INTERNATIONAL JOURNAL OF CONSERVATION SCIENCE
ISSN: 2067-533X Volume 10, Issue 4, October-December: 711-720 www.ijcs.uaic.ro

TAXONOMICAL STATUS OF LOCAL DURIAN (*Durio* Spp.) FROM TERNATE ISLAND NORTH MALUKU BASE ON MORPHOLOGICAL CHARACTER AND GEOGRAPHICAL FACTOR

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Abstract

Ternate Island has high variations of durian (Durio spp.). In the area, durian has many vernicular names as well as phenotypic differences. Currently, information about genetic diversity and taxonomical status has not enough yet. This research first reported the taxonomical status of local durian from Ternate. This study aimed to investigate and identify of species that have not been identified in order to taxonomical position be clearly. The results revealed that the taxonomical status of local durian (Durio spp.) in Ternate island can be grouped as species Durio zibethinus Murr and have distribution pattern spread in lowland. Durian pondak (T17) is know that the ancestor of the local durian from Ternate. Durian Afo (T22) and durian Moya (T23) are know that the highest similarity of morphological character. These three local durians are the native durian from Ternate. The phenomenon of anomaly for D zibethinus Murr. from Ternate have lowland hotspot with coastal environmental factors. In generally D zibethinus Murr can grow well in the highlands this is different for native Durio spp from Ternate island.

Keywords: *Taxonomical status; Durio spp; Native; Sinaphomorphy; Ternate*

Introduction

Durian (*Durio* spp.) is a tropical fruit plants which natively spread in Indonesia and Malaysia [1]. This plant is also exotically spread into other areas, such as Australia, Cambodia, India, Myanmar, Sri Lanka, Thailand, Vietnam and Zanzibar. It was reported that there are 27 species of durian in the world, 20 species can be found in Indonesia, and 11 in Malaysia [2, 3]. Indonesia is the center of durian distribution in the world because 18-20 durian species can be found in Borneo. Seven of those species grow in Sumatra and the rest species spread throughout Indonesia [3, 4]. Durian commodity has an important economic value in Thailand, Indonesia and Malaysia [5, 6]. Durian commodity in Indonesia is in fourth rank after bananas, oranges and mangoes [4]. Based on the benefit and economic value, durian is categorized into fresh fruit, processed food and others [7]. Durian is also used for building materials [3, 7].

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The North Maluku is one of the provinces in Indonesia which has high of durian variation. North Maluku durians spread in Ternate, Tidore and Halmahera [8]. Taxonomical status of durian in North Maluku has not been determined yet. Durian in North Maluku is wider known as local durian with many local names. Numerous local names of durian in North Maluku were caused by morphological variations, and multiethnic of durian owners who named to given durians come from different island. Several local name of local durian in Ternate Island are durian Mentega, durian Pare, durian Gosi, durian Pondak, durian Sambiki, durian Moya, durian Air tege-tege, durian Gajah kuning and durian Tusa. Ternate Island is the widest area of the distribution and production of durian in North Maluku. Local durian in Ternate Island is only used to fresh fruit consumption and processed food till now. In general, local people on Ternate Island are prefer to consume local durian from Ternate than those from other area [9].

Due to morphological and local name variation of durian in Ternate Island, it is necessary to analyse the distance of diversity of the durians related to their distribution area by using clustering analysis. The dendogram produced can be used also for predicting relationship and taxonomical position of local durians in Ternate Island. Previous research [10] reported that local durian in Ternate consist of 7 groups with the highest similarity index (90.32%) in Udi and Sina local durian based on morphological characters.

The distribution pattern of local durian in Ternate Island is spread throughout–Ternate Island [11]. Durian is ecologically grow well at 200-800 meter asl, average temperature of 22°C, rainfall intensity of 1500-2000mm/year, type of soil is sand [1, 3]. In the present, there is no information about the taxonomical status. Lack information of characterization and taxon status database of local durian diversity in Ternate Island may cause the conservation of the local durian is also not clear yet. This aimed of this study is to identify of species as name verification so that the taxonomical status of it can be clearly known. If species identity of it has been known, it is useful in conservation and to incrase utilization of genetic resources of local durian in Ternate Island.

Experimental

Area Study and Sample Collection

This research was conducted on Ternate Island which is surrounded by the sea with its geographical location of 0°-2° North Longitude and 126°-128° East Longitude. Ternate island area is about 162.03km², while oceans are 5547.55km². Ternate Island is entirely surrounded by the sea with eight island, three of them are unpopulated, and have the following boundaries: North of Maluku Sea, South of Maluku Sea, east of Halmahera Strait, and west of Maluku Sea. The research sampling was conducted in 15 villages in Ternate Island. Samples were collected by purposive sampling method. There are 27 plants of durian Ternate variants collected as listed in (Table 1).

Morphological Characteristics Analysis

Observations of morphological characters was based on [12] with 127 morphological characters of vegetative and generative organs on durian. Data were analyzed using the technique UPGMA cluster (Unweight Pair Group Method with Aritmathic Mean), Multivariate Statistical Package program (MVSP) ver. 3:22 [13]. The result of dendrogram then analyzed with synapomorphy, autapomorphy and apomorphy characters to know the distinguishing character local durian from Ternate island.

Table.1. Sampling Location Local Durian in Ternate Island

No	Site	Local name	Code	Amount (tree)	Altitude (meters above sea level)
1	Sasa	Boso	T5	5	256
		Luri Kecil	T16	7	296
		Mentega	T3	6	287
		Ratem	T15	6	292
2	Tobololo	Cinta	T1	10	248
		Urat	T2	9	251
		Mentega	T3	9	242
		Boso	T5	10	284
		Tobokome	T4	8	267
		Pare	T11	10	246
3	Tongole	Air tege-tege	T21	24	381
		Afo	T22	11	441
		Sina	T19	4	409
		Udi	T20	6	427
		Coklat	T6	15	398
4	Foramadiahi	Boso	T5	6	331
		Gajah Abu	T8	10	350
		Gajah Hijau	T9	6	329
		Pare	T11	6	352
		Biji Mati	T13	3	341
		Gosi	T7	6	368
5	Rua	Mentega	T3	8	24
		Pare	T11	6	15
		Rua 1	T12	13	29
		Rua 2	T14	6	40
6	Loto	Mentega	T3	7	82
		Boso	T5	9	35
		Biasa	T18	10	38
		Pondak	T17	11	34
7	Takome	Mentega	T3	7	76
		Tobokome	T4	8	77
		Urat	T2	12	67
		Cinta	T1	11	47
8	Sulamadaha	Mentega	T3	9	34
		Gajah kuning	T10	10	34
9	Bula	Boso	T5	9	94
		Gajah kuning	T10	6	76
10	Kulaba	Mentega	T3	9	253
		Gajah kuning	T10	9	233
		Pare	T11	9	175
		Pondak	T17	8	243
		Gajah abu2	T8	8	234
11	Togafo	Bantal	T24	5	19
		Poci	T25	8	17
		Boso	T5	5	35
		Gajah Hijau	T8	7	19
12	Moya/Torano	Moya	T23	14	227
		Mentega	T3	6	233
13	Ngade	Gajah hijau	T9	13	13
14	Kastela	Tusa	T26	5	36
		Balanga	T27	16	36
		Urat	T2	6	18
15	Tubo	Pare	T11	12	113
		Biasa	T18	7	118

Source: Research data (2015)

Spatial Distribution and Environmental Factor

Spatial distribution patterns and environmental factor was performed using a survey mapping hotspots method of local durian Ternate. This method aimed to record the coordinate points from GPS (*Global Positioning System*) in each plant in 15 villages and the data of physical environmental factors (altitude, pH, temperature, rainfall intensity and light intensity). Data analysis was performed with coordinate and environmental factor data into base map through ArcGIS application software version 10.2 [14, 15]. Analysis of environmental factors effect on phenotypic diversity and distribution patterns of local durian Ternate was performed with PCA analysis (*Principle Components Analysis*) using PAST program version 2.17c [16, 15].

Results and discussion

Morphological character

Variation of morphological characters of local durian Ternate with outgroup *Durio kutezenziz*. Similarity analysis using the MVSP ver 3.22 software program produces dendrograms as in figure 1.

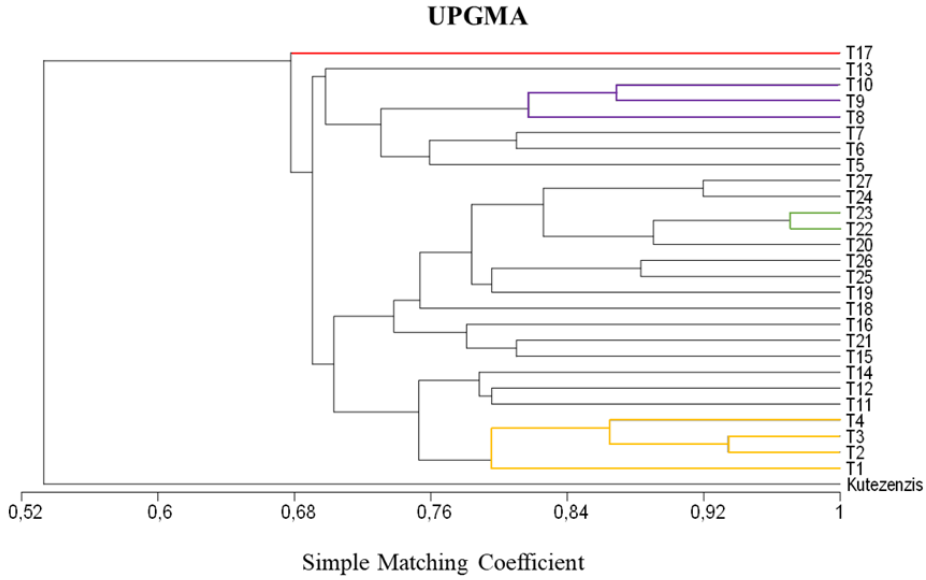

Fig 1. Dendogram based on morphological characters of local durian Ternate by UPGMA

Data analysis results, it can be seen that outline is formed from dendrogram showing the division of four main goups namely group 1 (T1, T2, T3, T4, T11, T12, T14), group 2 (T20, T22, T23, T24, T27, T18, T19 , T25, T26, T15, T16, T21), group 3 (T5, T6, T7, T8, T9, T10, T13) and group 4 (T17) separate themselves but still belong to durio spp. The grouping of morphological characters local durian in Ternate is based on the similarity of character (sinaphomorphy), namely: Types of growth of spreading tree, monopodial branch type, medium tree height, brown stem colour, green leaf surface color, elip leaf shape, caudate leaf base shape,flower position, flower shape and flower colour, convex fruit tip shape, truncate fruit base form, yellow brown seeds colour (Fig. 2).

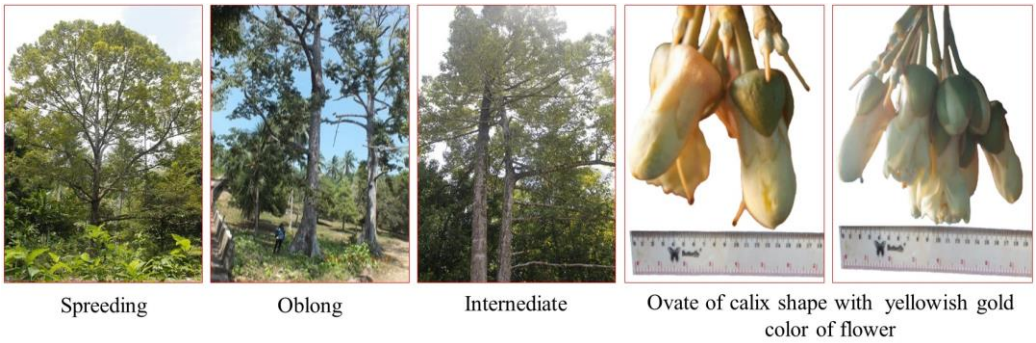

Fig 2. Growth of tree type, monopodial branch type and flower position as Sinaphomorphy character of local durian found Ternate island

Based on the closest genetic distance in group 1 it is known that T22 (durian Afo) and T23 (durian Moya) have a genetic distance (0.02) which means that both variants have autopomorphy on elip leaf shape, acuminate leaf tip, acute leaf base form, globose fruit form - oval, basic form of truncate fruit, concave thorn shape, intermediate spikes density, medium fruit weight, creamy white flesh color, oval shape, yellow brown seed color (Fig. 3). While in group 4 it know that T17 (durian Pondak) has the longest genetic distance (0.33) which means having the lowest resemblance with distinguishing character on: oblong head shape, intermediate tree growth type, very high tree height, greynish color of steam; Upper surface color of light green leaves, leaf shape, acuminate leaf tip, cuneate leaf base form; oval fruit shape, convex cone shape, convex fruit base, yellow-green fruit skin color, medium fruit weight, hoocked thorn shape, density of meeting density, lemmon yellow flesh color, strong aroma, fibrous fiber texture; oval seed shape, yellow brown seed color (Fig. 4).

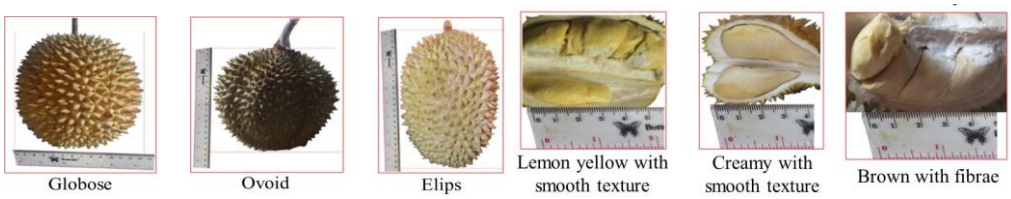

Fig. 3. Fruit shape, texture and color flesh as Autophomorphy character of local durian found Ternate Island

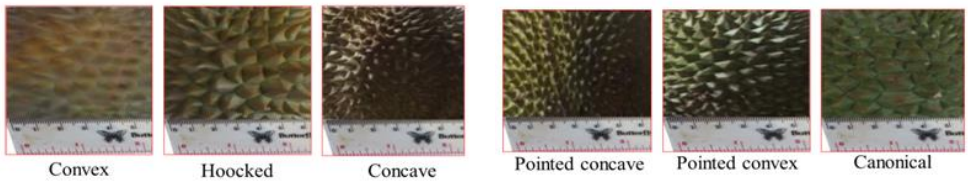

Fig. 4. Thorn shape as Apomorphy character of local durian found Ternate island

Geographical distribution patterns

Local durian in Ternate Island were almost spread out through the slope of Mount Gamalama with the main hotspots in 15 villages from the coastline (Ngade, Rua, Kastela and Togafo Village) at 13 meters asl until 427 meters asl in the village (Tongole, Moya and Air

tege-tege) (Table 1). Distribution pattern of this plants described on distribution map based on coordinate points record in area study (Fig. 5).

Data analysis results, it can be seen that outline is formed from distribution map showing the pattern of local durian Ternate distribution is spreading in lowland to highland as follows: i) Lowland hotspot consists of eight locations ranging from 13m asl height (Ngade location), altitude 15-40m asl (Rua), height 17-35m asl (Togafo), altitude 18-36m asl (Kastela), height 34m asl (Sulamadaha), height 34-82m asl (Loto), altitude 47-77m asl (Takome) and height 76-94m asl (Bula); ii) Medium plane hotspots consist of five locations, height 113-118mdpl (Tubo), height 175-253mdpl (Kulaba), height 227-233mdpl (Moya), height 246-284m asl (Tobololo), height 256-292m asl (Sasa); iii) Highland hotspots consist of two locations namely height 329-368m asl (Foramadiahi) and altitude 381-441m asl (Tongole).The distribution pattern with contours of local durian hotspots in Ternate is dominated by durian growing in the lowlands. Local durian Ternate growing in the lowlands as many as eight hotspots with more local name variation compared with other hotspots.

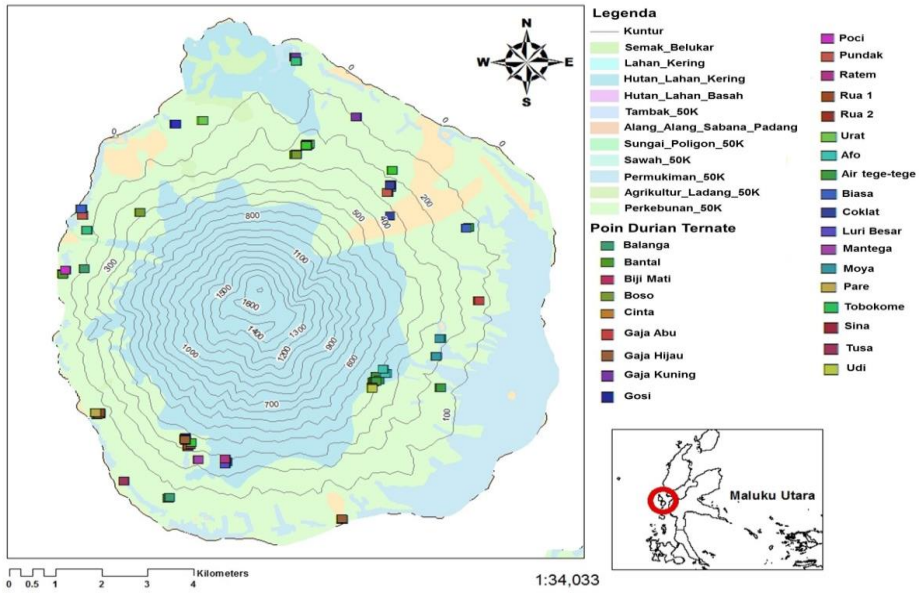

Fig. 5. Distribution Map Local Durian Ternate with Contour using ArcGIS ver 10.2 software

Environmental Characters

The morphological variation of local durian in Ternate Island is one of the parameters of genetic diversity. This is affected by environmental factors such as: temperature, soil pH, humidity, rainfall and altitude are very influential on the growth and distribution of durian. Based on data analysis results, it can be seen that outline is formed from graphic showing the division of two main goups. In group 1 the most influential environmental factors are temperature and pH, whereas in group 2 the height and humidity factors that most give influence on the diversity and distribution of local durian of Ternate. Environmental factors on the island of Ternate that support the growth and distribution of durian are the average daily temperature 27-31℃, pH averaging 5.8-6.3. Average daily air humidity reached 7.9-8.2% with average rainfall reach 478mm/year (MCGC, 2014). In general, local durians in Ternate are spread over lowland zones (Fig. 6).

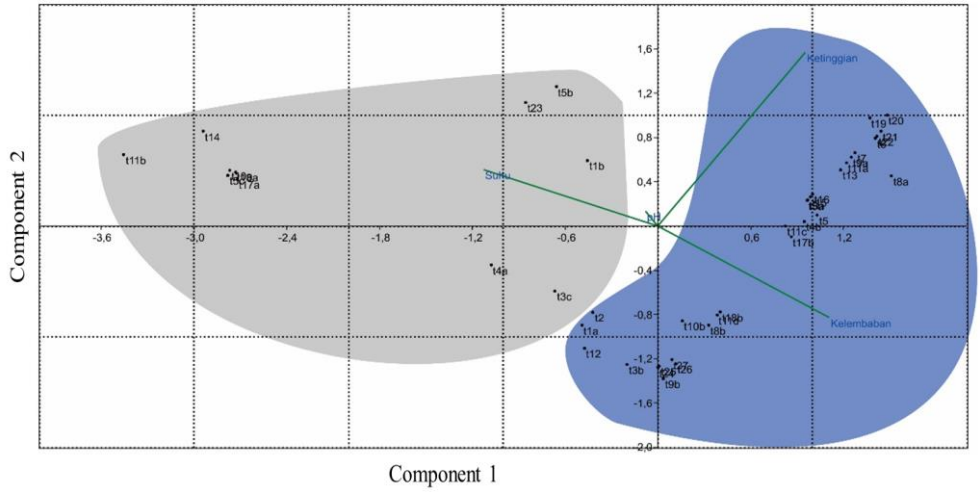

Fig 6. PCA analysis of morphological diversity and environmental factor of local durian found Ternate Island

Genus of *Durio* spp. in this study divided into 4 groups: group of durian Pondak (T17) as ancestor with primitive character, group of durian Gajah (T7) as big fruit weight and oval fruit shape, group durian from Tongole (T22 & T23) as Durio spp with hight similarity or limit space of genetic distance [17] as group with autophomorpy character and group durian Mentega (T3) as favorite durian with good fruit agronomy character [18]. Morphological characters in *Durio spp* genus based on similarity (synapomorphy). The similarity of these characters is grouped in *Durio zibethinus* Murr. The same character classifies Ternate's local durians into the genus of Durio. The genus of durio has specific characteristics such as: the lower surface of the leaves, the shoots and the scaly flower (lepidote), the globose-shaped petals, have rather large flowers with striking color and the color of the whitish or reddish petals, the anther consists of pollen locus groups Globular or elongated open either through apical pores or longitudinal slits, large spiny fruit with large seeds wrapped in fruit flesh [19-21]. Based on the above characters it is known that the genus Boscia and Cullenia is the closest related genus to Durio [20].

The specific character in four group is: group 1 it is known that have specific character are: globose fruit shape, Lemmon yellow fruit flesh colour, and flesh fruit smooth texture; group 2 have specific character are: oval and globose fruit shape, creamy white and lemon yellow fruit flesh colour, and flesh fruit smooth texture; goup 3 have specific character are: oval fruit shape, creamy white fruit flesh colour, and flesh fruit fibre texture; goup 4 have specific character are oval fruit shape, Lemmon yellow fruit flesh colour, and flesh fruit smooth texture.

The character is an apomorphy character that is a key character or unique that is only owned by ingroup and derived by its outgroup. In this study the outgroup character (*D. kutezensis*) is very different and not lowered to the ingroup. This is indicated by the absence of the same character between ingroup and outgroup so that all characters both qualitative and quantitative become apomorphy characters. The characters include fruit skin color, thorn shape, thorn density, and fruit aroma.

Based on the PCA analysis result it know that in two group form phenomena in group 1 consist T17, T22 and T23 is spread at varying altitude 286 - 398m asl spread at varying altitude 286 - 427m asl (cluster medium land *Durio spp*. group). In group 2 consist T1, T2, T7, T8 is spread at an altitude of 13-341m asl, and 19- 284m asl (cluster lowland Durio spp. group). This

is supported by PCA analysis results, that Goup 1 in the more primitive (native) durian character type with mediumland habitat (34m asl and 243m asl). This durian is assumed as the durian elder on the Ternate island and will evolve into durians in groups 2 (modern) that have variations in morphology and habitats more varied ranging from 13m asl to 427m asl. According to of [3, 22], durian (*D zibethinus* Murr.) can grow well at an altitude of 10-800m asl and grow optimum at an altitude of 50-600m asl. Furthemore Ministry of [17], Durian will grow well on soil with a pH of 5-7 and optimum at pH 6-6.5. The rainfall >2,000 mm/year and spread evenly throughout the year. Light intensity 40-50%, with a temperature of 22-30ºC. The altitude of a good place between 100-500 m asl, if planted in a higher area will degrade the quality [17]. Based on the morphological character and PCA analysis result it assumed that local durian in Ternate Island is *D. zibethinus* Murr. with character especially of the hotspot lowland coastal spesies.

The determination of material plant samples that have not been identified still requires further research, in order to more clearly identify so that the taxonomical status can be known. Besides of confirmation with morphological character, the taxonomical status of this species can be known based on confirmation from molecular marker to accurately species identity for durio spp from Ternate Island.

Conclussion

Our results indicated that the taxonomical status of local durian (*Durio* spp.) in Ternate island North Maluku base on morphological character and geographical factor can be grouped species *Durio zibethinus* Murr. Local durian Ternate have distribution pattern spread in lowland. This study shows that the durian pondak (T17) is the ancestor of the local durian from Ternate. Durian Afo (T22) and durian Moya (T23) are local durians from Ternate which have the highest similarity of morphological characteristic. These three local durians are the native durian from Ternate.

Acknowledgement

The authors thank to the Directorate of Higher Education, Ministry of Research Technology and Higher Education of the Republic Indonesia that has funded this research. Furthermore, author would like to thank for: Qomarudin, M. Si for technical asistance ArcGis research in the laboratory and Ismat Ishak, S. Pd for collection samples.

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Received: August 04, 2019
Accepted: November 24, 2019