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Morphological and Anatomical Leaf Characteristics of Mango Kuweni (*Mangifera Odorata* Griff*)* in Matansala and Bahoruru Villages Central Bungku of Morowali Regency

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Abstract- This study aims to describe and classify the kuweni mango plants in Bungku Tengah Subdistrict especially in Matansala and Bahoruru Villages through morphological characters and leaf anatomy to look for parent trees. Observations of morphological characteristics were carried out in the villages of Matansala and Bahoruru, while leaf anatomical observations were carried out in the Laboratory of Plant Pests and Diseases, Faculty of Agriculture, Tadulako University, from December 2016 to May 2017. Observation were carried out under a microscope with a scale of 400 times magnification. After all the primary data was collected, a dendrogram analysis was performed using the SYSTAT 8.0 program. The results showed morphological and anatomical characters observed based on cluster analysis described in the form of dendrograms. Unselected accessions in the combined dendrogram are caused by the concept of distance used. In the dendrogram analysis of the distance cluster formed, it can be interpreted that the farther the distance to the right, the more various similarities of characters from the accession. Conversely, the farther the distance to the left, the more similar the character of the kuweni accession.

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I. Introduction

Mango (*Mangifera indica L*) is one type of annual plant in the form of trees originating from India. Mango is a type of tropical plant that is very popular in the world community, especially in Indonesia. These plants then spread in Southeast Asia, including Indonesia and Malaysia. This plant grows in the form of trees trunk erect, multiple branches, are shady and looked green throughout the year. The height of matures tree can reaches 10-40 meters. The age of this plant can reach up to 100 years. Morphology of mango trees consists of roots, stems, leaves, and flowers. Flowers produce seeds which generatively can grow into new plants (Pracaya, 2006).

In Central Sulawesi Province the production of mangoes in 2013 was 174,726 tons (BPS, 2013), while in Morowali District the amount of mango production in 2014 reached 17,364 tons (BPS Morowali, 2014). The low production of mangoes is due to the influence of climate, cultivation techniques and different tree conditions (Oktavianto et al., 2015).

Morowali Regency has Kuweni mango (*Mangifera odorata* Griff) or in the local language called maca mango. The obstacle in cultivating this plant because its growth very slowly, as result this fruit production also relatively low both regarding quality and quantity. Because the cultivation of mango plants is limited at home garden scale and has not been cultivated properly, besides that the quality of agriculture is not yet known. For this reason, efforts to find a parent tree that can be a source of quality seeds are very necessary. The first step required is to make morphological and anatomical observations that will be useful and provide information about the diversity of characters for future research.

II. Materials and Methods

This research will be conducted from December 2016 to May 2017, samples taken from Matansala and Bahoruru villages, Central Bungku District, Morowali Regency and morphological identification were carried out at the Tadulako University Plant and Pest Disease Laboratory.

The tools used in morphological observations are roll meters, ruler, label paper, sample plastics, digital cameras, GPS, color paint, Distance Meter smartphone applications, and writing instruments. While the tools used in leaf anatomy observation are razor blades, drop pipettes, microscopes, and SYSTAT 8.0 software. The materials used for morphological observation are intact kuweni mango plants (stems, fruits, seeds, peak) and in leaf anatomy observation, the materials used are samples of kuweni mango leaves (30 sheets the sample) and iodine dye liquid.

This research is descriptive with a direct survey method. The first activity carried out was to determine the location of the study by purpose sampling. Location determination based on the distribution of existing mango plants and information from the community

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regarding the existence of these plants, so that Matansala and Bahoruru Village in Central Bungku District were selected as the research locations. Each village selected randomly a 15 kuweni mango, and from both villages selected 30 kuweni mango plants as a sample.

The symbols use is based on the initials of the village name where the sample is located. Then sorted from 1 to 15 based on each village. Matansala Village was coded (MT), and Bahoruru Village was coded (BU). The sampled mango plants are more than 15 years old, have produced, and visually this plant is healthy, well-maintained and known by the surrounding community. After 30 kuweni mango plants selected in both of villages, then carried out gradually identification.

This morphological observation is intended to assess the diversity of accessions from samples in that location. Identified parts of the kuweni mango plant are leaves, fruit, and seeds. Visual observations were made of the size, shape, and color of the parts of the organ. Anatomical observations are intended to examine differences in leaf anatomical structure in some samples taken from the study site. The leaf parts identified were stomata density, stomata number, stomata size, stomatal index, epidermal cell size, and epidermal cell count.

Observation of leaf anatomy was carried out in the Laboratory of Plant Disease, Faculty of Agriculture, Tadulako University, Palu. Leaf samples to be observed are washed and then dried using a cloth. After that take a small part of the bottom surface of the leaves using a razor blade and then put it on the glass and given iodine liquid. Observations were carried out under a microscope with 400 times magnification scale. If the primary data was collected, a dendrogram analysis was carried out using the SYSTAT 8.0 program. This step is intended to assess the similarity between the collection of the Kuweni mangoes sample.

The part of the anatomical characters observed included the stomata index, stomata density (mm2), stomata size (μm2 length), stomata number (mm2) and epidermal cell size (length μm2).

Stomata calculation formula:

$$\text{Indeks stomata} = \frac{\text{Jumlah stomata}}{\text{Jumlah stomata} + \text{Jumlah epidermis}} X\ 100$$

$$\text{Kerapatan stomata} = \frac{\text{Jumlah stomata}}{\text{Luas bidang pandang(mm)}}$$

The similarity of all parameters observed is calculated, then clustered which has relative similarities will form a new cluster. Cluster analysis is used to calculate and determine the kinship distance between species from the data set obtained (Ripley, 1976)

Grouping is done by looking at the similarities between variables measured by euclidian distance. Euclidius distance assumes that between variables are orthogonal. The greater euclidian distance it means the number between the observation units and the smaller Euclidius distance, its means the observational units will be similar (Plotkin *et al*., 2002).

Data Analysis

This analysis is widely used to classify plants based on surveys to obtain the diversity data the specific area to compile phylogenetic trees or dendrogram.

III. Results and Discussion

Based on the dendrogram analysis of clusters in Matansala Village shows that at a distance of 0.378 there are two accessions that have the same characters namely MT13 and MT12. At a distance of 0.404, there are two related accessions namely MT6 and MT4. Furthermore, at a distance of 0.429, there are three characters that have similarities namely MT8 and MT6. At the same distance there are two accessions which still have similarities namely MT14 and MT15.

At a distance of 0.452, there are three related accessions represented by MT11 and MT13. At a distance of 0.474, there are still related accessions namely MT5 and MT1. At a distance of 0.515, there is an accession group represented by MT 5 and MT15. Distance 0.535 has several accessions that have similarities so that forming groups represented by MT13 and MT15.

At a distance of 0.571, there are several accessions that have similar representations, namely MT15 and MT2. The distance of 0.589 that are ten accessions related so that forming group, and accessions that represent the groups are MT10 and MT15. At a distance of 0.617, there are 13 accessions that have similarities represented by MT10 and MT8.

At a distance of 0.670, there are related accessions forming groups represented by MT3 and MT10. Furthermore, at the last distance of 0.685 all accessions forming one group so that the chosen accession based on morphological and anatomical characteristics in Matansala Village, namely MT3, MT9 and MT10 as shown in figure 1.

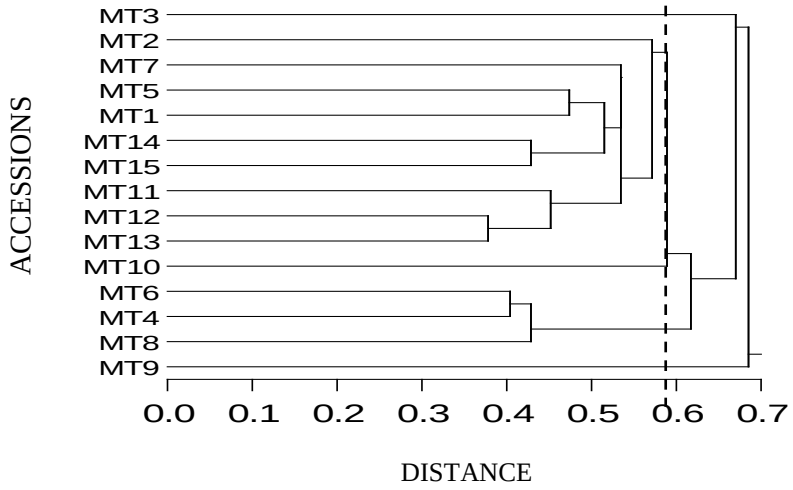


Figure 1: Dendrogram Cluster Analisys of Kuweni mango in Matansala Village

Based on the dendrogram analysis of clusters in Bahoruru Village there was a morphology and anatomy diversity of kuweni mangoes observed. Dendrogram data shows that at a distance of 0.216, there are related accessions namely BU6 and BU4. At a distance of 0.258, there are accessions that have kinship namely BU13 and BU8. At the same distance there are also related accessions, namely BU15 and BU14.

Furthermore, at a distance of 0.305, there is an accession that has a record, namely BU6 and BU3. The 0.365 distance is related to accessions, namely BU11 and BU1. At the same distance there are accession groups that still have kinship namely BU8, BU13, BU11, and BU1 which are represented by BU11, and BU13. At the same distance there are also some accessions that have a kinship, forming groups represented by BU12 and BU15.

At a distance of 0.374, there are related accessions namely BU10 and BU2. Furthermore, at a distance of 0.431 there are related accessions Namely BU7 and BU5 and at a distance of 0.447 shows that there are several related accessions that forming group (new cluster) represented by BU6 and BU11.

At a distance Of 0.457, there are several accessions that have kinship that forms groups represented by BU10 and BU6. Furthermore, at the same distance there is accession which still has a kinship that forming group represented by BU9, and BU10. And at a distance of 0.528 there are several accessions that have kinship and forming groups represented by BU9, and BU7. At the last distance of 0.577 all accessions forming one group. So that the selected kuweni mango plants based on morphological and leaf anatomy characteristics in Bahoruru Village namely BU7, BU5, and BU9, as shown in figure 2.

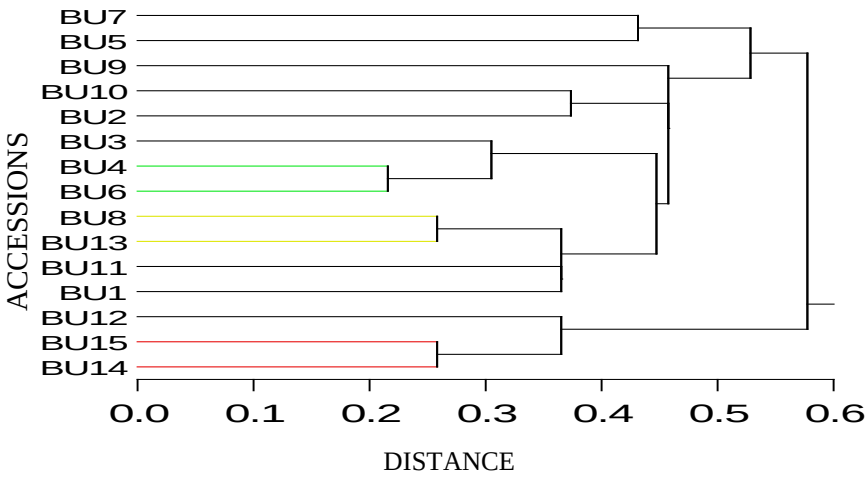


Figure 2: Dendrogram Cluster Analysis of Kuweni mango in Bahoruru village

To determine the morphological and anatomical diversity of Kuweni mango plants from both the village, then the combined cluster analysis of the Village Matansala and Village Bahoruru. Dendrogram of a cluster analysis the combined village found there are some similarities in the properties of accession Kuweni mango crop beginning of 0.216 within which there are accession-related BU6 and BU4.

At a distance of 0.258 there are accessions forming several groups, respectively is BU11 and MT14, BU13 and BU8, BU15 and BU14. At a distance of 0305 are accession forming a new cluster, represented by BU6 and BU3. The distance of 0.365 Formed several accession groups, each represented by MT1, MT10, BU1, BU13, and BU12. At a distance of 0.374, there is accession namely BU10 and BU2. At a distance of 0.403 there is an accession which forms several groups, each of which is represented by MT6, MT12, and MT6. Distance 0.431 has accession that has similarities, namely BU7 and BU5. At a distance of 0.447 several accession groups are formed, each represented by MT2, MT15, MT12, MT13, BU6, BU10, and BU3. Furthermore at a distance of 0.482 there are several accessions which forming the group represented by MT6 and MT5.

At a distance of 0.506, there is an accession that forming a group namely MT7 and MT6. Furthermore, at a distance of 0.528, there is an accession group represented by BU7 and MT7. Then at a distance of 0.577, there is an accessions group represented by BU12 and BU7. At the last distance of 0.648, all accessions become one group. Therefore the accession was chosen based on the analysis of the combined clusters of both villages, based on the morphological and anatomical characteristics of kuweni mango leave in this villages are BU9, MT5, MT7, and MT3 as shown in the following illustration (Figure 3).

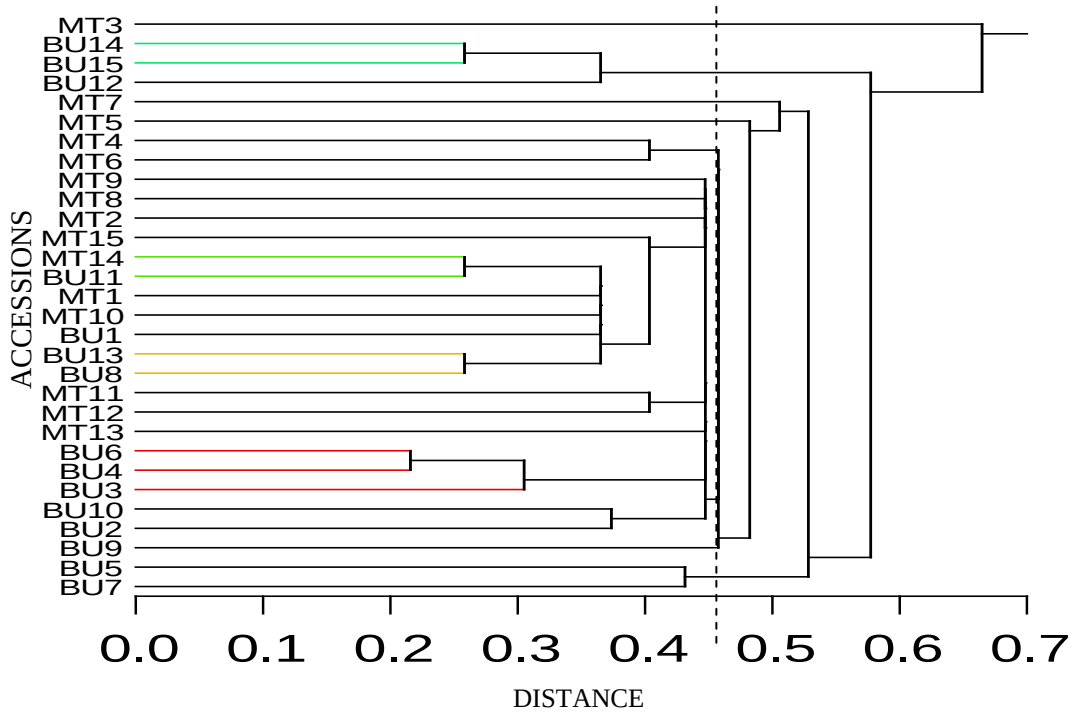
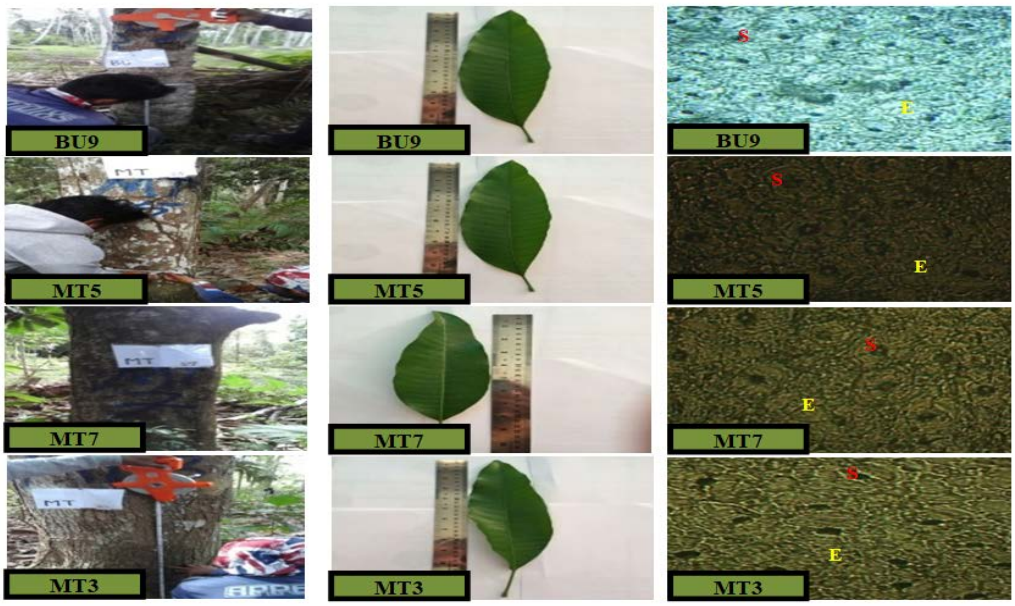


Figure 3: Dendrogram clusters analysis of Kuweni mango in Matansala Village and Bahoruru Village

The distinguishing characteristics of the four accessions chosen from the combined cluster analysis of both villages are presented in the following figure.



Notes: ***S*** *=Stomata,* ***E*** *= Epidermis, Magnification (400 times).*

Figure 4: Morphological and anatomical Identification of mango leaf based on stems morphology, leaves and leaf anatomy on accession BU9, MT5, MT7, and MT3 in the Matansala and Bahoruru village

Based on cluster analysis results on both villages represented by 30 samples, four accessions of the kuweni mango were selected as agriculture, namely BU9, MT5, MT7, and MT3. The accession choice is influence with the concept of distance used in the cluster analysis dendrogram. The farther distance formed on the dendrogram, its means smaller the similarities of the accession. According to Hendrawan (2004) in Hukmaeni (2011), if there are significant differences in the cluster, the sample will separate.

In dendrogram analysis can be defined distances farther than the distance to the right hand, the more diverse the similarity character of accession. More than the distance to the front left, the similarity character of accession to the kuweni mango. (Saparni, 2008) revealed that similarity is expressed as a percentage, 100% which means exact or perfect while 0% is equally different.

Dendrogram cluster analysis on a combination of both the village there is two accessions resurfaced from each village. In Matansala village, MT3 accession appeared on the both on special dendrogram in Matansala Village and dendrogram of the villages combined. While in Bahoruru villages, BU9 accession appeared both on special dendrogram in Bahoruru Village and dendrogram of the villages combined.

This accession emergence because that previously MT9 and MT10 appeared in the dendrogram Matansala village has similar characteristics with the accession in the Bahoruru Villages after a cluster analysis in both villages. Likewise in the accession of BU5 and BU9 which previously appeared in the dendrogram Bahoruru Village has the same character as the accession in Matansala Village after a cluster analysis in both villages.

Accession MT9 has a similar characteristic with the accession BU10 and BU12 are shown at 0.447 distance on the dendrogram of the villages combined. Whereas accession MT10 has similar characteristics with the accession BU1 shown at 0.365 distance on the dendrogram of the villages combined. For accession BU5 and BU7 have similar characteristics to the accession MT13, MT2, MT8, and MT9 shown at 0.431 distance. Therefore accession MT3 and BU7 appeared twice both on dendrogram each village and dendrogram combination both of villages.

The results showed that the oldest and the youngest kuweni mango plants, respectively MT3 (23 years) and BU9 (21 years). The highest plants of the four selected accessions MT3 (20.2 m) and the lowest BU9 (18.23 m). The observation found that the widest trunk circumference is MT7 (124 cm) and the smallest is BU9 (88 cm), while the canopy shape of the four accessions has the same oval shape.

The observation also found that the trunk color of local kuweni mango from the four chosen accessions had the same light brown color. This means that morphological characters are easily seen so that the variations can be assessed quickly compared to other characters. A good taxon restriction is done using hidden characters (Stace, 1981).

Forms of kuweni mango leaves contained in the research area largely elongated and has a length of leaves about 2½ x width, leaf tip chartaceous (taper)

with the surface of the leaf discount slippery coating, the basic form of the leaf that is acute (sharp) and color petioles (stalks) light green, broad and long petioles and leaf curvature varies, the color flush reddish brown and light green. Anatomically, the leaves are very varied and provide plenty of real character systematically (Stuessy, 1990).

Tjitrosoepomo (2009) argued that the color leaves of plants species may change according to circumstances where the growth and intimately linked with water and food supplies as well as radiation and generally the leaves color on the top and bottom is obviously different, Usually the upper side is greener, slippery, or shiny when compared with the bottom side. Some mango plants have varying leaf color, leaf color and shape differences are because the external influences such as the environment where the plants grow (Sadri, 2016).

Stomata located on the leaf surface, but is most commonly found on the surface of the bottom leaf (Pracaya, 2011). Anatomical observations of four selected mango accessions showed accession BU9 have the largest stomata size is 0.259µm with the sum of stomata 72/mm^2 while the smallest stomata are contained in the accession MT7 is 0.177µm with the sum of stomata 100/mm^2.

The epidermis is the layer outermost cells and covers the surface of leaves, flowers, fruits, seeds, stems, and roots. The epidermis serves as a protective inner organs in plants. Based on ontogeny, epidermis derived from meristematic tissue which protoderm (Sumardi and Pudjoarinto, 1994).

According to the function, shape, size, and arrangement of epidermal cells are not the same or different in various types of plants, as well as the form or stomata type. Although the epidermis is different, it all arranged tightly together and form dense buildings without inter-cell space (Woelaningsih, 2001).

The epidermal observations of the four selected accessions showed that BU9 accession had the largest epidermal size of 0.504μm with an epidermal number of 82/mm^2, MT3 of 0.203μm with epidermis number 128/mm^2, then MT7 had an epidermal size of 0.164μm with epidermis number 120/mm^2, while the smallest epidermal size was found in MT5 accession is 0.138μm with an epidermis number 160/mm^2.

According to Miskin *et al*., (1972) plants that have a high stomata density will have a higher transpiration rate than plants with low stomata density. The results showed that the stomatal index BU9 0.467 with 24 mm^2 stomata density, MT7 0.454 with 33.33 mm^2 stomata density, MT3 0438 with 33.33 mm^2 stomata density and MT5 0310 with 24 mm^2 stomata density.

Levit (1951) states that many factors influence plant resistance to drought including a tendency to slow dehydration such as efficient absorption of surface water and water conduction systems, leaf surface area and structure. This shows that stomata density may affect two important processes in plants, namely photosynthesis, and transpiration.

Of the four accessions of kuweni mango selected from the two villages, the accession MT5 has an index of stomata and stomata density smallest of the three other accessions. Thus accession MT5 allegedly resistant to dry environmental conditions. However, to determine the agriculture not only seen from morphological and anatomical characters of leaf accession. Therefore is a need advanced research to support the election of the agriculture Kuweni mango plants particularly in Matansala and Bahoruru Village Central Bungku of Morowali District.

IV. Conclusion

Kuweni mango selected in the Matansala village namely accession MT3, MT9, and MT10. While the crop elected in the Bahoruru village namely accession BU7, BU5, and BU9. The kuweni mango selected as the agriculture of both village dendrogram namely BU9, MT5, MT7, and MT3.

Accession of MT9, MT10, BU5, and BU9 is not selected because the four accessions have similar characters in the combined dendrogram of Matansala and Bahoruru Villages based on concept distance dendrogram cluster analysis concept. In this concept a distance formed can be interpreted that the farther the distance to the right, the more diverse the character resembles the accession. conversely, the farther the distance to the left, the more similar the character of the kuweni mango accession.

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