length;  $96.2 \pm 6.9$  mm for fruit width; and mean weights (g) of  $388.3 \pm 84.9$  for fruit,  $289.9 \pm 72.2$  for exocarp,  $85.4 \pm 10.9$  for endocarp,  $5.7 \pm 1.4$  for seed and  $3.8 \pm 1.4$  for nuts. Besides that, the occurrence of seeds adhering to bovine feces, and the absence of dispersers described for the area, suggest a new strategy of dispersion for the species in the analyzed region.

**Keywords:** Euphorbiaceae, cutieira, dispersion, biometry, Minas Gerais.

### RESUMO

Popularmente conhecida como “cutieira”, *Joannesia princeps* Vell. 1798, é uma espécie arbórea da família Euphorbiaceae. Este trabalho analisou a biometria de frutos e sementes e seus processos de dispersão em uma localidade da Zona da Mata, estado de Minas Gerais, Brasil. Os dados analisados foram provenientes de vinte e quatro frutos frescos inteiros coletados de uma árvore adulta e 250 endocarpos encontrados no solo, no Sítio do Tanque localizado na zona rural do município de São Francisco do Glória, Minas Gerais. A biometria revelou valores médios de  $102,2 \pm 8,4$  mm para o comprimento do fruto;  $96,2 \pm 6,9$  mm para largura do fruto; e pesos médios (g) de  $388,3 \pm 84,9$  para fruto,  $289,9 \pm 72,2$  para exocarpo,  $85,4 \pm 10,9$  para endocarpo,  $5,7 \pm 1,4$  para semente e  $3,8 \pm 1,4$  para castanha. Além disso, a ocorrência de sementes aderidas a fezes bovinas e a ausência de

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dispersores descritos para a área sugerem uma nova estratégia de dispersão da espécie na região analisada.

**Palavras-chave:** Euphorbiaceae, cutieira, dispersão, biometria, Minas Gerais.

## INTRODUCTION

The enormous botanical diversity of Brazil stands out on the South American continent, yet it remains relatively little known in several scientific aspects. The different biomes intersected by national geographic limits present plant species that arouse commercial interest due to their potential to provide healthy food as a source of essential nutrients (PINTO *et al.*, 2005). Several endemic plant species with different economic and industrial applications are found among the biomes of Brazil. In this context, *Joannesia princeps* Vell. 1798, a tree species of the family Euphorbiaceae, found predominantly in the Atlantic Forest but also smaller proportions in the Cerrado and Caatinga, stands out (CNCFlora, 2020).

According to Secco and co-authors (2012), species of Euphorbiaceae sensu lato, one of the most complex and diversified angiosperm families, are especially distributed in the tropics, where they occur in the most varied types of vegetation and habitats. The species *J. princeps*, popularly known as “boleira” or “cutieira”, depending on the region, is also called: andá-açu, andá-guaçu, bagona, arapacu, arrebenta-cavalo, coco-de-bugre, coco-de-gentio, coco-de-purga, fruta-de-arara, purga-de-cavalo, purga-de-gentio, cotieira, dandá, fruta-de-cutia, fruteira-de-arara, indaguaçu, indaí-açu, indaiucu, purga-de-paulista, purga-dos-paulistas, purgante-de-cavalo, among other popular names (CARVALHO, 2005; CNCFlora 2020). The adult tree can reach 20 m in height with a trunk of approximately 60 cm in diameter (DBH) and possesses digitate leaves with 3 to 5 leaflets that reach 20 cm in length (SANTOS, 2016). The tree of *J. princeps* has industrial applications and has aroused significant interest due to the quality of the wood and adaptability to different growing conditions. It can be used in the manufacture of matchsticks, canoes, and rafts, as well as supply cellulose (AVELAR *et al.*, 2005).

Silva and collaborators (2020) recently analyzed the physical properties of wood of native tree species of Brazil, including *J. princeps*, and pointed out that there is little information on the technological aspects of the wood of these species, which limits their proper use. Analysis of the physiochemical properties of *J. princeps* identified it as an important supplier of raw materials to produce biodiesel (ZUNIGA *et al.*, 2011). In

addition, Costa-Singh and co-authors (2012) reported that *J. princeps* figures in folk medicine and highlighted the laxative properties of its nuts, although there are reports of the excess human consumption of the nuts causing clinical poisoning. Araújo *et al.* (2016) also highlighted the common use of the plant in folk medicine as a laxative for menstrual discomfort, as an antimicrobial and anthelmintic and to reduce edema and improve tissue healing.

Azevedo and Silva (2006) included *J. princeps* as a medicinal plant in their list of medicinal and religious plant species sold in markets and open fairs in the municipality of Rio de Janeiro. The species also stands out for likely having an allelopathic effect and can be used as a source of raw material in pharmacology (CAPOBIANGO *et al.*, 2009). The pharmacological activity of seed oil of *Joannesia princeps*, administered systemically and topically, on acute pain and inflammation was evaluated, and this seed oil presents antinociceptive and anti-inflammatory actions, promoted by inhibition of leukocyte recruitment and cytokine production (SOUZA *et al.*, 2021). Beyond that, six new sesquiterpene lignans were also isolated from the methanolic extract of the seeds of *J. princeps*, as well as known neolignans such as americanol A, isoamericanol A, and isoamericanine A (WAIBEL *et al.*, 2003). Despite the growing number of studies involving *J. princeps*, knowledge about different aspects of its biology remain insufficient. Spectroscopic studies carried out with the species have led to the development of new natural products, such as joannesialactone isolated from the bark of its root (ACHENBACH & BENIRSCHKE, 1997). According to Donato-Trancoso and co-authors (2014), the therapeutic effects of the oil obtained from its seeds have yet to be demonstrated.

In this context, these authors developed an experiment to analyze the beneficial effects of seed oil of *J. princeps* in the treatment of skin lesions in Swiss rats. The authors concluded that the seed oil accelerates the closure of lesions by increasing angiogenesis, keratinocyte migration, and fibroblast activity, and reduces the inflammatory response and oxidative damage (DONATO-TRANCOSO *et al.*, 2014). The aggregate fruit of the tree has 2-3 seeds that are characterized by a thick, smooth, and hard testa (CHAVES & DAVIDE, 1996). According to Santos (2016), variation among populations of forest species occurs through adjustments to different edaphoclimatic conditions, with the expectation that these populations have different adaptive characteristics. Even though populations are classified as belonging to the same species, their genetic makeup generally varies, depending on their adaptation to different environments (KAGEYAMA,

1987). In this context, the present work aimed to investigate the phenotypic characteristics of a population of *Joannesia princeps* located in a remnant fragment of the Atlantic Forest in Zona da Mata, state of Minas Gerais, Brazil.

## MATERIAL AND METHODS

### Description of the study area

The samples of *J. princeps* analyzed in the present study were collected at Sítio do Tanque (20°50'15.70" S, 42°15'0.43" W; 695 m a.s.l.), a private property located in the rural region of the municipality of São Francisco de Glória (20°47'21" S, 42°17'04" W) in Zona da Mata of the state of Minas Gerais, Brazil (Fig. 1). Founded in Serra da Providência in the middle of the 19<sup>th</sup> Century (COSTA, 2010), the municipality of São Francisco de Glória currently has about 4,758 inhabitants in 2021, spread over an area of 164.6 km<sup>2</sup> (IBGE, 2023). The climate of the region is characterized as tropical of altitude with annual rainfall between 1,000 and 1,500 mm<sup>3</sup> and an average temperature of 18°C to 22°C. The soil of the study area has a characteristic clayey-sandstone-limestone capping.

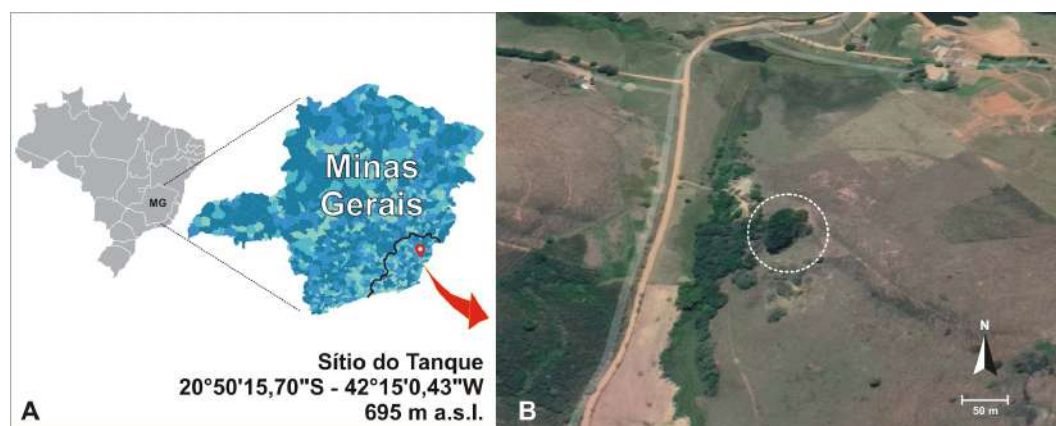


Fig. 1: (A) Map of Brazil showing the location of the state of Minas Gerais. The area of Zona da Mata in Minas Gerais is marked with a black line and the red and white marker indicate the location of the municipality of São Francisco do Glória; (B) view of the area of the Atlantic Forest fragment at Sítio do Tanque with the location of the study area indicated.

### Sampling and laboratory procedures

Twenty-four fresh fruits of an adult cutieira tree and 250 endocarps, fallen on the ground within a 5 m radius of its base, were collected (Fig. 2). All fruits and endocarps were bagged and identified, with fresh fruits being

stored in a refrigerator at a temperature between 4°C and 8°C. After storage, the material was transported to the municipality of Rio de Janeiro where it was processed in the Biology Laboratory on the Tijuca campus of Universidade Veiga de Almeida. In the laboratory, the fruits were weighed on a Marte MS20k1 analytical balance (0.001 g precision) and then opened and separated into exocarp, endocarp, and seeds. Due to the hardness of the endocarps, a Tramontina 1.5 kg tempered steel mallet was used to break them. The biometric analysis employed an adaptation of the method proposed by Avelar and collaborators (2005), with length, width, and thickness being measured with an 8"/Nove54 carbon steel caliper.

## RESULTS AND DISCUSSION

### Location

According to the owners of the study area, seeds of *J. princeps* arrived at the locality around 1948, being brought from the municipality of Pedra Dourada (20°49'54" S, 42°09'22" W) about 13 km from São Francisco do Glória. They were brought to be planted, and the seeds resulting from the adult tree were used as raw material for the preparation of bar soap for residential use. The analyzed cutieira is approximately 70 years old with a height of about 20 m and a DBH of 363 (Fig. 2). The tree showed a flowering period between July and September and fruiting between December and February. However, according to Carvalho (2005), the flowering of cutieira in Minas Gerais occurs from October to November and fruits ripen between March and July. This difference in flowering and fruiting periods may be due to regional climate change over the 13 years of difference between the works in question. Souza and co-authors (2006), the development and productivity of plants are directly affected by the absorption of nutrients, as well as by the rate of evapotranspiration, which is influenced by the water balance of the soil, which in turn is controlled by thermal conditions and the spatiotemporal distribution of precipitation.



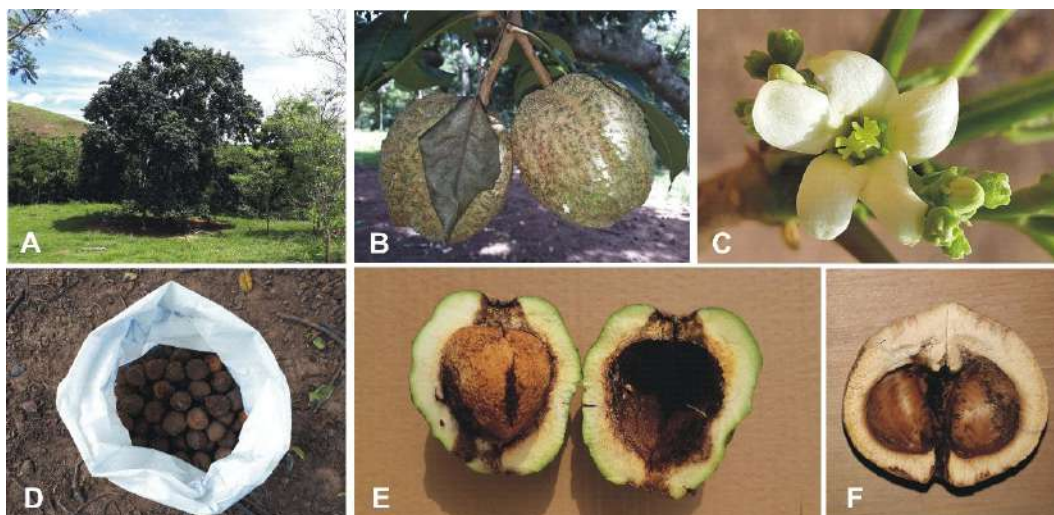


Fig. 2: Characteristics of the *J. princeps* analyzed in the present study: (A) adult tree; (B) two fresh fruits; (C) detail of flower; (D) dry endocarps collected at the base of the tree; (E) fruit opened in the middle exposing endocarp; (F) endocarp opened in the middle showing two seeds.

About 20 *J. princeps* trees were identified around Sítio do Tanque during the study, which was at different stages of development. According to Carvalho (2005), *J. princeps* has moderate to rapid growth with an average annual increase in volume, with bark, of up to 40 m<sup>3</sup>. ha<sup>-1</sup> at 20 years of age. The species is not mentioned in the first red book of Flora in Brazil, a publication that presents the results of scientific assessments of the risk of extinction of species of the national flora (MARTINELLI & MORAES, 2013). On the other hand, the species is currently classified as “Least Concern” and does not qualify as “Threatened”. This current category includes abundant or widely distributed species and is one of the eight categories of extinction risk established by the Red List Project of the National Flora Conservation Center. This classification was established for the species due to its abundance of more than 1 million individuals, with subpopulations known throughout the extension of its natural occurrence (CNCFlora, 2020). According to Cordeiro and Secco (2015), the species is endemic to Brazil where it is widely distributed in the states of Bahia, Rio de Janeiro, São Paulo, Espírito Santo, and Minas Gerais. However, in a phytosociological analysis carried out in Parque Estadual do Rio Doce (19°29' - 19°48' S, 42°28' - 42°38' W) in Minas Gerais, Lopes and co-authors (2002) identified *J. princeps* as one of the predominant species. Still, according to the authors, the size of the population and the distribution among environments were decisive factors for highlighting the species in the analyzed area. In addition, Beltrame and collaborators (2017) analyzed

the spatial distribution of attributes that determine the physiological quality of seeds of *J. princeps* with seeds collected at Horto Florestal Municipal Laerth Paiva Gama, located in the municipality of Alegre in the state of Espírito Santo.

### Biometric analysis of fruits

Biometric analyses were performed on 24 fresh fruits with an average length of  $102.2 \pm 8.4$  mm and an average width of  $96.2 \pm 6.9$  mm. The different components of the fruits were weighed separately and had the following average weights (g): fruit  $388.3 \pm 84.9$ , exocarp  $289.9 \pm 72.2$ , endocarp  $85.4 \pm 10.9$ , seed  $5.7 \pm 1.4$  and nuts  $3.8 \pm 1.4$  (Table 1). Of all 24 analyzed fresh fruits, 23 had two seeds and only one had a single seed.

**Table 1:** Biometry of the 24 analyzed fresh *J. princeps* fruits compared with other studies.

Characteristics	Present work	(CHAVES & DAVIDE, 1996)*	(AVELAR <i>et al.</i> , 2005)
Fruit length (mm)	102.2	85.5 - 104.0	66.01
Fruit width (mm)	96.2	75.0 - 105.0	62.36
Fruit weight (g)	388.3	338.0	64.37
Exocarp weight (g)	289.9	---	20.33
Endocarp weight (g)	85.4	997	33.10
Seed weight (g)	5.7	---	10.94
Nut weight (g)	3.8	---	---

\* Values presented in cm in the original article and converted to mm in this work to facilitate comparisons.

Comparisons of the values obtained in the present work with the biometry data for fruits and seeds of *J. princeps* located on the campus of Universidade Federal de Lavras in Minas Gerais (AVELAR *et al.*, 2005), revealed differences in fruit length, width, and weight. These differences can be explained by the fact that the weights presented by Avelar and collaborators (2005) were for fruits that were dried in the shade for 30 days, whereas this procedure was not performed in the present study. Of the 250 dry endocarps collected from the ground, 13 were discarded in the laboratory because of the significant degree of their deterioration. Thus, biometric analysis was carried out on 237 endocarps with an average length of  $63.0 \pm 5.0$  mm, an average width of  $56.7 \pm 4.2$  mm, and an average weight of  $54.1 \pm 12.3$  g. These values are compatible with the data presented by Chaves & Davide (1996) and Carvalho (2005): endocarps with seeds

measured 5.2 - 6.9 cm long and 5 - 7.2 cm in diameter and had an average weight of 99.7 g.

## Dispersion

The dispersion of fruits and seeds of *J. princeps* is autochorous, notably barochoric, by gravity, and zoochoric, mainly by wild rodents, with an emphasis on the agouti (*Dasyprocta azarae*), which transports the fruit to remove its seeds after germination (HERINGER, 1947). At the study site, however, extensive cattle participation in the mentioned phenophase was documented. The fruits that fall to the ground are trampled by cattle from the herd of the farm, which usually use the shaded area established by the tree's canopy to rest. As a result, the endocarps are broken (fragmented), exposing the seeds, which are sometimes transported in the hooves of the cattle and sometimes adhered to the animals themselves (Fig. 3).

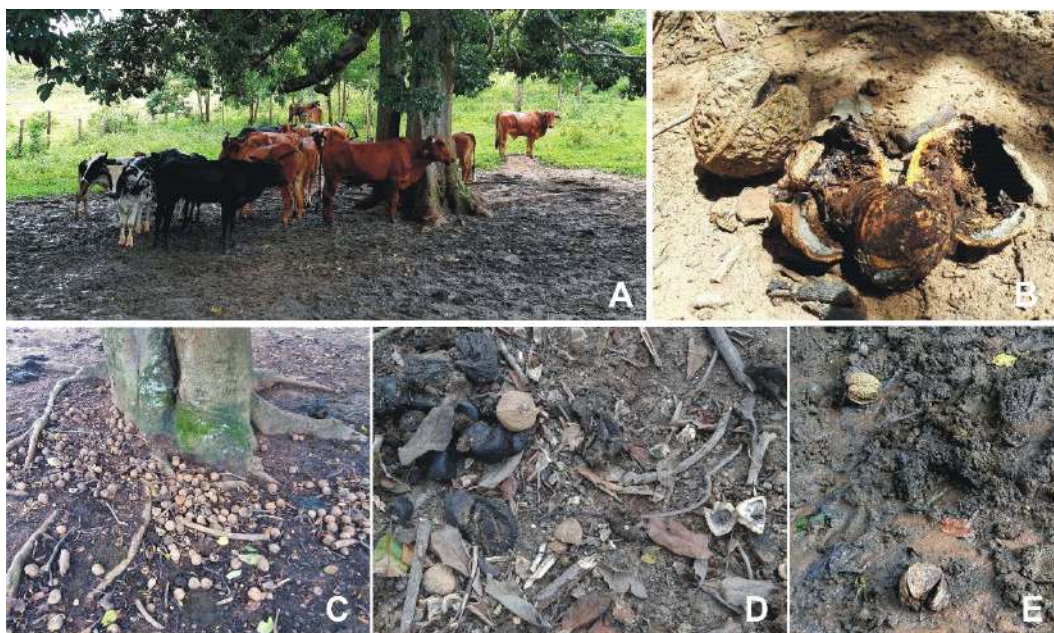


Fig. 3: (A) Cattle from the farm herd using the shaded area established by the canopy of the cutieira tree; (B) fruits fallen on the ground undergoing decomposition; (C) endocarps accumulated at the base of the tree; (D) dry and exposed broken endocarps next to dry cattle feces; (E) fruits fallen on the ground and covered with wet and trampled cattle feces.

Thus, the dispersion of *J. princeps* at the locality is verified as predominantly around the preferential area of passage of the herd. According to the residents of the site, individual agoutis have never been observed in the region. In addition, data published on Táxeus (2023) show that of the 10 species of agouti listed, only three are registered for the state



of Minas Gerais - *Dasyprocta azarae*, *Dasyprocta aurea*, and *Dasyprocta leporina* - none of which occur in Zona da Mata of Minas Gerais, where Sítio do Tanque is located (Fig. 4). Characterized as a collaborative online citizen science platform, Táceus promotes knowledge of Brazilian biodiversity from lists of species of birds, mammals, and amphibians. According to the Táceus project coordinators, from 2023 onwards, it is likely that the database will only be available for consultation, with no possibility of including new lists or modifying existing ones.



Fig. 4: Satellite images showing the occurrence (red dots) of the three agouti species that occur in the state of Minas Gerais: (left) *Dasyprocta azarae*; (center) *Dasyprocta aurea*; (right) *Dasyprocta leporina*. Source: <https://www.taxeus.com.br/>.

## CONCLUSIONS

The results of the present study indicate that *Joannesia princeps* cultivated in an Atlantic Forest fragment in Zona da Mata of Minas Gerais have a phenology like that described in the literature. Furthermore, the dimensions of the fruits and seeds do not differ from that described for the species. The absence of dispersers described for the region, and the occurrence of seeds adhered to the feces of cattle from an extensive family livestock herd, suggest a new strategy of dispersion for the species in the study region. The characteristics described here, along with low nutritional demand and relative adaptability to soils with low nutrient availability, suggest that studies on *Joannesia princeps* be expanded with a focus on knowledge about its economic viability and its use for reforestation in the study region.

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