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Cover Page Footnote

The author would like to give thanks to Herbarium Bogoriense's keeper and staffs especially to Ridha Mahyuni for assistance some sample collections.

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Abstract

The diversity of wild banana species (genus *Musa*, listed in *Flora of Java*) has been revised. The present taxonomic study is based on morphological characteristics observed in the herbarium specimens deposited at the Herbarium Bogoriense (BO), living collections in the Bogor Botanical Garden, the Cibodas Botanical Garden, and during the explorations done at Mt. Salak, West Java. Eight species of *Musa* (*Musa acuminata*, *M. balbisiana*, *M. coccinea*, *M. ornata*, *M. salaccensis*, *M. sanguinea*, *M. textilis* and *M. velutina*) and seven infraspecific taxa of *M. acuminata* are recognized in Java, of which two infraspecific taxa are endemic. West Java is the center of distribution for the wild banana species in Java. Taxonomic descriptions including an identification key are presented.

Abstrak

Keanekaragaman Pisang-pisang Liar (Marga *Musa*) di Jawa. Studi keanekaragaman jenis pisang-pisang liar (marga *Musa*) di Jawa dilakukan untuk memperbarui informasi dalam buku *Flora of Java*. Studi taksonomi ini dilakukan berdasarkan karakter morfologi dari spesimen yang berasal dari herbarium Bogoriense (BO), koleksi pisang liar di Kebun Raya Bogor, Kebun Raya Cibodas, dan hasil eksplorasi yang dilakukan di Gunung Salak, Jawa Barat. Sebanyak delapan jenis *Musa* (*Musa acuminata*, *M. balbisiana*, *M. coccinea*, *M. ornata*, *M. salaccensis*, *M. sanguinea*, *M. textilis* dan *M. velutina*) dan tujuh infraspecific taksa dari *M. acuminata* ditemukan di Jawa, dua diantaranya merupakan taksa endemik. Jawa Barat merupakan pusat keanekaragaman pisang-pisang liar di Jawa. Deskripsi taksonomi dan kunci identifikasi disajikan dalam tulisan ini.

Keywords: diversity, java, musa, musaceae, wild

Introduction

Musaceae is a small family consisting of three genera: *Ensete*, *Musa* and *Musella*. It is found in wet tropical lowlands, although recently some species have been found to occur in higher latitudes. The genus *Musa* is the largest genus in *Musaceae*. It is a large perennial herb with a rhizome and pseudostem. The pseudostem is composed of tightly clasping leaf sheaths, which are swollen at the base. The leaves are large and spirally arranged. Inflorescence springs from the rhizome and emerges at the top of the stem, either erect or hanging. The bract and flowers are inserted independently on the peduncle. Flowers are attached to the axil of the bracts, basal flowers are either female or hermaphrodite and male flowers are found in the distal hands. The fruits are berries. Wild banana species commonly grow in forests, riversides and open lands [1].

According to Hutchinson [2] and Simmonds [3], there are 37–45 wild banana species and over 500 cultivars in

the world [1, 4]. Malesia, a biogeographical region comprising Indonesia, Brunei Darussalam, Malaysia, Papua New Guinea, Philippines, Singapore and Timor Leste, is the primary center of distribution while India is the secondary center [5]. As the center of origin of bananas, Indonesia has a large number of wild banana species. In fact, Nasution & Yamada [6] noted that Indonesia has 12 wild banana species, which are widely distributed from Sumatra, Java, Nusa Tenggara, Kalimantan, Sulawesi to Papua. A taxonomic study of bananas in Java was conducted by Miquel [7], Koorders [8, 9], Backer [10], Nakai [11] and Backer & Bakhuizen van den Brink, Jr. [12]. In *Flora of Java*, Backer & Bakhuizen van den Brink, Jr. [12] indicated that there were 17 named *Musa* species, but some of them are not valid, so revision is needed. Although Nasution [13] studied the taxonomy of *Musa acuminata* Colla and its intraspecific taxa in Indonesia, and while Nasution and Yamada [6] studied the wild bananas of Indonesia, there are still unresolved taxonomy problems with the nomenclature and morphological and molecular

characterization as well as inconsistencies in the number of species proposed for inclusion in the genus *Musa* in Java. Moreover, the taxonomy of *Musa* has received little attention from taxonomists [14].

The objectives of this study were to revise Backer & Bakhuizen van den Brink, Jr.'s [12] treatment of *Musa* in *Flora of Java*, to provide an up-to-date account of the diversity of wild *Musa* species in Java and to provide an identification key to the species.

Methods

Specimens deposited in the Herbarium Bogoriense (BO) were used in this study, and morphological analyses were carried out on 77 collection numbers. Living collections in the Bogor Botanical Garden, the Cibodas Botanical Garden and the results of the explorations at Mt. Salak, West Java were used to support the morphological analyses. Descriptors for *Musa* spp. provided by the International Plant Genetic Resources Institute (IPGRI)–INIBAP [15] were used to identify morphological characteristics.

Results and Discussion

In *Flora of Java*, Backer and Bakhuizen van den Brink, Jr. [12] recorded 17 species names for the genus *Musa* occurring in Java: *Musa acuminata* Colla, *M. arnoldiana* De Wildem., *M. balbisiana* Colla, *M. chiliocarpa* Back., *M. ensete* Gmel., *M. glauca* Roxb., *M. nana* Lour., *M. ornata* Roxb., *M. paradisiaca* L., *M. salaccensis* Zoll., *M. sanguinea* Hook f., *M. textilis* Nee, *M. troglodytarum* L., *M. uranoscopos* Lour and three forma of *M. acuminata* (i.e. forma *acuminata*, *cerifera* and *rutilipes*). Based on the International Plant Names Index (IPNI) and the Plant List, some of these names are synonyms: (1) *M. arnoldiana* De Wildem is a synonym

for *Ensete ventricosum* (Welw.) Cheesman, (2) *M. chiliocarpa* Back is a synonym for *M. x paradisiaca* L., (3) *M. ensete* J.F. Gmel is a synonym for *E. ventricosum* (Welw.) Cheesman, (4) *M. glauca* Roxb. is a synonym for *E. glaucum* (Roxb.) Cheesman, (5) *M. nana* Lour is a synonym for *M. acuminata* Colla, (6) *M. uranoscopos* Lour. is a synonym for *M. coccinea* Andr. The three forma of *M. acuminata* are treated as varieties by Nasution [13].

M. x paradisiaca L. is an accepted name for the cultivated bananas deriving from a cross between *M. acuminata* and *M. balbisiana*. *Musa troglodytarum*, locally known as *pisang tongkat langit*, was cultivated in Purwodadi Botanical Garden, East Java from 1990–2010, but it no longer exists.

Based on the BO specimens, the living collections in Bogor and Cibodas Botanical Garden and data from the exploration conducted at Mt. Salak, it is concluded that there are eight wild banana species in Java: *Musa acuminata* Colla, *Musa balbisiana* Colla, *Musa coccinea* Andr., *M. ornata* Roxb., *M. salaccensis* Zoll., *M. sanguinea* Hook f., *M. textilis* Nee and *M. velutina* Wendl. & Drude, including seven varieties of *Musa acuminata* Colla (i.e. *M. acuminata* Colla var. *bantamensis* Nasution, *M. acuminata* Colla var. *breviformis* Nasution, *M. acuminata* Colla var. *cerifera* (Back.) Nasution, *M. acuminata* Colla var. *malaccensis* (Ridl.) Nasution, *M. acuminata* Colla var. *nakaii* Nasution, *M. acuminata* Colla var. *rutilipes* (Back.) Nasution and *M. acuminata* Colla var. *zebrina* (v. Houtte) Nasution). The identification key to those species are shown by Table 1 and Table 2. All are found in West Java, and two varieties are endemic. Nasution and Yamada [6], who also studied wild banana species in Indonesia, did not include *M. sanguinea*, whereas this species can be found in the Bogor Botanical Garden.

Table 1. Identification Key to Wild Banana Species in Java

No	Morphological characters	
1	a. Inflorescence erect, flowers and fruits in one series.....	2
	b. Inflorescence hanging, flowers and fruits in two series.....	3
2	a. Male bud not imbricate.....	4
	b. Male bud imbricate.....	5
3	a. Bract apex acuminate and revolute before falling; Fruit cylindrical, dehiscent at maturity.....	<i>Musa acuminata</i> Colla
	b. Bract apex intermediate to obtuse and not revolute before falling; Fruit ovoid, not dehiscent at maturity.....	6
4.	a. Peduncle and rachis of inflorescence covered with short hairs; Bracts bright red.....	<i>Musa sanguinea</i> Hook f.
	b. Peduncle and rachis of inflorescence glabrous; Bracts bright violet.....	7
5	a. Bracts orange; Seeds cylindrical with ring-like furrow halfway.....	<i>Musa coccinea</i> Andr.
	b. Bracts lilac; Seeds obpyriform, ornamented with circle lines.....	<i>Musa salaccensis</i> Zoll.
6	a. Bract brown-green to brown-violet with green color on tips, shiny.....	<i>Musa textilis</i> Nee
	b. Bract dark-violet with green-yellow in tips, waxy.....	<i>Musa balbisiana</i> Colla
7	a. Fruit bright red and hairy.....	<i>Musa velutina</i> Wendl. & Drude
	b. Fruit green and glabrous.....	<i>Musa ornata</i> Roxb.

Taxonomic Description. *Musa acuminata* Colla. Mem. Gen. Musa 66 (1820); Zoll. Kurz. J. Agr. Hort. Soc. India 5 (1878) 112–168; Koord. Exk. Fl. Java 314 (1911); *ibid*; Exk. Fl. Java 4, 96 (1913) 518–519; *ibid*. Fl. Tjibodas 1, 2, (1922) 53–54; Back. & Bakh., Jr. Fl. Java 3 (1968) 38; Cheesman, Kew Bull. 1 (1948) 17–28; Simmonds, Mal. Nat. J. 10 (1955) 2–3; *ibid*; Evol. Banana 15 (1962) 18. — Type: based on *Musa simiarum* Rumph., Herb. Amb. 5: 125 et 61, f. 1, 1750.

Musa simiarum Rumph., Back. Hand. Fl. Java 3 (1925) 136; Ochse & Bakh., D.E.I. (1977) 522; Nakai, Bull. Tokyo Sc. Mus. 22 (1948) 15 excl. *culta* Nakai, — Type: based upon live plants in the garden of Mr. van Houtte.

Plant slender. *Pseudostem* 1.3–6.5 m high, 5–22 cm diameter with varying development of brown-black markings to almost entirely reddish brown, with or without wax. *Petiole* 25–60 cm long, purple to black blotching, margin incurved, erect. *Midrib* green, yellowish green, pink or light purple; *Leaf blades* oblong to lanceolate, 1.3–4.2 m long, 29–97 cm wide, apex truncate, base rounded or cordate with equal or unequal lobes, green upperside, green or yellowish green to purplish underside, with or without bars of purplish brown pigmentation and varying in wax development. *Inflorescence* hanging, 0.9–2 m long. *Flowers* biseriate. *Hands* spirally arranged in 3 rows, 5–14 hands per bunch and 10–32 finger per hand. *Fruits* biseriate, cylindrical or subcylindrical with acuminate tip, 3.5–10 cm long, 1.4–1.9 cm diameter, pedicels 0.4–2 cm long, tip 0.4–1 cm long. *Seeds* irregularly depressed, rounded flat or subglobose, 3.5–6.5 cm diameter, black when ripe. *Male bud* in advanced blooming ovoid to turbinate, acute or blunt, bracts convolute, coracoid, 5.1–12.5 cm long, 3–7.5 cm diameter. *Bract* varies in color — red, purple, dark purple, yellowish green or yellow — with the inner surface paler in color than the outside and one

or two bracts lifted at a time, which become revolute and deciduous at maturity.

***Musa acuminata* Colla var. *bantamensis* Nasution.** Memoirs of Tokyo University of Agriculture 32 (1991) 65. — Type: Rusdy 1634, Ranca Danu, Banten, 23-1-1989 (BO).

Pseudostem 2.4–2.5 m high, 9–10 cm in diameter, purplish blotching. *Petiole* 36–40 cm, green with purplish brown blotching, petiole canal leaf wide with erect margins. *Leaf blade* 1.4–1.5 m long, 40–45 cm wide, lanceolate, apex truncate, midrib dorsal and ventral surface green, leaf bases asymmetric, both sides rounded. *Inflorescence* up to 1.4 m long. *Peduncle* thinly pubescent. *Male bud* 7–8 cm long, 3–4 cm diameter, coracoid, blunt tip, external face dark purple, internal face light purple. *Compound tepal* pink, bright yellow at tip, free tepal oblong, translucent white. *Stamen* yellowish, filament as long as anther. *Fruit* 5.3–6 cm long, 1.5–1.7 cm diameter, pedicels 0.8–1 cm long, tip 0.5–0.7 cm long, pericarp thin, pulp yellowish, slightly soft when ripe. *Seed* irregularly angular, depressed, 4.9–5.5 cm diameter, smooth, black when ripe.

Distribution. West Java (Banten): endemic

Habitat. Open places, at 50–450 m above sea level.

Notes. Originally described by Nasution based on its brown blotching on pseudostem and its stripe ornamentation on petiole. It's cultivated in Bogor Botanical Garden.

Specimen examined. West Java: Ranca Danu, Banten, 23 Jan 1989. Rusdy 1634 (Type) (BO); Cibinong Experimental Garden, collected from Ranca Danu, Banten, Dec 1982. Rusdy 1110 (BO), Oct 1982. Rusdy 1108 (BO).

Table 2. Key Identification for Intraspecific Taxa of *M. acuminata* Colla in Java

No	Morphological Characters	
1 a	Adult leaf upper surface ornamented with brown blotches.....	2
b	Adult leaf upper surface not ornamented with brown blotches.....	3
2 a	Fruits hairy; male bud convolute.....	<i>M. acuminata</i> Colla var. <i>nakaii</i> Nasution
b	Fruits not hairy; male bud coracoids	<i>M. acuminata</i> Colla var. <i>zebrina</i> (v. Houtte) Nasution
3 a	Male bud coracoid.....	4
b	Male bud convolute.....	5
4 a	Mature pseudostem with purplish blotching, wild in.....	<i>M. acuminata</i> Colla var. <i>bantamensis</i> Nasution
b	Mature pseudostem with brown blotching	<i>M. acuminata</i> Colla var. <i>rutilipes</i> Nasution
5 a	Fruits hairy.....	<i>M. acuminata</i> Colla var. <i>cerifera</i> (Back.) Nasution
b	Fruits not hairy.....	6
6 a	Free tepal of female flowers rounded, acuminate.....	<i>M. acuminata</i> Colla var. <i>malaccensis</i> Nasution
b	Free tepal of female flowers elliptic, not acute	<i>M. acuminata</i> Colla var. <i>breviformis</i> Nasution

***Musa acuminata* Colla var. *breviformis* Nasution.** Memoirs of Tokyo University of Agriculture 32 (1991) 71. — Type: Rusdy 1632, Botanic Garden XXIII. A. 77-77a, 18-3-1989, Bogor (BO).

Pseudostem 1.9-3 m high, 8-11 cm in diameter, brown blotching, devoid of wax. *Petiole* 34–36 cm, brown blotching, petiole canal leaf wide with erect margins, winged and not clasping the pseudostem. *Leaf blades* 1-1.8 m, 38-42 cm wide, lanceolate, apex truncate, upper surface green, lower surface light green, thinly glaucous, midrib dorsal and ventral surface green or yellow green, leaf bases asymmetric, one side rounded and one side pointed. *Male bud* ovoid, 5-6 cm long, 3.5-3.9 cm wide, bract bases large shoulder, convolute tip, external face dark-purple, internal face light purple, thinly glaucous, young bracts usually blotches with yellow at base, revolute before falling. *Compound tepals* white, 2.7-2.8 cm long, 1.6-1.7 cm wide, lobe of compound tepal yellow, free tepal oblong, translucent white, 1.3-1.4 cm long, 0.7-0.8 cm wide, simple folding under apex, with triangular apex. *Free tepal of female flowers* elliptic, not acute. *Fruits* curved toward the stalk, 3.3-4.2 cm long, 1.5-1.7 cm in diameter, pedicel 0.6-0.8 cm long.

Distribution. West Java: endemic

Habitat. Open places at 20-400 m above sea level.

Notes. Originally described by Nasution based on petiole in cross section, tip and shape of male bud, and free tepal of male flower. It is cultivated in Bogor Botanical Garden.

Specimen examined. West Java: Bogor Botanic Garden XXVIII. A. 77-77a, 18 March 1989. Rusdy 1632 (Type, BO); Kebun Raya Bogor XXIII A. 77, 25 Jan 1983. Rusdy 112 (BO); Jan 1983. Rusdy 111 (BO); Batavia, G. Asepan A. 527, 400 m, 2 July 1933. van Steenis 5425 (BO).

***Musa acuminata* Colla var. *cerifera* (Back.) Nasution.** Memoirs of Tokyo University of Agriculture 32 (1991) 60; *Musa acuminata* Colla f. *cerifera* Back., Back. & Bakh. Jr., Fl. Java 3: 38, 1963. — Type: Backer 18688, Madjenang, Banjoemas, Java, 30-80 m above sea level (BO).

Musa zebrina v. Houtte f. *cerifera* Back., Hands, Fl. Java 3 (1925) 137; Ochse & Bakh., Veg. D.E.I.: 522 (1931); Heyne, Nutt. Plant. 1 (1950) 472.

Inflorescence up to 1.5 m long, peduncle thinly hairy. *Male bud* ovoid, 9-11 cm long diameter, convolute, blunt tip, external face purple, internal face light purple, without wax. *Compound tepals* white at base and pink at tips. *Free tepals* oblong to elliptic, translucent white.

Stamens yellowish. *Anthers* yellow. *Filaments* as long as anthers. *Fruits bunch* with 7-8 hands, 8-16 fruits per hand on average, 7-8 cm in diameter, pedicel 1-1.5 cm long, thinly pubescent with brown hairs, pulp yellow and slightly soft when ripe. *Seeds* many, irregular, depressed, smooth.

Distribution. West Java and Central Java.

Notes. It's very rare variety, cultivated in Bogor Botanical Garden.

Specimen examined. West Java: Banjar, Padaherang, Feb 1983. Gozali s.n. (spirit; BO); Cibinong, Kebun Koleksi Pisang ATS 1980, Feb 1983. Rusdy 1115 (spirit; BO); Cibodas, Mt. Gede, Jan 1983. Rusdy 1113 (BO); Banjar, Des 1981. Rusdy & Atik 31 (BO); Padaherang, Geger Bintang, 25 May 1981. Rusdy & Atik 17 (BO); 26 May 1981. Rusdy & Atik 27 (BO); May 1981. Rusdy & Atik s.n. (BO); G. Salak, Sept 1919. Vrolijk s.n. (BO); Aug 1919. Vrolijk s.n. (BO). Central Java: Banjoemas, Madjenang, 30-80 m. Backer 18688 (BO); Banjoemas, Kroemoet, Sept. 1919, Leg In. s.n. (BO).

***Musa acuminata* Colla var. *malaccensis* (Ridl.) Nasution.** Memoirs of Tokyo University of Agriculture 32 (1991) 75.

Musa malaccensis Ridl., Transaction Linn. Soc. 2, 3 (1888-1894) 385, Fl. Mal. Pen. 1 (1908) 62; *Musa acuminata* Colla subsp. *malaccensis* (Ridl.) Simmonds, Kew Bull. 1 (1971) 93. — Type: Ridley s.n., 1894, Tanjung Gajah Mati, Pahang (SING.).

Pseudostem to 5-6 m high, 17-18 cm diameter, brown blotching, underlying colour green-yellow with pink-purple pigmentations, devoid of wax, sap watery. *Petiole* to 55 cm long, brown small blotching, petiole canal leaf wide with erect margin, pink-purple to red, with a colour line along, winged and not clasping the pseudostem. *Leaf blades* 2-3 m long, 60-70 cm wide, lanceolate, apex truncate, upper surface green and lower surface medium green, shiny, midrib dorsal surface medium green and ventral surface light green, leaf bases asymmetric, both sides rounded. *Peduncle* to 25 cm long, 4 cm in diameter, green, slightly hairy. *Male bud* ovoid, 9 cm long, 5 cm wide, bract bases large shoulder, intermediate apex, external face red-purple and tinted with yellow, internal face purple, lifting one bract at a time, revolute before falling, thinly waxy. *Compound tepal* white, lobe of compound tepal yellow. *Free tepal of male flowers* obovate, translucent white, oval, simple folding under apex, with triangular apex. *Free tepal of female flowers* rounded, acuminate. *Fruits* straight, 7 cm long, 1.5 cm in diameter, pedicel 1 cm long, blunt tipped, pericarp thin, pulp yellow.

Distribution. West Java, Sumatera, Mentawai, Krakatau, Malay Peninsula [13].

Habitat. Open places at 300-1600 m above sea level.

Notes. Very common and abundant at Mt. Salak – West Java.

Specimen examined. West Java: Pasir Reungit, Mt. Salak, 24 July 2009. Lulut Dwi Sulistyaningsih, LDS 26 (spirit; BO); Bodogol, 24 July 2009, Dyah Martanti, DM 110 (spirit; BO); Mt. Salak, 23 July 2009, Lulut Dwi Sulistyaningsih, LDS 9 (spirit; BO); Javana Spa, Mt. Salak, 1162 m. 3 July 2008, Lulut Dwi Sulistyaningsih, LDS 2 (BO); Taman Nasional Gn. Gede – Pangrango, Sept 1982. Rusdy 1138 (spirit; BO); Cipanas, Cibodas, May 1982, Rusdy 1120 (BO); Tjibodas, Pangrango-Gede Reserve, 1400 m. 7 Dec 1960. Kostermans 261 (BO); Mt. Salak, Sept 1919. Vrolijk s.n. (BO); Mt. Sanggaboena, 1000 m., 1 Apr 1918, Backer 23921 (BO); Tjibodas, Tjipoetri, Preanger, 1600 m, 13 Apr 1915, Koorders 42853 (BO); Telaga Patengan, Mt. Tikoekoer, 1450 m. 30 March 1914, Backer 12866 (BO); Pasir Bogor, Mt. Salak, 27 Sept 1913, Backer 9401 (BO); Pasir Bogor, Mt. Salak. 1913, Backer s.n. (BO); Bantam, Mt. Kantjana, 300 m. 16 June 1912, Koorders 41041 β (BO); Pasir Datar, Mt. Pangrango, 15 March 1904, Bakhuizen v.d. Brink s.n. (BO); Mt. Salak, 1904, Valetton s.n. (BO); Tjibodas, Tjibeureum, 10 Feb 1895, Hallier 651 (BO); Tjibodas, Tjipoetri, Preanger, 1700 m, Koorders 42199 β (BO); Tjigombong, Mt. Salak. Backer s.n. (BO); Priangan, Malabar, Forbes s.n. (BO).

***Musa acuminata* Colla var. *nakaii* Nasution.** Memoirs of Tokyo University of Agriculture 32 (1991) 58, — Type: Rusdy 1636, Cipayung, Bogor, 7-2-1984 (BO).

Pseudostem 3.5-4.5 m high, 10-13 cm in diameter, brown blotching, devoid of wax. *Petiole* 45-60 cm long, purplish brown blotching, petiole margin erect. *Leaf blade* 270-280 cm long, 45-50 cm wide, lanceolate, apex truncate, base cunate, upper surface green with bars of purplish brown pigmentation and lower surface purplish brown, midrib dorsal and ventral surface purplish. *Inflorescence* 1.5 m long, peduncle and rachis pubescent with brown hairs. *Male bud* 7-7.5 cm long, 3-3.5 cm wide, convolute, tip acute, purplish, thinly glaucous. *Bract* convolute. *Compound tepal* pink at base, yellow at tip. *Free tepal* obovate, translucent white, tip acuminate. *Stamen* yellowish. *Anther* yellowish. *Filament* as long as anther. *Fruit bunch* with 4-6 hands per bunch, 16-18 fruits per hand. *Fruit* 8-8.5 cm long, 1.5-2 cm diameter, pedicel 0.8-1.1 cm, tip 0.3-0.5 cm, pericarp thinly pubescent with brown hairs. *Seed* irregularly angular, depressed, 4.6-5 cm wide, smooth, black when ripped.

Distribution. West Java and East Java.

Habitat. Open places at 300-700 m above sea level.

Notes. The epithet *nakaii* was applied by Nasution to honour Prof. Nakai who studied the taxonomy of banana species in West Java intensively during his tenure as the Director of Bogor Botanical Garden between 1944 and 1945 [13]. The specimens of this variety were cultivated in the Bogor Botanical Garden and Purwodadi Botanical Garden.

Specimen examined. West Java: Cipayung, 7-2-1984. Rusdy 1636 (Type; BO); G. Salak, Vrolijk. s.n. (BO). East Java: Kebun Raya Purwodadi, June 1983. Rusdy 1131 (BO).

***Musa acuminata* Colla var. *rutilipes* (Back.) Nasution.** Memoirs of Tokyo University of Agriculture 32 (1991) 68.

Musa acuminata Colla f. *rutilipes* Back. & Bakh. Jr., Java 3: 38, 1963. — Type: Backer 24254, Pasoeroean, Res. Pasoeroean, Java, 4 m about sea level (Lecto; BO).

Pseudostem to 3 m high, 11 cm in diameter, brown blotching, devoid of wax. *Petiole* to 26 cm long, yellowish green, petiole canal leaf wide with erect margins. *Leaf blade* to 1.8 m long, 27 cm wide, lanceolate, apex truncate, upper surface medium green and lower surface medium green, shiny, midrib dorsal surface medium green and ventral surface light green, leaf bases asymmetric, both sides rounded. *Inflorescence* hanging, peduncle to 25 cm long, 4 cm in diameter, green, slightly hairy. *Male bud* coracoid, 9 cm long, 5 cm wide, bract bases large shoulder, intermediate apex, external face red-purple and tinted with yellow, internal face purple, colour discontinuing towards the base, lifting one bract at a time, revolute before falling, thinly waxy. *Compound tepal* white, lobe of compound tepal yellow, translucent white, oval, simple folding under apex, with triangular apex. *Stamen* 5. *Fruit* straight, 7 cm long, 1.5 cm in diameter, pedicel 1 cm long, blunt tipped.

Distribution. East Java and Central Java.

Habitat. Open place, along stream, 100-1500 m above sea level.

Specimen examined. East Java: Besoeki, Mt. Taroeb (Lamongan), 12 July 1938, van Steenis 10731 (BO); Pasoeroean, Pad. Smeroehoeve, 1000-1500 m, 12 June 1935, van Steenis 7286 (BO); Central Java: Cibinong Experimental Garden ATS 2062, May 1982, Rusdy 1106 (BO); Rembang, Koendoeran, 100 m, Aug 1920, Beumee 5218 (BO); Semarang, Manggar, 50 m, 12 March 1920, Beumee 5088 (BO).

***Musa acuminata* Colla var. *zebrina* (v. Houtte) Nasution.** Memoirs of Tokyo University of Agriculture 32 (1991) 73.

Musa zebrina v. Houtte, Fl. Des Serres 10:23, f. 1061-1062, 1854-1855; Nakai, Bull. Tokyo Sc. Mus. 22°: 15, 1948, excl. var. *culta* Nakai et f. *immaculate* Nakai. — Type: Not indicated, but based upon live plants in the garden of Mr. van Houtte in Belgium.

Pseudostem 2-2.7 m high, 6-9 cm in diameter, brown blotching, devoid of wax, sap watery. *Petiole* 35-40 cm, purple with black marking at base, petiole canal leaf wide with erect margins, petiole margins nearly revolute leaving an open adaxial channel. *Leaf blade* 130-150 cm long, 26-34 cm wide, apex truncate, upper surface green and lower surface purple, midrib dorsal and ventral surface light purple, leaf bases asymmetric. *Male bud* 5.5-7.8 cm long, 3.5-4.5 cm wide, blunt tip, external face dark-purple, internal face light purple, glaucous. *Bract* coracoid. *Compound tepal* white at base. *Free tepal* oblong, translucent white. *Fruit* bunch with 5-8 hands per bunch, 14-16 fruits per hand, 5-6.6 cm long, 1.5-1.9 cm across, pedicels 0.5-0.6 cm long, tips 1.1-1.2 cm. *Seed* irregularly angular, depressed, smooth, 5.8-6.3 mm diameter, black when ripe.

Distribution. Central Java and West Java, Sumatera [11, 13]. It's native to Java and Sumatera [11].

Habitat. Open place, 250-600 m above sea level.

Notes. Easily distinguished by its purplish brown pigmentations at leaf blades. It's cultivated in the Bogor Botanical Garden.

Specimen examined: Central Java: Mt. Parungpung, Bakh v/d Brink 7689; Banjoemas, Leg In s.n.; Besoeki, Djatiroto, Heubel & Prillwitz s.n.; Tjigombong, Leg In XV J 76; Poerwokerto, Leg In XV J 69 a. West Java: Cipayang, 28 July 1981. Rusdy 1128; Djasinga, 250 m. 15 Sept 1918. Backer 26021.

Musa balbisiana Colla. Memorie della Accademia delle Scienze di Torino 25 (1820) 384.— Type: India orientalis, ex. H. Rip. 1820, Anonymous.

Musa XI Pisang batu seu pisang bidii G. E. Rumphius, Herb. Amb. S 132 (1750). The Ambonese Curiosity Cabinet (1999).

Musa sapientum C. Linnaeus Sec. F.A.W. Miquel, Fl. Ind. Bat. 587 (1855) *quoad* Pisang bidji; sec. S. Kurz in Journ. Agric. Hort. Soc. India 14 (1865-66) 296-301.

Musa paradisiaca C. Linnaeus sec. Trimen, Flora of Ceylon 4 (1898) 265.

Musa brachycarpa C.A. Backer, Handb. Flora van Java 3 (1924) 134.

Plant intermediate. *Pseudostem* up to 4 m high, 30 cm in diameter, green or yellow-green, without brown

blotches and wax. *Petiole* 60 cm long. *Leaf habit* intermediate. *Leaf blade* to 3 m long, 60 cm wide, apex truncate, upper and lower surface green, leaf bases asymmetric. *Inflorescence* hanging, up to 1.5 m long, basal flowers female, upper flowers male 10-12 flowers. *Male bud* lanceolate, dark-violet with green colour in tips. *Male flower* 14-16, biseriate, compound tepal 4-5 cm long, 1-2 cm wide, brown purplish, free tepal lanceolate, transparent. *Fruit bunch* horizontal, lax. *Fruit* ovoid, 8-16 cm long, 3.5-5 cm wide, curved at maturity, green when ripe. *Seed* subglobose-turbinate, 0.4-0.6 cm in diameter, very irregular in shape, smooth, black.

Distribution. East Java, West Java (Indonesia). Native to China (Guangdong, Guangxi, Yunnan), India, Nepal, Sri Lanka, Myanmar, Thailand, Malaysia, Papua New Guinea, Philippines. *M. balbisiana* endemic to North Eastern India [16].

Notes. *M. balbisiana* is one of the progenitors of cultivated bananas and plantains. It's contributing to B genome [2]. In Indonesia, it's cultivated in Bogor Botanical Garden and Bahira Experimental Garden.

Specimen examined: West Java: Kebun Percobaan Bahira, Bogor. 20 October 1989, Mulyati Rahayu s.n. (BO). East Java: Besoeki, Mt. Taroeb, 1400 m, 12 July 1938. van Steenis 10731 (BO); Res. Besoeki, Djember, Leg In s.n. (spirit; BO).

Musa coccinea Andr. Botanist's Repository 1 (1979) 343. — Type: Andrews, Botanist's Repository 1: t.47 (1979); Baker, Bot. Mag. t. 1559 (1893); Simmonds, Kew Bull. 14 (1960) 204.

Musa uranoscopus Lour., Fl. Cochinch 645 (1793) non Rumph (1755).

Plant slender. *Pseudostem* 1.5 m high, 5 cm in diameter, devoid of wax, sap watery. *Petiole* 35-40 cm, purple with black marking at base, petiole canal leaf wide with erect margins. *Leaf habit* intermediate. *Leaf blade* 130-150 cm long, 26-34 cm wide, apex truncate, upper and lower surface green, midrib dorsal and ventral surface light green, leaf bases asymmetric. *Inflorescence* erect, peduncle thinly pubescent. *Male bud* in advanced blooming ellips. *Bract* orange with green tips, persisting for many days, ovoid, 5.5-7.8 cm long, 3.5-4.5 cm wide. *Male flower* 2 per bract, uniseriate, compound tepal 3.5-4 cm long, light orange. *Fruit* straight, 4-5 long, 2-2.5 wide, blunt tipped. *Seed* cylindrical with ring-like furrow halfway, black, 6 mm long.

Distribution. West Java (Indonesia), China (Guangdong, Guangxi, Yunnan), Vietnam. *M. coccinea* is native to China [17].

Notes. It's cultivated in the Cibodas Botanical Garden.

Specimen examined. Leg In s.n., Sept. 1919 (spirit; BO); Leg In s.n., 1918 (spirit; BO); Tjibodas, 1400 m. Lörzing 2339 (BO).

***Musa ornata* Roxb.** Hort. Beng. (1814) 19 nomen; Fl. Ind. Vol. 2 (1824) p. 488 descr. et ed. 2 (1832) 666; Miq. Fl. Ind. Bat. Vol. 3 (1855) 589; Backer, Flora von Java 3 (1924) 134; Cheesman, Kew Bull. (1931) 297.

Plant slender. *Pseudostem* 1-3 m high, 10 cm in diameter, upper part green, moderately waxy, black blotching. *Petiole* 60 cm long, petiole margins erect. *Leaf habit* intermediate. *Leaf blade* to 2 m long, 35 cm wide, apex truncate, upper and under surface green, midrib dorsal surface reddish, leaf bases asymmetric. *Inflorescence* erect, glabrous, basal flowers female 7 hands, upper flowers male. *Male bud* in advance blooming ellips, not imbricate, external face pink-purple with yellow tips, internal face pink-purple, shiny, usually only one bract lifted at a time and not revolute on fading. *Male flower* 3-6 per bract, uniseriate, compound tepal dark orange from half to tip, white at base, free tepal lanceolate, transparent. *Fruit* 3-6 per hand, 6-8 cm long, 1 cm across, slightly curved, cylindrical, obscurely 4-5 angled, pericarp thin, pulp white. *Seed* irregularly angular, depressed, smooth, 3 mm long, 5 mm wide, black.

Distribution. West Java and East Java (Indonesia), Northeast India, Bangladesh, Myanmar, and Northern Thailand [18].

Notes. Firstly listed by Roxburgh (1814) as a name only, the original description appeared in his *Flora Indica* edited by William Carey (1824). It was clearly classified by Cheesman (1949), later by Sundararaj and Balasubramanyam (1952), and revised by Häkkinen and Sharrock (2002). This species was firstly recorded growing in wild condition along the slopes of the Eastern Ghats. It is native to Chittagong [19]. In Java, it's cultivated in the Bogor Botanical Garden.

Specimen examined. West Java: Bogor Botanic Garden, 15 Jan 2009, Lulut Dwi Sulistyaningsih, LDS 7 (spirit; BO); May 1982, Rusdy 1117 (spirit; BO). East Java: Malang, 400 m. Backer s.n. (BO).

***Musa salaccensis* Zoll.** Systematische Verzeichniss 74 (1854).— Type: Ex Mt. Salak in HB VI, HZ 1353 (no longer exist).

Plant slender. *Pseudostem* 1-3 m high, 10 cm in diameter, upper part yellowish green, base red pigmented, without blotches and wax. *Petiole* 30–35 cm. *Leaf habit* intermediate, apex truncate, upper surface green, midrib purplish, marginal veins purple, leaf bases asymmetric. *Inflorescence* erect, peduncle violet ornamented with longitudinal lines, glabrous,

basal flower female, usually 4-5 hands, upper flower male. *Male bud* in advance blooming ellips, 14 cm long, 4.5 cm wide, strongly imbricate with blunt tip, external face purplish with green edges, usually only one bract lifted at a time and not revolute on fading. *Male flowers* 2-4 per bract, uniseriate, compound tepal linear, green from half to tip, free tepal lanceolate, transparent. *Fruits* 2-4 per hand, 9 cm long, 2 cm wide, pedicel 0.2 cm long, 1 cm in diameter, slightly curved, cylindrical, obscurely 4-angled, pericarp thin, pulp white. *Seeds* obpyriform, ornamented with circle lines, tubercles on upper halves, smooth, 5 mm long, 4 mm wide, yellowish-brown.

Distribution. West Java and Sumatera [20].

Notes. *M. salaccensis* was first mentioned by Heinrich Zollinger (1854) which is considered as an invalid name since there was no diagnosis (HZ 1353). Nasution [21] stated that HZ 1353 was collected from Mt. Salak, West Java and deposited in BO but disappeared. Häkkinen and Väre [21] neotypified this species with Beccari specimen (O. Beccari 534) collected from Padang, West Sumatera and the holotype is deposited in K. This typification was rejected by Veldkamp & Sulistyaningsih (in press) who made a nomenclature history and typification of *M. salaccensis* and made Kurz s.n. (CAL) as lectotype.

Specimen examined. Bodogol, 24 July 2009. Dyah Martanti, DM 108 (spirit); Jampang Kulon, Lengkong, Tjimonyet, 4 Feb 1985. Is s.n. (spirit); Lengkong, 800 m. 28 Jan 1984. van Balgooy 4540; Sukabumi, Lengkong, Tjimonyet, 600 m. 15 Nov 1970. J. Dransfield 1056; Tjitalahap, near Bodjonglopang, 640 m. 14 Feb 1959. LR Lanjouw 22; Tjampaka, Tjidadap, Mt. Karang, 1000-1300 m. 29 Dec 1937. Buwalda 3631a; Mt. Perbakti (Salak), 1800 m. 8 Nov 1928. van Steenis 205; Tjitjoeroeg, Mt. Tjijalak, 500 m. 9 Apr 1923. Bakh v/d Brink 6591; Leuwiliang, Tjianten, Mt. Batoe, 1000 m. 31 Aug 1918. Backer 25742; Tjibeber, Tjidadap, Ps. Gombong. 1100 m. 11 Sept 1917. Backer 23007; Lampegan, 900 m. 22 July 1914. Backer 14796; Mt. Soenarari, 900-1000 m. 10 Nov 1913. Backer 6355; Bantam, Bojongmanik, Mt. Liman, 14 June 1912. Koorders 41561 β; Mt. Karang Gantoengan, 900-1000 m. 1912. Backer 6298; Buitenzorg, Tjiapoes, 27 Dec 1894. Hallier s.n.; Preanger, 1000 m. 18 Feb 1894. Koorders 15115β; Salak, Aug 1919. Vrolijk s.n.

***Musa sanguinea* Hook f.** Bot Mag. 98: t. 5975. 1872; Baker, Ann. Bot. 7: 221. 1893 et Fl. Brit. Ind. 6: 263. 1893; Schumann in Engler. Pflanzenreich 4: 23. 1900; Cheesman, Kew Bull. 2: 110. 1947 et Kew Bull. 4: 133. 1949; Simmonds, Kew Bull. 14: 204. 1960.

Plant slender. *Pseudostem* 1-2 m high, 7-10 cm in diameter, upper part yellowish green, moderately waxy.

Petiole 60 cm long, petiole margins erect. *Leaf habit* intermediate. *Leaf blade* to 1 m long, 30 cm wide, apex acute, upper and under surface green, midrib dorsal surface reddish, leaf bases asymmetric. *Inflorescence* firstly erect, after that drooping, basal flowers female 2-5 hands, upper flowers male. *Male bud* in advance blooming ellips, not imbricate, external face bright red, internal face pink reddish, shiny, usually only one bract lifted at a time and not revolute on fading. *Male flower* 3-5 per bract, uniseriate, compound tepal dark orange from half to tip, white at base, free tepal lanceolate, white. *Fruit* 3-5 per hand, 6-8 cm long, 1 cm across, slightly curved, cylindrical, obscurely 4-5 angled, pericarp thin, pulp white. *Seed* irregularly angular, depressed, smooth, 3 mm long, 5 mm wide, black.

Distribution. Native to Assam [18]. In Java cultivated as an ornamental plant.

Notes. This species planted in Bogor Botanical Garden as an ornamental plant.

***Musa textilis* Nee.** Anales de Ci. Nat. 4 (1801) 123.

Plant intermediate. *Pseudostem* up to 4 m high, 20 cm in diameter, upper part dark blotches, without wax. *Petiole* 40-50 cm long. *Leaf habit* intermediate, apex truncate, upper surface green, leaf bases asymmetric. *Inflorescence* hanging, basal flowers female, upper flowers male usually 10-12 flowers. *Male bud* lanceolate, 30-35 cm long, 10-12 cm wide, brown-green with green colour in tips, shiny. *Male flowers* 4 cm long, biseriate, compound tepal linear, green from half to tip, free tepal lanceolate, transparent. *Fruit bunch* horizontal, lax. *Fruit* narrowly ovoid, 5-8 cm long, 2-5 cm wide, curved at maturity, green. *Seeds* subglobose-turbinate, very irregular in shape, smooth, black.

Distribution. West Java (Indonesia). Native to Philippines.

Notes. Cultivated in the Bogor Botanical Garden.

Specimen examined. Leg In s.n. (spirit); Cult. Batavia, Koorders 4282 HB; De Wit s.n., CHB.

***Musa velutina* Wendl. &Drude.** Gartenflora 65 (1875) t. 823.

Plant slender. *Pseudostem* 1-1.5 m high, 7 cm in diameter, upper part green yellowish, shiny. *Petiole* up to 40 cm long, petiole margins erect. *Leaf habit* intermediate. *Leaf blade* up to 1 m long, 30-40 cm wide, apex truncate, upper surface pale green, midrib dorsal surface reddish, leaf bases asymmetric. *Inflorescence* erect, glabrous, basal flowers hermaphrodite, upper flowers male. *Male bud* in advance blooming ellips, not imbricate, external face pink-purple, internal face red-purple, usually only one bract lifted at a time and not

revolute on fading. *Male flower* 3 per bract, uniseriate, compound tepal dark orange from half to tip, white at base, free tepal lanceolate, transparent. *Fruit* 3-6 per hand, 5-7 cm long, 3-4 cm across, pink, glabrous, slightly curved, cylindrical, coriaceous, pericarp thin, pulp white. *Seed* irregularly angular, depressed, smooth, 4-6 mm long, 2-3 mm wide, black.

Distribution. West Java (Indonesia). Native to Assam [6].

Notes. Cultivated in the Bogor Botanical Garden.

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