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Leaves as an Indicator of Potential Production of Palm Sap in Sugar Palm Plants (*Arenga pinnata* Merr) in South Tapanuli Regency

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Abstract

The sugar palm (*Arenga pinnata* Merr.) is a valuable natural resource, particularly as a source of sap that can be processed into palm sugar. However, its utilization remains suboptimal, as sugar palm plants in South Tapanuli Regency continue to grow wild and have not been cultivated intensively. The morphological characteristics of these plants, such as the number of leaf stalks, are believed to influence sap production. This study aims to identify the relationship between the number of leaf stalks and sap production in South Tapanuli Regency. The study employed a survey method and simple linear regression analysis to investigate the relationship between the number of leaf stalks and sap production. The results indicated a positive correlation between the number of leaf stalks and sap production; specifically, an increase in leaf stalks corresponded to higher sap production. The highest sap production, recorded at 10.27 liters per day, was observed with more than 21 leaf stalks, while the lowest sap production, at 6.78 liters per day, was noted with 1 to 5 leaf stalks.

Keywords: Indicator, Leaf Sheath, Palm Sap Production, South Tapanuli, Sugar Palm Plant

1. Introduction

The sugar palm plant (Arenga pinnata Merr.) is one of Indonesia's most valuable natural resources, especially as a sap producer that can be processed into palm sugar. In South Tapanuli Regency, the population of wild sugar palm plants is very large, but the benefits are still less than optimal (Maretha et al., 2020)

Plant morphological characteristics, such as the number and condition of leaves, influence plant production, including palm sap (DE Harahap, 2017; Harahap et al., 2018; Alfiah & Abdillah, 2025). As the primary photosynthetic organ, leaves produce photosynthate, which is stored in the stem and used to produce sap. Studies have shown that vegetative characteristics, such as the number of leaves, have a significant level of diversity that can affect sap production and its sugar content. Still, no specific research has been conducted on the relationship between Aren plants' leaf characteristics and sap production (Dewi et al., 2022).

Farmers must understand the relationship between leaf characteristics and sap production to increase the productivity of sugar palm plants. By understanding leaf morphological indicators related to sap production, farmers can choose more appropriate plants for tapping, resulting in increased efficiency and production results.

The development of palm derivative products, such as brown sugar, has great potential to increase community income in South Tapanuli Regency (Harahap et al., 2021). Therefore, research on leaf morphology indicators related to sap production can help develop the palm sugar industry in this area.

However, the problem faced in developing the production of sap and palm sugar in South Tapanuli Regency is that the palm plants that are cultivated still grow wild and have not been farmed intensively. Understanding the morphological indicators of leaves related to sap production is hoped to encourage more focused and productive palm cultivation.

Therefore, in-depth research on the relationship between leaf characteristics and sap production in Aren

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plants in South Tapanuli Regency is very important. This study's results are expected to guide farmers in managing aren plants more efficiently to improve their welfare and maximize the potential of local natural resources (Harahap et al., 2018).

This study aims to identify the number of leaf stalks on sugar palm plants that can be used to indicate the potential for sap production in South Tapanuli Regency. The results are expected to provide useful information for farmers and stakeholders in increasing sap production and developing the palm sugar industry.

2. Material and Methods

The location of the research study is South Tapanuli Regency, located in the western and southern parts of North Sumatra Province, is situated geographically between 0°58'35"-2°07'33" North Latitude and 98°42'50"-99°34'16" East Longitude, at an altitude of between 0 and 1,985 m above sea level, whose forests have stands of sugar palm plants that grow wild. The materials used are sugar palm stands. At the same time, the research tools include knives, driken, meters, liters, scales, ropes, and stationery.

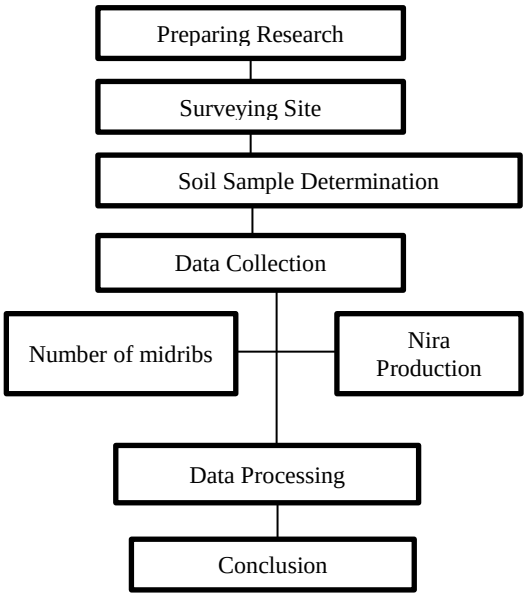

Figure 1. Research Flow Diagram

The data obtained in the field were then tabulated and to examine the relationship between the number of leaf stalks and the production of sap produced, a simple linear regression analysis was carried out using SPSS version 27, where the mathematical equation is: $\hat{Y} = \alpha + bx$, where $\hat{Y}$ = dependent variable (sap production); X = For the independent variable (number of leaves); a = intercept of the line on the Y axis and b = linear regression coefficient.

3. Results and Discussion

From Figure 2, it can be seen that the distribution of data on the number of leaf stalks from 253 plants used as sample plants at the research location can be seen that 37.94% of sugar palm plants grow with the number of leaf stalks of 6-10 strands; 34.39% with the number of 11-15 strands; 18.58% with 16-20 strands; 5.93% with the number of > 21 strands and 3.16% with 1-5 strands/plant.

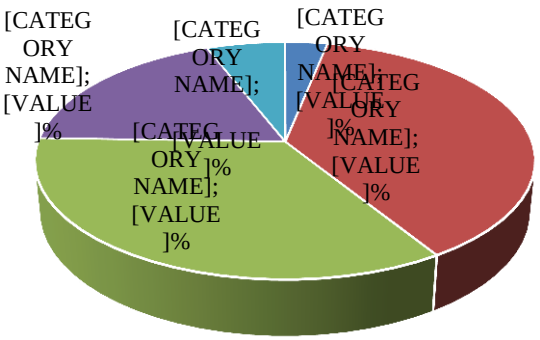

Figure 2. Distribution Data of Sample Plants Based on the Number of Leaf Sheaths

The regression analysis results of the relationship between the number of leaf stalks and sap production can be seen in Table 1.

Table 1. Regression Analysis of the Relationship Between the Number of Leaf Sheaths and Palm Sap Production

Model	JK	db	KT	F	Sig.
Regression	175.104	1	175.104	9,531	.002b
Remainder	4611.345	251	18,372		
Total	4786.449	252			

From the analysis of the variety of relationships between panicle levels and sap production (Table 1), the analysis model formed shows a significant value of $\alpha \leq 0.05$. This shows that the number of leaf stalks significantly affects sap production.

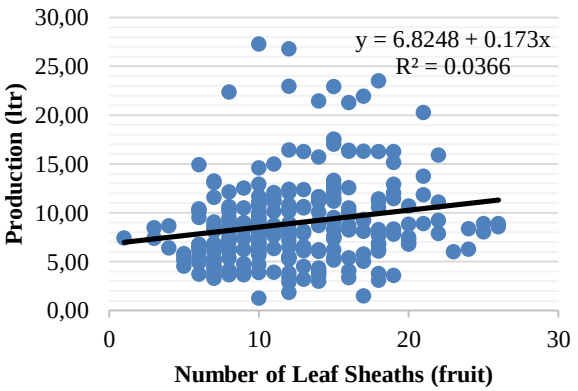

Figure 3. Relationship between the number of leaf stalks and sap production

From the statistical data analysis, the regression equation is also obtained, Y = 6.825 + 0.173x, which means that the more plant leaf stalks, the more the sap production increases. The R2 value for sap production can be seen that the role of the number of leaf stalks in

explaining sap production is 3.66%.

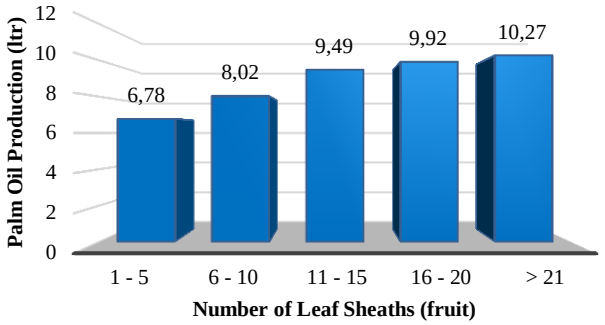

Figure 4. Histogram of the Relationship Between the Number of Leaf Sheaths and Palm Sap Production

From (Figure 4), it can be seen that the highest sap production (10.27 liters/day) occurs in the number of fronds (>21 fruits), and the lowest sap production (6.78 liters/day) occurs in the number of fronds (1 - 5 fruits).

In sugar palm plants, the large number of leaf stalks significantly influences sap production. Leaf stalks are an important part of photosynthesis, affecting the amount and quality of sap sugar palm trees produce.

Figure 5. Sugar palm leaves

Leaves are the main organs where photosynthesis occurs, the process by which plants convert sunlight into chemical energy in glucose. The greater the number of leaves, the greater the surface area available to absorb sunlight. This increases the capacity for photosynthesis, which in turn produces more glucose. This glucose is used for plant growth, energy storage, and making other organic compounds, such as sap in aren plants (Previansari et al., 2020).

The study conducted by Harahap et al. (2013) in Marancar District, South Tapanuli Regency, found that the number of leaves has a major influence on sap production; more leaves, more sap production. This shows how important leaf characteristics are as a tool that can be used to predict sap production.

In addition, additional research in South Tapanuli Regency found that leaf phenotype features, such as rachis length and leaflet length, were associated with sap production; plants with longer leaves and more leaflets tended to produce more sap. (Harahap et al., 2018) . (Tenda & Weda, 2015) , added that because leaves are where photosynthesis occurs, the morphology of sugar palm leaves is correlated with sap production.

The palm leaf sheath functions as the main place where photosynthesis occurs, where the chlorophyll in the leaves absorbs sunlight and converts it into chemical energy in the form of glucose. This glucose is then used for plant growth and converted into sap by the male flowers on the panicle. The more sheaths on the palm plant, the greater the plant's ability to absorb sunlight and carry out photosynthesis, which produces more glucose. Rizaludin et al. (2020) stated that more photosynthesis will produce more glucose. In the palm plant, this glucose is channeled to the male flowers to produce sap.

Widarawati et al. (2018) stated that increasing the number of fronds on sugar palm plants is directly related to increasing the volume and quality of sap produced because more raw materials are available for the sap production process.

Furthermore (Heldt & Piechulla, 2011) Rademaker, 2016) revealed that plants with more fronds have a more efficient vascular system in transporting sugar to male flowers, thus increasing the production of more sap. Hans & Thijs, (2008) added that plants with more leaves also have a more developed root system, which functions to absorb more water and nutrients, ultimately supporting higher production.

4. Conclusion

The number of leaf stalks positively correlates with sap production, meaning that the more leaf stalks a palm tree has, the higher the sap production will be. The highest sap production was found in the number of leaves (>21 fruits) with (10.27 liters/day), and the lowest sap production was found in the number of fronds (1 - 5 fruits) with (6.78 liters/day).

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