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Germplasm Diversity Of Banana (Musa Spp) in The City of Bandar Lampung, Indonesia by Type of Genome and Number of Chromosome

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Abstract: Bananas have a high diversity, so it can be a source of germplasm in plant breeding programs. This research aimed to investigate diversity of banana (Musa spp.) germplasm in the City of Bandar Lampung based on the number of chromosome and types of genome. The banana plant samples were taken randomly from 12 districts in Bandar Lampung. Morphological characterization for genomic determination of the plants was done using 15 characters from Simmonds and Shepherd (1955) and the expectation scores of genomes was adopted from Silayoi and Camchalow (1987). Banana chromosomes number was determined using the squash method.The results showed among 27 accessions of bananas collected from Bandar Lampung City, 26 accessions belong to the genus Musa, namely *Musa acuminata*, *Musa balbisiana*, *Musa paradisiaca*, and 1 accession belonging the genus Rhodhoclamys. The diversity of banana species in Bandar Lampung City is moderate. Variation of the genome obtained include AA (5 accessions), AAA (4 accessions), AAB (5 accessions), ABB (3 accessions), ABBB (1 accession), BBB (3 accessions), and 5 other accessions that cannot be determined. Chromosome number of the banana accessions found in Bandar Lampung is 22 (diploid), 33 (triploid) and 44 (tetraploid)
Keywords: banana germplasm, Musa spp., genus Musa, chromosome number, genome type.

INTRODUCTION

Banana is a tropical crops abundant in Southeast Asia and has a high diversity. Bananas are much liked by many people around the world, because of their complete nutritional value. Every 100 g of bananas produces 90 calories. Bananas clearly contain no cholesterol, rich in vitamins A, B6, C, calcium, potassium, and phosphorus. One banana contains 380 mg of potassium, so it can meet the daily potassium requirement of an adult [1]. Thus, it is not surprising that bananas become one of the world's fourth most important foods after rice, wheat and corn [2].

In Indonesia bananas are included in superior fruit commodities, with plantation areas covering almost all regions in the country. According to the Indonesia Statistics, banana production in Indonesia increases every year. Lampung Province occupies the first position as the highest banana production center in Indonesia with production reaches 1,937,349 tons, followed by the Provinces of East Java, West Java, and Central Java., Considering that Bandar Lampung City is a home industry center of banana chips that has a high contribution in the community economy, the banana germplasm in this district is feasible to be preserved [3].

Bananas that are currently cultivated are bananas from natural crosses between bananas *Musa acuminata* and *Musa balbisiana* [4]. The genetic diversity of banana plants can be used as a source of germplasm that needs to be continuously evaluated, since it has not been fully revealed.

Banana plants have varying ploidy levels. It occurs naturally as a result of crossings between wild banana species, takes place continuously and is influenced by its environment [5].The study result of chromosome number can be used for plant breeding because the number of chromosomes is constant, so it is important to maintain the character of a plant over time. Banana plants have the basic chromosome number x = 11 with the size of the haploid genome ranging from 500-600 Mb. Size of the banana genome, one-quarter times larger than the rice genome [6]. It has suggested that the small size of the genome has the potential to provide a better picture of the function and structure of the genomics. This is useful for banana plant breeding purposes [7]. Determination of genome type of banana plant can be done using scoring system based on morphological characteristics. Information from the results of the study of the determination of the number

of chromosomes and the genome type of banana plants will complement each other in the study of banana cultivation, and the results can be used as information in the plant breeding program. Therefore, the results of this study can reveal the biodiversity of banana germplasm based on the number of chromosomes and genomes in the city of Bandar Lampung.

MATERIALS AND METHODS

The study was conducted in three steps as follows: 1) collecting the banana plants, 2) characterization of the plant morphology to determine the genome of the banana, and 3) determination of chromosome number to determine the level of ploidy.

Colection of Banana germ plasm

Banana plant samples were collected randomly from 12 sub-districts in Bandar Lampung. The Diversity Index Value of the banana plants collection then determined using Shannon-Wiener Diversity Index, the Shannon-Wiener Diversity Index Value (H′) is calculated by equation bellows [8].

$$H' = -\sum_{i=1}^{s} Pi * \ln Pi$$

$$Pi = \frac{number\ of\ individu\ for\ each\ species}{number\ of\ individu\ for\ all\ species}$$

With: H' = value of Shannon-Wiener diversity index
Pi = proportion of total abundance represented by i^{th} species
s = number of species in community

If the index value (H′) < 1, diversity is low; if the index value (H′) is 1 < H' ≤3, the diversity is moderate; and if the index value (H′) > 3, then the diversity is high.

Mhorphological characterization to determinate genome of banana plant

The type of genome was determined using table of morphological character based on 15 characters according to Simmonds and Shepherd which was then calculated using the expectation scores of Silayoi and Camchalow. The characters observed to differ the genome of *Musa acuminata* from *Musa balbisisana* are vegetative characters.The characters observed to distinguish the genome of *Musa acuminata* and *Musa balbisisana* are vegetative characters consisting of the color of the pseudo stems, the stem of the bunches, the petiole, the fruit stalk, and the generative characters consisting of number of seeds of per locus, bractea ratio, bractea tip, rate of bractea coloring (color fading), bractea marks, free tepal of male flowers, flower color of males, and stigma color [9].

Scores of each cultivar were then summed and matched with the expectation scores of the genome group from Silayoi and Camchalow [10]. The number of scores from the matching results of the expectation scores with the AA / AAA genome group was (15-25), with the AAB genome group was (26-46), with the AB / AABB genome group was (47-49), with the ABB genome group was (59-63), with the ABBB genome group was (67-69) and with the genomes group was BB / BBB (70-75).

Chromosome number determination

Determination of the chromosome number was performed using the squash method Darnaedi, 1991 with the following sequence of steps: cutting the meristem of the root tip of banana done at 08.30 - 10.00 am, the pre-treatment of banana root pieces was done by soaking it in 0.03% hydroxiquinoline for 3-5 hour at 18-20°C, root- pieces fixation with 45% acetic acid for 10 minutes, hydrolysis of the root pieces in a mixture of HCL 1 N and 45% acetic acid (3: 1) was carried out for 3-5 min, heating the root pieces on the surface of the hot plate at 60°C, staining the root pieces by immersing them in 2% aseto-orcein for 15 min, then squashing the root pieces using erased wood pencils, and observations of banana root chromosome preparations under a microscope with 1000x magnification.

RESULTS AND DISCUSSION

The results showed that from 12 sub-districts in Bandar Lampung city, 27 accessions of bananas were obtained. All the 27 of banana acessions fall into two groups of genera. First is the group of genus *Eumusa* consisting of *Musa acuminata* which has 9 accessions, *Musa paradisiaca* which has 9 accessions, *Musa balbisiana* which has 3 accessions, and second is genus of *Rhodhoclamys* which only has 1 accession. The remaining 5 accessions of bananas whose genome type cannot be determined yet because when taking the banana root preparation will be done, the generative period of the banana plants have passed (Table 1). The result of calculation of Diversity Index Value (H') is 2,8369. Thus the diversity of banana plants in Bandar Lampung City is moderate.

The study resutts shows the genome types of banana plant obtained are AA, AAA, AAB, ABB, ABBB, and BBB with the number of basic chromosomes x = 11. The growth type of the upright to slightly erect leaves is characteristic of the banana cultivar from the descendants of *Musa acuminata* whereas in the descendants of *Musa balbisiana* has a drooped leaf growth type [11]. Another research results found 33 chromosome number from banana accession of morosebon (AAA), tanduk (AAB), raja sereh, kepok kuning, ambon kuning, and the number of chromosome 22 from banana accession of emas and lampung with AA genome type [12].

The results of characterisation above show that banana cultivar in Bandar Lampung City is dominated by the type of banana from the descendants of *Musa acuminata*. This shows that the type of banana *Musa acuminata* has a high crossing ability. The data obtained also indicate the presence of predominantly banana with triploid banana species. According to Simmonds (1962), the triploid banana cultivar has a sturdy and sturdy stout quasi-stature character, with leaves that are thicker and wider than those of diploid bananas, and in addition the triploid banana species are tolerant to minimal soil nutrients and more resistant to disease [13].

Table-1: Types of genome and chromosome number of banana in Bandar Lampung, Indonesia

No.	Species	Accessions	Score	Types of Genome	Number of Chromosome
1	*Musa acuminata*	Lilin (Janten)	20	AA	22
2		Mas	18	AA	22
3		Mas Kuning	21	AA	22
4		Muli (Lampung)	20	AA	22
5		Rejang	21	AA	22
6		Ambon Kuning	17	AAA	33
7		Ambon Lumut	22	AAA	33
8		Cavendish	19	AAA	33
9		Papan	21	AAA	33
10	*Musa paradisiaca*	Kepok Abu	42	AAB	33
11		Morosebo	28	AAB	33
12		Raja Nangka	34	AAB	33
13		Seribu	45	AAB	33
14		Tanduk	47	AAB	33
15		Kepok Batu	58	ABB	33
16		Rabig	64	ABB	33
17		Raja Sajen	59	ABB	33
18		Batu	65	ABBB	44
19	*Musa balbisiana*	Kepok Kapas	71	BBB	33
20		Kepok Kuning	71	BBB	33
21		Kepok Manado	70	BBB	33
22	Hasn't been determined	Ambon Australi	-	-	44
23		Kepok Libanon	-	-	33
24		Kidang	-	-	33
25		Raja Bakar	-	-	33
26		Raja Sereh		-	33
27	*Musa ornata*	*Musa ornata*	*	*	22

*belong to genus *Rhodhoclamys*

In this study, the banana cultivars found to have 22 (diploid), 33 (triploid) and 44 (tetraploid) chromosomes. It has suggested that the type of diploid, triploid, and tetraploid bananas that exist today is the result of a naturally occurring plant crosses continuously and influenced by environmental factors [14]. Previously, it has reported that in Bandar Lampung there were 12 accessions of banana plants that have potential as table fruit, processed fruits, and ornamental plants [15]. Another study conducted in Lampung Province found 21 accessions of bananas in the district of South Lampung with variation of genomes are AA, AAA, AAB, ABB, BB [16]. From the district of Pesawaran, still in the province of Lampung, Puspitasari (2011) found 13 accessions of bananas with the variation genomes are AA, AAA, AAB, ABB, and BB [17].

CONCLUSION

- There are 27 accessions of banana in the city of Bandar Lampung. Based on the cytological analysis and the diversity of morphological characters it is found that the Banana Diversity Index is 2.83 and so it is classified as medium.

- Types of banana genome obtained are: *Musa acuminata* (AA, AAA), *Musa balbisiana* (BBB), *Musa paradisiaca* (AAB, ABB, ABBB).
- The chromosome number of the bananas are 22 (diploid), 33 (triploid), and 44 (tetraploid).

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