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Short Communication

Distribution record of *Musa borneensis* var. *sarawakensis* Becc. and *Musa campestris* var. *sarawakensis* Becc. in West Kalimantan, Indonesia

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ABSTRACT

Borneo Island has a large number of wild banana species. As a part of Borneo Island, West Kalimantan has limited information about the diversity of wild bananas. This research aims to update the record distribution of wild bananas from Bonti District of Sanggau Regency and to determine their morphological characteristics. Exploration method and resident information were used in this study. Two species of wild bananas have been identified and considered as new distribution records in West Kalimantan Province, namely-*Musa borneensis* var. *sarawakensis* with morphological character pseudostem red-purple colour, sparse black-purple blotches at petiole base, leaf base shape rounded on both sides, male bud red-purple colour and *Musa campestris* var. *sarawakensis* with morphological character pseudostem yellow-green colour, inflorescence erect, leaf base one side rounded and one-pointed, the dorsally pink-purple and ventrally pink-purple colour of bract.

Keywords: Bonti District, *Musa borneensis* var. *sarawakensis*, *Musa campestris* var. *sarawakensis,* Pisang Kera, wild banana

Musaceae is composed of three genera: *Ensente*, *Musa*, and *Musella*. The largest genus in *Musaceae* is *Musa*. Based on DNA analyses such as atpB-rbcl, rps16, trnL-F DNA sequences (Li *et al*., 2010), nuclear ribosomal (ITS) and chloroplast (trnL-F) (Liu *et al*., 2010), and ITS1-5.8S-ITS2 sequence (Hřibová *et al*., 2011), Häkkinen (2013) have restructured Musa species into two sections, sect. *Musa* and sect. *Callimusa*. Previously, based on chromosome number and morphological character the genus *Musa* has five sections, *Musa* sect. *Australimusa* 2n = 2x = 20; sect. *Callimusa* 2n = 2x = 20; sect. *Musa* 2n = 2x = 22; sect. *Rhodochlamys* 2n = 2x = 22 (Chessman, 1947) and sect. *Ingentimusa* 2n = 2x = 14 (Argent, 1976).

Musaceae is found in wet tropical lowland but some species were also found in higher latitude. Indonesia has many varieties of wild banana species, which are widely distributed in Sumatra, Java, Nusa Tenggara, Kalimantan, Sulawesi, and Papua islands (Nasution & Yamada, 2001), including three species of wild bananas in Sumatra Island, i.e. *Musa salaccensis*, *M. sumatrana*, and *M. halabanensis* (Meijer, 1961), eight species in Java island, i.e. *M. acuminata* with seven infraspecific taxa, *M. balbisiana*, *M. coccinea*, *M. ornata*, *M. salaccensis*, *M. sanguinea*, *M. textilis*, and *M. velutina* (Sulistyaningsih, 2016), eight species in Sulawesi Island, i.e. *M. balbisiana* and *M. itinerans* as new records (Sulistyaningsih *et al*., 2014), *M. acuminata* (with four infraspecific taxa as new record), *M. textilis*, *M. borneensis* (Hastuti *et al*., 2019), and *M. borneensis* var. *donggalensis* as a new species and rejected the endemic status of *M. borneensis* in Kalimantan (Sulistyaningsih, 2017) and one new species of *M. arfakiana* from Papua (Argent, 2010).

Borneo Island is the third largest island in the world. Borneo Island is located on the equator, has high mountains which provide many different habitats as part of the centre of the primary banana diversity centre, which has a large number of wild banana species (Häkkinen, 2004a). The exploration to find out the diversity of wild bananas in Borneo

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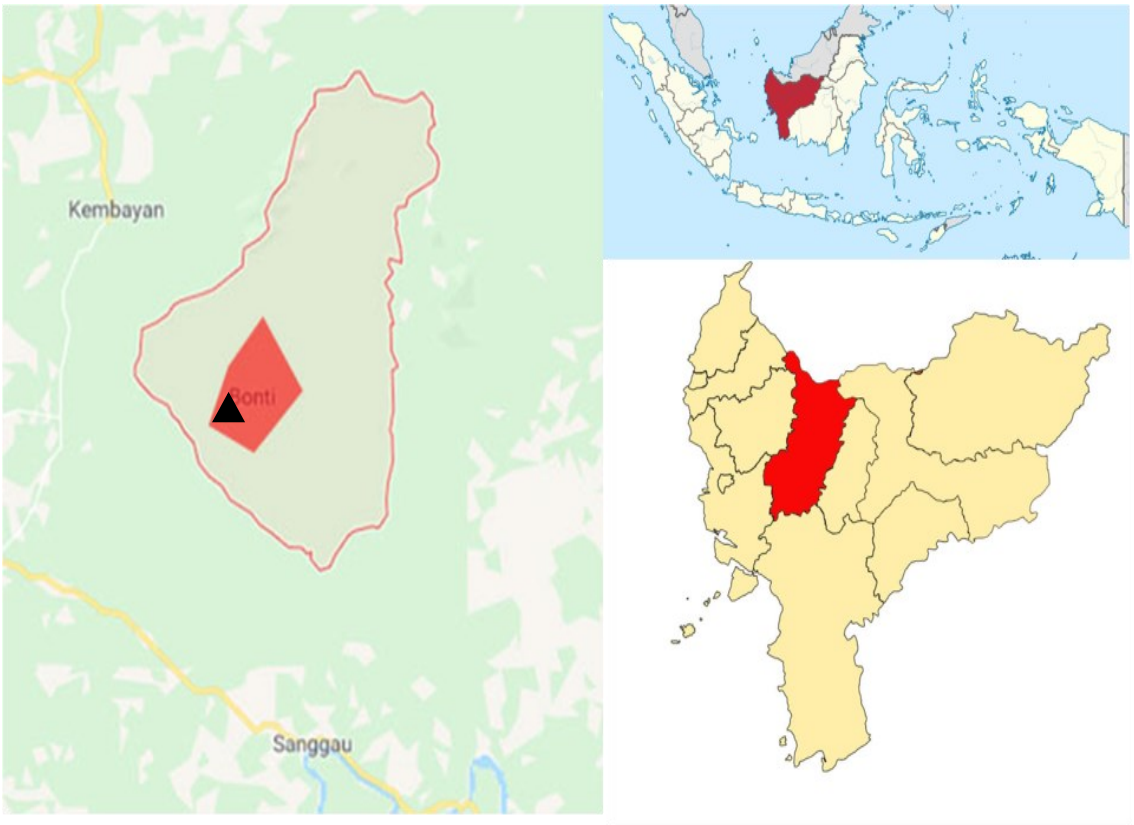

Figure 1. Study area in Bonti Village, Bonti District, Sanggau Regency,West Kalimantan, Indonesia.

Island has been carried out intensively in Sabah, Sarawak, and Brunei Darussalam. Häkkinen (2004a) also reported 20 species of endemic wild bananas were found in Borneo, but only 15 species have been previously described. Borneo Island is divided into three-state territories, namely Indonesia, Malaysia, and Brunei Darussalam. In Indonesia, the island of Borneo is known by the name Kalimantan which is divided into five provinces. However, the forest fire and resultant haze have potential impacts on Kalimantan's biodiversity such as habitat loss, forest fragmentation, and low sunlight on forest trees (Horrison *et al*., 2016). The exploration, inventory, and conservation of wild bananas in West Kalimantan need to be done before the wild banana species are lost due to forest fire.

Studies on wild bananas in West Kalimantan are still limited. Sulistyaningsih and Irawanto (2011) reported *M. campestris* var. *sarawakensis* Häkkinen or Pisang Kera in Nek Rokon Hill of Raya Pasi Natural Resources area, Singkawang-West Kalimantan. Previously, the distribution of *Musa campestris* was only considered in Sabah, Sarawak, and Brunei Darussalam (Häkkinen, 2004b). Moreover, Sunandar (2017) reported *Musa balbisiana* Colla or Pisang Klotok in Teluk Nibung Village, Kubu Raya District -West Kalimantan. Previously, *Musa balbisiana* Colla was known to be distributed in Java (Cheesman, 1948) and Sulawesi Island (Sulistyaningsih *et al*., 2014).

The information on the diversity and distribution of wild bananas in West Kalimantan are needed to improve the quality of cultivated banana using genetic manipulation in the future and for conservation management of wild bananas in West Kalimantan. This study aimed to update the record distribution of wild bananas from Bonti District of Sanggau Regency and to determine their morphological characteristics.

The study on wild bananas species were conducted in Bonti Village, Bonti District, Sanggau Regency, West Kalimantan, Indonesia (Figure 1). The study area was surrounded by Noyan and Kembayan Districts in the northern part, Parindu and Kapuas Districts in the southern part, and Tayan Hulu District in the western part. The average rainfall is 235 mm (BPS Sanggau, 2017). The topographic area in Bonti Sub-district is plains.

The exploration was carried out in March 2017. Morphological characters were documented with a digital camera. Morphological characterization was done under Descriptors for Banana (*Musa* spp.) from the International Plant Genetic Resources Institute (IPGRI, 1996). Morphological character records included the plant's general habit as well as characteristics of pseudostem, petiole, leaf, peduncle, male bud, male flower, fruit, and seed (shape and colour). Morphological characteristics obtained from the field were then crosschecked with references (Nasution & Yamada, 2001; Häkkinen, 2004b;

Häkkinen & Meekiong, 2005; Sulistyaningsih, 2017).

Based on the differences in 12 morphological characters, two species of wild banana were identified in Bonti District, West Kalimantan, i.e. *Musa borneensis* var. *sarawakensis* and *Musa campestris* var. *sarawakensis* (Table 1, Figure 2-3). Some morphological features of both species can be seen in Figures 2 and 3. In daily life, the villagers of Bonti District only utilized *M. borneensis* var. *sarawakensis* as food.

Musa borneensis var. *sarawakensis* has vernacular name Pisang Boha'(Bonti, Indonesia). However, local people in Sarawak called it Pisang hutan (Malay) or Baliek guun (Melanau) (Häkkinen & Meekiong, 2005). Geographically, *M. borneensis* var. *sarawakensis* located between 110^{0}32'56.781" E and 0^{0}24'47.893" N.

Characteristics: Mature pseudostem up to 4 m high, sheaths red-purple colour. Sucker Closed to parent and vertical growth. Petiole up to 42-93 cm long, petiole canal wide with erect margins, petiole bases corrugated auricles with sparse black-purple blotching. Leaf habit erects up to 400-470 cm long, 78-82 cm wide, colour of upper surface is green, lower surface is green-yellow, and leaf bases asymmetric and rounded on both sides, midrib dorsally yellow, midrib ventrally light green. Inflorescence first horizontal then pendulous, peduncle 37- 48 cm long, 8 cm in diameter, hairless, and red-green. Male bud rounded, normal male bud, apex obtuse and split with green tips, dorsally red-purple, ventrally yellow of bract, revolute bract behaviour, lifting two bracts at a time, and rachis position horizontal. Male flower compound tepal cream with cream lobes, free tepal translucent white, oval, with triangular apex, style straight, ovary straight. Fruit 6 fruits per hand, individual fruit 14 cm long, straight in shape, without any floral relicts, and apical part bottle-necked shaped. Seed obpyriform and brown (Figure 2). Variations morphology were found between *M. borneensis* var. *sarawakensis* in Bonti, West Kalimantan, and *M. borneensis* var. *sarawakensis* in Serian-Sri Aman, Sarawak. *Musa borneensis* var. *sarawakensis* in Bonti, West Kalimantan had red-purple pseudostem. Sucker closed to parent. Dorsally red-purple and ventrally yellow of bract (Table 1). However, *M. borneensis* var. *sarawakensis* in Serian-Sri Aman, Sarawak had purple-brown pseudostem. Sucker far from the parent plant. Dorsally pink-purple and ventrally yellow of bract (Table 1) (Häkkinen & Meekiong, 2005).

M. borneensis var. *sarawakensis* can be found on forest border in Bonti village, Sanggau District, West Kalimantan and considered as a new distribution record (Figure 2). Previously, *M. borneensis* was reported in Sarawak, Malaysia (Häkkinen & Meekiong, 2005) and Donggala-Central Sulawesi (Sulistyaningsih, 2017). In Serian-Sri Aman, Sarawak, *M. borneensis* var. *sarawakensis* was found on the roadside (Häkkinen & Meekiong, 2005).

Local people in Bonti village consume the young pseudostem of *M. borneensis* var. *sarawakensis*. The young pseudostem of *M. borneensis* var. *sarawakensis* boiled in water then cooked with coconut milk. Punan tribe consume the young pseudostem of *M. borneensis* var. *flavida* and as a land certificate (Sulistyaningsih & Wawo, 2011).

The key character of *M. borneensis* var. *sarawakensis* in Bonti, West Kalimantan is pseudostem red-purple colour, sparse black-purple blotches at petiole base, leaf base shape rounded on both sides, male bud red-purple colour**.**

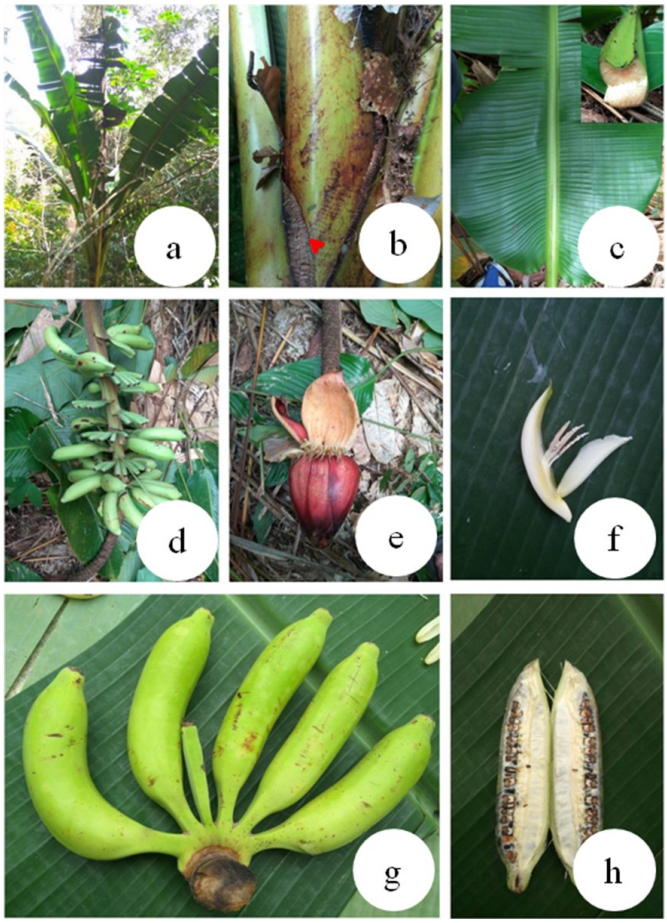

Figure 2. *Musa bornensis* var. *sarawakensis* in West Kalimantan. a. Habitus; b. Auricle; c. Leaf and petiole canal leaf; d. Bunch; e. Male bud; f. Male flower; g. A hand of fruits; h. Longitudinally section of fruit.

Another species of wild bananas have been identified namely-*Musa campestris* var. *sarawakensis*. *Musa campestris* var. *sarawakensis* has a vernacular name: Pisang Kera in Bonti District, Sanggau Regency. Local people in Nek Rokon Hill, Raya Pasi Natural Resource area, Singkawang, West Kalimantan also called it Pisang Kera

Table 1. Morphological characters of *Musa borneensis* var. *sarawakensis* and *Musa campestris* var. *sarawakensis*.

No	Character	*M. borneensis* var. *sarawakensis* in this study	*M. borneensis* var. *sarawakensis* (Häkkinen & Meekiong 2005)	*M. campestris* var. *sarawakensis* in this study	*M. campestris* var. *sarawakensis* (Häkkinen 2004)
1	Mature pseudostem color	Red-purple	Purple brown	Yellow-green	Yellow red-purple
2	Petiole canal leaf	Wide with erect margin	Wide with erect margin	Straight with erect margins	Straight with erect margins
3	Leaf habit	Erect, Lamina up to 400-470 x 78-82 cm	Erect, Lamina up to 350 cm x 80 cm	Erect, Lamina up to 210-285 x 30-42 cm	Erect, Lamina up to 240 cm x 50 cm
4	Colour of upper surface leaf	Green	Green and shiny	Dark green	Green
5	Colour of lower surface leaf	Green-yellow	Medium green	Green	Yellowish-green
6	Leaf bases	Asymmetric; rounded on both sides	Asymmetric; both side rounded	Asymmetric; one side rounded and one-pointed of leaf bases	Asymmetric; both side rounded
7	Midrib	Dorsally yellow; ventrally light green	Dorsally light green to yellow; ventrally yellow	Dorsally yellow; ventrally green	Dorsally light-green; ventrally medium green
8	Inflorescence	First horizontal then pendulous	First horizontal then pendulous	Erect	Erect
9	Peduncle	Hairless, red-green	Hairless, light green yellow	Very hairy, red-purple	Very hairy, reddish-purple
10	Male bud	Rounded; Dorsally red-purple, ventrally yellow; revolute before falling	Rounded or cordate; dorsally pink-purple, ventrally yellow; revolute before falling	Ovoid; dorsally pink-purple, ventrally pink-purple; not revolute	Ovoid; dorsally purple, ventrally pale-purple; deflexed but not rolled back
11	Male flower	Compound tepal cream; free tepal translucent white, oval	Compound tepal cream to yellow; free tepal cream, oval	Compound tepal cream**;** free tepal translucent white**,** rectangular	Compound tepal watery green; free tepal translucent white, oblong
12	Fruits	Straight	Straight	Straight	Straight

(Sulistyaningsih & Irawanto, 2011). However, local people in Kuching, Sarawak, Malaysia called it Pisang Lengki (Häkkinen, 2004b). Geographically, *M. campestris* var. *sarawakensis* located between 110^{0}31'59.593" E and 0^{0}24'31.938" N.

Characteristics: Pseudostem sheaths yellow-green colour. Sucker closed to parent and vertical growth. Petiole up to 42-93 cm long, petiole canal straight with erect margins. Leaf habit erect up to 210-285 cm long, 30-42 cm wide, colour of upper surface dark green, lower surface green, and leaf bases one side rounded and one-pointed, midrib dorsally yellow, midrib ventrally green. Inflorescence erect. Peduncle red-purple in colour. Male bud ovoid, normal male bud, apex slightly pointed, dorsally pink-purple, ventrally pink-purple colour of bract, not revolute bract behaviour, lifting one at a time, and rachis position erect. Male flower compound tepal cream with yellow lobes, free tepal translucent white, rectangular, with obtuse apex, style straight, ovary straight. Fruit 5 fruits per hand, individual fruit18 cm long, straight in shape, without any floral relicts, and apical part blunt-tipped. The Seed is obpyriform and brown color (Figure 3). Variations morphology were found between *M. campestris* var. *sarawakensis* in Bonti, West Kalimantan and *M. campestris* var. *sarawakensis* in Kg. Jambu, Sarawak. *M. campestris* var. *sarawakensis* in Bonti, West Kalimantan had yellow-green pseudostem colour. Leaf bases one side rounded and one-pointed. The Dorsally pink-purple and ventrally pink-purple colour of bract (Table 1). However, *M. campestris* var. *sarawakensis* in Kg. Jambu, Sarawak had yellow-red purple pseudostem colour. Leaf bases both sides rounded. The dorsally purple and ventrally pale-purple colour of bract (Table 1) (Häkkinen, 2004).

Figure 3. *Musa campestris* var. *sarawakensis* in West Kalimantan. a. Habitus; b. Leaf and petiole canal leaf; d. Peduncle; e. Male flower; f. Longitudinally section of fruit; g. A hand of fruit.

M. campestris var. *sarawakensis* can be found on forest border in Bonti village, Sanggau District, West Kalimantan and also considered as a new distribution record (Figure 3). Previously, *M. campestris* var. *sarawakensis* was reported in Sarawak, Malaysia (Häkkinen, 2004b) and on foothill in Nek Rokon hill, Raya Pasi Natural Resource area, Singkawang, West Kalimantan (Sulistyaningsih & Irawanto, 2011).

Local people in Bonti village have not utilized *M. campestris* var. *sarawakensis*. However, local people in Keritan Ulu, Mongool, Senagang Ulu villages, Sabah, consume the heart of inner shoot and flower inflorescence as a salad with chilli sauce or sambal biris (Noweg *et al.*, 2003).

The Key character of *M. campestris* var. *sarawakensis* from Bonti West Kalimantan is pseudostem yellow-green colour, inflorescence erect, leaf base one side rounded, and one-pointed, the dorsally pink-purple and ventrally pink-purple colour of bract.

The two wild bananas species were successfully identified from Bonti district, Sanggau Regency, West Kalimantan i.e. *M. borneensis* var. *sarawakensis* and *M. campestris* var. *sarawakensis* and it is considered as new distribution records. The Conservation of *M. borneensis* var. *sarawakensis*, *M. campestris* var. *sarawakensis*, and other wild bananas in Indonesia is important to be prioritized both *in-situ* and/or *ex-situ* before it goes to extinction caused of deforestation and forests fragmentations. Conservation of wild bananas will provide long term and sustainable conservation of genetic diversity, that's important resources to improve the quality of cultivated banana using genetic manipulation in the future.

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