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Morphological Characteristics of Batuah Red-Fleshed Durian (*Durio graveolens)*, an Endemic Exotic Plant from East Kalimantan, Indonesia

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ABSTRACT

Kalimantan Island is rich in genetic resources and species diversity of *Durio* spp. plant. The large number of Durio species that grow in Kalimantan illustrates that this area is the most important distribution center for durian relatives. The best-known edible durians are Durian (*Durio zibethinus*). However, Kalimantan also has various types of Durian that are not yet widely known and have superior potential. One of the unique and exotic plants is the red flesh Durian in East Kalimantan, Indonesia. The fruit of this plant is unique because it has red flesh. At present, there is no morphological identification of this East Kalimantan *Durio graveolens* plant. The study aimed to identify the morphological character of Batuah *D. graveolens* from East Kalimantan, Indonesia. This research was carried out by collecting data and information about the morphological characteristics of the plant and fruits. The results of the study successfully identified Batuah *D. graveolens* from East Kalimantan as a plant diverts from another *Durio* spp. plant known like *D. zibethinus* and *D. kutejensis* especially for red flesh character.

1. INTRODUCTION

Kalimantan is the largest island in Indonesia, with high level of biodiversity in the world. Kalimantan, especially East Kalimantan, is a place of mega biodiversity with humid tropical forest climate conditions (Debnath, et al., 2014; Ercisli & Sagbas, 2017). The humid tropical climate is a climate with humidity above 90%, high rainfall (more than 1500 mm/year), annual temperature above 18^{o}C, and the difference between the rainy season and the dry season is not very clear (Poepenoe, 1974). One of the rich diversity that exists is the presence of various types of tropical fruits, most of which are endemic to East Kalimantan. Indonesia is one of the eight centers of plant genetic diversity in the world, especially for tropical fruits such as durian (Biodiversity International, 2007; Brown, 1997). At present, it is recorded that of around 27 species of Durio worldwide, 18 of them are grown in Kalimantan, 11 are in Malaya, and seven are in Sumatra (Milow, et al., 2014). The great diversity of species and sources of germplasm *Durio* spp. in Indonesia is very important as basic capital for breeders (Poerwanto, 2003; Ryugo, 1988; Chakravarty, et al., 2016).

The high number of Durio species that grow in Kalimantan illustrates that this area is the most important distribution centre for durian relatives. In addition to being rich in durian diversity, Indonesia is also rich in the diversity of sources of germplasm from *Durio* spp. In Indonesia, there are quite a lot of durian cultivars that differ from one another in taste, aroma, and color of the flesh. Even durian seeds can be found without seeds. From plant breeding, it is expected that superior seeds will be obtained both in quality and fruit production. This rich diversity of species and germplasm has not been utilized optimally. Therefore, plant breeding in durian relatives (*Durio* spp.) in Indonesia needs to produce superior cultivars/seeds (The Indonesian Ministry of Agriculture, 2011). This can be done by collecting data and information about the rich diversity of species and sources of germplasm *Durio* spp. in Indonesia (Belgis, et al., 2015). The next step is select the types of sources of germplasm that have more value. With the availability of diversity in germplasm types or sources, the desired superior cultivars/seeds will be assembled. To be able to determine the type of plants to be planted, it must be known the characteristics of these plant types, especially

in relation to climate, soil, and growth velocity factors (Marschner, 1995; Bernier, et al., 2018; Sundari, 2015). Plants with the cross-pollination mechanism as well as the genus *Durio* spp. derived from natural crosses in nature is very difficult to obtain with potentially superior character (Chakravarty, et al., 2016). Therefore it is important to do a morphological identification activities and documentation of potential superior commodities in East Kalimantan.

Kutai Kertanegara Regency has many kinds of durian trees that have been traditionally and conventionally planted for a long time, and this has caused many interesting nature modifications of the *Durio* spp. plant character to be studied and do scientifically identified. *Durio graveolens* is one of durian species found in East Kalimantan. It has a unique size and good taste. This study aims to find, identify, and initially characterize of Batuah *D. graveolens* in Kutai Kertanegara district, East Kalimantan, Indonesia, as potentially superior endemic fruit plants

2. MATERIALS AND METHODS

Observations were carried out on productive crops, having produced more than three times, and productive. Identification was done by used survey method and in-depth interview to the owner of plants and farmers, as well as related stakeholders to explore the potential of *D. graveolens* fruit crops, and then made the characterization of durian plants. The experiment was conducted in Kutai Kertanegara, East Kalimantan, Indonesia, Agronomy Laboratory, Faculty of Agriculture, Universitas Mulawarman, Samarinda, East Kalimantan Province, Indonesia, from January to September 2019. Research was conducted used International Plant Genetic Resources Institute (IPGRI) morphological characteristics.

2.1 Statistical Data Analysis

This research was conducted by using a descriptive method of exploration. Sampling methods with purposive sampling, by tracing the primary data and secondary data from the informer, either directly from the key person(s) and library data.

3. RESULTS AND DISCUSSIONS

3.1 The Origin of *D. graveolens*

Kalimantan Island is one of the centres of diversity of durian plants (*Durio* spp.). Generally, durian trees in Kalimantan are grow wildly in primary or mixed forests, and residents in gardens have planted only a small portion. Type *D. zibethinus* Murray (durian) can be found around Indonesia and another country nearby. This type of durian habitat is in primary and secondary forests and can grow on various types of soil. This type of durian is widely cultivated by people in Kalimantan, including in East Kalimantan (Uji, 2005), although it has not used optimal cultivation technology.

The potential to find new various types of durian in Kalimantan is very large. Kurniadinata et. al (2019) success identifying six new potential superior plants varieties from natural cross breading of durian and lai plants which are endemic plants in Kalimantan. *D. graveolens* is a relative of durian, which is also an endemic plant in Kalimantan. This species has different fruit morphological characters from durian plants, especially for the flesh colour. Its tree is almost the same as *D. zibethinus*, but the leaves are wider than other durians. Trunk surface is rough, growth straight, with irregular crown shape and branching density medium to dense. The colour of its skin fruit is an orange yellow to orange, and the spines are dense, short, and sharp. The flesh of is drier than the other types of durian, with red, dark colour and strong aroma. The existence of various genera of *Durio* spp. in the forests of Kalimantan makes it possible for plants with distinctive character, especially *D. graveolens* in East Kalimantan.

Figure 1. The appearance of *D. graveolens* tress surrounded by other trees

3.2 Morphological Characteristics of *D. graveolens*

Observations were made in the production phase of *D. graveolens* plants that grow in Kutai Kertanegara, East Kalimantan. Based on observations of the morphological characteristics, there is diversity in the morphological characteristics of trees, leaves, flowers, fruits, and seeds. This species has an irregular crown shape with a tree height of approximately 10-15 meters (Figure 1). The stems are rough and grow straight, grey stems with a diameter of approximately 50 cm.

Figure 2. The appearance of *D. graveolans* fruit

The fruit colour is orange yellow to orange with bright intensity (Figure 2). Its fruit length is 10-13 cm with a diameter of 9-10 cm. The fruit consists of 5 segments, with aryl thickness in a medium to thick scale. It has red flesh with a slight sweet taste and soft texture. *D. graveolens* from East Kalimantan also has dark red flesh colour, with flesh thickness are medium with soft texture (Figure 3). Flesh is non-juicy with fair creaminess and has a strong aroma/odour. The unique odour of this *D. graveolens* is different compared to *D. zibenthinus* odour.

Figure 3. The segment and fleshes of *D. graveolens*

Each segment only has one flesh with seed and the seed length around 4.5-5 cm, with ellipsoid shape and dark brown colour. Some fruits only have 3 or 4 arils and seed each fruit because of some seed and aril, not growth in the rest of the segment (Figure 4).

Figure 4. The appearance of fruits, segment, flesh, and the seed of *D. graveolens*

Morphological characteristics of *D. graveolens* were presented in Table 1. Based on plant and fruit morphology characteristics, *D. graveolens* fruit from East Kalimantan has unique flesh color, different taste, and also different aroma if compared with D. zibethinus. The flesh color becomes the most unique character compare to other Durio spp plants, and it will become one of the advantages of this durian. Aside from being an exotic commodity, it is also a source of genetic diversity from Kalimantan, Indonesia, to develop another superior durian. Therefore, *D. graveolens* has a high potential economic value to be improved as superior commodities from East Kalimantan Province, Indonesia.

CONCLUSION

Batuah *Durio graveolens* fruit is a unique plant that differs from the other species of *Durio* spp. It has a red, dark color flesh, unique and strong aroma with soft texture aril. Therefore, Batuah Durio graveolens has a high potential economic value to be improved as Superior Commodities from East Kalimantan Province, Indonesia.

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Appendix

Table 1. Characteristics of *D. graveolens*

Characteristics of *Durio graveolens*	
Trunk Surface	: Rought
Trunk Growth habit	: Straight
Crown Shape	: Irregular
Tree Growth Habit	: intermediate
Branching density	: medium to dense
Bark Colour	: Grey
leaf upper color	: Green
leaf lower color	: Copperry Brown
Leaf density	: medium
Arrangement of leaves	: Alternate
leaf attitude	: Drooping at 45
Petiole length (mm)	: 20-25
Petiole Width (mm)	: 5-6
leaf lenght(cm)	: 24-27
leaf blade length	: long to very long
leaf width (cm)	: 8-10
leaf blade width	: wide to very wide
Leaf blade shape	: Obovate-lanceolate
Leaf apec shape	: Long Acuminate to Caudate
Leaf base shape	: Round to Obtuse
Leaf Blade Margin	: Entire
Leaf Texture	: Papery
Leaf Upper Surface Glossiness	: Glossy
Leaf Lower Surface Glossiness	: Not Glossy
Leaf Midrib Appearance	: Slightly Prominent
Waxiness on Adaxial Leaf Surface	: Shiny
Position of Infloresc	: Axillary
Flowering Regularity	: Regular
Flower Clustering Habit	: One flower per cluster
Density of Flowers	: Sparse
Flower Bud Shape	: Globose
Flower Bud Apex Shape	: Rounded
Apical Bud Color	: Greenish
Calyx Shape	: Campanulate
Calyx Tooth Apex Shape	: Pointed
Number of Sepal	: 5
Sepal Color	: Light Yellow
Flower Size	: large
Pedicel length (cm)	: 3-5
Number of Petals	: 5

Petal color	: Yellow
Petal color intensity	: Light
Petal margin color	: Green
Petal shape	: Spathulate
inner surface hairiness of petal	: Glabrous
outer surface hairiness of petal	: Glabrous
Type of Stamen	: Phalanx
stamen exsertion relative to stigma	: Short
Anther number	: 43-50
Anther shape	: Reniform
Anther dehiscence	: Longitudinal
Style length (cm)	: 5-6
Style shape	: Straight
hairiness on style	: Basal
Stigma shape	: Capitate, 5-lobed
Stigma color	: Yellow
Stigma color intensity	: light
Upper surface of stigma	: smooth
Fruit ripening	: Non-synchronous
Fruit dehiscene	: Yes
Fruit bearing habit	: Biennial (alternate years)
Fruit clustering habit	: One fruit per cluster
Fruit Rind Thickness (cm)	: 0.8-1.2
Fruit Spine length	: short
Fruits shape	: Globose
Shape of fruit apex	: Pointed to Convex
Shape of fruit base	: Convex
Blossom end	: small
Fruit stalk length	: short
Fruit stalk attachment	: strong
Fruit stalk color	: Brown
Fruit spininess	: Spiny
fruit spine shape	: Conical
Surface of spine	: Glabrous
Fruit spine density	: dense
Fruit spine length	: short
Fruit length [cm]	: 10-13
Fruit diameter [cm]	: 9-10
Fruit rind thickness	: Medium to thick
Number of fruit segments/ locules	: 5
Fruit skin/rind color	: Orange Yellow to Orange
Fruit skin/rind color intensity	: Light
Shelf life [d]	: 2-4

Aril thickness	: medium
Aril texture	: soft
Aril juiciness	: Non-juicy
Presence of fiber	: Low
Flesh creaminess	: Fair
Flesh taste	: Slightly sweet
Flesh aroma	: Strong
Flesh color	: Red
Flesh color intensity	: Dark
Number of rows of pulp units per locule	: Single row
Number of carpels per fruit	: 5
Persistence of calyx	: Yes
Persistence of stamen	: Yes
Easiness of splitting	: Easy
Flesh stickiness	: Slightly sticky
seed length (cm)	: 4.5-5
seed width (cm)	: 2.5-3
Seed shape	: Ellipsoid
Seed coat color	: Brown
Seed coat color intensity	: Dark

Source: Bioversity International (formerly International Plant Genetic Resources Institute (IPGRI), 2007.