

Germplasm and New Cultivars or Breeds

REDISCOVERY OF *Musa splendida* A. Chevalier AND DESCRIPTION OF TWO NEW SPECIES (*Musa viridis* and *Musa lutea*)

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INTRODUCTION

Musa splendida A. Chevalier, known in Vietnam as Chuoi Gai, is a very rare species of wild banana which was drifting toward oblivion. Cheesman (1947), who revised the classification of the bananas, simply mentioned the term *M. splendida* but did not include its description in his monumental series "Critical Notes on Species" published in Kew Bulletin from 1947 to 1950. Simmonds (1962) doubted the status of *M. splendida* as a valid species and Champion (1967) associated it with *M. sanguinea* Hook. f. and *M. laterita* Cheesman, two distinct and widely recognized species of the genus *Musa*. The leading banana taxonomists of the world seemed prepared to relegate the scientific epithet *M. splendida* as *species ignota*.

In 1994, the International Network for the Improvement of Banana and Plantain (INIBAP) and the Vietnam Agricultural Science Institute (VASI) co-sponsored a Banana Collection, Characterization and Conservation project in Vietnam. The banana prospection missions

under the leadership of Director Le Dinh Danh covered most of Vietnam and collected many new and very interesting *Musa* germplasm. However, the banana explorers never encountered Chuoi Gai (Danh et al. 1998).

A comprehensive report on germplasm resources of Vietnam devoted a section on bananas (Le et al. 1999). The article enumerated the most outstanding banana cultivars, all the popular ornamental species and some wild relatives but did not mention *Musa splendida*. Earlier, Cayco Vietnam, "An Illustrated Flora of Vietnam" showed drawings of indigenous *Musaceae*. Likewise, *Musa splendida* was not included (Ho 1993). However, some elderly people in Vietnam maintain that Chuoi Gai exists between Lao Cai and Sa Pa. Dr. Inge Van den Bergh, INIBAP Associate Expert at VASI, surveyed the original home of *Musa splendida* and discovered large populations still thriving in the Red River Valley, near Lao Cai.

The national banana variety collection of Vietnam is maintained at Phu Ho Fruit Research Center. The wild

and cultivated banana specimen gathered by the banana collection missions under Le Dinh Danh were added to the Phu Ho *Musa* germplasm collection.

HISTORY

Botanical Description of *Musa splendida* A. Chevalier

The original description of *M. splendida* was published by Auguste Chevalier in *Revue de Botanique Appliquée et d'Agriculture Tropicale* in 1934 under the subtitle "Bananiers Spontanés de l'Indochine." The formal description was in Latin and the text in French.

(In Latin). *Musa splendida*. Stolonifera, non caespitosa, truncus ad 1.5-2.0 m altus, gracilis, viridogrescens; folia erecta, lanceolata 1.5-2.0 m longo; inflorescentia pendula, rachis tomentosa; bractae lanceolatae rubro-aurantiaca; flores viridi-flavos 5-8 includentes; bacca matura reflecta lutea basi in pedicellum attenuata.

(Text in French translated to English). Upper-Tonkin: Muong-xen, at 700 m elevation, on the road from Laokay to Chapa in flower and fruit, December 4, 1913; one of the most characteristic plants of the region's vegetation.

Plant arising spontaneously, 3-4 m high (whole plant, including leaves), rhizomes creeping, not clump-forming

(always only one isolated plant and not in clumps); pseudostem slender, black-green. Leaves numerous, upright, lanceolate, 1.5 to 2.0 m long, green and not waxy, blades slightly shredded. Inflorescence spindly and short, at first upright, then arched, rachis finely hairy, 25-35 cm long. Bracts lanceolate, 12 cm long, 5-6 cm broad, red-orange, tightly clasping each other and strongly imbricate, dehiscing after anthesis. Flowers uniseriate, 5-8 per bract, lemon yellow, tinged with green at the tips, 5-5.5 cm long. Compound tepal 5-lobed, the two outer lobes largest with 2 overlapping auricles, the external subulating the internal, rounded, the 3 inner lobes a little shorter, rounded. Young fruits lanceolate, 3-sided, pointed at both ends; peduncle long, pendent at first, then curving upwards, 3-4 per row, ovules very numerous in each ovary, embedded in a gel. Mature fruits pale yellow, non-edible, containing seeds.

Plants are extremely abundant in the brushlands of Upper Tonkin and form large populations, especially in the Red River Valley. It is apparently not utilized in textile or paper manufacture. Vernacular name: Chuoi Gai (Annamese).

Distinguishing Characters of *Musa splendida*

M. splendida has been closely associated with or often mistaken for *M. sanguinea* and *M. laterita*. But a careful comparison of their important plant characters clearly shows that they are different and distinct from each other. The distinguishing characters are presented in Table 1.

Table 1. Distinguishing characters of *Musa splendida*.

	<i>M. splendida</i>	<i>M. sanguinea</i>	<i>M. laterita</i>
Rhizome	rhizomatous	non-rhizomatous	rhizomatous
Natural stand	sparse population, suckers spread to different directions	suckers sprout close to mother plant forming clusters	rhizomes creeping, forming sparse populations
Inflorescence	erect (Fig. 1)	sub-horizontal (Fig. 2)	erect (Fig. 3)
Bract color	red-orange (Fig. 1)	dark pink to pale crimson (Fig. 2)	bright brick-red (Fig. 3)
Fruits	pendant, droop towards the ground (Fig. 1)	fruits turn slightly upwards (Fig. 2)	fruits point upwards (Fig. 3)
Ripe fruit color	pale yellow	greenish-yellow	yellow
Bract shape,	broadly lanceolate,	narrowly lanceolate,	intermediate,
Imbrication	imbricated	convolute	convolute
References	Chevalier 1934; plus original observations	Cheesman 1949; Hakkinen and Sharrock 2003	Cheesman 1949; Hakkinen 2001; Hakkinen and Sharrock 2003



Fig. 1. *Musa splendida* A. Chevalier. Normal, fertilized fruit bunch (left), unfertilized fruits (right). Inset: closeup of male bud showing red-orange bracts. (Source: Inge Van der Bergh)



Fig. 2. *Musa sanguinea* Hook. f. Male bud color dark pink, fruit bunch sub-horizontal. (Source: C. Jenny, CIRAD)



Fig. 3. *Musa laterita* Cheesman. Male bud color bright brick-red. (Source: R. Valmayor)

The suspicion that *M. splendida* could be a mere synonym of either *M. sanguinea* or *M. laterita* can be dismissed with the clear differentiation presented above. The validity of *M. splendida* is established with the rediscovery of living specimen thriving near Lao Cai, where the original accession was collected and where the vernacular name Chuoi Gai has remained popular.

Recent Studies on *Musaceae* of South China

The southern provinces of China bordering Vietnam, Laos and Myanmar form the northern frontier of *Musa* germplasm diversity. The correct classification of *M. splendida* and other species endemic to northern Vietnam can not be authenticated without taking into consideration the *Musaceae* of South China. Many characterization studies were published in recent times but some only added confusion to an already complex situation.

Fortunately, A. Z. Liu et al. (2002) conducted an extensive field observation and intensive literature review and herbarium research on *Musa* of South China. They straightened out the confusing synonymy, abolished spurious species and established the true identities of the indigenous *Musa* species in South China. *M. luteola*, *M. lushangensis* and *M. dechangensis* described by J.L. Liu (1987, 1989, 1990) as new species in Szichuan province were reduced as mere synonyms of *M. basjoo* Siebold. *M. wilsonii* Tutch. and *M. rubra* Wall. ex Kurz earlier recognized by H.W. Li (1978) as present in Yunnan province were also considered misidentifications of *M. laterita* and *M. sanguinea*, respectively. But a distinct species previously grossly misidentified as *M. coccinea* Andr. was recognized as a new species and described as *M. paracoccinea* A. Z. Liu et al. (2002).

This development proved most interesting. First, *M. paracoccinea* looks very different from its namesake, *M. coccinea*. Second, the accompanying illustration of *M. paracoccinea* (Fig. 4) instead shows similarities with *M. splendida*. The authors are not surprised by the resemblances observed because *M. paracoccinea* is indigenous to Yunnan province of South China while *M. splendida* is native to Lao Cai province of northern Vietnam, separated in part only by the Red River.

But the similarities are limited to gross appearances as detailed comparison revealed marked differences in plant stature, color and shape of male bud, color and structure of flowers, and size and shape of seeds. *M. paracoccinea* is much bigger, the plant measures 4-6 m high compared to 3-4 m in the case of *M. splendida*. The male bud of the former species produces bracts which are bright red and ovate, those of the latter species are red-

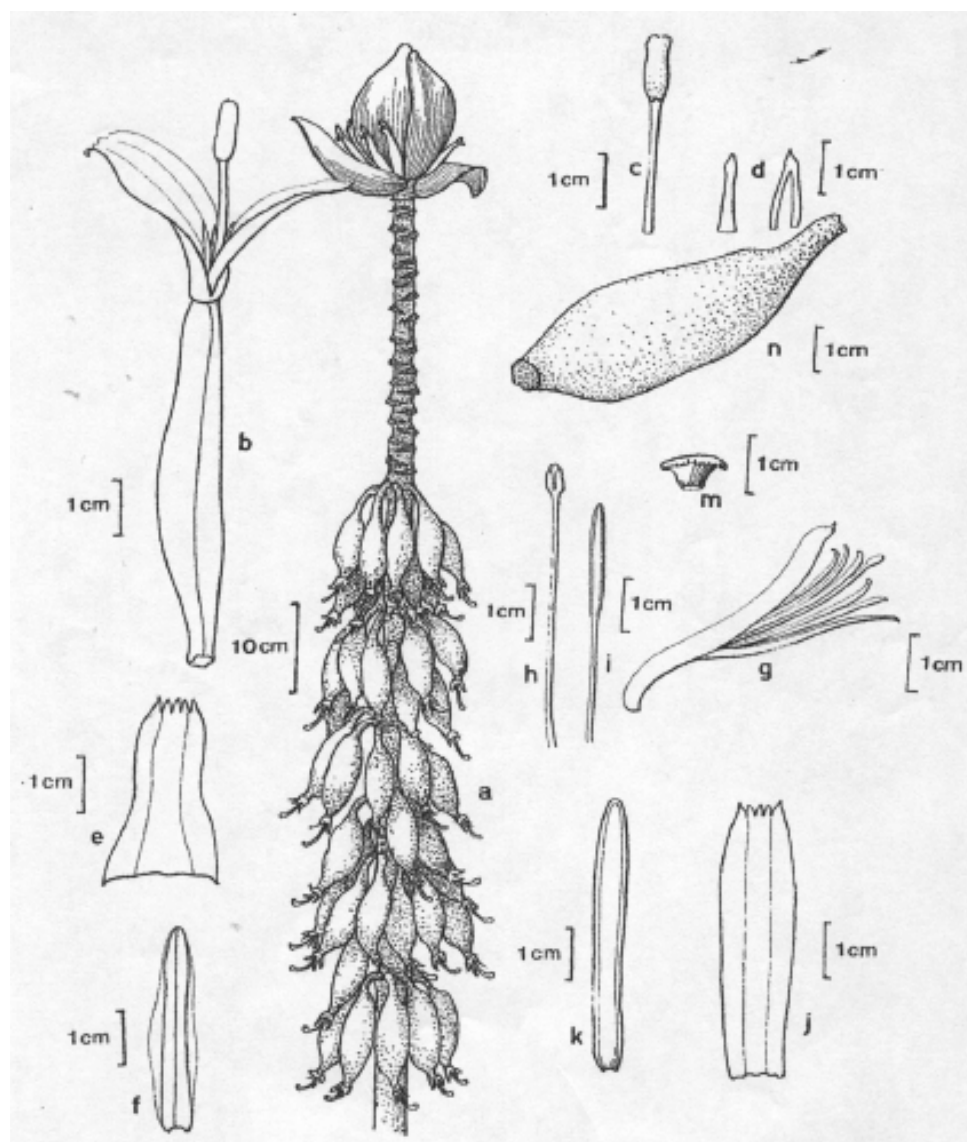


Fig. 4. *Musa paracoccinea*: a) infructescence and inflorescence; b) female flower; c) stigma of female flower; d) style of female flower; e) compound fused tepal of female flower; f) free tepal of female flower; g) male flower; h) stigma of male flower; i) style of male flower; j) compound fused tepal of male flower; k) free tepal of male flower; m) seed; n) mature fruit. (Source: Botanical Bulletin Academia Sinica, Vol. 43, 2002)

orange, and lanceolate-ovate in shape. The flowers of *M. paracoccinea* are orange-yellow, seeds are small and bell-shaped. Those of *M. splendida* are lemon yellow and seeds are large and mushroom-shaped. If these differences do not merit separation of species, *M. splendida* A. Chevalier published in 1934 enjoys the priority of usage principle and must prevail.

In 1996, INIBAP and the South China Agricultural University (SCAU) co-sponsored a Banana Collection,

Characterization and Conservation project in South China. Dr. Chen Houbin of SCAU was appointed leader of the South China banana prospection missions. He was assisted by Director Le Dinh Danh, leader of the highly successful *Musa* Collection, Characterization and Conservation program of Vietnam during the initial phase of the project. Dr. Houbin's team collected 54 accessions, 41 clones of edible banana and 13 wild and ornamental species (Houbin and Valmayor 1997). The majority of the wild accessions represented various forms of *M. itinerans*

Cheesman and *M. balbisiana* Colla. Two interesting accessions were labeled Hekou Zhitianjiao (CHN 001-03) and Napo Zhitianjiao (CHN 002-13). The former accession was obtained from Hekou county at the southeastern corner of Yunnan province and showed close affinities to *M. paracoccinea* (A. Z. Liu et al. 2002). The latter was collected from Napo county in the southwestern area of Guangxi province. It shows close affinities to Chuoi Rung Hoa Sen, an indigenous species growing in Lao Cai province of northern Vietnam. Yunnan and Guangxi provinces of South China share common boundaries with the northern provinces of Vietnam (Fig. 5).

The Muséum National d'Histoire Naturelle in Paris holds some very valuable herbarium materials of the genus *Musa* from Vietnam and South China. A specimen mislabeled *M. uranoscopus* Lour. was collected 70 years ago in southern China, in what was then called Kwangsi Province, now Guangxi, near Nanning (the provincial capital), W.T. Tsang 23320, December 4-6, 1933 (P). Markku Hakkinen carefully examined the herbarium materials in Paris and concluded that the specimen is actually *M. splendida* A. Chevalier, which was described in 1934 from

material collected in neighboring North Vietnam. *M. uranoscopus* was the old term for *M. coccinea*, a very popular ornamental banana in South China and Vietnam. Hakkinen's important observation stresses the need to expand the work initiated by A. Z. Liu et al. (2002) and consider *Musa* germplasm resources that transcend the Vietnam-China border. The authors hope that the cooperation initiated by researchers of SCAU and Phu Ho Fruit Research Center through INIBAP will continue and complete the identification and characterization of the *Musaceae* germplasm that the two neighboring countries share.

Characterization Studies of *Musa* Accessions at Phu Ho

Two of the most interesting indigenous accessions introduced at Phu Ho were recently characterized and classified. The first species described was *Musa exotica* (R. Valmayor 2001) followed by *Musella splendida* (R. Valmayor and L.D. Danh 2002). Four accessions remained undescribed but characterization data of two accessions,



Fig. 5. Map of Northern Vietnam and South China showing distribution of selected wild *Musa* species.

namely Chuoi Rung Hoa Sen and Chuoi Rung Hoa Do, are now complete and ready for formal, botanical description. The word Chuoi, meaning banana, is usually part of the actual name which is often descriptive. Chuoi Rung means jungle banana. Chuoi Rung Hoa Sen means jungle banana with lotus colored flower. The meaning of Chuoi Rung Hoa Do is jungle banana with red flower (Van den Bergh 2001).

Musa splendida A. Chevalier and *Musella splendida* R. Valmayor and L.D. Danh are different plants belonging to different genera.

BOTANICAL DESCRIPTIONS OF NEW *MUSA* SPECIES

(Based on Descriptors for Banana [*Musa* spp.] IPGRI-INIBAP/CIRAD)

Musa viridis R. Valmayor, L. D. Danh and M. Hakkinen, *sp. nov.*

Plantae non-rhizomatosae; bases foliorum acuturum; inflorescentiae et infructescentiae erectae; fructus pendentes, argenti-virides dum immaturi; alabastrum masculinum bracteis aurantiaci-rubris caducis praeditum.

Vernacular name: Chuoi Rung Hoa Sen

Plant suckering moderately, originating close to parent plant, position vertical; leaf habit intermediate between erect and drooping; pseudostem 2.1-2.9 m high, circumference at 100 cm above ground normal (intermediate between slender and robust); color medium green, appearance shiny, not pigmented.

Leaf petiole light green with small, brown-black blotches, petiole 51-70 cm long; petiole canal open with erect margins, not winged, not clasping the pseudostem, margin > 1 cm; leafblade 171-220 cm long, 71-80 cm wide, color of upper leaf surface green, lower surface medium green, appearance shiny, no wax on both surfaces, leaf base pointed (Fig. 6), asymmetric, leaf corrugation moderate, cigar leaf light green.



Fig. 6. Leaf base of *Musa viridis* pointed and asymmetric. (Source: L.D. Danh)

Inflorescence erect, peduncle 31-60 cm long, dark green, hairless; basal flowers hermaphrodite, uniseriate; rachis erect, sometimes bending slightly towards the tip, bare; male bud intermediate between lanceolate and ovoid, 21-30 cm long (Fig. 7a).

Bracts slightly pointed, slightly imbricated, external color pinkish-lilac, internal surface very light lilac, fading towards the base; bract scar not prominent on rachis; shape $0.28 < x/y < 0.30$ (intermediate between lanceolate and ovate); not revolute, not waxy, moderate grooves on bract (Fig. 7b).



Fig. 7a. Fruit bunch of *Musa viridis* erect, fruits pendant and green (Source: L.D. Danh)



Fig. 7b. Male bud of *Musa viridis* pinkish-lilac, fruits seedy and tip slightly curving upwards. (Source: L.D. Danh)

Male flower bright yellow, falling with the bract; compound tepal not pigmented, lobe green; free tepal opaque white, oval, simple folding under apex; anther and filament color white; style cream, stigma orange; ovary cream, ovules arranged in two rows (Fig. 8a).



Fig. 8. Male flowers of (a) *Musa viridis* yellow, compound tepal not pigmented, ovary cream; (b) *Musa lutea* yellow with red tinge, compound tepal pigmented reddish, ovary yellow. (Source: L.D. Danh)

Fruit bunch truncated, cone shape, compact; fruits pendant, 12 or less per cluster, 16 to 20 cm long, straight but tip sometimes curving upwards, cross-section round, bottlenecked, persistent style; immature color silvery green turning light green at maturity, pulp white turning ivory when ripe, sweet but seedy, seeds wrinkled, angular.

Original accessions collected from forested areas in Van Chan district, Yen Bai province, Vietnam on November 29, 1994 by Le Dinh Danh. Acc. No. VN1-052. Important physiographic data: latitude 21.36° north, longitude 104.31° east; elevation, 257 m; average rainfall, 1547 mm; average temperature, 22° C, soil type, fertile forest soil. Planting materials, suckers; collected accessions maintained in the National Banana Germplasm Collection at Phu Ho Fruit Research Center.

Holotypus: Herbarium specimen held at Phu Ho Fruit Research Center Herbarium, Phu Ninh, Phu Tho, Vietnam. Collector Le Dinh Danh, collection no. VN1-052, date collected November 29, 1994, place collected Van Chan district, Yen Bai province, Vietnam. Herbarium sheet no. PHH No. 002.

Musa lutea R. Valmayor, L. D. Danh and M. Hakkinen, *sp. nov.*

Plantae non-rhizomatosae; bases foliorum rotundatarum; inflorescentiae et infructescentiae erectae; fructus pendentes, lutei dum immaturi; alabastrum masculinum bracteis subrosei-lilacinis caducis praeditum.

Vernacular name: Chuoi Rung Hoa Do

Plant suckering freely, originating close to parent plant, position vertical; leaf habit erect; pseudostem 2.1 to 2.9 m high, circumference at 100 cm above ground slender, color green-yellow, appearance shiny, pigmentation pink purple.

Leaf petiole light green with small, dark-brown blotches, petiole 51-70 cm long; petiole canal open with erect margins, not winged, not clasping the pseudostem, margin < 1 cm; leafblade 171-220 cm long, < 70 cm wide, color of upper leaf surface green, lower surface medium green, appearance shiny, no wax on both surfaces, leaf base rounded (Fig. 9), asymmetric, leaf corrugation moderate, cigar leaf light green.



Fig. 9. Leaf base of *Musa lutea* rounded and asymmetric. (Source: L.D. Danh)

Inflorescence erect, peduncle 31 to 60 cm long, green-yellow, hairless; basal flowers hermaphrodite, uniseriate; rachis erect, bare; male bud ovoid, 21-30 cm long (Fig. 10a).

Bract slightly pointed, slightly imbricated, color of external and internal surfaces orange-red, not fading towards base, apex tinted with yellow; bract scar not prominent on rachis; shape $0.28 < x/y < 0.30$ (intermediate between lanceolate and ovate); lifting one at a time, not revolute, not waxy, moderate grooves on bract (Fig. 10b).

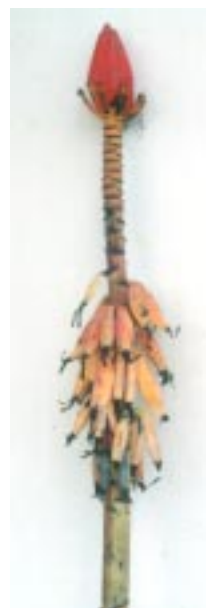


Fig. 10a. Fruit bunch of *Musa lutea* erect, fruits pendant and yellow even at immature stage. (Source: L.D. Danh)



Fig. 10b. Male bud of *Musa lutea* orange-red, many fruits unpollinate and seedless, color yellow with reddish tinge. (Source: L.D. Danh)

Male flower yellow with red tinge, falling with the bract, compound tepal pigmented reddish, lobe green; free tepal opaque white, oval, simple folding under apex; anther and filament color cream; style cream, stigma orange; ovary yellow, ovules arranged in two rows (Fig. 8b).

Fruit bunch shape cylindrical, lax; fruits pendant, 12 or less per cluster, 16-20 cm long, straight, cross section with pronounced ridges, lengthily pointed tip with persistent style. Unpollinated fruits common, seedless but persistent on the bunch; color yellow even when immature and sometimes develop orange-red blushes while approaching maturity; commonly seedless but when pollinated, many seeds develop.

Original accession collected from forested areas in Van Chan district, Yen Bai province, Vietnam on September 18, 1994 by Le Dinh Danh, Acc. No. VN1-049. Important physiographic data: latitude 21.36° north, longitude 104.31° east; elevation 257 m; average rainfall 1547 mm, average temperature 22° C, soil type, fertile forest soil. Planting materials, suckers; collected accessions maintained in the National Banana Germplasm Collection at Phu Ho Fruit Research Center.

Holotypus: Herbarium specimen held at Phu Ho Fruit Research Center Herbarium, Phu Ninh, Phu Tho, Vietnam. Collector Le Dinh Danh, collection no. VN1-049, date collected, September 18, 1994, place collected Van Chan district, Yen Bai province, Vietnam. Herbarium sheet no. PHH No. 003.

Paratypus: Vietnam, Thanh Hoa Province, between Lung Van and La Han, M.E. Poilane 18878, September 1, 1931 (P). This was discovered among the undetermined specimens of *Musa* at the Museum National d'Histoire Naturelle in Paris by Markku Hakkinen.

DIAGNOSTIC CHARACTERS OF THE TWO NEW SPECIES

Musa viridis and *Musa lutea* are differentiated from the common indigenous *Musa* species of Vietnam and South China, namely *M. balbisiana* Colla, *M. acuminata* Colla, *M. itinerans* and *M. sanguinea* by their erect inflorescences and fruit bunches. The other species enumerated above have pendulous or subhorizontal inflorescences and fruit bunches.

The two new species can also be easily distinguished from other native *Musa* species bearing erect inflorescences and fruit bunches such as the recently rediscovered *M. splendida* and the popular *M. laterita* because the latter two species are rhizomatous.

M. viridis and *M. lutea* can likewise be differentiated from the other species with erect inflorescences but are not rhizomatous, namely *M. coccinea* and *M. exotica*, by the color and structure of the male bud and plant stature. *M. coccinea* is a very small plant with red bracts that remain persistent on the inflorescence stalk, a highly desirable characteristic of ornamental bananas. The male bud of *M. viridis* is pinkish-lilac while that of *M. lutea* is orange-red. Their bracts are caducous, falling with the male flowers. *M. exotica* differs from *M. viridis* by its orange-red bracts and yellow fruits compared to the pinkish-lilac bracts and silvery green fruits of the later species. While both *M. lutea* and *M. exotica* bear yellow-colored fruits at

immature stage, those of the former species are pendant while those of the latter are held perpendicular to the stalk. Both new species are much larger than *M. coccinea* and slightly bigger than *M. exotica*. The stature of *M. paracoccinea* of South China is the largest among the species with erect infructescence described above.

M. viridis and *M. lutea* are easily differentiated from each other by the color of their fruits and male buds. Immature fruits of *M. viridis* are silvery green while those of *M. lutea* are yellow. The male bud of the former species is pinkish-lilac while those of the latter is orange-red (Figs. 7b & 10b). Both species produce viable seeds but *M. lutea* is partially parthenocarpic. Unpollinated fruits develop with sweetish but thin pulp. Leaf base of *M. viridis* is pointed, that of *M. lutea* is rounded (Fig. 6a & 9). The Latin terms *viridis* and *lutea* were selected to highlight the marked differences in immature fruit color of *M. viridis* which is silvery green from those of *M. lutea* which is yellow.

ADDENDUM

The senior author would like to take this opportunity to designate in detail the holotypus of his previously published species, so that they will conform to the requirements of the International Code of Botanical Nomenclature:

Musa exotica R. Valmayor, Philippine Agricultural Scientist 84:326. 2001.

Holotypus: Cuc Phuong Forest Reservation, Ninh Binh province, Vietnam. Collector R. Valmayor, date collected February 17, 1995. Botanical Herbarium (CAHUP), Museum of Natural History, University of the Philippines Los Baños, Laguna, 4031 Philippines. Herbarium sheet no. 67098.

Musa alinsanaya R. Valmayor, Philippine Agricultural Scientist 84:327. 2001.

Holotypus: *Musa* Germplasm Bank, Leyte State University, Baybay, Leyte, Philippines; Collected by Dr. Lelita Gonzal, date collected July 10, 2003. Botanical Herbarium, Department of Biological Sciences, Leyte State University, Philippines. Herbarium sheet no. VH No. 1280.

Musa acuminata Colla ssp. *errans* (Blanco) R. Valmayor, Philippine Agricultural Scientist 84:328. 2001.

Neotypus: Mt. Makiling, Los Baños, Laguna, Philippines. Collector Dean Domingo Angeles, date collected March

14, 2003. Botanical Herbarium (CAHUP), Museum of Natural History, University of the Philippines Los Baños, Laguna, 4031 Philippines. Herbarium sheet no. 67099.

Musella splendida R. Valmayor and L.D. Danh, Philippine Agricultural Scientist 85:205. 2002.

Holotypus: Forest in Ha Giang province, Vietnam. Collector Le Dinh Danh, date collected May 5, 1994. Accession No. VN1-038. Phu Ho Fruit Research Center Herbarium. Herbarium sheet no. PHH No. 001.

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