

Exploration and Morphological Characterization of Durian Vegetative Organs in Trenggulunan Region (Central Java, Indonesia)

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Abstract. In Indonesia, numerous varieties of local durians exhibit unique characteristics and high genetic diversity. Research is needed to explore the biodiversity and genetic relationship of local durian varieties through comprehensive exploration and characterization. This research aims to provide insights into the genetic diversity and kinship of durian in Trenggulunan, Rembang. An exploratory descriptive research method was employed, utilizing field surveys. The sampling technique used in this research was purposive random sampling in the form of snowball sampling. The morphological characteristics were observed according to the guidelines outlined in the Description Book of Durian. Data were analyzed using NTSYS 2.02 program. The findings revealed 13 durian accessions with morphological variation in vegetative organs, exhibiting a similarity coefficient ranging between 0.60 to 0.87.

1 Introduction

Indonesia is located on the Equator, and this situation offers several advantages, particularly in the biodiversity of flora and fauna. The huge number of fruit plant varieties and favourable mild climate support a year-round of fruit supplies. Indonesia's rich germplasm resources further enable the production of healthy and nutritious fruits. One of the famous perennial crops is durian [1]. In Indonesia, various local durian varieties exhibit unique characteristics and high genetic diversities, with 104 varieties registered by The Ministry of Agriculture as superior varieties [2].

Durian is referred to as the "King of fruits", due to its spiky skin, soft, and flavorful flesh with a strong smell [3]. This distinctiveness contributes to its high economic value [4]. Additionally, durian offers several health benefits, including reducing blood glucose and cholesterol levels [5]. It also serves as a valuable source of carbohydrates, proteins, vitamins B and C [6]. Therefore, identifying superior local durian varieties is important, considering the fruit's economic value and health significance.

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Central Java ranks as the third-largest durian-producing province in Indonesia, with a total production of 211.898 tons annually [7]. Within this province, Rembang Regency has quite a large number of local durian biodiversity; one of them is in Trenggulan Village, which is located adjacent to the durian tourism center namely Criwik Village. However, limited research on Trenggulan's local durians has resulted in scarce information on superior durian cultivar, posing challenges for future plant breeding efforts.

Research on the biodiversity and genetic relationship among local durian varieties become significant for supporting the local durian breeding and cultivation efforts. Therefore, it is necessary to carry out exploration and characterization activities aimed at obtaining information about the diversity and important characteristics of durian [8]. The morphological analysis can serve as a basis for assessing the genetic biodiversity of durian varieties. The previous research found that morphological characteristics such as the leaf size and shape can vary among the durian varieties, therefore, it can be used to analyze the genetic relationship [9]. Data and information on durian obtained from the identification and characterization process can then be used to develop the breeding program [10]. This research aims to gather information on the genetic diversity and kinship of durian varieties in Trenggulan, Rembang.

2 Methods

2.1 Location and Time Research

The observation of morphological diversity was conducted in Trenggulan Village (-06.72031510, 111.51382860), Pancur District, Rembang Regency, Central Java. from February to May 2024.

2.2 Research Design and Data Analysis

This study used exploratory descriptive research design through field surveys. Plant morphology was identified using the Durian Descriptor. The properties of each accession were identified by giving accession names. Accessions were assigned unique codes, designated by the prefix "TR" followed by numbers according to the data collection sequence.

A purposive random sampling was used, specifically in the form of snowball sampling, to select the fruiting plants. The morphological characteristics observed in this study were based on the Description Book of Durian [11] for vegetative organs, including both qualitative and quantitative characteristics. The tree characteristics analyzed were trunk-grown habit, trunk surface, bark color, crown shape, tree-grown habit, and trunk diameter. The leaf characteristics analyzed were leaf shape, leaf blade length, leaf blade width, leaf blade margin, leaf apex shape, leaf base shape, leaf upper surface color, leaf lower surface color, and glossiness of leaf upper surface and leaf lower surface.

The results were evaluated in a tabular form. The differences between each character were represented by sub-characters, which were then translated into binary data. Sub-characters absent in an accession were scored as 0, while those present were scored as 1 [12]. The data were analyzed using the SIMQUAL (similarity of qualitative data) method to generate a similarity matrix, followed by the SAHN (Sequential Aggregation, Hierarchical and Nested) with DICE coefficient and UPGMA methods (Unweighted Pairwise Method of Arithmetic Means) using numerical classification and multivariate system within the NTSYS-pc 2.02 software [13]. Results were presented as dendrograms and accompanied by descriptive interpretations.

3 Result And Discussion

3.1 Morphology of the Durian Tree

As a result of the exploration of durian plants in the Trenggulun Village, 13 local durian accessions were identified. All plants have a tree age exceeding 10 years, with the oldest surpassing over 100 years. Each accession exhibits diversity in tree and leaf morphological characteristics. Based on observations of tree morphology, two types of canopy crown shapes were identified, namely a pyramid-shaped header and an irregular shape (Figure 1).

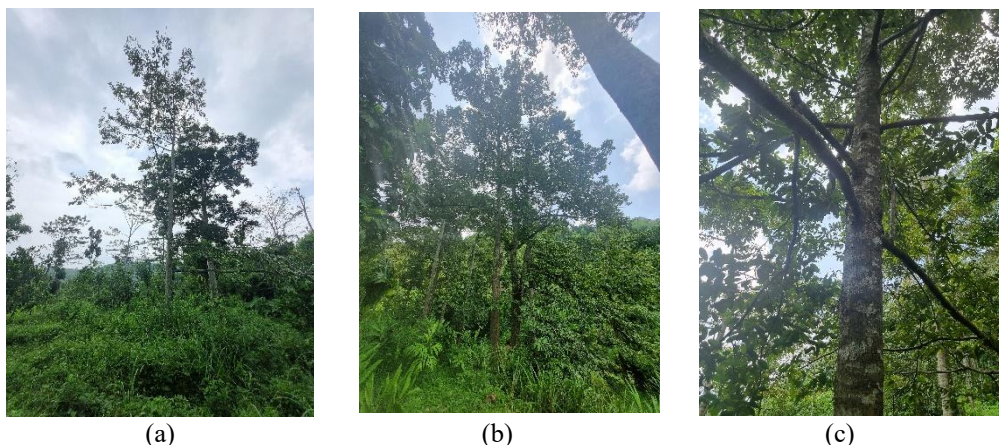


Fig. 1. (a) Irregular Canopy Shape (b) Pyramid Canopy Shape (c) Spreading Branch Grow

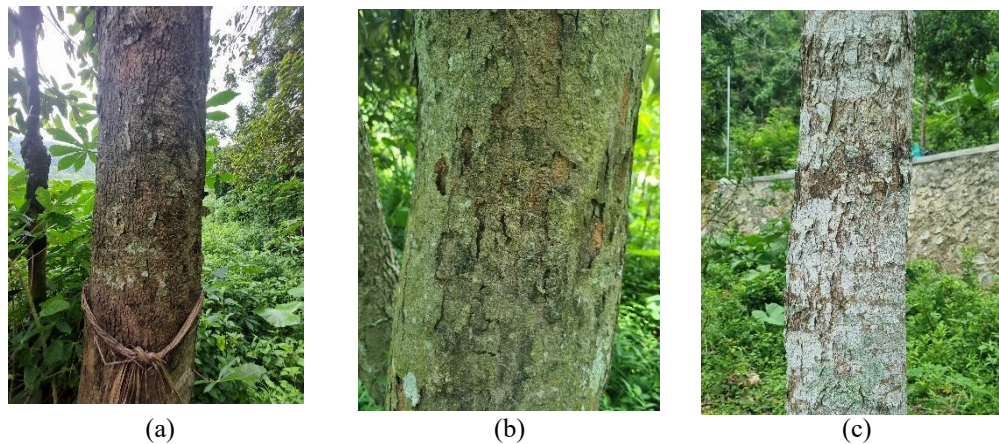


Fig. 2. (a) Dark brown bark color (b) Brown bark color (c) Gray bark color

For trees grown from seeds, seedlings, or air layering, the trunk circumference was measured 50 cm above the ground level. In contrast, for trees propagated through grafting, the circumference is measured 10 cm above the grafting point. In this present study conducted on 13 different plant accessions, it was found that the trunk diameter ranged from 70 cm to 203 cm, with trunk diameter being influenced by plant age, as there is a direct correlation between age and diameter. Additionally, the width of the trunk diameter is proportional to the amount of food reserves available, which impacts the availability of food for the plant [14].

The surface of the trunk across the 13 durian accessions was categorized as rough, flaky and very rough. Typically, durian bark has a rough surface due to the presence of crust formation [15]. The bark color also varied, with shades ranging from dark brown, brown and gray (Figure 2). While the tree grown habit has no variation, all accessions have a spreading tree grown habit. The morphological characteristics of each tree accession are detailed in Table 1.

Table 1. Qualitative morphological characteristics of durian tree

Accession code	Qualitative morphological characteristics of durian tree					
	Trunk circumference [cm]	Trunk grown habit	Trunk surface	Bark color	Crown shape	Tree grown habit
Tr1	203	Straight	Very rough	Brown	Pyramidal	Spreading
Tr2	117	Straight	Rough	Brown	Irregular	Spreading
Tr3	93	Straight	Very rough	Dark brown	Irregular	Spreading
Tr4	118	Straight	Rough	Brown	Irregular	Spreading
Tr5	104	Straight	Flaky	Brown	Pyramidal	Spreading
Tr6	94	Straight	Very rough	Gray	Pyramidal	Spreading
Tr7	76	Straight	Flaky	Gray	Irregular	Spreading
Tr8	90	Straight	Rough	Gray	Irregular	Spreading
Tr9	70	Straight	Flaky	Brown	Irregular	Spreading
Tr10	138	Straight	Flaky	Dark brown	Irregular	Spreading
Tr11	97	Straight	Flaky	Dark brown	Irregular	Spreading
Tr12	150	Straight	Flaky	Brown	Irregular	Spreading
Tr13	72	Straight	Rough	Brown	Irregular	Spreading

3.2 Morphology of the Durian Leaves

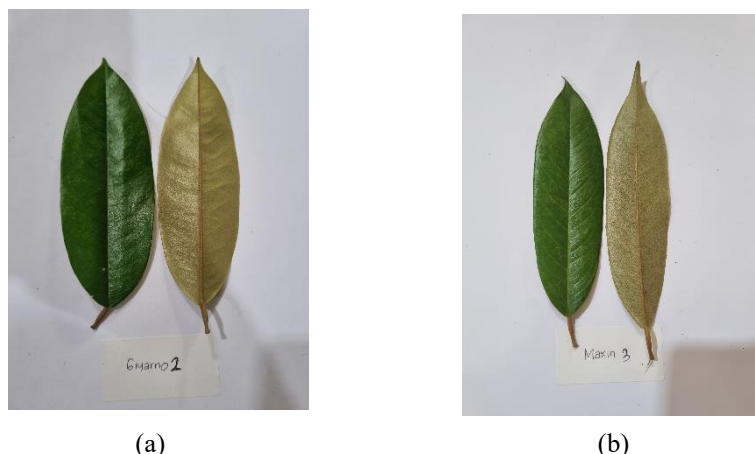


Fig. 3. (a) Oblong leaf blade shape with acuminate leaf apex shape (b) Linear oblong leaf blade shape with long acuminate leaf apex shape

Durian leaves are single leaves arranged alternately on the left and right sides of the twig. A distinct feature of durian leaves is the young leaves, which are partially fused on the left and right sides, forming a half-leaf structure [15]. Based on observation of the leaf morphology (Figure 3), variations were noted across accession, with exceptions in leaf blade margin and leaf lower surface glossiness characteristic. All accessions exhibited an entire leaf blade margin and a glossy leaf lower surface.

Table 2. Qualitative morphological characteristics of durian leaves

Accession code	Qualitative morphological characteristics of durian leaves									
	Leaf shape	Leaf blade length	Leaf blade width	Leaf blade margin	Leaf apex shape	Leaf base shape	Leaf upper surface colour	Leaf lower surface colour	Leaf upper surface glossiness	Leaf lower surface glossiness
Tr1	Linear oblong	Long	Intermediate	Entire	Acuminate	Cuneate	Dark green	Coppery brown	Glossy	Glossy
Tr2	Oblong	Intermediate	Intermediate	Entire	Acuminate	Cuneate	Green	Coppery brown	Glossy	Glossy
Tr3	Oblong	Long	Intermediate	Entire	Acuminate	Cuneate	Dark green	Coppery brown	Glossy	Glossy
Tr4	Linear oblong	Long	Intermediate	Entire	Long acuminate	Cuneate	Dark green	Coppery brown	Not glossy	Glossy
Tr5	Oblong	Intermediate	Intermediate	Entire	Acuminate	Round	Dark green	Coppery brown	Glossy	Glossy
Tr6	Oblong	Intermediate	Intermediate	Entire	Long acuminate	Cuneate	Green	Coppery brown	Glossy	Glossy
Tr7	Oblong	Intermediate	Intermediate	Entire	Acuminate	Cuneate	Green	Silvery brown	Glossy	Glossy
Tr8	Linear oblong	Long	Intermediate	Entire	Long acuminate	Acute	Light green	Silvery brown	Glossy	Glossy
Tr9	Linear oblong	Long	Intermediate	Entire	Acuminate	Cuneate	Dark green	Coppery brown	Glossy	Glossy
Tr10	Oblong	Long	Intermediate	Entire	Long acuminate	Cuneate	Green	Coppery brown	Glossy	Glossy
Tr11	Oblong	Long	Wide	Entire	Long acuminate	Acute	Dark green	Silvery brown	Glossy	Glossy
Tr12	Oblong	Long	Wide	Entire	Long acuminate	Cuneate	Dark green	Coppery brown	Glossy	Glossy
Tr13	Oblong	Long	Intermediate	Entire	Long acuminate	Acute	Green	Silvery brown	Glossy	Glossy

Leaf blade length was measured from the base to the tip of the leaf blade, categorized as follows: 1) Short (< 10.0 cm), 2) Intermediate (10.1–15.0 cm), 3) Long (15.1–25.0 cm) and 4) Very long (> 25.0 cm). The results indicated that only intermediate and long categories were present. Additionally, leaf blade width was measured at the widest point and categorized as follows: 1) Narrow (< 3.0 cm), 2) Intermediate (3.1–6.0 cm), 3) Wide (6.1–9.0 cm) and 4) Very wide (> 9.0 cm) [11]. The results showed that for leaf blade width, only two categories, namely intermediate and long, were observed. The detailed description of leaf morphological characteristics for each accession is provided in Table 2.

3.3 Analysis of Durian Vegetative Organs

A cluster analysis was performed to determine the similarity level of local durian accessions of Trenggulan based on vegetative morphological traits. The results of cluster analysis were illustrated in dendrograms (Figure 4). This cluster analysis was carried out using morphological characteristics of vegetative organs in the Descriptor of Durian.

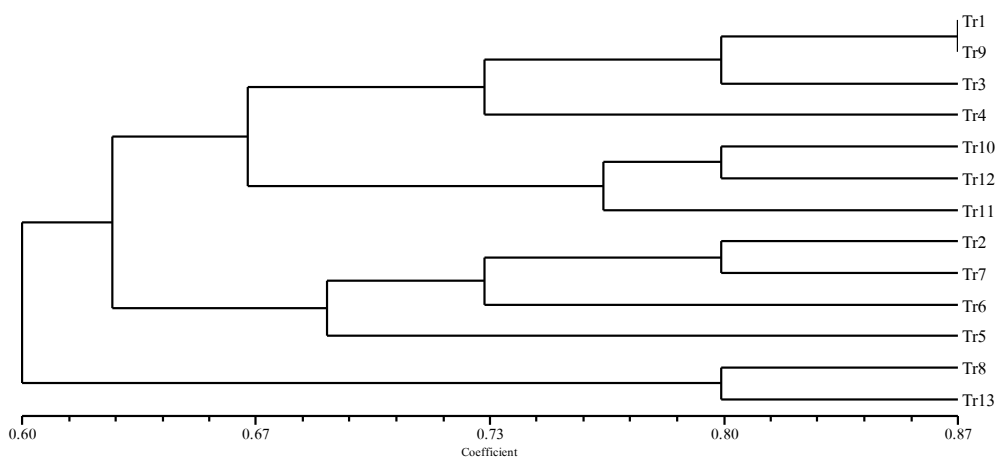


Fig. 4. Dendrogram grouping of vegetative organ characters

The analysis of vegetative organ similarities across 13 durian accessions revealed that the accessions exhibit spread at the taxonomic distance values (similarity level) ranging from 0.60 to 0.87. The durian accessions were clustered into 2 groups at a similarity coefficient threshold of 0.63 or 63% and divided into 8 large groups at the boundary of the equivalence of 0.8 or 80%. Among the accessions, Tr1 and Tr9 displayed the highest similarity, differing only in trunk surface characteristics.

Accessions from the same location did not necessarily cluster together or show closer taxonomic distances. To measure the degree of discrepancy between samples, coefficients known as "taxonomic distances" are used as quantitative indicators. Higher difference values suggest a lower degree of similarity and increased variation between individuals, whereas lower difference values indicate closer similarity levels among individuals [16].

4 Conclusion

Based on the research findings, 13 durian accessions were identified, with each exhibiting diversity in tree and leaf morphological characteristics. Analyzing vegetative organs showed morphological variation among the 13 durian accessions, with a similarity coefficient ranging from 0.60 to 0.87.

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