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# New Species and Variety of *Musa* (Musaceae) from Yunnan, China

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**ABSTRACT.** One wild banana species, *Musa yunnanensis* Häkkinen & Wang Hong, and one variety of *Musa* L., *M. acuminata* Colla var. *chinensis* Häkkinen & Wang Hong, from Yunnan, China, are newly described and illustrated. These studies are based on observed morphological characteristics in the field and from specimens in various herbaria, and are supported by the existing literature on the Musaceae. A key to *Musa yunnanensis* and related taxa is provided.

**Key words:** China, *Musa*, Musaceae, Yunnan, wild banana.

The genus *Musa* L. (1753) belongs to the family Musaceae, which includes two other genera, *Ensete* Horaninow (Horaninow, 1862) and *Musella* (Franchet) C. Y. Wu (Franchet, 1889; C. Y. Wu, 1978). The genus *Musa* includes both wild species and cultivated seed-sterile bananas and plantains, with enormous socioeconomic importance. It has been estimated that *Musa* comprises about 70 species (Häkkinen & De Langhe, 2001; Häkkinen & Sharrock, 2002; Häkkinen, 2003a, b, 2004a, b, 2005a, b, 2006a, b, c, 2007; Häkkinen & Meekiong, 2004, 2005; Häkkinen et al., 2005) and over 500 cultivars (Simmonds, 1966; Karamura, 1998; Valmayor et al., 2000, 2002). However, many regions within its center of diversification in Southeast Asia have not been explored systematically, and new species continue to be discovered.

Investigations of Musaceae in Yunnan, China, have shown that there are wild banana populations in both hills and plains below an elevation of 2100 m (Häkkinen, pers. obs.) that tolerate slight frost damage. The following species have been observed in these studies, viz. *Ensete glaucum* (Roxburgh) Cheesman, *Musa acuminata* Colla, *M. balbisiana* Colla, *M. basjoo* Siebolt, and *M. itinerans* Cheesman, as well as other misidentified banana species (Roxburgh, 1814; Colla, 1920; Siebolt, 1830; Cheesman, 1949). However, no previous studies have

identified the distinctive new species *M. yunnanensis* Häkkinen & Wang Hong, even though it is widely dispersed throughout the Mekong watershed in Yunnan. The taxon is not mentioned in Chinese Musaceae literature at all, and *M. acuminata* is mentioned only by name (C. Y. Wu, 1978, 1979; H. W. Li, 1978, 1981; Y. Li, 1996; T. L. Wu, 1997; T. L. Wu & W. J. Kress, 2000; Liu et al., 2001, 2002). There are adjacent areas in northeastern India, Myanmar, northern Thailand, and northern Laos where other *Musa* species and varieties similar to *M. yunnanensis* and *M. acuminata* var. *chinensis* Häkkinen & Wang Hong occur; these species have scant mention in the literature.

In one historic report, Cheesman (1948: 28) noted, "In Assam there is a plant represented at I.G.T.A. by I.R. 209 (Mariani), I.R. 211 and I.R. 241, all sent to us by P. H. Carpenter Esq., of the Indian Tea Association at Tocklai Experimental Station. I.R. 209 was collected in the Mariani Range, and is a rather larger plant with larger fruits than the other collections, but all agree in qualitative characters."

Cheesman's report could be considered to be *Musa flaviflora* N. W. Simmonds (Simmonds, 1956a). Cheesman (1948: 28) continued, "If this form has to be separated from *M. acuminata* it will probably prove conspecific with a plant from Tagwin, Myitkyina, Upper Burma (I.R. 183), which at present pending cytogenetic studies, we cannot place. The Tagwin plant closely resembles the Mariani form in bract and flower color and in the early abortion of the male bud—only in this case the bud aborts earlier, usually after producing only a dozen male hands."

However, *Musa yunnanensis* differs in many aspects from the two plants mentioned by Cheesman. The first author has studied Cheesman's samples at Kew and Simmonds' 1956 report from his banana-collecting expedition with photographs. Research in herbaria and the field indicates that *M. yunnanensis* belongs to a larger group of *Musa* species and varieties that with these taxa are affined to an *M. acuminata* group.

*Musa acuminata* is a highly polymorphic species whose description encompasses most of the described varieties (Colla, 1920; Simmonds, 1956a; De Langhe, 1960; Nasution, 1991). *Musa acuminata* subsp. *burmannica* N. W. Simmonds was described very briefly by Simmonds, but it differs from our newly described variety *chinensis* in many aspects. *Musa acuminata* var. *chinensis* has monoclinous, hermaphroditic female flowers and waxy leaf-sheaths green-yellow in color, without any blotches, which are typical for *M. acuminata* varieties. *Musa acuminata* subsp. *burmannica*, on the other hand, has contrasting characteristics of waxless leaf-sheaths bright green in color with dense purple blotches (Simmonds, 1956a, b).

One notable characteristic common to both *Musa yunnanensis* and *M. acuminata* var. *chinensis* is the presence of monoclinous hermaphroditic female flowers that self-pollinate before the bracts open. Consequently, no hybrids of these two taxa have been observed.

#### MATERIAL AND METHODS

This paper is based on field observations made by the authors during expeditions in 2005 and 2006 to Yunnan, China. The new species and the new variety are described based on living plants in the field by completing the International Network for the Improvement of Banana and Plantain (INIBAP) *Musa* descriptor list (IPGRI-INIBAP/CIRAD, 1996). The descriptive terms here also follow traditional banana taxonomy (Simmonds, 1962, 1966). Relevant portions of the plant specimens were deposited as holotypes at the herbarium of the Xishuangbanna Tropical Botanical Garden (HITBC), with isotypes at the herbaria of H, IBSC, MO, PE, and QBG. Chromosome numbers were not counted. The complete INIBAP descriptor lists are available at H and at HITBC.

#### RESULTS AND DISCUSSION

**1. *Musa yunnanensis* Häkkinen & Wang Hong, sp. nov.** TYPE: China. Yunnan: Xishuangbanna, Jinghong Co., Longpa, 1150 m, 13 Nov. 2005, Wang Hong 8303 (holotype, HITBC [5 sheets]; isotypes, H, IBSC, MO, PE, QBG). Figures 1, 2.

Planta robusta, 1 vel 2 surculis erectis proxime ad stipem, matura usque 5 m alta, pallidoviridis, maculis parvis atropurpureis praedita. Succus aquosus. Foliorum habitus intermedius. Flores basales hermaphroditici, gemmis masculinis lanceolatis, bracteas duas revolutas eceraceas extus rubropurpureas, intus albo-cremeas simul tollentibus. Pericarpium maturum flavo-viride.

Plant normal, suckering freely, close to parent plant, 1 or 2 suckers, position vertical; the mature pseudostem to 5 m high, covered with old brown leaf sheaths, underlying color light green with purple-black blotches, waxy, sap watery. Petiole to 70 cm, waxy, petiole margins curved inward with purple-black sparse blotching, petiole bases winged and clasping the pseudostem, very waxy; leaf habit intermediate, lamina to 250 × 60 cm, narrowly elliptic, truncate at the apex, green adaxially, medium green abaxially, appearance dull, surface partially covered with a waxy coating, leaf bases symmetric, both sides rounded and auriculate, midrib dorsally light green, ventrally greenish yellow, with very corrugated lamina. Inflorescence at first horizontal and then falling vertically downward, peduncle to 45 × 4 cm, very pubescent with short hairs, light green to black; sterile bracts 2, deciduous at the opening of the first female flowers; female bud lanceolate, to 40 × 15 cm, bracts red-purple externally and cream internally, sometimes waxy, slightly imbricate, lifting several bracts at a time, revolute before falling. Basal flowers hermaphroditic, to 11 cm, ovary light green, with ovules in 2 rows per locule, the compound tepal ca. 4.5 cm, with 2 prominent thickened keels and hyaline margins, orange to yellow, the lobes orange; the free tepal ca. 3.3 cm, boat-shaped, translucent white with thickened keel and orange lobe; stamens 5, purple with fertile pollen, style ca. 3.2 cm, cream to brown with red spots, stigma ca. 0.9 cm diam., brown-gray. Male bud lanceolate, ca. 12 × 4 cm, bracts red-purple externally, cream internally, with some wax outside, with pointed yellowish apex, lifting several bracts at a time, revolute before falling, the whole bud aborting before fruits mature; male flowers on average 14 per bract in 2 rows, falling with the bract, compound tepal ca. 3.8 cm, cream with thickened keel, ribbed at the dorsal angles, with 5-toothed orange apex, the central lobes smaller than the outer lobes, free tepal ca. 1.6 cm, translucent white, oval, smooth, with thread-like apex; stamens 5, filaments white, anthers purple, anthers and style exerted; stigma cream, ovary arched, pale yellow, without pigmentation. Fruit bunch lax, with 8 hands and 15 fruits per hand on average, in 2 rows, fingers curved toward the stalk, individual fruit ca. 8 cm, curved with a pronounced ridge, pedicel ca. 22 mm, glabrous, fruit apex rounded, without relictual floral remains, immature peel color green, becoming light yellowish green with black blotches and splitting lengthwise at maturity, immature fruit pulp white, becoming white and soft at maturity; seeds nearly flat, wrinkled, ca.

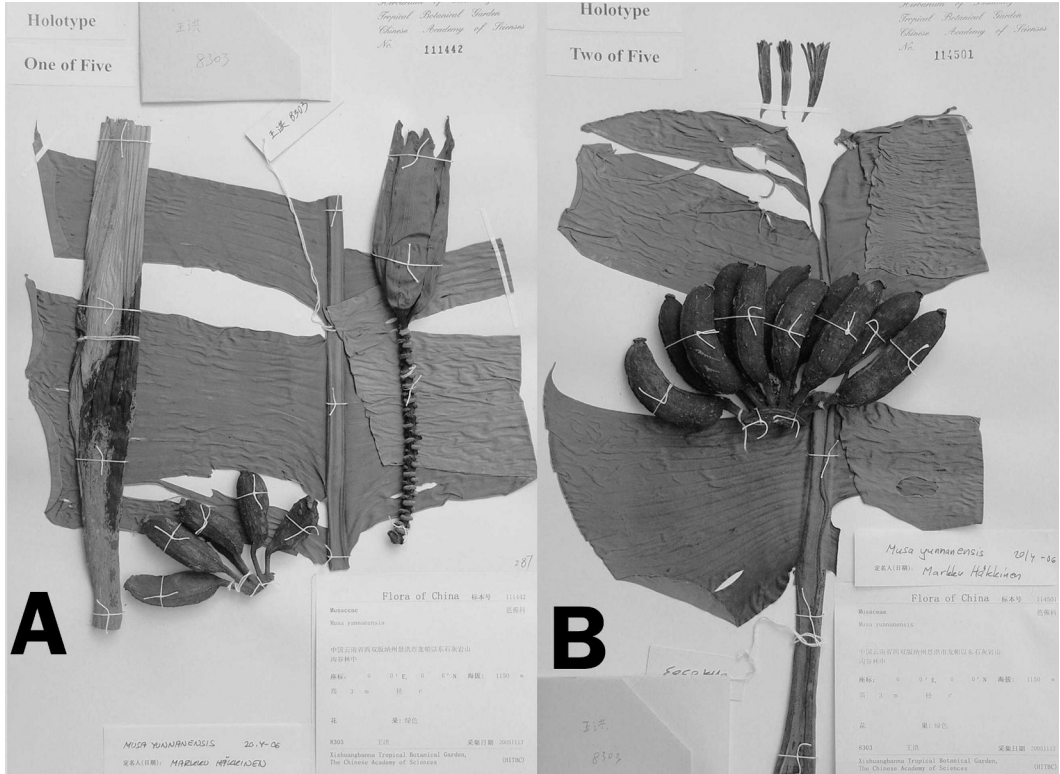


Figure 1. *Musa yunnanensis* Häkkinen & Wang Hong. —A–B. Holotype sheets one (A) and two (B) of five, Wang Hong 8303 (HITBC).

3.5 mm diam., 80 to 100 seeds per fruit. Chromosome numbers not counted.

**Vernacular names.** In Chinese, *Musa yunnanensis* is called “Lv Bajiao”—“Lv” means green and “Bajiao” means banana. The Dai name “Boguimen” refers to “Bo” as tree, “Gui” means banana, and “men” means wild (Häkkinen, pers. obs.).

**Distribution and habitat.** *Musa yunnanensis* grows abundantly in the Mekong River watersheds on slopes from 500–1800 m (Häkkinen, pers. obs.). The plants can tolerate seasonal frosts, which occur from January to February at higher elevations in Yunnan, China. The seeds, which are dispersed by monkeys and bats (Häkkinen, pers. obs.), germinate easily even in shaded environments. However, these young plants then remain dormant for years. When exposed to open light, the young plants thrive. This species is called the tree banana by the local people because it can grow among the tree branches under forest canopy, with some plants 1–2 m high. The plants appear dormant under the closed canopy, but as the canopy opens, they rapidly develop. *Musa yunnanensis* is cultivated commonly at higher elevations up to 2100 m, and the stems are used as animal fodder (Häkkinen, pers. obs.).

**Notes.** The first author tentatively used the name *Musa yunnanensis* without describing it a few years ago (Häkkinen, unpublished data) when seeds came to commercial markets from Yunnan.

**Paratypes.** CHINA. **Yunnan:** Xishuangbanna, Jinghong Co., July 2005, *M. Häkkinen*, 500, 501, 502, 503 (HITBC); Mengla, Xiola Hwy., 10 Nov. 2005, *Wang Hong* 8289 (HITBC); Mengla, Xiaola Hwy., 10 Nov. 2005, *Wang Hong* 8290, 8291, 8292 (HITBC); Mengla, Menglun, Yinchang, 11 Nov. 2005, *Wang Hong* 8300 (HITBC); Jinghong, Longpa, 13 Nov. 2005, *Wang Hong* 8302 (HITBC); Jinghong, 14 Nov. 2005, *Wang Hong* 8305 (HITBC); Jinghong, Mt. Mengsong, 29 Nov. 2005, *Wang Hong* 8363 (HITBC); Jinghong to Menglun, Mang Me, 15 Dec. 2005, *Wang Hong* 8377 (HITBC); Jinghong, A Ke Lao Zhai, 20 Dec. 2005, *Wang Hong* 8379 (HITBC); Dehong, Yinjiang, Mulai River, 8 Jan. 2006, *Wang Hong* 8382 (HITBC); Dadugang, Hill, 25 Jan. 2006, *Wang Hong* 8386 (HITBC); Xishuangbanna Trop. Bot. Garden, 6 Mar. 2006, *He Li-qing* 40 (HITBC).

**2. *Musa acuminata* Colla var. *chinensis* Häkkinen & Wang Hong, var. nov. TYPE:** China. Yunnan: Simao Distr., Jiancheng Co., Lixian Jang River, close to Vietnam border, 380 m, 7 Dec. 2005, *Wang Hong* 8369 (holotype, HITBC [5 sheets]; isotypes, H, IBSC, MO, PE, QBG). Figures 3, 4.

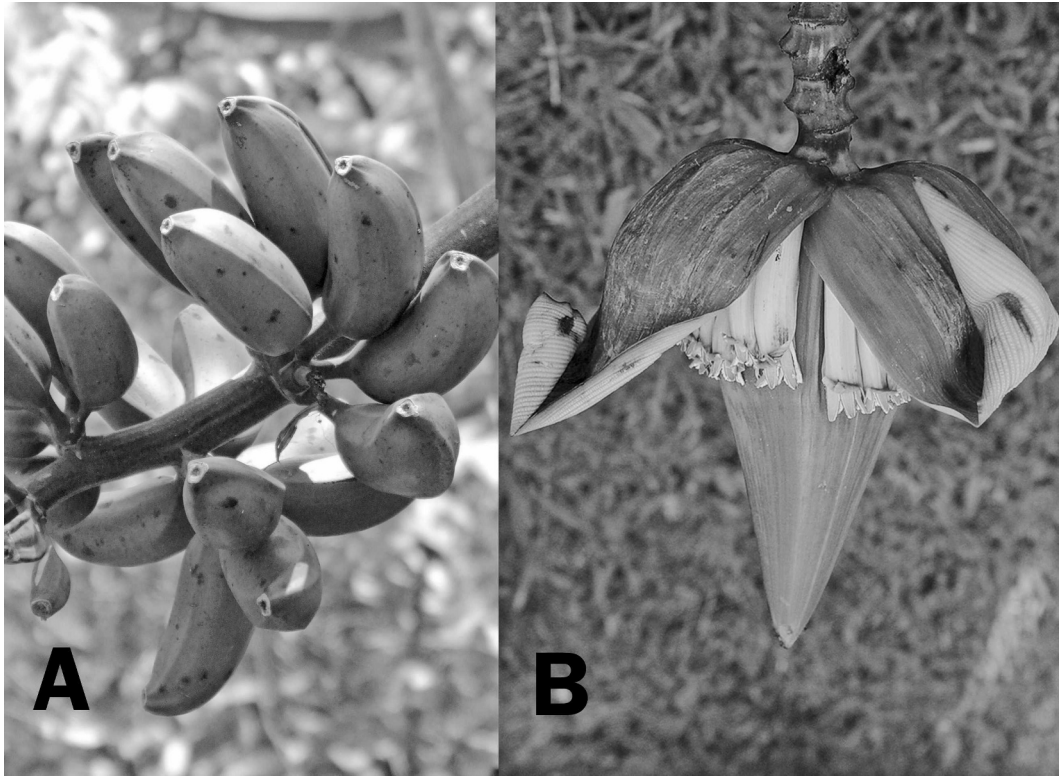


Figure 2. *Musa yunnanensis* Häkkinen & Wang Hong. —A. Fruit bunch. —B. Male flowers. Photos by Häkkinen (A) and Wang Hong (B) from Mengla, Xiola Hwy., Yunnan, China.

Planta intermedia, 3 ad 5 surculis erectis proxime ad stipem, matura usque 4 m alta, pallidoviridis, maculis parvis roseis praedita. Succus lacteus ac non aqueus. Foliorum habitus intermedius. Flores basales hermaphrodi, gemmis masculinis lanceolatis, bracteam unam, revolutam, ceraceam, extus lazulinopurpuream, intus atrorubram tollentibus. Pericarpium maturum luteum.

Plant intermediate, suckering freely, close to parent plant, 3 to 5 suckers, position vertical; the mature pseudostem to 4 m, covered with old brown leaf sheaths, underlying color light green with small rose color blotches, waxy, sap milky. Petiole to 75 cm, some wax, petiole margins wide and erect with dark brown large blotching, petiole bases winged and not clasping the pseudostem; leaf habit intermediate, lamina to 205 × 60 cm, narrowly elliptic, truncate at apex, green-yellow adaxially, medium green abaxially, appearance dull, wax on both surfaces, leaf bases symmetric, both sides rounded, midrib dorsally green, ventrally light green, with few stripes on lamina. Inflorescence semi-pendulous and then falling vertically downward, peduncle to 40 × 3.8 cm, glabrous and medium green in color; sterile bracts 2, persistent at the opening of first female flowers; female bud

lanceolate, to 28 × 10 cm, bracts blue-purple externally and dark red internally, some wax, bract apex obtuse, cream colored, heavily imbricate, lifting as several bracts at a time, revolute before falling. Basal flowers hermaphrodite, ca. 7 cm, the compound tepal ca. 4 cm, with 2 prominent thickened keels with hyaline margins, cream colored, lobes orange, free tepal ca. 3.3 cm, boat-shaped, translucent white with thickened keel; stamens 5, anthers brown, with fertile pollen; ovary light green, arrangements of ovules in 2 rows per locule, style ca. 3.3 cm, cream; stigma brown, ca. 0.6 cm diam. Male bud lanceolate, ca. 18 × 6.5 cm, bracts blue-purple externally and dark red internally, some wax, bract apex obtuse, cream colored, lifting one bract at a time, revolute before falling; male flowers on average 17 per bract in 2 rows, falling with the bract, compound tepal ca. 3.6 cm, cream with thickened keel, ribbed at the dorsal angles, with 5-toothed orange apex, the central lobes smaller than the outer lobes, free tepal ca. 2.1 cm, translucent white, rectangular, smooth, with triangular apex; stamens 5, filaments cream, anthers gray, anthers and style exerted, stigma orange, ovary arched, cream, without pigmentation.

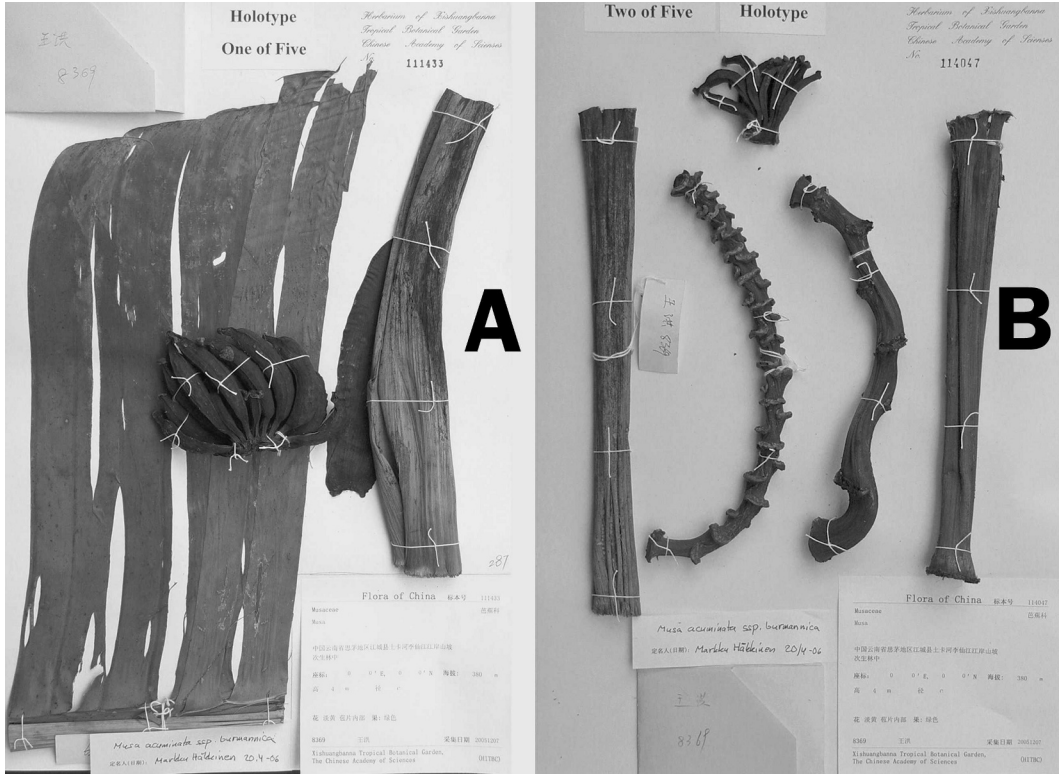


Figure 3. *Musa acuminata* var. *chinensis* Häkkinen & Wang Hong. —A–B. Holotype sheets one (A) and two (B) of five, Wang Hong 8369 (HITBC).

Fruit bunch compact, with 5 hands and 17 fruits per hand on average, in 2 rows, fingers curved upward; individual fruit ca. 11 cm, curved, rounded, pedicel ca. 1.5 cm, glabrous, fruit apex with acumen ca. 0.5 cm and floral relicts, immature peel light green, becoming yellow at maturity, immature fruit pulp white, becoming creamy and soft at maturity; seeds nearly flat, wrinkled, ca. 4 mm diam., ca. 80 seeds per fruit. Chromosome numbers not counted.

**Vernacular names.** In Chinese, variety *chinensis* is called “Xiao Guo Ye Bajiao”—“Xiao” means small or little, “Guo” means fruit, “Bajiao” means banana. The Dai name “Boguimen” refers to “Bo” as tree, “Gui” means banana, and “men” means wild (Häkkinen, pers. obs.).

**Distribution and habitat.** *Musa acuminata* var. *chinensis* grows abundantly from the Lixian River on the China–Vietnam border to Xishuangbanna westward along the China–Laos border to the Yingjiang River (Häkkinen, pers. obs.). The new taxon then extends northward along the China–Burma border and is found in river watersheds along these slopes, at altitudes between 300 and 800 m. This species is also called the tree banana by the local people because it

can grow under shaded tree cover. The new variety is not commonly cultivated for fodder.

**Paratypes.** CHINA. **Yunnan:** Mengla Co., Guangnali, Shorea forest, 1 Dec. 2005, Wang Hong 8364 (HITBC); Xishuangbanna Trop. Bot. Garden, 2005, He Li-qing 4, 25, 26, 45 (HITBC).

KEY TO *MUSA YUNNANENSIS* AND RELATED TAXA IN YUNNAN

- 1a. Sap watery; petiole margins curved inward; leaf bases auriculate; peduncle pubescent with short hairs; bracts red-purple externally, cream internally, with sharp yellowish apex, not imbricate . . . . . *Musa yunnanensis*
- 1b. Sap milky; petiole margins erect; leaf bases rounded; peduncle glabrous, bracts blue-purple externally, dark red internally, with obtuse cream apex, imbricate. . . . . 2
- 2a. Upper parts of leaf-sheaths green-yellow, without any blotches, waxy; basal female flowers hermaphroditic . . . . . *Musa acuminata* var. *chinensis*
- 2b. Upper parts of leaf-sheaths bright green, with heavy reddish brown blotches, not waxy; basal flowers female . . . . . 3
- 3a. Male flowers white with bright yellow apex; male bud persistent upon fruit maturity . . . . . *Musa acuminata* subsp. *burmannica*
- 3b. Male flowers pale orange-yellow with deep orange apex; male bud aborting before fruit maturity and dehiscence . . . . . *Musa flaviflora*

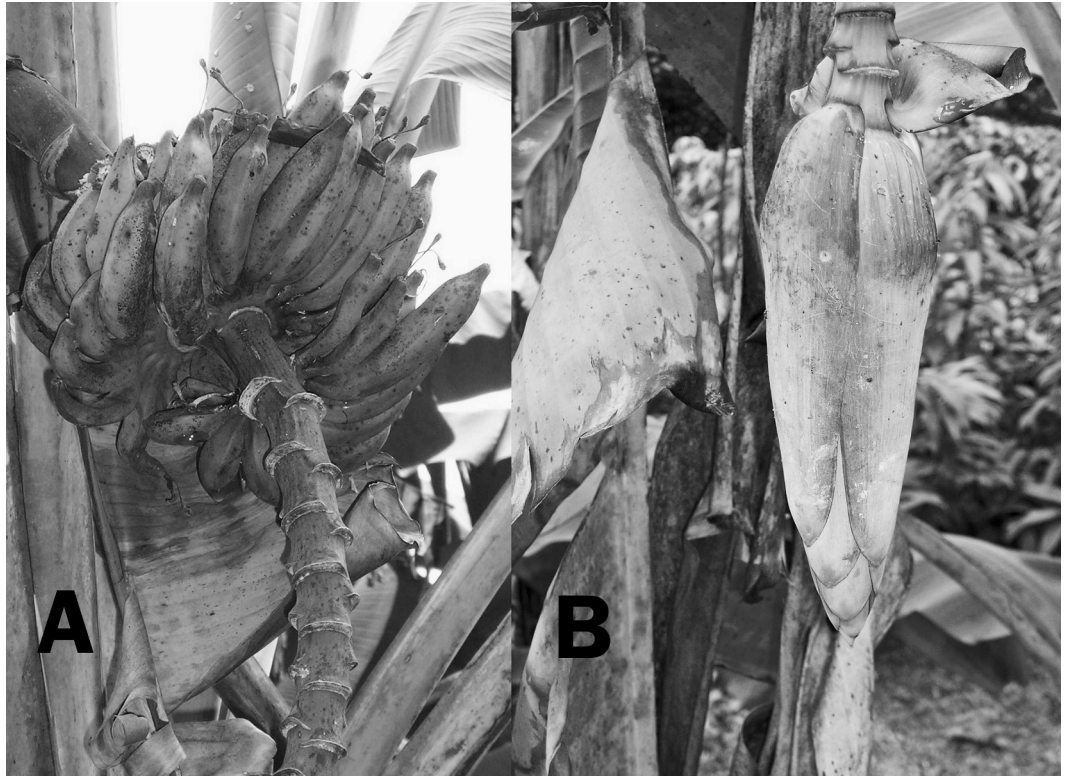


Figure 4. *Musa acuminata* var. *chinensis* Häkkinen & Wang Hong. —A. Fruit bunch. —B. Male flower. Photos by Häkkinen from the Xishuangbanna Tropical Botanical Garden, Yunnan, China.

In conclusion, both newly described taxa have huge potential breeding value. *Musa yunnanensis* is a cold-tolerant taxon and can stand several degrees of frost. It also appears to be disease resistant, as no common banana diseases have been observed among any visited wild populations. We observed more than 30 wild populations of *M. yunnanensis* during our field studies, with the individual plants varying from just a few up to hundreds, which were seen along roadsides, in river valleys and ravines, and on steep slopes. However, it remains to be determined how well the new species would thrive in altitudes below 500 m. Any natural variation within the species remains for further study. For breeding programs, *M. yunnanensis* is dwarf in size, and in some populations the fruit bunches are large and the flesh of the fruits is very sweet. The only challenge is to breed out the seeds.

Other similar germplasm from *Musa acuminata* subsp. *burmannicoides* De Langhe (1960) is already commonly used in breeding programs, so the two new, disease-free taxa could be worthy additions, especially in breeding new edible varieties: *M. yunnanensis* for cooler climates and *M. acuminata* var. *chinensis* for warmer ones. It is also notable that both *M.*

*yunnanensis* and *M. acuminata* var. *chinensis* have basal, hermaphroditic female flowers and therefore self-pollination occurs before the floral bracts open.

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