

Diversity in the genus *Musa* - Focus on Rhodochlamys

Markku Häkkinen and Suzanne Sharrock

This review of the section Rhodochlamys has been prepared largely from the original descriptions and illustrations made in the 19th and early 20th centuries, when most of the species were described for the first time by 'modern' botanists. However, it also draws on information from the first author's expedition trips to Southeast Asia, his studies of herbarium specimens (relatively few considering the difficulties involved in preparing adequate herbarium specimens of *Musa* species), at the Royal Botanic Gardens (RBG) Kew and RBG Edinburgh, and observations made in several botanical gardens around the world. The account also takes into consideration more recent information from morphological and cytogenetic studies. Although this review is based on the most up-to-date available information, it is recognised that Rhodochlamys species remain poorly known in the wild, and as they are known to hybridise with each other, it is possible that hybrids have been, and will continue to be, mistaken for natural species. It is entirely possible that the conclusions drawn here will need to be changed substantially when further explorations and phylogeny studies have been carried out.

Introduction

Rhodochlamys is one of the four sections into which the genus *Musa* is divided (the others being Australimusa, Callimusa and Eumusa, which is sometimes called *Musa*). Members of the Rhodochlamys and Eumusa sections have a basic chromosome number of $2n = 22$ compared with $2n = 20$ of the Australimusa and Callimusa. Species in Rhodochlamys are characterized by having inflorescences that are erect, at least at the base, with fruit pointing towards the bunch apex. Most of the species also typically have relatively few fruit and are best known for their brightly coloured bracts, a feature that makes them popular as ornamental plants. This paper focuses on the nine species of the section recognised by the authors. Five of these (*Musa ornata*, *Musa*

velutina, *Musa laterita*, *Musa sanguinea* and *Musa mannii*) are well known and described, while the remaining four (*Musa aurantiaca*, *Musa rosacea*, *Musa rosea* and *Musa rubra*) are less well known and of somewhat less definite status.

Distribution of Rhodochlamys

Rhodochlamys consist of the only *Musa* species adapted to withstanding seasonal droughts, which are common in the monsoonal areas to which they are native. The natural habitat of Rhodochlamys species is Northeast India, Bangladesh, Myanmar and N.W. Thailand (see map – Figure 1). *M. sanguinea* is also known to occur in Yunnan, China, but was probably introduced there as cultivated material centuries ago. *M. laterita* can be seen quite commonly as an ornamental plant in Vietnam, probably also introduced by man. Much of the diversity in the section is therefore located in areas that have been (and continue to be) difficult, sometimes even dangerous to travel and work in. For this reason, the present-day distribution, extent and status of many of the species described here is not clear.

Relationship with cultivated bananas

The section Rhodochlamys has long been recognised as being 'close' to the section Eumusa, which contains the cultivated bananas. Hybridization tests in controlled situations between members of the two sections have been carried out by a number of researchers.

Shepherd (1999) noted that hybrids between *Musa flaviflora* (Eumusa) and *Musa ornata* gave highly vigorous and highly fertile F1s, not at all the usual behaviour of inter-specific hybrids. He also noted the hybrid swarm of *M. flaviflora* and

M. velutina that Simmonds reported (1956, 1962) growing alongside *M. flaviflora* in Assam. There were indications that natural backcrossing and introgression were occurring and Simmonds therefore considered that *M. flaviflora* was a connecting link between *Eumusa* and *Rhodochlamys*. Although Shepherd agreed that this might be the case with *M. velutina*, his own studies indicated that other species in the *Rhodochlamys* section were far removed from *M. flaviflora*.

Shepherd therefore suggested the section should be divided into two groups, one of which would be "on the other side" of *Musa acuminata*, away from *M. flaviflora*, *M. ornata* and *M. velutina*. Further analyses of *Musa* diversity using various molecular techniques (Jarret and Gawel 1995, Carreel 1994, Wong et al. 2001) support the theory that the sections *Rhodochlamys* and *Eumusa* are closely related, as a clear distinction between the two sections could not be found in any of these studies.

Rhodochlamys species, being very close to *Eumusa* species, provide a potential



Figure 1. Possible distribution of species in the section *Rhodochlamys*.

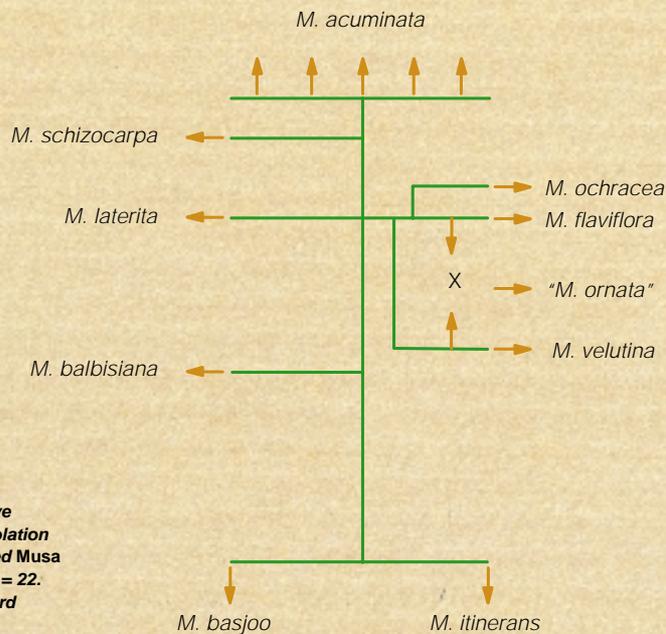


Figure 2. Relative reproductive isolation between selected Musa species with $2n = 22$. Source: Shepherd (1999).

source of exploitable new genes, thus expanding the genepool available to banana breeders. Figure 2 provides a graphic illustration of the relative reproductive isolation of Musa species with chromosome number $2n = 22$ studied by Shepherd. One particular feature of the group that could be of interest to breeders is the special mechanism that some species have for surviving drought. In unfavourable, dry conditions, they die right back, but rapidly produce new growth as soon as the first rains appear.

Uses of Rhodochlamys species

The products of hybridization and introgression involving the Rhodochlamys are likely to be attractive, and will therefore have ornamental potential. With the growing interest in exotic ornamental plants amongst gardeners in Europe and the USA, hybrids and partial hybrids of Rhodochlamys species may well find their way into commerce.

With the exception of their use as ornamental plants in the horticultural and florist industries, there is a little recorded human use of species in this section. In some areas of Northeast India, the male buds are collected and eaten as a vegetable (Figure 3), but the fruit are seedy and unpalatable, and therefore not used for food.



Figure 3. Male buds of *M. rosacea* (non Jacq.) for sale in India (S.Uma, NRCB).

Species in the Rhodochlamys

Musa ornata Roxb.

This species has been recently recorded in substantial wild populations along the slopes in certain moist regions of Araku Valley in Andhra Pradesh, India. It has also been recorded in Howaikong Forest, Hari Khola, Bangladesh in Dipterocarp forest growing on slopes by streams. Roxburgh (1824) recorded *M. ornata* as "a native of Chittagong".

Some confusion exists, particularly in horticultural texts, between *M. ornata* and *M. rosacea* (see *Musa rosacea*). As a result, in some texts, the name *M. rosacea* has been degraded to an alternative name to *M. ornata*. In this sense, when the name *M. rosacea* is used in horticultural circles, it has come to mean something quite different to the original *M. rosacea* Jacq. To further confuse matters, the species *M. rosacea* Jacq. is commonly also found for sale under the names of *Musa ornata* "standard lavender" or *Musa ornata* "dwarf blue". This confusion between *M. ornata* and *M. rosacea* means that reports in the literature regarding the distribution of the two species in the wild must be treated with care. Indeed the present day status and distribution of these two species is not at all clear.

Cheesman (1947) also noted that *Musa salaccensis* H. Zollinger is sometimes given as a synonym of *M. ornata* Roxburgh. However this is incorrect as the two species are in different sections of Musaceae. The confusion arose, because Zollinger when naming his species added in brackets "(ornata Roxb.?)" which, given the superficial similarity of the two was a reasonable query at the time. Miquel in his Flora van Nederlandsch Indie put it the other way around and thereafter certain later authors added *M. ornata* Roxburgh to the synonymy of *M. salaccensis*.

Shepherd (1999) had doubts about the status of *M. ornata*, considering that its distribution in the wild seemed to be limited and variation within the species not obvious. He therefore suggested that *M. ornata* could be "secondary species" resulting from a hybrid swarm between *M. flaviflora* and *M. velutina*. It is possible that Shepherd was referring to the other species, *M. rosacea*, whose origin is unknown and which is distributed all over the world.

Musa velutina H. Wendl and Drude

This species is found growing wild in the sub-tropical evergreen forests of Arunchal Pradesh and Assam in India, where it is considered common. The species was collected in Upper

Assam by Gustav Mann and described by H. Wendland and O. Drude from a plant that flowered in the garden at Herrenhausen. A probable synonym of this species is *Musa dasycarpa* described by Kurz (1865/66) "*Musa dasycarpa* Kurz. Fruits hairy. (Assam)". Later Kurz noted that "Wendland and Drude published in Regel's *Gartenzeitung* for 1875, a supposed new species which they call *M. velutina*". It is possible that Kurz recognised that this *M. velutina* was the same as his *M. dasycarpa*, but he had no time to comment further upon this matter; "I cannot embark here upon a sifting of the literature and synonyms, for such would be of too technical a character, and will be published in my revision of the Musaceae under preparation". Unfortunately Kurz died in Penang shortly after writing those words, leaving it to Cheesman some 60 years later to revise the Musaceae. The type specimen of *M. dasycarpa* is in Calcutta, but there is supposedly a drawing of it at the Royal Botanic Gardens, Kew. According to Cheesman "the drawing strongly suggests identity with *M. velutina*", but Cheesman was not prepared to confirm the synonymy and *M. velutina* is still regarded as the accepted name.

There is in the section *Callimusa* in Borneo a species that is morphologically very similar to *M. velutina* and which has a similar growing habit, namely *Musa hirta*. It has hairy fruits, which remain green on maturity and the fruits are self-peeling.

M. velutina is one of only five known *Musa* species in which the fruit splits (or dehisces or is schizocarpic) on maturity. The other four are *Musa hirta* from Borneo, *Musa johnsii*, a new species recently described from Papua (formally Irian Jaya) (Argent 2001), *Musa lolodensis* and *Musa schizocarpa* from Papua New Guinea.

***Musa laterita* Cheesman**

M. laterita is native to Northeast India, Myanmar and Northern Thailand. It is however common in cultivation as an ornamental plant worldwide. It is frequently sold as an ornamental under the name of *Musa ornata* "Bronze" or *Musa ornata* "Red Salmon". The name "*laterita*" derives from the bright colour of its bracts, which resemble the brick-red tropical soil, known as "*laterite*".

Cheesman notes that the plant has a strong general resemblance to *M. ornata* but, while it hybridizes with it, there is no strong genetic affinity between the two species, and in other respects it approaches species from the section *Eumusa* more closely than other species in *Rhodochlamys*. The ability of the plant to hybridize with *M. ornata* suggests one possible origin of the plants commonly but sometimes erroneously known in tropical horticulture as cultivars of *M. ornata*.

***Musa sanguinea* Hook. f.**

This species was reported as a native of the Mahuni forests on the banks of the Booree Deling River in Upper Assam, India, where it was discovered by in 1869 by Mr G. Mann of the Forest Department of India. A very similar species was also reported at this time from Burma (Myanmar) but its identity was never confirmed. The present day status and distribution of this species is not clear.

M. sanguinea was described by J.D. Hooker in Curtis' *Botanical Magazine* 1872, and again by Baker in *Annals of Botany*, 1893 and by Cheesman in the *Kew Bulletin*, 1949.

The species was first described from a plant growing at RBG Kew and it seems to be best known from cultivated material rather than wild. C.A. Backer, 1924 described the plant in his *Flora van Java* as a native of British India, found occasionally in Java in ornamental gardens. He also mentioned *Musa assamica*, Hort. Bull., as an allied plant, but this species remains imperfectly known. There are some doubts whether the living material described by Cheesman (from cultivated plants in Java) and Backer's plant are from the same species as that described by Hooker from India, or whether their plants are in fact *M. mannii*. It should also be noted that Cheesman himself gave his identification of the species as provisional.

Champion (1967) speculates that *Musa splendida* A. Chevalier may be identical to *M. sanguinea*. *M. splendida* is very poorly known and very tentatively placed by Simmonds 1960 in the *Callimusa*, although he acknowledges that it may not be a good species and may not be a *Callimusa*. However, in Vietnam, elderly people confirm that Chuoi Gai, a cultivar described by A. Chevalier as *M. splendida*, is synonymous with Chuoi Rung Hoa Sen. There are still large wild populations of Chuoi Rung Hoa Sen growing on roadsides from Lao Cai to Sa Pa from where Chevalier made his description of the species. Chuoi Rung Hoa Sen has a chromosome number of $2n = 20$ and therefore does not belong to the section *Rhodochlamys*.

***Musa mannii* H. Wendl. ex Baker**

This species is a native of the Assam valleys in India. It is described by J.D. Hooker in the *Flora of British India*, 1892 and in Curtis' *Botanical Magazine*, 1893. A description by Baker was published in the *Annals of Botany* of a specimen that flowered in the palm house at Kew, UK in March 1893. This species differs from *M. sanguinea* in the shorter pseudostem and longer leaves and from *M. rosacea* in the shorter petiole leaves, large pale purplish bracts and shorter yellow male flowers.

***Musa aurantiaca* Mann ex Baker**

M.aurantiaca was originally found in the Changlang District between Deban and Haldi Barie, Assam, India. Baker in the Annals of Botany, 1893, describes the species and there is also a more recent description (1994) from the herbarium of the Royal Botanic Gardens Edinburgh. The plant grows in loose clumps with a height of around 1.2 m. The peduncle is pink and erect, the male flowers orange-cream and the male bracts orange. The present day status of this species is not known.

***Musa rosacea* Jacq.**

There have been many serious questions about the identity of this plant. According to Cheesman in the Kew Bulletin (1949) the origin of the confusion between *M. rosacea* and *M. ornata* was a footnote appended by Nathaniel Wallich to the

wondered whether he had come upon an indigenous American *Musa*". Actually the species had been described 103 years earlier in Edward's Botanical register in 1823 (Figure 6). In this paper, Baron Humbolt suggested that several species of *Musa* may possibly be compounded under the names of plantain and banana, and that some of these species could be indigenous to America. Bassler however finally believed that the species had in fact been introduced from Asia.

The confusion between *M. ornata* and *M. rosacea* is such that the present day distribution of neither species is clear. However, there is a new description of another *M. rosacea* (non. Jacquin), which was found recently in the higher altitude forests of Arunachal Pradesh, India, by Singh et al. 2001. The plant is described as being freely suckering, with new

Figure 4.
Musa aurantiaca
(A. Rekha, IHR).



Figure 5.
Musa rosacea Jacq.
(M. Häkkinen).

original description of *M. ornata* in Flora Indica "This is probably *M.rosacea* Jacq.". It seems that Wallich, in editing Flora Indica after Roxburgh's death, made an honest mistake but the error was so commonly repeated that the synonymy of *M. ornata* and *M. rosacea* came to be accepted as fact. A further confusion dates back to 1805 when the names *M. rosacea* and "copper banana" (an AAB variety) were mixed.

Cheesman quotes Bassler (1926) who described in the Journal of the New York Botanical Garden that he had found *M. rosacea* in Peru and Mexico. Indeed he noted that the plant was "in so remote a locality that he at first

shoots emerging as far as 40-45 cm away from the mother plant. The plant grows to 2 - 2.4m height and the pseudostem is heavily waxy with black blotches. The inflorescence is erect, and the peduncle short. The bracts are pink with a yellow tip and the male flowers are orange.

***Musa rosea* Baker**

This species originates in Bangladesh and Myanmar and is poorly known. The species is described by Baker in the Annals of Botany, 1893 from two specimens in the Calcutta Herbarium.

M. rosea has the habit of *M. coccinea*, (*Callimusa*) but the leaves are much shorter and

broader in proportion to length. The inflorescence is short and erect with pale red bracts.

Cheesman in the Kew Bulletin (1949) quotes De Wildeman (1912) as saying that *M. rosea* was introduced into Europe around 1805, from Mauritius. Cheesman also mentions that there was a species known in Europe as *M. rosea* long before 1893, which is proved by the citation in Index Londinensis of three illustrations published with this name in 1841, 1842 and 1849. Cheesman wrote in the same article "I have not been able to refer to these illustrations to satisfy myself whether they represent Baker's plant, *Musa ornata*, or a third entity, but it seems to me likely that they may on examination prove to be *M. ornata*". The first author, having studied both the publications and the plants in the field and following discussions with Dr Argent

Suckers of *M. rubra* were received at Kew from Dr King in 1889, under the name of *Musa rosea*, which is however, a different species. Dr King further states that *M. rubra* has been in cultivation in the Royal Gardens, Calcutta, since 1882, but its origin is unknown.

There are several specimens of *M. rubra* in cultivation at the Indian Institute of Horticultural Research (IIHR) research station Bangalore, which were collected in India close to the border with Myanmar. These plants correspond very closely with the illustration of *M. rubra* in Curtis's Botanical Magazine (Figure 7).

Musa violacea

In Brazil there has been in cultivation for decades or even centuries a species called *Musa violacea*, which is very similar to *Musa*

Figure 6. *Musa rosacea* as illustrated in Edward's Botanical Register, 1823 (Courtesy of Hunt Institute for Botanical Documentation, Carnegie Mellon University, Pittsburgh, PA).



from RBG Edinburgh and Dr Ruth Kiew from Singapore Botanic Gardens has come to the conclusion that the plant shown in the picture is *M. rosea*.

***Musa rubra* Wall. ex Kurz**

M. rubra, a native of Myanmar, and also found in the Mizoram area of India, was first described in the work by S. Kurz (1865/66) from specimens collected by himself in Pegu. It must, however, have been discovered many years earlier, because Kurz adopted a name which Wallich had assigned, probably to plants cultivated in the Calcutta Botanical Gardens.

ornata except that the bracts are somewhat paler, sometimes nearly white. This species could be a hybrid between *M. ornata* x *M. velutina*. Another intriguing possibility is that some of the "Musa violacea" encountered today derive from a man-made hybrid between *Musa flaviflora* and *Musa velutina*. This cross was made in Trinidad at the Imperial College of Tropical Agriculture as part of a study of *Musa* cytogenetics. According to Simmonds 1962, "selections [of *M. flaviflora* x *M. velutina*] were so vigorous and ornamental that they were distributed to various tropical botanical gardens as being of potential horticultural interest".

Figure 7. Illustration of *Musa rubra* in Curtis's Botanical magazine, 1895 (Courtesy of Hunt Institute for Botanical Documentation, Carnegie Mellon University, Pittsburgh, PA).

Figure 8. *Musa violacea* (*M. Häkkinen*)

a – *Musa ornata* (M. Häkkinen)

The species is described by Roxburgh in *Flora Indica*, as a very slender, small plant, growing 2 – 2.4 m in height.

The inflorescence is completely erect, with the peduncle hairless. The bracts are rosy purple outside with the apex being yellowish and obtuse. The male bud in advanced condition is broadly lanceolate. The fruit bunch is compact and erect, with 3-5 hands, each having a single row of 3-6 fruits, which are inflexed to stand almost parallel to the fruit stalk. The fruit remain angled when ripe. The male flowers are deep orange in the upper half, paling to nearly white near the base.



b – *M. velutina* (M. Häkkinen)

Cheesman in the *Kew Bulletin* (1949) describes the species as stooling freely and growing up to 1.5 m high.

The midribs of the leaves are coloured red on the underside and the bunch is completely erect. The peduncle is red and covered in short white hairs and the bracts are pink. The fruit are bright pink and hairy like the peduncle. The name "velutina" was derived from the hairy, velvety nature of the fruit. On maturity the fruit peel splits and separates into irregular strips from apex to base, revealing a central mass of white flesh, filled with black seeds. The male flowers are orange-yellow with a pink flush on the back. The male bud aborts and falls off while the fruit are developing.



c – *M. laterita* (K. Tompeke, CRBP)

Cheesman describes the species in the *Kew Bulletin* (1949) as a plant that tillers freely, sending up suckers at long distances from the mother plant, and forming only lax, open stools. The plant is slender, reaching a height of 1-2 m. The inflorescence is erect, and the peduncle velvety with dense, minute hairs. The bracts are brick red, the same colour inside as outside. The fruit bunch is very compact, with the fruit almost pressing against the rachis. The fruits reach about 8-10 cm in length and the peel becomes yellow on ripening. The male flowers are orange-yellow in colour.



References

- Argent G.C.G. 2001. *Musa johnsii*. *Gardens' Bulletin* (Singapore) 53:1.
- Backer C.A. 1924. *Musaceae*. *Flora van Java* Alf. 3:133.
- Baker J.G. 1893. A synopsis of the genera and species of *Musaceae*. *Annals of Botany* 7:189-222.
- Bassler H. 1926. *Musa* in Tropical America. *Journal of the New York Botanical Garden* 27:49-54.
- Carreel F. 1994. Etude de la diversité des bananiers (genre *Musa*) à l'aide des marqueurs RFLP. Thèse de l'Institut National Agronomique Paris-Grignon. 90pp.
- Champion J. 1967. Notes et documents sur les bananiers et leur culture. Tome I: Botanique et Génétique. Institut français de recherches fruitières Outre-Mer (IFAC). Editions SETCO, Paris.
- Cheesman E.E. 1947. Classification of the bananas II. *The Genus Musa* L. *Kew Bulletin* 2(2):106-117.
- Cheesman E.E. 1949. Classification of the bananas III. *Critical Notes on Species*. 1:24-28, 2:133-137, 3:265-267.
- Constantine D. 1999. The *Musaceae* – an annotated list of the species of *Ensete*, *Musa* and *Musella*. www.users.globalnet.co.uk/~drc.
- Hooker J.D. 1872. *Musa sanguinea*. *Botanical Magazine* 98, Tab. 5975.
- Hooker J.D. 1892. *The Flora of British India* 6:263.

d – *M. sanguinea* (C. Jenny, CIRAD)

This is a slender plant, with a pseudostem about as thick as a stout cane, reddish, and growing to about 1 - 1.5 m high. The leaf midribs are red on both sides on young leaves, later becoming green above, but remaining red on the lower surface. The fruit stalk is red and velvety and the inflorescence grows out horizontally. The bracts are dark pink or pale crimson and the whole bud usually aborts before the fruit are ripe. The male flowers are orange-yellow and the fruit become greenish yellow when ripe.

e – *M. mannii* (M. Häkkinen)

Cheesman in 1949 in the Kew Bulletin cited the Cat. Hort. Bull. 6. issued 1871. The entry runs: "This is a peculiarly dwarf-habited and elegant species, and has been imported from Upper Assam. The slender pseudostems are about a foot and half high, green, bearing a crowded tuft of several elliptic lanceolate leaves, which are stalked, about a foot in length, remarkably unequal-sided at the base, acute at the apex, and running out into a slender tendril-like point. The leaves are green, with a narrow purple border."

f – *M. rubra* (A. Rekha, IHR)

The plant is described as having the habit of *M. coccinea*, (*Callimusa*), with the stem being slender and reaching about 1.5 – 2.5 m in height. The peduncle and inflorescence are erect; the bracts are bright rose-red with golden tips, and the male flowers golden yellow.



Hooker J.D. 1893. *Musa mannii*. Botanical Magazine 119, Tab. 7311.

Jarret R.L. & N. Gowel. 1995. Molecular markers, genetic diversity and systematics in *Musa*. Pp. 67-83 in *Bananas and Plantains*. (S. Gowen, ed.) Chapman and Hall, London, UK.

Kurz S. 1865/66. Note on the plantains of the Indian archipelago. *Journ. Agr. Hort. Soc. India* XIV:295-301.

Roxburgh 1824. *Musa ornata*. *Flora Indica* ed. Carey. 2:48

Shepherd K. 1999. Cytogenetics of the genus *Musa*. International Network for the Improvement of banana and plantain, Montpellier, France. 160pp.

Simmonds N.W. 1956. Botanical results of the banana collecting expedition 1954-5. *Kew Bulletin* 11(3):463-489.

Simmonds N.W. 1962. *The Evolution of the Bananas*. Longman, London. 170pp.

Singh H.P., S. Uma & Sathiamoorthy. 2001. A Tentative Key for identification and classification of Indian Bananas. 2001.

Wong C., R. Kiew, A. Lamb, O. Set, S.K. Lee, H.G. Leong & Y.Y. Gan. 2001. Sectional placement of three Bornean species of *Musa* (Musaceae) based on Amplified Fragment Length Polymorphism (AFLP). *Gardens' Bulletin, Singapore* 53:327-341.