Morphological characterization of local durian as parent tree in Bitingan District, Rembang

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Abstract. There is a variety of local durian cultivars in Indonesia. However, it has not been much developed, thus need a plant breeding program through morphological characterization to obtain local durian with superior characteristics. This study aimed to: 1) Obtain information of morphological diversity of several local durian accessions in Bitingan Village; 2) Obtain local durian information with superior characteristic as a prospective parent tree in Bitingan Village. This study was a descriptive exploratory research through field surveys. Sampling was done by purposive random sampling with the type of snowball sampling. Data was analyzed using NTSYS 2.02 program. Based on vegetative organs, durian accessions have morphological variations with a similarity coefficient between 0.64-0.87 whereas based on generative organs durian accessions have morphological variations with a similarity coefficient between 0.21-0.57. In Bitingan Village, it is also found durian with superior characteristics.

1. Introduction
Indonesia is a country with a very high plant diversity and is included in the list of the seventh largest country with number of flowering plant species with 20,000 species [1] including Durian (Durio spp.). In Indonesia, it has been released 71 superior durian cultivars up to 2010 [2]. Durian cultivars vary in morphological characteristics, such as skin color, thorn shape, aril color, aril thickness, thorn shape, fruit and seed shape, flavor, aroma and fruit size [3].

Durian is known as the 'king of fruit' because it has a strong taste and a unique odor [4], causing the high demand for it. On the other hand, 5% increase of durian production has not been able to meet the needs of the durian in the country [5]. This is related to low durian productivity and high variability production because durian crops in Indonesia are mostly not intensively cultivated, but only as a crop in yards and gardens on a small scale[6].

Low productivity of durian can be overcome by developing local durian. One region that has a high durian productivity reaching 105.36kg/tree is Rembang regency [7]. However, there is no study has been conducted on original durian genetic diversity in Rembang, thus there is a difficulty for the plant breeders in finding information regarding local durian. This limitation leads to a weak protection of natural resources so that extinction or theft of genetic resources may occur [8]. There is a need in plant breeding program through morphological characterization to obtain potentially superior durian as prospective mother tree.

The new improved varieties require extensive phenotypic and genotypic variability which can be obtained through morphological characterization. Then it is evaluated to find out the superior
characters. It is expected to obtain information of durian accession which has the most superior character [6].

2. Methods

2.1. Location of the study
The observation of morphological diversity was conducted in Bitingan Village, Sale District, Rembang Regency, Central Java, Indonesia.

2.2. Research design and data analysis
This study used descriptive explorative research method through field survey. Identification of plant morphology was done based on Descriptors for Durian [9]. Identification was continued to the characteristics of each accession with the name of durian accession based on owner’s name [9].

This study applied purposive random sampling with the type of snowball sampling observation made on 10 plants that have been fruitful. Observation on morphological character in this research was done on vegetative and generative organs which include qualitative and quantitative characters based on durian descriptor [9].

The results scored and then analyzed to create a matrix of resemblance to the SIMQUAL (Similarity for qualitative data) procedure, followed by SAHN (Sequential Agglomerative, Hierarchical and Nested) with UPGMA (Unweighted Pair Group Method with Arithmetic Average) method using Numerical Taxonomic and Multivariate System NTSYS-pc. 2.02 [10]. The results will appear in the form of a dendrogram diagram, then presented descriptively.

3. Result and discussion

3.1 Morphology of the durian vegetative organs
Observation on 10 accessions showed that the trees growth characteristic is spreading of all accessions with 90% of durian canopy shape are irregular and 10% pyramid shape. The plant grows horizontally and forms a variety of angle depending on the type and variety. There is a lot of branches forming canopy similar to a cone or triangle [11,12].

![Figure 1](image1.jpg)

**Figure 1.** (a) Irregular canopy shape (b) Pyramid canopy shape (c) Spreading branch growth

There are three bark surface categories, which are 50% very rough, 30% with rough and 20% smooth. Durian bark is generally rough because there is a crust [13]. Furthermore, there are three types of bark color, namely brown (70%), dark brown (20%) and grey (10%).

The observation of other vegetative organs is conducted on the leaves. Observation results are presented in Figure 2.
Figure 2. (a) Oblong leaf blade shape (b) Linear oblong leaf blade shape (c) Long acuminate leaf apex shape (d) Acuminate leaf apex shape

It is found four leaves form that are linear oblong by 30%, elliptic by 40%, oval by 10% and oblong by 20%. Durian plant leaves consisted of petiole leaf and leaf strands only. Durian leaf blade shapes are vary, such as ovoid, obovate, ellipse and oval [14]. The edge of the leaves is flat and smooth for all accessions. Most leaves have a thin and flat shape, which is related to optimal absorption of light energy and efficient internal gas diffusion[15].

The leaf apex shape consisted of 50% long acuminate and 50% acuminate. The shapes of the leaves base are cuneate by 70% and acute form by 30%. All of the accessions observed have the same surface, which are glossy upper surface and non-glossy bottom surface.

Observation of the leaves color indicated dark green and green color by 70% and 30%, respectively. Furthermore, there are two types of leaf chlorophyll namely blue-green chlorophyll and green-yellow chlorophyll. The difference in chlorophyll amount is depend on plant species, light and magnesium content [16,17].

3.2. Morphology of durian generative organs

Observation on generative organ morphology included the characters of flowers, fruits and (Figure 3).

Generative organ analysis can be done only on 7 accessions, because 3 accessions do not produce fruit at the time of study, probably due to pollination failure[18]. In addition, weather factor such as the rain season throughout the year makes durian unable to produce fruit [19]. The observation for obovate and round bud shape are 71% and 29%, respectively, with 29% of cream-beige crown, 29% of white, 14% of pink, 14% of yellow and yellowish green respectively. The color of the flower petals is 57% yellow, 29% cream-beige, and 14% yellowish green.

The shape of the fruit different in each accession, namely 14% elliptic, 14% oval, 29% oblong, 14% globose, 14% ovoid and 14% obovoid. The ripen fruit skin color were 29% of yellowish green, 14% yellow, 14% brownish green, 14% green, 14% brownish yellow and 14% yellowish orange. According to Antarlina (2009) [20], the skin of young durian fruit is green and after ripening it turns into yellowish green, dark green, or dull green.

The flesh colors from 7 accessions are 72% cream, 14% orange and 14% white. Then the total of segment is 5 and has a 72% oblong, 14% spheroid and 14% ellipse seeds shape. The taste of the fruit flesh is 28.6% sweet, 14.2% bitter sweet, 28.6% sweet with bitter after-taste and 28.6% slightly sweet while for the fruit aroma 72% medium aroma and 28% strong aroma.
3.3. Analysis of vegetative organs

Dendogram of similarity based on durian vegetative characters is presented in Figure 4.

Based on similarity analysis of vegetative organs from 10 accessions, the lowest similarity coefficient is 0.64 and the highest is 0.87. According to Miswarti and Putra [21], the more common characteristics, the closer the kinship relationship is. On the contrary, the more different characteristics, the kinship relationship will be far. At the limitation of the similarity coefficient of 0.64 (64%), the durian grouping is divided into two major groups, then divided into five major groups.
at the limitation of the similarity coefficient of 0.75 (75%). At this coefficient limitation, group A consisted of two accessions, namely sima1 and sono6. Group B only consisted of 1 accession, namely sono2. Group C consisted of 2 accessions, namely sono2 and sono8. Group D consisted of 1 accession, namely sono2. Group E consisted of 4 accessions, namely sono3. Group E consisted of 4 accessions, namely sono4, sono7, sono5 and sono9.

The sono4 and sono7 accessions have the highest coefficient limitation of 0.87, because both accessions have similarities in all leaf organs as well as bark shape, crown shape and tree growth habit. The great morphological character similarity makes the kinship relationship close.

3.4. Analysis of durian generative organs
Dendogram of similarity based on durian generative characters is presented in Figure 5. There are two major groups on the similarity coefficient of 0.21. In group one, there are 6 accessions whereas group two consisted of only 1 accession namely sono8. This means that sono8 accession has the smallest coefficient of similarity, which is only 0.21, thus, it has more differences than other accessions of 0.79 (79%). This indicates that there are still variations between durian accessions, which can be due to genetic factors or environmental conditions [22]. The higher the genetic variation, the more likely it is to get superior genotypes. Crossbreeding with relatively high genetic variations will produce individuals with higher heterozygosity[23].

3.5. Potentially superior local durian as parent tree
Local durian which has the potential of superior character can be identified based on fruit morphology (Table 1).

The criteria of superior durian are: (1) has an attractive appearance, (2) the shape of the fruit is ellipse and regular, (3) the thorn is large and pyramid-shaped, (4) the flesh is smooth, fluffy, dry, and the color is honey yellow (coper color), thick and sweet and (5) the fruit stem is relatively short [11]. The fruit criteria that determine consumer choice are: (1) medium fruit size (1.6-2.5 kg), (2) oval fruit shape (3) brownish green skin color, (4) strong aroma, (5) small seeds and (6) medium thorn length[24]. Based on the results of the analysis of 7 durian accessions, the fruit that is close to superior durian is sono7 (Figure 3) because it has a medium fruit size (2.5 kg) with a bitter sweet taste and has a cream fruit color. Furthermore, the sono7 accession can be developed into a potentially superior parent tree.

![Figure 5](image-url)
4. Conclusion

There is morphological diversity in local durian in Bitingan village. Based on vegetative organs, there are 10 durian accessions that have morphological variations with a similarity coefficient between 0.64-0.87 and based on generative organs there are 7 accessions of durian that have morphological variations with a similarity coefficient between 0.21-0.57. In Bitingan Village, it is also found durian with superior characteristics, namely sono7 because it has a medium fruit size (2.5 kg) with a bitter sweet taste and has a cream fruit color.

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Table 1. Observational data local durian fruit accessions in Bitingan District

| Criteria          | Sono2      | Sono3     | Sono4     | Sono5     | Sono6     | Sono7     | Sono8     |
|-------------------|------------|-----------|-----------|-----------|-----------|-----------|-----------|
| Fruit Shape       | Oval       | Oblong    | Elliptic  | Oblovoid  | Globose   | Oval      | Oblong    |
| Fruit weight      | 1 kg       | 0.75 kg   | 0.5 kg    | 1.4 kg    | 0.9 kg    | 2.3 kg    | 1.4 kg    |
| Fruit skin color  | Orange yellow | Green   | Browns green | Yellowish green | Browns green | Yellowish green | Yellow     |
| Color of fruit flesh | Orange | Creamy white | Creamy white | Creamy white | Creamy white | Creamy white | Creamy white |
| Fruit taste       | Sweet      | Sweet     | Slightly sweet | Sweet bitter after taste | Slightly sweet | Bitter sweet | Sweet bitter after taste |
| Fruit Aroma       | Moderate   | Moderate  | Strong    | Moderate  | Moderate  | Moderate  | Strong    |
| Fruit length      | 21 cm      | 15 cm     | 11.5 cm   | 17 cm     | 13 cm     | 19 cm     | 17 cm     |
| Fruit circumference | 44 cm | 40 cm     | 35 cm     | 49 cm     | 45 cm     | 58 kg     | 49 cm     |
| Fruit segment     | 5          | 5         | 5         | 5         | 5         | 5         | 5         |
| Seed shape        | Oblong     | Oblong    | Oblong    | Oblong    | spheroid  | oblong    | Oblong    |
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