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Research Article

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The diversity of banana cultivars in East Kalimantan based on morphological characteristic

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ABSTRACT

Banana is a plant with nutritious fruit and can help prevent stunting. Banana plants are widely cultivated in East Kalimantan, but the type characterization has not been identified. The purpose of this study was to determine the diversity of banana plants in East Kalimantan and to characterize banana plants based on morphology. This research is explorative in nature by identifying directly in the field the cultivated banana cultivars. Morphological characterization of stems, leaves and fruit was carried out based on the banana description contained in IPGRI-INIBAP/CIRAD. The research instrument is a banana morphology observation sheet which contains parameters: leaf habit, pseudostem color, predominant underlying color of the pseudostem, sap color, blotches at the petiole base, blotches color, petiole canal leaf III, color of leaf upper surface, color of midrib dorsal surface, color of leaf lower surface, color of midrib ventral surface, wax on leaves. The result shows that at East Kalimantan is found 12 types of banana cultivars were found, Talas bananas, Rutai bananas, Kepok bananas, Mas bananas, Morosebo bananas, Tanduk bananas, Susu bananas, Maulin bananas, Red bananas, Ambon bananas, Raja bananas, and Cavendish bananas.There are variations in the morphological characteristics of banana plants, leaves and fruit that can characterize each banana.

Keywords: Banana; diversity; morphological characterization

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INTRODUCTION

Banana (Musa sp.) belongs to the Musacease family and the genus Musa (Rizal & Triwidyawati, 2015). Bananas are a common plant. Bananas are also an easy plant to cultivate. This ability is related to its ability to grow and develop in various agroecological conditions (Rahmawati & Hayati, 2013) Indonesia is a tropical country that has very good environmental conditions for cultivating bananas, including one of its provinces, East Kalimantan. Which has the character of acid soil, varied organic matter, as well as the value of cation exchange capacity, exchangeable bases, base saturation, nutrient reserves, and low P and K nutrient status, but high aluminum (Al) saturation (Nata Suharta, 2010).

East Kalimantan is one of the banana-producing provinces which in 2020 produced 95528 tons of bananas based on Central Bureau of Statistics. This amount was produced by all regions in the East Kalimantan region. Banana production as well as banana collection in East Kalimantan are in scattered places. Further research on banana exploration needs to be carried out so that an inventory and preservation of banana germplasm in East Kalimantan can be carried out. Furthermore, this effort was made to support the banana plant breeding program. The diversity of banana plant populations is very necessary in the preparation of breeding strategies in order to achieve efficient improvement of banana varieties in the future (Ambarita et al., 2016).

Exploration through characterization activities on banana plants was carried out to determine the morphological and agronomic properties of the plant, as well as to eliminate duplication in the germplasm collection. Banana plants have high diversity, so the possibility of problems with the same name, but different genomes or vice versa is very likely to occur. Thus, it is also intended to avoid duplication of banana germplasm collection. The description that is owned can be a collection for the agricultural sector and can also be a reference for those who need it (Sihotang & Waluyo, 2021). Previous research related to this is observing the morphology of cultivar bananas and wild bananas, including Talas/Sunking, Rutai, Tanduk, Ambon, Liar/Monkey, and Klutuk (Sunaryo & Mulyadi, 2019). Based on the results of interviews with the community, there are more types of bananas, especially those that are cultivated. Therefore, further characterization is necessary.

The diversity of bananas is important because it relates to the benefits of the banana plant itself. The community utilizes almost all parts of the banana plant, including fruit, leaves, pseudostem and tepal compounds. The most common use is bananas for consumption. Bananas are one of the most consumed fruits in Indonesia (Pangestika & Srimiati, 2021). Bananas have good nutrition as a healthy daily diet. Consumption of nutritious food for pregnant women and toddlers can reduce the risk of stunting (Ningrum et al., 2020). Consumption of bananas directly or processed and combined with other types of food as additional food is useful for fulfilling nutrition for toddlers to prevent stunting. Bananas are also one type of food that can be mixed with other types of food ingredients, such as corn and soybeans which are recommended for therapeutic food for children with malnutrition (Yazew, 2022).

Bananas are a good source of K, Cu, Mg, and Mn in the diet, but do not supply much such as vitamin C or vitamin A (Fahrasmane et al., 2014). Other studies have shown that there are differences in the content of water, ash, carbohydrates, protein, fat, total sugar, vitamin C, potassium and energy in different types of bananas (Hapsari & Lestari, 2016). This fact further reinforces the need for exploration of various banana cultivars in the East Kalimantan region, as part of the effort to inventory and conserve germplasm, further to be able to provide suggestions for the types of bananas that are good for consumption in order to fulfill nutrition, especially preventing stunting.

RESEARCH METHODS

The research was conducted by descriptive method. Determination of the sample using a non-probability sampling design with purposive sampling method, by selecting certain individuals because they are considered to meet the criteria. The population of this study were all bananas found in East Kalimantan with samples in the form of banana trees found in banana plantations in the selected cities and districts. This research is exploratory in nature by identifying directly in the field the cultivated banana cultivars. The research was conducted from September to November 2021. The sampling locations were Kutai Kartanegara Regency, East Kutai Regency, West Kutai Regency, Paser Regency, Bontang City, Penajam Paser Utara Regency and Samarinda City. The material used is the whole banana plant and the tools used are writing instruments, machetes, poles, tape measurements and cameras. Morphological characterization of stems and leaves was carried out based on the banana description contained in International Plant Genetic Resources Institute- International network for the Improvement of Banana and Plantain/ Center de Cooperation Internationale Pour le Development (IPGRI-INIBAP/CIRAD, 1996). The research instrument is a banana morphology observation sheet which contains parameters: leaf habit, pseudostem color, predominant underlying color of the pseudostem, sap color, blotches at the petiole base, blotches color, petiole canal leaf III, color of leaf upper surface, color of midrib dorsal surface, color of leaf lower surface, color of midrib ventral surface, wax on leaves. The results of the study in the form of data exposure were analyzed based on the similarity of their characteristics to the characteristics contained in the Banana Description book (Poerba et al., 2018) and also supporting research journals.

FINDING AND DISCUSSION

The results showed that twelve kinds of banana peel were found in East Kalimantan. Each cultivar has specific characteristics. There are 10 banana cultivars commonly found in Indonesia and there is 1 banana cultivar native to Kalimantan, namely the Talas banana (Razie & Nisa, 2016) and the Rutai banana (Sunaryo & Mulyadi, 2019). The morphological characters presented in this study include leaf habit, pseudostem color, predominant underlying color of the pseudostem, sap color, blotches at the petiole base, blotches color, petiole canal leaf III, color of midrib dorsal surface, color of midrib ventral surface , color of leaf upper surface, color of leaf lower surface, wax on leaves (Table 1 & Table 2)

The character of Leaf Habit consists of 3 types, namely Drooping, Intermediete and Erect. Leaf Habit with a type of drooping among them is Red and Raja Banana. Leaf Habit with an intermediete type is a character from Ambon, Susu, Kepok, Morosebo and Talas Banana. While Leaf Habit Type of erect is found by Mas, Cavendish, Tanduk, Rutai, and Maulin Banana. These results support research (Sunaryo & Mulyadi, 2019) which shows that Talas, Tanduk and Ambon have a leaf of intermediete type habit, while the Rutai banana has an erect type. As well as research (Kurnianingsih et al., 2018) which shows that the Susu and Raja banana has intermediete type of leaf habi.

Psudostem Color has variations ranging from green to red. Bananas that have green pseudostem colors Are Mas, Cavendish, Ambon, and Kepok banana. The color of the green-red pseudostem is owned by Red, Talas, and Susu Banana (Figure 1). The color of the red pseudostem is found by Raja and Maulin Banana. As for bananas with the colors of pseudostem which are specific including Tanduk banana have a color of the Green medium, Morosebo banana has green-yellow colors, Red bananas have red. Predominant underlying Color of the Pseudostem also varies from green to purple red. Color variations in Pseudostem because there is a difference in the number of color pigments contained in each plant and

the color pigment involved is anthocyanin (Deng et al., 2021). The color difference in the pseudostem is produced from differences in cell regulations in expressing anthocyanin producing genes.

Pseudostem in banana plants also has phytochemical content, in addition to the existence of anthocyanin color pigment. The Phytochemical Compositions of Pseudostem are Oxalates, Tannins, Hydrocyanic Acid, Phytates, flavonoidsalkaloids, Saponins, and Steroids. Some of the Phytochemicals Served As the Protectants for The Pseudostem and Some Were Useful During The Growth Period of the Plants. The Mineral Elements Detected Were, K, Fe, Mg, P, Zn, Cu, Na, CA, and CD. This component is obtained through the Arbsorbsi process from the soil and several components are essential to growth processes in banana plants (Akpabio et al., 2012).

Table 1. Morphological Characterization of Bananas in East Kalimantan

Name of Banana	Red Banana	Mas Banana	Cavendish Banana	Raja Banana	Morosebo Banana	Tanduk Banana	Talas Banana
Leaf Habit	Drooping	Erect	Erect	Drooping	Intermediete	Erect	Intermediete
Pseudostem colour	Green-Red	Green	Green	Red	Green-yellow	Medium green	Green-red
Predominant underlying colour of the pseudostem	Red-purple	Light Green	Light Green	Pink-purple	Pink	Green yellowish	Green
Sap colour	Red-purple	Watery	Watery	Milky	Watery	Watery	Red-purple
Blotches at the petiole base	Small blotches	Large blotches	Small blotches	Sparse blotches	Small blotches	Sparse blotches	Small blotches
Blotches colour	Dark brown	Brown-black	Dark brown	Black	Brown	Dark brown	Brown-black
Petiole canal leaf III	Wide with erect margins	Wide with erect margins	Open with margins spreading	Margins curved inward	Open with margins spreading	Margins curved inward	Straight with erect margins
Colour of leaf upper surface	Green	Dark Green	Dark Green	Green	Dark Green	Dark Green	Dark Green
Colour of midrib dorsal surface	Red-green	Green	Green	Green	Green	Light green	Green
Colour of leaf lower surface	Medium green	Green	Green	Green-yellow	Green	Medium Green	Medium Green
Colour of midrib ventral surface	Pink-purple	Yellow	Green	Light green	Light green	Green-yellow	Green-yellow
Wax on leaves	Few wax	Very little or no visible sign of wax	Very little or no visible sign of wax	Moderately waxy	Very waxy	Few wax	Moderately waxy

Table 2. Morphological Characterization of Bananas in East Kalimantan

Name of Banana	Maulin Banana	Ambon Banana
Leaf Habit	Erect	Intermediete
Pseudostem colour	Red	Green
Predominant underlying colour of the pseudostem	Pink-purple	Green
Sap colour	Milky	Red-purple
Blotches at the petiole base	Sparse blotches	Sparse blotches
Blotches colour	Dark brown	Dark brown
Petiole canal leaf III	Wide with erect margins	Straight with erect margins
Colour of leaf upper surface	Green	Dark Green
Colour of midrib dorsal surface	Green	Green
Colour of leaf lower surface	Medium Green	Dark Green

Name of Banana	Maulin Banana	Ambon Banana
Colour of midrib ventral surface	Green-yellow	Yellow
Wax on leaves	Very little or no visible sign of wax	Moderately waxy

Sap color consists of three kinds, namely watery, milky and red-purple. Banana plants that have a watery color sap are Mas, Cavendish, Morosebo, Tanduk and Rutai banana (Figure 2). The milky type is owned by Raja, Maulin, Susu and Kepok banana, while red-purple sap color is owned by Red, Talas, and Ambon banana. Pseudostem sap contains lignin, carbohydrates, tannin and alpha cellulose (Barhanpurkar et al., 2015).

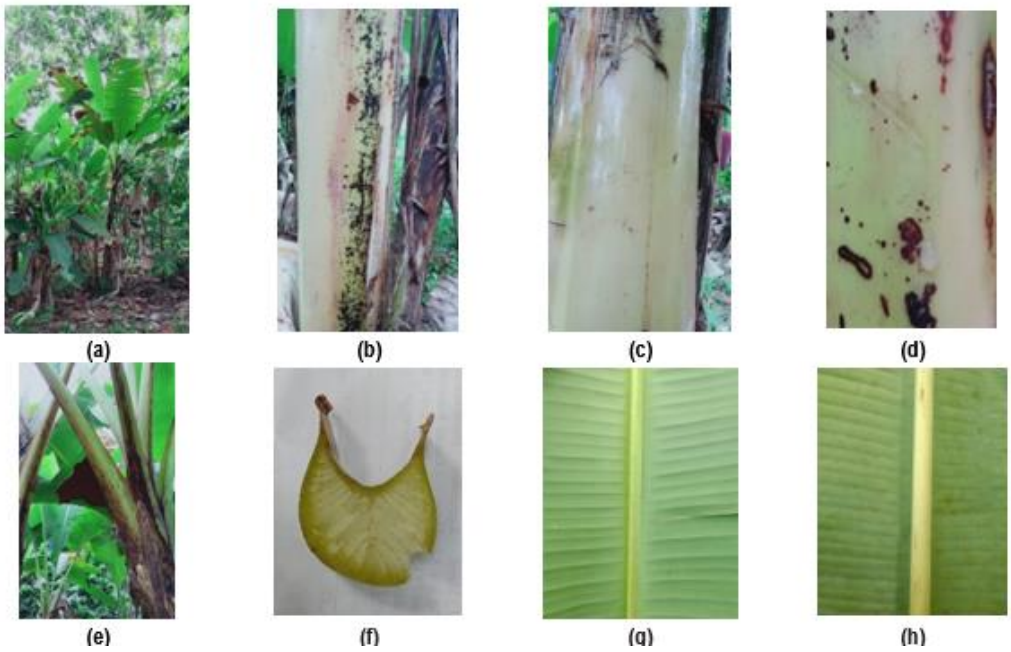

Figure 1. Morphological characteristics of Talas Banana: (a) Talas Banana Plant, (b) Pseudostem colour, (c) Predominant underlying colour of the pseudostem, (d) Sap colour, (e) Blotches at the petiole base, (f) Petiole canal leaf III, (g) Colour of leaf upper surface, (h) Colour of leaf lower surface. (Source: Research Documentation, 2021)

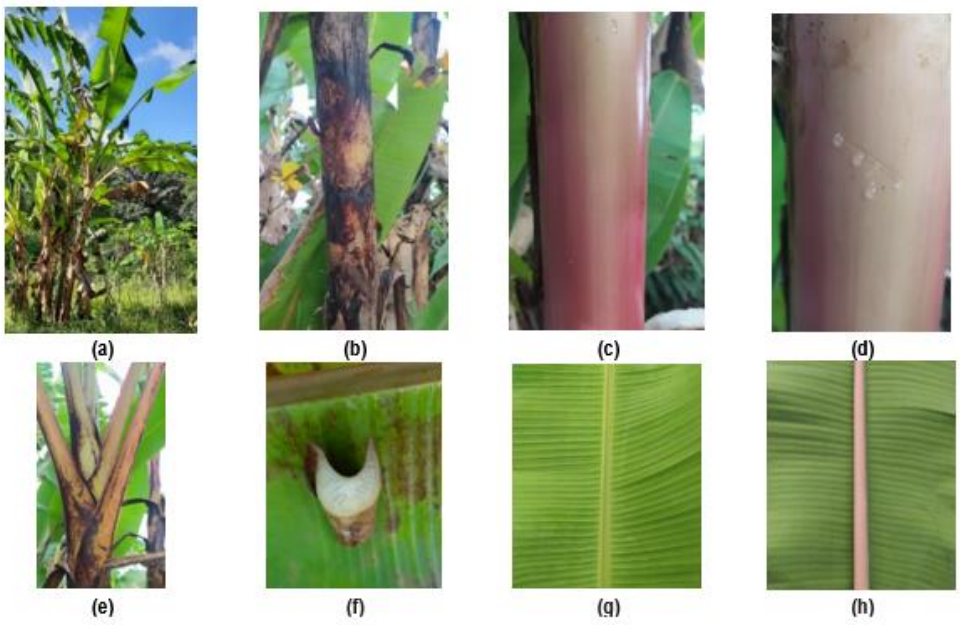

Figure 2. Morphological characteristics of Rutai Banana: (a) Rutai Banana Plant, (b) Pseudostem colour, (c) Predominant underlying colour of the pseudostem, (d) Sap colour, (e) Blotches at the petiole base, (f) Petiole canal leaf III, (g) Colour of leaf upper surface, (h) Colour of leaf lower surface. (Source: Research Documentation, 2021)

The color of the sap can be influenced by the phytochemical components of the sap itself or due to the influence of environmental pH. The sap liquid will be colorless if it is at an acidic pH and khaki if it is at an alkaline pH (Basak et al., 2015). Five types of blotches at the petiole base were found, namely small blotch, large blotch, sparse blotch, extensive pigmentation and without pigmentation. The color blotches found were brown, dark brown, and brown-black. Red banana, Cavendish, and Susu banana have the characteristics of small blotches with dark bown color. Tanduk and Maulin bananas have the type of sparse blotches with dark brown color. Several types of bananas have special characteristics, including the Mas banana which has large blotches with brown-black color, the Raja banana which has sparse clotches with brown color, and the Morosebo banana which has small blotches with brown-black color.

The morphology of the petiole canal leaf III found included wide with erect margins, open with spreading margins, inward curved margins, and straight with erect margins. Red, Mas, and Maulin have petiole canal leaf III wide with erect margin. Cavendish and Morosebo bananas have petiole canal leaf III type open with margin spreading. The Raja, Tanduk, and kepok have inward curved margins type. Ambon, Talas, Susu and Rutai are straight with erect margins. The characteristics of the color of leaf upper surface and midrib dorsal surface also vary, but there are several types of bananas that have the same characteristics. Mas banana, cavendish, morosebo, taro, and Ambon have the color of leaf upper surface is dark green and color of midrib dorsal surface is green. Raja, maulin and kepok banana have green color for the color of leaf upper surface and midrib dorsal surface. Red bananas, Susu bananas and Rutai bananas have a green color of leaf upper surface but have varying colors on the midrib dorsal surface color. Tanduk banana has a dark green color of the upper surface.

The color of leaf lower surface and midrib ventral surface also varies, but there are several types of bananas that have the same characteristics. Cavendish and Kepok bananas have a green color for both parameters. Tanduk, Talas and Maulin banana have green color of leaf lower surface medium and green-yellow color of midrib ventral surface. Cavendish and Kepok bananas have green color of lower surface leaf and midrib ventral surface. In other bananas, it varies from green to pink-purple. Leaf color and midrib surface are influenced by chlorophyll a, chlorophyll b, carotenoids and anthocyanins (Li et al., 2021). The color of anthocyanins changes depending on the pH, co-existing colorless compounds (co-pigments, typically flavones and flavonols), and metal ions (Tanaka et al., 2008). In addition, the color change in leaves is also determined by cyanidins and delphinidins which are part of anthocyanins.

The results of observations on wax on leaf show results with the criteria of very waxy, moderately waxy, few wax, and very little wax. Very waxy is found in morosebo bananas, milk, and kepok. Moderately waxy is found in plantain, rutai, taro, and ambon. Few waxy found in red bananas, horns, as well as in bananas mas, Cavendish and maulin very little or no sign visible wax. Banana leaves have a waxy coating on the surface which gives it hydrophobic properties that serve as a protector from water loss (Hassan et al., 2018). Plant waxes consist of a mixture of aliphatic hydrocarbons and their derivatives with carbon chain lengths between 20 and 40, and in the case of esters (two connected chains) about 60 atoms. The main component classes are usually primary and secondary alkanes, alcohols, fatty acids, ketones, and aldehydes (Koch, 2008). The existence of wax on leaf can be influenced by genetic factors and also by the environment.

Various types of bananas can live in the environment of East Kalimantan. The existence of variations or differences in morphological characters, especially color may be possible due to environmental factors. Banana plants are plants that are sensitive to the environment so that the environment greatly affects the appearance of banana plants, in addition to genetic factors (Sihotang &

Waluyo, 2021). The diversity of bananas in East Kalimantan needs to be preserved as part of efforts to preserve Indonesian germplasm.

CONCLUSION

In East Kalimantan province, 12 types of banana cultivars were found, Talas bananas, Rutai bananas, Kepok bananas, Mas bananas, Morosebo bananas, Tanduk bananas, Susu bananas, Maulin bananas, Red bananas, Ambon bananas, Raja bananas, and Cavendish bananas.There are variations in the morphological characteristics of banana plants, leaves and fruit that can characterize each banana.

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