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Short Communications

Morpho-Ecotype Characterization of Superior Local Durian (*Durio zibethinus* L.) in Jember Regency

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ABSTRACT
Panti and Sumberjambe Districts are known as durian centre in Jember Regency, it is necessary to characterise the main potential superior durian trees. The exploratory investigation was carried out between April - July 2023. Morphological characterisation and Ecological observations including topography, soil type and climate were carried out. Data were analysed in clusters and descriptively. The results showed that 10 local durian accessions from Panti District had 66% similarity. The highest similarity between Montong Belanda and Gendon durians (75%). Ten local durians from Sumberjambe showed 64% similarity. Si Sukun differed significantly, whereas LK 1 and LK 4 shared 85% similarity.

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Indonesia is one of the centres of durian diversity in the world (Belgis et al. 2016). Durian is known as the King of Fruit, an exotic tropical fruit with a unique taste and aroma. Durian fruit production in 2021 will reach 1.35 million tonnes, including the top five leading fruit commodities after bananas, pineapples, mangoes, and oranges (BPS 2021). East Java Province is one of the largest durians producing regions, with a total production of 276,426 tonnes (24.20%), followed by Central Java, West Java, North Sumatra, and other provinces.

Specific natural conditions in the surrounding of an area could led to the development of a distinctive flora, such as Besuki residential area in East Java that is surrounded by several mountains (Rusmiati et al. 2013). Some of these mountains are Mount Raung, Mount Argopuro, and Mount Ijen. Banyuwangi Regency, located on the slopes of Mount Ijen, has been known as an area with red durian fruit as its superior fruit (Basuki et al. 2022b). Jember Regency is located on the slopes of Mount Raung and Mount Argopuro, where several areas, such as Panti District and Sumberjambe District, are known as durian centres in Jember Regency.

Durian has various morphological characters (Sundari et al. 2015). The diversity of durian shows in the taste, aroma, texture, and colour of the fruit flesh as well as in the shape and size of the fruit (Belgis et al. 2016). Local durians on the slopes of Mount Raung and Mount Argopuro may have distinct advantages, both in morphological characteristics and

the chemical content of the fruit. Until 2019, 104 superior durian varieties had been registered at the Ministry of Agriculture, and there were still many candidates for varieties that had not been registered that had advantages (Directorate General of Horticulture 2019). Determination of superior varieties begins with morphological characterization.

The aim of this study was to explore local durians on the slopes of Mount Argopuro and Mount Raung. The superior potential of the local durians obtained will be characterized by their morphology and ecology. The morphological and ecological characteristics of each type of local durian fruit with superior potential will be an important source of information in the management of local durian fruit plants.

Exploratory research was conducted by survey method to Panti District and Sumberjambe District in Jember Regency, East Java Province, Indonesia. Panti District is on the slopes of Mount Argopuro, while Sumberjambe District is on the slopes of Mount Raung (Figure 1).

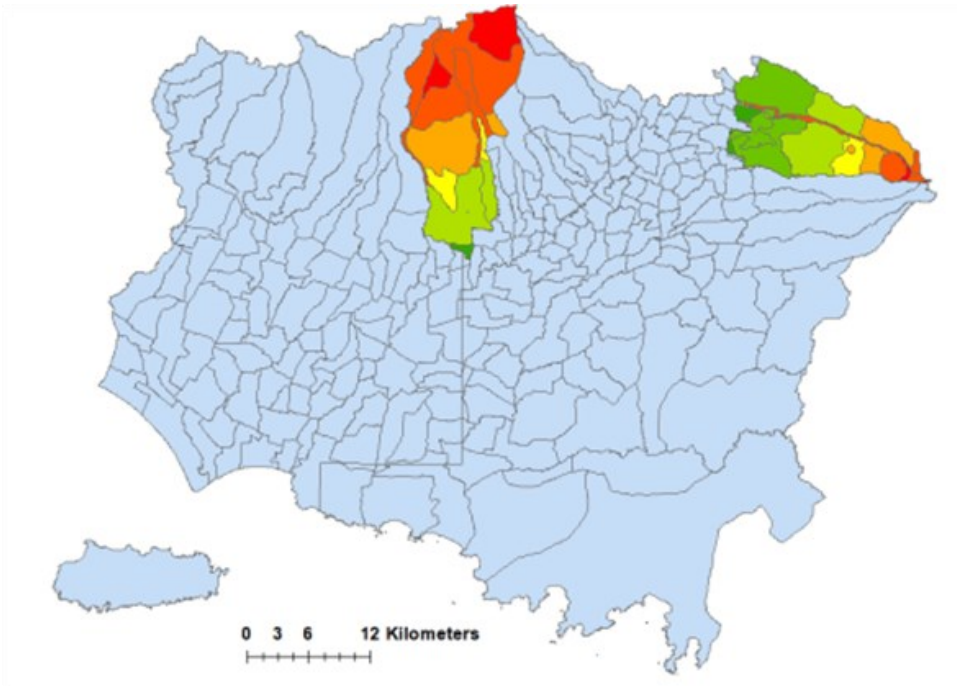

Figure 1. The Study Area of Durian Plants Used in Jember Regency, East Java, Indonesia.

Observation of land characteristics is divided into environment and soil. Observed environmental characteristics include slopes and rainfall. Slopes were analysed using DEM data analysis, while rainfall was analysed from several rainfall stations at the study site. Rainfall is taken from data for the last 10 years. The soil characteristics observed were previously taken from soil samples from the sampling results with a soil depth of 0-30 cm from the soil surface (Mustofa et al. 2024). Parameters observed included pH, C-Organic, total soil Nitrogen, Phosphate available (P_2O_5), Exchangeable potassium and Cation Exchange Capacity (CEC), and soil texture. The soil parameter analysis method is shown in Table 1.

The sampling technique used was purposive sampling. The selected durian trees are over 30 years old and are known for their high productivity and superior fruit quality, as reported by both durian tree owners and local residents. According to Sihaloho et al. (2021), the criteria for selecting durian plants for exploration and characterisation include those that are approximately 25 years old or older, have produced fruit multiple times, and possess desirable qualities that are valued by the communi-

Table 1. Parameters and methods of soil sample analysis.

No	Parameters	Methods	Reference
1	Soil pH	Sample and water ratio (1:5)	Zeraatpisheh et al. 2020; Basuki et al. 2023
2	C-Organic	Walkey & Black	Qureshi et al. 2012
3	Total soil Nitrogen	Kjeldahl	FAO 2021; Putra et al. 2021
4	Phosphate available (P_2O_5)	Olsen	Zhao et al. 2023
5	Exchangeable potassium	NH_4OAc 1 N pH 7	Shah et al. 2022
6	Cation exchange capacity (CEC)	NH_4OAc 1 N pH 7	Basuki et al. 2024
7	Soil Texture	pipette	Basuki et al. 2024

ty. The vegetative parts of the durian plant specifically the trees, branches, and leaves were examined using the Descriptors for Durio guidelines issued by Bioversity International (2007). The Global Positioning System (GPS) was utilized to gather location information. The morphological observations included ten traits of durian trees and eighteen traits of durian leaves. Additionally, ecological observations encompassed soil conditions, topography, and climate at the site. Microclimate data was collected from nearby weather stations.

Data were analysed by cluster using the Gower distance with average linkage program in statistic software. Cluster analysis resulting from morphological observations was also used in the study of Hariyono et al. (2022) to estimate morphological diversity in arrowroot plants resulting from exploration. The F test on statistics software is used to determine the effect of the environment on morphological characters. According to Neter et al. (1985), F test is often used to determine the variance of two groups.

A horticultural plant known as durian is categorized as an annual plant (Hafif 2014). The habitat in which it grows has a significant impact on the taste and fat content. The majority of durian plants are found on the sides of volcanic mountains, and there is a significant association between the appropriateness of the land and that level of suitability (correlation value: > 0.7) (Samsuri et al. 2019; Rahmawaty et al. 2020). There are 181 mountains in East Java that are more than 1,000 meters above sea level, and 7 of the mountains, including Mount Argopura, Mount Raung, Mount Baluran, Mount Ijen, Mount Lemongan, Mount Bromo, and Mount Semeru, are located in a horseshoe-shaped region.

The existence of adjacent mountains, and their environmental characteristics are not the same. In comparison to Mount Argopura, which is 3,088 meters above sea level, Mount Raung is 3,344 meters high (Basuki et al. 2022a). The topographic relief on the slopes of Argopura is topographically dominated by very steep topography (40-60%) with an area of 7,538.68 ha and sloping topography with an area dominating the second (3,759.95 ha) (Figure 2). On the slopes of Mount Argopura, there is 13.53 mm of rainfall each year on average. The research region is defined as having a C climatic type (wet), which has 4-5 dry months and 6-7 wet months, according to the Smith Ferguson climate classification. Mid-May to mid-October are the dry months (Figure 3). The soil formed on the slopes of Mount Argopura is dominated by the Inceptisol, Andisol, and Ultisol orders with seven great soil groups (Figure 4).

Seven reliefs (flat, slightly sloping, sloping, little hills, hilly, extremely steep, and steep) can be found on Mount Raung's slopes (Basuki et al. 2022b). The 5461.68 hectares of Mount Raung's slopes have a topographic gradient of 3–8% (Figure 2). The second dominant relief has an

area of 3884.04 ha and is gradually sloping (8–15%). The average annual rainfall is 2227.98 mm. The slopes of Mount Raung are classified by Smirt-Ferguson as having a mild climate with an average. There are 3–4 dry months and 8–9 wet months per year (Figure 3). The three orders—Andisols, Inceptisols, and Entisols—into which the soil types are subdivided are shown in Figure 4.

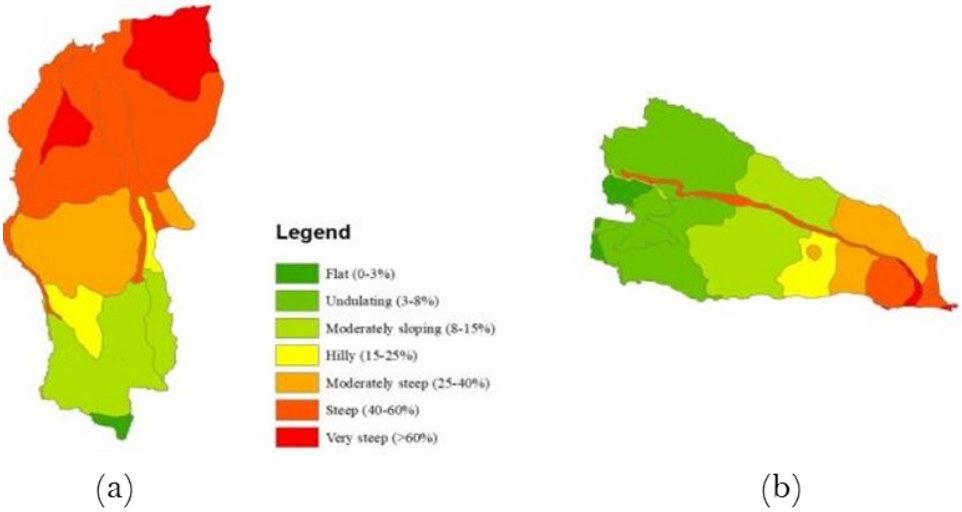

Figure 2. Geological formations (a) the southern slope of Mount Argopura, (b) the western slope of Mount Raung.

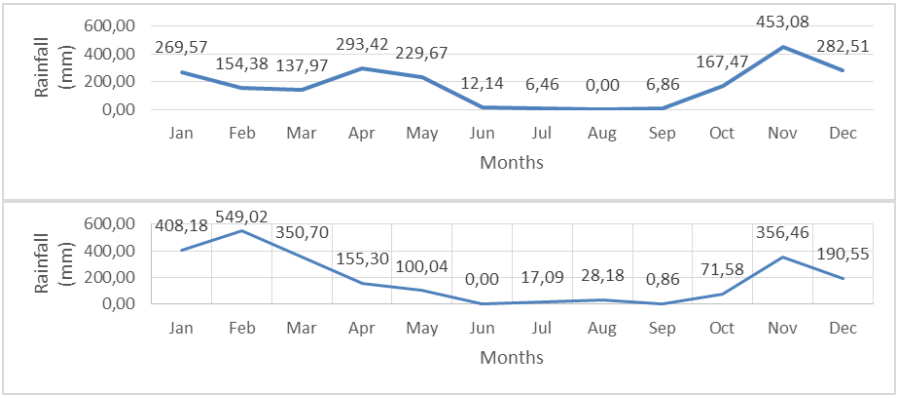

Figure 3. Distribution of annual rainfall on the slopes of Mount Argopura (top) and Mount Raung (bottom).

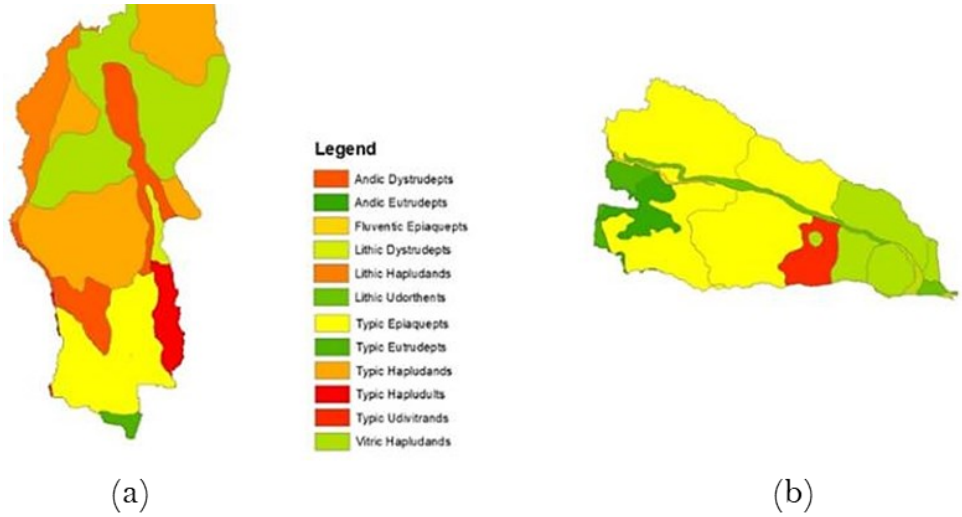

Figure 4. Soil type (a) the southern slope of Mount Argopura, (b) the western slope of Mount Raung.

The five variables that contribute to the formation of soil interact to create the features of soil (Neswati et al. 2019; Szalai et al. 2021; Bölscher et al. 2021). The soil characteristics, both physical and chemical, fluctuate depending on the topographical relief, altitude, rainfall, and type of soil generated at the study location (Table 2). The data in Table 2 demonstrates that the predominant soil texture is clay, which is made up of 20% sand, 40% silt, and 40% clay. The soil's volume weight on Mount Argopuro's slopes ranges from 1.03 to 1.05 g/cm3, with an average of 1.04 g/cm3. The hydrogen potential (pH) of soil is determined by the weathering effects of soil-forming elements (Da Costa et al. 2015; Zhong et al. 2019; Neswati et al. 2019; Alaboz et al. 2021). The results of weathering soil-forming materials result in soils with slightly acidic hydrogen potential (pH) (6.10), very low available phosphate (2.58 ppm), medium category exchangeable cations, particularly potassium (K), (0.42 Me/100g), and high Cation Exchange Capacity (CEC) of 32.38 Me/100g. On the slopes of Mount Argopura, the organic matter produced by the weathering of vegetation organic material is still low (1.94%) and inversely proportional to the total soil nitrogen value, which is moderate (0.28%). With a score of 6.93, the breakdown of organic matter on Mount Argopura's slopes falls into the low category. The amount of soil moisture, the type of litter, the nutrients that support the organic matter, and many other factors affect how quickly organic matter decomposes (Hajduk et al. 2015; Baskan et al. 2016; Wang et al. 2022; Soetriono et al. 2023).

The slopes of Mount Raung have a soil type that is dominated by inceptisol soil with a slightly acidic, pH value of 5.63 (Table 2). Other soil chemical characteristics that are formed, such as P_2O_5 is in the low category (5.05 ppm), potassium exchangeable is low (0.17 Me/100g), and CEC being in the very high category (40.05 Me/100g). The level of decomposition on the slopes of Mount Raung is in the high category with a C/N ratio of 33.3, where the C-Organic value is high (3.33%), and total soil nitrogen is in the low category (0.10%). The Raung slope is seen

Table 2. Soil characteristics of the slopes of Mount Argopuro and the slopes of Mount Raung.

No	Parameter	Unit	Value			
			The slopes of Mount Argopuro		The slopes of Mount Raung	
1	pH 1:5	-	6.10	Slightly acid	5.63	Slightly acid
2	C-Organic	%	1.94	Low	3.33	High
3	N Total	%	0.28	Mid	0.10	Low
4	P_2O_5	Ppm	3.58	Very low	5.06	Low
5	K	Me/100g	0.42	Mid	0.17	Low
6	CEC	Me/100g	32.38	High	40.05	Very high
8	C/N ratio	-	6.93	Low	33.3	Very high
9	BV	g/cm3	1.04	-	1.15	-
10	Texture					
	Sand	%	20	-	10	-
	Silt	%	40	-	50	-
	Clay	%	40	-	40	-
			Clay	-	Silty Clay	-

Note: Soil fertility assessment is based on the technical guidelines for soil water analysis of plant tissue issued by the Soil and Fertilizer Instrument Testing Center 2023.

from the physical characteristics of the soil, it is included in the silty clay soil texture category. Silty clay is a soil texture composed of 10% sand, 50% silt, and 40% clay, so the volume weight is 1.15 g/cm^3.

The soil texture of the Mount Argopuro and Raung slopes contains clay, and silt and sand in equal proportions. According to Karim et al (2017), this soil texture is very suitable for durian plants. Soil pH from both locations is slightly acidic. According to Mansur (2007), the durian habitat studied also has a clay type with a slightly acidic pH.

The level of land suitability for durian plants on the slopes of Mount Argopura and the slopes of Mount Raung is in the moderately suitable class (S2) with available nutrient barrier factors. The limiting factor for durian plants on the slopes of Mount Argopura is the availability of phosphate nutrients. Phosphate nutrients on the slopes of Mount Argopura are in the low category. Thus, to increase them to highly suitable (S1), fertilization is needed in the amount of 1-2 kg/plant/year. Meanwhile, for durian plants on the slopes of Mount Raung, the level of land suitability is classified as moderately suitable (S2) with the limiting factors for available nutrients, including total soil nitrogen, available phosphate, and available potassium. Therefore, management requires balanced fertilization for these primary macronutrients.

Based on Figure 5, the morphological similarity of the 10 local durian varieties from Slope Mount Argopuro is 66%, or the level of dissimilarity is 34%. This indicates the great level of local durian diversity observed in Panti District on the slopes of Mount Argopuro. Two major groups were established from the dendogram analysis's findings: group I, which included eight varieties of durian, and group II, which included two varieties, Gendon and Montong Belanda (MB). In line with the research results of Mustikarini et al. (2017), the results of exploration and characterization of durian on South Bangka Island, from 27 accessions formed 5 clusters with a similarity level of 60%.

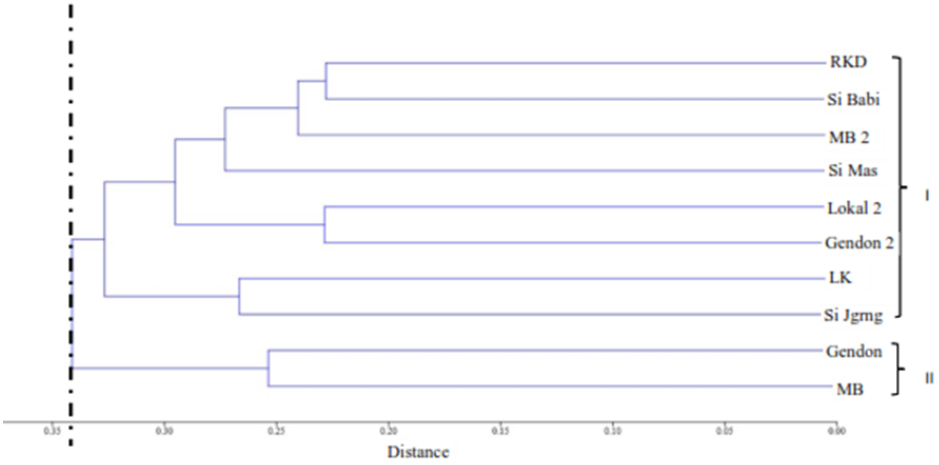

Figure 5. Dendogram of local durian plants from the slopes of Mount Argopuro.

Group I was made up of eight durian accessions that came from two distinct but nearby locales. The genotypes from the same region are not always in the same group, indicating that genotypes from various regions might also be in the same group (Susilawati & Sabran 2018; Sari et al. 2024). Meanwhile, in group II, the two local durian accessions had many morphological similarities compared to the other 8 types, and were in the same location, namely in Pakis Village. The degree of kinship depends on the degree of morphological similarity (Susilawati & Sabran 2018).

Local durians on the slopes of Mount Raung have a variety that is not too different from durians from the slopes of Mount ArgopuroMeanwhile, local durians in the District of Sumberjambe Slopes of Mount Raung shows high diversity. The dissimilarity of the 10 accessions based on the dendrogram formed was 36% or 64% similarity (Figure 6).

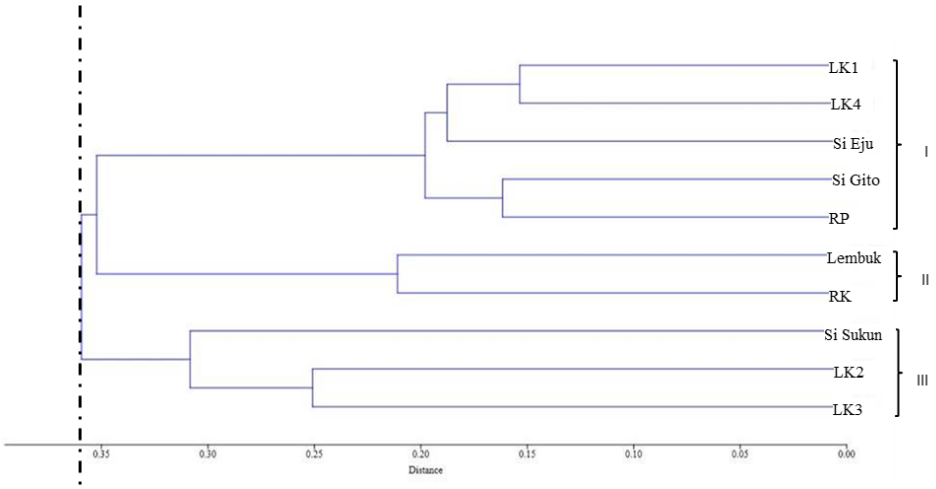

Figure 6. Dendogram of local durian plants from the slopes of Mount Raung.

Three major groups were established from the dendogram: group I, which included five varieties of durian, group II, which included two varieties (Lembuk and RK), and group III included three varieties (Si Sukun, LK 2, LK 3). According to Hu et al. (2014) and Pereira et al. (2015), the genetic diversity of a species in a population is a consequence of its sexual reproduction system. Handayani (2016) added that durian from Kalimantan has high genetic diversity because durian is a cross-pollinated and open plant that originates from random mating between other genotypes.

Seven quantitative morphological characteristics were observed, including stems, branches, and leaves. Among these, the height of the durian plant tended to vary depending on the ecotype, while the other six did not differ significantly (Table 3). Numerous genes regulate quantitative character. The growth characteristic of plant height is affected by numerous genes as well as environmental factors. The environment has a significant impact on how plants grow. In line with the findings of a study by Handayani and Ismadi (2018), which revealed variations in plant height between durian accessions in two separate sub-districts in the North Aceh District. Different planting timings and environmental factors like sunlight and soil qualities might contribute to variations in plant height. Yang et al. (2021) states beyond genetic effects, plant height is also influenced considerably by environmental conditions. Furthermore, Yang et al. (2021) describes that both agro-meteorological and soil properties influence plant height traits, but the agro-meteorological factors largely predominate.

Variations in the degree of similarity or dissimilarity caused by variations in the morphology of plants, including qualitative and quantita-

Table 3. F test on the morphological quantitative characters of local durian in 2 ecotypes in Jember Regency.

Quantitative Morphological Character	LHD	PHD	LTD	PTD	LB	TB	UT
F test	ns	ns	ns	ns	ns	*	ns

Notes: LHD: width of leaf blade; PHD: blade length; LTD: petiole width; PTD: petiole length; LB: leaf width; TB: stem height; UT: plant age; *: significantly different on the F test 0.05; ns: not significantly different.

tive characteristics, which are regulated by genetics and the environment. Plants require specific conditions in order to express their genetic potential (Handayani & Ismadi 2018). Weaknesses of morphological markers are affected by plant growth and environmental changes. It can be difficult to differentiate between genotypes since their morphology is similar even though they are distinct. Besides, due to self-incompatibility, durian plants have a high level of variety and undergo a significant amount of cross-pollination (Indriyani et al. 2012). Plant breeding activities are greatly enhanced by the availability of genetic resources (Lestari et al. 2016). This information on morphological variation may serve as the basis for future development and preservation.

The degree of similarity among the ten prospective superior local durians from Panti District, on the slopes of Mount Argopuro, is 66%, which is not significantly different from the level of similarity among the local durians from Sumberjambe, on the slopes of Mount Raung, at 64%. The most similar durians were Montong Belanda and Gendon from Panti District (75%), while those from Sumberjambe were closest to LK 1 and LK 4 durians (85%).

AUTHORS CONTRIBUTION

V.K.S. designed the research and supervised all the process, H.S. tabulated and analyzed the data morphology and wrote the interpretation, B. analysed the data of ecology and designed the maps.

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CONFLICT OF INTEREST

The authors declare no conflict of interest.

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