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Exploration of Jaboticaba (*Plinia cauliflora*.) Cultivation in Bengkulu: Conservation in an Optimized Environment

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ABSTRACT

Jaboticaba (*Plinia cauliflora*) is a plant with numerous benefits. The destruction of its natural habitat and illegal logging in areas where Jaboticaba grows have led to concerns about population decline. Therefore, serious conservation efforts are necessary to protect this plant. This research aims to plant and conserve Jaboticaba in an optimal environment in Bengkulu. To maintain the viability of jaboticaba populations, it is essential to protect their natural habitat and implement conservation efforts. The methods used included seedling preparation, jaboticaba planting, and treatment and observation of soil conditions, air, light, and height gain. The results indicated that Jaboticaba can grow in areas with soil pH 5.5; 50% soil moisture, 28℃ air temperature, 69% air humidity, and 900 µmol/m²/s light intensity. The study employed an experimental approach to investigate the growth of Jaboticaba. The growth of Jaboticaba from 15 cm to 30 cm was promoted within the study period through continuous care, including watering and fertilization. The study results indicate that environmental factors play an important role in the growth of Jaboticaba. Therefore, protecting its natural habitat in Bengkulu, Indonesia is crucial for environmental sustainability and human health. Jaboticaba holds high ecological, economic, and health values. The study's findings regarding the cultivation, environmental requirements, and urgency of conservation are enlightening for safeguarding this species for future generations.

Keywords: *Jaboticaba, benefits, cultivation, conservation, optimal conditions.*

1. INTRODUCTION

The Plinia cauliflora, commonly known as the Brazilian grape tree or Jaboticaba, is a fruit-bearing plant native to Brazil South America. Renowned for its delectable fruit, the jaboticaba tree is typically of modest height, not exceeding 15 meters. Its leaves, which are oval or egg-shaped, possess a glossy green hue and are arranged in opposing directions along the stem (Miranda et al., 2023). The flowers, emerging directly from the stems and branches, are small and white. Resembling grapes, the Jaboticaba fruit boasts thick skin, tender flesh, and petite seeds. When fully ripe, this fruit exhibits a dark purple or black coloration. Notably, the jaboticaba tree bears fruit directly on its main trunk and branches, posing challenges for harvesting from the uppermost branches (Moura et al., 2022).

The jaboticaba plant has roots in Brazil but has now spread to different regions with tropical or subtropical climates (Baptista et al., 2020). This plant flourishes in areas that receive ample rainfall, have fertile soil, and experience warm weather. In Brazil, Jaboticaba can be found in dense forests and moist lowland areas. Despite its Brazilian origins, this plant has the ability to thrive in several countries with favorable climatic conditions, such as Indonesia (Regina Risso Gobato, 2018).

In Indonesia, Jaboticaba growth can succeed in various regions, particularly in warm and humid climates like southern Sumatra, Java, Kalimantan, and Sulawesi. However, it is crucial to consider that the optimal growth of this plant is heavily influenced by environmental conditions such as adequate sunlight, fertile soil, and proper drainage. Additionally, providing good care through regular watering and fertilization is crucial for the successful growth of Jaboticaba in Indonesia (Setiawan, 2020). In the southern part of Sumatra, specifically in Bengkulu province, which experiences a tropical climate, Jaboticaba can thrive if the environmental factors are favorable. With its year-round warm weather, Bengkulu has the potential to support the growth of Jaboticaba, a plant that offers numerous benefits (Tawakal et al., 2022).

Jaboticaba holds significant value in the culinary realm due to its delectable fruit, frequently used to produce jellies, beverages, flour, or directly consumed (Madruga et al., 2022). Additionally, this plant exhibits potential in the healthcare sector and serves as a medicinal plant. The extract derived from Jaboticaba bark showcases antioxidant activity, sun protection factor (SPF), and the ability to aid in wound healing (Cefali et al., 2021). Furthermore, Jaboticaba bark powder is abundant in polyphenols, carotenoids, and dietary fiber, and has demonstrated preventive effects in mouse models of inflammatory bowel disease (IBD)-related colorectal cancer (Nascimento et al., 2023). The Jaboticaba fruit is rich in phenolic compounds, flavonoids, anthocyanins, tannins, and phenolic acids, offering diverse health benefits, including treating and preventing chronic diseases. Regular consumption of Jaboticaba has been proven to reduce plasma total cholesterol and triacylglycerol levels, enhance antioxidant capacity, and decrease lipid peroxidation in diabetic rats, highlighting its potential in managing oxidative stress (Lamas et al., 2020).

Rich in benefits, this plant is not yet considered an endangered species. However, there are concerns about population decline due to the destruction of natural habitats and illegal logging in areas where Jaboticaba grows. Protection of natural habitats and conservation efforts are very important to maintain the survival of the jaboticaba population (Handayani et al., 2023). Threats to the habitat of this species can cause a decrease in the abundance of jaboticaba plants. In addition, the loss of local biodiversity due to environmental change is a significant problem that can affect plant populations (Gill et al., 2023).

It is crucial to prioritize managing and conservating endangered plants such as Jaboticaba to prevent further decline. Efforts such as planting, collecting ecological data, and understanding the factors driving population declines can help inform conservation strategies (Gill et al., 2023). Previous research has highlighted the importance of protecting natural habitats and preventing the spread of invasive species as crucial steps in conserving jaboticaba populations (Larkin et al., 2023). Focusing on efforts to protect natural habitats, the study shows that by implementing these measures, the potential to maintain jaboticaba populations for future generations is more assured. However, in research conducted in Bengkulu, researchers emphasized more specific research related to Jaboticaba cultivation in optimal environments. This study covers the protection of natural habitats and broadens the scope by considering optimal environmental factors for Jaboticaba growth (Handayani et al., 2023).

Considering the Jaboticaba plant's unique morphological characteristics, diverse benefits, and noteworthy conservation status, it offers ecological, economic, and social values that are important to maintain. Jaboticaba can live in the Bengkulu part of Indonesia, so planting and conserving this plant is crucial for environmental sustainability and human health. This research provides in-depth insights into the cultivation and specific environmental requirements that support the optimal growth of Jaboticaba. As such, its contribution complements previous conservation approaches by highlighting the important cultivation and environmental aspects for long-term success in maintaining jaboticaba populations. Therefore, this paper entitled "Exploration of Jaboticaba (Plinia cauliflora.) Cultivation in Bengkulu: Conservation in an Optimal Environment".

2. MATERIAL AND METHODS

The study was conducted at Bengkulu University's Center for Biodiversity Conservation Studies, spanning from October 8, 2023, to November 25, 2023. An experimental approach was employed in this research, utilizing the planting and nurturing techniques for jaboticaba plants. This approach entails a systematic process of preparation, planting, nurturing, observing, and analyzing the growth and development of jaboticaba plants. The primary emphasis of this method lies in cultivating plants and regularly monitoring their growth using specific parameters such as pH and soil moisture, air temperature and humidity, light intensity, and plant height.

This research did not manipulate control variables between plant groups but focused on observing the plants' response to the care given. Scheduled data collection and planned maintenance were conducted using an experimental approach to understanding plant interactions and their effects under specific conditions (Schöb et al., 2012). The Jaboticaba planting procedure can be seen in Figure 1.

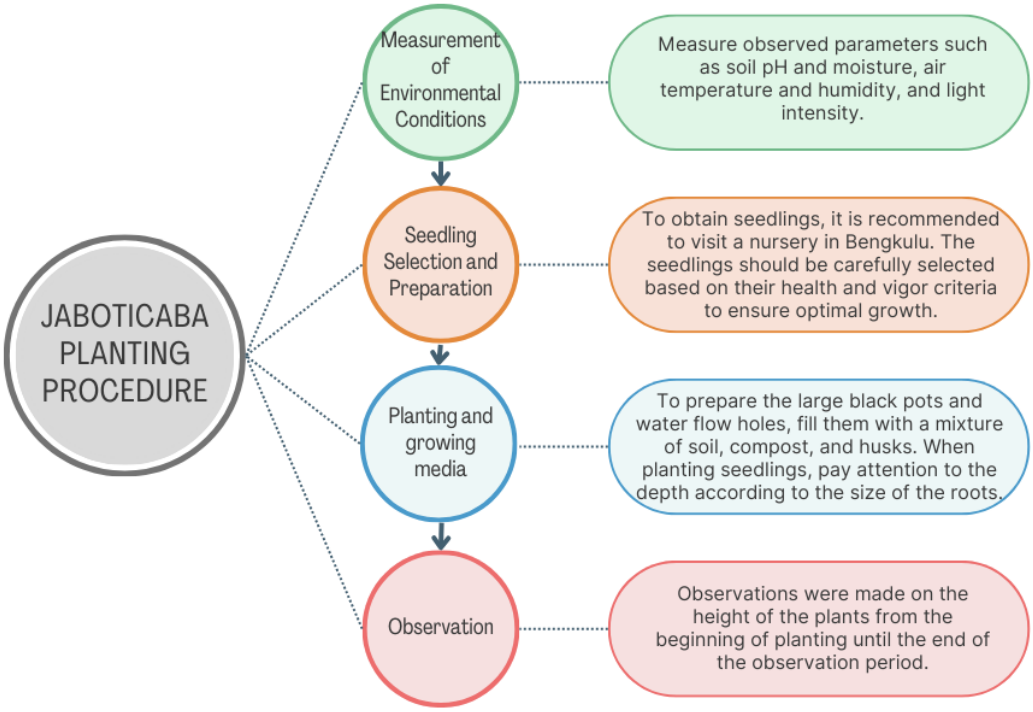

Figure 1. Research Procedure Diagram.

Observations are made periodically on plant growth. Observation data includes plant height growth. The resulting data is then analyzed to evaluate plant growth and the effect of treatment on the observed parameters.

3. RESULT AND DISCUSSION

Observing data on environmental conditions is essential in determining optimal conditions for the growth of jaboticaba plants. Several factors, such as soil pH, temperature, humidity, and water availability, significantly influence the growth of jaboticaba seedlings (Amaral et al., 2021). The results of observations of environmental conditions can be seen in Table 1.

Table 1. Results of measurements of environmental conditions at the Center for Biodiversity Conservation Studies, Bengkulu University

Measurement	Result
Soil pH	5.5
Soil Moisture	50
Temperature	28.8℃
Air humidity	69%
Light Intensity	Area 1: 900 µmol/m²/s. Area 2: 154 µmol/m²/s.
Early Jaboticaba height	15 cm
Final Jaboticaba height	30 cm

3.1 Observation of pH and Soil Moisture

The jaboticaba planting procedure was examined by assessing the soil's pH level. Soil pH indicates the soil's acidity or alkalinity and is crucial in determining crop productivity (Salim et al., 2022). The pH value of the soil directly affects the accessibility of nutrients to plants and their growth potential. Additionally, soil pH influences various biological, chemical, and physical properties and

processes within the soil, all of which impact plant development and biomass production (Turhal & Turhal, 2022).

Assessing environmental factors is crucial in determining the ideal conditions for cultivating jaboticaba plants. The growth of jaboticaba seedlings is affected by various environmental factors, such as soil pH, temperature, humidity, and water availability (Amaral et al., 2021). One of the key aspects to observe during the jaboticaba planting process is the soil pH. Soil pH measures soil acidity or alkalinity and significantly determines crop productivity (Salim et al., 2022). The soil's pH level directly impacts the availability of nutrients to plants and their overall growth potential. Additionally, soil pH also influences a range of biological, chemical, and physical properties and processes within the soil, impacting plant growth and biomass yield (Turhal & Turhal, 2022).

Observations were carried out at the Center for Biodiversity Conservation, Bengkulu University. The first observation measured soil pH and moisture using a soil pH meter. The results of both measurements are directly obtained from the tool used. Measurements using a soil pH meter can be seen in Figure 2.

Figure 2. Measure pH and soil moisture using a soil meter

The soil pH results obtained were 5.5 and humidity 50. The pH results were in accordance with the correct pH for planting Jaboticaba. This is in accordance with literature from Neina (2019), which states that the ideal soil for planting jaboticaba trees is fertile, rich in organic matter, and has good drainage. Jaboticaba grows well in slightly acidic soil with a pH of around 5.5 to 6.5. The soil moisture result is 50, indicating the soil is in an ideal moist condition. According to Merbawani et al. (2021), Good soil moisture values depend on the type of plant planted. However, ideal soil moisture for plant growth ranges from 40%-60%, including Jaboticaba.

The results of soil moisture measurements provide information about the amount of water in the soil. This critical parameter influences various aspects of soil and plant health (Ahmad et al., 2016). Jaboticaba grows better in moist soil with good drainage. The number 50 for soil moisture measurement results is ideal for jaboticaba plants. Too much water or poor drainage can cause roots to rot and damage the growth of the jaboticaba tree (Yu, 2021).

3.2 Observation of Air Temperature and Humidity

The next observations and measurements made are air temperature and humidity. Measurements using a thermohygrometer. This measurement is important because air temperature and humidity are important factors for plant growth and development. Higher humidity levels have been found to improve plant growth, as they help maintain photosynthesis processes and minimize evaporation (Hoang & Kim, 2018). The results of measuring air temperature and humidity can be seen in Figure 3.

Figure 3. Measurement of air temperature and humidity

The results obtained for the air temperature were 28.8℃, and the air humidity was 69%. This air temperature is a good temperature for jaboticaba growth. According to Setiawan (2020), Jaboticaba grows best at temperatures ranging from 15℃ to 30℃. As a result, air humidity of 69% is good humidity for Jaboticaba to grow well. This is because Jaboticaba grows well in relatively high humidity. Ideally, around 60% to 80% of air humidity can support good growth for jaboticaba trees (Handayani et al., 2023). It also influences the water use efficiency of plants and their sensitivity to pollution (Villalobos et al., 2016). Therefore, maintaining proper air temperature and humidity levels is essential to ensure optimal plant growth and development.

3.4 Light Intensity Observation

Jaboticaba generally requires sufficient sunlight to grow well. They grow best in locations with a good intensity of direct or semi-direct sunlight. Ideally, they need around 6-8 hours of direct sunlight daily (Saka & Okoye, 2021). Light intensity measurements were carried out in two different areas. First, measurements are taken in an area exposed directly to sunlight without shadows from trees or other obstructions. This area is an open space where sunlight can shine without any obstructions. Second, measurements are carried out in an area that receives indirect sunlight. Even though the tree's shadow slightly blocks it so it is not too hot, sunlight still shines into the area.

The tool used to measure light intensity is a lux meter. The measurement results are in PPFD (Photosynthetic Photon Flux Density) or µmol/m²/s. The results obtained can be seen in Figure 4 and Figure 5.

Figure 4. First area light intensity measurement

Figure 5. Second area light intensity measurement

The results obtained from the first area measurement were 900 µmol/m²/s. The result for measurements in the second area is 154 µmol/m²/s. This result is in the optimal Jaboticaba growing category. The most suitable light intensity for Jaboticaba to grow optimally, according to Saka & Okoye (2021), in influencing gas exchange and chlorophyll fluorescence of Jaboticaba seedlings is around 200 µmol/m²/s to 1000 µmol/m²/s. Jaboticaba prefers to grow in areas that receive direct light or partial shade. Jaboticaba is a plant that can adapt to different light conditions. They grow well in direct sunlight but also tolerate partial shade. However, exposure to direct sunlight usually provides better results in growth and fruit production (Saka & Okoye, 2021)

Based on the results of light intensity measurements, jaboticaba plants planted in pots are placed in areas exposed to direct sunlight, as stated by Saka & Okoye (2021) in their research that Jaboticaba requires around 6-8 hours of direct sunlight every day. This is very important for optimal plant growth because Jaboticaba requires sufficient light so that the photosynthesis process runs well. Exposure to direct sunlight also allows plants to carry out the energy absorption process needed to produce nutrients and healthy growth (Setiawan, 2020).

3.5 Jaboticaba Height Observation

The rate at which jaboticaba plants grow can differ greatly due to various factors such as environmental conditions, plant genetics, care, and other variables (Setiawan, 2020). The planting of Jaboticaba plants is scheduled to commence on October 8, 2023. These plants will be approximately 15 cm at the time of planting. Figure 6 displays the initial photograph of the planting process in a pot.

Figure 6. Initial planting of Jaboticaba into pots in October 2023

Observing and caring for jaboticaba plants is a routine practice that requires special attention. This process involves a series of actions, from regular watering to maintain proper soil moisture to regular fertilization to provide the nutrients the plant needs. Bao (2017) states watering is essential for plant health and growth. It is recommended to water the plant regularly, ensuring that the soil is moist but not waterlogged.

In addition, cleaning the pot area from weed growth is an important step to avoid competition for nutrients and ensure plants can grow optimally. According to da Silva et al. (2019), cleaning the potting area regularly and removing any weeds that may be growing too much is important. A combination of careful observation and programmed care helps ensure that jaboticaba plants develop healthily and productively.

Observation and nurture were carried out optimally, which made Jaboticaba grow well. Jaboticaba's growth until the end of November 2023 can be seen in Figure 7.

Figure 7. Jaboticaba growth end of November 2023

The height of jaboticaba plants at the Center for Biodiversity Conservation, Bengkulu University, has shown a positive indication of optimal conditions. The growth has increased from 15 cm to 30 cm, reflecting a healthy and robust environment (Bao, 2017). Planting Jaboticaba in conservation settings offers dual advantages. Firstly, it contributes to biodiversity conservation by preserving ecologically significant plant species. Secondly, Jaboticaba is renowned for its rich antioxidant content, which can potentially provide substantial health benefits to individuals who consume it directly or in derivative forms like juice or extract. Therefore, the successful cultivation of Jaboticaba in conservation centers supports nature preservation and presents opportunities for developing nutritious products for human well-being.

4. CONCLUSION

Jaboticaba or Brazilian Grape (Plinia caulifolra.) has high ecological and health value. Growth from 15 cm to 30 cm at the Center for Biodiversity Conservation at Bengkulu University shows a supportive environment. This plant requires a soil pH of 5.5, humidity of 50, temperature of 28℃, air humidity of 69%, and light intensity of 900 µmol/m²/s to grow optimally. The protection of natural habitats is essential for the survival of this species. With its potential in the health sector and high conservation value, protecting the natural habitat of Jaboticaba is crucial to maintaining the survival of this species. In Indonesia, especially in Bengkulu, Jaboticaba planting and conservation promises great environmental and human health benefits.

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