

Physiological maturity of *Cnidosculus quercifolius* Pax & K. Hoffm. seedsMaturidade fisiológica de sementes de *Cnidosculus quercifolius* Pax & K. Hoffm.Lígia Maria de Medeiros Silva¹; Ivor Bergemann de Aguiar²; Valderez Pontes Matos³;
Ricardo Almeida Viégas⁴; Izaque Francisco Candeia de Mendonça⁴**Abstract**

Cnidosculus quercifolius (Euphorbiaceae) is an important tree species native from the semi-arid region of the northeastern Brazil. Physiological maturity of seeds was studied in order to establish indices to determine the best time for fruit collection. Fruits were weekly collected from 30 to 72 days after flowering, and features such as color, size, both fresh and dry mass and dehiscence were observed. Extracted seeds were analyzed regarding the color, moisture content, germination and vigor. The results showed that color, size and fresh mass of fruits were not able to predict seed maturity. Seed physiological maturity occurred 65 days after flowering, when higher values of fruit dry mass, as well as seed germination and vigor were found. At this time seed moisture content was 22.7%. The fruit exocarp was coiled, but remained adhered to the endocarp; this feature represents an effective and practical visual indicator of collection time. Seeds are released in an explosive way by natural dehiscence after 72 days of flowering.

Keywords: Forest seed, Maturation, Physiological quality, Fruiting, Collection

Resumo

Cnidosculus quercifolius (Euphorbiaceae) é uma importante espécie arbórea nativa da região nordeste do Brasil, conhecida como faveleira. A maturidade fisiológica das sementes dessa espécie foi estudada com o objetivo de determinar índices que estabeleçam a melhor época de coleta de seus frutos. Os frutos foram coletados semanalmente, durante o período de 30 a 72 dias após o florescimento, quando características como coloração, tamanho, massas fresca e seca e deiscência foram observadas. As sementes extraídas foram analisadas quanto à coloração, teor de água, germinação e vigor. Os resultados mostraram que a coloração, o tamanho e a massa fresca dos frutos não foram eficientes para refletir a maturidade das sementes. A maturidade fisiológica ocorreu aos 65 dias após o florescimento, quando foram obtidos valores máximos de massa seca dos frutos, bem como de germinação e vigor das sementes. Nessa época, o teor de água das sementes foi de 22,7%. O epicarpo dos frutos fica enrolado, porém aderido ao endocarpo, constituindo um eficiente e prático índice visual da época de coleta. A deiscência natural ocorre aos 72 dias após o florescimento, liberando de forma explosiva as sementes do interior dos frutos.

Palavras-chave: Semente florestal, Maturação, Qualidade fisiológica, Frutificação, Coleta, Faveleira

INTRODUCTION

Studies on seed physiological maturity are important for the planning of collection, since mature seeds have a higher germinative capacity and energy (BARNETT, 1979; EDWARDS, 1980; PIÑA-RODRIGUES and AGUIAR, 1993). Seeds collected before maturation present a smaller potential of storage because they are not completely formed in terms of reserve components (OLIVER, 1974), while those collected

with high physiological quality are able to keep the physiological quality and thus support, besides storage, programs of breeding and restoration of degraded areas (FIGLIOLIA and KAGEYAMA, 1994).

Morphological, physical and biochemical changes occurring in fruits and seeds are used as indices of seed physiological maturity (BARNETT, 1979; EDWARDS, 1980). For native tree species in Brazil, physiological maturity of seeds is frequently associated with fruit features such

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as color, texture, size, weight and moisture content (PIÑA-RODRIGUES and AGUIAR, 1993).

Cnidoscylus quercifolius is an important arboreal species native of semi-arid region of Brazil, with great resistance to drought and therefore used both in commercial plantings and in restoration of degraded areas (BRAGA, 1976; GOMES, 1982; LORENZI, 1998). Seed physiological maturity of *C. quercifolius* was studied to determine the right time for seed collection in the area of natural occurrence.

MATERIAL AND METHODS

This study was carried out in the Caatinga biome in the city of Patos, Paraíba State, Brazil (07° 01' S and 37° 17' W, at 250 m of altitude). The climate is type BSh (hot and dry) and the average temperature varies between 26 and 29 °C. The annual precipitation oscillates between 250 and 800 mm and the rain is concentrated on a period of three to five months (AMARO and CAVALCANTE, 1981).

The observations of flowering and fruiting were done from January to July 1998. Five trees located in different places of the area were selected according to the size, vigor and sanity, and identified with a metallic foil. In March, during the peak of flowering, branches were marked in each tree with a red plastic ribbon and weekly observed in order to verify the fruiting development.

From 30 days after flowering, when the fruits are completely green, they were weekly collected by hand until the natural dehiscence. The collected fruits were packaged in cotton bag and placed under shade to drying, spontaneous opening and seed extraction, according to Silva *et al.* (1993).

The following evaluations were conducted in the Laboratory of Systematic Botany of the Centro de Saúde e Tecnologia Rural da Universidade Federal da Paraíba, *campus* de Patos: (a) fruit size – volume (v) was used as fruit index size; due to the ellipsoidal shape, the formula $v = \pi/6 \cdot h \cdot d^2$ was used, where both height (h) and diameter (d) were measured with a calipers in four replications of 25 fruits and the results were expressed in cm^3 ; (b) fruit fresh and dry mass – four replications of eight fruits were weighed in analytical balance with precision of 0,001 g to obtain the fresh mass; the dry mass was determined after drying at 80 °C until constant weight; (c) seed moisture content – performed by submitting four replications of 100 seeds in an oven regulated at the temperature of 105 ± 3 °C for 24 h and the results were expressed in percentage as

described in the Brazilian Rules for Seed Testing (BRASIL, 1992); (d) seed germination and vigor – obtained as following described.

The germination was performed with four replications of 25 seeds, with an eight hours photoperiod under fluorescent lamps and average room temperature ranging from 29 °C (day) to 21 °C (night). Seeds were initially immersed in 2% sodium hypochlorite solution for 10 min and then placed on sand washed and autoclaved into plastic box (30 cm length and 28 cm width), and then daily humidified with distilled water. The germination was counted daily, being considered germinated the seeds which presented primary root with positive geotropic curvature and 1 cm length. Germination (final germination percentage) and vigor (speed of germination, expressed in days^{-1}) were calculated according to Labouriau and Agudo (1987). Evaluations were concluded after 28 days of seeding.

The experimental design used was the completely randomized (PIMENTEL-GOMES and GARCIA, 2002). Equations of regression for the evaluated parameters were adjusted and analysis of simple correlation among the parameters was performed. For each evaluated parameter, analysis of variance was done and the Tukey test was applied to compare averages between each collection at 5% probability; the results of these last analyses are not presented, but were used in the discussion.

RESULTS AND DISCUSSION

For all the evaluated parameters, the observed data were adjusted to the equation of cubic regression.

The germination started 44 days after flowering and has gradually increased until 72 days, when maximum values of germination and vigor were obtained (Figure 1). These values did not differ significantly from those obtained 65 days after flowering, indicating that at this time seeds had already reached the physiological maturity.

Seed moisture content decreased during maturation (Figure 1) and that reduction showed small change until 44 days after flowering. However, it was accentuated after this period and attained the minimum value at 72 days after flowering. At the physiological maturity (65 days after flowering), seeds had 22,7% of water. In the previous collection (58 days after flowering), seed moisture content was significantly superior (38,7%), indicating that this parameter is effective to express seed maturation.

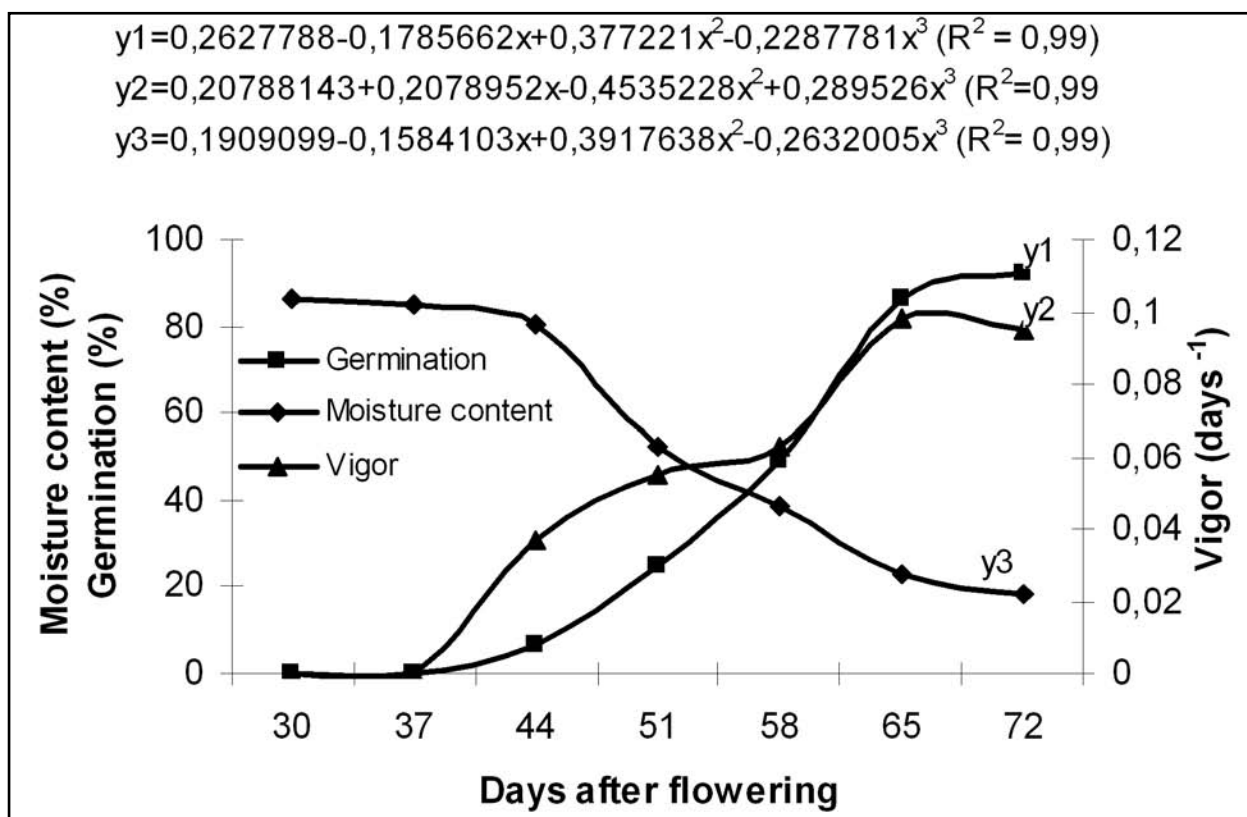


Figure 1. Seed moisture content, germination and vigor of *Cnidoscylus quercifolius* in different maturation stages. Patos (PB), Brazil.

Figura 1. Germinação e vigor de sementes de *Cnidoscylus quercifolius* em diferentes estádios de maturação. Patos (PB), Brasil.

In some Brazilian tree species, seed moisture content varied from 20 to 25% at the maturity, as in *Enterolobium contortissiliquum* (BORGES *et al.*, 1980), *Tabebuia avellanedae* (BARBOSA *et al.*, 1992), *Dalbergia nigra* (MARTINS and SILVA, 1997) and *Mimosa caesalpiniiifolia* (ALVES *et al.*, 2005). In contrast, seeds of other species attained physiological maturity with a high moisture content (50 to 62%), as in *Tabebuia impetiginosa* (GEMAQUE *et al.*, 2002), *Tabebuia chrysostricha* (FONSECA *et al.*, 2005) and *Bixa orellana* (MENDES *et al.*, 2006).

Fruit size and mass increased during maturation (Figure 2) and the maximum values were attained at 58 days (size and fresh mass) and 65 days (dry mass) after flowering. Generally maximum fruit size is achieved before seeds reach physiological maturity, as reported by Barnett

(1979), Edwards (1980), Piña-Rodrigues and Aguiar (1993) and Castellani and Aguiar (2001).

Positive and high correlations between fruit dry mass and both germination and vigor of seeds were verified and seed moisture content correlated in a negative way with all the evaluated parameters (Table 1). Only fruit fresh mass presented positive correlation with fruit size and this shows that variation in fresh mass followed by fruit size changes.

Little changes were observed on fruit color, which was maintained green during whole the processes of formation and maturation. More changes were observed in the seed coat color, which was white in the initial crops. Seeds were brown from 51 to 65 days after flowering, but were again white after 72 days of flowering. So, both fruit and seed color were not a good indicator of seed physiological maturity.

Table 1. Coefficient of simple correlation among parameters of *Cnidoscylus quercifolius* fruits and seeds collected in different maturation stages. Patos (PB), Brazil.

Tabela 1. Coeficiente de correlação simples entre os parâmetros de frutos e sementes de *Cnidoscylus quercifolius* avaliados em diferentes estádios de maturação. Patos (PB), Brasil.

Parameter	Seed vigor	Seed moisture content	Fruit dry mass	Fruit fresh mass	Fruit size
Seed germination	0,95**	-0,98**	0,98**	0,44 ^{ns}	0,22 ^{ns}
Seed vigor		-0,96**	0,98**	0,62 ^{ns}	0,49 ^{ns}
Seed moisture content			-0,97**	-0,63 ^{ns}	-0,41 ^{ns}
Fruit dry mass				0,55 ^{ns}	0,34 ^{ns}
Fruit fresh mass					0,91**

** significant at P < 1%; ^{ns} - not significant at P > 5%

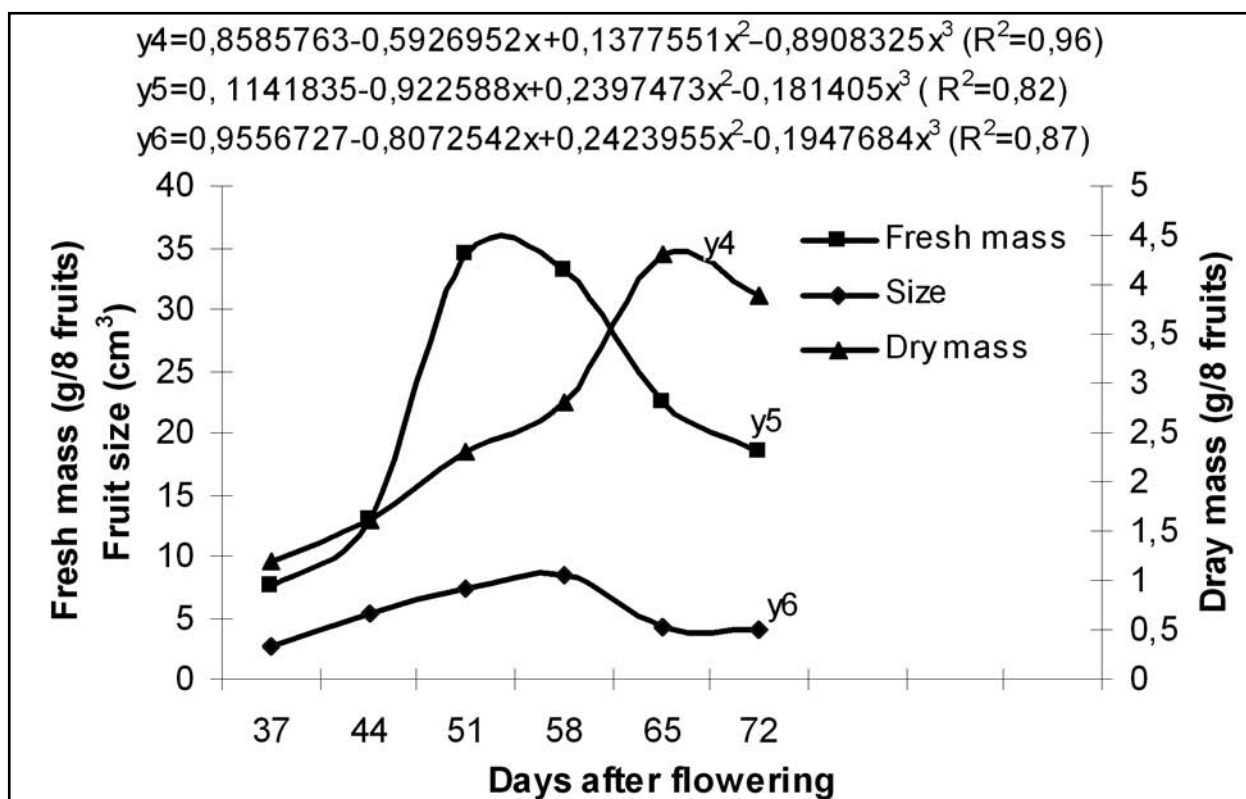


Figure 2. Fruit fresh and dry mass, and size of *Cnidosculus quercifolius* in different maturation stages. Patos (PB), Brazil.

Figura 2. Massas fresca e seca, e tamanho de frutos de *Cnidosculus quercifolius* em diferentes estádios de maturação. Patos (PB), Brasil.

Considering the results of seed germination and vigor, as well as fruit dry mass and seed moisture content, it can be inferred that the physiological maturity of seeds was reached between 65 to 72 days after flowering. However,

as the dehiscence happens around 72 days (Figure 3), fruits may be collected 65 days after flowering. Since dehiscence is explosive the seeds are thrown and consumed by animals, making seed collection a difficult task.

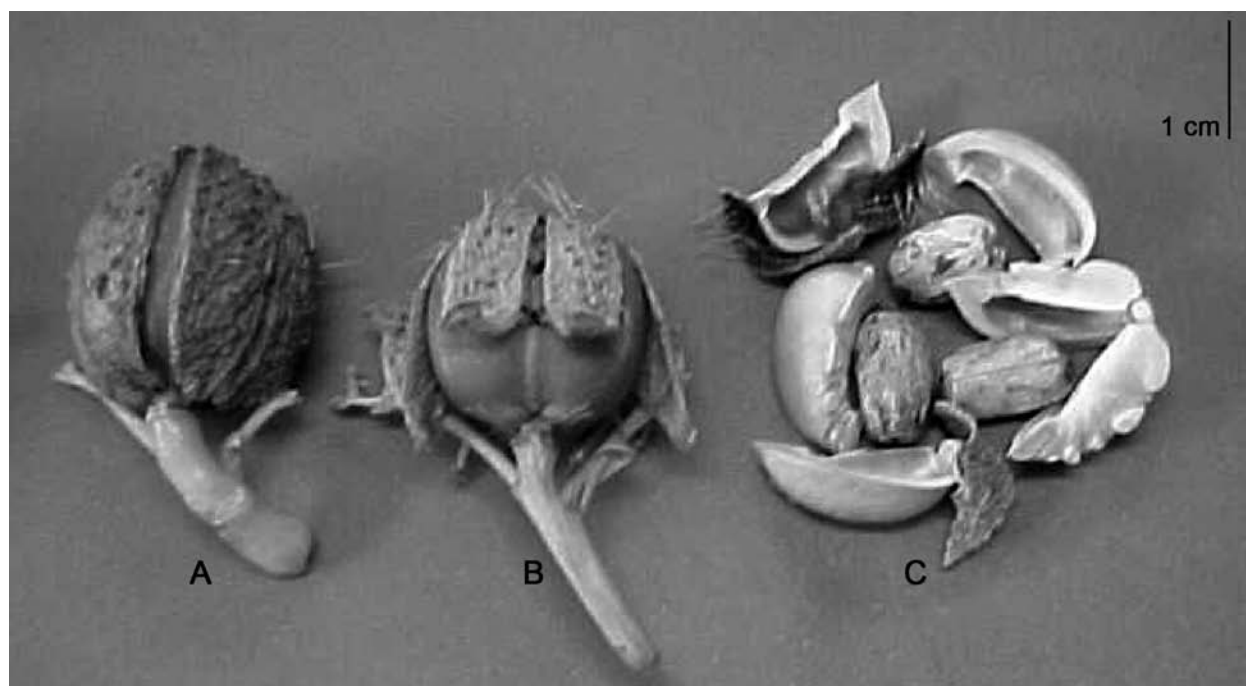


Figure 3. External aspect of *Cnidosculus quercifolius* fruits after 58 (A), 65 (B) and 72 (C) days of flowering. Patos (PB), Brazil.

Figura 3. Aspecto externo dos frutos de *Cnidosculus quercifolius* após 58 (A), 65 (B) e 72 (C) dias após o florescimento. Patos (PB), Brasil.

Analyzing the external aspect of fruits during maturation, it was observed that at 58 days after flowering the exocarp begins to come off from the endocarp (Figure 3), as a result of loss of water. This detachment happened progressively, from the apex to the base of the fruits. After 65 days of flowering, the exocarp was coiled, but remained adhered to the endocarp until the moment of dehiscence. This morphological characteristic can be easily used as a field visual indicator of fruit collection and seed physiological maturity.

CONCLUSION

Seeds of *Cnidoscylus quercifolius* achieve the physiological maturity at 65 days after flowering.

At this time, fruit exocarp was coiled, but remained adhered to the endocarp. This feature represents a practical and effective visual indicator of collection time.

Moisture content of seeds was 22,7% at the physiological maturity. After 72 days of flowering, seeds are released in an explosive way by natural dehiscence.

REFERENCES

- ALVES, E.U.; SADER, R.; BRUNO, R.L.A.; ALVES, A.U. Maturação fisiológica de sementes de sabiá. *Revista Brasileira de Sementes*, Pelotas, v.27, n.1, p.1-8, 2005.
- AMARO, L.M.; CAVALCANTE, L.F. Balanço hídrico de um solo litólico com três tipos de culturas para Patos, PB. In: CURSO DE PÓS-GRADUAÇÃO EM MANEJO E CONSERVAÇÃO DE SOLOS, 1981, Areia. *Anais...* Areia: Universidade Federal da Paraíba, 1981. p.117-121.
- BARBOSA, J.M.; SANTOS, S.R.G.; BARBOSA, L.M.; SILVA, T.S.; PISCIOTTANO, W.A.; ASPERTI, L.M. Desenvolvimento floral e maturação de sementes de *Tabebuia avellanedae* Lorentz ex Griseb. *Ecosistema*, Espírito Santo do Pinhal, v.17, p.5-11, 1992.
- BARNETT, J.P. Maturation of tree seeds. In: SYMPOSIUM ON FLOWERING AND SEED DEVELOPMENT IN TREES, 1979, Starkville. *Proceedings...* Starkville: USDA Forest Service, 1979. p.206-217.
- BORGES, E.E.L.; BORGES, R.C.G.; TELES, F.F.F. Avaliação da maturação e dormência de sementes de orelha de negro. *Revista Brasileira de Sementes*, Brasília, v.2, n.2, p.29-32, 1980.
- BRAGA, R. *Plantas da caatinga: especialmente do Ceará*. 3.ed. Fortaleza: Imprensa Oficial, 1976. v.62, 540p.
- BRASIL. MINISTÉRIO DA AGRICULTURA E DA REFORMA AGRÁRIA. *Regras para análise de sementes*. Brasília: SNDA/DNDV/CLAV, 1992. 365p.
- CASTELLANI, E.D.; AGUIAR, I.B. Seed maturation and effect of temperature regime on *Trema micrantha* (L.) Blume seed germination. *Seed Science and Technology*, Zürich, v.29, n.1, p.73-82, 2001.
- EDWARDS, D.G.W. Maturity and quality of tree seeds: a state-of-art review. *Seed Science and Technology*, Zürich, v.8, n.4, p.625-657, 1980.
- FIGLIOLIA, M.B; KAGEYAMA, P.Y. Maturação de sementes de *Inga uruguensis* Hook et Arn. em floresta ripária do Rio Moji Guaçu, município de Moji Guaçu, SP. *Revista do Instituto Florestal*, São Paulo, v.6, n.único, p.13-52, 1994.
- FONSECA, F.L.; MENEGARIO, C.; MORI, E.S.; NAKAGAWA, J. Maturidade fisiológica das sementes de ipê amarelo, *Tabebuia chrysotricha* (Mart. ex DC.) Standl. *Scientia Forestalis*, Piracicaba, n.69, p.136-141, 2005.
- GEMAQUE, R.C.R.; DAVIDE, A.C.; FARIA, J.M.R. Indicadores de maturidade fisiológica de sementes de ipê-roxo (*Tabebuia impetiginosa* (Mart.) Standl.). *Cerne*, Lavras, v.8, n.2, p.84-91, 2002.
- GOMES, R.P. *Forragem farta na seca*. 2.ed. São Paulo: Livraria Nobel, 1982. 233p.
- LABOURIAU, L.G; AGUDO, M. On the physiology of seed germination in *Salvia hispanica* L.: 1-temperature effects. *Anais da Academia Brasileira de Ciências*, Rio de Janeiro, v.59, n.1/2, p.37-56, 1987.
- LORENZI, H. *Cnidoscylus phylacanthus* (M. Arg.) Pax & K. Hoffm. In: LORENZI, H. *Árvores brasileiras: manual de identificação e cultivo de plantas arbóreas nativas do Brasil*. Nova Odessa: Plantarum, 1998. v.2, p.92.
- MARTINS, S.V.; SILVA, D.D. Maturação e época de colheita de sementes de *Dalbergia nigra* (Vell.) Fr. All. ex Benth. *Revista Brasileira de Sementes*, Campinas, v.19, n.1, p.96-99, 1997.

- MENDES, A.M.S.; FIGUEIREDO, A.F.; SILVA, J.F. Crescimento e maturação dos frutos e sementes de urucum. **Revista Brasileira de Sementes**, Pelotas, v.28, n.1, p.133-141, 2006.
- OLIVER, W.W. Seed maturity in white fir and red fir. **USDA. Forest Service. PSW Research Paper**, Berkeley, n.99, p.1-12, 1974.
- PIMENTEL-GOMES, F.; GARCIA, C.H. **Estatística aplicada a experimentos agrônômicos e florestais: exposição com exemplos e orientações para uso de aplicativos**. Piracicaba: FEALQ, 2002. 309p.
- PIÑA-RODRIGUES, F.C.M.; AGUIAR, I.B. Maturação de sementes. In: AGUIAR, I.B.; PIÑA-RODRIGUES, F.C.M.; FIGLIOLIA, M.B. (Coord.). **Sementes florestais tropicais**. Brasília: ABRATES, 1993. p.215-274.
- SILVA, A.; FIGLIOLIA, M.B.; AGUIAR, I.B. Secagem, extração e beneficiamento de sementes. In: AGUIAR, I.B.; PIÑA-RODRIGUES, F.C.M.; FIGLIOLIA, M.B. (Coord.). **Sementes florestais tropicais**. Brasília: ABRATES, 1993. p.303-331.

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