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Domestication of *Euterpe oleracea* (Arecaceae) to provide food from peatlands

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Abstract. *Euterpe oleracea* (Arecaceae), which is known as Acai, is a palm tree originating from swampy forest of Suriname. Acai is naturally distributed in swampy, sandy soil, river edges and seasonally flooded habitats; hence it is considered as paludiculture species. Acai's domestication study in Indonesia is limited, therefore our study aimed to assess morphology and germination of Acai's seeds in the nursery, and early growth performance in the field. Acai's seed diameter was ranging from 0.88 ± 0.01 cm; seed wet weight was 1.19 ± 0.31 g. Acai seeds germinated for up to 5-7 months. Soaked seeds in warm water overnight had 8.33% germination rate, while soaked seeds in tap water overnight had lesser germination rates (1.75%). After one year transplanted to a peat swamp forest ecosystem of Tumbang Nusa, Central Kalimantan, Acai's seedlings had 100% survival rate. The relative growth rate of height and diameter of Acai seedlings were $4.21 \text{ cm month}^{-1}$ and $0.08 \text{ cm month}^{-1}$, respectively. Acai seedlings survived floodings that occurred in November 2021 to March 2022. The water level was around -35.6 to 17.7 cm. Despite of some challenging, açai is a promising species to be domesticated on degraded peatlands.

1. Introduction

Domestication of trees is referred to as a continuous process that includes product creation, management, adoption of preferred germplasm, and marketing [1]. Tree domestication can be started from the introduction of new species from abroad, like numerous estate crops, such as coffee, rubber tree, and oil palm. The process of domesticating trees had seven stages, each of which began with the recognition of a tree product's commercial worth. Owing to depleted wild stocks, domestication is started with seeds or planting stock distribution, and cutting or seedlings from nursery in part of landscape [2-3]. Very limited information about peat swamp tree commodities from abroad that have been introduced to Indonesia. Numerous native trees of tropical peat swamp forests from Indonesia have been reported [4]; however, their utilizations are limited [5-6].

Euterpe oleracea Mart. (Arecaceae) is a native tropical peat swamp forest of Central and South America; it distributes in the Amazonian, Peruvian, Venezuela and Suriname. *E. oleracea* is known as açai in Portuguese [7-8] or 'podosiri' in Surinamese [9]. Açai grows naturally along the riverbank,



forest-dominant palm species grow on marginal land that is unsuitable for agriculture. For instance, the majority of forest-dominant palms grow on intermittently or permanently waterlogged lands with little to no agricultural activity; temporarily and permanently inundated, on muddy soil substrates [7, 10].

All parts of trees are beneficial. The leaves can be used as roofs, mats, baskets, fibre and fertilizer. Fruits are known as food sources, that can be consumed raw. They can be processed into liquor, and used as traditional medicine. The palm heart of açai can be processed as food and vegetable. The stem can be used as constructions, firewood and electrical insulation. The inflorescences can be used as fertilizers. The roots can be used as herbal tea and anthelmintic [8, 11]. Owing to large benefit of the trees and adaptation to flooding condition, it is potential to be domesticated in Indonesia; however the study of Açai in Indonesia is not known yet.

The objectives of the study were to describe the seed morphology, the germination rate, the early growth of açai in the nursery and after transplanted to the peatlands of Tumbang Nusa, Central Kalimantan.

2. Methods

2.1. Research site

The experiment in the nursery was conducted in two places, those are in the greenhouse of the Standardization Center for Sustainable Forest in Bogor, West Java Province, and The Forest Area with Specific Purposes, which is also known as *Kawasan Hutan dengan Tujuan Khusus* (KHDTK) of Tumbang Nusa, in Pulang Pisau District, Central Kalimantan Province. The research in the nursery in Bogor was conducted from February 2020 to July 2023; while the experiment in the nursery and field experiment on peatland was started from March 2020 to March 2022.

The KHDTK of Tumbang Nusa geographically is located at the coordinates of 02°18'37" – 02°22'34" South dan 114°02'48" – 114°06'46" East. It has a Histosol soil (hemist fibrist), with peat depth ranging from 400 to 800 cm depth. The biophysical properties of KHDTK Tumbang Nusa have been described [12, 13].

2.2. Seed morphology and germination

The *E. oleracea* seeds originated from Suriname. They were bought from an acai processor in Meerzorg. The seeds were transported to Indonesia in January 2020, especially for this research. The number of seeds was limited (n=278), and they were divided into 2 parts, for the experiments in Bogor and KHDTK Tumbang Nusa.

In Bogor, the seed scarification was done by removing the hair-like on the endocarp. The seeds were measured and weighed in the laboratory. The seeds were split into two; one part was soaked in tap water and another in warm water and left overnight. The seeds were then sowed in the cocopeat media in February 2020, and they were observed until they germinated after 6 months.

The seed germination was also carried out in the KHDTK Tumbang Nusa. Some seeds have already germinated due to long transfer lag. The viable seeds were then sowed in the mixed soil+rice husk media without any treatment in March 2020.

2.3. Transplanting, maintenance and observation

The seedlings were then transferred into planting bags that have been filled with planting media. Mineral soil was used as planting media for the experiment in Bogor, and mixed of soil and rice husk was used as planting media for the experiment in KHDTK Tumbang Nusa. In Bogor, five seedlings were maintained in the nursery in a container with a saturated condition. The growth of açai seedlings in the nursery was measured at the beginning in March 2021 (T1) and at 28 months after planting (T2).

Transplanting to the field was carried out only for the seedlings that have been prepared in the nursery of KHDTK Tumbang Nusa. Ten seedlings were then planted in the field in a planting space of 5m x 5m, and a planting hole of 25cm x 25cm. The plot was located about 20 m from the ditch. The growth measurement in the field was conducted at the beginning in March 2021 (T1) and at 12 months

after planting in the field (T2). The stem diameter, plant height, and number of leaves were the measurement variables.

The groundwater table was measured every month from April 2021 to March 2022. Rainfall data was derived from secondary data of the climatology station at Palangkaraya city [13].

2.4. Data analysis

The relative growth rate (RGR) of stem diameter and height of acai seedlings were calculated following formula given by Hoffmann & Poorter [14].

$$RGRD = \frac{(\ln H_2 - \ln H_1)}{(t_2 - t_1)}$$

where $\ln H_1$ and $\ln H_2$ are the means the natural logarithmic transformed of plant height.

$$RGRD = \frac{(\ln D_2 - \ln D_1)}{(t_2 - t_1)}$$

where $\ln D_1$ and $\ln D_2$ are the means the natural logarithmic transformed of plant diameter.

The each variable of seedling growth from the field and nursery experiment were analyzed using an Independent Sample *T*-test using the Statistical Package for the Social Sciences (SPSS) ver. 16.

3. Results and Discussion

3.1. Seed measurements and germination

The seeds of *E. oleracea* have brown color and a hairy-like exocarp as shown in Figure 1. After scarification of the hairy-like, seeds were measured for their diameter and weight (Table 1). Viable seeds that could germinate is shown in Table 1.



Figure 1. Seeds of *E. oleracea*.

Table 1. The measure and germination rate of *E. oleracea* seeds

Variables	Mean
Seed diameter (cm)	0.88 ± 0.01
Seed wet weigh (g)	1.19 ± 0.31
Germination soaked in warm water (%)	8.33
Time of germination	4-5 months
Germination soaked in cold water (%)	1.75
Time of germination	5 months
Germination without any treatment (%)	20.0
Time of germination	2 weeks

According to [15] the seed develops and germinates quickly. The optimal time to sow seed in a nursery seedbed is as soon as it is mature because it has a short viability of less than three months. Our research showed that seeds soaked in warm water increased the germination rate. Seeds without any treatment resulted in the highest germination rate. It is expected that the seeds have already been ripened physiologically. However, the germination rate was so low compared to the report of Lorenzi [16]. Seed soaking in cold water overnight resulted in 80% of germination rate. The seed sprout in 30 to 70 days and have a germination rate of 80% or more [16].

3.2. Seedlings growth in the nursery and in the field

The acai seedling growth in the field of KHDTK Tumbang Nusa and in the nursery of Bogor is shown in Figure 2. The *T*-test showed the RGRD and RGRH of açai seedlings in both locations are significantly different. The RGRD, RGRH, and number of leaves of açai in the field have better performance than that of the nursery (Table 2).

Table 2. The relative growth rate of diameter (RGRD), the relative growth rate of height (RGRH), and number of leaves of *E. oleracea* in the field and in the nursery.

Variables	Seedlings in the field	Seedlings in the nursery
RGRD (cm month ⁻¹)	0.08 ± 0.02 ^{**}	0.03 ± 0.006
RGRH (cm month ⁻¹)	4.21 ± 0.35 ^{**}	0.02 ± 0.002
Number of leaves	6.7 ± 1.2 [*]	5.4 ± 0.9

^aasterisk denotes significant value in the field compare to the nursery; ^{*} at $p < 0.05$, ^{**} at $p < 0.01$

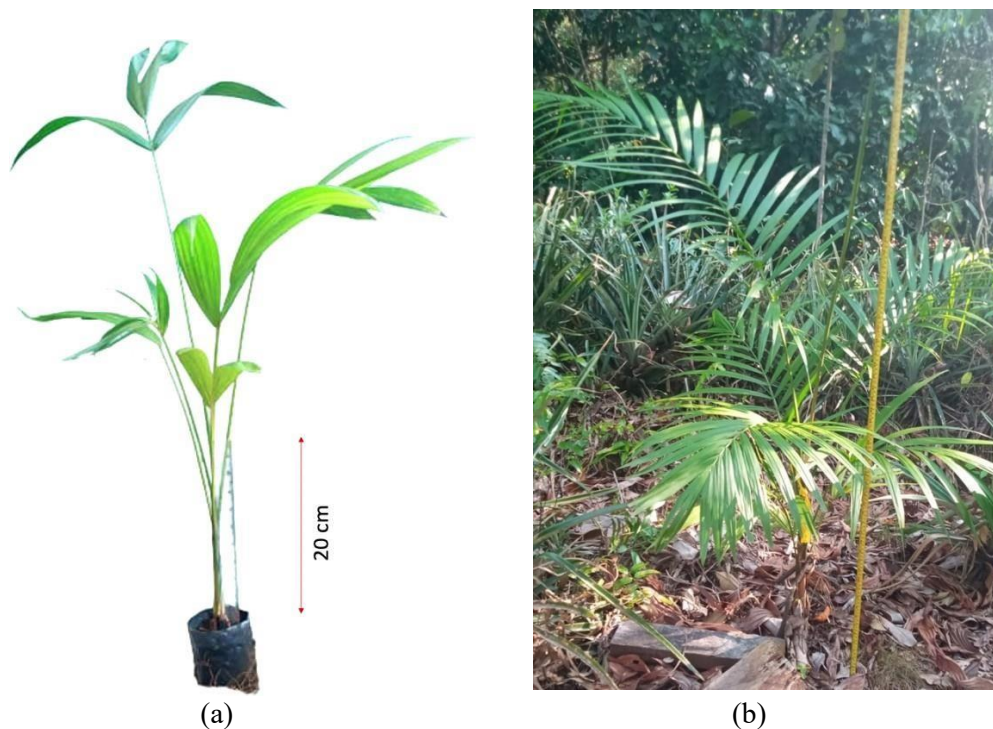


Figure 2. Performance of *Euterpe oleracea*. (a) at the age of 28 MAP in the nursery, (b) at the age of 12 MAP in the KHDTK Tumbang Nusa.

In the natural habitat, the açai plant grows rapidly. The height may reach 2 m within a year [10]. Açai seedlings in the field of KHDTK Tumbang Nusa at the age of 12 MAP have a height mean of 92.4 ± 30.5 cm and diameter of 2.5 ± 0.5 cm.

3.3. Flooding occurrence at the plot of *E. oleracea* in KHDTK Tumbang Nusa

The plot of *E. oleracea* at the KHDTK Tumbang Nusa was located about 20 m from the ditch. The plot of açai in the KHDTK Tumbang Nusa was flooded from November 2021 to March 2022. Water level and precipitation during the açai growth measurement are shown in Figure 3.

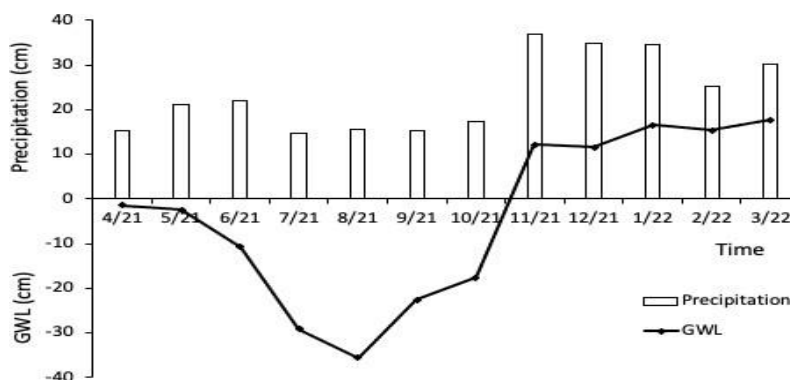


Figure 3. Precipitation and groundwater level (GWL) in the KHDTK Tumbang Nusa, Central Kalimantan from April 2021 to March 2022

Although flooding occurred for more than 2 months, açai seedlings survived. The mean water level in November 2021 to March 2022 ranged from 11.6 to 17.7 cm. The apical shoot of açai did not submerge under water, hence they still could grow and survive. Naturally, açai grow on swamps and floodplains, in seasonally flooded and permanently flooded forests [10]. It prefers a mean annual rainfall in the range of 1800 – 2300 mm, but it tolerates 1200 – 3000 mm [5]. The annual rainfall in Tumbang Nusa of Central Kalimantan during the growth observation was in the range of annual precipitation preference, which was 2829 mm.

3.4. Prospects and challenges of açai domestication in Indonesia

Owing to its adaptability to grow on peat-swamps and floodplains area, açai is a promising species to be domesticated and planted as paludiculture species in a tropical peatlands. As it provides foods from the fruit and core of the stems. The leaves are also useful as a roof, basket or mats. The fruits can be consumed raw and processed into juice, liquor, drinks, ice cream, cakes, porridges, and natural dye [10]. The açai fruits contains lots of nutrients, such as Omega-6, Omega-9, fibre, protein, and Vitamin A and C, but it doesn't contain cholesterol [10]. It is one species potential for the synergies between food security and climate change objectives in Indonesia [17].

Açai has become more popular and exported worldwide, as it does not only provide foods, but also possesses numerous bioactive properties in the leaf, pulp, fruit, bark, and seeds [8]. Roots can be used as herbal medicine and tonic [10]. It is beneficial for health promotion and disease prevention because it contains antioxidant and anti-inflammatory properties and exerts cardioprotective, gastroprotective, hepatoprotective, neuro-protective, reno-protective, antilipidemic, antidiabetic, and antineoplastic activities [8, 18].

Despite of many benefits from açai domestication, however, there are some risks and challenges to be aware of. *E. oleracea* is a new and an exotic palm species of Indonesia. Ecological processes in native populations, like pollination and dispersal patterns, may change as a result of the introduction of a species, changing the population structure [19]. Even though palm species are not frequently regarded as invasive [19], the overall detrimental effects of exotic species on ecosystems and biodiversity have long been understood. Exotic plants species may cause many impacts on the ecological patterns of the

local community. When it has same genus (congeneric) with local species, the exotic plant species may encourage competition for pollinators or result in interspecific interference with pollen in native flowers, among other effects on the local community's ecological processes [19].

Moreover, the introduction and domestication of an exotic species to Indonesia should follow the national regulation, which is regulation of the Minister of Environment and Forestry number P3/MenLHK/Setjen/Kum.1/1/2020 regarding the Implementation of Forest Plant Seeding [20]. This regulation aims to (i) ensure the preservation of plant genetic resources forest and its utilization; and (ii) ensure the availability of good quality of seeds and/or seedlings. The seed exporter should provide some documents, such as a phytosanitary and the origin of the seeds certificates, while the importer must apply for the seed import permits to the Ministry of Environment and Forestry. There is still a long way to go for the implementation of açai domestication in Indonesia.

4. Conclusions

As a paludiculture species, açai palm has a prospect to be domesticated in the peatlands of Indonesia. One year after transplanting to the field, açai seedlings grow well under the saturated condition of KHDTK Tumbang Nusa. This was a recent initiative; hence regular growth monitoring shall be continued to observe whether there is an impact on the neighborhood's environment.

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References

- [1] Leakey R R B, Tchoundjeu Z, Smith R I, Munro R C, Fondoun J M, Kengue J, Anegbeh P O, Atangana A R, Waruhiu A N, Asaah E, Usoro C and Ukafor V 2004 *Agrofor Syst.* **60** 101–111 <https://doi.org/10.1023/B:AGFO.0000013259.95628.22>
- [2] Roshetko J M and Evans D O 1999 *Domestication of Agroforestry Trees in Southeast Asia. Forest, Farm, and Community Tree Research Reports*, special issue (Arkansas: Winrock International Institute for Agricultural Development)
- [3] Tata H L, van Noordwijk M, Jasnari and Widayati A 2016 *Agrofor Syst.* **90** 617-630 DOI 10.1007/s10457-015-9837-3
- [4] Giesen W 2015 *J Indon Nat Hist.* **3** 10–19
- [5] Tata H L and Susmianto A 2016 *Prospek Paludikultur Ekosistem Gambut Indonesia (The Prospects for Paludiculture in Indonesia's Peatland Ecosystems)* (Bogor: FORDA Press) (in Bahasa Indonesia) p 71
- [6] Uda S K, Hein L and Adventa A 2020 *Wetlands Ecol Manage* **28** 509-526 <https://doi.org/10.1007/s11273-020-09728-x>
- [7] Anderson A B 1988 *Advances in Economic Botany* **6** 144-154
- [8] Laurindo L F, Barbalho S M, Araújo A C, Guiguer E L, Mondal A, Bachtel G and Bishayee A 2023 *Nutrients* **15** 989 <https://doi.org/10.3390/nu15040989>.
- [9] Mans D R A 2023 *Naturally Occurring Antioxidants in Seven Well-Known Fruits from the Republic of Suriname (South America): Part I* (London: IntechOpen) 33. DOI: 10.5772/intechopen.110078. <https://www.intechopen.com/chapters/86019>
- [10] Cymerys M, Vogt N and Brondizio E 2011 Açai: *Euterpe oleracea* Mart *Fruit Trees and Useful Plants in Amazonian Life* eds P. Shanley *et al.* FAO CIFOR PPI P:157-168. <http://www.fao.org/3/i2360e/i2360e04.pdf>
- [11] Tata H L 2019 *Mires and Peat* **25** 1-17. DOI: 10.19189/MaP.2018.KHR.360
- [12] Saleilei A A S, Salampak, Yulianti N, Adji F F, Damanik Z and Giyanto 2022 *J. Ilmu Lingkungan* **16** 59-66 DOI 10.31258/jil.16.1.
- [13] BPS Kalimantan Tengah 2022 *Curah hujan dan hari hujan Kota Palangkaraya tahun 2020-2022*. Accessed on 10 August 2023 [online]. Available at:

<https://palangkakota.bps.go.id/indicator/151/291/1/-jumlah-curah-hujan-menurut-bulan-di-kota-palangka-raja.html>

- [14] Hoffmann W A and Poorter H 2002 *Annals Bot* **80** 37-42
- [15] Blombery A and Rodd T 1992 *Palms of the World* Sydney (Victoria: Angus and Robertson)
- [16] Lorenzi H 2002 *Brazilian Trees. (Vol I) 4th edition.* (Brazil: Instituto Plantarum De Estudos Da Flora).
- [17] Lupascu M, Taillardat P, Sasmito S D, Agus F, Murdiyarso D, Ramchunder S J, Tata H L and Taylor D 2023 *Glob Environ.Chan.* **82** 102731 <https://doi.org/10.1016/j.gloenvcha.2023.102731>
- [18] Martins R G, Mattos M M G, Nascimento F M, Brum F L, Mohana-Borges R, Figueiredo N G, Neto D F M, Domont F D, Nogueira F C S, Campos P and da Silva A 2022 *J. Agric. Food Chem.* **70** 16218–28. <https://doi.org/10.1021/acs.jafc.2c07028>
- [19] Tiberioa F C S, de Silvaa T A S, Matosa D M S and Antunes A Z 2016 *Braz. J. Biol.* **76**, 66-72 <http://dx.doi.org/10.1590/1519-6984.12114>
- [20] Ministry of Environment and Forestry 2020 *Regulation of Minister Environment and Forestry No. P.3/2020 regarding the Implementation of Forest Plant Seeding (Peraturan Menteri Lingkungan Hidup dan Kehutanan No. P3/2020 tentang Penyelenggaraan Perbenihan Tanaman Hutan).* Jakarta: Ministry of Environment and Forestry (in Bahasa Indonesia). Accessed: August 11, 2023. [Online], Available at: <https://peraturan.bpk.go.id/Home/Details/163508/permen-lhk-no-3-tahun-2020>