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ARTICLE

Fruit biometrics and maturity on the quality of *Diospyros inconstans* Jacq. seeds

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ABSTRACT: This study aimed to evaluate the biometric characteristics of fruits and seeds of *Diospyros inconstans* Jacq., germination and formation of seedlings obtained from fruits at three maturity stages, subjected to different temperatures. Biometric data were obtained from 100 fruits and 100 seeds. The determining parameters in the biometry of the fruits were: length, width, mass and number of seeds/fruit and for the seeds: length, width, thickness and mass. In the germination test, a factorial scheme (3x4), three maturity stages (green, intermediate and reddish), and four temperatures (20, 25, 30 and 35 °C) were used. The analyzed variables were: germination, germination speed index (GSI), mean germination time (MGT), time to obtain 50% germination (t50), percentage of seedlings, length and dry mass of shoots and roots, and collar diameter. Fruits and seeds showed greater variation in the parameters fresh mass and number of seeds per fruit. The germination speed index was higher in seeds from reddish fruits, and seeds from green fruits originated better-developed seedlings. Temperatures of 25 and 30 °C are recommended for conducting the seed germination test at the three maturity stages.

Index terms: maturity stages, native species, seed germination.

RESUMO: Este trabalho teve como objetivo avaliar as características biométricas de frutos e sementes de *Diospyros inconstans* Jacq.; a germinação e formação de plântulas obtidas de frutos em três estádios de maturação, submetidos a diferentes temperaturas. Os dados biométricos foram obtidos de 100 frutos e 100 sementes. As variáveis analisadas na biometria dos frutos foram: comprimento, largura, massa e número de sementes/fruto e para as sementes: comprimento, largura, espessura e massa. No teste de germinação utilizou-se esquema fatorial (3x4), três estádios de maturação (verde, intermediário e avermelhado), e quatro temperaturas (20, 25, 30 e 35 °C). As variáveis analisadas foram: germinação, índice de velocidade de germinação (IVG), tempo médio de germinação (TMG), tempo para se obter 50% de germinação (t50), porcentagem de plântulas e, determinou-se o comprimento e a massa seca da parte aérea e da raiz e, o diâmetro do colo. Os frutos e sementes apresentam maior variação nos parâmetros de massa fresca e número de sementes por fruto. O índice de velocidade de germinação é maior em sementes de frutos avermelhados e, sementes de frutos verdes originaram *plântulas melhor desenvolvidas.* Recomenda-se as temperaturas de 25 e 30 °C para a condução do teste de germinação de sementes nos três estádios de maturação.

Termos para indexação: estádios de maturação, espécie nativa, germinação de sementes.

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INTRODUCTION

Diospyros inconstans Jacq. is a native species known in Portuguese as ‘marmelinho’, ‘marmelinho-do-mato’, ‘maria-preta’, ‘cinzeiro’, ‘fruta-de-jacú-macho’, ‘fruta-de-jacú-do-mato’ and ‘granadilo’ (Lorenzi, 2009), belonging to the family Ebenaceae Gürke 1891 and order Ericales Bercht. & J. Presl 1820 (Chase et al., 2016). The dispersal of *D. inconstans* fruits is zoochorous, and these fruits are attracted mainly by the avifauna, responsible for the wide distribution of the seeds (Santos and Sano, 2007).

It is a fleshy fruit that shows color variation in the different stages of its development, with uneven maturation, even in the same plant, which hinders the collection of ripe fruits. Therefore, studies are needed to evaluate the behavior of seeds obtained from fruits at different maturity stages when subjected to different germination temperatures. Temperature variations affect germination speed, percentage and uniformity (Marcos-Filho, 2015). Studies have shown that the different temperature ranges employed influence differently the germination behavior of seeds at different maturity stages (Luz et al., 2014; Silva et al., 2017a). Thus, it is essential to conduct studies evaluating this behavior in order to expand the physiological knowledge about the species.

In addition, biometric evaluations of fruits and seeds are important for the characterization of the studied species, making it possible to know the variability, generating useful information for the conservation and rational exploitation of natural resources, and assisting future studies on genetic improvement and in the differentiation of species of the same genus (Bezerra et al., 2014; Silva et al., 2017b; Silva et al., 2021). The objective of this study was to evaluate the biometric characteristics of fruits and seeds, and the effect of fruits at different maturity stages on seed germination at different temperatures and formation of seedlings of *D. inconstans.*

MATERIAL AND METHODS

Diospyros inconstans Jacq. fruits were collected in June 2020 from six parent trees located in a pasture area in the municipality of Carlinda, MT, Brazil (09°48’24.17” S and 55°49’5.24” W, 750 km from Cuiabá, MT). The botanical material was deposited in the Herbarium of the Southern Amazon (HERBAM/UNEMAT) under the number 26700. Fruits with epicarp color between green and reddish were collected and transported to the Seed Laboratory of the Faculty of Agronomy and Animal Science (FAAZ) of the *Universidade Federal de Mato Grosso State* (UFMT), campus of Cuiabá.

Biometrics: performed on 100 fruits and 100 seeds selected at random. For fruit biometrics, length, width, mass and number of seeds per fruit were determined. In the case of seeds, length, width, thickness and mass were determined. The measurements of length, width and thickness were taken with a precision digital caliper (0.01 mm); length was considered as the measurement from the base to the apex, whereas width and thickness (of the seed) were measured in the midline. Mass was obtained by individual weighing of the fruits and seeds (0.0001 g).

Fruit maturity: The collected fruits were visually classified based on epicarp color and divided into three classes (Figure 1).

The seeds were manually extracted from the fruits, washed in running water with the aid of a sieve and left on a bench for surface drying for 14 ± 1 hour.

Determination of water content: seeds randomly sampled from each class were dried in an oven at 105 ± 3 °C for 24 hours (Brasil, 2009), using three replications of five seeds. Water content was expressed as an average percentage of moisture (wet basis).

Germination test at different temperatures: the seeds were previously treated with Vitavax® fungicide. Then, 100 seeds of each class were placed to germinate in a roll of germitest paper substrate, moistened with water in the amount equivalent to 2.5 times the dry paper mass, using four replications of 25 seeds. The bags with the rolls were placed in a LimaTec® incubator chamber (BOD type, model LT320 TFP-I/320) regulated at constant temperatures of 20, 25, 30 and 35 ± 0.5 °C, with a photoperiod of 12 hours, using LED-PAR lighting (60 $\mu mol.m^{-2}.s^{-1}$).

Maturity stages		Visual color of epicarp	Classification
1		Green	Green
2		Green with reddish spots	Intermediate
3		More than 50% of reddish color	Reddish

Figure 1. Maturity stages of *Diospyros inconstans* Jacq. fruits based on the visual color of the epicarp.

Counts of germinated seeds and formation of seedlings were performed daily for 84 days. However, at a temperature of 20 °C there was a delay in the beginning of germination and consequently in the formation of seedlings. Thus, the evaluations were extended over a period of 136 days. Seeds with protrusion of at least 2 mm of primary root length were considered germinated, and seedlings with all complete structures (root system and shoot) were considered formed.

The following variables were evaluated: germination percentage, germination speed index (GSI) according to Maguire (1962), mean germination time (MGT) expressed in days and calculated according to Labouriau (1983), time to obtain 50% germination (t50) according to Farooq et al. (2005), percentage of seedlings, shoot length, root length, collar diameter and dry mass of the seedlings. Germination percentage corresponded to the percentage of germinated seeds relative to the number of seeds arranged to germinate, determined on the last day of evaluation, according to Labouriau (1983).

Seedling length and dry mass were determined at 84 days after setting up the experiment. Seedling shoot and root (root system) length measurements were taken with a millimeter ruler and expressed in cm. Seedling collar diameter measurements were taken with a precision digital caliper (0.01 mm) and expressed in mm. For these analyses, the number of seedlings formed in each replication (25 seeds) and treatment were used. After being individually measured, the seedlings of each replication were weighed on an analytical balance (Fisher Scientific®, 0.0001g) and placed in kraft paper bags for drying in an oven with forced air circulation regulated at a temperature of 60 ± 1 °C for 48 hours. Soon after this period, they were weighed again on an analytical balance for subsequent calculation of the average dry mass, with results expressed in grams per seedling.

Data analysis: biometric data were subjected to descriptive analysis, obtaining the respective means, minimum value, maximum value, coefficient of variation and standard deviation of the mean. Biometric characteristics were analyzed by frequency distribution and plotted in frequency histograms, with measures of skewness (S) and kurtosis (K). The reference values adopted for the skewness coefficient were: $S < 0$, asymmetric distribution on the left and $S > 0$, asymmetric distribution on the right. For the kurtosis coefficients, the reference values were: $K > 0$, distribution more "tapered" than the normal (leptokurtic) and $K < 0$, distribution more "flattened" than the normal (platykurtic) (Ferreira, 2011). In the case of number of seeds per fruit, a bar graph was used.

The Shapiro-Wilk test was used to assess data normality, and the need for Spearman's correlation (rS) was checked. Statistical analyses were performed using R software (R Core Team, 2021), employing the "agricolae" package to assess skewness and kurtosis (Mendiburu, 2020) and the "corrgram" package for correlation analysis (Wright, 2021).

For the germination test at different temperatures, the experimental design was completely randomized with 12 treatments, in a factorial scheme (4x3) with four constant temperatures (20, 25, 30 and 35 ± 0.5 °C) and three maturity stages (green, intermediate, and reddish) with four replications of 25 seeds each.

The data were subjected to homogeneity (Bartlett) and normality (Shapiro-Wilk) tests, analysis of variance (ANOVA) was performed, and the means were compared by Tukey test at 5% probability level using the “ExpDes.pt” package (Ferreira et al., 2021). The “germinationmetrics” package was used to calculate t50 (Aravind et al., 2021), and the analyses were performed in R software (R Core Team, 2021).

RESULTS AND DISCUSSION

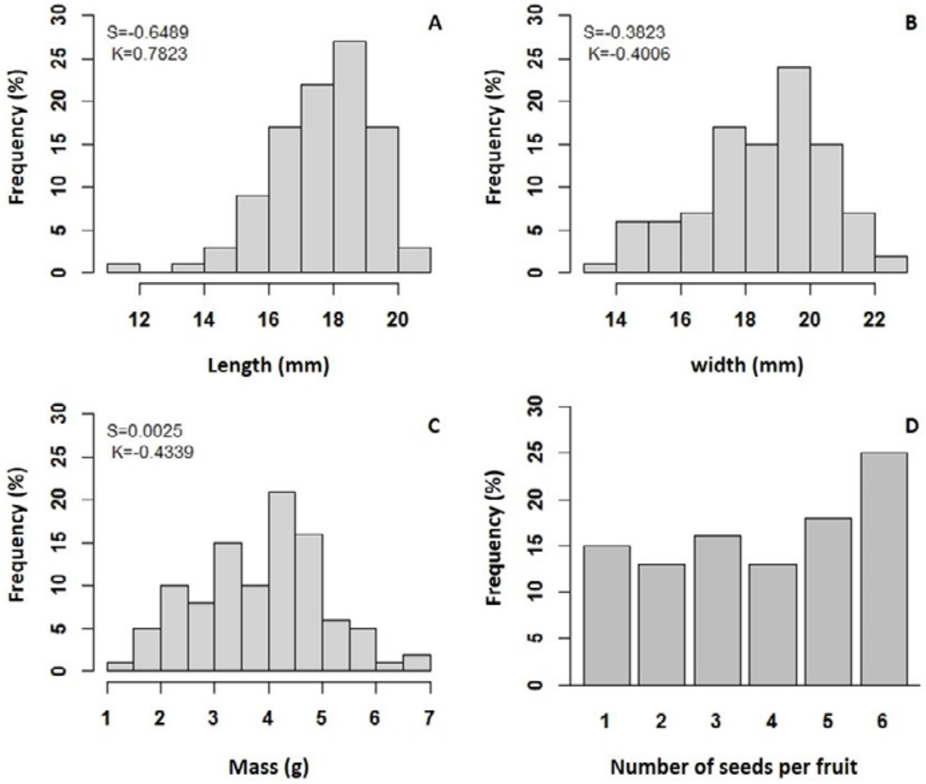
The mean values of fruit dimensions, as well as fresh mass and number of seeds are shown in Table 1. The coefficient of variation for the number of seeds per fruit was high (46.99%), indicating heterogeneity, since the values ranged from 1 to 6 seeds, with an average of 3.81. For both fruits and seeds, the mass showed greater variation when compared with the size of fruits and seeds (Table 1). Mean values of length (13.0 ± 0.5 mm) and width (6.0 ± 0.6 mm) (n = 30) of *D. inconstans* seeds, with dimensions similar to the ones described in here have already been found in other studies (Liesenfeld et al., 2008).

The data of length, width, mass and number of seeds per fruit were distributed in frequency classes (Figure 2). The fruits showed variation in length from 11.99 to 20.90 mm, width from 13.93 to 22.80 mm and mass from 1.43 to 6.75 g. Most fruits had greater length (84%) ranging from 16.00 to 19.85 mm and greater width (71%) from 17.08 to 21.00 mm (Figures 2A and 2B). For mass data, 62% of the fruits had values from 3.0863 to 4.9609 g (Figure 2C). The number of seeds ranged from 1 to 6, and all fruits evaluated had at least 1 seed (Figure 2D). There was little variation between the percentages of fruits with 1 (15%), 2 (13%), 3 (16%), 4 (13%) or 5 seeds (18%), with greater representativeness, 25%, of fruits with 6 seeds.

Lopes (1999) mentions that the species *D. ebenaster*, despite having 8 locules and 8 ovules, showed several seeds ranging between 1 and 8, because some ovules do not develop. This author also mentions that *D. janeirensis* has 6 locules and 6 ovules and has fruits with seeds that begin their development but are small compared to the others. According to the same author, in *D. inconstans* there was no reduction in the number or even in the size of the seeds. However, in this study it was observed that *D. inconstans* fruits showed variation from 1 to 6 seeds and there were seeds that did not develop completely (Figure 3). In addition, Liesenfeld et al. (2008) stated that the number of seeds per fruit of *D. inconstans* is variable. However, the authors found a variation of 3 to 6 seeds (mode = 4; n = 46), with no occurrence of 1 or 2 seeds per fruit.

Table 1. Mean, standard deviation (SD) and coefficient of variation (CV) of the biometric variables of fruits and seeds of *Diospyros inconstans* Jacq.

Characteristics	Mean	SD	CV (%)
	Fruits		
Length (mm)	17.63	1.55	8.78
Width (mm)	18.59	2.04	10.97
Fresh mass (g)	3.885	1.16	29.99
Number of seeds per fruit	3.81	1.79	46.99
	Seeds		
Length (mm)	13.67	1.15	8.42
Width (mm)	7.63	0.54	7.13
Thickness (mm)	4.61	0.44	9.53
Fresh mass (g)	0.3447	0.07	20.42



S: skewness coefficient; K: kurtosis coefficient; (n = 100).

Figure 2. Length (A), width (B), mass (C) and number of seeds per fruit (D) of *Diospyros inconstans* Jacq.

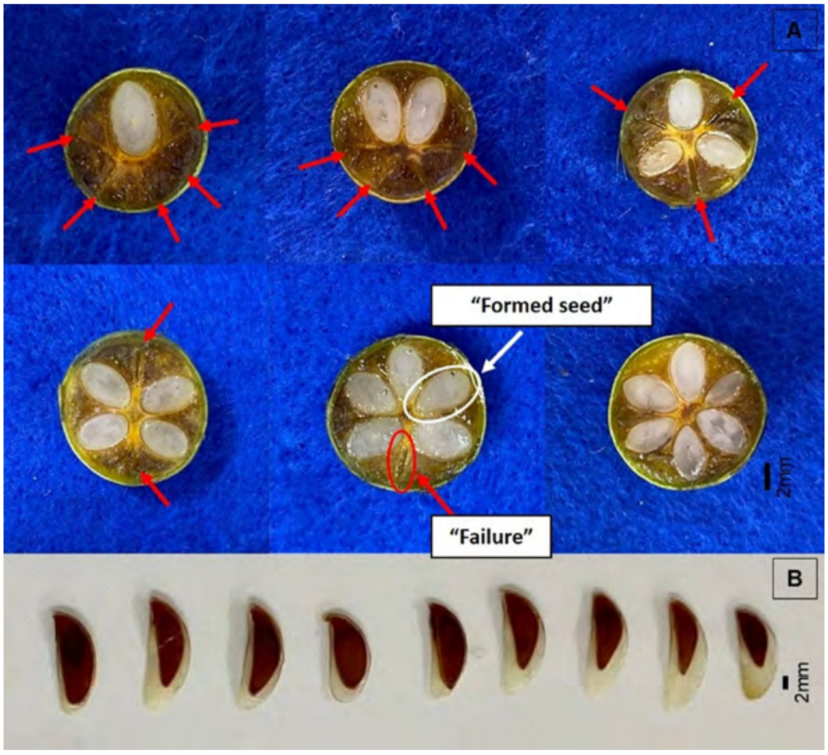


Figure 3. Variation in the number of seeds per fruit, 1 to 6 seeds (A) and "failures" in the formation of seeds (B) of *Diospyros inconstans* Jacq., 2020. Red arrows indicate "failure" and white arrow indicates a formed seed.

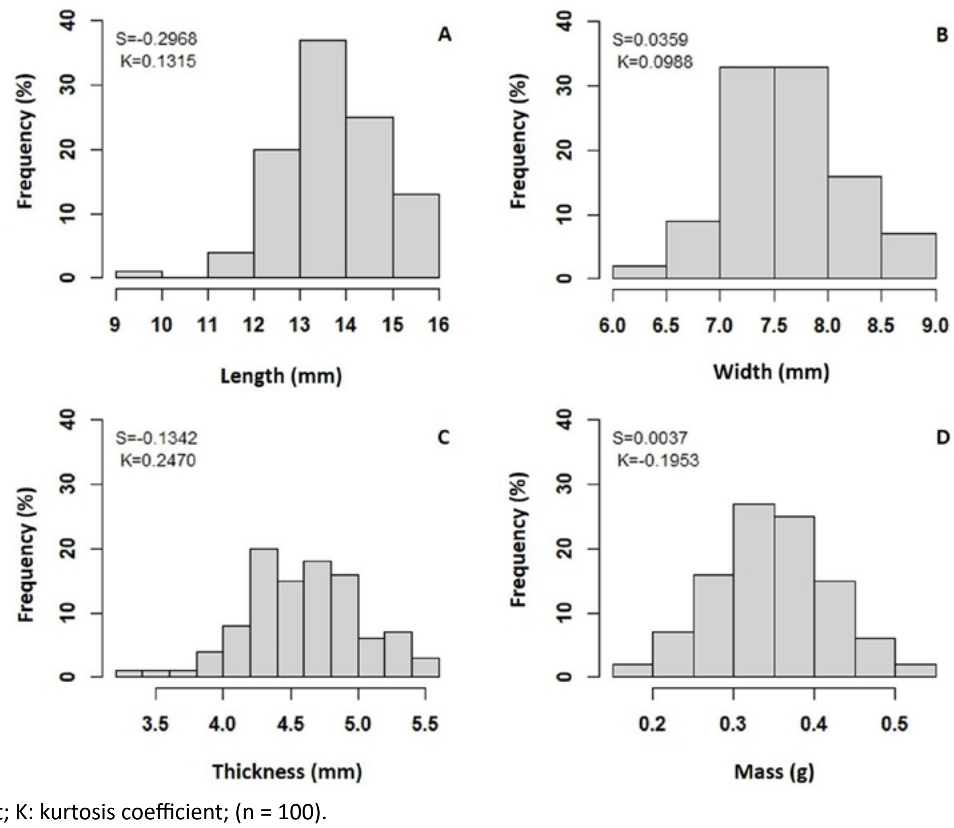
These differences found in relation to the number of seeds per fruit may be associated with genetic characteristics or even with characteristics of the environment in which they are found, since they come from different regions. In addition, forest species have periodicity in seed production; in some years, flowering may be abundant, while in the other two or three subsequent years, it may be much lower (Medeiros and Nogueira, 2006).

The number of seeds per fruit is related to the effectiveness of pollination (Kageyama and Piña-Rodrigues, 1993; Sousa et al., 2009). Thus, the variation in the number of seeds per fruit may be associated with pollination failures, since this species has unspecialized pollination syndrome, with pollination carried out by small insects, such as small wasps, bees, flies, butterflies, moths, beetles, and other insects (Yamamoto et al., 2007). In addition, there are several factors that can affect the production of seeds of tree species.

Environmental stresses during early seed development can have effects on the potential yield of the plant, as factors that reduce photosynthesis, such as water stress, shading or defoliation, can drastically reduce success in seed development (Castro et al., 2004). Basic studies on floral biology, phenology and pollinator behavior are needed to better understand the causes of failures in seed production, periodicity, and low production (Kageyama and Piña-Rodrigues, 1993).

The values of length, width, thickness and mass of the seeds were distributed in frequency classes (Figure 4). The seeds had length ranging from 9.96 to 15.91 mm, width from 6.16 to 8.86 mm, thickness from 3.36 to 5.60 mm and mass from 0.17 to 0.51 g. Most of the seeds sampled had greater length (82% with 12.02 to 14.91 mm) and thickness (69% with 4.21 to 5.00 mm) (Figures 4A and 4C), as well as smaller width (66% from 7.06 to 8.00 mm) and mass (52% from 0.3013 to 0.3966 g) (Figures 4B and 4D).

In addition to evaluating the aspects of fruits and seeds, it is necessary to know the association between these attributes. Positive correlations ranging from 0.04 to 0.97 and negative correlations ranging from -0.01 to -0.42 were observed (Figure 5).



S: skewness coefficient; K: kurtosis coefficient; (n = 100).

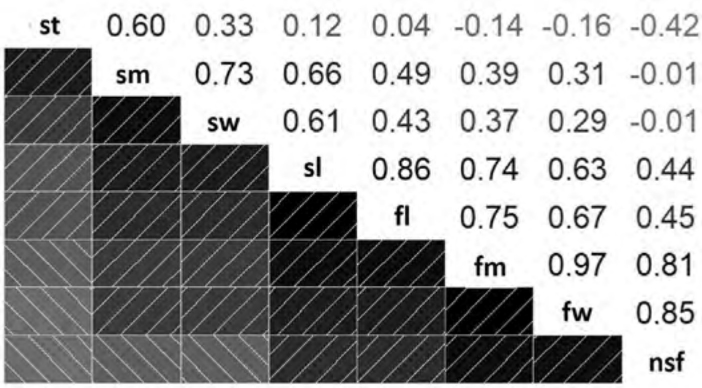
Figure 4. Length (A), width (B), thickness (C) and mass (D) of seeds of *Diospyros inconstans* Jacq.

As illustrated in Figure 5, seed mass showed a positive correlation with the other biometric variables of the seeds, such as thickness (0.60), width (0.73) and length (0.66). A selection by seed size would allow obtaining seeds with higher fresh mass. According to Carvalho and Nakagawa (2012), seeds with larger dimensions have a greater amount of reserve substances for the development of the embryonic axis. Seed length was positively correlated with seed width (0.61), and with fruit length (0.86), width (0.63) and mass (0.74).

Fruit mass showed a positive correlation with the biometric variables length (0.75), width (0.97) and number of seeds per fruit (0.81). The number of seeds per fruit was also correlated with fruit width (0.85). Thus, fruits with a greater number of seeds can be obtained through the selection of fruits with greater width or fresh mass. According to Lopes (1999), *D. inconstans* fruit has a poorly developed mesocarp, so its mass is not associated with the amount of pulp but may be associated with the number of seeds per fruit.

The initial water content of the seeds was 48.46% for those obtained from green fruits, 55.19% for those from intermediate fruits and 50.37% for those from reddish fruits. The interaction between the factors fruit maturity stages and germination temperature was not significant for germination percentage and germination speed index, seedling formation and t50.

Germination percentage, seedling formation and t50 did not differ between the maturity stages, but seeds from reddish fruits showed a higher germination speed index (Table 2). These results may be associated with seed maturation since reddish fruits are at a more advanced stage of maturity. Kaiser et al. (2016) studied seeds of *Allophylus edulis*



st: seed thickness; sm: seed mass; sw: seed width; sl: seed length; fl: fruit length; fm: fruit mass; fw: fruit width and nsf: number of seeds per fruit.

Figure 5. Spearman's correlation (rS) of biometric characteristics of fruits and seeds of *Diospyros inconstans* Jacq.

Table 2. Germination percentage, germination speed index (GSI), time to obtain 50% germination (t50) and percentage of formation of seedlings of *Diospyros inconstans* Jacq. grown from seeds obtained from fruits at three maturity stages, at constant temperatures.

Maturity stages	Temperatures (°C)				Means
	20	25	30	35	
	Germination (%)				
Green	87.89 Bb	97.91 Aa	93.30 Aab	93.96 Aab	93.26 A
Intermediate	95.83 ABa	94.74 Aa	92.57 Aa	94.88 Aa	94.50 A
Reddish	96.00 Aa	95.92 Aa	97.00 Aa	93.96 Aa	95.71 A
Means	93.24 a	96.19 a	94.29 a	94.26 a	
	CV (%) = 4.93				

Continue...

Table 2. Continuation.

Maturity stages	Temperatures (°C)				Means
	20	25	30	35	
			Seedlings (%)		
Green	0.00 Ac	95.91 Aa	89.90 Aa	16.42 Ab	50.55 A
Intermediate	6.17 Ac	92.65 Aa	88.36 Aa	20.58 Ab	51.94 A
Reddish	10.00 Ab	93.92 Aa	96.00 Aa	15.13 Ab	53.76 A
Means	5.38 c	94.16 a	91.41 a	17.37 b	
			CV (%) 13.02		
			GSI		
Green	0.52 Ac	0.96 Aa	0.98 Ba	0.68 Bb	0.78 B
Intermediate	0.60 Ac	0.90 Aab	0.97 Ba	0.79 ABb	0.81 B
Reddish	0.64 Ac	0.98 Ab	1.15 Aa	0.85 Ab	0.90 A
Means	0.58 d	0.94 b	1.03 a	0.77 c	
			CV (%) = 8.69		
			t50 (days)		
Green	38.05 Ac	24.79 Aa	21.62 Aa	33.49 Bb	29.49 A
Intermediate	39.18 Ac	25.70 Aa	22.89 Aa	30.43 ABb	29.55 A
Reddish	38.60 Ac	24.35 Aa	21.11 Aa	28.60 Ab	28.16 A
Means	38.61 d	24.95 b	21.87 a	30.84 c	
			CV (%) = 6.56		

Means followed by different lowercase letters in the rows and uppercase letters in the columns differ from each other by Tukey test ($p<0.05$). CV: coefficient of variation.

(A. St.-Hil., A. Juss. & Cambess.) Hieron. ex Niederl. and observed the highest germination speed indices in seeds extracted from red fruits (more advanced maturity stage). Cruz et al. (2021) found that the germination speed indices of *Anadenanthera colubrina* (Vell.) Brenan seeds were influenced by the maturity stage, as seeds from fruits with dark reddish brown and light brown colors showed higher germination speed index. Silva et al. (2022) studying the maturation of seeds of *Trichosanthes cucumerina* L. (Cucurbitaceae) also found that the germination speed is increased with advancing age at fruit harvest.

Temperature did not influence the germination percentage, with values ranging from 93.24 to 96.19%. At temperatures of 25 and 30 °C, the percentage of seedling formation was higher (94.16 and 91.41%, respectively) (Table 2). The temperature of 30 °C promoted higher seed performance regarding the germination speed index and reduced the time to obtain 50% germination (t50). This may have occurred because temperature influences germination by acting both on the speed of water absorption and on the biochemical reactions that determine the entire process (Carvalho and Nakagawa, 2012).

The seeds began to germinate from the ninth day after sowing, varying according to the fruit maturity stage and temperature used in the test. The best germination behavior of the seeds occurred at a temperature of 30 °C with a reduction in the mean germination time for the three maturity stages (Figure 6, 7 and 8). Seeds from reddish fruits showed lower mean germination time at all temperatures evaluated (Figure 8).

The temperature of 20 °C delayed the start and prolonged the period of germination and seedling formation. The percentages of formed seedlings grown from seeds obtained from green, intermediate, and reddish fruits were 78.94, 90.00 and 84.62%, respectively. Fruit maturity stages did not influence the percentage of seedling formation, shoot length, root length and collar diameter when the seeds were subjected to a temperature of 20 °C. However,

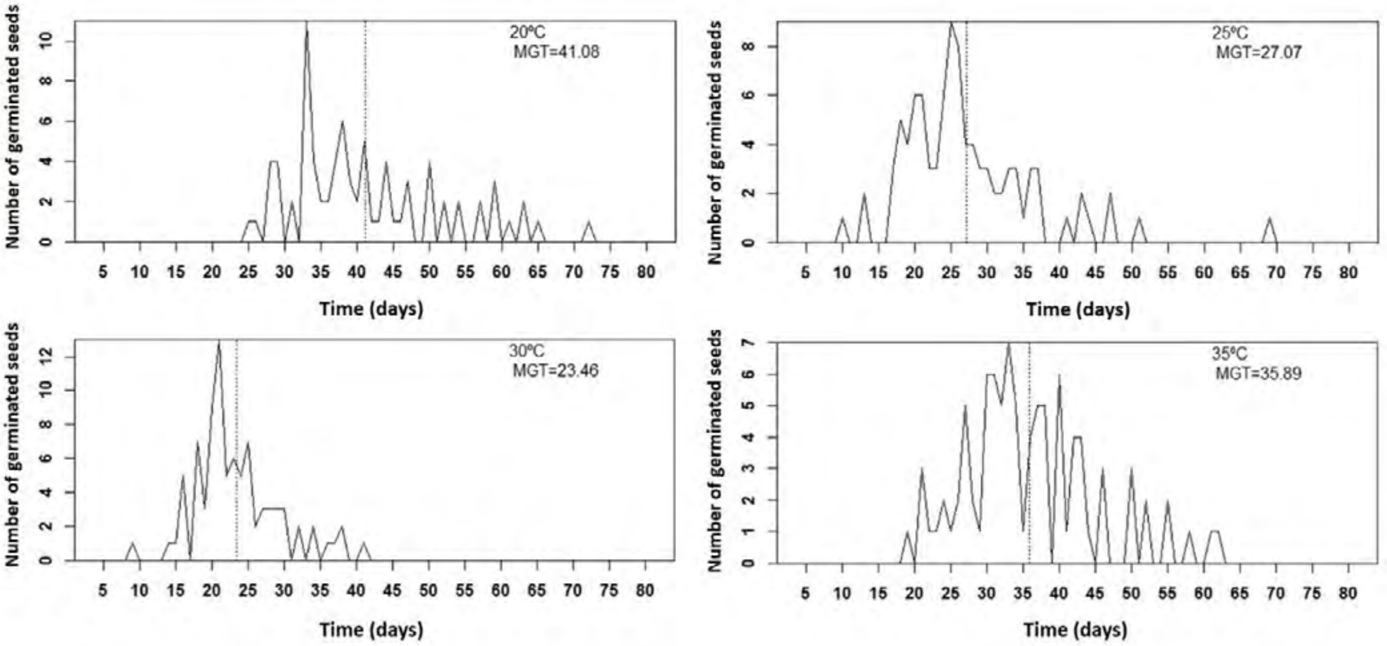


Figure 6. Germination frequencies of seeds from green fruits of *Diospyros inconstans* Jacq. under different temperatures. Vertical bars represent the mean germination time (MGT) of the seeds.

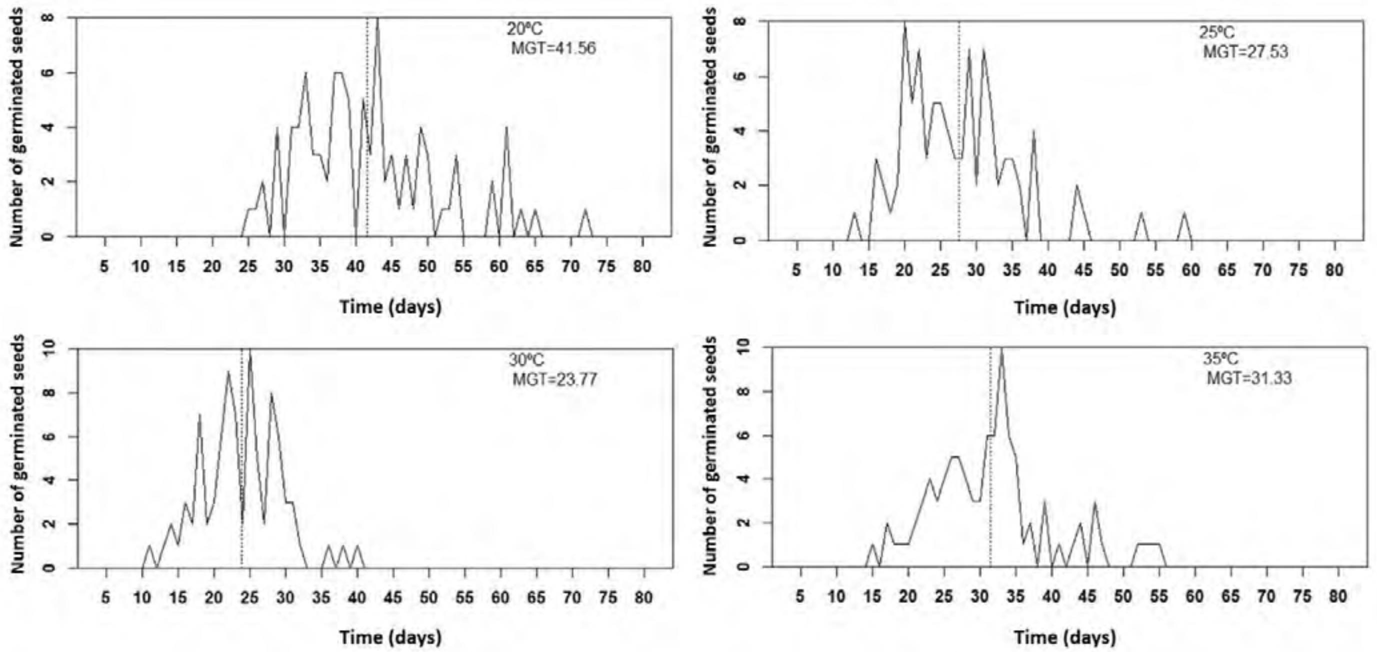


Figure 7. Germination frequencies of seeds from intermediate fruits of *Diospyros inconstans* Jacq. under different temperatures. Vertical bars represent the mean germination time (MGT) of the seeds.

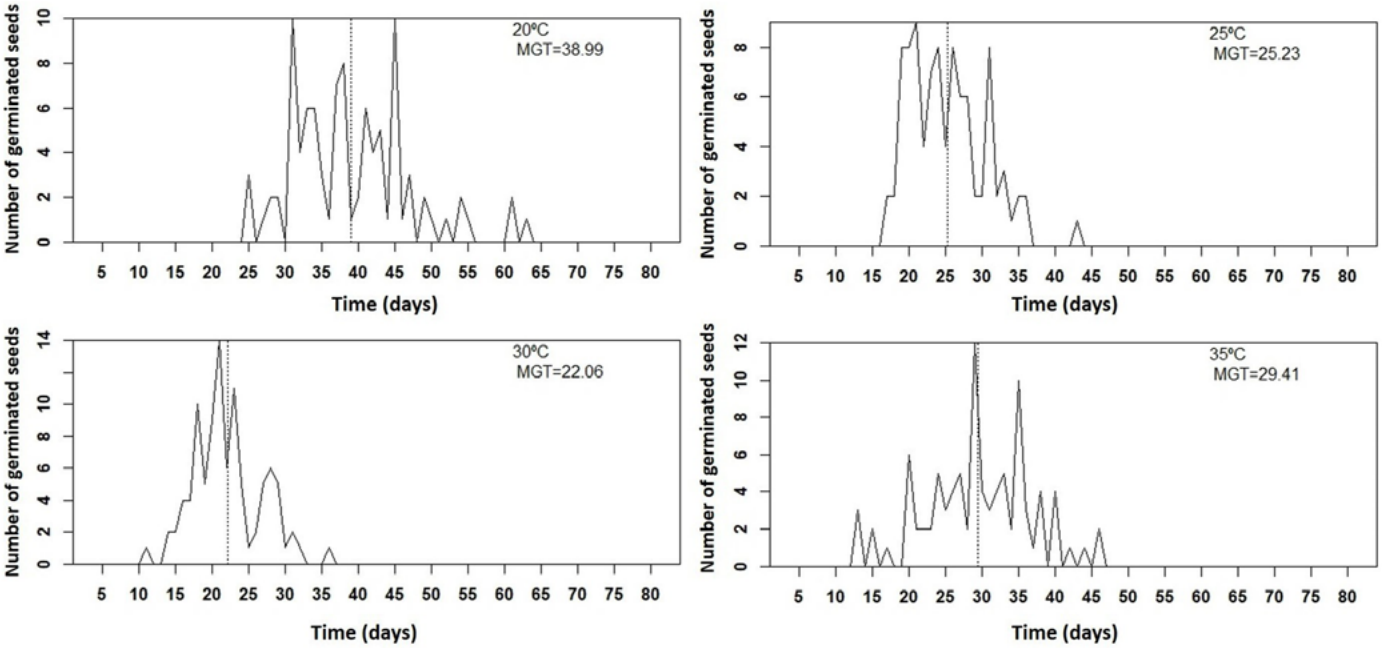


Figure 8. Germination frequencies of seeds from reddish fruits of *Diospyros inconstans* Jacq. under different temperatures. Vertical bars represent the mean germination time (MGT) of the seeds.

seeds from green fruits generated seedlings with higher dry mass, not differing from seedlings grown from seeds from intermediate fruits (Table 3).

After a period of 136 days, the seedlings formed at a temperature of 20 °C showed a reduction in growth, with lower values of shoot length, root length and collar diameter compared to those developed at temperatures of 25 and 30 °C. According to Marcos-Filho (2015), when imbibition occurs at low temperature it can cause delayed growth of seedlings, because the reduction of temperature causes a decrease in the speed of imbibition and mobilization of reserves, which leads to a reduction in germination speed. Similarly, seeds of species such as *Peltophorum dubium* (Spreng.) Taub. (Pereira, 2013), *Diptychandra aurantiaca* (Mart.) Tul. (Oliveira et al., 2013), *Cedrela fissilis* Vell. (Oliveira and Barbosa, 2014), *Dalbergia cearensis* Ducke (Nogueira et al., 2014) showed lower germination speed at a temperature of 20 °C. According to Leão-Araújo et al. (2019), the imbibition and primary root protrusion of *Campomanesia adamantium* (Cambess.) O. Berg. seeds are slower when they are subjected to a temperature of 20 °C.

The temperature of 35 °C was harmful to the species, because despite promoting a normal germination, the percentage of seedling formation was reduced regardless of the maturity stage of the fruit from which the seed was obtained. The seedlings showed reduced total length and stunted root system.

There was no interaction between maturity stages and temperatures for shoot length, collar diameter and seedling dry mass (Table 4). It was observed that the temperature of 30 °C promoted greater growth of seedlings in terms of shoot and root length. Conversely, greater dry matter accumulation and larger collar diameter were obtained at a temperature of 25 °C. For root length, there was an interaction between the maturity stages and the temperatures evaluated. At a temperature of 30 °C, seeds from green fruits showed better performance, with higher root growth (Table 4).

For the maturity stages, it was observed that seedlings grown from seeds obtained from green fruits were more vigorous, because they had greater shoot length, root length, collar diameter and dry mass, showing no significant difference regarding shoot length compared to those grown from seeds from reddish fruits. Possibly, this is due to the variation in seed quality during development, as the ability of seeds to germinate is the first to be developed, followed by desiccation tolerance, vigor and finally longevity in storage (Castro et al., 2004). Therefore, the maximum vigor of

Table 3. Seedling formation, shoot length, root length, collar diameter and dry mass of seedlings of *Diospyros inconstans* Jacq. grown from seeds obtained from fruits at different maturity stages, at a temperature of 20 °C.

Maturity stages	S (%)	SL (cm)	RL (cm)	CD (mm)	DM (g.seedling^{-1})
Green	78.94 A	3.49 A	7.72 A	1.30 A	0.0967 A
Intermediate	90.00 A	3.89 A	7.29 A	1.30 A	0.0890 AB
Reddish	84.62 A	3.73 A	7.02 A	1.24 A	0.0790 B
CV (%)	9.28	7.49	8.19	2.58	6.42

Percentage of seedlings formed (S), shoot length (SL), root length (RL), collar diameter (CD), seedling dry mass (DM) and coefficient of variation (CV). Means followed by the same letter, uppercase in the column, do not differ statistically from each other by Tukey test (p<0.05). CV: coefficient of variation.

Table 4. Shoot length, root length, collar diameter and dry mass of seedlings of *Diospyros inconstans* Jacq. grown from seeds obtained from fruits at different maturity stages, at temperatures of 25 and 30 °C, 2020.

Maturity stages	Temperatures (°C)		Means
	25	30	
Shoot length (cm)			
Green	6.13 Ab	8.83 Aa	7.47 A
Intermediate	5.52 Bb	7.95 Ba	6.73 B
Reddish	5.88 ABb	8.32 ABa	7.10 AB
Means	5.84 b	8.36 a	
CV (%) = 4.30			
Root length (cm)			
Green	11.40 Ab	16.26 Aa	13.83 A
Intermediate	10.15 Ab	12.19 Ba	11.17 B
Reddish	10.12 Ab	13.12 Ba	11.62 B
Means	10.55 b	13.85 a	
CV (%) = 7.26			
Collar diameter (mm)			
Green	2.43 Aa	2.16 Ab	2.30 A
Intermediate	2.31 Ba	2.05 ABb	2.18 B
Reddish	2.12 Ca	1.97 Bb	2.04 C
Means	2.29 a	2.06 b	
CV (%) = 2.93			
Dry mass (g.seedling^{-1})			
Green	0.0923 Aa	0.0815 Ab	0.0869 A
Intermediate	0.0873 Aa	0.0727 Bb	0.0800 B
Reddish	0.0758 Ba	0.071 Ba	0.0734 C
Means	0.0851 a	0.0750 b	
CV (%) = 4.7			

Means followed by different lowercase letters in the rows and uppercase letters in the columns differ from each other by Tukey test (p<0.05). CV: coefficient of variation.

seeds can be reached before the complete ripening of the fruit, so studies that evaluate the longevity in storage are necessary, since it is the last characteristic acquired by the seed.

According to Carvalho and Nakagawa (2012), the maximum vigor of a seed can be reached when the maximum dry matter accumulation is obtained, with possible lags between the curves, depending on the species and environmental conditions, and from this point on it tends to remain constant or decrease. It was found that, for other species, the seeds reached the point of physiological maturity when the fruits were still green in color, as observed for *Capsicum annuum* L. (Ricci et al., 2013), *Sabal mauritiiformis* (H. Karst.) Griseb. ex. H. Wendl. (Luz et al., 2014), and *Veitchia merrilli* (Becc) H. E. Moore (Zuffo et al., 2022). Thus, seeds obtained from green fruits of *D. inconstans* can be used for the production of seedlings, without losses in germination percentage (above 85%) and with the formation of vigorous seedlings. In addition, the collection of seeds can be performed before the change of color, avoiding losses due to the possible delay of collection (fall of the fruits) or consumption and predation by animals, since *D. inconstans* has fruits that are attractive mainly for birds, and most of them are eaten before they fully ripen.

CONCLUSIONS

D. inconstans fruits and seeds show greater variation in the parameters fresh mass and number of seeds per fruit.

Fruits with a greater number of seeds can be obtained through the selection of fruits with greater width and mass.

Temperatures of 25 and 30 °C are suitable for germination of seeds and formation of seedlings of *D. inconstans*, regardless of the maturity stage.

Germination speed index is higher in seeds from reddish fruits, and seeds from green fruits originated *better-developed seedlings.*

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