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CHARACTERISTICS OF MORPHOLOGICAL AND ANATOMICAL MANGO (*MANGIFERA INDICA* L.) IN NAMBO AND LAROUE, EAST BUNGKU, MOROWALI

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ABSTRACT

This study aims to determine the characteristics of mango plants relied on morphological and anatomical leaf of mango plants in the villages of Nambo and Laroue,subdistrict of East Bungku, Morowali district. An observation of morphological features was conducted in Nambo and Laroue, whereas anatomical observations had been made in the laboratory of Biotechnology, Faculty of Mathematics and Natural Sciences, University Tadulako, from April to July in 2016. The morphological parameters observed includedage of the plant, plant height, stem diameter, canopy diameter, canopy shape and color bars. The alteration of leaf anatomy consists of the size of the stomata, the size of the epidermis, and stomatal index. Moreover, the resulthighlightsmorphological and anatomical characters observed on cluster analysis, described in the form of a dendrogram.The implication of the cluster analysis for two villages resultsin four accessions, namely NM1, NM2, NM15 and LR4 that can be benefited as the planting material of quality mango seeds which will be cultivated.

Keywords: Dendogram, East Bungku, Morphology, Mango Anatomy.

INTRODUCTION

Mangoes (*Mangifera spp.*) involve *anacardiaceae family* that are common in Southeast Asia, especially on the Melanesian Islands. This plant had been cultivated since 4000 years ago, (Candole, 1984). It is a type of commercial plant in Southeast Asia and South Asia such as the Philippines, Indonesia, Malaysia, Thailand, India and Pakistan. Three types of fruits that are given priority to be developed by the government as aprima donna of horticulture in Indonesia are bananas, oranges and mangoes. The varieties referred to are species that belong to native plants, (Setijati et al., 1987).

Mango production in the regency of Parigi Moutong in 2013 was 40,293 tons (BPS, 2013), while in Morowali the amount of mango production reached 17,364 tonsin 2014, (BPS Morowali, 2014). Yet, the low production of mango fruit in Morowali has been caused by the limited cultivation of mango in the yard, and the community tends not to be interested in cultivating on a plantation scale. According to Prahasta, another obstacle is the lack of cultivated varieties and fruit loss at each stage of fruit development, causing in low productivity of mango, (Prahasta, 2009).

The availability of superior and good quality varieties, productivity, and its resistance to pests and diseases as well as in accordance with consumer needs, is as a condition that must be met in the era of agricultural industrialization and trade liberalization. By this consideration, there are several steps taken to gain new superior varieties as follows: (1) exploration; (2) collection;(3) characterization and selection; (4) utilization of germplasm, (Karsinah and

Manshur, 2007). Constraints in the field are not well identified varieties that are suitable to be used as a source of seeds. However, efforts to identify mango accessions that will be implemented as a source of seed need to be carried out by the basic researchs, one of which is identifying morphology and anatomy. Because of the limited information, an identification of mango plants requires considerablya necessary research, especially in the villages of Nambo and Laroue, sub district of East Bungku,Morowali district.

METHOD OF RESEARCH

The research was conducted in Nambo and Laroue, East Bungku, Morowali, while leaf anatomy observations had been carried out at the Biotechnology Laboratory, Faculty of Mathematics and Natural Sciences, Tadulako University. The examination was conducted from April to June in 2016.

The tools used in this study were meter roll, calipers, GPS with type of montana 650, android (*distance meter*), ruler, microscope bycarton light type (*software v micro USB*), card holder, rope, coll box, digital camera, label paper, plastic samples and stationery. In the other words, the ingredients deliveredwere tissues, aquades and mango plants.

This study uses a survey and descriptive methods directly, in which the survey activities are intended to determine the location of the study. The research location is determined intentionally (*purpose sampling*) in the level of village or sub-district located in Morowali. The locations chosen by considering the distribution of mango plants in the area areNambo and Laroue, located in East Bungku. Each villagehad been randomly selected 15 mangoes, so that the total number of local mango plants used was 30 trees.

The use of a password is taken from the initial name of the village where the sample come from. Then, those are arranged in numbers from 1 to 15 of each village such as Nambo Village (NM) and Laroue Village (LR) as samples are plants that has been produced and were more than 15 years old, and visually had a level of health ranging from moderate to good, well known to the surrounding community. To get further information on the mango plants of the two villages, it is necessary to interview the owner of the mango plant selected as the sample.

Identification of Morphology. This activity intends to examine the morphological diversity of cultivars gained from the location. For the next, the aspects observed are stem characters (stem color, stem diameter, canopy diameter, plant height and leaf character including leaf shape, leaf fragrance, leaf color, leaf length, width leaves, petiole length). Furthermore, visual observations are carried out directly by referring to the book of "*Descriptors for Mango(Mangifera indica)*, published by The International Plant Genetic Resources Institute (IPGRI) in 2006, which covered descriptions of plant, leaf, fruit, pelok and seeds.

Identification of Anatomy. This activity is intended to examine differences in leaf anatomical structure in a number of accessions obtained from the study site, taking the leaves of mango plants that will be used as samples for anatomical observation, namely the leaves that have formed perfectly located at the bottom branch, on the first branch and the sixth leaf of flus. The method of taking the leaves is that the leaves are taken by using a knife by means of cutting between the ends of the petiole leaves and twigs. The process of anatomical observation uses a microscope, and the anatomy of leaves observed is stomatal size (stomatal length and width), epidermal size (epidermal length and width), stomatal number, epidermal number, stomatal density and stomatal index.

Cluster Analysis. Data, that has been obtained from the field analyzed using cluster analysis,are resultedfrom the observation parameters converted into binary data, and then used as equation matrix or distance data. The data is then used to construct dendrogram through cluster analysis, (Bustaman et al, 1998). From this matrix and binary data, the similarity and dissimilarity between the accession numbers of mangoes are observed. Based on the similar value, the number of mango collection are grouped by using the Unweighted Pair Group Method woth Arithmetic (UPGMA).

This grouping highlights the relationship of similarities between individual tree of mango collections observed rooted at leaf morphology and anatomy as well as morphological fruit. If there is not a similarity, the sample will separate from the other samples in accordance with the distance analysis used. To conclude the kinship between the types observed, all the collected data are analyzed by calculating the Euclid range linked derived on the closest kinship with the help of a computer with using the program of SYSTAT 8.0.

RESULT AND DISCUSSION

Relying on the survey in the field and the result of cluster analysis, there are similarities and dissimilarities in accessions referred to morphology and anatomy of mango in some surveys conducted in each village. In Nambo, cluster analysis at a distance of 0.255 formed two related accessions namely NM8.

The results of the cluster analysis of mango plant in Nambo also showed that at a distance of 0.361 formsfour accessions namely NM6, NM12, NM11 and NM8 represented by NM8 and NM11 respectively. Furthermore, at a distance of 0.390, seven accessions formed one group namely NM6, NM12, NM8, NM11, NM5, NM13 and NM14 represented by NM14, NM5 and NM11, respectively. Then, at a distance of 0.417, two accessions formed were NM10 and NM7. At the distance of 0.442 six accessions were formed represented by NM11 and NM3. At a distance of 0.466 eight accessions were formed represented by NM11 and NM10. At a distance of 0.489 twelve accessions were formed represented by NM4 and NM9. Then at a distance of 0.511 four accessions were formed, namely NM4, NM13, NM15 and NM14, and at a distance of 0.532 thirteen accessions were formed, represented by NM9 and NM15. Also at a distance of 0.571 one accession was formed NM1 joined in which this distance represents NM1 and NM9, finally at a distance of 0.643 represented by NM2 and NM9 the dendogram shown all accessions combined as well as specific and different accessions from the other accessions morphologically and anatomically selected, namely NM2 and NM1 as in the figure1.

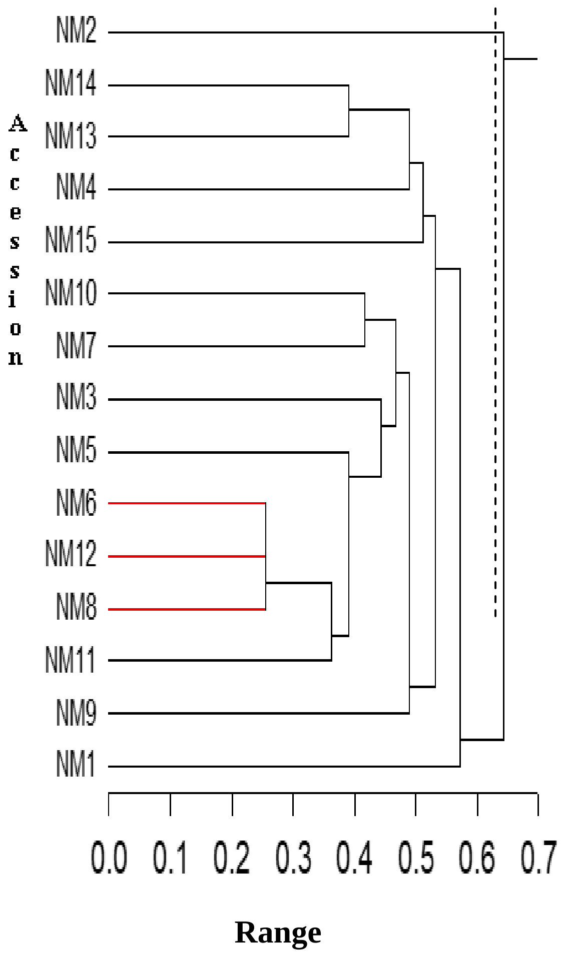

Figure 1. Cluster Analysis' Dendogram of Mango Crop in Nambo

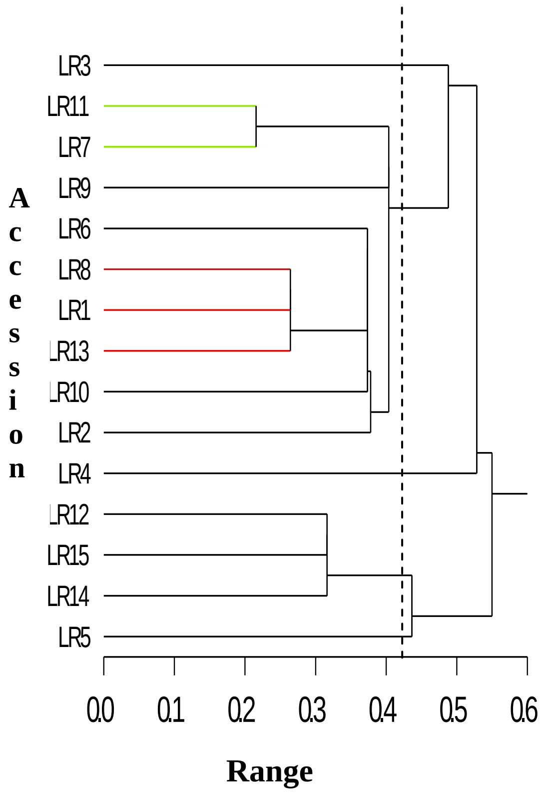

Figure 2. Cluster Analysis' Dendogram of Mango Crop in Laroue.

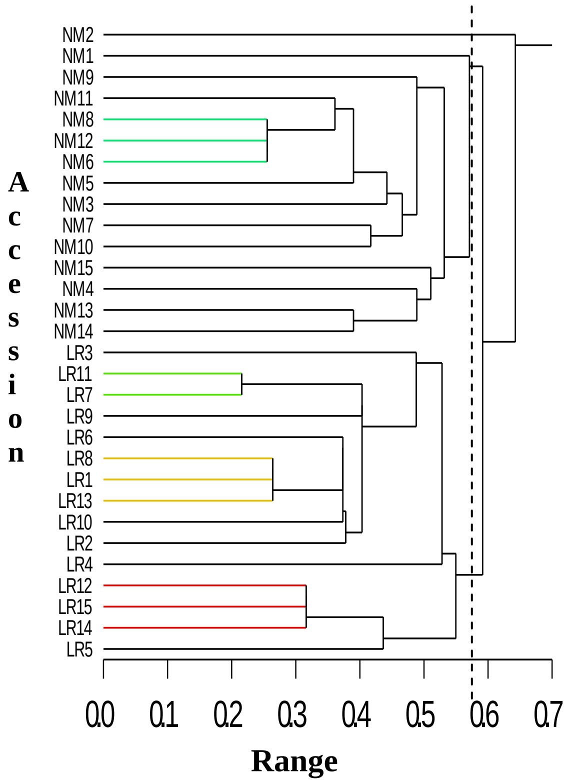

Figure 3. Dendogram of mango crop in East Bungku, Morowali.

The results of research in Laroue Village based on cluster analysis at a distance of 0.216 formed two related accessions namely LR11 and LR7. At a distance of 0.264 three accessions were formed namely LR8, LR1 and LR13. Furthermore, at a distance of 0.316 three accessions wereformed namely LR15, LR14, and LR12. Distance of 0.374 formed five accessions namely LR6, LR1, LR8, LR10 and LR13. Then at a distance of 0.378 six accessions formed one group namely LR6, LR1, LR8, LR13, LR2 and LR10 represented by LR13, LR2 and LR10. At a distance of 0.403 nine accessions formed one group represented by LR9 and LR10, and at a distance of 0.436 four accessions were formed namely LR12, LR15, LR5 and LR14.

Moreover, at a distance of 0.488 ten accessions wereformed represented by LR3 and LR10. At a distance of 0.528 eleven accessionswere formed represented by LR3 and LR4. At a distance of 0.550 all accessions formed a group of fifteen represented by LR3 and LR4. Specific accessions based on morphology and anatomy of mango leaves in Laroue are LR3 and LR4, as shown in figure 2.

The diversity of mango plant's accessions in accordance with morphology and anatomy in East Bungku wascarried out by combining the morphological and anatomical observations of mango plants in Nambo and Laroue. It was conductedthe cluster analysis. The following are the morphological and anatomical dendograms of mango crop in East Bungkushown in figure 3.

The morphological and anatomical leaf of mango cropin Eats Bungku, Morowali, are shown in figure 4 below.

Information:

1. Morphology of mango trees
2. Morphology of leaves
3. Anatomy of mango leaves

A. Accession NM1
B. Accession NM2
C. AccessionNM15
D. AccessionLR4
S. Stomata
E. Epidermis

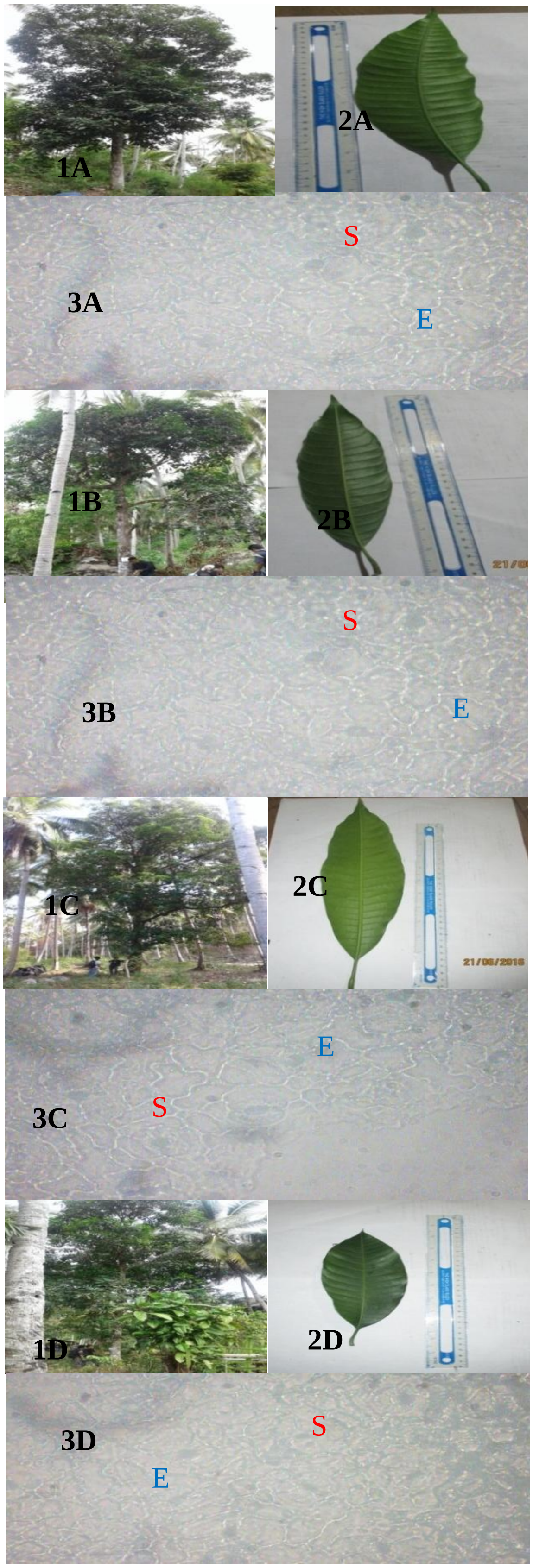

Figure 4. Morphology of mangoes, leaves and anatomy of mango leaves in East Bungku.

With the results of the dendogram analysis, mango plants in Nambo have two morphological variations. The first group contains one accession, namely NM2, and the second group contains fourteen, represented by NM1 (*Figure 1*).

The characters of morphological mango plants in Nambo depict differentiation of accessionNM2 with NM1, NM2 tree height (11.4 m),whereas NM1 (17.7 m), stem diameter NM2 (61 cm) and NM1 (70.5 cm), leaf lengthNM2 (20.7 cm) and NM1 (28 cm), leaf widthNM2 (6.2 cm) and NM1 (9.3 cm), and petiole lengthNM2 (4.3 cm) and NM1 (5.5 cm).

Characters, that distinguish anatomical for NM2 and NM1 samples,are in the number of epidermis NM2 (599.96 µm2) and NM1 (543.36 µm2), and the number of stomata NM2 (421.67 per mm2) and NM1 (486.76 per mm2), stomatal density NM2 (0.15 mm2) and NM1 (0.19 mm2), and stomatal index NM2 (41.27) and NM1 (47.25).

The anatomical observations show the most number of stomata in accession for NM1 (486.76 per mm2) while the least number of stomata are NM2 accession (421.67 per mm2). The amount of stomata on the lower surface is a mechanism of tree adaptation to the terrestrial environment thereby reducing transpiration, (Larcher W, 1995).

Compared to the results of the dendogram analysis of mango plants in Laroue, there are two very specific groups, each of which is represented by accessions of LR3 and LR4. The distinguishing characters from the morphological test results are LR3 tree height (20 m) and LR4 (18 m), LR3 stem diameter (59 cm) and LR4 (53 cm), LR3 leaf length (25.6 cm) and LR4 (19, 3 cm), LR3 leaf width (9.2 cm) and LR4 (6 cm), petiole length LR3 (5.2 cm) and LR4 (4.4 cm).

Based on observations of morphological characters, several accessions of mango plants are different, but there are also some of the same characters, such as at the height of the place, also in terms of plant height which varies dependson the age of the plant. Hence, most of the mango plants found in Eats Bungku have oval canopy and round pyramid shapes.

The results elucidate that the average sample of mango plants in East Bungku own oval and pointed leaf shape and has a grayish brown stem color as well as also a scattered twig shape. The morphological characters are easy to see in order for variations can be assessed quickly when compared to other characters.

Based on the anatomical observations of mango leaves in Laroue represented by LR3 and LR4, the difference is the number of epidermisLR3 (633.92 per µm2) and LR4 (803.72 per µm2), stomataLR3 (455.33 per mm2) and LR4 (503.74 per mm2), stomatal densityLOM3 (0.17 mm2) and LR4 (0.22 mm2), and stomatal indexLR (41.82) and LR4 (38.53).

From the cluster analysis of the two villages in East Bungku represented by Nambo and Laroue, it highlights that the diversity of morphological and anatomical mango at a distance of 0.7 obtained four selected accession samples, namely NM1, NM2, NM15, and LR4. The formation of this accession into a separate group is the influence of the concept of distance used, in order that the results of the dendogram show the greater the distance formed from grouping, the smaller the diversity that occurs.

Due to morphological observations of mango plant from the two villages, the difference from the sample of NM1, NM2, NM15, LR4 is the height of the trees from the four selected accessions, in which the highest tree is LR4 (18 m) and the lowest is NM2 (11.4 m). The measurement of the stem diameter of mango tree results the widest NM15 (75 cm) and the smallest LR4 (53 cm). For the length of the leaf, the longest is NM1 (28 cm) and the shortest is LR4 (19.3 cm), whilst for the width of the leaf, the widest is NM1 (9.3 cm) and the smallest is LR4 (6 cm). The longest measurement of petiole leaves is NM15 (8.2 cm) and the shortest is NM2 (4.3 cm). The most severe observation of mango fruit is NM15 (180 g), while the lightest mango fruit is LR4 (120 g).

The results of anatomical observations of accession mango leaves NM1, NM2, NM15, LR4 on the highest number of epidermis are LR4 (803.72 (µm2),whereasthe smallest one is NM1 (543.36 (µm2). The highest number of stomata obtains in LR4 accession (503.74 per mm2) while the least is NM2 and NM15 (421.67 per mm2). Moreover, the most number of stomata found in accession LR4 is 0.22 per mm2 and the least is at accession NM2 and NM15 0.15 per mm2, as the highest observations of the stomatal index are NM1 (47.25) and the lowest is LR4 (38.53).

The variable observations used in this cluster analysis are all morphological observations of stem and leaf. The cluster analysis results are displayed in the form of a dendogram with a correlation coefficient distance in the form of a similar percentage. The greater the percentage value means the greater the similarity between accessions. The perfect resemblance (*exactly the same*) occurs if there is a 100% correlation coefficient, (Saparni, 2008).

Environment is one of the main factors in the process of growth and development of plants. The presence of these factors causes one type of plant to have the same chance to experience differences in morphological appearance to physiology. Therefore, environment is a determinant of the diversity from a plant population in an area such as altitude, rainfall, and humidity as well as other supporting factors. This meansthe differences in one of the environmental factors will affect the character of the type population, (Ismail, 2004).

In accordance with the experiment of mangoes in Nambo, the diversity of mango morphology and anatomy is different in Laroue. It can be seen in two accession groups representing sub-districts, namely the differences in morphological and anatomical characters clearly visible in tree height, stem diameter, leaf length, leaf width, petiole length and anatomical character, namely the number of epidermis, stomatal number, stomatal density, and stomatal index. The logical consequence is that it can be assumed mango plants in East Bungku which have more than one type of accession.

The results of cluster analysis depict that at a distance of 0.550 there is no kinship relationship between accessions namely NM1, NM2, NM15 and LR4. According to Hairs et al (2006) the purpose of cluster analysis is to place a set of objects into two or more groups relied on the similarity of objects on the basis of a characteristic, such as distance or correlation between objects. For this reason, with clustersanalysis ofmango plant was carried out in each village and then merged two villages in order to obtain a mango dendogram at the sub-district level. Dendogram of mango plants from Nambo and Laroue show morphological diversity in accession NM1, NM2, NM15 and LR4 on a scale of 0.5.

Stomata are a gap in the epidermis bounded by two cover cells that contain chloroplasts and also have different shapes and functions. The stomata density in accession of mango plants and stomatal index, unequal length and width are caused by external factors such as lighting, temperature, humidity and water.

Leaves are vegetative parts of plants that attract an great attention, so that the shape of leaf strands is often used to obtain certainty regarding varieties, (Directorate General of Horticulture, 2006). Besides that, the leaves are the most vegetative part of the plant diversity, (Jintanawong et al 1991).

Mango plant stems grow upright with branching branches and many twigs. Those are overgrown with dense leaves with dome-shaped, oval or elongated canopy. The bark of the mango tree is thick and rough and there are many small cracks and scales of the stalk. The color of mango plants' bark that are old are generally grayish brown, dark gray, to almost black, (Prahasta, 2009).

The number and size of stomata are influenced by genotype and environment. The closing cells surrounding the stomata function to control the opening and closing of the stomata. Stomatal closure is important to prevent water loss when the water supply is limited while constraining CO2 uptake for photosynthesis. Stomata open during the day and close at night. The process of opening and closing the stomata is affected by turgor pressure in the closing cell.The amount of stomata will decrease if the intensity of light decreases, according to Fahn (1991).

There fore, stomata density can affect two important processes in plants, namely photosynthesis and transpiration. According to Poor et al (1972) barley plants that have high stomatal density will have a higher transpiration rate than plants with low stomatal density. In the one side, Levit (1951) states that many factors that influence plant resistance to drought include the tendency to slow down dehydration such as the absorption of surface water efficiently and the water conduction system, leaf surface area and structure.

CONCLUSION AND RECOMMENDATION

Conclusion

Based on the result of research in East Bungku represented by Nambo Village and Laroue Village, the accession of mangoes thathas the farthest kinship relationship derived from dendogram analysis. It is used each village represented by accession NM1 and NM2 and LR3 and LR4. Then at the sub-district level it is represented by accession NM1, NM2, NM15 and LR4.

Suggestion

Further research is needed on the test of resistance to pest attack, on the morphology of leaves, flowers and local mango of Morowali.

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