

Local durian (*Durio zibethinus* murr.) exploration for potentially superior tree as parents in Ngrambe District, Ngawi

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Abstract. The characteristics durian based on specific area gives a wide diversity of phenotype. This research objective was to build an inventory of the local durian of Ngrambe as well as to obtain potentially superior local durian as prospective parent trees. The research was conducted in Ngrambe sub-district, on October 2015 until April 2016 using the explorative descriptive method. The determination of sample point used the non-probability method of snowball sampling type. Primary data include the morphology of plant characters, trunks, leaves, flower, fruits and seeds and their superiority. The data of the research were analyzed using SIMQUAL (Similarity for Qualitative) function based on the DICE coefficient on NTSYS v.2.02. The data cluster and dendrogram analyses were determined by Unweighted Pair-Group Arithmetic Average (UPGMA) method. The result of DICE coefficient analyses of 58 local durian accession based on the phenotypic character of vegetative organs ranged from 0.84-1.0. The phenotypic character of the vegetative and generative organ from 3 local durian accession superior potential ranged from 0.7 to 0.8. In conclusion, the accession of local durian which were Miyem and Rusmiyati have advantage and potential as prospective parent trees.

1. Introduction

The diversity of the Indonesian germplasms is a great asset for plant breeders to carry out evaluations of naturally superior characters and then to combine them into new, better genetic products [1]. Indonesia has various types of tropical fruits, such as durian. Durian has a wide variety of phenotypes exhibited by plant height, first branch height, stem circumference, leaf length, fruit length, fruit circumference, fruit weight, fruit flavor, the thickness of fruit pulp and seed weight.

According to Setiono [2], the potential development of durian as one of the plantation commodities is very large. The nature of the region-specific durian plants provides different production variations. In addition, the pollinating nature of open flower crops produces variation in production and form [3]. The people's favorite durian according to Ihsan [4] that has a medium size, sweet taste, soft texture, thick fruit pulp and small seeds.

The number of durian species in Indonesia provides a great opportunity to produce superior durian cultivars. Ngrambe sub district was one of durian centers in Ngawi Regency. Topography in Ngrambe district meets as a requirement for growing durian to grow well. Based on Horticultural Commodity



Information [5], durian production in 2012, 17.83% durian in Indonesia was from East Java Province. Ngawi District ranks tenth in East Java Province in 2011 with 2.184 tons of production.

The prospect of developing durian was very good but it has not been taken care adequately. Therefore, it was necessary to conduct a research on the exploration of potentially superior local durian that aims to build an inventory of local durian crops grown in Ngrambe Subdistrict as a resource of germplasm and to obtain local durian crops Ngrambe which has the potential to excel as prospective parent trees.

2. Methods

2.1. Location and Time Research

This research was held out at the village of Giriharjo, Wakah, Babadan, Setono, and Sambirejo, Ngrambe subdistrict, Ngawi district. The altitude of this village was 400-500 meters above the sea level. The topographic conditions were flat to hilly. The observations were carried out at the plant breeding laboratory, Faculty of Agriculture, Sebelas Maret University from October 2015 to April 2016.

2.2. Materials

The material and tools were 58 accessions of local durian Ngrambe that was more than 50 years based on the results of the research location. The materials were stationary, ruler, digital camera, crop descriptor for durian (*Durio zibethinus* Murr.) that was published by Biodiversity International [6], official PVT news (Registration of Plant Varieties) local durian, analytical scales, caliper, and hand refractometer.

2.3. Research Design and Data Analysis

The quantities and qualities character data identified by the descriptive analysis. The kinship relationship was observed by scoring the presence or absence morphological character in an observational variable [6]. The results were translated into binary data if there was morphological character get score 1, and if none get score 0. The analysis was done by cluster analysis [7] used NTSYS 2.02 program with Unweighted Pair-Group Method Arithmetic Average (UPGMA) SIMQUAL (for qualitative similarity). Similarity matrix used DICE coefficient [8].

$$S = \frac{2n_{ab}}{n_a + n_b}$$

Description:

- S = coefficient of equation
- nab = two individuals are compared
- na = the same number of characters between individuals (1 and 1)
- a = number of character in individual a only
- b = number of character in individual b only

3. Results and Discussion

3.1. General Explanation about Durian

The research activities had begun with that exploration, which searches, collects and identify local durian germplasm that was older than 50 years old. Simultaneously, durian exploration activities were characterized to identify the characters possessed by an accession. Based on the exploration results at five locations obtained 58 accessions of local durian.

3.2. *The Diversity of Durian*

The identification of durian studied consisted of the accession of local durian from exploration on the vegetative part which were trunks and leaves and the generative parts of the flower, fruit, and seed. Local durian accession criteria that were observed were fruitful, over 50 years old and located in the administrative area of Ngrambe sub-district. This was according to Prastowo [9] that the plants from the seeds to be used as parent trees must have been produced at least five seasons, to determine the stability of the nature that was carried.

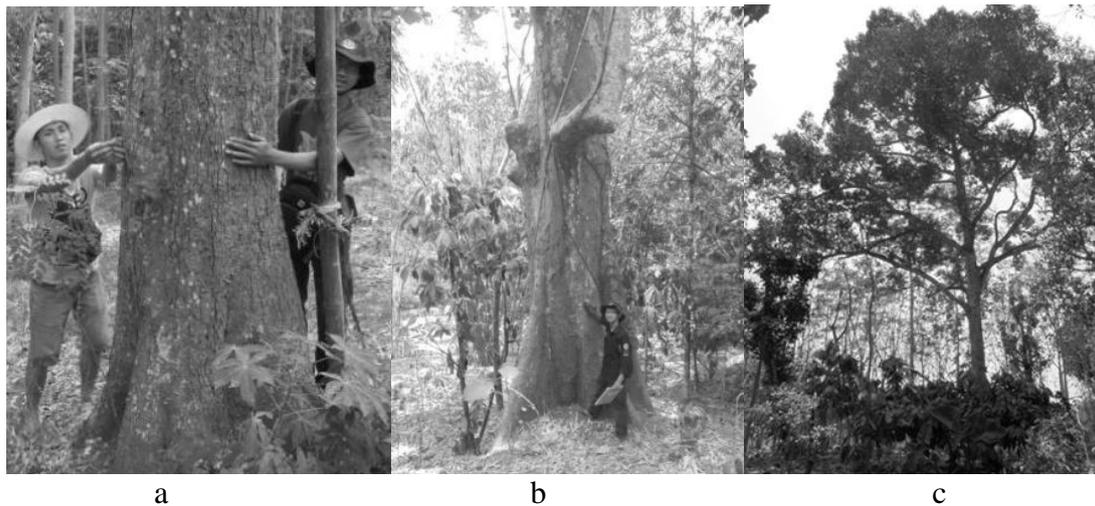


Figure 1. The morphology of diameter (a and b) and canopy of the durian

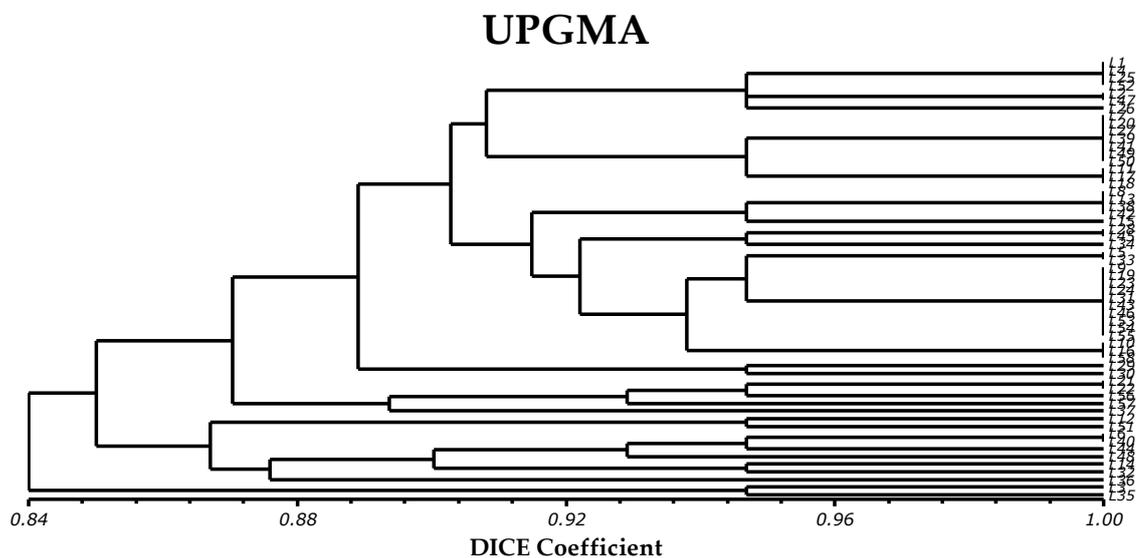


Figure 2. Dendrogram based on UPGMA analysis of 58 local durian Ngrambe based on phenotypic characters of vegetative organs morphology processed with NTSYS program version 2.02

The result of durian accession grouping was based on phenotypic character of plant vegetative morphology which includes 1) plant character, i.e age, plant height, crown shape, growth direction, branching, 2) trunks, i.e cross-sectional shape, trunk texture, trunk color, 3) leaves, i.e leaf shape, leaf tip, leaf margin, leaf blade, leaf surface, leaf length, leaf width, the color over the leaf surface, and the bottom surface of leaf color on 58 durian accessions indicate wide diversity.

The morphology of the durian height was 20 m for the shortest and reached 50 m for the highest. The durian was more than 100 years old, tree height reached 50 m [9]. The morphology of the canopy form of the durian that found was (1) triangle (Pyramidal), (2) spherical and (3) irregular. The morphology of diameter of the durian plant ranges from 40 cm for the smallest and 180 cm for the largest (fig 1).

3.3 Identification of Vegetatif Organ

Accessing the local durian Ngrambe, does not yet have a variety name. The name of the local durian variant, usually given by the local community based on morphological variations, the name of the owner or the area where the durian grows [11]. The result of durian accession grouping was based on the phenotypic character of plant vegetative organ morphology, which includes 1) plant character, ie age, plant height, crown shape, growth direction, branching, 2) trunks, in cross-sectional shape, rod texture, trunk color, trunk, 3) leaves, ie leaf shape, leaf tip, leaf margin, leaf blade, leaf surface, leaf length, leaf width, upper surface of leaf color, and lower surface of leaf color on 58 accessions durian show that at the coefficient of similarity limit 0.92 was divided into twelve groups (fig.2).

Group A consist of seven accessions, including accession (local durian) L1, L4, L25, L52, L2, L47 and L26. Group B consist of ten accessions, including L7, L20, L27, L39, L41, L49, L50, L11, L17 and L18. Group C consist of five accessions, including L8, L13, L38, L42 and L15. Group D consist of eighteen accessions, including L28, L45, L34, L5, L33, L9, L19, L23, L24, L31, L43, L46, L53, L54, L55, L10, L16 and L58. Group E consist of two accessions, including L29 and L30. Group F consist of four accessions, including L21, L22, L56 and L57. Group G consist of one accession, L37. Group H consist of two accessions, including L12 and L51. Group I consist of four accessions, including L6, L40, L44 and L48. Group J consist of two accessions, including L14 and L32. Group K consist of one accession, namely L3. Group L consist of two accessions, including L3 and L35.

Dendrogram of 58 durian accession based on vegetative organ morphology, also showed eleven clusters that showed the similarity of coefficient reaches 1.00. Cluster 1 consist of four accessions namely accession durian L1, L4, L25, and L52. Cluster 2 consist of two accessions namely accession durian L2 and L47. Cluster 3 consist of seven accessions that were durian accessions L7, L20, L27, L39, L41, L49, and L50. Cluster 4 consist of three accessions namely accession durian L11, L17, and L18. Cluster 5 consist of four accessions namely accession durian L8, L13, L38, and L42. Cluster 6 consist of two accessions namely accession durian L28 and L45. Cluster 7 consist of two accessions namely accession durian L5 and L33. Cluster 8 consist of ten accessions of accession durian L9, L19, L23, L24, L31, L43, L46, L53, L54, and L55. Cluster 9 consist of three accessions namely accession durian L10, L16, and L58. Cluster 10 consist of two accessions namely accession durian L21 and L22. Cluster 11 consist of two accessions namely accession durian L6 and L40. Each cluster shows that the accession of durian in one cluster has the same morphological character.

Dendrogram based on morphological of vegetative organs showed the existence of the lowest characteristic similarity of 0.84. This means that there was a mismatch based on morphological characters of 16%. The value indicates that there was still variation between durian accession, this can be due to genetic factors and environmental conditions.

Grouping occurs because accession has a morphological characteristic similarity due to growth in the same or adjacent location and the proliferation of the durian from seed or vegetative originating from the same parent. While the differences between individuals durian can be caused by the cross-pollination naturally in durian with the help of bats, birds, squirrels and some types of beetles [14].

3.4 Identification of Generatif Organ

Based on the exploration of local durian accession, from 58 accessions that were identified the morphologically of durian fruit and seeds had only three accessions, namely L5 (durian Miyem), L8 (durian Amin) and L10 (durian Rusmiyati). The accession of local durian that were identified by fruit was an accession that has potentially superior characteristics according to interviews with the owners and local residents. In addition, some durian trees that have superior potential experience failure in

flowering, pollination and even have molted to death, so cut by the owner. Observation data of durian fruit shape was presented in table 1.

Table 1. Observation Data on 3 Local Duian Fruit Accessions

Fruit character	L5 (D. Miyem)	L8 (D Amin)	L10 (D. Rusmiyati)
Fruit clustering habit	<i>Combination</i>	<i>Combination</i>	<i>Combination</i>
Fruit Shape	<i>Oval</i>	<i>Elliptic</i>	<i>Oblong</i>
Fruit weight	<i>2.6 kg</i>	<i>1.25 kg</i>	<i>2.1 kg</i>
Fruit rind colour.	<i>Heavy</i>	<i>Light</i>	<i>Medium</i>
Fruit rind colour (at maturity)	<i>(2.6 – 4.0 kg)</i>	<i>(0.9 – 1.5 kg)</i>	<i>(1.6 – 2.5 kg)</i>
Fruit rind thickness	<i>Green</i>	<i>Green</i>	<i>Green</i>
Fruit spine shape	<i>Greenish Yellow</i>	<i>Greenish Yellow</i>	<i>Yellowish Green</i>
Flesh colour	<i>Medium</i>	<i>Thin</i>	<i>Medium</i>
Flesh taste	<i>Hooked</i>	<i>Convex</i>	<i>Convex</i>
Flesh creaminess	<i>Creamy White</i>	<i>Creamy White</i>	<i>Lemon Yellow</i>
Flesh aroma	<i>Sweet</i>	<i>Slightly Sweet</i>	<i>Bitter Sweet</i>
Aril thickness	<i>Intermediate</i>	<i>Intermediate</i>	<i>Intermediate</i>
Fruit Length	<i>Moderate</i>	<i>Mild</i>	<i>Moderate</i>
Fruit diameter	<i>1,2 cm</i>	<i>0,5 cm</i>	<i>1,5 cm</i>
Number of carpels per fruit	<i>Medium</i>	<i>Thin</i>	<i>Medium</i>
Seed shape	<i>(0.6 – 2.0 cm)</i>	<i>(< 0.5 cm)</i>	<i>(0.6 – 2.0 cm)</i>
Seed coat colour	<i>31 cm</i>	<i>21 cm</i>	<i>34 cm</i>
	<i>56 cm</i>	<i>45.5 cm</i>	<i>51 cm</i>
	<i>Five</i>	<i>Five</i>	<i>Five</i>
	<i>Oblong</i>	<i>Spheroid</i>	<i>Oblong</i>
	<i>Yellow Brown</i>	<i>Yellow Brown</i>	<i>Yellow Brown</i>

According Sundari [11], durian have no striking difference in the flower character, shape, and color of seeds. The texture and flesh colour on the local durian has several variations. Some are white and some are yellow. Moisture content is one of the most important physicochemical characteristics, as it will influence the flavor, texture, appearance and shelf life of fruit. Durian fruits had moisture content within the range of 58.80-79.35% [12] which is in accordance with those reported by Charoensiri [13].

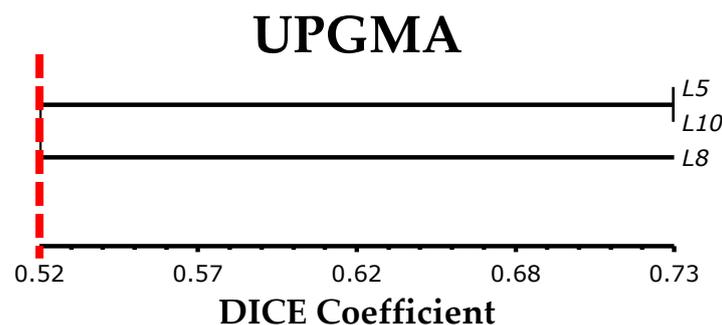


Figure 3. Dendrogram based on UPGMA analysis of 3 local durian accession based on phenotypic characters of generative organs morphology processed with NTSYS program version 2.02

The results of classification of 3 local durian accession which have superior potential based on the morphological character of the generative organ were presented in figure 3. Based on the dendrogram (fig. 3), it was found that at a coefficient of 0.52 the level of similarity of the lowest properties. This means there was a 48% mismatch. The coefficient was divided into two groups, namely group A consist of accession L (5) durian Miyem and L (10) durian Rusmiyati, and group B consist of accession L (8) durian Amin. Accession durian Miyem and Rusmiyati, is the most similar accession with the coefficient of similarity 0.73. The value indicates that there were still variation between

durian accession, this can be due to genetic factors and environmental conditions. Grouping the sample into a single cluster, indicating a high degree of similarity between generative characters shown through the coefficient of similarity [15].

The variables that cause differences between groups A and B were variations in morphology of fruit shape, fruit weight, fruit rind colour (at maturity), fruit rind thickness, fruit spine shape, flesh colour, flesh taste, flesh aroma, rail thickness, fruit length, fruit diameter and seed shape. According to Sri Lestari [16], the weight of fruit was positively correlated with fruit length, fruit weight, and fruit diameter. The fruit with heavyweight has a long fruit shape, large diameter, and thick fruit flesh. While the fruit with a lightweight has a short fruit shape, small diameter, and little pulp.

3.5 Identification of Potentially Superior Durian

The accession of local durian of exploration in Ngrambe subdistrict, Ngawi indicates that the potential of local durian development has the potential to be superior as the parent tree was large enough. Adjid [17] and Sunarjono [18] provide criteria for excellence include, (a) on the short age has been reproducing, (b) high productivity, (c) flavor and aroma of the fruit to satisfy the tastes of the consumer, (d) fruit flesh was thick, the texture was soft and it has the small size of seeds, (e) the shape and color relatively uniform and (f) it has resistant to disease.

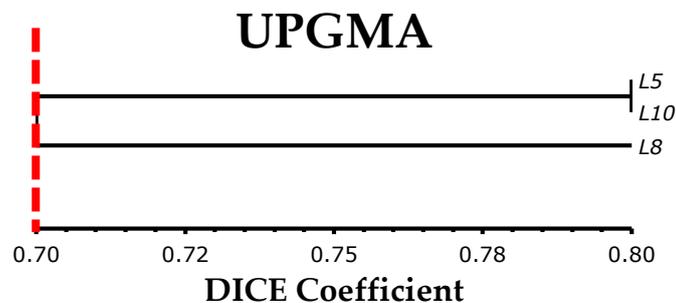


Figure 4. Dendrogram based on UPGMA analysis of 3 local durian accession based on phenotypic characters of vegetative and generative organs morphology processed with NTSYS program version 2.02

Based on dendrogram (fig.4) obtained that the coefficient of similarity 0.70 divided into two groups. Group A consist of accession L5 (durian Miyem) and L10 (durian Rusmiyati) and Group B consist of accession L8 (durian Amin), Identification of morphology of vegetative and generative organ showed the similarity of the highest character based on the value of coefficient of similarity 0,80 that was seen at accession L5 (Durian Miyem) and L10 (durian Rusmiyati). The degree of diversity of durian accession based on the morphological characteristics of fruits and seeds was high, presumably, this was due to the influence of plant genetic factors as well as environmental factors.

The variables that were differentiating between groups A and B were the variation in the morphology of crown shape, branching, leaf width, fruit shape, fruit weight, fruit rind colour (at maturity), fruit rind thickness, fruit spine shape, flesh colour, flesh taste, flesh aroma, rail thickness, fruit length, fruit diameter and seed shape.

Selection of 58 durian accessions that have potentially superior character based on fruit length, fruit diameter, fruit weight, fruit spine shape, rail thickness, flesh colour, flesh taste and sugar content, flesh creaminess, flesh aroma, fruit rind thickness, and seed shape obtained 2 accessions Durian, namely accession durian Miyem (L5) and durian Rusmiyati (L10). Durian Amin (L8) was not included in the potentially superior because plants were being attacked by plant-disturbing organism caused fruit identification result not matched with the result of interview with the owner.

The recognition of local varieties of regions that were superior and preferred consumers need to be done by proposing these varieties through efforts to release the regional varieties as a superior variety approved by the Minister of Agriculture [19].

The first durian accession (L5) had located in Munggur Hamlet, Giriharjo Village at ± 500 m above sea level. Durian superiority was 31 cm in length, 56 cm fruit diameter, 2.6 kg in fruit weight, with shaped spines. Aril thickness was 1.2 cm, creamy white color with medium in flesh creaminess, medium aroma, 1.5 cm in fruit rind thickness, sweet taste with sugar content was 28.8 Brix $^{\circ}$, longitudinal round shape, brownish yellow (Figure 5).

The second durian accession was L10 that located in Gunung Hamlet, Wakah Village at ± 500 m above sea level. The superiority of durian fruit has 41 cm in fruit length, 51 cm fruit diameter, fruit weight was 2.1 kg (medium), convex spikes (Convex). Aril thickness was 1.5 cm (medium), medium yellow (Lemon yellow) with medium texture (Intermediate), medium aroma, 1.5 cm (medium) fruit rind thickness, bittersweet taste with sugar content > 30 Brix $^{\circ}$, Yellow brown longitudinal (Oblong) shape (Yellow-brown) (fig. 5).

Durian ripening is characterized by increasing sugar content in fruits [12]. Color and appearance are critical factors of food for both its esthetic value and for quality judgment. Dark product is usually less attractive for the consumers [20].

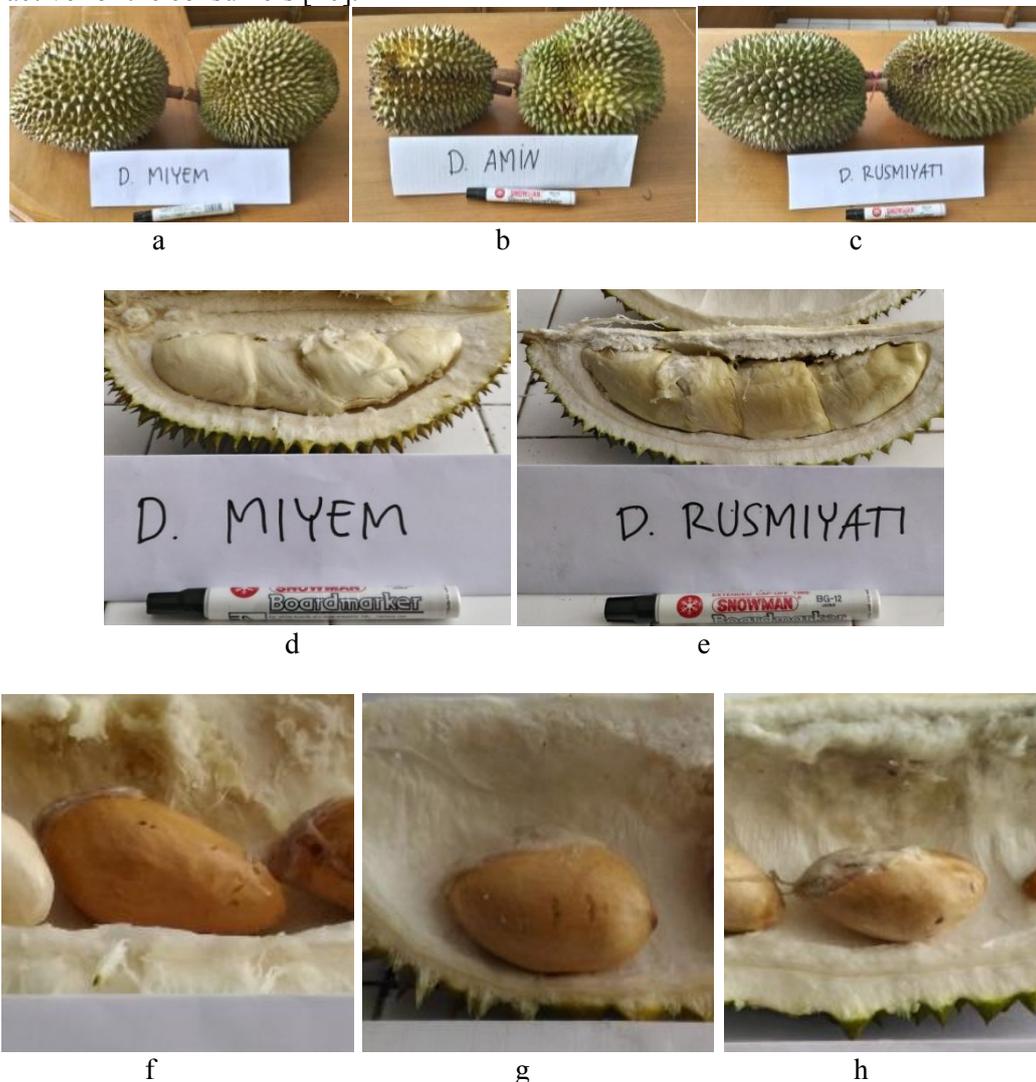


Figure 5. The fruit shape of durian miyem was oval (a), durian amin was elliptic (b), durian rusmiyati was round longitudinal (c), the pulp color of durian miyem was creamy white (d), durian rusmiyati lemon yellow (e) seed coat colour of durian miyem (f), amin (h) and rusmiyati (h) are yellow brown.

Wiriyanta [10] added that durian could be classified into 3, that was quality I, quality II and quality III. Durian shape was grouped into four kinds, which was very good, good, less good, and not good. Durian fruit that was very nice and good shape generally has five rooms (lokulus) full of flesh and seeds. While the fruit was less good and not good, the number of five or less room and not all the room contains seeds and fruit pulp. Durian Miyem and Rusmiyati can be included in grade I and the quality of fruit form was very good.

The overall results, indicating that there are variability found among potentially superior local durian accessions. This research, is the first step of inventory and identification of local durian, before a local varieties are proposed to be regional and national superior varieties [19].

4. Conclusions

Based on the result, it can be concluded that 58 accessions of local durian at research sites that were more than 50 years old with similarity coefficients ranged from 0.84 to 1.0 based on the phenotypic character of the vegetative organ. The result of coefficient analysis of phenotypic resemblance of the vegetative and generative organ from 3 local durian accessions potentially superior ranged from 0.7 to 0.8. Accession durian Miyem and durian Rusmiyati had the advantage and potential as a prospective parent plant of durian.

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References

- [1] Saleh M, Mawardi, Khairullah I. 2013. Diversity of durian phenotype of local cultivars in Karang Intan Kalimantan Selatan. *Agricultural Research Institute of Swamp Land, Agroscentiae* 20(1): 22-25. [Indonesian]
- [2] Setiono. 2012. Economic boosts develop durian cultivation. Government of Ngawi Regency. District Government Ngawi URL: <http://www.ngawikab.go.id/home/2012/12/dongkrakperekonomian-kembangkan-budidaya-durian/> Diakses 31 Agustus 2015. [Indonesian]
- [3] Sudjijo. 2009. Influence of rootstock and stem size on growth durian Monthong, Hepe, and DCK-01. *J. Hort.* 19(1):89-94. [Indonesian]
- [4] Ihsan, F, Sukarmin, Engkos, K. 2012. Durian crossword technique for assembling new improved varieties. *Agricultural Engineering Bulletin.* 17(1):14-17. [Indonesian]
- [5] Information on Horticultural Commodities. 2013. Durian. Jakarta: Data and Information System Center of the Ministry of Agriculture. 01/07/1 hal 1-4. [Indonesian]
- [6] Bioversity. 2007. Descriptors for Durian (*Durio zibethinus* Murr.) International Plant Genetic Resources Institute (IPGRI). Rome, Italy: International Bioversity International.
- [7] Supranto, J. 2004. *Multivariate Analysis of Meaning and Interpretation.* Publisher: Rineka Cipta, Jakarta. [Indonesian]
- [8] Rohlf, F. J. 1998. NTSYSpc Version 2.0. Exeter Software, New York.
- [9] Prastowo NH, James MR, Gerhard ESM, Erry N, Joel MT et al. 2006. *Nursery Techniques and Vegetative Propagation of Fruit Crops.* world agroforestry centre (ICRAF) dan Winrock International. Bogor, Indonesia. p.100 ISBN 979 - 3198 -28 – 1. [Indonesian]
- [10] Wiriyanta BTW. 2002. *Planting Durian.* Jakarta (ID): AgroMedia Pustaka. [Indonesian]
- [11] Sundari, Estri Laras Arumingtyas, Luchman Hakim, Rodiyati Azrianingsih. 2015. Exploration and Morphological Character Identification of Local Durian (*Durio zibethinus* Murr.) from Tidore Island, North Maluku. *Proceeding of 6th ICGRC (International Conference on Global Resource Conservation).*
- [12] Belgis, M., Wijaya, C.H., Apriyantono, A., Kusbiantoro, B. and Yuliana, N.D. 2016. Physicochemical Differences and Sensory Profiling of Six Lai (*Durio kutejensis*) and Four

- Durian (*Durio zibethinus*) Cultivars Indigenous Indonesia. International Food Research Journal 23(4): 1466-1473.
- [13] Charoensiri, R., Kongkachuichai, R., Suknicom, S. and Sungpuag, P. 2009. Beta-carotene, lycopene and Alpha-tocopherol Contents of Selected Thai Fruits. J. Food Chemistry 113: 202-207
- [14] Yumoto T. 2000. Bird-Pollination of Three Durio Species (*Bombacaceae*) in A Tropical Rainforest in Sarawak, Malaysia. American Journal of Botany 87 (8) : 1181-1188.
- [15] Yulita, KS. 2013. Molecular Identification of parent Trees of Some Varieties Durian from Jepara using Random Amplified Polymorphic DNA. J. Hort. 23(2): 99-106. [Indonesian]
- [16] Sri Lestari, Fitmawati dan Ninik Nihayatul Wahibah. 2011. Diversity of Durian (*Durio zibethinus* Murr.) in Bengkalis Island based on morphological characters. Kebun Raya Bulletin 14(2): 29-44. [Indonesian]
- [17] Adjid DA. 1994. Guide of horticultural cultivation (Durian). Project for Increasing Food Crop Production. Bengkulu Provincial Food Crops Agency. Bengkulu. [Indonesian]
- [18] Sunarjono H. 1995. Various Problems Durian and Solution. Penebar Swadaya, Jakarta. [Indonesian]
- [19] Nandariyah. 2009. Breeder Role in Participatory Plant Breeding by Using of Genetic Resource of Local Varieties. J. Agrosains 11(1): 28-35. [Indonesian]
- [20] Norjana, I. and Aziah, N. A. A. 2011. Quality of Durian (*Durio zibethinus* Murr) Juice after Pectinase Enzyme Treatment. International Food Research Journal 18:1117-112