

## Classification and characterization of *Musa exotica*, *M. alinsanaya* and *M. acuminata* ssp. *errans*

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**B**anana is native to Southeast Asia and is the region's greatest contribution to the tropical fruit industry. From its center of origin, banana was introduced to Africa, Latin America, and the South Pacific where it gained popularity and great economic importance. In the developing countries of the world, cooking bananas serve as a staple food while dessert bananas are the most affordable

fruit. Vast plantations have been established in the tropics and banana is shipped to distant temperate markets where the fruit enjoys strong and consistent demand.

But the commercial cultivars of banana succumb to serious diseases. For almost a century, Gros Michel was the leading export variety until it had to be replaced by Cavendish clones in the mid-1960s because it was susceptible to Fusarium wilt. Cavendish banana later proved to be susceptible to the Sigatoka disease, for which existing control measures were

economically prohibitive and environmentally hazardous.

Every time a serious epidemic occurs, a banana breeding programme is launched. A vital part of any plant improvement programme is the assemblage of germplasm materials that provide sources for resistance genes. The favourite donors are the wild relatives that thrive under adverse conditions. The popular destination of banana collection missions is Southeast Asia, the center of origin and diversity of bananas.

The earlier banana improvement programme was based in Trinidad and Jamaica in the former British West Indies. The exploration missions primarily covered Malaysia, Thailand (formerly known as Siam) and Myanmar (formerly Burma). The banana collectors concentrated on wild *Musa acuminata* Colla, the progenitor with close affinity to both Gros Michel and Cavendish cultivars. The large assemblage of the polymorphic *M. acuminata* was segregated into various forms. These forms were later classified by Simmonds (1956) into five subspecies: (1) *malaccensis* (Ridl) Simmonds, (2) *siamea* Simmonds, (3) *burmanica* Simmonds, (4) *microcarpa* (Beccari) Simmonds, and (5) *banksii* (F.v. Muell.) Simmonds. The characteristic that distinguishes *banksii* is the presence of hermaphrodite basal flowers rather than female flowers as commonly observed in the other *Musa* species.

The United Fruit Company and its banana collection teams sponsored the later banana improvement programme, concentrating on Indonesia and the Philippines. The germplasm materials they gathered were sent to the Lancetilla Plant Introduction Garden in La Lima, Honduras. Wild *M. acuminata* and its edible derivatives were again the center of interest because wild *M. balbisiana* and its hybrids with *M. acuminata* introduce the gene responsible for starchiness in their hybrid progenies. Starchiness is an undesirable characteristic of bananas in the export market.

The banana germplasm resources of Vietnam had not been systematically explored due to the country's extended struggle for freedom. But in 1994, Vietnam's Agricultural Science Institute (VASI) received a grant from the International Network for the Improvement of Banana and Plantain (INIBAP) to collect, conserve, and evaluate indigenous *Musa* germplasm. Five prospection missions were launched and a large collection was established at Phu Ho Fruit Research Center in Vinh Phu province. Under the leadership of Mr. Le Dinh Danh, the author joined the exploration of the Cuc Phuong Forest Reservation, collected and introduced *M. exotica* R. Valmayor sp. nov. to Los Baños, Laguna, Philippines. Much earlier (1959-60), the author was appointed as the Filipino counterpart of Paul Allen, leader of the United Fruit Co. banana prospection mission to the Philippines. Together, they explored the whole country, gathered all sorts of *Musa* germplasm, and cooperated to

reestablish the national banana variety collection of the University of the Philippines Los Baños.

The common *M. acuminata* in the Philippines with its perfect basal flower clusters had earlier been associated with the subspecies *banksii* (Brewbaker and Gorrez 1956). But detailed characterization studies revealed major differences in plant, fruit and flower bract characteristics from the *banksii* found in Papua New Guinea, Samoa and northern Queensland, Australia. This finding led Allen to suggest the reclassification of the Philippine *acuminata* under the subspecies *errans* (Allen 1965). The adoption of *errans* conforms with the priority of usage principle as Fr. Blanco first applied the term *errans* for the *acuminata* of the Philippines in 1837 whereas F.v. Muell. used *banksii* in 1863 (Cheesman 1948). The adoption of *M. acuminata* Colla ssp. *errans* (Blanco) R. Valmayor, comb. nov., is the first effort to formalize the classification and registration of the new subspecies.

Another major discovery of the banana prospection missions in the Philippines was that alinsanay was a distinct species. Peasant farmers had formerly mistaken alinsanay with wild abaca (*M. textilis* Nees). Brewbaker and Gorrez (1956) later surmised it to be a hybrid between abaca and the local saging matsing (*M. acuminata*). However, based on the results of detailed morphological and cytogenetic studies, alinsanay significantly differs from abaca in plant, fruit, and flower bract characteristics. Neither can alinsanay be accepted as a hybrid of abaca which has 10 pairs of chromosomes and saging matsing which has 11 pairs of chromosomes, because the expected sterile progenies are fully seeded during normal meiosis. Simmonds rejected the hybrid theory, whereas Allen recommended elevation of alinsanay to a distinct species. The author agrees with Allen, and this report is the first effort to describe *M. alinsanaya* R. Valmayor sp. nov. as an indigenous *Musa* species in the Philippines.

The botanical description of *M. exotica* is original while descriptions of alinsanay and saging matsing have been adapted from Brewbaker and Gorrez (1956). The accompanying diagnostic descriptions (in Latin and English) rationalize their new status as species and subspecies and explain why the given names were selected. Photographs provide strong evidences of the uniqueness of the three wild banana species. A note on the cytology of *M. exotica* by Mendioro (2001) indicating 10 pairs of chromosomes sup-

ports its classification under section *Callimusa*.

## Botanical descriptions of new *Musa* species and subspecies

*Musa exotica* R. Valmayor, sp. nov. (Figure 1)

Plant stooling profusely; suckers vertical, originating close to parent plant; pseudostem slender 0.5-2 m high, 3-6 cm in diameter, light green with purplish blotches.

Leaf petioles green with sparse purple blotches, 20-42 cm long, petiole canal open with erect margins, slightly winged not clasping the pseudostem, petiole margins with purple lines. Leaf blades oblong, up to 1.5 m long, 25-40 cm wide, upper and lower surface light green, dull, leaf base pointed, asymmetric, hardly any wax on surface, midrib green, leaf corrugation striped, cigar leaf green. Bract leaves 2, basal portion orange-red, tip green, leaflike.

Inflorescence erect, its peduncle 10-15 cm long, smooth, yellow-green; flower bud ovoid, 10 cm long, 4-6 cm wide, bract colour orange-red on the outside, paler on the inside, apex yellow, bracts greatly overlap, lifting 2 or more at a time, not revolute, smooth, not waxy, strongly grooved.

Basal flowers female, 2-3 per bract, compound tepal yellow, 2.5-2.8 cm long, tip greenish, free tepal cream, closely appressed to the large orange stigma. Stamens infertile, 5, short, inserted at the base of the style. Ovary yellow, smooth, about 5 mm long, pedicel almost indistinguishable from ovary.

Male bud in advanced flowering erect, 10 cm long, 4 cm wide. Bracts orange-red on the external face, paler on the internal face, tip yellow, greatly overlapping, several bracts lifted at any one time, persistent, turning brown and falling off at a later stage.

Male flowers 3 per bract; compound tepal yellow-orange, lobe green, longitudinally grooved; free tepal yellow-orange, rectangular, boat-shaped, slightly longer than compound tepal. Fertile stamens 5 as long as compound tepal, filaments creamy, translucent. Anthers yellowish orange; style yellowish; stigma orange. Mature male flowers brown, persistent at its early stages, dehiscent at maturity.

Fruits yellow, few, 10-22, uniseriate, perpendicular to stalk, 2-3 per hand, small, 2-3 cm long, 3-4 cm wide, straight, seedless, angular, apex blunt; style persistent, brown at maturity.



Figure 1. *Musa exotica* R. Valmayor sp. nov.

Original accession collected from the Cuc Phong Forest Reservation, Ninh Binh province, Vietnam on February 17, 1995. Important physiographic data: Latitude, 20°14' - 20°24' North; Longitude, 105°29' - 105°44' East; Elevation, 200-650 m; Average rainfall, 2157 mm; Temperature, 24.7°C (max 39°C, min 16.7°C); Soil type, Argillite - Quartz, yellow feralite.

Holotypus: Living accession now growing in the garden of the author in Los Baños and at the Horticulture Nursery, University of the Philippines Los Baños. Herbarium specimen held at the Department of Botany, College of Arts and Sciences, University of the Philippines Los Baños, CAHUP.

*Musa alinsanaya* R. Valmayor, sp. nov. (Figure 2)

Plant stooling; pseudostems 2.5-4.0 m high, 20-30 cm in diameter at base, deep reddish purple; leaf sheath and petioles glaucous, green.

Leaf blades oblong, 3-4 m long, 40-55 cm wide, truncate at apex, rounded at base, with unequal basal lamina, green, glaucous, midribs green; petioles 50-60 cm long, their margin almost erect, leaving an open adaxial channel, rather upright, closely appressed to the pseudostem.

Inflorescence subhorizontal, its peduncle and rachis thickly pubescent with brown hairs, flowers in the 10-16 basal hands female, upper hands male.

Female flowers from 12-23 per hand (average 16) in two rows; compound tepal white, tips green with filiform appendages; free tepal white, about half as long as compound tepal.

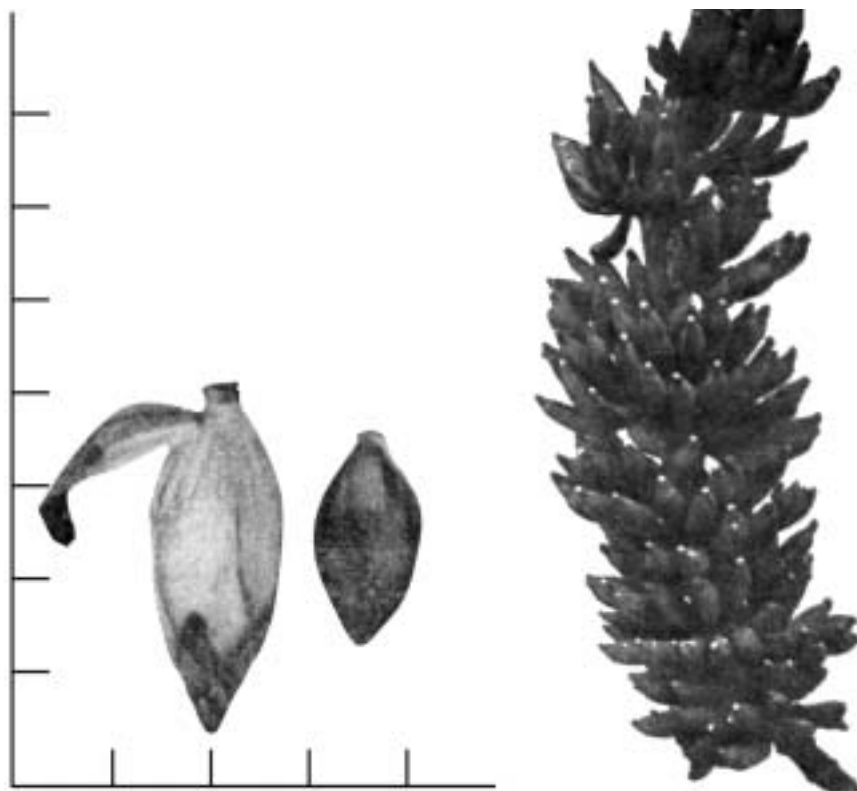


Figure 2. *Musa alinsanaya* R. Valmayor sp. nov. (Original photographs from Brewbaker and Gorrez).



Figure 3. *Musa acuminata* Colla ssp. errans (Blanco) R. Valmayor ssp. nov.

Male bud in advanced blooming ovoid, more or less acute, the bracts imbricate, outer surface green with purple edges, about two-thirds of the length of the bud, not conspicuously ribbed, subacute at tips, glaucous, inner surface deep reddish purple at tip and gradually becoming lighter at basal end. One bract lifted at a time, deciduous.

Male flowers per bract from 8-12 (average 10) in two rows 5-6 cm long; compound tepal 4.0-4.8 cm long, with an average of 4.5 cm; white, tips green with 3 filiform appendages about 3-4 mm long, the center filiform usually a little bit shorter; free tepal 2.5-3.0 cm long with an average of 2.7 cm, 1.0-1.3 cm wide with an average of 1.1 cm, boat-shaped, white, apiculate.

Fruit bunch asymmetrical, fruits and pedicels exhibiting marked geotropic reflex. Individual fruits very seedy, 10-12 cm long, 2.0-2.3 cm in diameter, conspicuously 4-5 angled, abruptly narrowing at the base into a pedicel of 1.5 cm long, and at the apex into a conspicuous acu-

men; pericarp about 2 mm thick, green at ripening, pulp nearly absent, white; fruits heavily seeded.

Seeds black, flattened, more or less smooth, 3-4 mm in diameter and 5-7 mm high.

The description of alinsanay was based on plants growing along roadsides in the Bicol National Park between Daet, Camarines Norte Province and Sipocot, Camarines Sur Province, Philippines. Original description by Dr James L. Brewbaker and David D. Gorrez, formerly of the University of the Philippines Los Baños.

Holotypus: Living accession now maintained at the Abaca Research Center, Leyte State University in Baybay, Leyte Province, Philippines. Herbarium specimens held at the same institution.

*Musa acuminata* Colla ssp. errans (Blanco) R. Valmayor, comb. nov. (Figure 3)

Basionym: *Musa troglodytarum* L. var. *errans* Blanco, Fl. Filip. 247. 1837.

Plant stooling freely, habitat sylvan; pseudostems 3.0-4.5 m high, 25-30 cm in diameter at height of 50 cm, green or more or less purplish, black-brown with age; leaf sheaths and petioles, glaucous, green. Fiber strips poorly, longitudinally weak, stems transversely very tough.

Leaf blades oblong, 2.5-4.0 m long, 50-70 cm wide, truncate at tip, rounded at base, with basal lamina equal, green, glaucous, mid-ribs green; petioles 50-90 cm long, their margins almost erect, leaving an open adaxial channel, rather lax, closely appressed to pseudostem where margins flare and become more or less blackened and scarious.

Inflorescence subhorizontal or pendent, its peduncle and rachis thickly pubescent with short brown hairs, basal flowers hermaphrodite, the number of hands 15-17, upper hands male. Spadix acute, green, 50-60 cm long.

Perfect flowers 20-28 per bract in two rows; 2 or 3 stamens perfectly developed in flowers of all basal bracts, shedding abundant pollen, remaining stamens more or less rudimentary (staminodal); development of staminodes into well-formed stamens taking place in the apical, 5-7 hands preceding the male flowers. Subtending bracts long (30-35 cm) narrow (9-11 cm), green, conspicuously ribbed longitudinally, transversely corrugated between the ribs, compound tepal about 3.4 cm long, 1.2 cm wide, translucent, yellow-tipped, deeply lobed, the outer two lobes acute and 10-11 mm long, central three lobes fused with outer two of these appearing as serrations about 4 mm from tip of central lobe; free tepal translucent, boat-shaped, rounded at tip with faint shoulders, about half as long as compound tepal; stigma broad, flattened, slightly bifurcate, upper part of style red-speckled; ovary pale green, distinctly 3-5 angled, glabrous above, minutely pubescent at base.

Male bud in advanced blooming ovoid to top-shaped, acute, the bracts convolute, reaching the tip of bud; bracts pale yellowish, green turning red-brown on fading, longitudinally ribbed, transversely corrugated between the ribs, acute at tips, glaucous, inner surface light green. One bract lifted at a time, not conspicuously revolute on fading, deciduous.

Male flowers about 20 per bract in two rows; tepals similar in length and colour to those of female flowers; compound tepal yellow at tip, lobed, with outer lobes only 4-6 mm long tipped with a short filament, inner 3 lobes equal in length, 3-4 mm long; free tepal boat-shaped, acutely tipped with more or less prominent shoulders; stamens at first about as long as com-

pound tepal, later exerted, colourless, stigma and ovary greatly reduced.

Fruit bunch asymmetrical if borne subhorizontally, regularly symmetric when pendent; the 300-350 fruits and pedicels exhibiting marked geotropic curvature. Individual fruits very seedy, 8-12 cm long, 1.3-1.6 cm in diameter, conspicuously 4-5 angled when immature but only obsoletely angulate when mature, abruptly narrowed at the base into a pedicel of 1-1.5 cm (minutely pubescent) and at the apex into a conspicuous acumen 6-8 mm long; pericarp about 2 mm thick, yellow-green at ripeness, pulp nearly absent, whitish.

Seeds dull black, commonly more or less warty, irregularly angulate, strongly flattened, 6-8 mm broad and 3-4 mm high.

The description of saging matsing was based on plants growing on the slopes of Mt. Makiling, Los Baños, Laguna, Philippines. Original description by Dr James Brewbaker and David D. Gorrez, formerly of the University of the Philippines Los Baños.

Neotypus: *M. acuminata* ssp. *errans* is natural to the forest of Mt. Makiling. Since the original material used by Fr. Blanco is no longer available, fresh specimens were collected from Mt. Makiling. Herbarium specimens held at the Department of Botany, College of Arts and Sciences, University of the Philippines Los Baños, CAHUP.

### Diagnostic characters of the three wild bananas in Latin and English

(In Latin). *M. exotica* R. Valmayor, sp. nov. A musis speciebus popularis ornamentalis aliis differt alabastro masculino valde imbricato pulchro aurantiorubro. Hoc alabastrum masculinum ab illo musarum pictarum aliarum bracteis singulis ad apicem flavissimis et distale viridis discedent. Tepalum compositum floris masculi colore vivide flavo-auranto, ad apicem lobis viridibus notat. Ex specibus aliis seriei Callimusae fructibus juvenibus flavissimus ad pedunculum erectum perpendicularibus *Musa exotica* praeterea distinguit. Epitheton *exotica* pulchritudinem et singularitatem speciei novae indicat.

(In English). *M. exotica* R. Valmayor is differentiated from other popular ornamental bananas by its attractive, orange-red, male bud. The markedly imbricate orange-red, male bud is distinguished from other colourful bananas by the bright yellow apices of individual bracts that are lined with a streak of green at the distal end. The compound tepal of the male flower is characterized by a bright,

yellow-orange colour, punctuated at its tip by green lobes. *M. exotica* can further be differentiated from other species in the Callimusa series by the bright yellow colour of immature fruits that are attached perpendicular to the erect stalk. The term *exotica* was selected to describe the beauty and uniqueness of the new species.

(In Latin). *Musa alinsanaya* R. Valmayor sp. nov. A *Musa textilis* Nee (nomen commune: abaca) et cetero speciebus seriei Australimusae coloribus bractearum extus viridibus autem intus atrorubropurpureis distinguenda. Color ruber basin versus bractearum gradatim decrescens. Ex abaca, quae fructus comparate perpauciores grandioresque infructescentibus subhorizontales exorientes ferens, alinsanay fructibus numerosibus parvis geotropis infructescentibus pendentibus etiam recedit. *Musa fehi* Bert. ex Viell. (nomen commune: Fe'i banana) fructibus grandibus esculentis infructescentibus erectibus valde distinguit. *Musa peekelii* Lauterbach (nomen commune: pakel) differt coloribus bractearum et bracteis multis (singillatim in alinsanay) simultaneis elevatis. Epitheton *alinsanaya* nomen vernaculum alinsanay perpetuat.

(In English). *M. alinsanaya* R. Valmayor sp. nov. is distinguished from abaca, *M. textilis* Nee and other species in the Australimusa series by the green outer surface but deep reddish purple inner surface of its bracts. The red coloration gradually becomes lighter toward the base. The species can also be differentiated from abaca by the large number of small, geotropically reflexed fruits borne on pendent bunches in contrast to the fewer but larger fruits arising from subhorizontal bunches of abaca. It is distinctly different from Fe'i bananas, *M. fehi* Bert. ex Viell., which bears large and edible fruits on erect, upright bunches. *M. alinsanaya* also differs from pakel, *M. peekelii* Lauterbach, because of its bract color and the habit of lifting only one bract at a time in contrast to pakel where many bracts lift simultaneously. The term *alinsanaya* was adapted to perpetuate its vernacular name.

(In Latin). *Musa acuminata* Colla ssp. *errans* (Blanco) R. Valmayor, comb. nov.

Basionym: *Musa trogloditarum* L. var. *errans* Blanco, Fl. Filip. 247, 1837

Differt a subspeciebus aliis *Musae acuminatae* floribus hermaphroditis in fasciculis florum basilibus contentis. Subspecies *banksii* Papua New Guineae, Samoae, et Queenslandiae borealis hunc caractere insolitem etiam praebentem, autem subspeciem *errans* infructescen-

tibus usque ad 26 manis unaquaeque usque ad 25 fructibus parvis congestis praeditis. Ex contrario, infructescens subspecies *banksii* 10-14 manis unaquaeque 13-17 fructibus relative grandioribusque laxioribus praedita.

(In English). *M. acuminata* Colla ssp. *errans* (Blanco) R. Valmayor comb. nov.

Basionym: *Musa troglodytarum* L. var. *errans* Blanco, Fl. Filip. 247, 1837.

This subspecies is differentiated from other *acuminata* subspecies by the presence of hermaphrodite flowers in its basal flower clusters. This characteristic is unique also in one other *acuminata* subspecies, namely, *banksii* of Papua New Guinea, Samoa and northern Queensland, Australia. However, the subspecies *errans* differs from *banksii* in having an extended fruit bunch bearing up to 26 hands with as many as 25 small, densely packed fruits per hand. On the other hand, the fruit bunch of *banksii* only produces 10 to 14 hands with each

hand bearing 13 to 17 fruits that are larger and less compact than those of *errans*. ■

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