

## Short Communication: New record of wild banana (*Musa balbisiana* Colla) in West Kalimantan, Indonesia

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Manuscript received: 26 September 2016. Revision accepted: 24 July 2017.

**Abstract.** Sunandar A. 2017. *Short Communication: New record of wild banana (Musa balbisiana Colla) in West Kalimantan, Indonesia. Biodiversitas 18: 1324-1330.* Kalimantan Island (Indonesia) is part of the center of origin and diversity of wild bananas in Indo-Malesia region. West Kalimantan is one of province in Kalimantan Island. However, only a little information is available about diversity of wild bananas in West Kalimantan. The aims of this study were to study a possible new record of wild banana species in Nipah Panjang and Teluk Nibung Villages, Kubu Raya District and to describe its phenetic relationships among wild banana species based on morphological characters. By examination based on the morphological character, one species of wild banana was identified, i.e. *Musa balbisiana* found in Teluk Nibung Village (Local name: Pisang Klotok). However, we didn't found any wild bananas in Nipah Panjang Village. *M. balbisiana* was a new record in West Kalimantan. Previously, *M. balbisiana* is widely distributed only in Java and Sulawesi. *M. balbisiana* was found in roadsides or backyards of residents in Teluk Nibung Village. Dendrogram of phenetic relationship showed that *M. balbisiana* from West Kalimantan had similarity with *M. balbisiana* from Sulawesi with coefficient of similarity 80%.

**Keywords:** *Musa balbisiana*, pisang klotok, Teluk Nibung, West Kalimantan, wild banana

### INTRODUCTION

*Musaceae* family consists of three genera, namely *Musa* L., *Musella* C.Y. Wu and *Ensete* Horan (Nasution and Yamada 2001). The genus of *Musa* is divided into three groups, namely giant bananas such as *M. ensete*, edible bananas viz. *M. paradisiaca*, *M. sapientum* and *M. troglodytarum*, and ornamental bananas which have certain morphological characteristics such as upright inflorescences and brightly coloured bracts i.e. *M. ornata*, *M. sanguinea* and *M. coccinea* (Sagot 1887). In 1893, Baker divided the genus of *Musa* into three subgenera: *Physocaulis* with bottle-shaped stem and inedible fruits, *Eumusa* having cylindrical stem and edible fruits, and *Rhodochlamys* having cylindrical stem, non edible fruits, and brightly colored bracts (Baker 1893). In 1947, based on number of chromosomes, Cheesman divided the *Musa* into four sections: *Australimusa* (x=10), *Callimusa* (x=10), *Eumusa* (x=11), and *Rhodochlamys* (x=11) (Cheesman 1947). In general, *Musa* is grouped into seeded bananas (wild), which consists of approximately 70 species (Häkkinen 2008) and seedless bananas (edible bananas), which consists of approximately 500 cultivars (Valmayor et al. 2002).

Indonesia is the center of origin of bananas (Simmonds 1966) and also the center of diversity (Daniells et al. 2001). Approximately, more than 325 cultivars of bananas were found in Indonesia (Valmayor et al. 2002) and 12 wild banana species have been documented (Nasution and Yamada 2001). The wild banana species can be found in all

islands in Indonesia, such as Sumatra, Java, the Lesser Sunda Island, Kalimantan, Sulawesi, Maluku, and Papua (Sulistyaningsih et al. 2014). Kalimantan Island is located on the equator, so it has a rainy humid equatorial climate. It has high mountains which provide many different habitats supporting Kalimantan Island as part of the center of origin and diversity of wild bananas (Häkkinen 2004a).

Kalimantan Island has 20 species of endemic wild bananas, but only 15 species that have been previously described (Häkkinen 2004a). Endemic wild bananas were found in Sarawak, Malaysia, such as *M. bauensis* (Häkkinen and Meekiong 2004), *Musa voonii* (Häkkinen 2004a), *M. campestris* Becc (Häkkinen 2004b), *M. azizii* (Häkkinen 2005), *M. beccarii* (Häkkinen et al. 2005), *M. suratii* and *M. monticola* (Argent 2000). There was one study about distribution of wild banana in West Kalimantan-by Sulistyaningsih and Irawanto (2011) reporting that *M. campestris* Becc. var. *sarawakensis* Häkkinen or Pisang Kera was found in Nek Rokon hill, Raya Pasi Natural Resource area, Singkawang -West Kalimantan.

On Recent years, the human activities, such as illegal logging, illegal mining, and forest fire have damaged habitat of wild bananas and influenced the population of wild bananas. Deforestation and forests fragmentations are major cause on the loose of genetic resources of *Musa* (Hapsari 2014). Between 1973 and 2015, an estimated 18.7 Mha of Borneo's old-growth forest were cleared (14.4 Mha and 4.2 Mha in Indonesian and Malaysian Borneo) and it is contested in tropical biodiversity hotspots where objective

data are limited (Gaveau et al. 2016). Therefore a study on wild bananas in Kalimantan Island is necessary to conduct. The aims of this study were to study wild banana species in Nipah Panjang and Teluk Nibung Villages, Kubu Raya District-West Kalimantan, to propose a possible new record, and to describe phenetic relationships among wild banana species based on morphological characters.

## MATERIALS AND METHODS

### Study area

The study on wild bananas species was conducted in two villages of Batu Ampar Sub-district, Kubu Raya District, West Kalimantan, Indonesia, i.e. Nipah Panjang and Teluk Nibung Villages (Figure 1). Batu Ampar is located about 108 km from the capital city of Kubu Raya District. Geographically, it is located between 109°26.936' East longitude and 00°47.308' South latitude, with total area of 2.002 km<sup>2</sup>. This region has the following boundaries, namely: northern side borders on Kubu Sub-district, while eastern side borders on Sanggau District, Southern border borders on Ketapang District, and western border borders on Karimata Strait. Average rainfall is 229.6 mm with daily temperatures range from 22.8°C to 33.2°C (BPS Kubu Raya 2015).

### Method

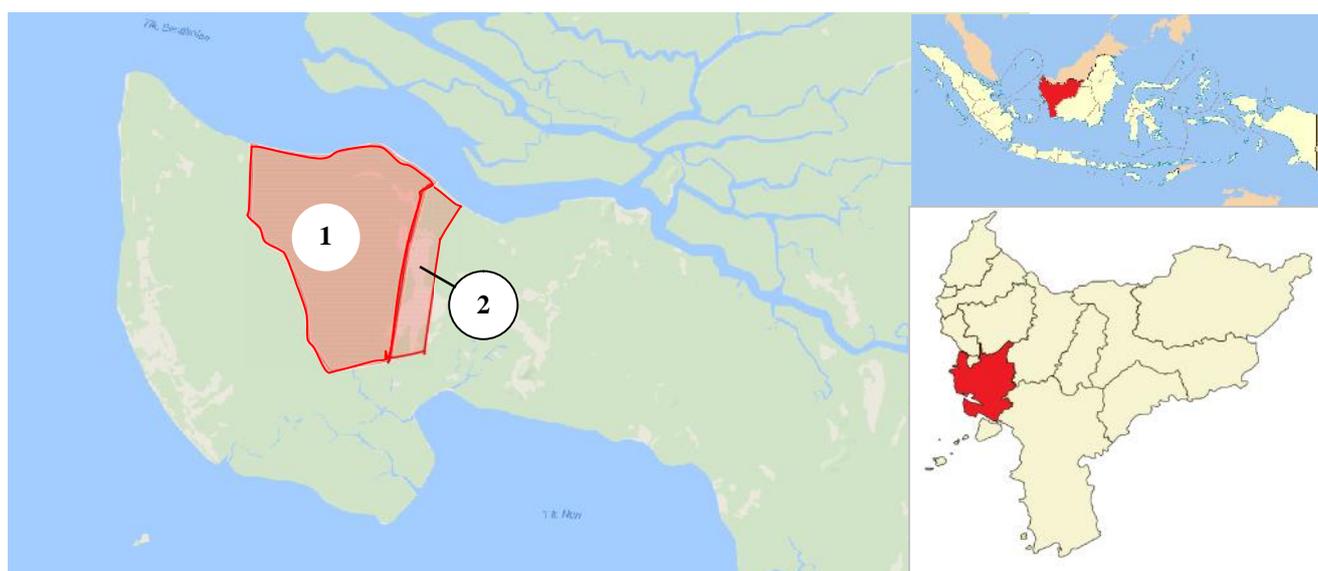
The study was carried out in May 2016. Morphological characters were documented with digital camera. Morphological characterizations were conducted by following the instruction on "Descriptors for Banana (*Musa* spp.)" from International Plant Genetic Resources Institute

(IPGRI 1996). Morphological character records include plant's general habit; as well as characteristics of pseudostem; petiole; leaf; peduncle; male bud; male flower; fruit; seed (shape, diameter, and color) (Table 1). Morphological characteristics were obtained from field then were crosschecked with references.

Phenetic relationships among *M. balbisiana* were analyzed by comparing the morphological characters of *M. balbisiana* from Teluk Nibung Villages, West Kalimantan to *M. balbisiana* (Klutuk Wulung) and *M. balbisiana* (Klutuk ijo) from Java (Hapsari 2014), and *M. balbisiana* from Sulawesi (Sulistyaningsih et al. 2014). NTSYSpc version 2.11a was used in this study. Coefficient of similarity was analyzed by SIMQUAL (Coefficient of similarity for Qualitative Data) using the simple matching (SM) method. Clustering analysis was analyzed using SAHN (Sequential Agglomerative Hierarchical and Nested clustering) by the method of unweighted pair-group method with arithmetic average (UPGMA). Dendrogram was produced using tree display (TREE).

## RESULTS AND DISCUSSION

By observing the morphological characters, one species of wild banana was identified in Kubu Raya District, West Kalimantan, i.e. *M. balbisiana* Colla (Figure 2-3). From this study, it was found that there were not any wild bananas in Nipah Panjang Village. Information from local people in Teluk Nibung Village shows that *M. balbisiana* Colla is originally available in the village by nature and is not introduced by the villagers recently.



**Figure 1.** Location of study area in Batu Ampar Subdistrict, Kubu Raya District, West Kalimantan, Indonesia. 1. Nipah Panjang Village, 2. Teluk Nibung Village

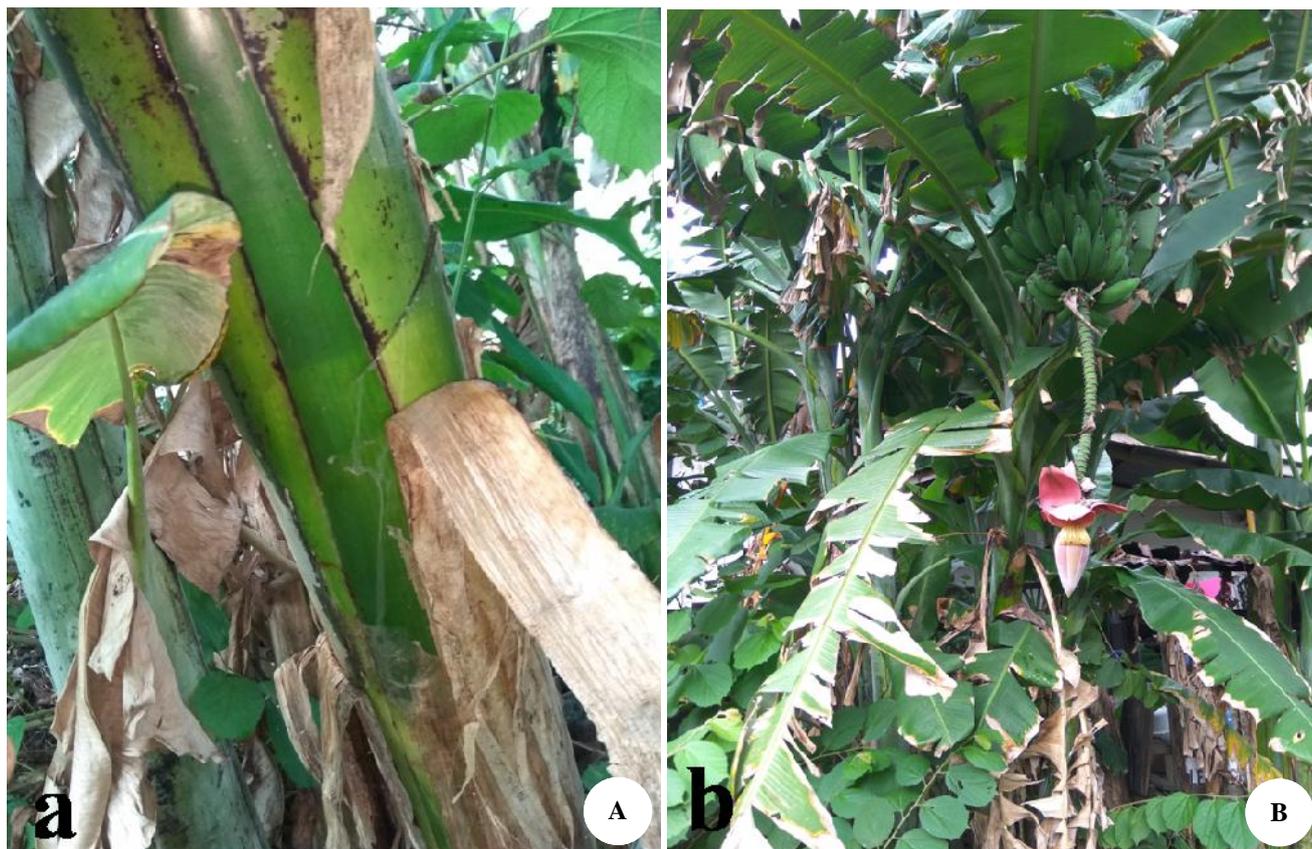


Figure 2. *Musa balbisiana* morphology. A. Pseudostem, B. Bunch

### *Musa balbisiana* Colla

Vernacular name: Pisang Klotok

Characteristics: intermediate *Leaf habit*, 4-6 m high of *Pseudostem* of mature plant, green color. Closed to parent *Sucker*, growing at angle. 54-94 cm *Petiole*, inward curved of petiolar canal leaf margins. 160-260 x 60-100 cm *Leaf*, upper surface dark-green, lower surface medium green, midrib dorsally green-yellow, midrib ventrally light green, round on both sides of leaf bases. 30 cm *Penducle*, 7-9 width, green-color. Ovoid *male bud*, normal male bud, bract base shape small shoulder, obtuse apex, external red-purple and internal pink-purple of bract, tinted with yellow, moderate grooving, not revolute bract behavior, lifting two at a time on male bract, and rachis position at an angle. *Male flower* falling with bract, compound tepal cream with yellow lobes, translucent white free tepal, oval, triangular apex; five stamens, yellowish, exerted, white filament; straight style, same level exertion style, cream stigma, arched ovary, cream. *Fruit* is 13 cm long with 9-12 fruits per hand in two rows, straight and apex blunt-tipped with persistent style, green peel on immature fruit but yellow peel on mature fruit. *Seed* is globular and wrinkled, brown, 3.67-5.23 mm in diameter (Table 1-2).

Location found: Teluk Nibung Village

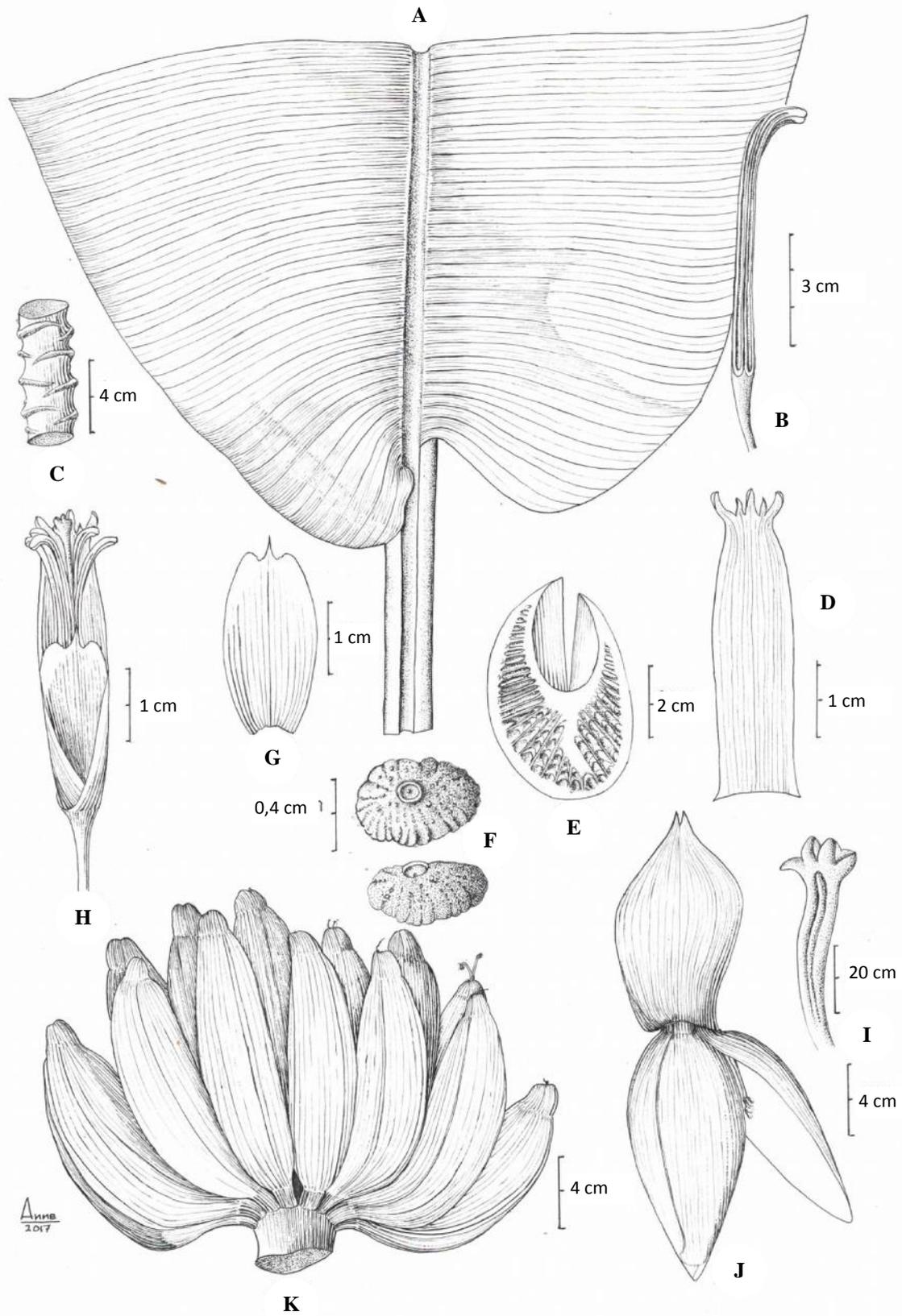
Habitat: *M. balbisiana* can be found in open spaces along roadsides or backyards of residents in Teluk Nibung Village, Kubu Raya District, West Kalimantan (Figure 3).

Nasution and Yamada (2001) reported that *M. balbisiana* can never found in wild. *M. balbisiana* were founded in Indonesia banana plantations. Sulistyaningsih et al. (2014) reported that *M. balbisiana* can be found on the roadside in the suburb and grow widely on forest border at Manado and North Sulawesi.

Geographical distribution: *M. balbisiana* from Teluk Nibung Village, West Kalimantan is a new record. Previously, *M. balbisiana* was reported to be in distribution in Myanmar, Sri Lanka, India, Malaya, New Guinea, Philippines, Thailand, and Indonesia. In Indonesia, *M. balbisiana* is widely distributed in Java (Cheesman 1948) and Sulawesi (Sulistyaningsih et al. 2014).

Uses: Local people in Teluk Nibung Village processed the fruit into *sale* (dried banana). Dry leaves are used as cigarette paper, exudates deposited from pseudostem are used to treat diabetes.

Many parts of *M. balbisiana* are used as potential medicines in India. Borborah et al. (2016) reported that exudates deposited from pseudostem of *M. balbisiana* were used to expel intestinal worm infection and to treat infertility in women. Furthermore, *M. balbisiana* had higher accumulation level of potassium and chloride causing high alkalinity in the plant which justified their medical uses (Mudoj et al. 2011). The inflorescence was used to treat jaundice. The fruit bark was used to treat gout.



**Figure 3.** *Musa balbisiana* Colla botanical illustrations. A. Leaf, B. Stamen, C. Peduncle, D. Compound tepal of male flower, E. Petiole canal leaf, F. Seed, G. Free tepal of male flower, H. Male flower, I. Style, J. Male bud, K. Fruit

The dried peels were used to heal gastritis and cough or as health tonic. The fresh peel of ripe banana was used to heal dysentery (Borborah et al. 2016). The paste of fresh or dried seeds of *M. balbisiana* was used as contraceptive in Tripura, India. The tablets were prepared from the paste of fresh or dried seeds weighing 5 g and taken orally twice a day in empty stomach for 7 days (Das et al. 2014).

In Indonesia, *M. balbisiana* has some miscellaneous uses. Hapsari et al. (2017) reported that local people in Java, particularly in East Java used leaves for wrapping and medicinal use, immature fruit and male bud were for consumption, and fruit was used as medicine. Leaves of *M. balbisiana* are preferred as wrapper because they were thick, wide, and were not easily torn. Fruits of *M. balbisiana* were used to cure diarrhea. Unripe fruit of *M. balbisiana* was added onto *rujak cingur*, a popular side dishes in East Java. The male bud of *M. balbisiana* was commonly eaten as a *pecel*, *urap*, and *gulai sayur* in rural communities of East Java, the male bud of *M. balbisiana* had lesser astringent taste than *M. acuminata*.

#### Key to the species of *Musa balbisiana*, a new record in West Kalimantan

Sucker is close to parent and grows at angle; petiolar canal leaf margins curve inward; bract apex is obtuse and split; bract behavior makes no revolute before falling; seeds are globular, wrinkled, brown ..... *Musa balbisiana*

In Indonesia, *M. balbisiana* had some variation in local names i.e., Pisang Klutuk Wulung, Pisang Klutuk Batu, Pisang Klutuk Sukun, Pisang Roti, Pisang Pataga (Ahmad et al. 2014), and Pisang Klutuk Ijo (Hapsari 2014). Pisang Klutuk Ijo was different from Pisang Klutuk Wulung on its pseudostems color, which is dark purple to black for Pisang Klutuk Wulung and green on Pisang Klutuk Ijo (Hapsari 2014). *M. balbisiana* found in West Kalimantan had similarity with Pisang Klutuk Ijo, with pseudostem color are green. *M. balbisiana* from Sulawesi had similarity with *M. balbisiana* from West Kalimantan in type of petiol canal leaf III, color of leaf upper surface, color of leaf lower surface, color of midrib dorsal and ventral surface, male bud shape, free tepal color, free tepal apex shape, fruit apex, remains of flower relicts, and color and shape of seed (Tabel 2).

#### Phenetic relationship

Phenetic relationship analysis showed that two groups were formed among *M. balbisiana* at the coefficient of similarity of 51% (Figure 4). Group I contained Klutuk Wulung and Klutuk Ijo from Java. Group II contained *M. balbisiana* from Sulawesi and *M. balbisiana* from West Kalimantan. They were separated from the others by type of petiolar canal leaf III, fruit apex, remnants of flower relicts, and seed surface. Dendrogram shows that *M. balbisiana* from West Kalimantan had similarity *M. balbisiana* from Sulawesi with coefficient of similarity of 80%.

#### Importance of *M. balbisiana*

*M. balbisiana* is important species in the origin of cultivated bananas (Simmonds 1966); it is believed to be

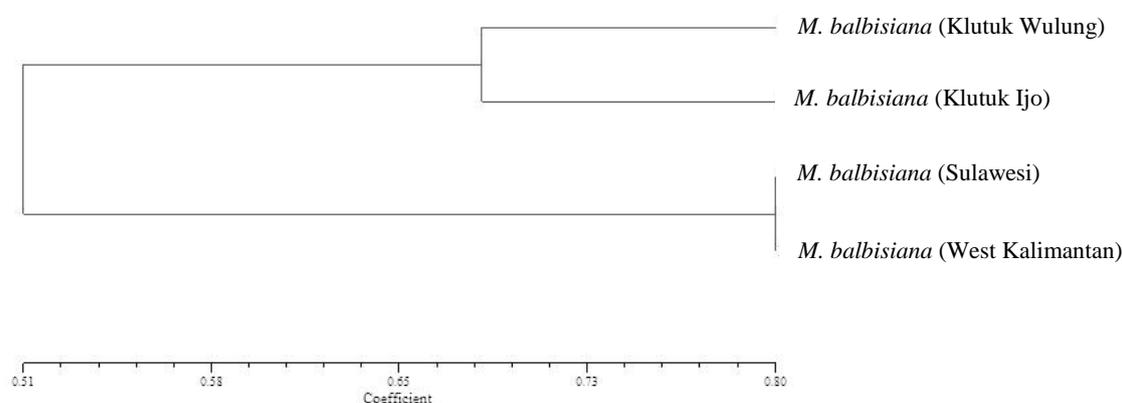
one of progenitors of cultivated banana contributing B-genome (Davey et al. 2013). B-genome of banana is a target for breeding program because B-genome has high tolerance to both biotic and abiotic stresses (Hu et al. 2015). B-genome in *M. balbisiana* corresponds to a more tolerant on drought condition and more disease resistant than A-genome in *M. acuminata* (Daniels et al. 2001) and more tolerant to BBTV (Hapsari and Masrum 2012), Panama wilt, and leaf spot diseases (Singh et al. 2001).

**Tabel 1.** Wild banana's morphological characters

Characters	Character set (code)
Leaf habit	Erect (0), intermediate (1)
Dwarfism	Dwarfism (0), normal (1)
Pseudostem Height (m)	3 (0), 4(1)
Pseudostem color	Black-dark purple (0), green (1), brown-purple (2)
Position of sucker	Growing at angle (0), vertical growth (1)
Petiole canal leaf III	overlapping Margin (0), curved inward (1)
Leaf blade Length (cm)	171-220 (0), 151-170 (1), 180-300 (2), 160-220 (3)
Leaf blade width (cm)	51-60 (0) 60-100 (1)
Color of leaf upper surface	Dark green with red-purple (0), dark green (1)
color of leaf lower surface	Green (0), medium green (1)
Shape of leaf base	pointed on both sides (0), round sides (1)
Color of midrib dorsal surface	Green (0), light green (1), greenish yellow (2)
Color of midrib ventral surface	Green-purple (0), light green (1)
Peduncle length (cm)	≥31 (0), ≤30 (1)
Male bud type	Like true-horn 'Plantain' (0), normal (1)
male bud shape	Rounded (0), ovoid (1)
Bract apex shape	Obtuse and split (0), intermediate (1), obtuse (2)
Color of bract external face	Purple (0), red-purple (1)
Color on the bract apex	Not tinted with yellow (0), tinted with yellow (1)
Male bract lifting	Lifting one at a time (0), lifting two or more at a time (1)
Bract behavior before falling	Revolute (0), not revolute (1)
Compound tepal basic color	White (0), cream (1)
Lobe color of compound tepal	Cream (0), yellow (1)
Free tepal color	Tinted with pink (0), tinted with yellow (1), translucent white (2)
Free tepal shape	Rectangular (0), oval (1)
Free tepal apex shape	Thread-like (0), triangular (1)
Ovary shape	Arched (0), straight (1)
Number of fruit	≥ 13 (0), ≤ 12 (1)
Fruit length (cm)	15 (0), 14 (1), 13 (2)
Fruit shape	Curved (0), straight (1)
Fruit apex	Pointed (0), blunt (1)
Remains of flower relicts	Without any floral relicts (0), persistent style (1)
Seed surface	Slightly wrinkled (0), wrinkled (1)
Seed shape	Rounded (0), globular (1)
Seed color	Dark brown (0), brown (1)

**Table 2.** Morphological characteristics differentiation of *M. balbisiana* (Klutuk Wulung) and *M. balbisiana* (Klutuk Ijo) from Java, *M. balbisiana* (Sulawesi) and *M. balbisiana* (West Kalimantan)

Description	<i>M. balbisiana</i> (Klutuk Wulung) (Hapsari 2014)	<i>M. balbisiana</i> (Klutuk Ijo) (Hapsari 2014)	<i>M. balbisiana</i> (Sulawesi) (Sulistyaningsih et al. 2014)	<i>M. balbisiana</i> (West Kalimantan) <i>This research</i>
Leaf habit	Intermediate	Intermediate	Erect	Intermediate
Dwarfism	Normal	Normal	Normal	Normal
Pseudostem height (m)	3	3	4	4
Pseudostem color	Black-dark purple	Green	Brown-purple	Green
Position of sucker	Vertical growth	Vertical growth	Vertical growth	Growing at angel
Petiole canal leaf III	Margins overlapping	Margins overlapping	Curved inward	Curved inward
Leaf blade length (cm)	171-220	151-170	180-300	160-220
Leaf blade width (cm)	51-60	51-60	60-100	60-100
Color of leaf upper surface	Dark green with red-purple	Dark green	Dark green	Dark green
Color of leaf lower surface	Green	Medium green	Medium green	Medium green
Shape of leaf base	Both side rounded	Both side rounded	Both side rounded	Both side rounded
Color of midrib dorsal surface	Green	Light green	Green yellow	Green yellow
Color of midrib ventral surface	Green purple	Light green	Light green	Light green
Peduncle length (cm)	31-60	31-60	30	30
Male bud type	Normal	Normal	Normal	Normal
Male bud shape	Ovoid	Ovoid	Ovoid	Ovoid
Bract apex shape	Obtuse and split	Obtuse and split	Intermediate	Obtuse and split
Color of bract external face	Red-purple	Purple	Red-purple	Red-purple
Color on the bract apex	Tinted with yellow	Tinted with yellow	Tinted with yellow	Tinted with yellow
Male bract lifting	Lifting two or more at time	Lifting two or more at time	Lifting two or more at time	Lifting two or more at time
Bract behavior before falling	Not revolute	Not revolute	Not revolute	Not revolute
Compound tepal basic color	Cream	Cream	Cream	Cream
Lobe color of compound tepal	Yellow	Yellow	Yellow	Yellow
Free tepal color	Tinted with pink	Tinted with yellow	Translucent white	Translucent white
Free tepal shape	Oval	Oval	Oval	Oval
Free tepal apex shape	Triangular	Thread-like	Triangular	Triangular
Ovary shape	Straight	Straight	Straight	Arched
Number of fruit	12	13-16	12	12
Fruit length (cm)	10-15	10-15	10-14	13
Fruit shape	Straight	Straight	Straight	Straight
Fruit apex	Pointed	Pointed	Blunt	Blunt
Remains of flower relicts	Without any floral relicts	Without any floral relicts	Persistent style	Persistent style
Seed surface	Slightly wrinkled	Slightly wrinkled	Wrinkled	Wrinkled
Seed shape	Globular	Globular	Globular	Globular
Seed color	Brown	Dark brown	Brown	Brown

**Figure 3.** Dendrogram of phenetic relationship among *M. balbisiana*: *M. balbisiana* from West Kalimantan, *M. balbisiana* from Sulawesi (Sulistyaningsih et al. 2014), *M. balbisiana* (Klutuk Wulung) and *M. balbisiana* (Klutuk Ijo) from Java (Hapsari 2014)

bZIP genes in B-genome of banana showed 74% of increased transcription levels under cold, drought, and salt stresses (Hu et al. 2015). Banana cultivars from ABB group i.e. Kepok, Siem, and Cepatu tend to be more tolerant to drought and more disease resistant than *M. acuminata* cultivars (AAA and AA) such as Ambon, Berangan, and Mas (Nasution and Yamada 2001).

Bioactive compound is another potential of *M. balbisiana*. Tin et al. (2016) reported three triterpenes were isolated from *M. balbisiana* inflorescence. They are 31-norcyclolaudene, cycloartenol and (24R)-4a,24-trimethyl-5a-cholesta-8,25(27)-dien-3b-ol. Triterpene from *M. balbisiana* inflorescence is a new source of natural products for food or pharmaceutical applications in future.

It can be concluded from this study that one wild banana species was successfully identified from Teluk Nibung Village, Kubu Raya District, West Kalimantan, i.e. *M. balbisiana* and it is considered as new record. *M. balbisiana* from West Kalimantan was closely related to *M. balbisiana* from Sulawesi with coefficient of similarity of 80%. Conservation of *M. balbisiana* and other wild banana in Indonesia is important to be prioritized both *in-situ* and/or *ex-situ* before it goes to extinction. Conservation of wild bananas will provide long term and sustainable conservation of genetic diversity. Genetic diversity of wild banana is important resources to improve quality of cultivated banana using genetic manipulation in the future.

#### ACKNOWLEDGEMENTS

The study was funded by Universitas Muhammadiyah Pontianak, West Kalimantan, Indonesia through DIPA. The authors are gratefully appreciated to Rajudiansyah for help and supports in field.

#### REFERENCES

- Ahmad F, Megia R, Poerba YS. 2014. Genetic diversity of *Musa balbisiana* Colla in Indonesia based on AFLP marker. *Hayati J Biosci* 21 (1): 39-47.
- Argent G. 2000. Two interesting wild *Musa* species (Musaceae) from Sabah, Malaysia. *Gard Bull Sing* 52: 203-210.
- Baker G. 1893. A synopsis of the genera and species of Musaceae. *Ann Bot* 7: 189-222.
- BPS. 2015. Kubu Raya Regency in Figures. Badan Pusat Statistik, Sungai Raya. [Indonesian]
- Borborah K, Borthakur SK, Tanti B. 2016. *Musa balbisiana* Colla-taxonmy, traditional knowledge and economic potentialities of the plant in Assam, India. *Indian J Trad Knowl* 15 (1): 116-120.
- Cheesman EE. 1947. Classification of the bananas I: the genus *Musa* L. *Kew Bull* 2: 106-117.
- Cheesman EE. 1948. Classification of the bananas 3: Critical notes on the species *M. balbisiana* Colla. *Kew Bull* 1: 11-17.
- Daniells J, Jenni C, Karamura D, Tomelpe K. 2001. *Musalogue: A Catalogue of Musa Germplasm, Diversity in the Genus Musa*. INIBAP, Montpellier.
- Das B, Talukdar AD, Choudhury MD. 2014. A few traditional medicinal plants used as antifertility agents by ethnic people of Tripura, India. *Intl J Pharm Pharm Sci* 6 (3): 47-53.
- Davey MW, Gudimella R, Harikrishna JA, Sin LW, Khalid N, Keulemans J. 2013. A draft *Musa balbisiana* genome sequence for molecular genetics in ploidy, inter- and intra specific *Musa* hybrids. *BMC Genomics* 14: 683-702.
- Gaveau DLA, Sheil D, Husnayaen, Salim MA, Arjasakusuma A, Anrenaz M, Pacheco P, Meijaard E. 2016. Rapid conversions and avoided deforestation: examining four decades of industrial plantation expansion in Borneo. *Sci Rep* 6 (3): 1-13.
- Hapsari L, Masrum A. 2012. Preliminary screening resistance of *Musa* germplasm for banana bunchy top diseases in Purwodadi Botanic Garden, Pasuruan, East Java. *Buletin Kebun Raya* 15 (2): 57-70.
- Hapsari L. 2014. Wild *Musa* species collection of Purwodadi Botanic Garden: Inventory and its morpho-taxonomic review. *J Trop Life Sci* 4 (1): 70-80.
- Hapsari L, Kennedy J, Lestari DY, Masrum A, Lestari W. 2017. Ethnobotanical survey of bananas (Musaceae) in six districts of East Java, Indonesia. *Biodiversitas* 18 (1): 160-174.
- Häkkinen M. 2004a. *Musa voonii*, a new *Musa* species from Northern Borneo and Discussion of the Section *Callimusa* in Borneo. *Acta Phytotax Geobot* 55 (2): 79-88.
- Häkkinen M. 2004b. *Musa campestris* Becc. (Musaceae) varieties in Northern Borneo. *Folia Malaysiana* 5 (2): 81-100.
- Häkkinen M, Meekiong K. 2004. A new species of the wild banana genus, *Musa* (Musaceae), from Borneo. *Syst Biodiv* 2 (2): 169-173.
- Häkkinen M. 2005. *Musa azizii*, a new *Musa* species (Musaceae) from Northern Borneo. *Acta Phytotax Geobot* 56 (1): 27-31.
- Häkkinen M, Suleiman M, Gisil J. 2005. *Musa beccarii* (Musaceae) varieties in Sabah, Northern Borneo. *Acta Phytotax Geobot* 56 (2): 135-140.
- Häkkinen M. 2008. Typification and check-list of *Musa* L. names (Musaceae) with nomenclatural notes. *Adansonia Sér* 30 (1): 63-112.
- Häkkinen M. 2013. Reappraisal of sectional taxonomy in *Musa* (Musaceae). *Taxon* 62: 809-813.
- International Plant Genetic Resources Institute. 1996. Description for Bananas (*Musa* spp). IPGRI, Rome.
- Mudoi T, Deka DC, Tamuli S, Devi R. 2011. Fresh ripe pulp (FRP) of *Musa balbisiana* has antiperoxidative and antioxidant properties: An *in vitro* and *in vivo* experimental study. *J Farma Res* 4 (11): 4208-4213.
- Nasution RE, Yamada I. 2001. Wild bananas in Indonesia. Pusat Penelitian dan Pengembangan Biologi LIPI, Bogor. [Indonesian]
- Sagot P. 1887. Sur le genre bananier. *Bull Soc Bot France* 34: 328-330.
- Simmonds NW. 1966. Bananas. 2nd ed. Longmans, London
- Simmonds NW, Shepherd K. 1955. The taxonomy and origins of the cultivated bananas. *J Linn Soc Bot* 55: 302-312.
- Singh HP, Uma S, Sathiamoorthy S. 2001. A tentative key for identification and classification of Indian bananas. National Research Centre for Banana (ICAR), Tiruchirapalli.
- Sulistyaningsih LD, Irawanto R. 2011. Distribution study of *Musa campestris* Becc. var. *sarawakensis* Häkkinen in Raya Pasi Natural Resource Area, West Kalimantan. *Berk Penel Hayati* 5A: 121-124. [Indonesian]
- Sulistyaningsih LD, Megia R, Widjaja EA. 2014. Two new records of wild bananas (*Musa balbisiana* and *Musa itinerans*) from Sulawesi. *Makara J Sci* 18 (1): 1-6.
- Tin HS, Padam BS, Kamada T, Vairapan CS, Abdulah MI, Chye FY. 2016. Isolation and structure elucidation of triterpenes from inflorescence of banana (*Musa balbisiana* cv. Saba). *IFRJ* 23 (2): 866-872.
- Valmayor RV, Jamaluddin SH, Silayoi B, Kusumo S, Danh LD, Pascua OC, Espino RRC. 2002. Banana Cultivars Names and Synonyms in Southeast Asia. IPGRI, Rome.