

Germplasm and New Cultivars or Breeds

The Wild and Ornamental *Musaceae* of Vietnam with Descriptions of Two New Traveling Bananas

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Two new species of *Musa* found in Vietnam are described for the first time: *Musa tonkinensis* R. Valmayor, L. D. Danh and M. Hakkinen, sp. nov. and *Musa itinerans* Cheesman ssp. *annamica* R. Valmayor, L. D. Danh and M. Hakkinen, sp. nov. The two species can easily be differentiated from the other members of the genus *Musa* by their long and extended rhizomes that produce suckers far from the mother plant, hence, the term traveling bananas. But *M. tonkinensis* can be segregated from other rhizomatous species of *Musa* by its unique male bud. The apex of the male bud is markedly imbricated and the tips of individual bracts are neatly arranged in a beautiful spiral so different from other species of *Musa*. While the external color of mature bracts are purple with green margins, the young, unexposed bracts are solid yellow. The exposed tips of the imbricated bracts dry up early and turn brown. These unique features serve as diagnostic characters of *M. tonkinensis*. The morphology of *Musa itinerans* ssp. *annamica* is very similar to that of the common *M. itinerans* but can easily be distinguished by its unique method of bract opening. The bracts twist and curl sideways as they roll open, instead of curling and rolling upward as is commonly observed in the other species of *Musa*. Other distinguishing characteristics are based on their fruits. The fruits of the subspecies *annamica* are elongated and slightly narrowing toward both ends while those of *itinerans* are short and obovoid, widest near the apex and narrowing gradually toward the pedicel. Ripe fruits of the former species turn brown with cracked peeling while those of the latter turn yellow with their pericarp remaining smooth.

The Latin terms for the species *tonkinensis* and the subspecies *annamica* were selected to indicate the regions where the original specimens were collected. Tonkin was an ancient empire that extended from northern Vietnam to southeastern China while Annam was an old kingdom in Central Vietnam.

Key words: Chuoi Rung, Chuoi Rung Hoa Soan, *Musa*, *Musa tonkinensis*, *Musa itinerans* ssp. *annamica*, Vietnam

INTRODUCTION

The countries that once comprised French Indochina - Vietnam, Laos and Cambodia (now Kampuchea) - are located within the center of diversity of the family *Musaceae*. *Ensete*, *Musa* and *Musella*, the three genera of the family *Musaceae*, are indigenous to the region. Several species

were earlier described based on specimens collected from the former Indochinese countries in peninsular Southeast Asia. The more important species are: *Musa uranoscopos* Loureiro (1790), *Musa angcorensis* Gagnepain (1907) and *Musa splendida* Chevalier (1934). In Vietnam, description of these species had been sporadic and was interrupted by the nation's long and difficult struggle for freedom. After

Vietnam became independent and economic stability was attained, a national banana germplasm collection, characterization and conservation program was launched by the Vietnam Agricultural Science Institute (VASI) in Hanoi in 1994. This program was undertaken with the cooperation of the International Network for the Improvement of Banana and Plantain (INIBAP), Montpellier, France through its Asia and Pacific Network (ASPNET). INIBAP's regional office in Asia and the Pacific was based at the Philippine Council for Agriculture and Resources Research and Development (PCARRD) in Los Baños, Laguna, Philippines. The resulting Vietnam Banana Germplasm Collection was established at the Phu Ho Fruit Research Center in Phu Ninh, Phu Tho, Vietnam. The banana explorers gathered 88 different cultivars and 19 wild species, 6 of which were then unidentified (Danh et al. 1998). The banana germplasm collection at Phu Ho became the source of recent classification and characterization studies on the indigenous *Musaceae* of Vietnam.

HISTORY

Clerics and botanists in the old French Indochina did the early descriptions of indigenous species. Juan de Loureiro was a Portuguese Jesuit missionary and naturalist who served in Vietnam for many years. Upon his retirement in Portugal, de Loureiro compiled his comprehensive *Flora Cochinchinensis*, which included a description of *Musa uranoscopos*, for Chuoi Tau, the Anamese vernacular name of a local ornamental banana (Loureiro 1790). Another famous botanist who described a different ornamental banana was François Gagnepain who published his *Musa angcorensis* based on specimens collected near the world famous Angkor Wat ruins in Kampuchea (Gagnepain 1907). The third taxonomist who identified a wild species with ornamental value was Auguste Chevalier. He characterized *Musa splendida*, locally known as Chuoi Gai in its original collection area, the Red River Valley near Lao Cai, northern Vietnam (Chevalier 1934). Loureiro also named and described *Musa nana* and *Musa corniculata*, which now are considered mere cultivars of edible bananas and not true species. The former is the popular Dwarf Cavendish, a dessert banana, while the latter is the Horn plantain, a cooking variety.

While these three ornamental bananas are native to the former French Indochina, their range extends beyond their borders. Because they are attractive and popular, botanists elsewhere also described and disseminated these ornamental bananas to many parts of the world, thereby resulting in duplication problems in botanical nomenclature. Since the communication system during the colonial period was inadequate, *Musa uranoscopos* of Vietnam was also described as *Musa coccinea* by H.C. Andrews based



Fig. 1. *Musa coccinea* Andr. An ornamental banana growing in a farmer's backyard. (Courtesy of Le Dinh Danh)

on specimens collected from Canton (now Guangzhou) in southern China (Andrews 1797). *Musa angcorensis* of Kampuchea was discovered to be a synonym of *Musa rosea* described earlier by J. G. Baker based on herbarium materials preserved at the Calcutta Botanic Gardens, India (Baker 1893). The identity of *Musa splendida* remained obscure until it was recently rediscovered thriving in the Lao Cai province of Vietnam (Valmayor et al. 2004). The famous banana taxonomist E. E. Cheesman accepted *Musa coccinea* Andrews (Fig. 1) over *Musa uranoscopos* Loureiro despite the fact that Loureiro's *Flora Cochinchinensis* was published seven years earlier. Cheesman disregarded the principle of nomenclatural priority and justified his decision based on the clarity and completeness of Andrews' characterization of *Musa coccinea* and the presence of a well-preserved herbarium specimen (Cheesman 1950). On the other hand, Hakkinen (in press) preferred *Musa rosea* Baker (Fig. 2) to *Musa angcorensis* Gagnepain, in accord with priority, in spite of the more complete description and availability of well-preserved herbarium specimens of *Musa angcorensis*. These difficulties have lasted for more than a century. A. Chevalier's epithet *Musa splendida* (Fig. 3) for Chuoi Gai, is secure with the rediscovery of wild stands in northern Vietnam and the lack of synonyms published elsewhere.

Characterization Studies of *Musa* Accessions at Phu Ho

Director Le Dinh Danh of Phu Ho Fruit Research Center headed the banana collection, characterization and con-



Fig. 2. *Musa rosea* Baker. (Courtesy of M. Hakkinen)

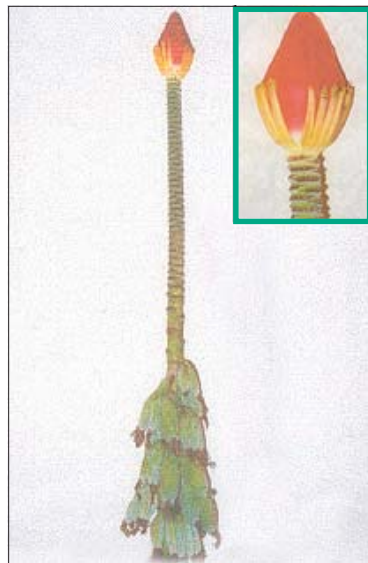


Fig. 3. *Musa splendida* Chev. Newly rediscovered in Lao Cai province. (Courtesy of I. Van den Bergh)

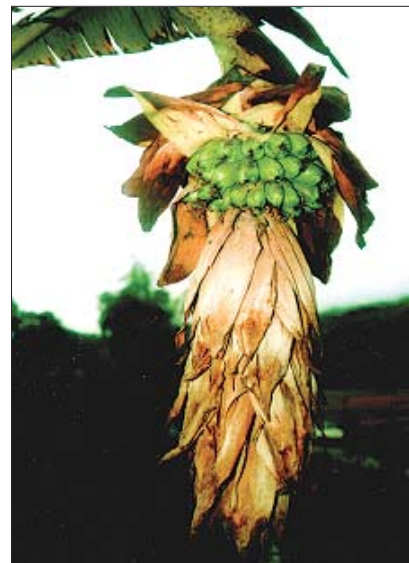


Fig. 4. Fruit bunch of *Ensete glaucum* (Roxb.) Cheesman. (Courtesy of Le Dinh Danh)

servation program of Vietnam. His team gathered 88 cultivars of edible bananas and 19 wild species, 17 of which belonged to the genus *Musa*, while the remaining two were classified under *Ensete* and *Musella*. The indigenous *Ensete* of Vietnam, known locally as Chuoi Nguon (Fig. 4), was identified as *Ensete glaucum* (Roxb.) Cheesman (Danh et al. 1998). This interesting species is known for its wide range extending from Myanmar to the Philippines and Java in Indonesia.

The *Musella* known locally as Chuoi Canh (Fig. 5) proved to be most fascinating because morphological studies at Phu Ho clearly showed it to be distinct from *Musella lasiocarpa* Franchet of South China, formerly the sole species of the genus. After thorough comparison, Chuoi Canh was described as a new species, *Musella splendida* (Valmayor and Danh 2002).

The remaining five undescribed taxa belong to the genus *Musa*. The most attractive was an unknown and unnamed specimen collected from Cuc Phuong Forest Reservation, Ninh Binh province, Vietnam. This accession was the first specimen formally described, and was given the scientific name *Musa exotica* (Fig. 6; Valmayor 2001). The next two species formally described were Chuoi Rung Hoa Sen and Chuoi Rung Hoa Do (Figs. 7 and 8), and were named *Musa viridis* and *Musa lutea*, respectively (Valmayor et al. 2004). Those two species are sympatric and were collected from Van Chan district, Yen Bai province, Vietnam. The final two undescribed *Musa* specimens are the subjects of this paper. One is known as Chuoi Rung



Fig. 5. *Musella splendida* R. Valmayor and L.D. Danh. Discovered in Ha Giang province. (Courtesy of Le Dinh Danh)



Fig. 6. *Musa exotica* R. Valmayor. Discovered in Cuc Phuong, Forest Reservation, Minh Binh province. (Courtesy of R. Valmayor)



Fig. 7. *Musa viridis* R. Valmayor, L.D. Danh and M. Hakkinen. Collected in Yen Bai province. (Courtesy of Le Dinh Danh)



Fig. 8. *Musa lutea* R. Valmayor, L. D. Danh and M. Hakkinen. Collected in Yen Bai province. (Courtesy of Le Dinh Danh)



Fig. 9. *Musa ornata* Roxb. (Courtesy of R. Valmayor)

Hoa Soan, which means “jungle banana with spiral flower” and the other is simply called Chuoi Rung, a general term for jungle banana (Nhi personal communication). The rest of the accessions were classified under *Musa balbisiana* Colla, *Musa acuminata* Colla and *Musa itinerans* Cheesman. A closer observation of the three species revealed that various forms exist under *Musa balbisiana* and *Musa itinerans* while *Musa acuminata* accessions were surprisingly uniform.

Musa ornata Roxb. (Fig. 9), *Musa velutina* Wendl. and Drude (Fig. 10) and *Musa laterita* Cheesman (Fig. 11) are very popular ornamental plants in the gardens and florist shops of Vietnam. However, they are not considered endemic to the country. The banana exploration missions under Director Le Dinh Danh that covered most of Vietnam did not encounter natural stands of the three ornamental species. But wild populations of *Musa ornata* have been recorded in Andhra Pradesh, India, in Hownikong Forest, Bangladesh and Chittagong, Myanmar. *Musa velutina* was reported to grow wild in the evergreen forests of Arunchal Pradesh and Assam, India while *Musa laterita* is also native to the northeastern states of India, as well as Myanmar and northern Thailand (Hakkinen and Sharrock 2002). While the three very popular ornamental bananas are recognized as introduced species to the country, they have certainly enriched the ornamental *Musa* germplasm resources of Vietnam.



Fig. 10. *Musa velutina* Wendl. and Drude. (Courtesy of R. Valmayor)



Fig. 11. *Musa laterita* Cheesman. (Courtesy of R. Valmayor)



Fig. 12. Leaf base of *Musa tonkinensis* rounded and asymmetric. (Courtesy of Le Dinh Danh)

In the following sections, we describe two new travelling bananas - *Musa tonkinensis* and *Musa itinerans* ssp. *annamica*, originally collected in Yen Bai and Nghe An provinces, respectively.

BOTANICAL DESCRIPTIONS OF TWO NEW TRAVELLING BANANAS – *MUSA TONKINENSIS* AND *MUSA ITINERANS* SSP. *ANNAMICA* (BASED ON DESCRIPTORS FOR BANANA [*MUSA* SPP.] IPGRI-INIBAP/CIRAD 1996)

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

Musa rhizomatibus elongatis, surculos remotos procreantibus. Bracteis alabastris maris magnopere imbricatis atque apicibus bractearum in spiram propriam pulchram dispositis statim dignoscenda.

Vernacular name: Chuoi Rung Hoa Soan

Plant suckering freely originating far from mother plant, position vertical, leaf habit normal (intermediate between erect and drooping); pseudostem 2.1-2.9 m high, circumference at 100 cm above ground normal (intermediate between robust and slender), color light green, appearance shiny, pigmentation pink-purple.

Leaf petiole light green with brown-black blotches, petiole 51-70 cm long; petiole canal straight with erect margins, petiole margin winged and not clasping the pseudostem, petiole margin width >1 cm; leaf blade 171-220 cm long, 71-80 cm wide, color of upper and lower surfaces dark green, appearance shiny, no wax on both surfaces, leaf base rounded and asymmetric (Fig. 12), leaf corrugation moderate, cigar leaf dorsal surface light green.

Inflorescence horizontal at first (female phase) then hanging with a curve (male phase), peduncle 31-60 cm long,



Fig. 13. Bunch position of *Musa tonkinensis* horizontal, male bud hanging vertically. (Courtesy of Le Dinh Danh)



Fig. 14. Male bud of *Musa tonkinensis* extremely imbricated, bracts spirally arranged. (Courtesy of Le Dinh Danh)



Fig. 15. Young unexposed bracts color yellow. The exposed tips dry up early and turn brown. (Courtesy of Le Dinh Danh)

green, hairless; bunch position horizontal (Fig. 13), lax with few hands of fruit (only 2-4 hands), basal flowers hermaphrodite, biseriate; rachis falling with an angle, bare.

Bracts oblong, apex obtuse, imbrication extreme, arrangements markedly spiral (Fig. 14); external color mainly purple but apical portion green; internal color cream to yellow, uniform until base; young, unexposed bracts to sunlight uniformly cream to yellow; tip of old bracts dry up early and turn brown (Fig. 15); bract scar not prominent on rachis; shape $0.28 < x/y < 0.30$ (intermediate between lanceolate and ovate); lifting one to two at a time, slightly revolute, not waxy, not grooved.

Male flower cream, falling with the bract; compound tepal not pigmented, lobe ivory; free tepal opaque white, oval, simple folding under apex; anther and filament color cream; style white, straight; stigma cream; ovary cream, ovules arranged in 4 rows.

Fruit perpendicular to the stalk 12 or less per cluster, less than 15 cm in length, straight, cross-section slightly ridged, blunt tip, no floral relicts; immature fruit color silvery green turning light green at maturity, pulp white turning cream when ripe, soft and sweet but seedy; seeds wrinkled and globular.

Original accession collected from forested areas in Van Chan district, Yen Bai province, Vietnam on November 30, 1994 by Le Dinh Danh. Acc. No. VNI-054; 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 material, sucker; original accessions maintained at the National Banana Germplasm Collection at Phu Ho Fruit Research Center.

Holotypus: Herbarium specimen held at Phu Ho Fruit Research Center, Phu Ninh, Phu Tho, Vietnam. Collector Le Dinh Danh, collection no. VN1-054, date collected, November 30, 1994, place collected Van Chan district, Yen Bai province, Vietnam. Herbarium sheet no. PHH No. 004.

Musa itinerans Cheesman ssp. *annamica* R. Valmayor, LD. Danh and M. Hakkinen, ssp. nov.

Musa rhizomatibus elongatis, surculos remotos procreantibus. A ssp. *itinerans* bracteis alabastris maris tortas et crispas per obliqua singulariter aperientibus, ambitibus fructuum non obovatis sed anguste-elongate-ellipticis differt.

Vernacular name: Chuoi Rung (a general term for jungle banana applied to both *Musa itinerans* and *Musa tonkinensis* ssp. *annamica*)

Since Cheesman (1949) published a very detailed description of *Musa itinerans*, the authors felt no need to elaborate on the distinguishing characters of the original species in this paper except the term *Musa itinerans*, applied by Cheesman to describe the unique habit of producing suckers far from the mother plant through its elongated rhizomes, hence, the common term – travelling banana.

Plant suckering freely originating far from mother plant (more than 0.5 m), position vertical, leaf habit normal (intermediate between erect and drooping); pseudostem >3 m high, circumference at 100 cm above ground normal (intermediate between robust and slender), color green, pigmentation absent; sap color milky, wax on leafsheaths very slight.

Leaf petiole green with large brown-black blotches, petiole 51-70 cm long, petiole canal open with margins spreading, winged and not clasping the pseudostem, margin <1 cm; leafblade <170 cm long, <70 cm wide, color of upper and lower leaf surfaces green-yellow, appearance of both leaf surfaces shiny, wax on leaf surfaces very slight, leaf corrugation slight, cigar leaf green.

Inflorescence hanging vertically, peduncle 31-60 cm long, dark green, hairless; bunch position hanging vertically, bunch shape cylindrical, lax with 5-6 hands, fruit arrangement biseriate; rachis hang vertically, slightly curved and bare; male bud unique, bracts open in a very distinctive manner unknown in the genus *Musa*; the bracts are revolute, but instead of rolling back, the bracts twist and curl sideways thus exposing its whitish internal surface (Fig. 16).

Bracts lanceolate, apex slightly pointed, imbrication convolute; external color purple, uniform until apex, internal color whitish; bract scar very prominent; bract shape $x/y < 0.28$ (lanceolate); surface not waxy, not grooved, almost completely smooth.

Male flower cream, falling with the bract; compound tepal cream, not pigmented, lobe yellow; free tepal opaque white, rectangular, simple folding under apex; anther yellow, filament cream; pollen sac brown; style cream, inserted and curved under stigma; stigma yellow; ovary cream, ovules arranged in four rows.

Fruits curved toward stalk, 13-16 per cluster, less than 15 cm in length, slightly curved, cross-section slightly ridged, fruit apex bottle necked, no floral relicts; immature fruit silvery (Fig. 17), ripe fruit rusty-brown; peel cracked; pulp cream and soft; seeds globular and smooth.

Original accession collected from forested areas in Anh Son district, Nghe An province, Vietnam on September 4, 1994 by Le Dinh Danh. Acc. No. VN1-026. Important physiographic data: latitude 19.03° north, longitude 105.53° east, elevation 27 m, average rainfall 1791 mm; average temperature, 24° C, soil type, fertile forest soil. Planting material, sucker: Original accessions maintained at the



Fig. 16. Revolute bract of *Musa itinerans* ssp. *annamica* twists and curls sideways exposing the whitish undersurface. (Courtesy of Le Dinh Danh)



Fig. 17. Fruit bunch of *Musa itinerans* ssp. *annamica* showing fruits heavily covered with bloom and unique twisting of bract. (Courtesy of Le Dinh Danh)



Fig. 18. Fruit shape of *Musa itinerans* is obovoid, wider near the apex but narrow towards the long pedicel. (Courtesy of Le Dinh Danh)

National Banana Germplasm Collection at Phu Ho Fruit Research Center.

Holotypus: Herbarium specimen held at Phu Ho Fruit Research Center, Phu Ninh, Phu Tho, Vietnam. Collector Le Dinh Danh, collection No. VN1-026, date collected September 4, 1994, place collected Anh Son district, Nghe An province, Vietnam, Herbarium sheet no. PHH No. 005.

Diagnostic Characters of *Musa tonkinensis* and *Musa itinerans* ssp. *annamica*

Musa tonkinensis can be differentiated from most members of the genus *Musa* because it is rhizomatous, its suckers emerging some distance from the mother plant. It can also be segregated from other rhizomatous *Musa* species by its unique male bud. The apex of the male bud is markedly imbricated and the tips of individual bracts are neatly arranged in a beautiful spiral so different from all described species, except *Musa textilis* Neé, where imbrication is slighter. While the external color of the mature bract is purple with green margins, the internal surface is cream to yellow. Interestingly, the young unexposed bracts are solid yellow but the exposed tips of the imbricated bracts dry up early and turn brown. These unique features serve as diagnostic characters of *Musa tonkinensis*.

Musa itinerans ssp. *annamica* is also rhizomatous and can be differentiated from most species of *Musa* through its long and extended rhizomes. It is closest to *Musa itinerans* but is easily identified by its distinctive male bud with its unique method of bract opening. The bracts twist and curl sideways as they roll open, instead of curling and rolling upwards as commonly observed in most species of *Musa*. The bracts of some species lift upwards and fall



Fig. 19. Reddish-purple male bud of *Musa itinerans* showing distinctive yellow margin. (Courtesy of M. Hakkinen)

without curling as in *Musa balbisiana* but only in this new subspecies have the bracts been observed to twist sideways and expose their whitish undersurface as the bracts roll. In addition to all the features already enumerated, *Musa itinerans* and *Musa itinerans* ssp. *annamica* differ from each other in the shape and the color of their fruits. The fruits of the subspecies *annamica* are elongated and slightly narrowing towards both ends (Fig. 17); those of *itinerans* are short and obovoid, widest near the apex and narrowing gradually towards the pedicel (Fig. 18); ripe fruits of the former species turn brown with cracked skin while those of the latter turn yellow with its pericarp remaining smooth. The purple male bud of *Musa itinerans* often shows the distinctive yellow margins sometimes variegated with longitudinal stripes of yellow (Fig. 19), while those of the subspecies *annamica* have solid purple bracts.

The Latin terms *Musa tonkinensis* for Chuoi Ruong Hoa Soan and *Musa itinerans* ssp. *annamica* for Chuoi Ruong were selected to indicate the regions where the original specimens were collected. Tonkin was an ancient empire embracing northern Vietnam and southeastern China while Annam was an old kingdom based in Central Vietnam.

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