Genetic relationships

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Genetic Relationships of Local Durians from Halmahera by Clustering Analysis Based on Morphological Characters

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Abstract. The genetic relationships of 37 local durians from various villages on the island of Halmahera, North Maluku were identified by 142 morphological characters in the vegetative and generative phases. The study was conducted at the Laboratory of Taxonomic Department of Biology at Brawijaya University from May 2016 until October 2016. The results of genetic relationship analysis from the dendrogram showed that the 37 local durians from Halmahera were divided into four main clusters with a similarity coefficient of 0.71. This suggests a close association of genetic variations for local durian variants based on 142 morphological characters. The genetic relationship also indicates that there is regional specificity to the spread of local durian variants in Halmahera. The results of this study can be used as a basis for recommendations on the genetic diversity level of the local durian germplasm from Halmahera to be developed further, as well as for conservation. However, the current data needs to be supported with other character data from research, to accurately obtain higher kinship data.

Keywords: Genetic, durians, morphological.

INTRODUCTION

Indonesia is one of the main durian producing countries, after Malaysia and Thailand.[1] West Halmahera Island especially Jailolo is one of durian production centers in North Maluku.[2] Durians, in plant systematics, are included in the *Malvaceae* family.[3] Durians have a distinctive characteristic for their size of fruit, its unique aroma and its spines on the skin.[4] The durian *Durio zibethinus* Murr. Is the "king of fruit", and is one tropical fruit that has important economic value in Indonesia. Jailolo is the local name of the durian variant (*Durio zibethinus* Murr.) that grows naturally in Jailolo community gardens and comes from hereditary seeds.[5]

Currently there is no information about the genetic relationship between local durian variants in North Maluku. Several studies have been conducted based on the morphological characteristics of trees, leaves, flowers and durian fruit.[5,6]. Information on local genetic variations in West Halmahera Island is based on Random Amplified Polymorphic DNA (RAPD).[7] However, until now, the distinction between morphological characters of practical cultivars has not been reported. No information is available about the genetic relationship between Jailolo's local durians cultivated by the community,[5] as well as in North Maluku province, although durians have been cultivated for hundreds of years. Classification and evaluation of the genetic diversity of local durians can be studied based on phenotypic expression of plants such as fruit shape, size and shape of the spines on the skin and other morphological characters.[5]

Characterization is an activity that aims to get a picture of the plant variants tested. Characterization based on morphological characters (leaves, stems, flowers, and fruit) can determine the taxon position and utilization of the characterized plant. Germplasm collection can be better utilized when the characteristics of the plant are known.[8] Characterization activities can be used as a necessary foundation before further research. The objective of this study

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was to assess the genetic variation of local durians with morphological characters to evaluate genetic diversity and genetic relationships of 37 variants of local durians in Jailolo in West Halmahera district of North Maluku province.

EXPERIMENTAL DETAILS

Study Area and Sample Collection

The research was conducted on the island of West Halmahera. Sampling locations were six urban villages in the Jailolo subdistrict. Samples were collected by a purposive sampling method. This study was conducted from May until October 2016. There were 37 variants of local Jailolo durians collected as listed in Table 1.

TABLE 1. Sampling Location

Location	Local name	code	amount
Worat-worat	Malal	J1	6
	Yang	J2	5
	Lole	J3	8
	Serkaya	J4	11
Tibobo	Buro-buro	J5	12
	Boga	J6	12
	Nanas	J7	10
	Pisang	J8	11
	Amo	J9	10
	Nene	J10	11
Balisoang	Namo-namo/ayam	J11	10
	Sahbadar	J12	8
	Nicodimus	J13	6
	Batu	J14	12
	Tabesang/wu'dus	J15	15
	Kudu	J16	11
	Soroa	J17	8
	Kopi	J18	5
	Gajah	J19	11
	mentega	J20	9
Gamsungi	Ping	J21	11
	Pelesku	J22	10
Golo	Kopi	J23	11
	Gajah	J24	10
	Manggis	J25	10
	Chano	J26	25
	Mentega	J27	12
Aketola	gumala	J28	9
	Bebe	J29	6
	Tete	J30	8
	Papan	J31	8
	Lametiko	J32	9
	Sambiki	J33	6
	Tobu	J34	3
	Goiom	J35	1
	Pare	J36	3
	Gajah	J37	5

The observations of morphological characters were conducted based on Bioversity International Descriptor[9] using 142 characters of vegetative and generative organ morphology on durians. The observation of morphological characters was done at the Laboratory of Plant Taxonomy of the Biology Department of Brawijaya University. The

data were analyzed using the UPGMA technique (Unweight Pair Group Method with Arithmetic Mean), Multivariate Statistical Package (MVSP) program version 3.22.[10]

RESULTS AND DISCUSSION

Referring to the average value of the 142 morphological characters observed in local durian variants, it appears that variations in the observed characters were based on the value of variation shown for each character. Although there were characters that did not have variations, so having a variance value of 0.00, this shows the characters of one type were the same. The following is the genetic distance matrix data from 37 variants of local Jailolo durians (Table 2).

TABLE 2. Matrix Genetic distance of local durian Jailolo

	Kut	J1	J2	J3	J4	J5	J6	J7	J8	J9	J10	J11	J12	J13	J14	J15	J16
Kut	1																
J1	0.554	1															
J2	0.554	0.743	1														
J3	0.581	0.824	0.797	1													
J4	0.581	0.784	0.919	0.77	1												
J5	0.608	0.73	0.743	0.811	0.77	1											
J6	0.568	0.77	0.703	0.797	0.73	0.851	1										
J7	0.514	0.73	0.689	0.703	0.73	0.784	0.824	1									
J8	0.514	0.757	0.689	0.676	0.703	0.797	0.824	0.851	1								
J9	0.514	0.77	0.73	0.73	0.743	0.784	0.811	0.811	0.797	1							
J10	0.554	0.757	0.757	0.757	0.784	0.811	0.811	0.797	0.757	0.919	1						
J11	0.554	0.797	0.784	0.77	0.77	0.784	0.784	0.77	0.784	0.811	0.824	1					
J12	0.595	0.757	0.757	0.757	0.757	0.77	0.811	0.757	0.77	0.784	0.811	0.824	1				
J13	0.588	0.736	0.75	0.777	0.75	0.736	0.723	0.682	0.736	0.75	0.777	0.75	0.791	1			
J14	0.554	0.77	0.784	0.743	0.784	0.797	0.784	0.824	0.757	0.851	0.851	0.838	0.811	0.75	1		
J15	0.547	0.736	0.709	0.777	0.764	0.75	0.791	0.791	0.736	0.804	0.818	0.764	0.75	0.784	0.818	1	
J16	0.5	0.716	0.676	0.73	0.703	0.77	0.77	0.716	0.743	0.824	0.878	0.73	0.784	0.818	0.757	0.791	1
J17	0.541	0.73	0.716	0.77	0.743	0.797	0.784	0.743	0.743	0.811	0.892	0.757	0.797	0.831	0.811	0.818	0.932
J18	0.527	0.77	0.689	0.716	0.743	0.784	0.77	0.77	0.743	0.811	0.797	0.77	0.73	0.764	0.851	0.75	0.797
J19	0.52	0.628	0.723	0.696	0.736	0.764	0.764	0.75	0.764	0.75	0.723	0.709	0.669	0.743	0.764	0.77	0.709
J20	0.561	0.682	0.696	0.709	0.723	0.777	0.764	0.804	0.75	0.791	0.791	0.75	0.736	0.757	0.804	0.824	0.75
J21	0.554	0.676	0.703	0.689	0.676	0.703	0.676	0.743	0.716	0.77	0.743	0.743	0.743	0.804	0.784	0.75	0.743
J22	0.554	0.689	0.703	0.73	0.676	0.703	0.703	0.689	0.689	0.77	0.716	0.757	0.743	0.791	0.77	0.75	0.757
J23	0.514	0.676	0.743	0.703	0.73	0.716	0.73	0.716	0.703	0.838	0.811	0.784	0.757	0.791	0.797	0.723	0.797
J24	0.574	0.709	0.791	0.709	0.791	0.75	0.75	0.723	0.682	0.75	0.804	0.791	0.764	0.77	0.831	0.757	0.764
J25	0.534	0.736	0.709	0.709	0.682	0.75	0.709	0.696	0.75	0.75	0.764	0.764	0.736	0.797	0.75	0.73	0.791
J26	0.534	0.723	0.696	0.655	0.709	0.723	0.75	0.696	0.764	0.791	0.764	0.75	0.764	0.77	0.764	0.743	0.777
J27	0.52	0.655	0.682	0.669	0.696	0.791	0.764	0.845	0.764	0.804	0.791	0.723	0.736	0.649	0.804	0.716	0.723
J28	0.527	0.676	0.716	0.703	0.689	0.743	0.73	0.797	0.743	0.757	0.757	0.703	0.689	0.682	0.77	0.764	0.73
J29	0.534	0.709	0.669	0.655	0.669	0.696	0.709	0.723	0.723	0.736	0.764	0.655	0.709	0.703	0.736	0.716	0.764
J30	0.493	0.75	0.682	0.669	0.696	0.696	0.723	0.764	0.75	0.764	0.723	0.696	0.669	0.676	0.777	0.73	0.696

Continue

Kut		J1	J2	J3	J4	J5	J6	J7	J8	J9	J10	J11	J12	J13	J14	J15	J16
J31	0.541	0.649	0.676	0.662	0.703	0.716	0.689	0.676	0.716	0.689	0.676	0.608	0.662	0.682	0.662	0.682	0.703
J32	0.554	0.689	0.716	0.743	0.757	0.824	0.757	0.73	0.716	0.743	0.757	0.662	0.716	0.696	0.73	0.75	0.743
J33	0.527	0.716	0.73	0.676	0.73	0.743	0.811	0.811	0.824	0.824	0.797	0.77	0.77	0.682	0.824	0.777	0.703
J34	0.568	0.703	0.703	0.689	0.703	0.757	0.743	0.757	0.757	0.824	0.797	0.743	0.811	0.736	0.784	0.75	0.784
J35	0.48	0.723	0.628	0.709	0.669	0.75	0.791	0.777	0.764	0.845	0.818	0.764	0.818	0.757	0.791	0.797	0.818
J36	0.466	0.696	0.682	0.682	0.682	0.791	0.75	0.791	0.804	0.818	0.764	0.736	0.75	0.703	0.764	0.757	0.764
J37	0.514	0.716	0.703	0.703	0.689	0.77	0.77	0.784	0.811	0.784	0.757	0.784	0.824	0.709	0.784	0.764	0.757
	Kut	J1	J2	J3	J4	J5	J6	J7	J8	J9	J10	J11	J12	J13	J14	J15	J16

Continue→

Kut	J17	J18	J19	J20	J21	J22	J23	J24	J25	J26	J27	J28	J29	J30	J31	J32	J3
J17	1																
J18	0.811	1															
J19	0.777	0.777	1														
J20	0.791	0.791	0.784	1													
J21	0.757	0.784	0.736	0.804	1												
J22	0.757	0.784	0.736	0.777	0.892	1											
J23	0.77	0.77	0.777	0.777	0.77	0.797	1										
J24	0.764	0.791	0.757	0.797	0.777	0.764	0.831	1									
J25	0.777	0.791	0.703	0.743	0.764	0.764	0.75	0.757	1								
J26	0.75	0.818	0.716	0.77	0.723	0.709	0.804	0.811	0.838	1							
J27	0.723	0.777	0.716	0.824	0.736	0.736	0.75	0.784	0.757	0.757	1						
J28	0.757	0.757	0.75	0.858	0.73	0.73	0.716	0.804	0.791	0.764	0.885	1					
J29	0.75	0.736	0.662	0.757	0.764	0.709	0.709	0.797	0.797	0.77	0.784	0.831	1				
J30	0.723	0.791	0.757	0.797	0.696	0.682	0.723	0.743	0.784	0.77	0.811	0.831	0.811	1			
J31	0.716	0.676	0.723	0.655	0.716	0.689	0.676	0.628	0.723	0.669	0.723	0.689	0.723	0.736	1		
J32	0.77	0.716	0.764	0.75	0.73	0.73	0.689	0.736	0.736	0.696	0.804	0.797	0.75	0.723	0.878	1	
J33	0.73	0.77	0.791	0.804	0.757	0.73	0.716	0.777	0.777	0.804	0.858	0.824	0.804	0.818	0.757	0.797	1
J34	0.824	0.757	0.723	0.791	0.797	0.811	0.703	0.723	0.804	0.764	0.831	0.811	0.764	0.709	0.757	0.797	0.838
J35	0.831	0.75	0.743	0.784	0.736	0.75	0.777	0.73	0.77	0.797	0.784	0.75	0.743	0.743	0.723	0.791	0.818
J36	0.736	0.75	0.73	0.797	0.723	0.709	0.736	0.716	0.784	0.797	0.838	0.818	0.73	0.784	0.736	0.777	0.831
J37	0.77	0.743	0.723	0.791	0.716	0.716	0.703	0.696	0.777	0.791	0.818	0.797	0.736	0.75	0.716	0.757	0.851
	Kut	**J17**	**J18**	**J19**	**J20**	**J21**	**J22**	**J23**	**J24**	**J25**	**J26**	**J27**	**J28**	**J29**	**J30**	**J31**	**J32**

Continue→

Kut	J33	J34	J35	J36	J37
J33	1				
J34	0.838	1			
J35	0.818	0.831	1		
J36	0.831	0.804	0.851	1	
J37	0.851	0.851	0.885	0.926	1
Kut	**J33**	**J34**	**J35**	**J36**	**J37**

Based on the interpretation of the diversity of morphological characters and the calculation of the coefficient of similarity among the variants of local Jailolo durians, the value of the similarity coefficient ranged from 0.525 to 1.000 for the 37 local durian varieties in this research. At a similarity value of 0.71, four main clusters were formed (Fig.1).

The dendrogram consisted of four groups. Group 1 consists of the local durians coded J1-J4 from Worat; group 2 consists of local durians coded J5-J12, J14-J18 and J23, 24 from Tibobo, part of Balisoang and part of Golo. Group 3 consists of local durians coded J20, J25-J30 and J33-J37, part Balisoang, part Golo and part Aketola; group 4 consisted of local durians coded J13, J19, J21, J22, J31 and J32, part Balisoang, Gamsungi and part Aketola.

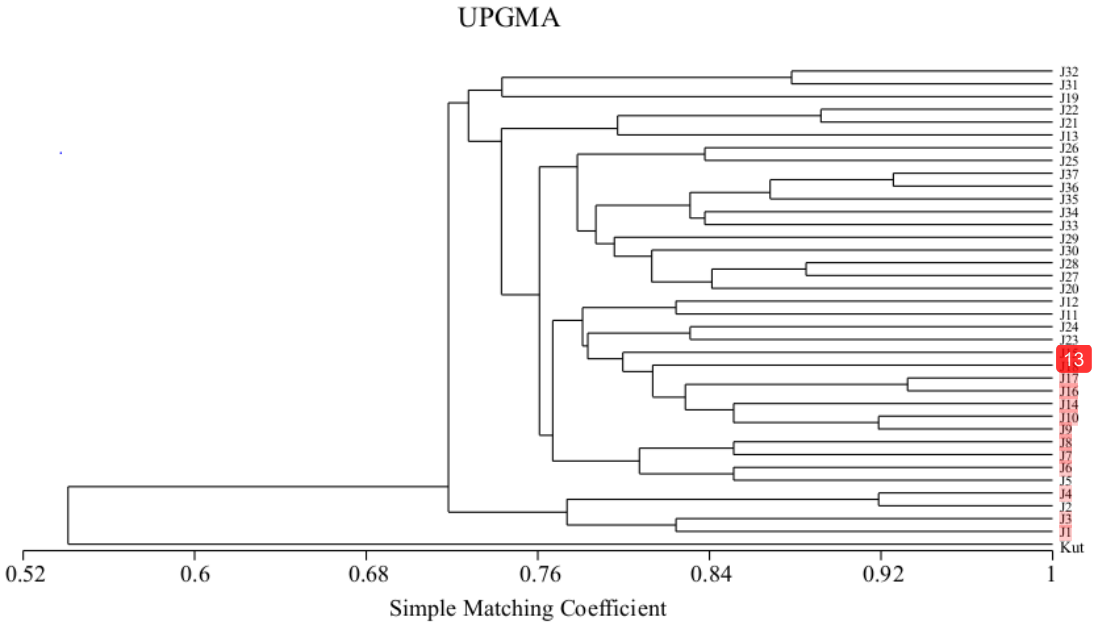

FIGURE 1. Genetic Relationship Dendrogram 37 variants of local durian Jailolo based on morphological characters.

The relationships of local durians from Jailolo, based on morphological characters, indicates that the spread of local Jailolo durian variations has a specific dispersal pattern for durians of Worat, Tibobo and Gamsungi, which are found in one cluster group. The local durians from Balisoang, Golo and Aketola are spread over three groups of dendrogram clusters. Durians from Worat are the oldest durians (anchestor) of the local Jailolo durians, while the local durians from Balisoang, Golo and Aketola are phylogenetically relatively more modern durians. Genetic relationships can serve as a potential basis for more genotyping assemblage. The genotype with the farthest genetic distance is then selected and crossed. The longer the genetic relationships between prospective elders, the greater the chance of potential cultivar formation. Elders must also have desirable characteristics such as high yield, good yield quality, resistance to major pests and diseases, and have far-reaching genetic relationships in order to avoid inbreeding depression in cross-pollinated plants.[11] These are important sources of selection information to determine the genetic relationship between varieties that need to be identified. Plant identification will indirectly obtain information based on the resemblance of the observed characters.[12]

Further studies using other characters, such as molecular characters, will be very supportive and helpful to confirm these findings. The results of this study can be used as a basis for recommendation of genetic diversity levels of the local durian germplasm from Halmahera for further development and conservation efforts of local germplasm.

SUMMARY

Analysis of local durian clustering from Jailolo based on morphological characters yielded four main groups. Based on genetic relationship analysis of local durians, those from Worat were the oldest durians (anchestor) among local Jailolo durians, whereas the local durians from Balisoang, Golo and Aketola are phylogenetically relatively more modern durians. Jailolo genetic local kinship analysis also shows a specific dispersal pattern based on the distribution area.

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Genetic relationships

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