Study morphology of loquat plants (*Eriobotrya Japonica* Lindl.) from Karo, Dairi, and Simalungun Districts, North Sumatra

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**Abstrak.** Loquat (*Eriobotrya japonica* Lindl.) is a flowering plant that belongs to the Rosacea family. The loquat has many health benefits. Cultivation and information about loquat plants in Indonesia are still limited, so they are rarely found and known by the public. Limited information and data regarding loquat plants is also an obstacle to the development of loquat plants. Research on loquat plants aims to analyze the morphological characters in three districts, namely, Karo, Dairi, and Simalungun districts. This research was conducted using a descriptive method. The analysis of the morphological characteristics of loquat plants using morphological data scoring into binary data. The similarity between individuals was analyzed using clusters with the NTSYS program version 2.0 with the UPGMA method of the SimQual function. Morphological Observation Results Loquat plants (*Eriobotrya japonica* Lindl.) in Karo, Dairi, and Simalungun Districts have uniform characters in the morphology of stems, leaves, and flowers. However, the observed fruit and seed morphology showed different characters. Different characters exist in the shape of the fruit and seeds. The morphological similarity level of loquat plants was grouped at a similarity coefficient value of 95%. Clusters I and II have the highest similarity with a coefficient value of 100%. Cluster III has the lowest similarity with a coefficient value of 97%.

1. **Introduction**

Loquat (*Eriobotrya japonica* Lindl.) is a flowering plant that belongs to the Rosacea family. The loquat originated in China and is scattered in subtropical areas [1]. Loquat plants in Indonesia are found in highland areas such as in North Sumatra (Karo, North Tapanuli, Simalungun, Toba Samosir, and Dairi districts), in West Java (Cipanas, Cianjur Regency), and North Sulawesi [2]. The loquat has many health benefits, and various plant organs have been used in traditional medicine for thousands of years [3]. Loquat pulp contains citric acid, carotene, vitamins A, B, and C. Loquat fruit contains iron and copper, which can help the formation of red blood cells. In addition, the leaves and seeds contain amygdalin, which acts as an anti-cancer [4]. The extract of the loquat plant has been used for the treatment of cough, chronic bronchitis, inflammation, diabetes, and cancer in traditional Chinese medicine [5]. Cultivation and information about loquat plants in Indonesia are still limited, so it is rarely found and known by the public. Limited information and data regarding loquat plants is also an obstacle to the development of loquat plants, so it is necessary to study the morphology of loquat plants as a source of scientific reference. This study was conducted to determine the morphological characters of loquat plants in three districts, namely, Karo, Dairi, and Simalungun, North Sumatra.
2. Method

2.1. Time and Place
This research was conducted for 5 months from September 2019 to February 2020 at the Plant Physiology and Tissue Culture Laboratory, and Plant Systematics Laboratory, Department of Biology, Faculty of Mathematics and Natural Sciences, Universitas Sumatera Utara, Medan. The sampling activity was carried out in Karo District, namely in Aek Hotang Village, Garingging Village and Gundaling II Village. Dairi District in Tanjung Beringin I Village. Simalungun District in Bandar Hinalang Village and Sipahalan Village.

2.2. Research Method
This research used a descriptive method. Determination of the sampling location is done by using a purposive sampling method. The sampling locations were determined in Karo, Dairi, and Simalungun Districts. Three samples were taken in each district.

2.3. Work Procedures

2.3.1. Sampling and Labeling of Samples. Each sample that has been taken is then wrapped in wet paper, then put in clear plastic and given a label containing information on the location of the sample. Samples from Karo District in Aek Hotang Village were coded K1, Garingging Village were coded K2, and Gundaling II Village were coded K3. Samples from Dairi District in Tanjung Beringin I Village were coded D1, D2, and D3. Samples from Simalungun District in Bandar Hinalang Village were coded S1 and S2, and in Village Sipahalan were coded S3.

2.3.2. Retrieval Data Abiotic Factors. Retrieval of abiotic factor data includes taking place altitude data using the altimeter android application and environmental coordinates using the android application Global Positioning System (GPS). Soil pH is measured using a soil pH meter. Micro climates in the form of air temperature using a thermo hygrometer, humidity using a thermo hygrometer, and light intensity using a lux meter.

2.3.3. Morphological Description. Loquat morphological characters observed directly in the field, namely the stem organs. The morphological characters of loquat plants observed in the laboratory were the leaves, flowers and fruit organs.
   a. Stem Morphology
   The morphological characteristics of the stems observed were the type of stem, the shape of the stem, the direction of stem growth, the branching pattern of the stem, the surface of the stem, and the color of the stem.
   b. Leaf Morphology
   The leaf morphological characteristics observed were leaf type, leaf arrangement, leaf shape, leaf bone arrangement, leaf tip, leaf base, leaf edge, leaf flesh type, upper leaf surface, lower leaf surface, upper leaf color, lower leaf color, leaf length, and leaf width.
   c. Flower Morphology
   The morphological characteristics of the observed flowers were flower type, compound type, flower layout, flower symmetry, crown color, petal color, additional petal color, number of petals, number of sepals, number of additional petals, number of stamens, number of pistils, flower diagram, and the flower formula.
   d. Fruit Morphology
   The fruit morphological characteristics observed were fruit group, fruit type, fruit shape, fruit taste, fruit color, seed color, and seed shape.
2.4. Data Analysis
Data analysis was performed using scoring morphological data into binary data. A score of zero (0) for a trait that is not present in a plant and a score of one (1) for a trait that is present in a plant. The amount of similarity between individuals was analyzed in clusters or clusters with the NTSYS program version 2.0 with the UPGMA (Unweighted Pair Group Method of Arithmetic Average) method with the Similarity for Qualitative Data function (SimQual) [6].

3. Results And Discussion
Morphological Observation Results Loquat plants (Eriobotrya japonica Lindl.) in Karo, Dairi, and Simalungun Districts have uniform characters in the morphology of stems, leaves, and flowers. However, the observed fruit and seed morphology showed different characters. Different characters exist in the shape of the fruit and seeds. The loquat fruit shapes observed were piryform, obovoid, oval, and round, while the seeds observed had shapes of spheroid and obovoid.

Based on the results of morphological descriptions of loquat stems in Karo, Dairi, and Simalungun districts, it shows that loquat plants have woody stems, round stem shapes, upward-inclined stem growth direction, and sympodial branching types. The loquat stems in all samples were brown. The surface of the loquat stems had a rough and scarred texture. On the surface of the loquat stems there were marks where the leaves were attached. A scarred stem is a stem whose surface has scars or scratches. These wounds or scratches are the places where plant organs attach, such as leaves and leaves on the stems, branches and twigs of plants [7]. The morphology of loquat plants in Karo, Dairi and Simlaungun districts can be seen in Figure 1.

Results of observations on leaf morphological characteristics Loquat plants in the three districts showed that the loquat leaves in all samples observed had a single leaf type, alternate leaf arrangement, pinnate leaf formation, and lanceolate leaf shape. The loquat plant has a tapered leaf bases, pointed leaf tips, serrated leaf margins, which have blunt sinuses and sharp angulus. The upper leaves are dark green, while the lower leaves are light green. Young leaves have soft and short hairs on the upper and lower surfaces. The top of adult leaves has a slick surface and only the lower surface has soft and short hairs. Type of flesh leaves like skin. Figure 2 shows the morphology of loquat leaves.

The results of the morphological characterization of loquat flowers in all samples showed that loquat plants had a limited type of compound interest, the location of the terminal flowers, and actinomorph flower symmetry. The flower crown is white. On the inner surface, there are brown soft hairs. The color of the petals is brownish green with the petals sticking together, and the additional petals are brown. Stalks stick together. The type of stamen based on the attachment of the stalk is polyadelphous, where the stalk is attached to more than 2 bundles. Pistils are compound and are attached to each other. The fruit will sink. Sepals and petals have the same number, which is 5 in each flower. There are 20 stamens and 5 pistils in all observed samples, so it has the flower formula ♂ * K (5) C 5 A (20) G (5). Based on the flower formula obtained, a diagram of the flower on the loquat plant can be drawn. Loquat floral diagram can be seen in Figure 3.
Figure 1. Morphology of Loquat Plants

Figure 2. Morphology of Loquat Leaves
The uniform morphological character of loquat plants is thought to be due to genetic factors and the environmental conditions where it grow, which are both in the highlands. The emergence of the same characters between varieties is caused by the presence of genes composing the same phenotype, although influenced by different environments, will produce the same phenotype [8]. Flower morphology can be seen in Figure 4.

The loquat fruit is a single true fruit of the pome type. The loquat has fine hairs on the surface of the fruits skin. Based on Observations of the morphological characters of the loquat showed that there was diversity in the shape of the fruit. The fruit in samples K1 and K2 had a pear shape, K3 had a round shape, D1, D3, S1, S2, S3 had an obovoid shape, and in sample D2 the fruit was oval. According to [9], the variation of loquat morphology was caused by the origin and cultivar. According to [10], the diversity of characters found in loquat plants in North Sumatra is influenced by the origin of the plant, which is mostly seed propagation. Loquats have a sweet and sour taste. Fruits that have a sweet taste are found in samples D2, S1, and S2, while the fruits in samples K1, K2, K3, D2, D3, and S3 have a sour taste. The morphology of the loquat can be seen in Figure 5.
The loquat fruit consists of 3 layers, namely the outer layer of the fruit skin, the middle layer of the fruit skin, and the innermost layer. The transverse incision of loquat fruit can be seen in Figure 6.

The results of the morphological characterization of loquat seeds in Karo, Dairi, and Simalungun districts showed that there were variations in the shape of the seeds. Samples K1-K3, D1-D3, S1, and S3 have a shape spheroid, while the S2 samples have an obovoid shape. The morphology of loquat seeds can be seen in Figure 7.
The differences in the characters in the shape of the fruit and seeds are thought to be caused by genetic factors, because the abiotic factors and the geographical location of the loquat plants in Karo, Dairi, and Simalungun Districts are both in the highlands. Data on abiotic factors and geographic location can be seen in Table 1.

**Table 1. Abiotic factors**

| Sample | Sampling Location | Altitude (msl) | pH | Soil Temperature (°C) | Humidity (%) | Intensity Light (Lux) | Geographical Location |
|--------|-------------------|---------------|----|-----------------------|--------------|----------------------|-----------------------|
| District Karo |
| K1 | Aek Hotang | 1486 | 6.2 | 29.4 | 50 | 92300 | 2°54'21" LU and 98°29'35" BT |
| K2 | Garingging | 1417 | 6 | 30 | 48 | 95200 | 2°58'01" LU and 98°32'08" BT |
| K3 | Gundaling II | 1389 | 6 | 30 | 44 | 96000 | 3°11'21" LU and 98°30'06" BT |
| District Dairi |
| D1 | Tanjung Beringin I | 1152 | 6 | 30 | 41 | 96700 | 2°45'26" LU and 98°28'23" BT |
| D2 | Tanjung Beringin I | 1104 | 6.2 | 30 | 40 | 96800 | 2°45'26" LU and 98°28'23" BT |
| D3 | Tanjung Beringin I | 1052 | 5.7 | 30.5 | 40 | 97300 | 2°45'26" LU and 98°28'23" BT |
| District Simalungun |
| S1 | Bandar Hinalang | 1410 | 6 | 29.7 | 46 | 93300 | 2°55'11" LU and 98°37'42" BT |
| S2 | Bandar Hinalang | 1382 | 5.8 | 30 | 45 | 94000 | 2°55'11" LU and 98°37'42" BT |
| S3 | Sipahalan | 1264 | 6 | 31 | 41 | 96100 | 2°54'05" LU and 98°45'24" BT |

Based on the morphological observations, the Loquat plants were analyzed using morphological data scoring into binary data. Score (0) for traits that are not present in a plant, score (1) for traits that are present in a plant. Binary data is used to determine grouping patterns based on morphological
similarities. Binary data of loquat plants in Karo, Dairi, and Simalungun Districts can be seen in Table 2.

Table 2. Binary Data of Loquat Plants in Karo, Dairi, and Simalungun Districts

| Karakter                              | Samples |
|---------------------------------------|---------|
|                                       | K1      | K2      | K3      | D1      | D2      | D3      | S1      | S2      | S3      |
| Leaf type : simple                    | 1       | 1       | 1       | 1       | 1       | 1       | 1       | 1       | 1       |
| Leaf arrangement : alternate          | 1       | 1       | 1       | 1       | 1       | 1       | 1       | 1       | 1       |
| Leaf shape : lanceolate               | 1       | 1       | 1       | 1       | 1       | 1       | 1       | 1       | 1       |
| Leaf venation : pinnate               | 1       | 1       | 1       | 1       | 1       | 1       | 1       | 1       | 1       |
| Leaf tip : acute                      | 1       | 1       | 1       | 1       | 1       | 1       | 1       | 1       | 1       |
| Leaf base : acuminate                 | 1       | 1       | 1       | 1       | 1       | 1       | 1       | 1       | 1       |
| Leaf margin : dentate                 | 1       | 1       | 1       | 1       | 1       | 1       | 1       | 1       | 1       |
| Flesh type leaf coriaceous           | 1       | 1       | 1       | 1       | 1       | 1       | 1       | 1       | 1       |
| Upper surface of leaf : slick        | 1       | 1       | 1       | 1       | 1       | 1       | 1       | 1       | 1       |
| Lower surface of leaf : pubescents   | 1       | 1       | 1       | 1       | 1       | 1       | 1       | 1       | 1       |
| Upper leaf color : dark green        | 1       | 1       | 1       | 1       | 1       | 1       | 1       | 1       | 1       |
| Lower leaf color : light green       | 1       | 1       | 1       | 1       | 1       | 1       | 1       | 1       | 1       |
| Stem type : woody                    | 1       | 1       | 1       | 1       | 1       | 1       | 1       | 1       | 1       |
| Stem shape : round                   | 1       | 1       | 1       | 1       | 1       | 1       | 1       | 1       | 1       |
| Directions grow stem : ascends       | 1       | 1       | 1       | 1       | 1       | 1       | 1       | 1       | 1       |
| Sympodial branching                  | 1       | 1       | 1       | 1       | 1       | 1       | 1       | 1       | 1       |
| Surface stem : rough                 | 1       | 1       | 1       | 1       | 1       | 1       | 1       | 1       | 1       |
| Bark color : brown                   | 1       | 1       | 1       | 1       | 1       | 1       | 1       | 1       | 1       |
| Compound inflorescence               | 1       | 1       | 1       | 1       | 1       | 1       | 1       | 1       | 1       |
| Type of inflorescence : cymose       | 1       | 1       | 1       | 1       | 1       | 1       | 1       | 1       | 1       |
| Terminal flower                      | 1       | 1       | 1       | 1       | 1       | 1       | 1       | 1       | 1       |
| Flower symmetry : actinomorphic      | 1       | 1       | 1       | 1       | 1       | 1       | 1       | 1       | 1       |
| Flower crown color : white           | 1       | 1       | 1       | 1       | 1       | 1       | 1       | 1       | 1       |
| Petal color : brownish-green         | 1       | 1       | 1       | 1       | 1       | 1       | 1       | 1       | 1       |
| epicalyx: brownish-green             | 1       | 1       | 1       | 1       | 1       | 1       | 1       | 1       | 1       |
| Simple fruit                         | 1       | 1       | 1       | 1       | 1       | 1       | 1       | 1       | 1       |
| Type of fruit : pome                  | 1       | 1       | 1       | 1       | 1       | 1       | 1       | 1       | 1       |
| Fruit shape : obovoid                | 0       | 0       | 0       | 1       | 0       | 1       | 1       | 1       | 1       |
| Fruit color : yellow                 | 1       | 1       | 1       | 1       | 0       | 1       | 0       | 0       | 1       |
| Seed shape : spheroid                 | 1       | 1       | 1       | 1       | 1       | 1       | 1       | 0       | 1       |
| Seed color : dark brown              | 1       | 1       | 1       | 1       | 1       | 1       | 1       | 1       | 1       |

The results of the binary data analysis of loquat plant morphology in Karo, Dairi, and Simalungun districts which have been translated then carried out a cluster similarity analysis using the NTSYS version 2.0 program with the UPGMA method. The results of the analysis of morphological similarities in loquat plants in Karo, Dairi, and Simalungun districts can be seen in Figure 8.

![Figure 8. Dendogram of the Similarity of Loquat Plant Morphology in Karo, Dairi and Simalungun Districts](image-url)
The results of the analysis of morphological similarities based on the morphological characters of the loquat plants in all samples unified at a morphological similarity of 95%. At a coefficient of 97%, all samples were separated into three main clusters. Based on the three clusters formed, there are two clusters that have the highest similarity coefficient value of 100%, namely cluster I, consisting of four samples (K1, K2, K3, and D2), and cluster II, consisting of four samples (D1, D3, S1, and S3). Cluster I separated from cluster II due to differences in the shape of the loquat fruit. There is one sample that grouped itself, namely in cluster III, consisting of the S2 sample with a similarity coefficient value of 97%. Cluster III is separated from cluster I and cluster II due to differences in the shape of the loquat seeds. Based on the coefficient of similarity of loquat plants in all samples, it shows that loquat plants are closely related. This can be seen in the similarity coefficient, which is clustered at 95% similarity. According to [11], the more similarities in the characteristics you have, the closer the kinship relationship and vice versa. Phenotypic diversity in species can be seen from their relationship with one another.

4. Conclusion

Based on the results of morphological characterization of loquat plants in Karo, Dairi, and Simalungun Districts, it can be concluded that: The similarity level of loquat plants from Karo, Dairi, and Simalungun Districts based on their morphological characters is high with a coefficient value of 95%, resulting in three main clusters. Cluster I, consisting of loquat plants from three locations in Karo Districts and one location in Dairi Districts (D2), had a similarity level of 100%. Cluster II, consisting of loquat plants from two locations in Dairi Districts (D1 and D3) and two locations in Simalungun Districts (S1 and S3), had a similarity level of 100%. At a coefficient value of 97%, Cluster I and Cluster II separated due to differences in the shape of the loquat fruit. Cluster III, namely loquat plants from one location (S2) in Simalungun, has a similarity level of 97%. Cluster III is separated from Clusters I and II because there are differences in the shape of the loquat seeds.

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