THE VARIABILITY OF Lansium domesticum Corr. (DUKU) ACCESSIONS BASED ON THE CHARACTERS OF MORPHOLOGY, PHYSIOLOGY AND ANATOMY IN MUSI RAWAS REGENCY, SOUTH SUMATRA INDONESIA

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ABSTRACT

The research was aimed to examine morphological, physiological and anatomical characters of *Lansium domesticum* Corr. (duku) accessions from three locations in Musi Rawas Regency, South Sumatra Indonesia. The experiment was carried out from February to April 2016. The physiology and anatomy analysis were carried out in the Laboratory of Plant Physiology, Department of Agronomy, Faculty of Agriculture, Sriwijaya University, South Sumatra. The methodology used was direct survey and observation strikethrough. Based on the results of research in Musi Rawas Regency to the morphology, anatomy and physiology characters of duku gained wide variability of phenotypic diversity on leaf color, leaf area, plant height, stem girth, number of abaxial stomata, and leaf chlorophyll, while the other variables (leaf length, leaf width, number of adaxial stomata, leaf sucrose, leaf total N, leaf shape, leaf venation, leaf edge, leaf base, leaf tip, branching type, and type of stomata) had a narrow variability. Based on genetic relationship gained two large groups with the value diversity between the accession of 50%.

Key words: *Lansium domesticum* Corr., duku, accessions, similarity analysis, dendogram

INTRODUCTION

Lansium domesticum Corr. (Duku) in Indonesia has been widely distributed with production center areas located in Sumatra (South Sumatra, North Sumatra, West Sumatra and Jambi), Java (Central Java and Jakarta) and Kalimantan (West Kalimantan) (Directorate General of Horticulture, 2001). South Sumatra Province is one of the regions producing highly potential duku cultivar: 'Rasuan' and 'Palembang' cultivar which have distinctive taste and high economic value. Duku plantation area in South Sumatra is approximately 6,430.16 hectares with an average productivity of 5.7 tons/ha/year (Department of Agriculture and Horticulture of South Sumatra, 2002).

Based on the result findings by Lestari (2010), Musi Rawas Regency, South Sumatra is one of the centers of fruit production grown along Musi river basin. The largest duku plantation in Musi Rawas is located in Muara Kelingi dan Muara Lakitan having 1,915 ha of planting area. The duku harvested area was 221 ha with 0.348 tons/ha productivity. A Total of 77 tons of fruit production was recorded in the past 10 years (The Central Bureau of Statistics Musi Rawas, 2010). Kartika *et al.* (2012) stated that the variability of plant morphological characters is necessary for tracing down the relations between ecology and vegetation analysis related to geography and morphological variations such as leaf variation can be used as the basis for determining the categories of varieties. Moreover, it also could be used as the basis to determine cultivar categorization. The research was aimed to examine the morphological, physiological, and anatomical characters of duku accessions from several locations of Musi Rawas Regency.

MATERIALS AND METHODS

The research was conducted from February to April 2016 in Musi Rawas Regency, South Sumatra,

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Indonesia located in Semanggus Lama Village in Muara Lakitan District (SL) and in Bingin Jungut (BJ) and Mambang Village (DM) in Muara Kelingi District. The analysis of physiology and anatomy was carried out in The Laboratory of Plant Physiology, Department of Agronomy, Faculty of Agriculture, University of Sriwijaya. The experimental tools used were Munsell Color Chart of plant tissue, cool box, scissors, hygrometer, camera, compass, leaf area meter, microscope, measuring ruler, gauge, manual of Leaf Architecture, analytical balance, electrical oven, spectrophotometer, ladder, and plastic rope. While the materials included Aceton 80%, adhesive morphological variations such as leaf variation can be used as the basis for determining the categories of varieties. tape, filter paper, plastic bag, labelling paper, transparent nail polish, and duku plant samples.

Methods used were survey and literature study. Sampling was performed by using purposive sampling method. Five plant samples were observed in each location resulted in total 15 plant samples. The working steps for the research included surveys and determining the locations, determining the plant samples, taking leaf samples, data collecting for morphological characters in the field, and anatomical and physiological analysis in the laboratory. The observation in stem morphology consisted of the parameters of plant height, stem girth and branching type. The analysis of leaf morphology, leaf anatomy and leaf physiology was carried out in the laboratory of Plant Physiology, Department of Agronomy, Faculty of Agriculture, University of Sriwijaya.

Leaf chlorophyll was analyzed by soaking 2 cm x 2 cm of fresh leaf samples into 10 ml of ethanol 80% for about 48 hours in dark room. The absorbance then was determined using spectrophotometer with 650 and 665 nm of wavelength (Hall & Rao, 1987). Antrone method was used to determine leaf sucrose. 2 g of fresh leaf was added with 15 ml of ethanol then crushed in the mortar. Another 10 ml of ethanol then was added to the crushed leaf samples. It was then filtered and heated in 70°C temperature for 30 minutes. After cooling down, 0.2 ml of sample solution was added with 6 ml antrone (0.25 antrone + 177.5 ml H_2SO_4 + 72.5 ml of water). The solution was heated until it changed into blue-ish color. After cooling down, the absorbance was determined using spectrophotometer with 600 nm. Leaf nitrogen was determined by using Kjeldahl method. 0.1 g of dry samples added with strong sulphate acid was heated in the acid room. Distillation process then was performed by using Borax acid and indicator. The solution then was titrated with 0.01 N of sulphate acid until the color changed into red (Lorenz, 1978).

Phenotypic analysis of variance was performed to examine the variability range of the observed characters (plant height, stem girth, leaf length, leaf width, number of abaxial stomata, number of adaxial stomata, leaf chlorophyll, leaf sucrose, and leaf total N) by comparing the phenotypic characters and deviation standard. The variability of observed characters was determined based on the criteria from Daradjat (1987) as below: $\sigma_f^2 > 2.Sd$: large phenotypic variability and $\sigma_f^2 < 2.Sd$: narrow phenotypic variability. Genetic relationship was determined by using cluster method analysis UPGMA with NTSYS-pc 2.02 program (Rohlf, 1998).

RESULTS AND DISCUSSION

Morphological characteristics of duku plant

The variance quantitative morphological characters of duku plants was found in plant height, leaf area and stem girth as given in Table 1. From the table, it was found that the accession of SL 3 had the longest leaf with 19.76 cm and the shortest was BJ 1 with 15.5 cm. The average of leaf length was 17.18 cm. For leaf width, the widest leaf was also SL 3 with 10.08 cm and the narrowest was BJ 4 with 7.3 cm, while the average was 8.18 cm. Leaf area of BJ 1 was 185.188 cm^2 which was the highest among others and the smallest was DM 4 with 139.704 cm^2 and the average was 160.185 cm^2. BJ 1 also had the tallest plant height with 20 m and the shortest was DM 5 with 8 m and the average of plant height was 13.5 m. The largest stem girth was in SL 4 with 167 cm and the smallest was DM 5 with 45 cm. The average of stem girth was 116.6 cm. Ferita *et al.* (2015) stated that quantitative character was the character affected by several genotypic factors (internal factors), however, the phenotypic factors (external factor) still had more significant impact.

All duku accession taken as samples from three sites in Musi Rawas District have the same leaf shape that is eliptic. Eliptic leaf shape has a ratio between length and width 1½ – 2: 1 and the stem of the leaf is embedded in the base of the lamina. The form of pinnate leaf repeat is formed a single leaf bone. Leaf edges of the leaves are thin and have no fibers. Leaf color differed among locations in which SL was 7,5 GY (3/4), BJ 7,5 GY (4/4), and DM 7,5 GY (4/4) and 7,5 GY (4/6). Leaf base was complex (there are more than two inflection points in the curve of the margin between the base) and leaf tip was acuminate. Monopodial branching shape was branching type in which the main stem was more strikethrough bigger and longer than its branches, and branching direction tend to go upward. The variations on qualitative characters of plant morphology were mostly influenced by genetic factor causing the

Table 1. The quantitative morphological characteristics of duku plant

Accession	Leaf length (cm)	Leaf width (cm)	Leaf area (cm^2)	Plant height (m)	Stem girth (cm)
SL1	17.09	8.96	148.01	20.0	156.0
SL2	16.20	7.83	148.96	18.0	164.0
SL3	19.76	10.08	175.39	11.0	142.0
SL4	16.74	8.24	158.17	16.0	1670
SL5	15.83	7.62	159.88	10.0	108.0
SL average	17.12	8.54	158.08	15.0	147.4
BJ1	17.85	8.55	185.18	10.0	90.0
BJ2	15.50	7.46	155.37	20.0	154.0
BJ3	17.80	8.76	168.79	13.0	93.0
BJ4	17.26	7.30	141.65	17.5	147.0
BJ5	18.56	8.47	164.29	15.0	128.0
BJ average	17.39	8.10	163.05	15.1	122.4
DM1	16.44	7.48	169.23	14.0	102.0
DM2	17.38	7.75	149.37	8.0	73.0
DM3	17.78	8.13	176.63	10.0	86.0
DM4	16.74	7.99	139.70	12.0	94.0
DM5	16.95	8.27	162.11	8.0	45.0
DM average	17.05	7.92	159.41	10.4	80.0
Total average	17.18	8.18	160.18	13.5	116.6

Note: SL (Semanggus Lama); BJ (Bingin Jungut); DM (Desa Mambang).

similarity among the accessions (Suryani & Nurmansyah, 2009) since the genes had the ability to surpress the environmental factor.

Leaf physiological characteristics

The highest leaf chlorophyll was found in DM 5 with 27.665 mg/l and the lowest was 13.067 mg/l in BJ, while the average was 19.91 mg/l. This research resulted different leaf chlorophyll for each duku accession causing the difference in photosynthetic activity and the yield (Ristiawan, 2011). The highest leaf sucrose was 3.531% in BJ 2 and the lowest was 1.671% in DM 4. Leaf sucrose average was 2.78%. Leaf sucrose affected the forming of carbohydrate in plants (Sholikhah *et al*., 2015). Sucrose was the main product resulted from photosynthesis and could be translocated to all plant's organs through phloem to support plant growth and development. The highest leaf total N was found in DM 3 with 3.08% and the lowest was in SL 1 with 0.98%. The average of leaf total N was 1.98%. So that the increase in leaf chlorophyll would affect leaf total N since N was the main element in chlorophyll (Hernita *et al*., 2012). All data of leaf physiological characters were given in Table 2.

Anatomical characteristics

The highest number of adaxial stomata was found in BJ 1 with 10.7 and the lowest was 6.2 in SL 2, while the average was 9.3. BJ 3 was the accession with the lowest number of abaxial stomata which was 26.7 and the lowest was in DM 5 with 15.2. The average of abaxial stomata was 20.1. The results of Yuliasmara and Ardiyanti (2013) found that the number of stomata of the leaves is more prevalent on the lower surface of the leaf than the lower surface of the leaf. Type of stomata for all accession was Anomocytic (Figure 1). Damayanti (2007), all accessions had the same Anomocytic type of stomata, where the guard cells were surrounded by several certain cells with similar shape and size.

Phenotypic analysis of variance

The results of phenotypic variability analysis showed two types of variabilities: narrow and large. Narrow variability (similar) was obtained from leaf length, leaf width, number of adaxial stomata, leaf sucrose, leaf total N, leaf shape, leaf venation, leaf edge, leaf base, leaf tip, branching type, and type of stomata. Narrow variability showed the impact of environmental factor to plant performance (Mangoendidjojo, 2003). Large variability was identified from leaf color, leaf area, plant height, stem girth, number of abaxial stomata, and leaf chlorophyll. Large variability showed the role of genetic factor in the variability of plant characters (Satria *et al*., 2008). The phenotypic variability occurred due to the interaction between the genetic and environmental factor.

The analysis of genetic relationship among duku accessions was carried out based on 17 characters of the morholophy, physiology and anatomy of duku plants. The relation was presented

Table 2. Leaf physiological characters

Accession	Leaf chlorophyll (mg/l)	Leaf sucrose (%)	Leaf total N (%)
SL1	20.69	2.65	0.98
SL2	16.95	2.95	1.82
SL3	16.26	2.84	2.10
SL4	14.67	2.74	1.96
SL5	20.05	2.47	2.24
SL average	17.72	2.73	1.82
BJ1	17.04	2.91	2.52
BJ2	26.27	3.53	1.96
BJ3	21.00	3.37	1.96
BJ4	20.11	3.33	1.26
BJ5	13.06	3.52	2.10
BJ average	19.49	3.33	1.96
DM1	18.65	1.92	1.12
DM2	23.86	2.69	2.24
DM3	19.17	2.31	3.08
DM4	23.26	1.67	2.38
DM5	27.66	2.85	2.10
DM average	22.52	2.28	2.18
Total average	19.91	2.78	1.98

Note: SL (Semanggus Lama); BJ (Bingin Jungut); DM (Desa Mambang).

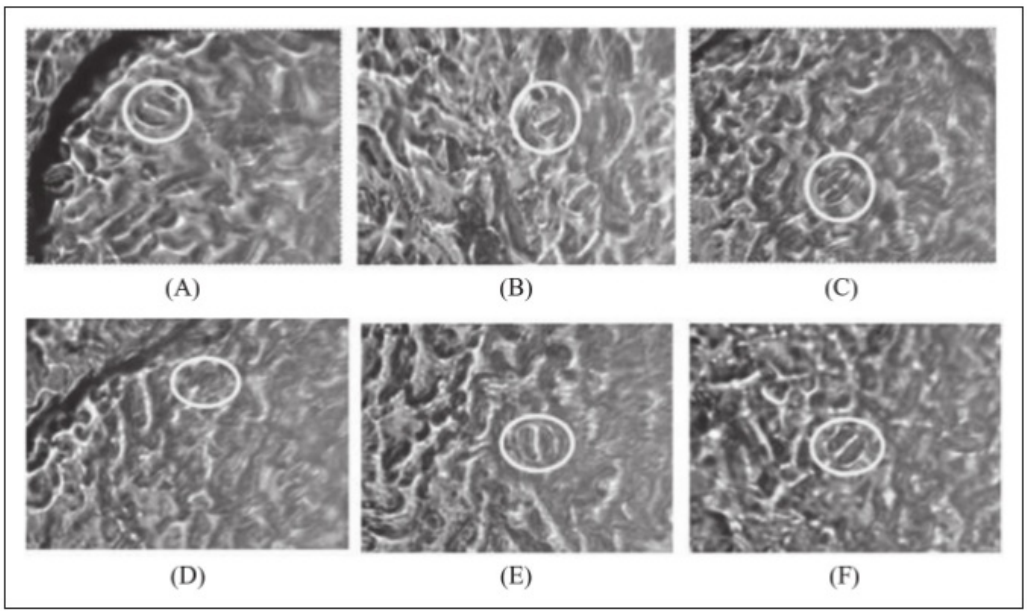

Fig. 1. (A) Type of stomata adaxial SL site; (B) Type of stomata abaxial SL site; (C) Type of stomata adaxial BJ site; (D) Type of stomata abaxial the BJ site; (E) Type of stomata adaxial DM sites; (F) Type of stomata abaxial DM site.

by using the dendogram (Figure 2). The nearest genetic relation was found in 67% of similarity index from SL1 – DM 1, SL 5 – DM 4 and BJ 3 – DM 3. Musi Rawas Regency had the highest genetic relation index of 67%. The higher similarity index, the closer genetic relationship among the accessions. Based on the results of research Aryanti *et al*. (2015) that plants cultivated in the same location would have a differentiation in the growth and development due to environmental factor expressed by their phenotypic appearance.

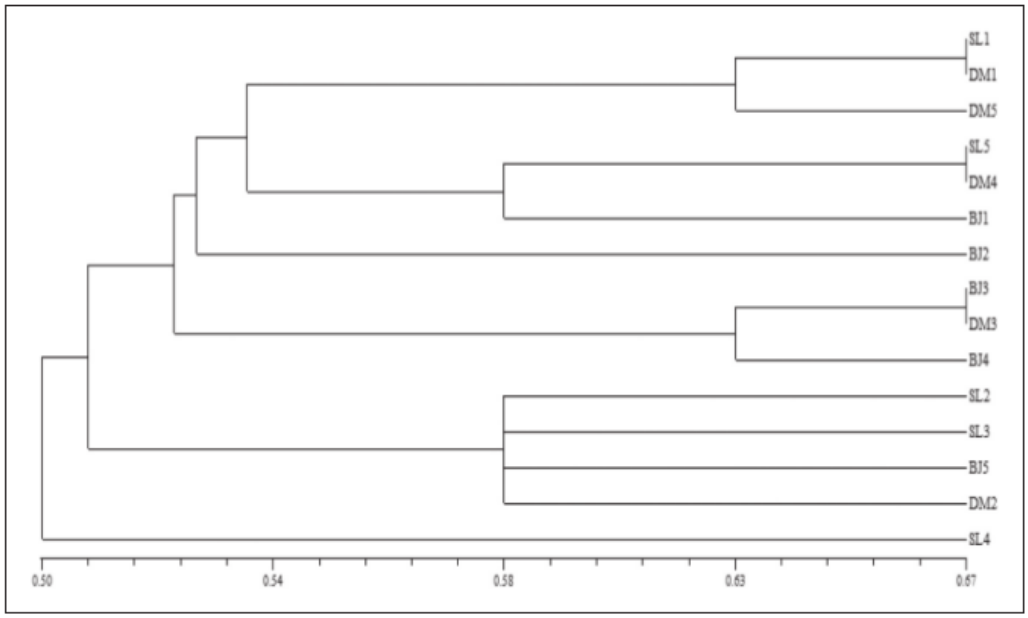

Fig. 2. The dendogram of genetic relationship 50% among duku accessions in Musi Rawas Regency.

Table 3. Leaf Anatomical Characteristics

Accession	Number of adaxial stomata	Number of abaxial stomata	Type of stomata
SL1	11.5	25.7	Anomocytic
SL2	6.2	17.0	Anomocytic
SL3	12.0	21.7	Anomocytic
SL4	9.0	21.7	Anomocytic
SL5	9.2	18.5	Anomocytic
SL average	9.5	20.9	Anomocytic
BJ1	10.7	20.0	Anomocytic
BJ2	8.7	21.0	Anomocytic
BJ3	9.7	26.7	Anomocytic
BJ4	9.7	20.0	Anomocytic
BJ5	9.0	19.5	Anomocytic
BJ average	9.5	21.8	Anomocytic
DM1	8.7	17.7	Anomocytic
DM2	8.5	19.5	Anomocytic
DM3	9.7	20.7	Anomocytic
DM4	10.5	16.2	Anomocytic
DM5	7.7	15.2	Anomocytic
DM average	9.0	17.8	Anomocytic
Total average	9.3	20.1	Anomocytic

Note: Type of stomata was determined based on the Manual of leaf architecture (Ash *et al.*, 1999). SL (Semanggus Lama); BJ (Bingin Jungut); DM (Desa Mambang).

CONCLUSION

The variance quantitative morphological characters of duku plants was found in plant height, leaf area and stem girth, while qualitative characters (branching type, leaf shape, leaf color, leaf repeating pattern, leaf base, leaf tip, leaf margin shape) showed relatively similar results.

All variance of characters physiology, and quantitative anatomi characters of duku was found

Number of adaxial and abaxial stomata, while qualitative character (Type of stomata). Based on similarity analysis (dendogram) of duku accessions in Musi Rawas Regency showed 67% of similarity level and a close genetic relationship.

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REFERENCES

Aryanti, I., Bayu, E.S. & Kardhinata, E.H. 2015. Morphological Characteristics and Genetic Relationship on Ginger Plant (*Zingiber officinale* Rosc.) in Dolok Saribu Village, Simalungun Regency. *Online Journal of Agroecotechnology*, **3(3)**: 963-975.

Ash, A., Ellis, B., Hickey, L.J., Johnson, K., Wilf, P. & Dan, S.W. 1999. Manual of leaf architecture. Morphological description and categorization of dicotyledonous and net-veined mono-cotyledonous angiosperms. 1st Ed. Smithsonian institution. Washington.

Damayanti, F. 2007. Analysis of chromosome number and stomata anatomy on several banana (*Musa* sp.) germplasm from east kalimantan. *Bioscientiae*, **4(2)**: 53-61.

Daradjat, A.A. 1987. Genotype adaptation variability of wheat plants on different planting environment in indonesia. University of Padjajaran. Bandung.

Department of Agriculture and Horticulture of South Sumatra. 2002. Horticultural Crops Development. Department of Agriculture and Horticulture of South Sumatra, Palembang.

Directorate General of Horticulture. 2001. The Information of Horticultures and Other Various Plants. Directorate General of Horticulture. Jakarta.

Ferita, I., Tawarati. & Syarif, Z. 2015. Identification and Characterization of Arenga Palm (*Arenga pinnata*) in the district of Gayo Lues. Proceedings of the National Seminar on Indonesian Biodiversification Society, **1(1)**: 31-37.

Hall, D.O. & Rao, K.K. 1987. Photosynthesis. 4th ed King's college, University of London, London.

Hernita, D., Poerwanto, R., Susila, A.D. & Anwar, S. 2012. The Determination of Nutrient Status on Duku Seedlings. *Journal of Horticulture*, **22(1)**: 29-36.

Kartika, D., Fitmawati. & Nery, S. 2012. Phylogenetic Analysis of Three Populations of Duku Turak (*Lansium domesticum* Corr.) Originated from Kuantan Singingi Regency Based on the Morphological Characters. Faculty of Mathematics and Natural Sciences, University of Riau.

Lestari, R.R. 2010. The Development Strategy for Estate Plant in Musi Rawas, South Sumatra Province. (Klassen Typology Approach). S2 thesis (Published). Faculty of Agriculture, University of Sebelas Maret. Surakarta, Indonesia.

Lorenz, O.A. 1978. Potential nitrate level in edible plant parts. P. 201-219. In D.R Nielsen J.G. MacDonald (Eds) Nitrogen in The Environment. Academic Press, New York.

Mangoendidjojo, W. 2003. Basic of Plant Breeding. Kanisius. Yogyakarta.

Ristiawan, A.P. 2011. Physiological Characters of Two Robusta Coffee Clones at Different Shading Types. Thesis (Published). Faculty of Agriculture. University of Jember. East Java.

Rohlf, F.J. 1998. NTSys-pc. Numerical Taxonomy and Multivariate Analysis System. Version 2.02. Exerter Software. New York.

Satria, B., Gustian, E., Swasti, M. Kasim & Darnetti. 2008. Characteristics of Morphology and *Genetic of Aquilaria* spp. Endemic Plant Producers in West Sumatra. *Saintek*, **1**: 43-52.

Sholikhah, U., Munandar, D.A. & Pradana, A. 2015. Physiological Characters of Robusta Coffee Clone BP 358 at Different Shading Types. *Agrovigor*, **8(1)**: 58-67.

Suryani, E. & Nurmansyah. 2009. The Inventory and Characterization of Seilon Cinnamon (*Cinnamomum zeylanicum* Blume) in Laing Solok Experimental Farm. *Bulletin Litro*, **20(2)**: 99-105.

The Central Bureau of Statistics Musi Rawas. 2010. Planting area, Harvest , Productivity and Fruit Production Fruits in Musi Rawas. BPS Musi Rawas.

Yuliasmara, F. & Dan, F.A. 2013. Morphology, physiology and anatomy paku picisan (*Drymoglossum phyloselloides*) and its influence on the cocoa tree. *Pelita Plantation*, **29(2)**: 128-141.

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