



The Wild Bananas

A catalogue of wild *Musa* species
and tribute to the work of
Markku Häkkinen

By Gabriel Sachter-Smith



The Alliance of Bioversity International and the International Center for Tropical Agriculture (CIAT) delivers research-based solutions that address the global crises of malnutrition, climate change, biodiversity loss, and environmental degradation.

The Alliance focuses on the nexus of agriculture, nutrition and environment. We work with local, national, and multinational partners across Africa, Asia, and Latin America and the Caribbean, and with the public and private sectors and civil society. With novel partnerships, the Alliance generates evidence and mainstreams innovations to transform food systems and landscapes so that they sustain the planet, drive prosperity, and nourish people in a climate crisis.

The Alliance is part of CGIAR, a global research partnership for a food-secure future dedicated to transforming food, land, and water systems in a climate crisis.

alliancebioversityciat.org

www.cgiar.org

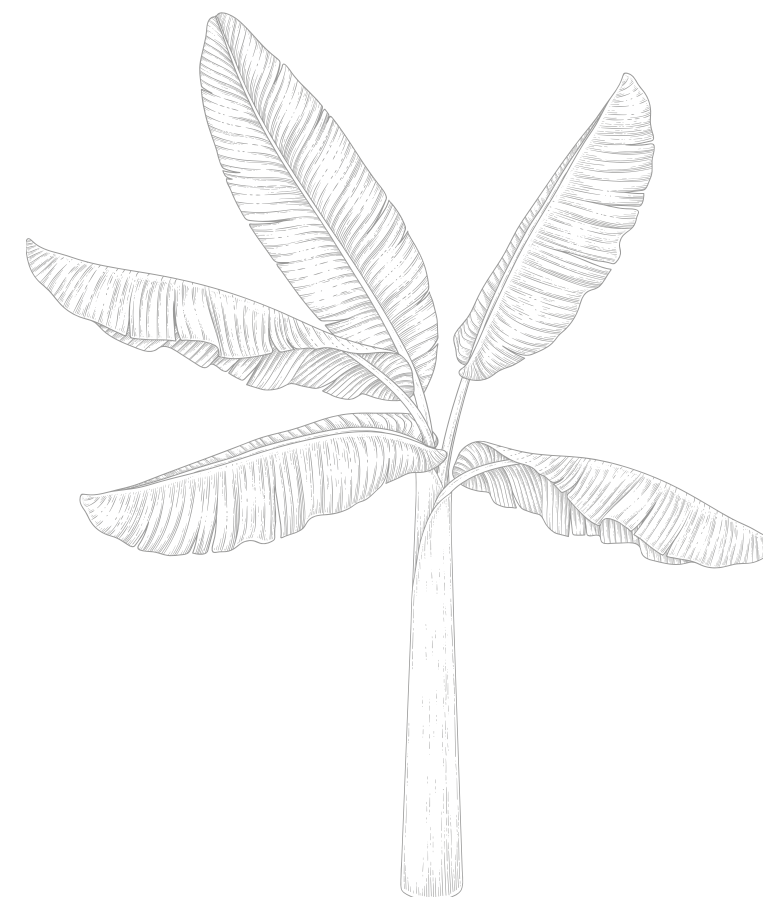
The Global *Musa* Research Network (MusaNet) is a global collaborative framework for *Musa* related research and a partnership of all key stakeholders, aiming at ensuring the long-term conservation on a cooperative basis, and facilitating the increased utilization of *Musa* diversity globally.

Our vision is a world in which *Musa* diversity is valued, secured and supporting all life.

To create this world our mission is: “To build upon existing strengths in the global, regional and national collections by bringing people to optimize the effort to conserve, add value and promote the use and safe distribution of a wide range of *Musa* diversity as a foundation for further breeding or direct use by farmers.”

www.musanet.org

ISBN: 978-92-9255-260-2



The Wild Bananas

A catalogue of wild *Musa* species and tribute to the work of Markku Häkkinen

By Gabriel Sachter-Smith





Alliance of Bioversity International and the International Center for Tropical Agriculture (CIAT)
Headquarters
Via di San Domenico, 1
00153 Rome, Italy
Tel: (+39) 0661181
Website: <https://alliancebioversityciat.org/>

Citation
Sachter-Smith Gabriel. 2023. The Wild Bananas. A catalogue of wild *Musa* species and tribute to the work of Markku Häkkinen. Bioversity International. Rome, Italy. 217 p.

About the author
Gabriel Sachter-Smith, Banana Farmer and Researcher, member of the Taxonomic Advisory Group (TAG) of MusaNet.

Contacts at the Alliance of Bioversity International and CIAT, and the Musanet Secretariat:
Nicolas Roux, Principal Scientist, Biodiversity for Food and Agriculture research area, Alliance of Bioversity International and CIAT.
n.roux@cgiar.org
Rachel Chase, Associate Scientist, Biodiversity for Food and Agriculture research area, Alliance of Bioversity International and CIAT.
r.chase@cgiar.org

ISBN: 978-92-9255-260-2

Design and layout: Ximena Hiles
Cover photos: Gabriel Sachter-Smith

This work is licensed under a
Creative Commons Attribution Non-Commercial 4.0 International License (CC-BY-NC)
<https://creativecommons.org/licenses/by-nc/4.0/>

Copyright © Bioversity International 2023. Some rights reserved.

February 2023



Content

II	Preface
IV	Markku Anton Häkkinen
V	Sections of the Genus <i>Musa</i> and a note about this document
8	Species of the section <i>Musa</i>
9	Species of the section <i>Callimusa</i>
13	Section <i>Musa</i>
134	Section <i>Callimusa</i>
228	Bibliography
234	Acknowledgements

Preface

My correspondence with Markku Häkkinen began over email in 2004 when I was about 15 years old. My burgeoning curiosity with all things Musaceae led me to frequently write to him with questions I had about wild bananas. Not only was he always willing to answer, but also generously shared many photos and documents to aid in my studies.

We were first able to meet in person in 2006 when he was an invited speaker at the annual California Rare Fruit Growers festival held that year in San Luis Obispo, California, USA. Seeing as that California was much closer to my home in Colorado than to his in Finland, it seemed like the perfect opportunity to finally meet after a few years of back and forth emails.

For the next 10 years our communication continued, including several more meet-ups at his home in Finland, in Florida USA, and in Bogor Indonesia for a meeting. In 2013, I had the pleasure to work with him in his home for 10 days straight, where we sifted through all of his decades of field notes and countless papers extracting location data for all the various wild bananas. It was during this project and time with him where I saw what his grand plans for taxonomic revisions within the genus held. Some of those ideas eventually made it to the press, many others have yet to.

For many years, Markku had mentioned to me and others that he was working on a monograph of all known wild bananas, a synthesis and culmination of his career and seminal reference for wild banana taxonomy and information.



In 2015, I asked him how his monograph was going, knowing his health had been in decline. He let me know that it was in progress, but that the work was slow, and with his illness advancing if he were to be able to finish it, he would need help and offered to me that we work on it together as a joint publication. I eagerly accepted, and we began sharing files and ideas. Exactly one week later, the emails stopped, and I found out not long after that he had passed away. Left with a skeleton outline, and a mountain of questions, I wasn't sure what to do.

It wasn't until a few years later that I was contacted by some other *Musa* colleagues inquiring about the status of his monograph. After informing them of the story, an effort was made to produce some form of the work he had in mind.

The following catalogue is a far cry from what Markku must have imagined, but the intent to create a reference document about wild bananas for the *Musa* researcher is hopefully achieved and will allow other *Musa* researchers to more easily access the knowledge he hoped to share. Documentation on wild bananas can be as hard to track down as the plants themselves, so it is hoped that this document, in conjunction with the many publications it relies on (including a number of important works by Markku) may at least serve as a starting point to be continually improved upon as we collectively continue the expedition.

Gabriel Sachter-Smith, 2021



Markku Anton Häkkinen

(14 January 1946 – 5 December 2015)

Markku Häkkinen's career as a banana taxonomist began in at the age of 32 in Kotka, Finland where in 1978 he saw a small banana plant growing in the window of a local flower shop. Having seen banana plants previously on his travels throughout the tropics as a captain of cargo ships, he was intrigued to see one growing in his homeland of Finland. He inquired with the shop owner about the presence of the plant, who in fact did not know it was a banana. Markku decided to take the plant home and grow it as a houseplant. During his subsequent travels abroad in tropical locations for the shipping industry work, he made it a habit to collect various banana plants he came across, and began to learn more about them. In 1985, when his eye sight was deteriorating due to an illness and he was no longer able to pass the medical exams to continuing captaining the ships, he turned his attention fully towards plants.

The following three decades led him on a journey to eventually become the worlds foremost expert in wild *Musa*. During the span of his banana career, Markku published over 80 scientific papers, many describing new taxa of wild *Musa*, embarked on 18 field expeditions, and exhaustively studied herbarium specimens and literature in an attempt to bring forth a more coherent understanding of the diversity of wild bananas.

In 2009, he was honored by the Linnean Society in London with the H.H. Bloomer Award, given to amateur naturalists who have made significant contributions to the knowledge of their field of study.

His willingness to share information, photos, and stories from his studies and travels made him a fruitful collaborator and mentor to many scientists all over the world interested in wild *Musa*.

Sections of the Genus *Musa* and a note about this document

Wild banana taxonomy and classification has been a subject of debate and study since the time of Linnaeus. In fact, the first species ever described by Linnaeus was a banana (*Musa cliffortiana*), but since it was before his landmark publication *Species Plantarum*, it is oddly enough a pre-Linnean-Linnean taxon and is thus not valid (Cheesman, 1948a). However, even the validly published and accepted *M. paradisiaca* and *M. sapientum* later published by Linnaeus are long since rejected due to them being hybrids of different wild bananas, and also so intensely domesticated as to remove them completely from the realm of Linnean binomials (they are now considered belonging to no species) (Shepherd, 1999).

The various species of *Musa* were first classified into three subgenera by Sagot (1887), and later refined by Baker (1893); namely, subgenus *Physocaulis*, subgen. *Eumusa* and subgen. *Rhodochlamys*. In 1947, Cheesman performed a major overhaul of the classification and recognized *Physocaulis* as a separate genus, *Ensete*, and established two new sections, *Callimusa* and *Australimusa* (Cheesman, 1947).

However, it should be noted that Cheesman (1947) indicated "the groups have deliberately been called sections rather than subgenera in an attempt to avoid the implication that they are of equal rank." He further pointed out that his publication "may stimulate investigation of a genus that is difficult to collect and study, but sufficiently interesting and important in both economic and its more strictly botanical aspects to repay the investigators."

Argent (1976) later described *Musa* sect. *Ingentimusa* based on a single species, *Musa ingens* N.W. Simmonds. Chromosome numbers for these five previously proposed sections are as follows: *M.* sect.

Australimusa $2n=2x=20$; sect. *Callimusa* $2n=2x=20$ (except *Musa beccarii* $2n=2x=18$); sect. *Ingentimusa* $2n=2x=14$; sect. *Musa* ("Eumusa") $2n=2x=22$ and sect. *Rhodochlamys* $2n=2x=22$.

Finally in 2013, Markku published a paper formally reducing the sections to just two, *Musa* incorporating all the species of the previous sections *Eumusa* and *Rhodochlamys*, and *Callimusa*, incorporating all the species of the former separate sections *Callimusa* (which included *Ingentimusa*) and *Australimusa* (Häkkinen, 2013).

Though the understanding and documentation of the wild bananas has come a long way, there are still many questions to be answered. Taxonomically, there are still a number of loose ends and names of dubious status, along with a handful of species which are likely due to be reduced under others, as well as equally more which may well warrant elevation to their own species status.

For this reason, the species presented here are deliberately not an exhaustive list of all known taxa, and this document is not meant to be a taxonomic reference of all legitimate *Musa* names. Rather, the intent is to provide photos and information, and resource citations on those wild species of which we do know something about, and that one may come across in the field, or in germplasm collections. Certain species which bear valid names, but have no known living specimens or references in recent times have been omitted.

References given on each species' page are those which first published the name, and those which have given detailed description and study of the species from which the critical morphological traits and other pertinent information is derived.

For a detailed analysis on the taxonomic history of the great number of published *Musa* names, please refer to Häkkinen and Väre (2008a)¹.

¹ Häkkinen M; Väre H. 2008a. Typification and check-list of *Musa* L. names (Musaceae) with nomenclatural notes. *Adansonia* 30(3):63–112.



Species of the section *Musa*

SPECIES	RELEVANT PUBLICATIONS	GEOGRAPHICAL RANGE	PAGE
<i>M. acuminata</i>	Colla, 1820; Simmonds, 1956; Nasution, 1950	All of tropical and subtropical Asia, Western Oceania	14
<i>M. argentei</i>	Gogoi & Borah, 2014a	India	38
<i>M. arunachalensis</i>	Joe et al., 2013	India	40
<i>M. aurantiaca</i>	Gogoi, 2014; Häkkinen & Väre, 2008b; Baker, 1893	India	42
<i>M. balbisiana</i>	Colla, 1820; Cheesman, 1948b	India, Sri Lanka, China, SE Asia, Papua New Guinea	44
<i>M. basjoo</i>	Siebold & Zucc, 1874	China	48
<i>M. cheesmanii</i>	Simmonds, 1957; Gogoi et al., 2014; Joe et al., 2014	India	52
<i>M. chunii</i>	Häkkinen, 2008a; Sabu et al., 2013	China, India	54
<i>M. cylindrica</i>	Joe et al., 2014	India	56
<i>M. flaviflora</i>	Simmonds, 1956; Häkkinen et al., 2013; Joe et al., 2013	India	58
<i>M. griersonii</i>	Noltie, 1994	Bhutan	60
<i>M. itinerans</i>	Cheesman, 1949a; Häkkinen et al., 2008; Chiu et al., 2011; Chiu et al., 2015	India, China, Myanmar, Laos, Vietnam, Thailand	62
<i>M. kamengensis</i>	Gogoi & Häkkinen, 2013a	India	78
<i>M. mannii</i>	Hooker, 1872; Häkkinen & Väre, 2009a; Joe et al., 2014; Gogoi & Borah, 2014b	India	80
<i>M. markkuana</i>	Sabu et al., 2013; Hareesh, 2017	India, Myanmar	82
<i>M. markkui</i>	Gogoi & Borah, 2013	India	84
<i>M. nagalandiana</i>	Dey et al., 2014	India	86
<i>M. nagensium</i>	Prain, 1904; Cheesman, 1948c; Häkkinen, 2008; Joe et al., 2014b	India, China, Myanmar	88
<i>M. nanensis</i>	Swangpol et al., 2015	Thailand	90
<i>M. ochracea</i>	Shepherd, 1964; Joe et al., 2013	India	92
<i>M. ornata</i>	Roxburgh, 1814; Roxburgh, 1820; Cheesman, 1949b; Joe & Sabu, 2016	Bangladesh, Myanmar, India	94
<i>M. puspanjaliae</i>	Gogoi & Häkkinen, 2013b	India	96
<i>M. rubra</i>	Kurz, 1867; Cheesman, 1949c; Häkkinen, 2008a; Joe at. al., 2013; Joe et al., 2016	India, Myanmar	98
<i>M. rubinea</i>	Häkkinen & Teo, 2008	China	100
<i>M. ruiiensis</i>	Chen et al., 2014	China	104
<i>M. sabuana</i>	Prasad et al., 2013; Singh, 2014; Hareesh et al., 2017	India	106
<i>M. sanguinea</i>	Hooker, 1872; Cheesman, 1949d; Häkkinen & Väre, 2009a; Joe & Sabu, 2016	India	108
<i>M. schizocarpa</i>	Simmonds, 1956; Argent, 1976	Papua New Guinea	112
<i>M. siamensis</i>	Häkkinen & Wallace, 2006	Thailand	114
<i>M. sikkimensis</i>	Kurz, 1877; Simmonds, 1956; Joe et al., 2016	India	116
<i>M. thomsonii</i>	Häkkinen et al., 2013; Joe et al., 2013	India, China	120
<i>M. velutina</i>	Kurz, 1867; Wendland & Drude, 1875; Häkkinen & Väre, 2008c; Väre & Häkkinen, 2009	India, Myanmar	122
<i>M. yamiensis</i>	Yeh et al., 2008	Taiwan	124
<i>M. yunnanensis</i>	Häkkinen & Wang, 2007; Häkkinen & Wang, 2008a	China	126
<i>M. zaijui</i>	Häkkinen & Wang, 2008b	China	132

Species of the section *Callimusa*

SPECIES	RELEVANT PUBLICATIONS	GEOGRAPHICAL RANGE	PAGE
<i>M. arfakiana</i>	Argent, 2010	Indonesia	136
<i>M. azizii</i>	Häkkinen, 2005	Malaysia	138
<i>M. barioensis</i>	Häkkinen, 2006a	Malaysia	140
<i>M. bauensis</i>	Häkkinen & Meekiong, 2005	Malaysia	142
<i>M. beccarii</i>	Simmonds, 1960; Häkkinen et al., 2005	Borneo	144
<i>M. boman</i>	Argent, 1976	Papua New Guinea	148
<i>M. borneensis</i>	Beccari, 1902; Cheesman, 1950a; Hotta, 1967; Häkkinen & Meekiong, 2005; Sulistyaningsih, 2017	Borneo	150
<i>M. bukensis</i>	Argent, 1976	Bougainville, Papua New Guinea	154
<i>M. campestris</i>	Beccari, 1902; Hotta, 1967; Häkkinen, 2003	Malaysia, Indonesia	158
<i>M. coccinea</i>	Andrews, 1797; Argent, 2002	Vietnam, China	164
<i>M. exotica</i>	Valmayor, 2001	Vietnam	166
<i>M. gracilis</i>	Ridley, 1924; Cheesman, 1950b; Norfazlina et al., 2016	Malaysia	168
<i>M. haekinnenii</i>	Ly et al., 2012	Vietnam	172
<i>M. hirta</i>	Beccari, 1902; Hotta, 1967	Malaysia	174
<i>M. ingens</i>	Simmonds, 1960; Argent, 1976	Papua New Guinea	178
<i>M. jackeyi</i>	Hill, 1874; Simmonds, 1956	Australia	182
<i>M. johnsii</i>	Argent, 2001	Indonesia	184
<i>M. juwiniana</i>	Meekiong et al., 2008	Malaysia	186
<i>M. lawitiensis</i>	Nasution & Supardiyono, 1998; Argent ,2000; Häkkinen, 2006b	Malaysia, Indonesia	188
<i>M. lokok</i>	Geri & Ng, 2005	Malaysia, Papua New Guinea	192
<i>M. lolodensis</i>	Cheesman, 1950c; Argent, 1976	Indonesia	194
<i>M. lutea</i>	Valmayor et al., 2004	Vietnam	196
<i>M. maclayi</i>	Mueller, 1885; Simmonds, 1953, Simmonds, 1956; Argent, 1976	Papua New Guinea	198
<i>M. monticola</i>	Argent, 2000	Malaysia	202
<i>M. muluensis</i>	Hotta, 1967	Malaysia	204
<i>M. peekelii</i>	Lauterbach, 1914; Cheesman, 1949f; Simmonds, 1953; Argent, 1976	Papua New Guinea	206
<i>M. sakaiana</i>	Meekiong et al., 2005	Malaysia	210
<i>M. salaccensis</i>	Zollinger, 1854; Häkkinen & Väre, 2009b; Veldkamp & Sulistyaningsih, 2016	Indonesia	212
<i>M. splendida</i>	Chevalier, 1934; Valmayor et al., 2004; Ly et al., 2018	Vietnam, China	214
<i>M. textilis</i>	Née, 1801; Copeland, 1927; Cheesman, 1949e; Hotta, 1967; Christenhusz, 2009	Philippines, Borneo	216
<i>M. tuberculata</i>	Hotta, 1967	Brunei	220
<i>M. violascens</i>	Ridley, 1893; Cheesman, 1950b; Simmonds, 1956	Malaysia	222
<i>M. viridis</i>	Valmayor et al., 2004	Vietnam	224
<i>M. voonii</i>	Häkkinen, 2004	Malaysia	226

Section *Musa*

This section of the genus *Musa* was first published as *Eumusa* by Ernest Cheesman in 1947 along with section *Rhodochlamys*, and was named for representing the “true bananas”, those which the vast majority of edible cultivars belonged, as well as their wild progenitors *Musa acuminata* and *M. balbisiana*.

Initially, the *Eumusa* were defined as having pendent or semi-pendent inflorescences, fruits curving from the base towards the basal end, many flowers to a bract in two rows, bracts which are dull-colored, and pseudostems reaching 3m or more high.

Likewise, *Rhodochlamys* were defined as those species with erect or semi-erect inflorescences, fruits which curve from rachis towards the distal end, few flowers to a bract typically in a single row, brightly colored bracts, and pseudostems less than 3m high.

These differences surely made perfectly logical sense at the time, but with more study and an increasing number of specimens that no longer fit neatly into each category, the difference between the two sections became harder to maintain.

In 2013, Häkkinen published a taxonomically legitimate restructuring of the sections and designated *Musa* as the sole section containing all former *Eumusa* and *Rhodochlamys* species with a chromosome count of $x=11$, thus finally making official what had only been previously suggested (Häkkinen, 2013).

Section *Callimusa*

This section of the genus *Musa* was first published by Ernest Cheesman in 1947 along with section *Australimusa*, and was named for the often beautiful appearance of a number of member species (from a Latin and Greek derivation of “beautiful bananas”), particularly *M. coccinea* Andrews which was regarded as the most beautiful banana species known. For many years following Cheesman’s lead, *Musa* taxonomists had maintained the separation of the sections *Australimusa* and *Callimusa* based on morphology, particularly of the seeds, though genetic similarities and a number of intermediate traits had been well documented.

Initially, Cheesman sought to define *Callimusa* by seed morphology with the following description: “Seeds cylindrical, barrel-shaped, or top-shaped, marked externally by a transverse line or groove, above which they are warted, tuberculate or variously patterned, below usually smooth; internally with a well- developed perisperm chamber above the same line, this chamber empty in the ripe seed”. This was in contrast to the *Australimusa* which were defined as having “Seeds sub-globose or more or less dorsiventrally compressed, smooth, striate, tuberculate, or irregularly angulate, with a marked or obsolete umbo opposite to the hilum corresponding to a small perisperm chamber within.” However, both sections were recognized as being affiliated to one another with the common traits of a typical chromosome number of $x=10$, bracts which are flat and firm in texture which typically have a smoothed or polished texture on the outside, are rarely or never waxy, are strongly imbricate in the male bud, and never or only slightly rolling back (“revolute”) before falling (Cheesman, 1947).

With the insights of modern genetic analysis as well as more recently described species which defied the previous sectional boundaries, a number of taxonomists, including Häkkinen, had sought to unite the two sections. Genetic data also suggested that Argent’s monotypic section *Ingentimusa* (formerly containing the sole species *M. ingens*, seen as unique for having the only documented chromosome number of $x=7$) fit within the single clade despite its anomalous chromosome count and somewhat unique traits (Li et al., 2010; Argent, 1976). Additionally, it has since been documented that despite a unique chromosome count of $x=9$, *M. beccarii* also clusters comfortably within *Callimusa* based on genetics (Häkkinen et al., 2007).

In 2013, Häkkinen published a taxonomically legitimate restructuring of the sections and designated *Callimusa* as the sole section containing all *Musa* species with a chromosome number of $x=10$, $x=9$, and $x=7$, thus finally making official what had only been previously suggested (Häkkinen, 2013).



Section *Musa*

Musa acuminata



Section: *Musa*



Geographical range: All of tropical and sub-tropical Asia, and Western Oceania



Publications:

Colla LA. 1820. *Musa*. In *Memorie dell'accademia reale del lescienze di Torino*. 384 p.

Nasution R. 1990. A taxonomic study of the species *Musa acuminata* Colla with its Intraspecific Taxa in Indonesia. *Memoirs of the Tokyo University of Agriculture* 32:122

Simmonds NW. 1956. Botanical results of the banana collecting expedition. *Kew Bulletin* 11(3):463–489. <https://doi.org/10.2307/4109131>

CRITICAL MORPHOLOGICAL TRAITS

Pseudostem height (m)	2–4m
Petioles	(highly variable)
Inflorescence position	horizontal or pendent
Male bud shape	lanceolate-ovoid
Bract imbrication	none or slight
Color and texture of bract external face	highly variable color, texture dull
Bract behavior before falling	revolute
Compound tepal basic color	white-cream
Fruit shape and position	straight or slightly curved, pointing upwards
Fruit apex	bottle necked
Fruit quantity	highly variable, but always in 2 rows per hand
Seed size and shape	4–6mm, irregularly angular, wrinkled, black
Other traits of importance	



NOTES:

Musa acuminata, being the primary ancestral species to the majority of edible cultivated bananas, is of great interest to understand and document. It also happens to be a highly polymorphic species with a wide geographic range, from India to Papua New Guinea and nearly everywhere in between. They typically grow in disturbed areas and along roadsides, and in the areas where they are present tend to be one of the most common species of banana. This great diversity and range has complicated its full understanding, and there is still much left to be known about the extent of diversity within this species, and particularly, how best to classify it. Many different subspecies and varieties of *M. acuminata* have been published over the years, though many of the names remain somewhat poorly known and there is a great need for more field studies to bring forth taxonomic clarity.

With such a vast geographic range across many climates and habitats, there is bound to always be a degree of uncertainty and disagreement about classification, with plants presenting on a spectrum of morphological traits, and populations which overlap and merge into intermediate forms.

The critical morphological traits detailed on this page are intended to capture what traits are associated with *M. acuminata* across all published subspecies and varieties. A table is given summarizing the published taxa, and the following pages include many photographs to help depict them when available. Additionally, certain taxa on which more information is known or bear special significance in relation to the domesticated bananas are given their own text treatment.

Musa acuminata

Summary of published taxa

TAXON	AUTHOR, YEAR	GEOGRAPHICAL RANGE	TYPICAL UNIQUE TRAITS	PAGE
<i>Musa acuminata</i> subsp. <i>banksii</i>	Muell, 1864	Papua New Guinea. Australia: Queensland. Samoa	Pendent bunch, bend in rachis, large brown blotches on pseudostem	16
<i>Musa acuminata</i> subsp. <i>burmannica</i>	Simmonds, 1957	Myanmar, India, China, Vietnam, Laos	Compact pendent bunch, bracts dark purple with yellow tips, imbricate	20
<i>Musa acuminata</i> var. <i>chinensis</i>	Häkkinen & Wang, 2007	China: Yunnan	Allied with subsp. <i>burmannica</i> , waxy petioles	23
<i>Musa acuminata</i> var. <i>flava</i>	Nasution, 1991	Malaysia: Pulau Tijau - Pahang River	Green-bract form of subsp. <i>malaccensis</i>	24
<i>Musa acuminata</i> subsp. <i>halabanensis</i>	Hotta, 1989	Indonesia: West and Central Sumatra	Brown pseudostems, large pendent bunches	25
<i>Musa acuminata</i> subsp. <i>malaccensis</i>	Simmonds, 1957	Malaysia: Peninsular	Bracts red, non-imbricate	26
<i>Musa acuminata</i> subsp. <i>microcarpa</i>	Simmonds, 1957	Malaysia: Sarawak (Borneo)	Yellow tinged leaves, brown pseudostem, more rounded/“plump” male bud	27
<i>Musa acuminata</i> subsp. <i>acuminata</i> var. <i>acuminata</i>	Colla, 1820; Nasution, 1991	Indonesia: Maluku & West Papua	Bunches pendent, male buds green-yellow	28
<i>Musa acuminata</i> var. <i>sumatrana</i>	Nasution, 1991	Indonesia: Sumatra	Long skinny fruits that point upwards, large bunches	29
<i>Musa acuminata</i> var. <i>tomentosa</i>	Nasution, 1991	Indonesia: Celebes - Minahasa	Seeds not tuberculate	30
<i>Musa acuminata</i> var. <i>zebrina</i>	Nasution, 1991	Indonesia: Java	Leaves with red-brown blotches, fruits not hairy	31
<i>Musa acuminata</i> var. <i>alasensis</i>	Nasution, 1991	Indonesia: Aceh - Ketambe - Kutacane	Brown pseudostems, glabrous penduncle	32
<i>Musa acuminata</i> subsp. <i>siamea</i>	Simmonds, 1957	Malaysia: Peninsular, Thailand	Allied with subsp. <i>burmannica</i> , bud imbricate	33
<i>Musa acuminata</i> subsp. <i>truncata</i>	Kiew, 2001	Malaysia: Peninsular	Allied with subsp. <i>microcarpa</i> and subsp. <i>malaccensis</i> , yellow-green inner bract color	34
<i>Musa acuminata</i> var. <i>rutilifes</i>	Nasution, 1991	Indonesia: Java - Pasoreroean		35
<i>Musa acuminata</i> subsp. <i>errans</i>	Valmayor, 2001	Philippines	Bracts green, large bunches up to 26 hands	36
<i>Musa acuminata</i> var. <i>bantamensis</i>	Nasution, 1991	Indonesia: Banten - Ranca Danu	Brown blotched pseudostem, bud slightly imbricate	-
<i>Musa acuminata</i> var. <i>breviformis</i>	Nasution, 1991	Indonesia: Bogor Botanic Garden	Similar to <i>zebrina</i> but without extensive leaf pigmentation	-
<i>Musa acuminata</i> var. <i>cerifera</i>	Nasution, 1991	Indonesia: Java - Madjenang - Banjuoemas	Male bud ovoid, fruits hairy,	-
<i>Musa acuminata</i> var. <i>longepetiolata</i>	Nasution, 1991	Indonesia: Palembang - Musi rawas	Petiole as long as leaf blade	-
<i>Musa acuminata</i> var. <i>nakaii</i>	Nasution, 1991	Indonesia: Bogor - Cipayung	Leaves with red-brown blotches, fruits hairy	-

Musa acuminata subsp. *banksii*



Musa banksii was first described by Ferdinandus Mueller in 1863 from plants collected in Queensland, Australia. The status of *M. banksii* as it relates to *M. acuminata* has been debated over the years, with taxonomists variously treating it as a unique species, or as a subspecies of *M. acuminata*.

Cheesman reviewed the species in 1948, and though he did not choose to reclassify it at that time, he did note its affinity with *M. acuminata* and speculated on its relationship as follows: “Both type and variety cross readily with forms of *M. acuminata* Colla and give fertile hybrids. On this ground, as well as on consideration of the many close resemblances between the species in habit and floral characters, I am very doubtful whether *M. banksii* ought to be maintained as a species at all. For the present it may be maintained for convenience, but intermediate forms may be discovered in New Guinea or the Moluccas connecting it so closely with the polymorphic *M. acuminata* assemblage that it has to be reduced to varietal status. On present evidence we regard it rather as “replacing” typical *M. acuminata* at the south-eastern extremity of the range of that species, but its genotypic differentiation is evidently slight.” (Cheesman, 1948c).

It wasn't until 1957 that Simmonds reclassified it as a subspecies of *M. acuminata* based on extensive field observations in New Guinea, Australia, and Samoa, as well as crossing experiments in Trinidad. Simmonds noted that the number of ovules per ovary was on average higher than any other forms of *M. acuminata* recorded at that time, correlating with large fruits and a higher number of seeds per fruit, making it an ideal candidate for breeding purposes if disease resistant specimens could be identified. The *Musa* of West Papua have only been scantily studied, and Simmonds hypothesized that another unique form may be present to the west of Papua New Guinea, and its introgression into eastern populations may be responsible for the greater variability observed in Papua New Guinea.

Argent (1976) chose to treat it as a species, and was not convinced that Simmonds' evidence was sufficient to warrant subspecific status, but was intrigued by Simmonds' theory of unique populations to the west, even going so far as to use that as justification to withhold the status of subspecies until further field studies could be conducted. Even farther to the west

in the so called “triangle” of East Kalimantan, Maluku, and Lesser Sunda Islands of Indonesia, collecting missions in 2012 and 2013 revealed forms of *M. acuminata* speculated to be close to ssp. *banksii*, but with unique characteristics, potentially giving weight to Simmonds' 1956 theory (Hermanto et al., 2014a, 2014b).

Väre and Häkkinen (2008) suggested preserving *M. banksii* at the species status following Argent. This recommendation comes after citing that both Simmonds & Weatherup (1990) and Shepherd (1990) evidenced treating it as a species, though that is not precisely the case, rather both sources suggested it may be more distantly related to other forms of *M. acuminata*, but do not go so far as to explicitly suggest it be treated as a distinct species.

Documented forms and variations:

var. *banksii*: This varietal status is technically designated for any specimens from New Guinea and Australia as the only other documented variety specifically refers to plants found in Samoa, though it is rarely applied in practice.

var. *samoensis*: This is the form described by Cheesman (1948c) from Samoa. Although the plants grow feral, seeing as they are not found on any other Pacific islands between Samoa and New Guinea, it is likely they were brought by humans at some point, and that they are not truly native plants to that island, but more studies would be needed to confirm that. Cheesman had been evaluating specimens at the Imperial College of Tropical Agriculture (ICTA) in Trinidad, where he had previously acquired only three different specimens of ssp. *banksii*. It was decided

to distinguish a fourth specimen from Samoa as a distinct variety based on the observations that it was a seemingly taller and more robust plant with purple as opposed to green bracts observed in the other specimens. Though at the time this perhaps made sense and seemed unique, it has since been documented that purple or reddish bract forms of ssp. *banksii* are relatively common within the populations of New Guinea, and it is unlikely that specimens from Samoa are appreciably different from specimens which may be found in New Guinea. Simmonds (1956) later noted that all specimens examined in Samoa had “dirty brownish red” bracts, whereas specimens from Australia were mostly all yellow-green with a few red bract specimens, and in New Guinea “variability was the rule”, with a range of bracts colors observed.

Relevance to edible bananas:

Researchers at French Agricultural Research Centre for International Development (CIRAD) have identified subsp. *banksii* as being one of four main types of *M. acuminata* which have contributed to the genetics of the edible bananas. It has been shown that nearly all edible diploids have some amount of contribution of ssp. *banksii* in their genetic makeup combined with various other subspecies of *M. acuminata*. This suggests that some of the first forms of edible bananas may have arisen in New Guinea from wild ssp. *banksii* populations, and early primitive cultivars were transported by humans to other regions where they were then free to cross with other subspecies of *M. acuminata*, giving rise to a greater diversity of edible bananas.



***Musa acuminata* subsp. *banksii*
var. *banksii***



A, B, C, D: Gabriel Sachter-Smith.

***Musa acuminata* subsp. *banksii*
var. *samoensis***



A, B, C, D, E: Gabriel Sachter-Smith.

Musa acuminata subsp. *burmannica*

The original recognition of this unique form of *M. acuminata* was in 1948 by Cheesman, who although did not formally publish it as a taxon, described its traits and identified it as the “Tavoy form” of *M. acuminata*, as it had originated from Tavoy (now Dawei, Myanmar). In 1956, Simmonds formally upgraded its classification to a distinct subspecies. It was between the original recognition, and Simmond’s 1956 publication which, that in 1952 *M. kattuvazhana* was published, a name which fell into obscurity and apparently evaded the notice of Simmonds, or if he was aware, it at least did not draw any suspicions of being allied with the *M. acuminata* complex he was working to sort out. *M. kattuvazhana* was described in a monograph on the bananas of the Madras province of India in 1952 by K. Cherian Jacob. It is interesting to note that in the monograph, not a single mention of the species *M. acuminata* is present, while a profile of introduced *M. textilis* clearly depicts forms of *M. balbisiana* instead, revealing a less than expert treatment of the wild *Musa* under examination.

In 2016, the once lost and mostly unknown name *M. kattuvazhana* was revived after extensive field studies, and subsequently identified as being synonymous with *M. acuminata* subsp. *burmannica*, as well as *M. banksii* var. *singampatti* on literature based morphological grounds. Subspecies *burmannica* was thus reduced under *M. kattuvazhana* as it has priority based on publication date (Hareesh et al., 2017). It would seem that perhaps the theoretical combination “*M. acuminata* subsp. *kattuvazhana*” may be more appropriate taxonomically, however even such a compromise is unlikely to be widely accepted as ‘Calcutta 4’ and ‘Long Tavoy’ have both been long ingrained into the *Musa* research community as belonging to *M. acuminata* that to change course would require monumental revision to the literature and undoubtedly impose much undue complexity in a field which is desperately seeking simplicity and clarity.

The material Cheesman described came from Myanmar (then Burma) and comprised two collections: I.R. 124 (Clone Calcutta 4) and I.R. 187 (Clones Tavoy and Long Tavoy). The Burmese name was given in both cases as Taw-byaw, and the two collections differ only slightly in quantitative characters such as size of bunch and length of fruit, important to the banana breeder but not to the systematist (Cheesman, 1948c).

According to Simmonds (1956), this subspecies is distinguished by its yellowish and waxless foliage, light

brown markings on the pseudostem and by its compact pendulous bunch and strongly imbricate purple bracts.

Documented forms and variations:

***M. acuminata* var. *chinensis*:** prior to his passing in 2015, the taxonomist Markku Häkkinen had been planning to reclassify *M. acuminata* var. *chinensis* as a variety within subsp. *burmannica*, but this reclassification has not yet been realized in the literature (Markku Häkkinen, pers. commun.). The most notable difference between it and more classic subsp. *burmannica* is the presence of a heavy waxy coating on the petioles.

subsp. *burmannicoides* (‘Calcutta 4’): This name was given to an accession from the Royal Botanic Gardens in Calcutta, India has been famously used rather extensively in the breeding of bananas with increased disease resistance. Taxonomists have mostly considered the classification as a separate subspecies unjustified, and treat it as a cultivar of subsp. *burmannica*.

Musa acuminata subsp. *burmannica*

From wild populations observed in Northern Vietnam



A, B, C: Gabriel Sachter-Smith.

Musa acuminata subsp. *burmannica*



A, C: Long Tavoy; B, D: Calcutta 4; Gabriel Sachter-Smith.

Musa acuminata var. *chinensis*

From wild populations observed in Yunnan, China



A, B, C: Gabriel Sachter-Smith.

Musa acuminata* var. *flava



A, B, C: Ong Jyh Seng.

Musa acuminata* subsp. *halabanensis



A: Agus Sutantowwq/ITFRI-IAARD; B, C: Markku Häkkinen.

Musa acuminata subsp. *malaccensis*



A, B, C, D: Gabriel Sachter-Smith.

Musa acuminata subsp. *microcarpa*



A, B, C, E: Markku Häkkinen; D: ITFRI-IAARD.

***Musa acuminata*
subsp. *acuminata* var. *acuminata***



The original description by Colla (1820) describes a banana growing in the Maluku Islands of Indonesia which is described as having: a pendent inflorescence, sterile flowers (presumably referring to seedless fruits), male flowers which fall off, long undulating leaves with a petiole, and fruit which is sub-cylindrical and tapers to a point (acuminate). This description was actually based off an earlier description by Rumphius in his 1750 Herbarium Ambonense of a “Pisang Jacky” or “Pisang Monyet” which are known to refer to wild bananas, but because that description is pre-Linnean, it is not considered valid and thus Colla’s description is accepted (Nasution, 1991). However, the vagueness of the description and its similarity to almost any cultivated edible banana begs the question of which banana, if any this important taxon should actually refer to. To avoid even more confusion associated with the taxonomy of edible bananas Nasution (1991) choose to assume it referred to a wild species of the Maluku, an example of which is depicted here. The wild *M. acuminata* type bananas of this region have been known to have affinity with the subsp. *banksii* populations of Papua, but for the time being are considered as a separate taxon.

A: Agus Sutanto/ITFRI-IAARD.

***Musa acuminata*
var. *sumatrana***



A: Agus Sutanto/ITFRI-IAARD; B, C, D: Markku Häkkinen.

Musa acuminata* var. *tomentosa



A: Agus Sutanto/ITFRI-IAARD.

Musa acuminata* var. *zebrina



A, B, C, D, E: Gabriel Sachter-Smith.

Musa acuminata var. *alasensis*



A, B, C: Lia Hapsari.

Musa acuminata subsp. *siamea*



A, B, C, D: Sasivimon Swangpol.

Musa acuminata subsp. *truncata*



A, C: Gabriel Sachter-Smith; B, D: Markku Häkkinen.

Musa acuminata subsp. *rutilifes*



A, B, C, D, E: Lia Hapsari.

Musa acuminata* subsp. *errans



Jeff Daniells.

Musa argentii



Section: *Musa*



Geographical range: India: Lohit district, Arunachal Pradesh



Publication:

Gogoi R; Borah S. 2014. *Musa argentii* (Musaceae), a new species from Arunachal Pradesh, India. *Edinburgh Journal of Botany* 71(2):181–188. <https://doi.org/10.1017/S0960428614000079>

CRITICAL MORPHOLOGICAL TRAITS

Pseudostem height (m)	~2
Petioles	Green-light pink with dry brown wings
Inflorescence position	Pendent
Male bud shape	Lanceolate, aborts early
Bract imbrication	None
Color and texture of bract external face	Light purple, pubescent
Bract behavior before falling	Revolute
Compound tepal basic color	Orange
Fruit shape and position	Curved
Fruit apex	Slightly pointed
Fruit quantity	6–10 hands, 8–12 fruits per hand, two rows per hand
Seed size and shape	Angular, wrinkled, 6mm diameter, brown
Other traits of importance	Immature ovaries pubescent, becoming glabrous upon maturity



NOTES:

A rare species only known from the type locality. It is reported to be similar to *M. velutina* in that it has a hairy ovary when young, but differs in that the bunch is pendent with many more fruits that are non schizocarpic and that become glabrous by maturity. It's vegetative characteristics are somewhat similar to *M. mannii* in having significant amounts of red-brown blotching and broad dry wings towards the base of the petioles. It grows on the edges of dense forest near to, but not overlapping with populations of *M. velutina*. Named in honor of the late Dr. George Argent of the Royal Botanic Garden Edinburgh who made many contributions to the understanding and taxonomy of wild *Musa*.

Musa argentii



A: Anthony Rodriguez.

Musa arunachalensis



Section: *Musa*



Geographical range: India: West Kameng District, Arunachal Pradesh



Publication:

Sreejith PE; Joe A; Sabu M. 2013. *Musa arunachalensis*: A new species of *Musa* section *Rhodochlamys* (Musaceae) from Arunachal Pradesh, Northeastern India. *Phytotaxa* 134(1):49. <https://doi.org/10.11646/phytotaxa.134.1.4>



NOTES:

A rare species only known from the type locality. It is reported to grow both in the forest under canopy as well as in forest margins sympatric with *M. cheesmanii*, *M. sikkimensis*, and *M. markkuana*. The description bears a striking resemblance to *M. kamengensis*, which was also described from nearly the same area around the same time, but it is not presently clear what the relation between these taxa is.

CRITICAL MORPHOLOGICAL TRAITS

Pseudostem height (m)	1.4–3
Petioles	Green, glossy, margins straight and erect
Inflorescence position	Emerges erect, later curves sideways, arched at maturity
Male bud shape	Lanceolate, aborts early
Bract imbrication	Slight
Color and texture of bract external face	Red-orange with yellow apices, dull
Bract behavior before falling	Revolute
Compound tepal basic color	Orange-yellow
Fruit shape and position	Straight, perpendicular or towards rachis
Fruit apex	Lengthily pointed
Fruit quantity	2–6 hands, 3–5 fruits per hand, single row per hand
Seed size and shape	(Unknown)
Other traits of importance	Slight purple coloration on leaf underside

Musa arunachalensis



A, B, C: Alfred Joe.

Musa aurantiaca



Section: *Musa*



Geographical range: India: Lohit district, Arunchal Pradesh



Publications:

Baker JG. 1893. A synopsis of the genera and species of Museae. *Annals of Botany* 7(2):189–222. <https://doi.org/10.1093/aob/os-7.2.189>

Gogoi R. 2014. *Musa aurantiaca* (Musaceae) and Its Intraspecific Taxa in India. *Nordic Journal of Botany* 32(6):701–709. <https://doi.org/10.1111/j.1756-1051.2013.00480.x>

Häkkinen M; Väre H. 2008b. A taxonomic revision of *Musa aurantiaca* (Musaceae) in Southeast Asia. *Journal of Systematics and Evolution* 46(1):89–92.

CRITICAL MORPHOLOGICAL TRAITS

Pseudostem height (m)	~1
Petioles	Margins straight and erect, winged and clasping, bases with sparse brown blotches
Inflorescence position	Erect
Male bud shape	Ovate
Bract imbrication	None
Color and texture of bract external face	Orange-red, dull, slightly waxy
Bract behavior before falling	Revolute
Compound tepal basic color	Orange
Fruit shape and position	Straight, pointing upwards at an angle from stem
Fruit apex	Rounded
Fruit quantity	5 hands, 4–5 fruits per hand, single row per hand
Seed size and shape	Rounded, ~2mm diameter
Other traits of importance	Sometimes with slight purple coloration on leaf underside



NOTES:

Musa aurantiaca has a wide distribution in an area bounded in the Northwest by Tibet's southern slope of the Himalayas, by Northern Arunachal Pradesh in the Northeast, extending as far South as Northern Assam, and East to Putao in Northern Myanmar, where it was reported in 2006 (Häkkinen & Väre, 2008b). It grows primarily at higher altitudes between 300m and 1200m in moist ravines of evergreen forests and along riversides. Three varieties are published as described by Gogoi (2014): var. *aurantiaca*, var. *homenborgohainiana* (approximately twice the size of standard type in most metrics), and var. *jengingensis* (larger than standard type, and with hermaphrodite basal flowers).

Musa aurantiaca



A, C, D, E: Markku Häkkinen; B: Remko Beuving.

Musa balbisiana



Section: *Musa*



Geographical range: India: Sri Lanka, Myanmar, Laos, China, Vietnam, Thailand, Indonesia, Papua New Guinea.



Publications:

Cheesman EE. 1948b. Classification of the bananas, III. Critical notes on species: *Musa balbisiana*. *Kew Bulletin* 3(1):1–17.

Colla LA. 1820. *Musa*. In *Memorie dell'accademia reale del lesienze di Torino*. 384 p.

CRITICAL MORPHOLOGICAL TRAITS

Pseudostem height (m)	3–6, sometimes taller
Petioles	Heavy wax, margins strongly curved inwards, not winged, tightly clasping pseudostem
Inflorescence position	Pendent
Male bud shape	Variable from round or broadly ovoid to lanceolate
Bract imbrication	Slightly imbricate
Color and texture of bract external face	Occasional green to yellow apices, corrugated and waxy
Bract behavior before falling	Lifting, non-revolute
Compound tepal basic color	Cream, commonly with some purple striations
Fruit shape and position	Straight, perpendicular
Fruit apex	Often pointed or bottle nosed
Fruit quantity	Variable up to 10 hands, 8–14 or more fruits per hand, two rows per hand
Seed size and shape	Irregularly globose, tuberculate, 5–6mm diameter
Other traits of importance	Several bracts lifting at once, and often persistent (and dry) along the rachis to some degree. Fruit very compact on bunch. Plant often highly waxy.



NOTES:

Musa balbisiana is one of the most common wild species of banana, distributed all over the world for many non-fruit uses, and it, along with *M. acuminata*, is one of the primary ancestral progenitors to the domesticated edible bananas (Cheesman, 1948). The diversity within this species is at least as great as within *M. acuminata*, but because of its frequent cultivation for a variety of uses, it can be difficult to ascertain which populations may represent true wild forms, and which are merely escapes from cultivation. Reasons for growing it include: pseudostem fibers for cordage or cloth, leaves for cooking in, male buds as a vegetable, pseudostem and leaves for animal fodder, fruits and seeds for medicinal use.

A typical specimen that one may come across would almost invariably be cultivated or escaped from cultivation, but seemingly true wild populations can be found in northeast India, through to southern China, and northern Laos. A number of cultivated forms exist, including a type with large fruits and ample pulp which although seeded, the seeds normally do not develop properly and remain soft (Gabriel Sachter-Smith, personal observation).

Despite it's wide morphological diversity, the species can readily be recognized to the trained eye by the following traits: relatively erect leaves, bracts which lift multiple at a time and do not roll (non-revolute), male flowers which fall before the bract (if the bracts fall), internal bract face which is red without any discoloration towards the base, leaf lamina bases which are highly recurved, and seeds which are more or less round and tuberculate. Bract persistence is common, often the entire rachis may be draped with dried bracts, but it is also not uncommon to come across specimens with bracts which readily fall off.

At least eight botanical varieties are described, however a number of them are simply old published species names which were referred to *M. balbisiana* either for lack of a better guess as to their true status, or are essentially domesticated forms that have little to do with the diversity one may expect to find in a wild population. For this reason, the botanical varieties are not addressed here, but a number of morphological variations within the species are illustrated in the following pages.

Musa balbisiana

Examples of inflorescence variations



A, B, C, D, E, F: Gabriel Sachter-Smith.

Musa balbisiana



G, H, I: Markku Hakkinen; J: Gabriel Sachter-Smith.

Musa balbisiana



J, K, L, M: Gabriel Sachter-Smith; N: Markku Hakkinen.

Musa basjoo



Section: *Musa*



Geographical range: China: Sichuan



Publication:

Siebold & Zucc. ex linuma. 1874. *Musa basjoo*. Sinte Somoku Dzu-sestu [Illustrated Flora of Japan], ed. 2. <https://bit.ly/3K9vgrU>

CRITICAL MORPHOLOGICAL TRAITS

Pseudostem height (m)	2–3
Petioles	Green with prominent often wavy-winged margins, not clasping base
Inflorescence position	Horizontal bunch with pendent male axis
Male bud shape	Broadly ovoid to round
Bract imbrication	Slight
Color and texture of bract external face	Yellowish-green occasionally with purple blush, dull, corrugated, with little to no wax
Bract behavior before falling	Revolute, lifting multiple at a time
Compound tepal basic color	Cream with yellow tip
Fruit shape and position	Straight, perpendicular to stem
Fruit apex	Rounded obtuse
Fruit quantity	Around 5–10 hands, 10–16 fruits per hand in two rows
Seed size and shape	6–8mm, irregularly angulate, warty, black
Other traits of importance	Plants normally waxless and totally green except occasional red coloration along upper and lower leaf midribs and leaves on juvenile plants



NOTES:

This species is best known for its extreme tolerance to cold, making it a popular ornamental plant in the horticulture trade in temperate areas. Often erroneously referred to as the “Japanese Fiber Banana”, though was never used in Japan for fiber, and is native to China. The actual banana used for fiber in some southern islands of Japan is another Chinese species, *M. balbisiana* var. *liukuensis*. This species most closely resembles *M. itinerans*, but differs by not typically producing long traveling rhizomes, however some plants in certain circumstances do seem to have a propensity to produce suckers further away than the typical banana (Gabriel Sachter-Smith,, personal observation). Though widely cultivated as an ornamental in China, wild populations seem to be rather rare, but have been reported as recently as 2019 from Sichuan (Zhang Ting, pers. commun.).

Two additional varieties have been published, var. *lushanensis*, and var. *luteola*, but are currently not well understood (Häkkinen & Väre, 2008a).

Musa basjoo



A: Markku Hakkinen.

Musa basjoo



B, D: Gabriel Sachter-Smith; C: Markku Hakkinen; E: Xue-Jun G.

Musa basjoo



F: Xue-Jun Ge; G; H: Markku Häkkinen.

Musa cheesmanii

Section: *Musa*

Geographical range: India: Assam, Arunachal Pradesh, Manipur, Nagaland

Publications:

Gogoi R; Häkkinen M; Borah S; Satyanarayana P. 2014. Taxonomic identity of *Musa Cheesmanii* (Musaceae) in Northeast India. *Nordic Journal of Botany* 32(4):474–478. <https://doi.org/10.1111/j.1756-1051.2013.00429.x>

Joe A; Sreejith PE; Sabu M. 2014. On the rediscovery and extended distribution of *Musa Cheesmanii* Musaceae from North-East India. *International Journal of Plant, Animal and Environmental Sciences* 4(2):1–4.

Simmonds NW. 1956. Botanical results of the banana collecting expedition. *Kew Bulletin* 11(3):463–489. <https://doi:10.2307/4109131>

CRITICAL MORPHOLOGICAL TRAITS

Pseudostem height (m)	3–6
Petioles	Greenish-yellow to purple, margins closed and overlapping, with reddish-black blotches at base, winged and clasping pseudostem
Inflorescence position	Pendent
Male bud shape	Lanceolate
Bract imbrication	Slightly
Color and texture of bract external face	Dark brown-purple to pink-purple with yellow apices, smooth, waxy
Bract behavior before falling	Non-revolute, often persistent to varying degrees on rachis
Compound tepal basic color	Cream to cream-yellow
Fruit shape and position	Curved, elongate and angled, pointing towards peduncle
Fruit apex	Slightly pointed
Fruit quantity	6–12 fruits per hand, 3–14 hands, two rows per hand
Seed size and shape	Irregularly angulate, intensely warty, 6–10mm diameter
Other traits of importance	Plants waxy, rachis sometimes containing persistent dry bracts

NOTES:

This large species resembles *M. balbisiana* in many respects but has seeds which are nearly twice as large, as well as having a more lax bunch and fruits which point more upwards. It also closely resembles *M. nagensium* in general appearance, especially in it’s size, generous amount of wax, typically darn brown-black pseudostems and seed morphology, but is easily distinguished by the fact that the fruits in *M. nagensium* hang downwards from the bunch as opposed to the strongly upwards pointing fruit of *M. cheesmannii*.

Musa cheesmanii



A, D, E: Markku Häkkinen; B, C, F, G, H: Remko Beuving.

Musa chunii



Section: *Musa*



Geographical range: China: Yunnan, Myanmar: Myitkyina, India: Arunachal Pradesh



Publications:

Häkkinen M. 2008a. *Musa chunii* Häkkinen, a new species (Musaceae) from Yunnan, China and taxonomic identity of *Musa rubra*. *Journal of Systematics and Evolution* 46(6):87–91. <https://doi.org/10.1111/j.1759-6831.2009.00005.x>

Sabu M; Joe A; Sreejith PE. 2013. *Musa chunii* Häkkinen (Musaceae): An addition to the wild banana flora of India and notes on conservation of a critically endangered species. *Annals of Plant Sciences* 2(5):160–162.

CRITICAL MORPHOLOGICAL TRAITS

Pseudostem height (m)	1–2
Petioles	Margins open and erect, red-pur margins open and erect, red-purple blotches at base, winged and not clasping pseudostem
Inflorescence position	Pendulous
Male bud shape	Lanceolate
Bract imbrication	None
Color and texture of bract external face	Pale lilac, very little wax
Bract behavior before falling	Revolute, lifting multiple at a time, typically degenerating before maturity
Compound tepal basic color	Cream
Fruit shape and position	Curved towards peduncle, slightly ridged
Fruit apex	Blunt tipped
Fruit quantity	5 hands, 4–6 fruits per hand in a single row
Seed size and shape	Unknown
Other traits of importance	



NOTES:

This species shows similarity with *M. mannii* and *M. rubinea* but differ from those in having pale lilac to purple colored bracts, and cream colored peduncle with more and larger fruits.

Musa chunii is very rare in Yingjiang County, Dehong Prefecture, Yunnan, in the area bordering Myanmar where it was originally described from. Only one population of it with some ten individual plants was found during the initial study by Häkkinen. However, there have been several observations of *M. chunii* from Myitkyina District, Myanmar where it occurs in isolated populations but these areas need further study (Häkkinen, pers. commun.). In 2014, Sabu et al. reported the species being identified in Arunachal Pradesh India in the cultivated nursery of a commercial seedsman, but wild populations had not been observed at that time. The species is named in honor of Chinese academician and botanist Chun Woon-Young for his contributions to the botany of China.

Musa chunii



A, B, C: Markku Häkkinen; D: Anthony Rodriguez.

Musa cylindrica



Section: *Musa*
Geographical range: India: Meghalaya
Publication:

Joe A; Sreejith PE, Sabu M. 2014. *Musa cylindrica*, a new species of *Musa* (Musaceae) from North-East India. *Phytotaxa* 172(2)137–140.
<https://doi.org/10.11646/phytotaxa.172.2.11>

CRITICAL MORPHOLOGICAL TRAITS

Pseudostem height (m)	2–3.5
Petioles	Slightly waxy, wide with erect marings, brown-black blotches at base, winged and clasping pseudostem
Inflorescence position	First pendulous, then somewhat horizontal, rachis falling vertically
Male bud shape	Lanceolate
Bract imbrication	Slightly at apex
Color and texture of bract external face	Red-purple
Bract behavior before falling	Revolute, lifting one at a time
Compound tepal basic color	Creamy orange or light orange
Fruit shape and position	Straight or slightly curved, perpendicular to rachis
Fruit apex	Bottle nosed
Fruit quantity	5–7 hands, 14–16 fruits per hand, two rows per hand
Seed size and shape	Irregularly angular
Other traits of importance	



NOTES:

Very little is reported about this taxon except that it is somewhat similar to *M. flaviflora*, *M. thomsonii*, and *M. acuminata*, but is said to differ from all in having a cylindrical female bud (Joe et al., 2014).

Musa cylindrica



A, B: Alfred Joe.

Musa flaviflora



Section: *Musa*



Geographical range: India: Assam, Nagaland, Manipur, Meghalaya



Publications:

Häkkinen M; Gogoi R; Borah S. 2013. A Taxonomic study of *Musa Flaviflora* and *M. Thomsonii* (Musaceae). *Nordic Journal of Botany* 32(5):578–583. <https://doi.org/10.1111/j.1756-1051.2013.00370.x>

Joe A; Sreejith PE; Sabu M. 2013. Notes on the rediscovery and taxonomic status of *M. flaviflora* N.W. .*Simmonds* and *M. thomsonii* (King Ex Schumann) A.M. Cowan & Cowan (Musaceae) From India. *Annals of Plant Sciences* 2(8):260–267.

Simmonds NW. 1956. Botanical results of the banana collecting expedition, 1954-5. *Kew Bulletin* 11(3):463–489. <https://doi:10.2307/4109131>

CRITICAL MORPHOLOGICAL TRAITS

Pseudostem height (m)	1.8–2
Petioles	Waxy, winged with erect margins, black-brown blotches at base
Inflorescence position	Horizontal to pendulous
Male bud shape	Lanceolate
Bract imbrication	Slight imbrication
Color and texture of bract external face	Red with yellow apex, moderately grooved, slightly waxy
Bract behavior before falling	Lifting one at a time, revolute, degenerating before maturity
Compound tepal basic color	Yellow
Fruit shape and position	Slightly curved, pointing towards peduncle
Fruit apex	Bottle-nosed
Fruit quantity	5–8 hands, 12–20 fruits per hand in two rows
Seed size and shape	Irregularly angular, 5–6mm, slightly warty
Other traits of importance	Very <i>M. acuminata</i> -like but with distinctly yellow male flowers



NOTES:

Musa flaviflora was first described by Cheesman in 1948 based on a plant grown in Trinidad at the Univ. of West Indies and the Banana Board Research Dept, Jamaica (ICTA, Trinidad) from a seed collected in the Mariani Range, Jorhat, Assam. Cheesman called the plant the ‘Mariani form’ as he could not place it in the *M. acuminata* group. Subsequently, Simmonds described it as *M. flaviflora*, a new species from Assam, India (Simmonds, 1956) based on his expedition to the area. He also mentioned: “This species resembles *Musa acuminata* and on purely morphological grounds would best to be treated as the northernmost subspecies of it. It differs from all known forms of *M. acuminata* and, above all, in its breeding behaviour in which it shows itself to be more closely allied to some species of *Rhodochlamys* than to any other known *Eumusa*” (Simmonds, 1956). Simmonds reported it 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 the *Musa* and *Rhodochlamys* sections at that time.

Musa flaviflora is widely distributed in northeast India. It is easily distinguishable due to the dense waxiness of immature plants with erect leaves, and reddish-pinkish male buds with a compact fruit bunch. It is named for its distinctive yellow flowers which are in stark contrast to the characteristically white flowers of *M. acuminata* which it largely otherwise superficially resembles.

Musa flaviflora



A: Remko Beuving; B, C, D: Rajib Gogoi.

Musa griersonii



Section: *Musa*
Geographical range: Bhutan: Sarbhang District
Publication:

Noltie HJ. 1994. Notes relating to the flora of Bhutan: XXVIII. Eriocaulaceae (*Eriocaulon*), Musaceae (*Musa*), Cyperaceae (*Actinoscirpus*). *Edinburgh Journal of Botany* 51(2):169–174. <https://doi.org/10.1017/S096042860000086X>

CRITICAL MORPHOLOGICAL TRAITS

Pseudostem height (m)	3
Petioles	Winged and spreading, dark purple on abaxial side
Inflorescence position	Pendulous
Male bud shape	Elongate, acute
Bract imbrication	Unknown (likely slight to none)
Color and texture of bract external face	Dark brown to purple-red
Bract behavior before falling	Revolute
Compound tepal basic color	Orange-yellow
Fruit shape and position	Unknown
Fruit apex	Unknown
Fruit quantity	7 or more hands, 22 or more per hand in two rows
Seed size and shape	Unknown
Other traits of importance	Black-purple leaf midribs



NOTES:

Extremely little is known about this taxon, with its only description being in the original publication which only compares it morphologically to *M. acuminata* and *M. balbisiana*. *M. griersonii* is surely quite different from those species, but may prove closely related to others known in the region such as *M. sikkimensis*, *M. thomsonii*, and *M. flaviflora*. A mature bunch was not observed, and the only two photos of the plant in the publication do not show very much useful detail. It is reported to have distinctive blackish-purple midribs, and winged petioles.



Musa griersonii



A, B, C: © David G. Long.

Musa itinerans



Section: *Musa*



Geographical range: India, China, Myanmar, Thailand, Laos, Vietnam, Thailand, Taiwan



Publications:

Cheesman EE. 1949. Classification of the bananas, III. Critical notes on species: *M. itinerans*. *Kew Bulletin* 4:23–24.

Chiu H; Shii C; Yang TY. 2011. A new variety of *Musa itinerans* (Musaceae) in Taiwan. *Novon: A Journal for Botanical Nomenclature* 21(4):405–412. <https://doi.org/10.3417/2009051>

Chiu H; Shii C; Yang TY. 2015. *Musa itinerans* var. *chiumei* (Musaceae), A New Addition to the Taiwan Flora. *Taiwania* 60(3):133–136.

Häkkinen M; Hong W; Ge X. 2008. *Musa itinerans* (Musaceae) and its intraspecific taxa in China. *Novon: A Journal for Botanical Nomenclature* 18(1):50–60. <https://doi.org/10.3417/2006162>

CRITICAL MORPHOLOGICAL TRAITS

Pseudostem height (m)	3–13
Petioles	30–50cm long, often spreading and erect margins
Inflorescence position	Pendent
Male bud shape	Variable, elongate ellipsoidal, to rounded
Bract imbrication	Typically none
Color and texture of bract external face	Typically dark purple-red, often with yellow striations
Bract behavior before falling	Revolute, occasionally tearing
Compound tepal basic color	Whitsh-cream
Fruit shape and position	Ovate and straight or slightly curved with a long tapered pedicel
Fruit apex	Mostly rounded with a small bottle-nose
Fruit quantity	Variable to 7 or more hands, 14 or more per hand in two rows
Seed size and shape	Tuberculate, irregularly angular, 5–7mm across
Other traits of importance	Long rhizomes, mats spreading with suckers appearing up to 3–5m away, inner bract color white-cream/yellow, young leaves often with red undersides



NOTES:

Musa itinerans was first described by Cheesman in 1949 from plants grown from seed imported from Myitkyina, Myanmar (Cheesman, 1949). The species is highly variable and one of the most common wild bananas in its native range, and thus far a total of 10 botanical varieties have been described from across its wide geographical distribution. It is not uncommon to see great variation within this species in the field, often making it difficult to refer any given population to a published variety outside of their type localities. The traits which unite this complex species across its many and varied forms and make it distinguishable from others growing sympatric with it are: a long traveling rhizomatous (“itinerant”) suckering habit, pale yellow-cream bract internal face color, and long tapering pedicels. Beyond those traits, there is great variability in terms of pseudostem height and color, fruit color, male bud external face color, and male bud shape. A table summarizing the most notable differences between the published varieties is given on the next page.

In its native habitat it commonly grows on slopes in forested areas in the lowlands, and all the way up to 2200m in elevation, even occurring in areas with annual frost and snowfall (Häkkinen et al., 2008). It often forms dense and extensive stands covering large areas in sunny as well as shaded understory conditions (Gabriel Sachter-Smith, personal observation).

The plant is commonly harvested from the wild as a vegetable, with male buds and the inner pseudostem being non-astringent when eaten raw. (Gabriel Sachter-Smith, personal observation).



A sprawling decentralized grove, typical of *M. itinerans*. Gabriel Sachter-Smith

Musa itinerans

Basic differences between published varieties

TAXON	GEOGRAPHICAL RANGE	TYPICAL UNIQUE TRAITS	PAGE
<i>Musa itinerans</i> var. <i>itinerans</i>	India, Myanmar, Vletnam, China	Dark red-purple bracts with yellow margins, whitish-green fruit	64
<i>Musa itinerans</i> var. <i>annamica</i>	Vietnam: Yen Bai	Bracts twist sideways as they unroll, silvery fruits	65
<i>Musa itinerans</i> var. <i>chinensis</i>	China: Guangdong	More weakly itinerant, green immature fruits ripens yellow, petiole canal margins curved inward	66
<i>Musa itinerans</i> var. <i>guangdongensis</i>	China: Guangdong	Male bud dark purple with pink streaks,	67
<i>Musa itinerans</i> var. <i>hainanensis</i>	China: Hainan	Pale green fruit, yellow-green male bud,	67
<i>Musa itinerans</i> var. <i>lechangensis</i>	China: Lechang Guangdong	Bracts non-revolute, round male bud	69
<i>Musa itinerans</i> var. <i>xishuangbannaensis</i>	China: Xishuangbanna Yunnan	Up to 12m, watery red sap, hermaphrodite basal flowers	70
<i>Musa itinerans</i> var. <i>chiumei</i>	Taiwan: Taoyuan County	Pale green fruit with purple spots, yellow-green male bud with purple streaks, inflorescence starts erect then falls	71
<i>Musa itinerans</i> var. <i>kavalanensis</i>	Taiwan: Yilan County	Whitish-green fruits, yellow-green male bud	72
<i>Musa itinerans</i> var. <i>formosana</i>	Taiwan	Pale green fruit with purple spots, yellow-green male bud with purple streaks	73

Musa itinerans var. *itinerans*



A, B, C: Markku Häkkinen.

Musa itinerans var. *annamica*



A, B: Markku Häkkinen.

Musa itinerans* var. *chinensis



Musa itinerans* var. *guangdongensis



A, B: Markku Häkkinen.

Musa itinerans* var. *hainanensis



A, B: Markku Häkkinen.



A: Markku Häkkinen.

Musa itinerans var. *hainanensis*



B, C, D, E: Markku Häkkinen.

Musa itinerans var. *lechangensis*



A, B: Markku Häkkinen.

Musa itinerans var. *xishuangbannaensis*



A, B, C: Markku Häkkinen.

Musa itinerans var. *chiumei*



A, B, C: Chiu Hui-Lung/TARI.

Musa itinerans var. *kavalanensis*



A, B, C: Chiu Hui-Lung/TARI.

Musa itinerans var. *formosana*



A, B, C: Chiu Hui-Lung/TARI.

Musa itinerans

Various male bud forms



A, B, C, D: Gabriel Sachter-Smith.

Musa itinerans

Various fruit color forms



A, B, C, D: Gabriel Sachter; E: Remko Beuving.

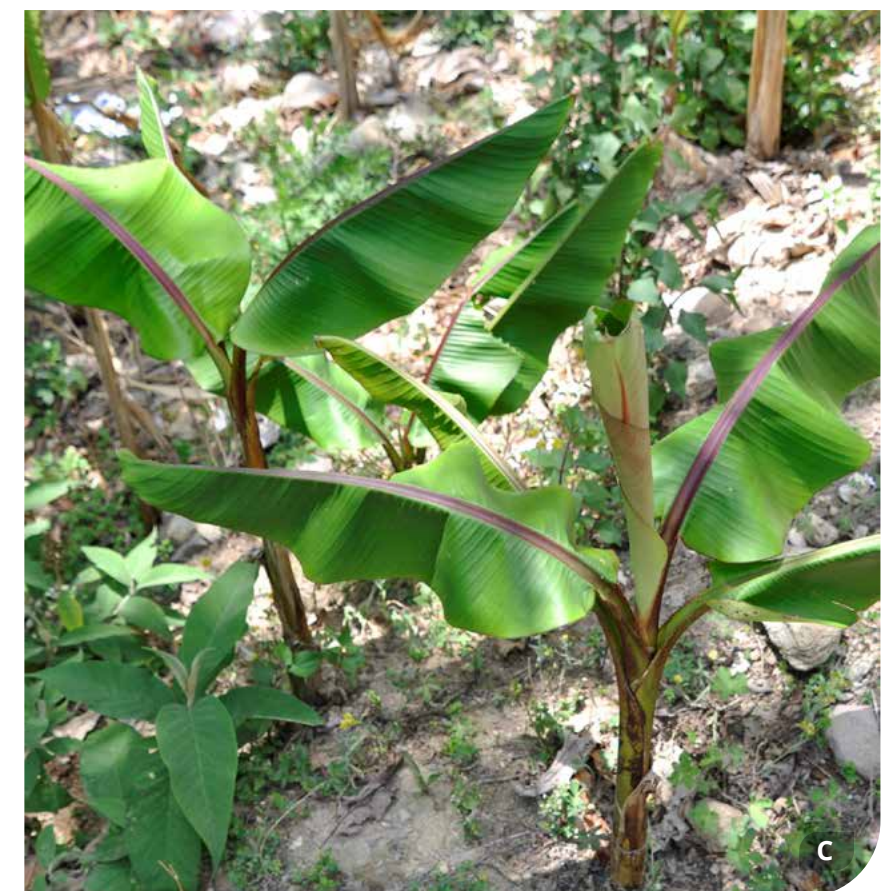
Musa itinerans

Various pseudostem color forms



A, B, C: Gabriel Sachter-Smith.

Musa itinerans



A, B, C: Gabriel Sachter-Smith.

Musa kamengensis

-  **Section:** *Musa*
-  **Geographical range:** India: Arunachal Pradesh, West Kameng District
-  **Publication:**
Gogoi R; Häkkinen M. 2013. *Musa Kamengensis* (Musaceae), a new species from Arunachal Pradesh, India. *Acta Phytotaxonomica Et Geobotanica* 64(3):149–153.

CRITICAL MORPHOLOGICAL TRAITS

Pseudostem height (m)	4–5
Petioles	With dry wings
Inflorescence position	Erect or slightly angled, with curving rachis
Male bud shape	Lanceolate
Bract imbrication	Unknown (description states so, but photos show no imbrication)
Color and texture of bract external face	Pink-orange, not-waxy
Bract behavior before falling	Non-revolute, lifting two at a time
Compound tepal basic color	Yellow-orange
Fruit shape and position	Ovate and straight or slightly curved with a long, tapering pedicel
Fruit apex	Mostly rounded with a small bottle-nose
Fruit quantity	4–8 hands, 3–9 fruits in a single row per hand
Seed size and shape	Angular, wrinkled, 3mm tall to 7mm wide
Other traits of importance	



NOTES:

Musa kamengensis is common on the mountain slopes of Jamiri between 800m and 1500m in altitude and thus seems to be a cold-tolerant species.

It is reported to be most similar to *M. sikkimensis*, but differs in having erect to horizontal inflorescence, pink bracts, fruits pointing towards male bud, and more seeds in each fruit (up to 133 seeds as compared to 65 seeds in *M. sikkimensis* [Gogoi & Häkkinen, 2013a]). The description bears a striking resemblance to *M. arunachalensis*, which was also described from nearly the same area around the same time, but it is not presently clear what the relation between these taxa is.

Musa kamengensis



A



B



C

A: Anthony Rodriguez; B, C: Remko Beuving.

Musa mannii



Section: *Musa*



Geographical range: India: Changlang District, Arunachal Pradesh



Publications:

Gogoi R; Borah S. 2014. *Musa mannii* var. *namdangensis* (Musaceae) from Arunachal Pradesh, India. *Taiwania* 59(2):93–97.

Häkkinen M; Väre H. 2009a. Typification of *Musa mannii*, *M. sanguinea* and *M. x kewensis* (Musaceae). *Kew Bulletin* 64(3):559–564. <https://doi.org/10.1007/s12225-009-9145-z>

Baker JG. 1894. Scitamineae. In: Hooker JD. *The Flora of British India*. Reeve & CO, London. pp 198–264. <https://bit.ly/3Cio4YQ>

Joe A; Sreejith PE; Sabu M. 2014. Notes on the rediscovery, taxonomic history and conservation of *Musa mannii* H. Wendl. Ex Baker (Musaceae). *Journal of Plant Taxonomy and Geography* 69(1):117–122.

CRITICAL MORPHOLOGICAL TRAITS

Pseudostem height (m)	>1–1
Petioles	Light green, margins erect with black to reddish-brown blotches at base, bases winged with broad brown wrinkled margins
Inflorescence position	Erect or slightly leaning, occasionally pendent
Male bud shape	Lanceolate
Bract imbrication	None
Color and texture of bract external face	Red-pink
Bract behavior before falling	Non-revolute
Compound tepal basic color	Cream-orange
Fruit shape and position	Straight or slightly curved
Fruit apex	Blunt
Fruit quantity	3–4 hands, 2–6 per hand in a single row
Seed size and shape	5 mm, irregularly angular, round, flattended
Other traits of importance	



NOTES:

Musa mannii was first described from a plant growing at the Royal Botanic Gardens Kew which had originally been collected in the wild in Assam. It is currently reported to be very rare in the wild and plants matching the type description have been found recently only from one location in Changlang District, Arunachal Pradesh. It grows from 150m to 400m in elevation sympatric with *M. acuminata*, *M. itinerans* and *M. nagensium*. This species seems to need wet soil and grows primarily along narrow margins of small streams in shady conditions under forest canopy (Joe et al., 2014).

In 2014, Gogoi and Borah found another population which varied somewhat from the original description and was named var. *namdangensis*. It differs by being a taller plant with a much larger inflorescence, basal flowers which are female as opposed to hermaphrodite, and many more fruits in a more compact bunch.

Though rare in the wild, it has been widespread among botanic gardens and in the horticultural trade where material matching the original type can be easily found (Häkkinen & Väre, 2009a).

The species is named after Gustav Mann, a German botanist, who worked in the Forest Department of India and collected the original specimen from Assam and sent it to Hermann Wendland, from whom the material reached Kew (Häkkinen & Väre, 2009a).

Musa mannii



A, C: Markku Häkkinen; B, D: Gabriel Sachter-Smith.

Musa markkuana



Section: *Musa*



Geographical range: India: Arunachal Pradesh, West Kameng. Myanmar: Kachin



Publications:

Hareesh VS; Joe A; Sreejith PE; Sabu M. 2017. *Musa markkuana* Stat. Nov. (Musaceae) — A reassessment of *Musa velutina* Subsp. *markkuana*. *Phytotaxa* 303(3):279–284. <https://doi.org/10.11646/phytotaxa.303.3.8>

Sabu M; Joe A; Sreejith PE. 2013. *Musa velutina* subsp. *markkuana* (Musaceae): A new subspecies from Northeastern India. *Phytotaxa* 92(2):49–54. <https://doi.org/10.11646/phytotaxa.92.2.3>

CRITICAL MORPHOLOGICAL TRAITS

Pseudostem height (m)	1–1.6m
Petioles	Margins curved inward, waxy, black-brown pigmentation at base
Inflorescence position	Erect
Male bud shape	Intermediate (ovoid-lanceolate), degenerating
Bract imbrication	None
Color and texture of bract external face	Pink, slightly grooved, very little wax
Bract behavior before falling	Revolute
Compound tepal basic color	Yellow
Fruit shape and position	Angular, pointing upwards
Fruit apex	Blunt
Fruit quantity	Up to 5 hands, 4–6 fingers per hand in one row
Seed size and shape	Angular, tuberculate, 4–6mm wide, brown-black
Other traits of importance	Similar to <i>M. velutina</i> , but fruits are non-hairy, and non-schizocarpic



NOTES:

Musa markkuana was originally published as a subspecies of *M. velutina* in 2013, but later revised and elevated to species status in 2017 by Hareesh et al. It is similar to *M. velutina* but mainly differs in having bracts and fruits without hair, basal flowers which are female as opposed to hermaphrodite, and fruits that do not split at maturity. It was reported to be common around Balupong in West Kameng district, and Tezu and Halyulyang in Arunachal Pradesh. In 2018 it was reported from Kachin State, Myanmar (Tanaka et al., 2018).

This species is named in honor of Markku Häkkinen.

Musa markkuana



A: Remko Beuvink.

Musa markkui



Section: *Musa*



Geographical range: India: Arunachal Pradesh, Lohit District



Publication:

Gogoi R; Borah S. 2013. *Musa Markkui* (Musaceae), a new species from Arunachal Pradesh, India. *Gardens' Bulletin Singapore* 65(1):19–26.

CRITICAL MORPHOLOGICAL TRAITS

Pseudostem height (m)	3–3.25
Petioles	Bases winged and not clasping pseudostem
Inflorescence position	Erect or erect and later becoming horizontal
Male bud shape	Lanceolate
Bract imbrication	None
Color and texture of bract external face	Pink
Bract behavior before falling	Revolute
Compound tepal basic color	Yellow
Fruit shape and position	Straight or slightly curved, angled
Fruit apex	Blunt tipped
Fruit quantity	7–10 hands, 4–7 fingers per hand in a single row
Seed size and shape	4–5mm, compressed, quadrangular, tuberculate
Other traits of importance	



NOTES:

Musa markkui somewhat resembles *M. ornata* in developing slender plants with erect inflorescences, green peduncles, and buds with pink bracts, but primarily differs in attaining a greater height with larger leaves, having bunches with more and larger fruit, and inflorescences that are at first erect but later become horizontal.

It is reported to be common in the hilly slopes of Tidding, Salangam, from Hyuliang to Mataliang, at elevations of 900m–1400m in the Lohit and Anjaw district of Arunachal Pradesh. It grows along side populations of *M. nagensium* and *M. cheesmanii*.

This species is named in honor of Markku Häkkinen.

Musa markkui



Musa nagalandiana

 **Section:** *Musa*

 **Geographical range:** India: Nagaland, Zuhenboto District

 **Publication:**
Dey S; Jamir NS; Gogoi R; Chaturvedi SK; Jakha H; Kikon Z. 2014. *Musa Nagalandiana* Sp. Nov. (Musaceae) from Nagaland, Northeast India. *Nordic Journal of Botany* 32(5):584–588. <https://doi.org/10.1111/njb.00516>

CRITICAL MORPHOLOGICAL TRAITS

Pseudostem height (m)	Up to 10
Petioles	Margins curved inwards, overlapping, bases tightly clasping pseudostem
Inflorescence position	Pendent
Male bud shape	Ovate
Bract imbrication	Imbricated
Color and texture of bract external face	Yellowish-orange, not waxy
Bract behavior before falling	Lifting many at a time, non-revolute
Compound tepal basic color	Cream
Fruit shape and position	Curved
Fruit apex	Pointed
Fruit quantity	Up to 13 hands, up to 17 fruits per hand in two rows
Seed size and shape	4mm, globose, smooth
Other traits of importance	

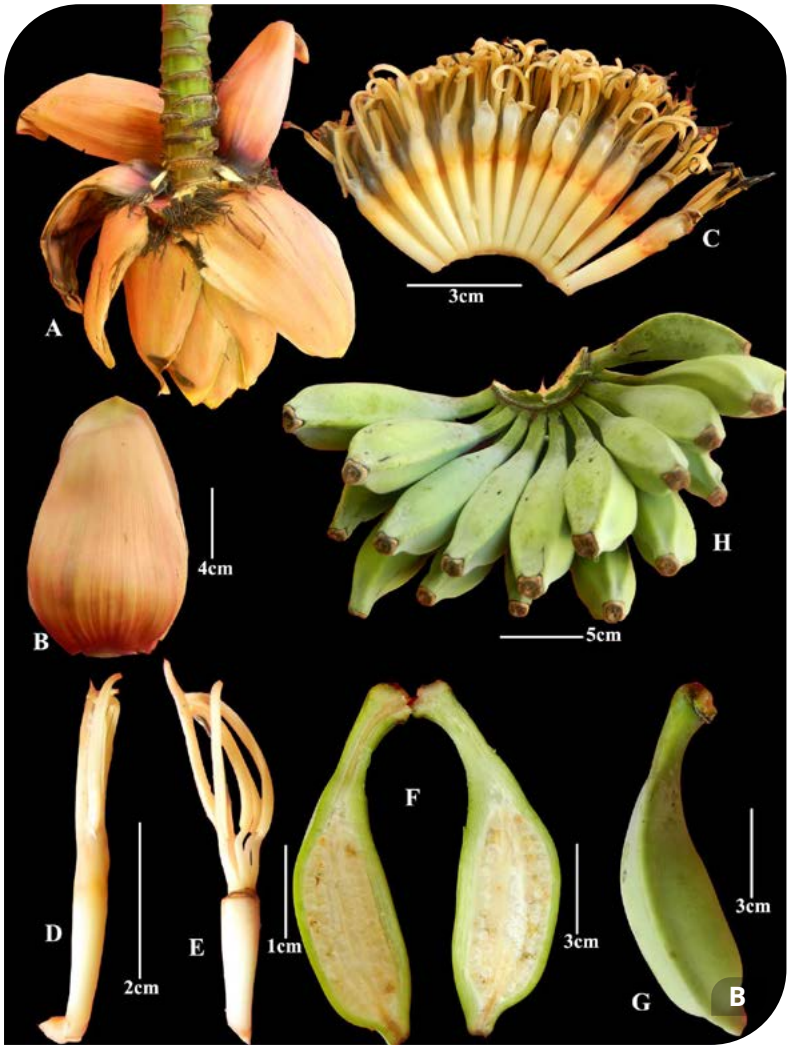
NOTES:

Musa nagalandiana grows near the Doyang river of Zunheboto district of Nagaland on hilly slopes of tropical semi-evergreen forests. At the time of it's discovery only two populations were found and it is presumed to be very rare and facing the threat of existence due to deforestation and urbanization in the area.

It strongly resembles *M. cheesmanii* and *M. nagensium* in many respects, but is easily distinguished in having ovate male buds which are orange to orange-yellow in color, and seeds which are about half the size and smooth in surface texture.



Musa nagalandiana



A, B: Rajib Gogoi.

Musa nagensium



Section: *Musa*

Geographical range: India: Nagaland, China: Yunnan, Myanmar: Kachin

Publications:

Cheesman EE. 1948d. Classification of the bananas: Critical notes on species: *Musa Nagensium*. *Kew Bulletin* 3(3):325–328. <https://doi.org/10.2307/4108836>

Häkkinen M. 2008b. Taxonomic identity of *Musa nagensium* (Musaceae) in Southeast Asia. *Novon: A Journal for Botanical Nomenclature* 18(3):336–339 <https://doi.org/10.3417/2006181>

Joe A; Sreejith P; Ashfak O; Sabu M. 2014. Regarding the identity, rediscovery and taxonomic history of *Musa nagensium* (Musaceae) from India. *Rheedea* 24(1):5–11.

Prain D. 1904. An undescribed Indian *Musa*. *Journal of the Asiatic Society of Bengal* 73:21–22.

CRITICAL MORPHOLOGICAL TRAITS

Pseudostem height (m)	3.5–7
Petioles	Yellow-green, waxy, without blotches at base, red margins at base clasping the pseudostem
Inflorescence position	Pendent
Male bud shape	Lanceolate to cylindrical
Bract imbrication	Highly imbricated
Color and texture of bract external face	Red-purple to orange-yellow, heavily waxy
Bract behavior before falling	Non-revolute, occasionally persistent
Compound tepal basic color	Cream-orange
Fruit shape and position	Straight, hanging downwards
Fruit apex	Pointed
Fruit quantity	4–8 hands, 4–12 fruits per hand in to rows
Seed size and shape	Irregularly angular, warty, 0.9mm–1.4mm across
Other traits of importance	Heavily waxy fruits with blush appearance, pseudostem typically dark brown and waxy leaf undersides intensely waxy



NOTES:

Musa nagensium Prain was initially described by David Prain in the Royal Botanic Garden, Calcutta (today the Indian Botanic Garden, Howran), based on the plant grown from rootstock collected from the Naga Hills region in the states of Nagaland and Assam, India (Prain, 1904). *Musa nagensium* is reported to still commonly grow in the Naga Hills region in the place of its original description. It is very common in Yingjiang County, Dehong, Yunnan, in the area bordering Burma, occurring typically at elevations from 800m–1300m in moist ravines (Häkkinen, 2008b). It was reported by Cheesman (1948d) as occurring in Myitkyina District, Myanmar, and in 2018 it was reported from Kachin State, Myanmar (Tanaka et al., 2018).

Two varieties were described by Häkkinen, var. *nagensium* with red bracts and var. *hongii* with yellow bracts, but later Joe et al., 2014 reduced both varieties citing a wide range of bract colors from red to orange and yellow within the originally described population.



Musa nagensium



A, B, D, G: Gabriel Sachter-Smith; C, E, F, H: Markku Häkkinen.

Musa nanensis



Section: *Musa*

Geographical range: Thailand: Nan

Publication:
Swangpol SC; Traiperm P; Somana J; Sukkaewmanee N; Srisanga P; Suksathan P. 2015. *Musa nanensis*, a new banana (Musaceae) species from northern Thailand. *Systematic Botany* 40:(2):426–432.
<https://doi.org/10.1600/036364415x688790>

CRITICAL MORPHOLOGICAL TRAITS

Pseudostem height (m)	1.5–3.0
Petioles	Green, base without blotches, petiole canal widely open with wings
Inflorescence position	Horizontal to erect, rachis erect
Male bud shape	Lanceolate
Bract imbrication	None
Color and texture of bract external face	Red fading to bright yellow at base, apex light green
Bract behavior before falling	Non-revolute
Compound tepal basic color	Green
Fruit shape and position	Straight to slightly curved, angular with prominent ridges
Fruit apex	Bottle-nosed
Fruit quantity	3–10 hands, 4–10 fruits per hand in two rows
Seed size and shape	Irregularly angled, rough surface, 3–5mm across
Other traits of importance	Male flowers unusual, with 6 tepals forming a tube



NOTES:

Musa nanensis is a very rare species and is only known from one locality close to the Thai-Laos border in Changwat Nan, Thailand where it was described. It was found at 835m in elevation in a dry evergreen forest near to streams in a valley where less than 50 plants have been observed. The population is reported to be threatened by encroaching deforestation and habitat fragmentation.

M. nanensis is quite unusual in appearance, having bracts and flowers reminiscent of *Callimusa* species in the region such as *M. coccinea*, *M. splendida*, and *M. lutea*, but with a bunch and fruits more similar to *M. acuminata* of section *Musa*. Thus far chromosome counts have not been undertaken to confirm sectional status which is so far based upon floral morphology.



Musa nanensis



A, B, C, D: Sasivimon Swangpol.

Musa ochracea



Section: *Musa*



Geographical range: India: Manipur, Mizoram, and Tripura



Publications:

Joe A; Sabu M; Sreejith P. 2013. On the rediscovery of *Musa ochracea* K. Sheph. (Musaceae) from North-East India. *Taiwania* 58(4):321–325. <https://doi.org/10.6165/tai.2013.58.321>

Shepherd K. 1964. A new species of banana. *Kew Bulletin* 17(3): 461–463. <https://doi.org/10.2307/4113815>

CRITICAL MORPHOLOGICAL TRAITS

Pseudostem height (m)	1.9–3
Petioles	Margins erect, strongly winged with dry wrinkled margin at base
Inflorescence position	Slightly pendulous to horizontal
Male bud shape	Lanceolate
Bract imbrication	None
Color and texture of bract external face	Moderately grooved, dark purple-brown, yellow towards apex
Bract behavior before falling	Lifting one at a time, revolute
Compound tepal basic color	Cream
Fruit shape and position	Straight or slightly curved, wider towards apex
Fruit apex	Pointed/bottle nosed
Fruit quantity	5–7 hands, 12–15 fruits per hand in two rows
Seed size and shape	2–4mm, round and flattened, smooth
Other traits of importance	Yellow pseudostem, fruits remain green upon ripening



NOTES:

Musa ochracea was originally described in 1964 from plants grown by Ken Shepherd in the Caribbean having been introduced as seed from the Poona Agricultural College in Bombay India, but no provenance had been known at that time. It wasn't until 2013 when wild populations had been found northeast India in the states of Manipur, Mizoram, and Tripura. It is reported to be relatively common and grows at elevations between 150m and 400m in moist ravines, roadsides, and forest margins sympatric with *M. acuminata*, *M. balbisiana*, *M. cheesmanii*, and *M. ornata* (Joe et al., 2013).

It can be distinguished from the other members of the section *Musa* in India by the ochre-yellow color of pseudostem and heavily wrinkled and winged base of the petiole. The fruit remains green upon ripening and the seeds are unusually small (Joe et al., 2013).

Musa ochracea



A, B, C, D: Alfred Joe.

Musa ornata



Section: *Musa*



Geographical range: Bangladesh, Myanmar, India: Mizoram, Andra Pradesh



Publications:

Cheesman EE. 1949. Classification of the bananas: Critical notes on species: *Musa ornata*. *Kew Bulletin* 4(1):24–28. <https://doi.org/10.2307/4119031>

Joe A; Sabu M. 2016. Wild ornamental bananas in India: An overview. *South Indian Journal of Biological Sciences* 2(1):213–221.

Roxburgh W. 1814. Hortus Bengalensis or a catalogue of the plants growing in the Honourable East India Company's Botanic Garden at Calcutta. Mission Press, Serampore.

Roxburgh W; Care W. 1824. Flora Indica. pp. 484–494. <https://bit.ly/3BM2wCL>

CRITICAL MORPHOLOGICAL TRAITS

Pseudostem height (m)	1–3
Petioles	Margins erect or slightly spreading, green and slightly waxy
Inflorescence position	Erect
Male bud shape	Lanceolate
Bract imbrication	Very slightly, occasionally more pronounced
Color and texture of bract external face	Light pink-purple, lightly waxy
Bract behavior before falling	Lifting 1–2 at a time, non-revolute
Compound tepal basic color	Yellow
Fruit shape and position	Straight, parallel to rachis
Fruit apex	Slightly pointed
Fruit quantity	3–5 hands, 2–5 fruits per hand in one row
Seed size and shape	Warty, irregularly angular, 5mm across
Other traits of importance	Fruits ripen to a pale-yellow or yellow-green color



NOTES:

Though originally described in 1814 at the Botanic Garden Calcutta collected from a population in what is now Bangladesh, this species was already becoming wide spread among collectors and botanic gardens and was documented in Mauritius as early as 1805 (Cheesman, 1949). There is a long and complicated history regarding its taxonomic identity summarized by Cheesman, but the pure species is well known and documented today. However, further confusion still persists in the horticultural trade with the belief that many various ornamental cultivars exist, when in reality almost all of them are other species or hybrids created and distributed for the floriculture trade. True wild populations were difficult to ascertain until more recently and populations have been found in Mizoram and Andhra Pradesh.

The pure species of *M. ornata*, though still somewhat variable, can be easily distinguished from other similar species by its pale lilac-purple bracts with a small amount of yellow on the apices, green immature fruits and peduncle, waxy petioles, and erect inflorescence.

Musa ornata



A, B, C, D: Markku Häkkinen.

Musa puspanjaliae

Section: *Musa*

Geographical range: India: Arunachal Pradesh, West Kameng

Publication:
Gogoi R; Häkkinen M. 2013. *Musa puspanjaliae* sp. nov. (Musaceae) from Arunachal Pradesh, India. *Nordic Journal of Botany* 31(4):473–477. <https://doi.org/10.1111/j.1756-1051.2013.00182.x>

CRITICAL MORPHOLOGICAL TRAITS

Pseudostem height (m)	7.5–9
Petioles	Margins curved inward, green, waxy
Inflorescence position	Pendent
Male bud shape	Ovoid
Bract imbrication	Highly imbricate
Color and texture of bract external face	Yellow-green or purple, slightly waxy
Bract behavior before falling	Lifting multiple at a time, non-revolute, often persistent and dry
Compound tepal basic color	Pale pink
Fruit shape and position	Straight, round, very compact on bunch
Fruit apex	Pointed
Fruit quantity	Up to 8 hands, up to 15 fruits per hand in two rows
Seed size and shape	10mm, angular, smooth, slightly wrinkled
Other traits of importance	Waxy fruits give silvery appearance, slightly rhizomatous with suckers appearing 45–75cm away

NOTES:

This species grows in large colonies in moist stream banks and hill slopes in subtropical dense forests up to at least 1200m in elevation. It is reported to be common in Sessa, from Zero Point to Ramda along the Sepa Road of West Kameng district and Hiza Basti, Ziro in Lower Subansiri district and not presently facing any immediate conservation threats. The species is named after the late Puspanjali Gogoi, mother of author Rajib Gogoi.

Musa puspanjaliae



A, D, F: Remko Beuving; B, C: Rajib Gogoi; E: Anthony Rodriguez.

Musa rubra



Section: *Musa*



Geographical range: Myanmar, India: Manipur



Publications:

Cheesman EE. 1949. Classification of the bananas: Critical notes on species: *Musa Laterita*. *Kew Bulletin* 4(3):265–267. <https://doi.org/10.2307/4109188>

Häkkinen M. 2008a. *Musa chunii* Häkkinen, a new species (Musaceae) from Yunnan, China and taxonomic identity of *Musa rubra*. *Journal of Systematics and Evolution* 47(1):87–91. <https://doi.org/10.1111/j.1759-6831.2009.00005.x>

Joe A; Sabu M; Ashfak A; Sreejith P. 2013. *Musa laterita* Cheesman (Musaceae): A new record for India from the wild, with a Key to the *Musa* (Section Rhodochlamys) in India. *Folia Malaysiana* 14(1):37–44.

Joe A; Sreejith P; Sabu M. 2016. Notes on *Musa rubra* Kurz (Musaceae) and reduction of *M. laterita* Cheesman as conspecific. *Taiwania* 61(1):34–40. <https://doi.org/10.6165/tai.2016.61.34>

Kurz S. 1867. Note on the plantains of Indian archipelago. *The Journal Agricultural and Horticultural Society of India* 14:295–301.

CRITICAL MORPHOLOGICAL TRAITS

Pseudostem height (m)	>1 to 2
Petioles	Green with open spreading wings
Inflorescence position	Erect
Male bud shape	Lanceolate, often degenerate at maturity
Bract imbrication	Slightly
Color and texture of bract external face	Orange-pink with yellow apices, highly grooved
Bract behavior before falling	Non-revolute, lifting 1–2 at a time
Compound tepal basic color	Yellow-orange
Fruit shape and position	Straight with short pedicel, pointing towards male bud
Fruit apex	Slightly pointed
Fruit quantity	4–6 hands, 4–8 fruits per hand in one or two rows per hand
Seed size and shape	3–9mm, globose, smooth, black
Other traits of importance	Fruits ripen bright yellow, rhizomatous with a spreading mat habit



NOTES:

Musa rubra was first described by Sulpiz Kurz in 1867 from plants collected in Pegu, Myanmar, and growing at the Calcutta Botanical Gardens (Joe et al., 2016). *M. laterita* was described by Cheesman in 1949 from plants collected as seed from Burma, and even at that time Cheesman suspected it may have been the same species as *M. rubra* Kurz, but decided to publish it as *M. laterita*. It was a new species anyway due to uncertainty over the description of *M. rubra* in the literature (Cheesman, 1949). It is commonly sold in the nursery trade incorrectly as *M. ornata* 'Bronze'.

In 2016 it was shown by Joe et. al that the names represented the same species and that *M. rubra* had priority following examination of wild specimens in Manipur. The main distinguishing trait of *M. rubra* that set it apart from *M. laterita* was the presence of persistent bracts, which was shown to be an unstable and fleeting trait that can change depending on conditions.

M. rubra can be easily distinguished from other similar looking species by its orange-bracts with yellow apices, waxless leaves and pseudostem, petioles with open and spreading canals, and a rhizomatous spreading habit. It is very similar to *M. siamensis* in all respects except for bract color.

Musa rubra



Musa rubinea

 **Section:** *Musa*

 **Geographical range:** China: Yunnan, Xishuangbanna

 **Publication:**
Häkkinen M; Teo C. 2008. *Musa rubinea*, a new *Musa* species (Musaceae) from Yunnan, China. *Folia Malaysiana* 9(1):23–33.

CRITICAL MORPHOLOGICAL TRAITS

Pseudostem height (m)	1–2
Petioles	Canals open, with blackish scarious margins, bases heavily wrinkled and not clasping pseudostem
Inflorescence position	Initially erect, often becoming horizontal or pendulous with maturity
Male bud shape	Lanceolate
Bract imbrication	None
Color and texture of bract external face	Red, occasionally orange, smooth, waxless
Bract behavior before falling	Lifting several at a time, revolute
Compound tepal basic color	Orange-yellow
Fruit shape and position	Curved, pronounced ridges, very lax in bunch
Fruit apex	Blunt
Fruit quantity	5–7 hands, 2–6 fruits per hand in one row
Seed size and shape	Smooth, rounded (according to original description, but only angular and tuberculate seeds were observed in wild populations by G. S. Smith)
Other traits of importance	

NOTES:

Musa rubinea was discovered in western Yunnan in 2003 growing in cultivation. Extensive field expeditions in Yunnan were made by Häkkinen from 2005–2007 but no wild populations of this species were found. The species was described from plants growing at the Xishuangbanna Tropical Botanic Garden (Häkkinen & Teo, 2008).

In 2019, a field expedition in southern Yunnan did manage to locate a number of wild populations of *M. rubinea*, including orange bract forms. Additionally, it was observed that variation in size of bunch, orientation of bunch (erect vs. horizontal vs. pendent), and degeneration habit of the male buds were quite diverse among the populations, and even within large groups. They were typically found growing on slopes in moist ravines often under some degree of canopy shade (Gabriel Sachter-Smith, personal observation).

It is morphologically very similar to *M. mannii*, particularly the described *M. mannii* var. *namdangensis*, primarily differing only in bract color. It is therefore also speculated it may be allied to or a rediscovered population of the poorly understood *M. sanguinea*.

Musa rubinea



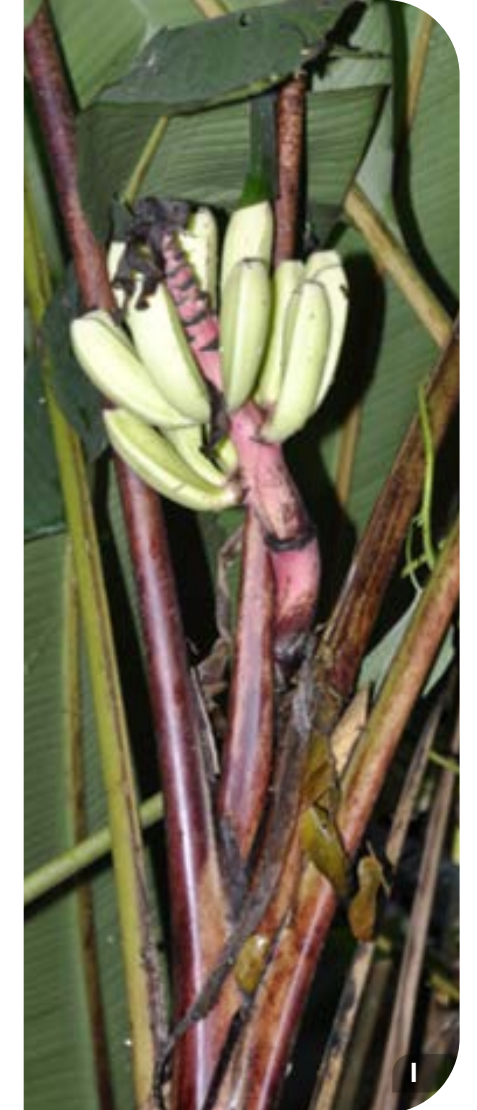
A, B, C: Gabriel Sachter-Smith.

Musa rubinea



D, E, F: Gabriel Sachter-Smith.

Musa rubinea



G, H, I: Gabriel Sachter-Smith.

Musa ruiliensis



Section: *Musa*
Geographical range: China: Yunnan, Ruili
Publication:

Chen W; Häkkinen M; Ge X. 2014. *Musa ruiliensis* (Musaceae, section *musa*), a new species from Yunnan, China. *Phytotaxa* 172(2):109. <https://doi.org/10.11646/phytotaxa.172.2.6>

CRITICAL MORPHOLOGICAL TRAITS

Pseudostem height (m)	1.8–2.5
Petioles	Margins curved inward, bases winged and clasping pseudostem
Inflorescence position	Initially erect, becoming pendulous with maturity
Male bud shape	Lanceolate
Bract imbrication	None
Color and texture of bract external face	Pink-red, smooth, waxless
Bract behavior before falling	Lifting several at a time, revolute, persistent
Compound tepal basic color	Orange-yellow
Fruit shape and position	Straight, compact on bunch, pointing upwards
Fruit apex	Blunt/rounded
Fruit quantity	7–8 hands, average 4 fingers per hand in one row
Seed size and shape	Irregularly angled, warty, 4–6mm accross
Other traits of importance	Male bud commonly aborts before fruit maturity



NOTES:

Musa ruiliensis occurs in Yunnan, southwestern China. It was described in 2014 from plants found growing in stream valleys around Daoba village, Ruili, in the Dehong Dai and Jingpo Autonomous Prefecture around 10km from the border with Myanmar. It is similar to *M. mannii*, *M. chunii* and *M. rubinea* in habit, but primarily differs from them in being a taller plant with more erect leaves.

Musa ruiliensis



A, B, C, D, E, F: Xue-Jun Ge.

Musa sabuana



Section: *Musa*

Geographical range: India: Andaman and Nicobar Islands

Publications:

Hareesh V; Joe A; Alappatt J; Sabu M. 2017. Musaceae of Andaman and Nicobar Islands with two new synonyms and one distributional record. *Rheedea* 27(2):71–78. <https://doi.org/10.22244/rheedea.2017.27.2.12>

Prasad K; Joe A; Bheemalingappa M; Rao BR. 2013. *Musa sabuana* (Musaceae): A new species from Andaman and Nicobar Islands, India. *Indian Journal of Forestry* 36(1):151–153.

Singh LJ. 2014. *Musa indandamanensis* L. J. Singh: A new species (Musaceae) from the Bay Islands, India. *Taiwania* 59(1):26–36. <https://doi.org/10.6165/tai.2014.59.26>

CRITICAL MORPHOLOGICAL TRAITS

Pseudostem height (m)	6–9
Petioles	Waxy, winged and clasping pseudostem
Inflorescence position	Sub-horizontal to pendulous
Male bud shape	Lanceolate
Bract imbrication	Slightly imbricated towards apex
Color and texture of bract external face	Purple-brown with green striations to completely green, moderately grooved
Bract behavior before falling	Lifting, mostly non-revolute but variable
Compound tepal basic color	Cream-white
Fruit shape and position	Curved, pointing towards peduncle
Fruit apex	Bottle-nosed
Fruit quantity	8–10 hands, 18–22 fruits per hand in two rows
Seed size and shape	Irregularly angular, 6mm
Other traits of importance:	Orange fruit pulp



NOTES:

M. sabuana is located in evergreen forests of Middle and Little Andamans found growing along streams at an altitude of 50m–100m. It is reported to be very rare and at risk of habitat destruction from land clearing and as food for elephants. It was reported by locals that many more populations of the species used to exist but were wiped out by a tsunami affecting Great Nicobar in 2004 (Singh, 2014; Hareesh et al., 2017).

Singh published *M. indandamanensis* around the same time in 2014, but later it was reduced as a synonym and part of the normal variation seen within populations of *M. sabuana*, a name which had priority. The color of the bracts is said to be highly variable from striped purple and green to fully green. Waxiness of the plants was also noted to be highly variable (Hareesh et al., 2017).

The species is named after Dr. Mamiyil. Sabu for his significant contributions to the taxonomy of Indian Musaceae.



Musa sabuana



A, B, C, D: Lal Ji Singh.

Musa sanguinea



Section: *Musa*



Geographical range: India: Assam (potentially extinct in the wild)



Publications:

Cheesman EE. 1949. Classification of the bananas. III. critical notes on species. *Musa sanguinea*. *Kew Bulletin* 4(2):133–135.
<https://doi.org/10.2307/4113662>

Hooker JD. 1872. *Musa sanguinea* tab 5975. *Curtis's Botanical Magazine* 98.
<https://bit.ly/3dwwCkz>

Häkkinen M; Väre H. 2009a. Typification of *musa mannii*, *M. Sanguinea* and *M. X Kewensis* (Musaceae). *Kew Bulletin* 64(3):559–564.
<https://doi.org/10.1007/s12225-009-9145-z>

Joe A; Sabu M. 2016. Wild ornamental bananas in India: An overview. *South Indian Journal of Biological Sciences* 2(1):213–221.



NOTES:

Musa sanguinea was discovered in 1869 by Gustav Mann, in the Mahuni forests on the banks of the Booree Deling River in Upper Assam, India. Hooker described it from a flowering plant at Kew Garden in January 1872 and provided an illustration (Hooker, 1872). After the illustration was drawn, parts of inflorescence and fruits were preserved in a liquid (Häkkinen & Väre, 2009a). Cheesman observed plants grown from seed obtained from Java in 1949 and determined although they were certainly not collected from a wild population, they seemed to match perfectly well the original description from Hooker.

Joe and Sabu (2016) report that it has not been seen in India in the wild. Photos from Häkkinen depict a plant which is highly similar to the original drawing, but where the photos were taken or their context is not known. Based on the description as well as the photos from Häkkinen, the species seems quite closely related to *M. mannii*, it's primary difference being bract color for which it is named ("sanguinea" refering to the blood-red colored bracts), and therefore also speculatively closely related to *M. rubinea*.



Musa sanguinea



A: Markku Häkkinen; B: ©Curtis's Botanical Magazine.

CRITICAL MORPHOLOGICAL TRAITS

Pseudostem height (m)	1
Petioles	Slender and reddish
Inflorescence position	Erect
Male bud shape	Ovate-lanceolate
Bract imbrication	None
Color and texture of bract external face	Bright red
Bract behavior before falling	Revolute
Compound tepal basic color	Orange-yellow
Fruit shape and position	Smooth, turgid, obtusely 3–4 angled (from original description)
Fruit apex	Unknown
Fruit quantity	Unknown
Seed size and shape	Irregularly cubical, tubercled, black (from original description)
Other traits of importance	Fruits tinged with red spots or streaks

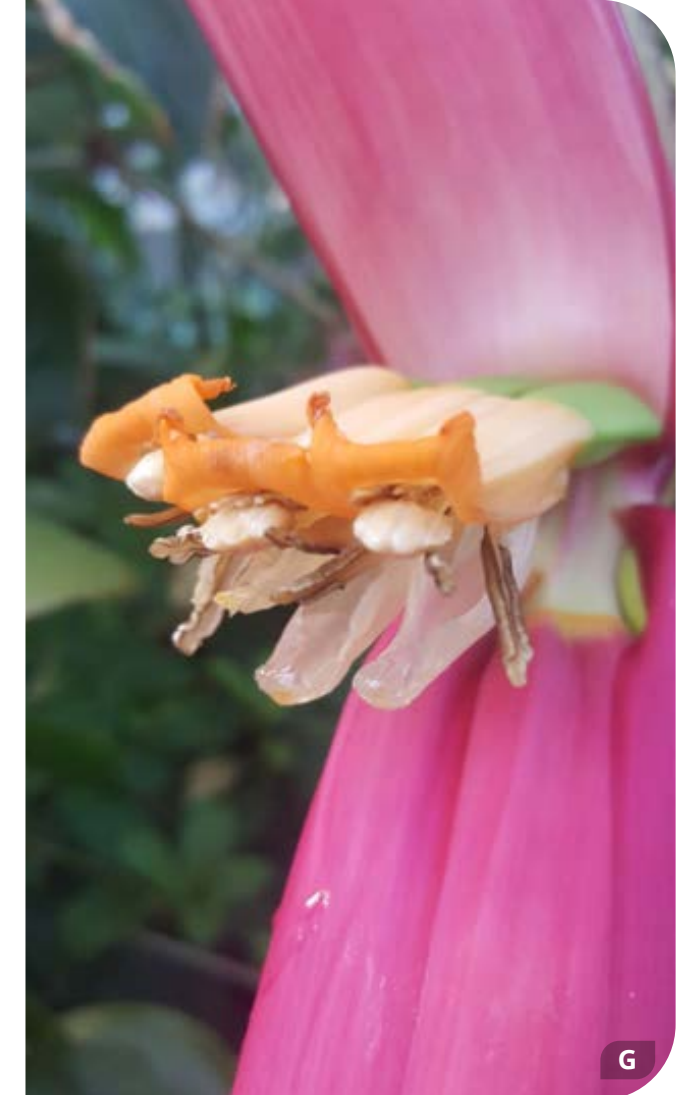
Musa sanguinea



Accession "19761560 - *Musa sanguinea* Hook.f." at the Royal Botanic Garden Edinburgh. The relation between this accession and the original plant described at Kew is presently unknown.

C, D: Markku Häkkinen; E: ©Royal Botanic Garden Edinburgh.

Musa sanguinea



F, G: ©Royal Botanic Garden Edinburgh.

Musa schizocarpa



Section: *Musa*



Geographical range: Papua New Guinea: W. Sepik, E. Sepik, W. Highlands, E. Highlands, Madang, Morobe, Central, Milne Bay



Publications:

Argent G. 1976. The wild bananas of Papua New Guinea. *Notes from the Royal Botanic Garden, Edinburgh* 35(1):77–114.

Simmonds NW. 1956. Botanical results of the banana collecting expedition, 1954–5. *Kew Bulletin* 11(3):463–489. <https://doi.org/10.2307/4109131>

CRITICAL MORPHOLOGICAL TRAITS

Pseudostem height (m)	Up to 10
Petioles	Green, margins erect, often with black blotches at base
Inflorescence position	Pendent
Male bud shape	Ovate-lanceolate
Bract imbrication	None
Color and texture of bract external face	Green, dull
Bract behavior before falling	Revolute
Compound tepal basic color	Cream-white
Fruit shape and position	Straight or slightly curved, short, highly angled, perpendicular to stem
Fruit apex	Bottle-nosed
Fruit quantity	Unknown (generally large and compact bunches)
Seed size and shape	Irregularly angular
Other traits of importance	Fruit does not change color upon ripening, but rather splits open from the distal end



NOTES:

Argent, in his 1976 review of the wild bananas of Papua New Guinea, recognized two variants of this species, and informally designated them as follows: “var. A, plant rarely fruiting when less than 7m tall, without obvious wax, male bracts curling from the distal end only; var. B, plant small, often fruiting when only 2m–3m high, the leaf sheaths and shoulders distinctly waxy, male bracts curling from both distal and proximal ends” (Argent, 1976).

M. schizocarpa is easily distinguished from the similar *M. acuminata* subsp. *banksii* with which it is typically growing nearby due its compact bunch of shorter and stouter, self-peeling fruits. Hybrids between the two are common and can make some pollen and seed, but are not as fertile as a typical wild banana. Though a somewhat rare occurrence, *M. schizocarpa* has been documented as being a contributing species to a number of edible, domesticated cultivars within Papua New Guinea (Argent, 1976).

Musa schizocarpa



A, B, C, D, E: Gabriel Sachter-Smith.

Musa siamensis



Section: *Musa*



Geographical range: Thailand



Publication:

Häkkinen M; Wallace R. 2006. *Musa siamensis*, a new *Musa* species (Musaceae) from S.E. Asia. *Folia Malaysiana* 8(2):61–70.

CRITICAL MORPHOLOGICAL TRAITS

Pseudostem height (m)	1
Petioles	Canal open, margins spreading, winged and clasping pseudostem
Inflorescence position	Erect
Male bud shape	Lanceolate
Bract imbrication	Slightly
Color and texture of bract external face	Pale yellow tinged with green, no wax
Bract behavior before falling	Revolute
Compound tepal basic color	Orange-yellow
Fruit shape and position	Straight, pointed upwards
Fruit apex	Blunt
Fruit quantity	Up to 6 hands of 5 fruits per hand in one row
Seed size and shape	Rounded, smooth, 4mm
Other traits of importance	Fruits ripen bright yellow, rhizomatous with a spreading mat habit



NOTES:

Musa siamensis is closely allied to *M. rubra* and only differs notably in bract color, being yellow-cream as opposed to orange-red. The species is only known from cultivation and has not yet been found in the wild. It was first recognized in the horticultural trade from eastern Thailand in 2002 where it was being sold as ‘Thai Gold’ in nurseries. It is also reported from Cambodia under the name ‘Chek Meas’ (Häkkinen & Wallace, 2006).

Musa siamensis



A, B, C, D, E, F: Markku Häkkinen.

Musa sikkimensis



Section: *Musa*



Geographical range: India: Darjeeling, Assam, West Bengal, Manipur, Mizoram, Bhutan, Nepal



Publications:

Joe A; Sreejith P; Sabu M. 2016. A new variety of *Musa sikkimensis* Kurz and notes on the taxonomic identity and history of *Musa sikkimensis* (Musaceae) from north-East India. *Webbia* 71(1):53–59. <https://doi.org/10.1080/00837792.2015.1113721>

Kurz S. 1877. Journal of Agricultural and Horticultural Society of India, 5, nova series part 1(5):164.

Simmonds NW. 1956. Botanical results of the banana collecting expedition, 1954–5. *Kew Bulletin* 11(3):463–489. <https://doi.org/10.2307/4109131>

CRITICAL MORPHOLOGICAL TRAITS

Pseudostem height (m)	Up to 4m
Petioles	Canals open, often with dry papery wings at base on older shoots
Inflorescence position	Bunch horizontal, rachis pendent
Male bud shape	Ovoid or rounded
Bract imbrication	None or slightly imbricated
Color and texture of bract external face	Purple-red, waxy, often yellow at apex
Bract behavior before falling	Lifting 1–2 at a time, revolute
Compound tepal basic color	Cream-orange
Fruit shape and position	Straight or slightly curved, highly angular
Fruit apex	Bluntly rounded
Fruit quantity	4–7 hands, 7–9 fingers per hand
Seed size and shape	Angular, smooth, black, 6mm–10mm wide, thick walled and very hard
Other traits of importance	It is common for leaves to completely die off before fruit maturity, young plants commonly with reddish leaf undersides



NOTES:

There is a long and complicated history regarding the taxonomic identity of *Musa sikkimensis*, but the species is well known and documented today. It is commonly found in many parts of northeast India and is not considered threatened (Joe et al., 2016). In 2018 it was also reported from Kachin State, Myanmar (Tanaka et al., 2018). *M. sikkimensis* is most noted for its ability to withstand cold and drought, naturally growing at elevations up to 2000m. A second variety, var. *simmondsii*, was described in 2016 from Manipur and is distinguished from the typical variety by having a tighter bract arrangement, more compact fruit bunch, spherical fruits, fused pedicel bases, and seeds which have a warty as opposed to smooth surface (Joe et al., 2016).

It is not uncommon to see *M. sikkimensis* flowering in the winter in its native habitat, where all leaves are killed from the plant but the plant continues to flower with the pseudostems covered in the dry dead leaves. The young plants often have red leaf undersides which may fade upon maturity, and the petiole bases typically have a dry edge (Joe et al., 2016).

Musa sikkimensis



A: Markku Häkkinen.

Musa sikkimensis



B, C, D, E: Gabriel Sachter-Smith.

Musa sikkimensis



F, G, H: Gabriel Sachter-Smith.

Musa thomsonii



Section: *Musa*



Geographical range: India: Sikkim, Meghalaya, China: Yunnan



Publications:

Häkkinen M; Gogoi R; Borah S. 2013. A taxonomic study of *Musa flaviflora* and *M. thomsonii* (Musaceae). *Nordic Journal of Botany* 32(5):578–583. <https://doi.org/10.1111/j.1756-1051.2013.00370.x>

Joe A; Sreejith P; Sabu M. 2013. Notes on the rediscovery and taxonomic status of *M. flaviflora* N.W.Simmonds and *M. thomsonii* (King ex Schumann) A.M.Cowan & Cowan (Musaceae) From India. *Annals of Plant Sciences* 2(8):260–267.

CRITICAL MORPHOLOGICAL TRAITS

Pseudostem height (m)	3–5
Petioles	Waxy, canal margins erect, green with black blotches at base
Inflorescence position	At first horizontal, sometimes falling vertically later
Male bud shape	Lanceolate
Bract imbrication	Not imbricate
Color and texture of bract external face	Purple-brown with yellow streaks
Bract behavior before falling	Revolute
Compound tepal basic color	Orange-yellow to cream-yellow
Fruit shape and position	Straight or slightly curved, perpendicular to stem
Fruit apex	Blunt
Fruit quantity	8–12 hands, up to 18 fruits per hand in two rows
Seed size and shape	3–4mm, irregularly angled, black
Other traits of importance	Inner surface of bracts yellowish to cream color



NOTES:

Sir George King was the first one to collect *M. thomsonii* in 1875–1876 from the Sikkim Himalayas and gave a vague description which had subsequently caused a lot of confusion in the literature over many years, a full accounting of which can be studied in the works of Joe et al. (2013), as well as Häkkinen et al. (2013).

It is reported to be closely allied with *M. flaviflora* and *M. yunnanensis*, but notably differs from those species by having yellow streaks on the bracts of the male bud, one of the only distinguishing traits made in the initial description.

Musa thomsonii



A, B, C, D: Gabriel Sachter-Smith.

Musa velutina



Section: *Musa*



Geographical range: India: Assam, Arunachal Pradesh, Meghalaya, Nagaland, Myanmar



Publications:

Häkkinen M; Väre H. 2008c. Taxonomic history and identity of *Musa dasycarpa*, *M. velutina* and *M. assamica* (Musaceae) in Southeast Asia. *Journal of Systematics and Evolution* 46(2):230–235. <https://doi.10.3724/SP.J.1002.2008.07115>

Kurz S. 1867. Note on the plantains of Indian archipelago. *The Journal of the Agricultural & Horticultural Society of India* 14:295–301.

Väre H; Häkkinen M. 2009. (1903) proposal to conserve the name *Musa velutina* against *M. dasycarpa* (Musaceae). *Taxon* 58(3):1008–1009.

Wendland H; Drude G. 1875. *Musa valutina*. *Gartenflora* 24:65–67.



NOTES:

Sulpiz Kurz was a German botanist who worked in India and Myanmar and first described what would become *Musa velutina* under the name of *M. dasycarpa* in 1867 giving the brief description of “fruits hairy”. *M. velutina* was described by Hermann Wendland and George Drude from a flowering plant at Herrenhausen Botanic Garden at Hannover where it was introduced from Assam by Gustav Mann. In 2008, Häkkinen & Väre showed that the two names represented the same species, and *M. dasycarpa* had priority due to it being published first, and though the description was short, the hairy fruits were enough to be sure it was the same species in question. However, since the former name has been very rarely used, Väre & Häkkinen (2009) subsequently proposed to conserve *M. velutina* against *M. dasycarpa* to avoid confusion, as *M. velutina* is such a widespread and popular ornamental banana that changing it’s name would be impractical in real-world usage.

Joe and Sabu (2016) report it to still be common in northeast India, and grows abundantly along roadsides and open areas, and notably absent from forested areas.

It is easily recognized by it’s bright pink and hairy fruits which self-peel upon ripening. The name is derived from the velvet-like texture of the fruit skin.

Musa velutina



A, B, C, D: Gabriel Sachter-Smith.

CRITICAL MORPHOLOGICAL TRAITS

Pseudostem height (m)	1–2m
Petioles	Margins straight or slightly curving inward
Inflorescence position	Erect
Male bud shape	Intermediate (ovoid-lanceolate), degenerating
Bract imbrication	None
Color and texture of bract external face	Pink, grooved
Bract behavior before falling	Revolute, lifting 1–2 at a time
Compound tepal basic color	Yellow
Fruit shape and position	Angular, pointing upwards
Fruit apex	Blunt
Fruit quantity	Up to 5 hands, 2–4 fruits per hand in a single row
Seed size and shape	4–6mm, tuberculate, irregularly angular, black
Other traits of importance	Always with hermaphrodite basal flowers, fruits pink and hairy, schizocarpic

Musa yamiensis



Section: *Musa*



Geographical range: Taiwan: Lanyu Island



Publication:

Yeh C; Chen J; Yeh C; Lee S; Hong C; Chiu T; Su Y. 2008. *Musa yamiensis* C. L. Yeh & J. H. Chen (Musaceae), a new species from Lanyu, Taiwan. *Gardens Bulletin Singapore* 60(1):165–172.



NOTES:

Musa yamiensis was discovered on Lanyu Island, Taiwan in 2006 from a single location in a shaded ravine between 150m and 250m elevation. It is considered to be extremely rare, and little is known about the current population status. It bears many similarities to *M. acuminata* and is easily distinguished from *M. itinerans* which is the only other common wild banana on Lanyu.

CRITICAL MORPHOLOGICAL TRAITS

Pseudostem height (m)	2.5
Petioles	Margins erect, with wings
Inflorescence position	Sub-horizontal
Male bud shape	Lanceolate
Bract imbrication	Slightly imbricate
Color and texture of bract external face	Yellow-green, tinged with pink
Bract behavior before falling	Revolute, semi-persistent
Compound tepal basic color	White
Fruit shape and position	Curved
Fruit apex	Bottle-necked
Fruit quantity	3–4 hands, 8 fruits per hand in 2 rows
Seed size and shape	5mm wide, smooth, irregularly angled, black
Other traits of importance	Glabrous peduncle

Musa yamiensis



A, B, C: Chiu Hui-Lung/TARI.

Musa yunnanensis



Section: *Musa*
Geographical range: China: Yunnan
Publications:

Häkkinen M; Wang H. 2007. New species and variety of *Musa* (Musaceae) from Yunnan, China. *Novon* 17:440–446.
Häkkinen M; Wang H. 2008a. *Musa yunnanensis* (Musaceae) and its intraspecific taxa in China. *Nordic Journal of Botany* 26(5–6):317–324. <https://doi.org/10.1111/j.1756-1051.2008.00305.x>

CRITICAL MORPHOLOGICAL TRAITS

Pseudostem height (m)	3–5m
Petioles	Waxy, margins curved inward, black blotches at base
Inflorescence position	Horizontal to sub-horizontal
Male bud shape	Lanceolate, often degenerating at maturity
Bract imbrication	Not imbricate
Color and texture of bract external face	Red-purple, often with yellow at apex
Bract behavior before falling	Lifting several at a time, revolute
Compound tepal basic color	Cream
Fruit shape and position	Curved and with distinct ridges,
Fruit apex	Rounded
Fruit quantity	Up to 8 hands, with up to 15 fruits per hand in 2 rows
Seed size and shape	3.5mm, very flat, wrinkled, black
Other traits of importance	Pseudostem and petioles often waxy, abaxial side of young leaves start reddish and fade to green with aging, base of leaves often highly rounded and recurved



NOTES:

Four varieties were described by Häkkinen & Wang in 2008.

Musa yunnanensis var. *yunnanensis* grows abundantly in the Mekong River watersheds on slopes from 500m–1800m. The plants can tolerate seasonal frosts, which occur from January to February at higher elevations in Yunnan, China. This species is called the tree banana by the local people because it can grow among the tree branches under forest canopy. The plants appear dormant under the closed canopy, but as the canopy opens, they rapidly develop. *Musa yunnanensis* is cultivated commonly at higher elevations up to 2100m, and the stems are used as animal fodder.

var. *cail* occurs in very few isolated wild populations in Yunnan, China’s subtropical regions at elevations from 1550 to 1850 m, along roadsides, ravines and on steep slopes. It can withstand seasonal frost and snow, which it faces each winter in its range. It is notable for a compact fruit bunch and large seeds, and in that regard is more similar to var. *yongpingensis* than to the other two varieties, but is distinguished by having red-pink inner bract faces.

var. *yongpingensis* occurs in the western part of Yunnan Province in subtropical regions close to the Burma border at elevations from 1550m to 2250m, along roadsides, ravines and on steep slopes. It is more commonly cultivated than *M. yunnanensis* var. *cail* in mountainous rural areas of western Yunnan. It can withstand seasonal frost and snow, which it faces in each winter from December to January in its range. It is more similar to var. *cail* than to the other two varieties, but is different from that variety by having white-cream inner bract faces.

var. *jingdongensis* was found only in one cultivated population at Mt Wuliang

Shan Hengduan, at an elevation of some 1600 m. It was cultivated for animal fodder together with var. *yongpingensis*. It is most similar to the original var. *yunnanensis* except it notably has a persistent male bud as opposed to one which is mostly degenerated by the time the fruits are mature.

Musa yunnanensis var. yunnanensis



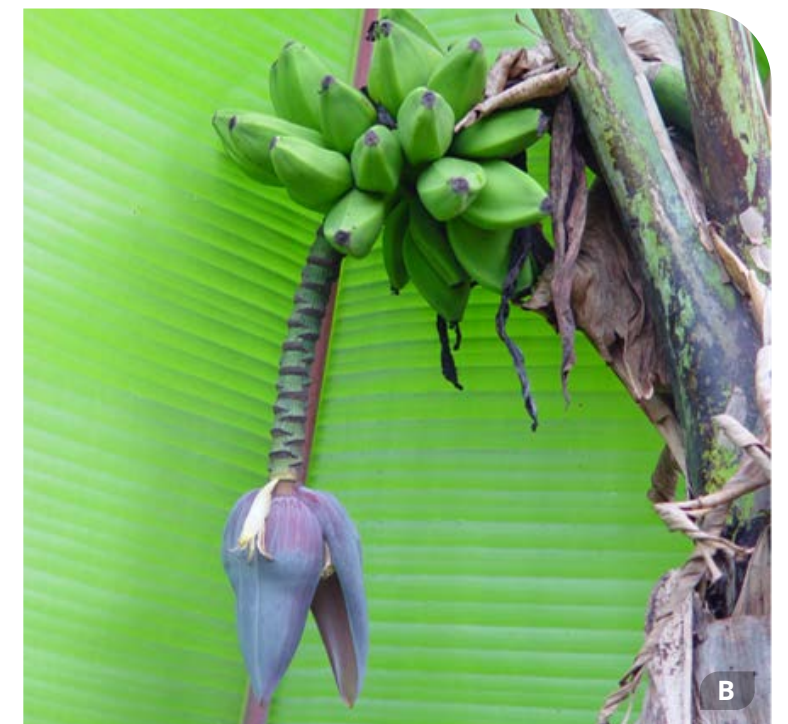
A, B, C, D, E, F: Gabriel Sachter-Smith.

Musa yunnanensis var. *yunnanensis*



H, I, J, K: Gabriel Sachter-Smith.

Musa yunnanensis var. *caili*



A, C: Gabriel Sachter-Smith; B, D: Markku Häkkinen; E: Remko Beuving

Musa yunnanensis var. *jingdongensis*



A, B, C, D, E: Markku Häkkinen.

Musa yunnanensis var. *yongpingensis*



A, E, F: Gabriel Sachter-Smith; B, C, D: Markku Häkkinen.

Musa zaifui



Section: *Musa*



Geographical range: China: Yunnan Yingjiang County.



Publication:

Häkkinen M; Wang H. 2008b. *Musa zaifui* sp. nov. (Musaceae) from Yunnan, China. *Nordic Journal of Botany* 26(1–2):42–46. <https://doi.org/10.1111/j.0107-055X.2008.00267.x>

CRITICAL MORPHOLOGICAL TRAITS

Pseudostem height (m)	Approximately 1m
Petioles	Green to pink-purple, canal margins erect, bases winged and clasping pseudostem
Inflorescence position	Horizontal
Male bud shape	Lanceolate
Bract imbrication	Not imbricate
Color and texture of bract external face	Pink-purple
Bract behavior before falling	Lifting several at a time, revolute
Compound tepal basic color	Cream-yellow
Fruit shape and position	Straight or slightly curved, perpendicular to stalk
Fruit apex	Blunt/rounded
Fruit quantity	3 hands per bunch, 4 fruits per hand in one row
Seed size and shape	6mm wide, tuberculate, irregularly angular, black
Other traits of importance	



NOTES:

Musa zaifui has only been found in Yingjiang County, Dehong Prefecture, Yunnan. At the time of its discovery only three populations with some five individual plants with suckers were found (Häkkinen & Wang, 2008b). Plants were deposited at Xishuangbanna Tropical Botanic Garden (XTBG), but upon inspection in 2019 no plants remained at the garden, and none were found in the wild around the vicinity of its original collection place (Gabriel Sachter-Smith, personal observation). *M. zaifui* is presumed to be very rare and little is known about its current status in the wild.

M. zaifui is named in honour of Prof. Xu Zaifu, the third director of the Xishuangbanna Tropical Botanical Garden, for his great contributions to the botany of China and to the XTBG.

Musa zaifui



A, B, C, D, E: Markku Häkkinen.



Section *Callimusa*

Musa arfakiana



Section: *Callimusa*



Geographical range: Indonesia: West Papua



Publication:

Argent G. 2010. A new species of wild banana *Musa arfakiana* (Musaceae) from Papua (Formerly Irian Jaya) of Indonesia. *Gardens' Bulletin Singapore* 61(2):243–248.

CRITICAL MORPHOLOGICAL TRAITS

Pseudostem height (m)	1.5–2
Petioles	Green, margins curved inwards
Inflorescence position	Erect
Male bud shape	Rounded
Bract imbrication	Not imbricate or only very slightly
Color and texture of bract external face	Green or yellow, smooth
Bract behavior before falling	Non-revolute
Compound tepal basic color	Cream
Fruit shape and position	Straight, mostly perpendicular to stalk, strongly angled
Fruit apex	Pointed
Fruit quantity	Up to 10 fruits per hand, in two rows
Seed size and shape	5–7mm, dark brown, irregularly angled
Other traits of importance	Sterile pulp chamber in distal end of fruit, fruit bunch nearly spherical in general shape



NOTES:

Musa arfakiana was found above Siobri village in the Arfak Mountains of West Papua Indonesia at an elevation of 1500–1800m. The population was found growing both in open areas that had been recently cleared by timber harvest and gardening, as well as in deep shaded areas within the forest (Argent, 2010).

Musa arfakiana is similar to *M. johnsii* in having a dense sub-spherical bunch of fruits having almost no pedicel, and with sterile distal pith chambers. It is different from *M. johnsii* due to its smaller stature; almost closed petiole canals; canal margins inflexed; erect bunches of fruit; fruits tapering distally to broad points; and non schizocarpic fruit (Argent, 2021).

Musa arfakiana



A: Chien Lee.

Musa azizii



Section: *Callimusa*
Geographical range: Malaysia: Sarawak, Borneo
Publication:
Häkkinen M. 2005. *Musa azizii*, a new *Musa* species (Musaceae) from Northern Borneo. *Acta Phytotaxonomica Et Geobotanica* 56(1):27–31.

CRITICAL MORPHOLOGICAL TRAITS

Pseudostem height (m)	1.5–2
Petioles	Yellow-green with brown blotches with pink-purple margins, canal margins curved inwards
Inflorescence position	Initially erect, horizontal at maturity
Male bud shape	Ovoid
Bract imbrication	Imbricate
Color and texture of bract external face	Red-purple with darker line at bract edge, greenish at apex, smooth
Bract behavior before falling	Non-revolute, lifting several at a time
Compound tepal basic color	Light green-yellow
Fruit shape and position	Straight, pointed upward
Fruit apex	Pointed
Fruit quantity	2–3 hands, 1–2 fruits per hand in a single row
Seed size and shape	1.5mm, rounded, tuberculate
Other traits of importance	Very small, slender plant



NOTES:

Musa azizii is known from only one population of 3 to 4 mats, each mat having around 10 stems. The population was observed at 500 m in the Lumut Range Sarawak. This population was also strange to the local people and no other populations were found even after making extensive studies in the area. Several *Musa* species such as *M. acuminata*, *M. borneensis*, *M. hirta*, and *M. muluensis* were growing in the surrounding area. There are no obvious topographic boundaries that separate these areas of growth. *M. azizii* cannot grow in open exposure, and seems to only grow in shade. At the time of its discovery the isolated small population was under a severe threat of extinction. If its natural habitat is changed, it is expected that *M. azizii* will become extinct.

Musa azizii is named in honour of Chairman of Sarawak Biodiversity Council Datuk Amar Haji Abdul Aziz Haji Husain for his work to save the heritage of Sarawak biodiversity for coming generations (Häkkinen, 2005).

Musa azizii



A, B, C: Markku Häkkinen.



Musa barioensis



Section: *Callimusa*



Geographical range: Malaysia: Sarawak



Publication:

Häkkinen M. 2006a. *Musa barioensis*, a new *Musa* species (Musaceae) from Northern Borneo. *Acta Phytotaxonomica Et Geobotanica* 57(1):57–62.

CRITICAL MORPHOLOGICAL TRAITS

Pseudostem height (m)	Up to 2.5
Petioles	Yellow-green with brown blotches, canal margins overlapping with a purple edge
Inflorescence position	Initially pendulous, near erect at maturity
Male bud shape	Lanceolate
Bract imbrication	Imbricate
Color and texture of bract external face	Yellow-red, greenish at apex, smooth
Bract behavior before falling	Revolute, lifting several at a time
Compound tepal basic color	Light green
Fruit shape and position	Curved, pointed upward
Fruit apex	Pointed
Fruit quantity	Up to 6 hands, up to 6 fruits per hand in a single row
Seed size and shape	5–7mm, cylindrical-obpyriform, tuberculate
Other traits of importance	



NOTES:

Musa barioensis was first discovered in 2004 in Bario on the island of Borneo at an elevation of 1,105m. Bario is one of the most isolated settlements in Sarawak, East Malaysia. There are no roads or rivers connecting Bario to settlements outside of the Kelabit territory. The Bario inter-montane plateau lies in the Kelabit highlands, close to the Indonesian border in Sarawak, with an average altitude of 1,100m. The ring of mountains, which are covered with largely untouched sub-montane dipterocarp forest with rich flora and fauna, surround the undulating Bario valley effectively isolating the plateau from surrounding areas. The cool-temperate climate in the Kelabit highlands has caused a highly diverse indigenous flora and fauna.

This species has unique habit during flowering. First, the initial female stage is pendent, when the female flower bracts open the inflorescence becomes horizontal, but by maturity the bunch of fruits is in an erect position.

Musa barioensis



A, B, C: Markku Häkkinen.

Musa bauensis



Section: *Callimusa*

Geographical range: Malaysia: Sarawak

Publication:
Häkkinen M; Meekiong K. 2004. A new species of the wild banana genus, *Musa* (Musaceae), from Borneo. *Systematics and Biodiversity* 2(2):169–173. <https://doi.10.1017/S1477200004001434>

CRITICAL MORPHOLOGICAL TRAITS

Pseudostem height (m)	Up to 3m
Petioles	Extensive purple pigmentation at base, margins curved inward
Inflorescence position	Erect
Male bud shape	Rounded
Bract imbrication	Imbricate
Color and texture of bract external face	Red-purple, non-waxy, moderately grooved
Bract behavior before falling	Non-revolute
Compound tepal basic color	Cream
Fruit shape and position	Truncated-cone shape, perpendicular to peduncle
Fruit apex	Lengthily pointed
Fruit quantity	6 hands, up to 16 fruits per hand in a two rows
Seed size and shape	5mm, round
Other traits of importance	Strongly wrinkled wings on base of petioles, male flowers often persistent



NOTES:

Musa bauensis is not apparently closely related to any other *Musa* species. A careful comparison of important characters shows that it is a unique species in the genus *Musa*. The suspicion that *M. bauensis* could be a natural hybrid is unlikely because of its unique characters that distinguish it from other *Callimusa* species growing in the vicinity. In the Bau area, *Musa* species often form mixed communities from different sections: *M. acuminata* (*Musa*), *M. campestris*, and *M. borneensis* (*Callimusa*). Wild hybrids have not been observed in this area. *M. bauensis* seems to be a clearly distinct species, which grows in isolated populations. During an exhaustive study of section *Callimusa* species in Sarawak in 2002, Häkkinen & Meekiong took the opportunity to study *M. bauensis* populations in the Bau limestone area. The species seems to be extremely rare and is so far not been encountered in any other area in Sarawak. The few plants that were found were growing at the foot of a steep limestone hill as understory growth.



Musa bauensis



A, B, C, D, E: Markku Häkkinen.

Musa beccarii



Section: *Callimusa*

Geographical range: Malaysia: Sabah

Publications:

Häkkinen M; Suleiman M; Gisil J. 2005. *Musa beccarii* (Musaceae) Varieties in Sabah, Northern Borneo. *Acta Phytotaxonomica Et Geobotanica* 56(2):135–140.

Simmonds NW. 1960. Notes on banana taxonomy. *Kew Bulletin* 14(2):198–212. <https://doi.org/10.2307/4114778>

CRITICAL MORPHOLOGICAL TRAITS

Pseudostem height (m)	1–1.5m
Petioles	Green, canal margins erect or slightly curved inwards
Inflorescence position	Erect
Male bud shape	Lanceolate
Bract imbrication	Highly imbricate
Color and texture of bract external face	Red, often with yellow or green bract apices, smooth and polished
Bract behavior before falling	Non-revolute, lifting 1–2 at a time
Compound tepal basic color	Green
Fruit shape and position	Straight or slightly curved, parallel to peduncle
Fruit apex	Bottle-nosed
Fruit quantity	2–5 hands, 1–4 fruits per hand in a one row
Seed size and shape	4–5mm, obpyriform, tuberculate, black
Other traits of importance	Ripe fruits remain green



NOTES:

Simmonds, who never visited Borneo, originally described *Musa beccarii* from a cultivated plant in Trinidad, which he grew from seeds imported from Sabah. It is the only species of *Musa* known with a chromosome count of $2n=18$, as opposed to the more common $2n=20$ typical of *Callimusa* species. Häkkinen reports that var. *beccarii* wild populations are still quite commonly seen despite massive land clearing for oil palm plantations in the area, which restrict the natural habitats. Häkkinen described a second variety he named var. *hottana* in honour of Prof. Mitsuru Hotta who had previously studied the wild *Musa* of Borneo (Häkkinen, 2005).

The two varieties evolved in different directions, as an adaptation of their growing conditions. Var. *beccarii* grows in open exposure, under a shady canopy it may soon shrivel and die. Var. *hottana* is extremely rare and was found in only one location in the lower Kinabatangan River region in Sabah, and conversely to var. *beccarii* it requires shade and only grows under the forest canopy (Häkkinen, 2005).

Var. *hottana* can be distinguished from var. *beccarii* by its smaller stature, more drooping leaves, and purple-red peduncle (as opposed to green in var. *beccarii*) (Häkkinen, 2005).

Musa beccarii var. beccarii



Musa beccarii var. *hottana*



A, B: Markku Häkkinen.

Musa beccarii var. *hottana*



C: Markku Häkkinen.

Musa boman



Section: *Callimusa*



Geographical range: Papua New Guinea: West Sepik



Publication:

Argent G. 1976. The wild bananas of Papua New Guinea. *Notes from the Royal Botanic Garden, Edinburgh* 35(1):77–114.

CRITICAL MORPHOLOGICAL TRAITS

Pseudostem height (m)	Up to 10m
Petioles	Grey-green, waxy, canal margins curved inward
Inflorescence position	Initially near horizontal, becoming pendent at maturity
Male bud shape	Round
Bract imbrication	Imbricate
Color and texture of bract external face	Cream or slightly greenish-yellow
Bract behavior before falling	Non-revolute
Compound tepal basic color	Yellow-cream
Fruit shape and position	Straight or slightly curved with a lengthily tapered pedicel, mostly perpendicular to penduncle
Fruit apex	Pointed
Fruit quantity	8–10 hands, up to 14 fruits per hand in two rows
Seed size and shape	6–7mm, irregular, tuberculate, black
Other traits of importance	Basal flower hermaphroditic



NOTES:

Musa boman was first described by Argent in 1976 in the Torricelli mountain highlands of West Sepik province, Papua New Guinea. It is reported to occur most frequently on slopes in high clay content soils by rivers. It superficially resembles *M. ingens* in its large stature, waxy vegetation, and pale cream colored somewhat round male bud, but can be easily distinguished by its fruits which ripen to an orange color and a fruit bunch which is less compact. The species name is derived from the vernacular name for the plant at Kilifas village where it was first documented. Hybrids between it and *M. lolodensis* have been observed, but the resulting plants are reported to be mostly sterile (Argent, 1976).



Musa boman



A, B, C, D, E, F: Steven Janssens.

Musa borneensis



Section: *Callimusa*
Geographical range: Malaysia: Sabah, Sarawak, Brunei, Indonesia: Kalimantan, Sulawesi

Publications:
Beccari O. 1902. Nota sui banani selvatici di Borneo. *Nelle foreste di Borneo* 611–624 Tipografia di Salvatore Landi.
Cheesman EE. 1950. Classification of the bananas: Critical notes on species: *Musa borneensis*. *Kew Bulletin* 5(2):152–155. <https://doi.org/10.2307/4117213>
Häkkinen M; Meekiong K. 2005. *Musa borneensis* Becc. (Musaceae) and its Intraspecific Taxa in Borneo. *Acta Phytotaxonomica Et Geobotanica* 56(3):213–230. <https://doi.org/10.18942/apg.KJ00004623253>
Hotta M. 1967. Notes on the Wild banana of Borneo. *The Journal of Japanese Botany* 42(11):344–351.
Sulistyaningsih LD. 2017. Newly described and newly recorded of infraspecific taxa of *Musa borneensis* BECC. (Musaceae) from Sulawesi, Indonesia. *Reinwardtia* 16(1):19–24. <https://doi.org/10.14203/reinwardtia.v16i1.2744>

CRITICAL MORPHOLOGICAL TRAITS	
Pseudostem height (m)	3–7
Petioles	Canal open with erect margins, bases with wrinkled wings
Inflorescence position	Horizontal to pendent
Male bud shape	Round or ovoid
Bract imbrication	Imbricate
Color and texture of bract external face	Pink-purple, red or yellow, often with green apices, polished or dull
Bract behavior before falling	Typically non-revolute, some revolute
Compound tepal basic color	Green to cream, often with green apex
Fruit shape and position	Straight slightly curved, pedicel bases fused
Fruit apex	Pointed to bottle-necked
Fruit quantity	8–36 hands, 5–8 fruits per hand in one row
Seed size and shape	4–10mm, obpyriform, tuberculate
Other traits of importance	Large plant and bunches may be mistaken for a common cultivated banana



NOTES:

Odoardo Beccari was the first to describe any of the wild bananas on Borneo in his classic book “Nelle Forestre di Borneo”, which included *Musa borneensis* (Beccari, 1902). The plants and bunches can attain a rather large size and are certainly the largest wild banana plants native to Borneo, and to the untrained eye could easily be mistaken for a common cultivated edible banana. The plant is reported to be relatively common in many locations in Borneo with a number of described varieties having been published (Häkkinen & Meekiong, 2005). Presently a total of seven varieties are described, six from Borneo and one from Sulawesi, var. *donggalaensis* (Sulistyaningsih, 2017).



The most basic distinguishing traits for the Bornean varieties as described by Häkkinen & Meekiong (2005) are given below:

VARIETY	KNOWN RANGE	HEIGHT	BRACTS	MALE BUD	BUNCH SIZE	SPECIAL TRAITS
var. <i>borneensis</i>	Sarawak: Kuching, Bau, Samarahan	≤ 3.5m	polished red-purple	ovoid, non-revolute	up to 20 hands	hairy peduncle
var. <i>alutacea</i>	Sarawak: Samarahan	≥3.5m	polished red-purple	intermediate, non-revolute	up to 8 hands	red-purple sap, yellow fruit pulp
var. <i>flavida</i>	Brunei: Temburong, Sarawak: Miri, Limbang, Lawas	≥3.5m	polished yellow	ovoid, revolute	up to 26 hands	hairless peduncle
var. <i>lutea</i>	Sabah: Crocker Range, Tawau	≥3.5m	dull yellow	round, revolute	up to 36 hands	hairy peduncle
var. <i>phoenicia</i>	Sarawak: Bau, Kuching, Samarahan, Serian	≤ 3.5m	polished pink-purple	round, non-revolute	up to 7 hands	watery red sap, yellow fruit pulp
var. <i>sarawakensis</i>	Sarawak: Belaga, Bintulu, Padawan, Serian, Sri Aman. West Kalimantan: Bonti	≥3.5m	polished pink-purple	round, non-revolute	up to 26 hands	hairless peduncle

Musa borneensis varieties



A: var. *borneensis*, B: var. *flavida*, Markku Häkkinen.

Musa borneensis varieties



C: var. *alutacea*; D: var. *lutea*; E: var. *sarawakensis*, Markku Häkkinen.

Musa borneensis



F: var. *borneensis*, G: var. *lutea*, Chien Lee.

Musa buakensis



Section: *Callimusa*

Geographical range: Papua New Guinea, Bougainville island

Publication:

Argent G. 1976. The wild bananas of Papua New Guinea. *Notes from the Royal Botanic Garden, Edinburgh* 35(1):77–114.

CRITICAL MORPHOLOGICAL TRAITS

Pseudostem height (m)	Up to 12m
Petioles	Canal margins open and widely spreading, green with dark brown patches
Inflorescence position	Bunch typically horizontal or slightly erect, rachis pendulous or curved downward
Male bud shape	Lanceolate/conical
Bract imbrication	Highly imbricate
Color and texture of bract external face	Dark brown-purple-red, polished
Bract behavior before falling	Non-revolute, only slightly lifting
Compound tepal basic color	White with yellow tips
Fruit shape and position	Straight with long taper on both ends, mostly perpendicular to peduncle
Fruit apex	Pointed
Fruit quantity	5 or more hands, up to 16 fruits per hand in two rows
Seed size and shape	4–6mm, irregular, tuberculate, black
Other traits of importance	Orange-red ripe fruit skin color with orange flesh. Sap variably clear or purple/red



NOTES:

Musa buakensis is one of only two wild banana species known to Bougainville Island, Papua New Guinea, and is not observed at all on nearby Buka island, after which one might assume it was named (Gabriel Sachter-Smith, personal observation). It can be found growing abundantly along the roadsides and open areas from Kieta to Panguna towards the middle of the island up to 1000m in elevation, but tends to not flower at the higher elevations. It is very similar to the also abundant *M. maclayi* var. *erecta* but can be distinguished by its horizontal bunch with pendent rachis, and dark purple-brown bracts, whereas *M. maclayi* var. *erecta* tends to have green to yellowish bracts and erect inflorescences. There is evidence of crossing between the two species with intermediate forms being relatively common and apparently fully fertile (Argent, 1976). As of 2016, the population was abundant in no obvious threat of decline as much of the interior of Bougainville remains densely forested and largely undisturbed (Gabriel Sachter-Smith, personal observation).

An allied, but not well studied population of similar plants also exists farther south in the Solomon Islands. A number of forms exist varying in bunch orientation and bract retention, but most have predominantly green male buds and notably longer pedicels than in the population on Bougainville. More field studies are needed to determine the status of the wild *Musa* of the Solomon Islands and their relation to the populations of Bougainville and the rest of the eastern islands of Papua New Guinea (Gabriel Sachter-Smith, personal observation).

Musa buakensis

Typical form as observed on Bougainville Island



A, B, C, D, E, F: Gabriel Sachter-Smith.

Musa buakensis

Allied population observed on Malaita, Solomon Islands



A



C



B

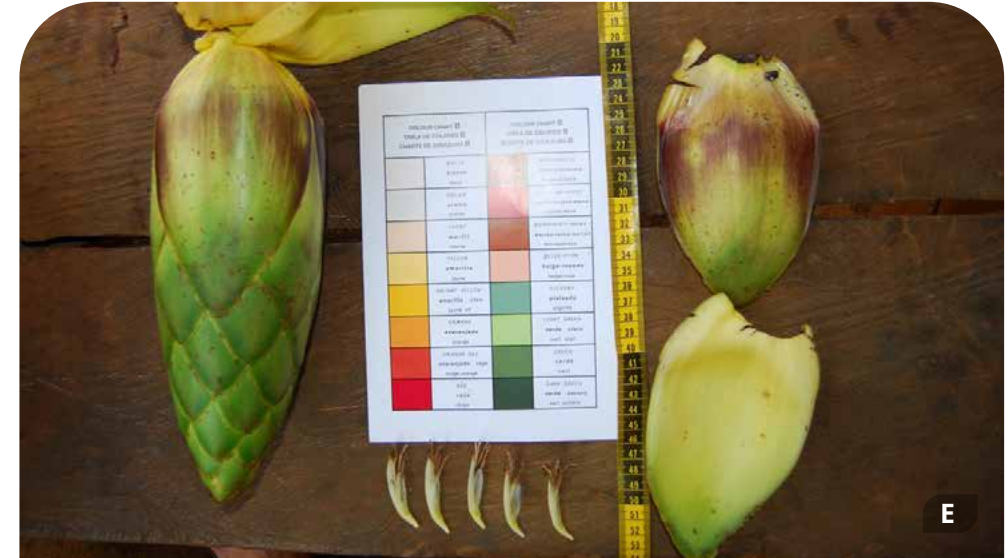


D

A, B, C, D: Gabriel Sachter-Smith.

Musa buakensis

Allied population observed on Malaita, Solomon Islands



E



F

E, F: Gabriel Sachter-Smith.

Musa campestris



Section: *Callimusa*



Geographical range: Malaysia: Borneo Sarawak and Sabah. Indonesia: West Kalimantan



Publications:

Beccari O. 1902. Nota sui banani selvatici di Borneo. *Nelle foreste di Borneo* 611–624 Tipografia di Salvatore Landi.

Häkkinen M. 2003. *Musa campestris* Beccari varieties in Northern Borneo. *The Philippine Agricultural Scientist* 86(4):424–435.

Hotta M. 1967. Notes on the wild banana of Borneo. *The Journal of Japanese Botany* 42(11):344–351.

CRITICAL MORPHOLOGICAL TRAITS

Pseudostem height (m)	1–2
Petioles	Canal margins erect to incurved, base with auricles
Inflorescence position	Erect
Male bud shape	Ovoid
Bract imbrication	Imbricate
Color and texture of bract external face	Purple-pink commonly with white, polished
Bract behavior before falling	Non-revolute
Compound tepal basic color	Orange towards apex, white towards base
Fruit shape and position	Straight to slightly curved, pointing upwards
Fruit apex	Bottle-necked to truncate/ blunt
Fruit quantity	3–8 hands, 2–10 fingers per hand in one or two rows
Seed size and shape	4–5mm, cylindrical-obpyriform, tuberculate
Other traits of importance	Fruits often light green to whitish in base color, with or without additional purple-pink pigmentation, fruit does not change color upon ripening



NOTES:

Odoardo Beccari was the first to describe any of the wild bananas on Borneo in his classic book “Nelle Forestre di Borneo”, which included *Musa campestris*. Beccari conducted his studies in Sarawak from 1865 to 1868. After O. Beccari’s explorations in Sarawak, studies of wild bananas in Borneo were neglected until Prof. Mitsuru Hotta of Japan made a series of expeditions in 1963–4, 1968–9 and 1976 mainly in Sabah and Brunei. He described several additional species, including a revision of *M. campestris* from Brunei. Both of these botanists studied very small areas and therefore did not observe the entire diversity of the species. In 2003, Häkkinen published five additional varieties based on extensive field studies in 2002 which are illustrated in the following pages.

M. campestris is a lowland species, which has evolved into several different varieties depending on the growing conditions, and is common in most parts of lowland northern Borneo. The highest elevation where *M. campestris* varieties were observed growing in their natural habitat was 600m in the Crocker Range of Sabah (Häkkinen, 2003).

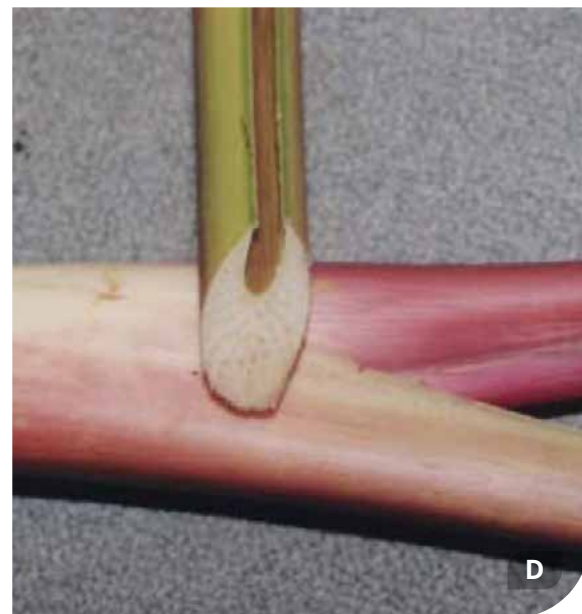


Musa campestris var. lawasensis



A, B, C: Markku Häkkinen.

Musa campestris var. *limbangensis*



A, B, C, D: Markku Häkkinen.

Musa campestris var. *miriensis*



A, B, C, D: Markku Häkkinen.

Musa campestris var. *sabahensis*



A, B, C: Markku Häkkinen.

Musa campestris var. *sarawakensis*



A, B, C, D: Markku Häkkinen.

Musa coccinea



Section: *Callimusa*

Geographical range: Vietnam, China: Yunnan

Publications:

Andrews HC. 1797. The Botanist’s Repository. Bensley, London.

Argent G; Kiew R. 2002. *Musa coccinea*. *Plantsman* 1(2):103–105.

CRITICAL MORPHOLOGICAL TRAITS

Pseudostem height (m)	Up to 1.5
Petioles	Green with narrow, erect margins
Inflorescence position	Erect
Male bud shape	Ovoid-rounded
Bract imbrication	Imbricate
Color and texture of bract external face	Red with yellow tips, dull textured with distinct ridges
Bract behavior before falling	Non-revolute, persistent and staying fresh for weeks
Compound tepal basic color	Orange with green tips
Fruit shape and position	Straight, pointing upwards
Fruit apex	Blunt but with pointed persistent perianth
Fruit quantity	3–5 hands, with only 1–2 fruits per hand
Seed size and shape	5–6mm, cylindrical and slightly conical, black with warty ridges
Other traits of importance:	Fruit is yellow when immature and undergoes no color change upon ripening



NOTES:

Musa coccinea was first described by Andrews in 1797 and is widely distributed in the horticultural trade and botanic gardens all over the world due its extraordinary bright red inflorescence with bracts that remain persistent and fresh (Argent & Kiew, 2002). It is native from southern China to central Vietnam, but likely extinct in China. It grows in lowland forests in shady environments where it favors hill slopes or wet ravines at elevations around 200m–500m (Thomas Haevermans, pers. commun.).

It is easily identified by its persistent bright red bracts which remain fresh and upright long after their emergence. The only other species with such a trait is the similar *M. haekkinenii* in which the bracts turn downwards (Ly et al., 2012).

Musa coccinea



A, B, C, D: Gabriel Sachter-Smith.

Musa exotica



Section: *Callimusa*
Geographical range: Vietnam: Ninh Binh
Publication:

Valmayor R. 2001. Classification and characterization of *Musa exotica*, *Musa alinsanaya* and *Musa acuminata* ssp. *errans*. *The Philippine Agricultural Scientist* 84(3):325–331.

CRITICAL MORPHOLOGICAL TRAITS

Pseudostem height (m)	0.5–2
Petioles	Green with purple blotches, canal margins erect
Inflorescence position	Erect
Male bud shape	Ovoid-rounded
Bract imbrication	Imbricate
Color and texture of bract external face	Red with yellow-green apices, dull textured with distinct ridges
Bract behavior before falling	Non-revolute, initially persistent but falling when dry after some time
Compound tepal basic color	Orange with green tips
Fruit shape and position	Straight, perpendicular to peduncle
Fruit apex	Blunt
Fruit quantity	Few hands, with only 1–3 fruits per hand in a single row
Seed size and shape	Unknown
Other traits of importance	Fruit is yellow when immature

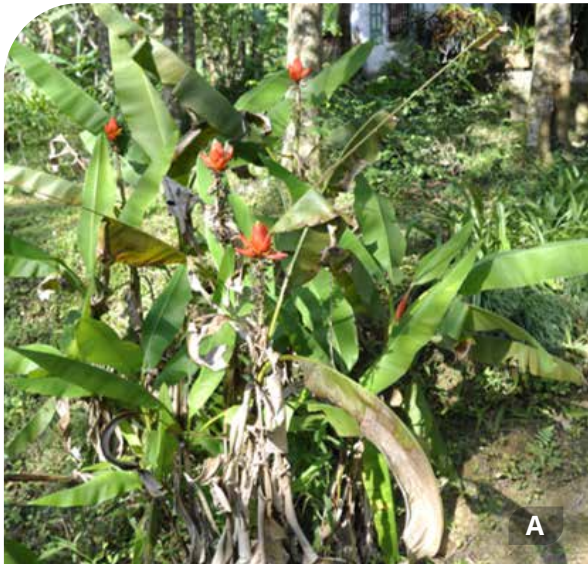


NOTES:

Musa exotica was described by Ramon Valmayor in 2001 from plants found at the Cuc Phuong Forest Reservation in northern Vietnam (Valmayor, 2001). The plant was introduced to the visitor center area of the park as a garden ornamental, and was not found wild within the reservation and the current status of its wild populations is unknown, but it is seemingly quite rare (Gabriel Sachter-Smith, personal observation).

It is relatively similar to *M. coccinea* in general appearance, being a small and thin plant with bright red erect inflorescences. However, it can be distinguished from *M. coccinea* by its bracts which dry and fall off the rachis, and by the fruits which become perpendicular to the stalk as they mature. It is also similar to *M. lutea* but can be distinguished by its much smaller stature, bracts and male flowers which remain partly persistent before falling, by the male bud lifting many bracts at once, and by the orientation of the mature fruits which are horizontal and not hanging downward as in *M. lutea* (Valmayor, 2001).

Musa exotica



A, B, C, D: Markku Häkkinen; E, F: Gabriel Sachter-Smith.

Musa gracilis



Section: *Callimusa*

Geographical range: Malaysia: Terengganu, Pahang, Johor, Perak, Kelantan, Negeri Sembilan

Publications:

Cheesman EE. 1950. Classification of the bananas: critical notes on species: *M. violascens* and *M. gracilis*. *Kew Bulletin* 5(2):152–155. <https://doi.org/10.2307/4117213>

Norfazlina B; Wickneswari R; Choong CY. 2016. *Geographical distribution of Musa gracilis* Holtum in Peninsular Malaysia. AIP Conference Proceedings. <https://doi.org/10.1063/1.4966869>

Ridley HN. 1924. *The Flora of the Malay Peninsula*. L. Reeve & CO, London. 918 p.

CRITICAL MORPHOLOGICAL TRAITS

Pseudostem height (m)	0.5–2
Petioles	Variably green with blotches to nearly pure black, canal margins erect
Inflorescence position	Erect
Male bud shape	Lanceolate
Bract imbrication	Highly imbricate
Color and texture of bract external face	Variably white to purple with green apices, polished
Bract behavior before falling	Non-revolute
Compound tepal basic color	Green or white-yellow with green tips
Fruit shape and position	Straight or slightly curved, pointing upwards
Fruit apex	Blunt
Fruit quantity	4–6 hands, up to 4 fruits per hand in a single row
Seed size and shape	3–5mm, cylindrical
Other traits of importance	Fruit is often pale whitish-green, but sometimes with purple striations



NOTES:

Musa gracilis was first described by R.E. Holtum of the Singapore Botanic Garden via Cheesman’s 1950 publication (Cheesman, 1950). In Ridley’s 1924 *The Flora of the Malay Peninsula*, a species matching well the description of *M. gracilis* was noted, but no name was given, apparently because not enough specimens had been closely enough examined to give Ridley the confidence to diagnose the species (Ridley, 1924).

It is a lowland species which commonly grows close to bodies of water, and is limited to the eastern and southern parts of Peninsular Malaysia. The color of the bracts and fruit are quite variable ranging from nearly entirely white to entirely purple and many combinations in between. Specimens as short as 0.5m have been found, with an average height of around 1m (Norfazlina et al., 2016).

It is closely related to *M. violascens* but is distinct in its much smaller size, deciduous bracts and longer, more slender fruits, which are rarely more than 4 to a hand, in one row (Cheesman, 1950).

A form can be found in the horticultural trade as (erroneously) *Musa ornata* ‘Leyte White’ which deviates slightly from the original description but does closely match forms depicted by Norfazlina et al. (2016).

Musa gracilis



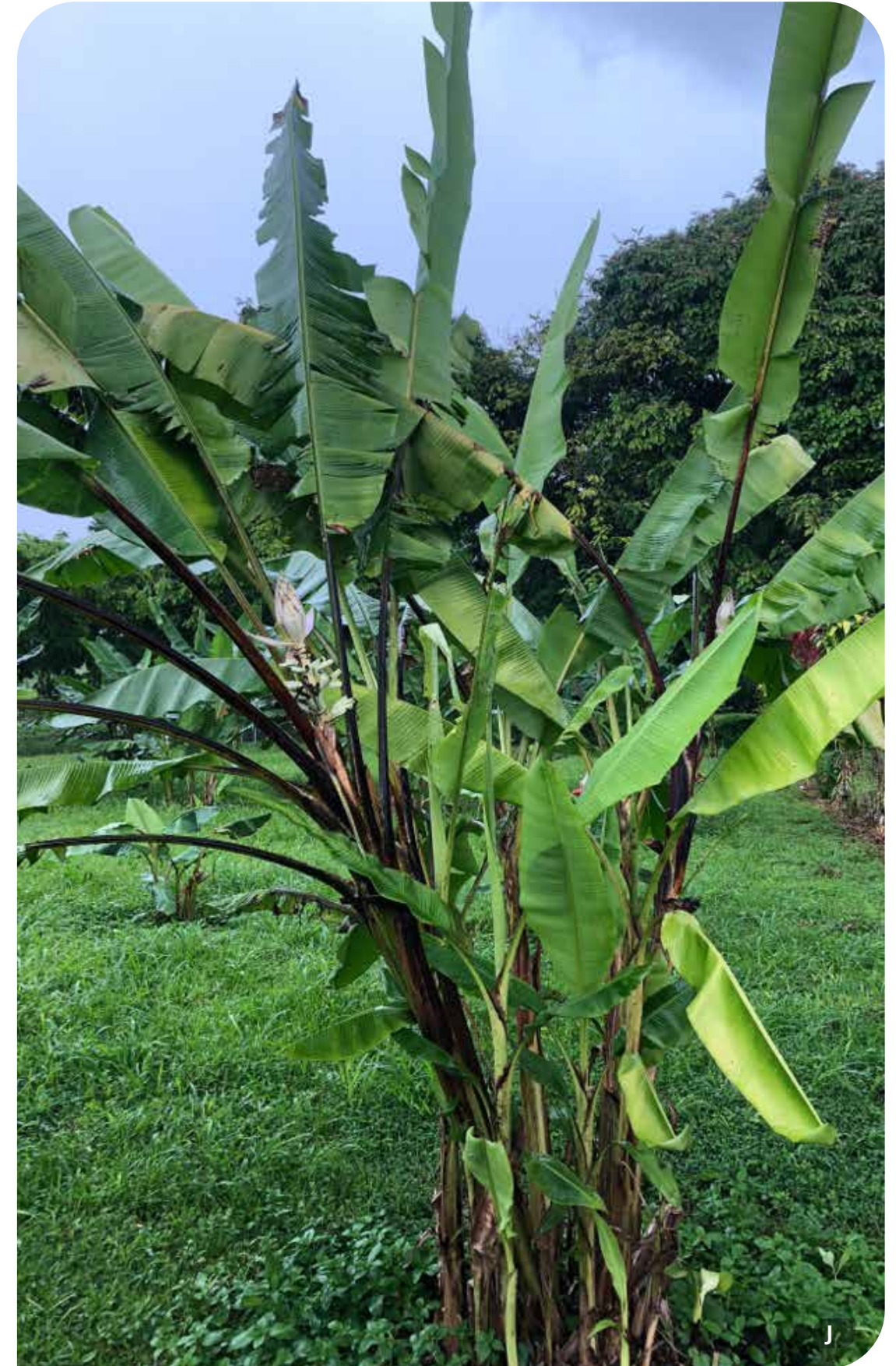
A, B: Gabriel Sachter-Smith; C, D, E, F, G: Markku Häkkinen.

Musa gracilis



F, G: Gabriel Sachter-Smith; H, I: Cultivar 'Leyte White', Gabriel Sachter-Smith.

Musa gracilis



J: Cultivar 'Leyte White', Gabriel Sachter-Smith.

Musa haekkinenii



Section: *Callimusa*
Geographical range: Vietnam: Phu Tho
Publication:
Ly N; Le C; Trieu T; Haevermans A; Lowry PJ; Haevermans T. 2012. A distinctive new species of wild banana (*Musa*, Musaceae) from northern Vietnam. *Phytotaxa* 75(1):33–42. <https://doi.org/10.11646/phytotaxa.75.1.3>

CRITICAL MORPHOLOGICAL TRAITS

Pseudostem height (m)	0.5–1m
Petioles	Green with sparse black blotches at base
Inflorescence position	Erect
Male bud shape	Ovoid-rounded
Bract imbrication	Imbricate
Color and texture of bract external face	Red with yellow tips, dull textured with distinct ridges
Bract behavior before falling	Non-revolute, persistent and staying fresh for weeks
Compound tepal basic color	Orange with green tips
Fruit shape and position	Straight, pointing upwards
Fruit apex	Blunt but with pointed persistent perianth
Fruit quantity	3–6 hands, 2–3 fruits per hand
Seed size and shape	Unknown, but presumed similar to <i>M. coccinea</i>
Other traits of importance	Very similar to <i>M. coccinea</i> but bracts point downwards after lifting



NOTES:

Musa haekkinenii was described by Ly et al. in 2012 and is so far known only from cultivated material found in gardens in northern Vietnam. It is very similar in appearance to *M. coccinea* being a small, slender plant with bright red erect inflorescences with persistent bracts which remain fresh for many weeks after emergence. It differs most notably from *M. coccinea* in that its bracts fold and point downwards, and the overall inflorescence can become significantly larger and more elongated than in *M. coccinea*.

This species is named in honor of Markku Häkkinen.

Musa haekkinenii



A, B, C, D: Gabriel Sachter-Smith.

Musa hirta



Section: *Callimusa*
Geographical range: Malaysia: Sarawak
Publications:

Beccari O. 1902. Nota sui banani selvatici di Borneo. *Nelle foreste di Borneo*. 611–624 Tipografia di Salvatore Landi.
Hotta M. 1967. Notes on the Wild Banana of Borneo. *The Journal of Japanese Botany* 42(11):344–351.

CRITICAL MORPHOLOGICAL TRAITS

Pseudostem height (m)	1–1.5m
Petioles	Green with brown blotches, margins curved inward, with corrugated wings at base
Inflorescence position	Erect
Male bud shape	Ovoid
Bract imbrication	Imbricate
Color and texture of bract external face	Purple-pink, polished
Bract behavior before falling	Non-revolute
Compound tepal basic color	Yellow
Fruit shape and position	Straight, perpendicular to peduncle
Fruit apex	Blunt
Fruit quantity	5–6 hands, 3–6 fruits per hand
Seed size and shape	3mm, cylindrical-obpyiform, tuberculate
Other traits of importance	Fruits, peduncle and rachis are hairy and often split to some degree upon maturity



NOTES:

Musa hirta is one of the four earliest species that were described from Borneo by Beccari in 1902, and is endemic to the central part of Sarawak including the areas of Betong, Sarikei, Sibu, Kapit, and Bintulu. A description by Beccari (1902) stated that this species was very closely related to *M. velutina* from India, which though they are superficially similar we now know they are not closely related, *M. hirta* being of the section *Callimusa* and *M. velutina* of the section *Musa*. He described that *M. hirta* possessed fruit peels that do not change color and split open upon maturity similar to *M. velutina*. However, Häkkinen noticed that some populations do change color from green yellow or yellowish-orange and often just the pericarp of matured fruits are cracked when ripe, and not fully self-peeling as in *M. velutina* or *M. schizocarpa* (Häkkinen, 2003). Another peculiar feature of this species is the tendency for the fruits to be partially fused to one another within each hand for approximately up to two thirds of their length (Hotta, 1967).

It is a lowland species inhabiting secondary forests and open space on flat land or riverbanks. The distribution of this species is not observed to typically overlap with populations of *M. campestris*, another common lowland species in Sarawak (Häkkinen, 2003).

Musa hirta



A, B, C, D: Markku Häkkinen..

Musa hirta



E: Markku Häkkinen

Musa hirta



F: Chien Lee.

Musa ingens



Section: *Callimusa*



Geographical range: Papua New Guinea: Madang, Morobe, Western Highlands, Eastern Highlands



Publications:

Argent G. 1976. The wild bananas of Papua New Guinea. *Notes from the Royal Botanic Garden, Edinburgh* 35(1):77–114.

Simmonds NW. 1960. Notes on banana taxonomy. *Kew Bulletin* 14(2):198–212. <https://doi.org/10.2307/4114778>

CRITICAL MORPHOLOGICAL TRAITS

Pseudostem height (m)	10–15m
Petioles	Green with sparse brown blotches, margins erect
Inflorescence position	Pendent
Male bud shape	Rounded
Bract imbrication	Not-imbricate
Color and texture of bract external face	Yellow-white to grey-purple, dull
Bract behavior before falling	Non-revolute
Compound tepal basic color	Cream-white with orange-yellow tip
Fruit shape and position	Straight, perpendicular to peduncle
Fruit apex	Blunt or round
Fruit quantity	Up to 20 hands, 16–25 fruits per hand in two rows
Seed size and shape	4–10mm, irregular, black, smooth
Other traits of importance	Up to 2m in circumference at base



NOTES:

Musa ingens is the largest and tallest of the bananas and, presumably, the largest non-woody plant in the world (Simmonds, 1960). It is typically found in highland areas on the island of New Guinea at elevations ranging from 1000m–2100m. Argent (1976) noted that although seeds could be germinated at lower elevations, the plants failed to thrive and would soon die unless brought into an air conditioned room for the night. It is the only species yet known to have a chromosome count of 2n=14 as compared to 2n=20 as is typical for most other *Callimusa* species (Simmonds, 1960). For this reason, it had been unassigned to a section of genus by Simmonds, and later was placed in its own section named *Ingentimusa* by Argent (1976).

Simmonds notes that it did not thrive in tropical Trinidad, and all seedlings produced died before being able to be field-planted (Simmonds, 1960).

Musa ingens



A: Chien Lee.

Musa ingens



B, C: Steven Janssens. D: Chien Lee; E: Jeff Daniells.

Musa ingens



F, G: Jeff Daniells.

Musa jackeyi



Section: *Callimusa*

Geographical range: Australia: Queensland

Publications:

Hill W. 1874. Report on the Brisbane Botanic Garden. 7 p.

Simmonds NW. 1956. Botanical results of the banana collecting expedition, 1954–5. *Kew Bulletin* 11(3):463–489. <https://doi.org/10.2307/4109131>

CRITICAL MORPHOLOGICAL TRAITS

Pseudostem height (m)	9–12m
Petioles	Green
Inflorescence position	Erect
Male bud shape	Lanceolate
Bract imbrication	Highly imbricate
Color and texture of bract external face	Green, polished
Bract behavior before falling	Non-revolute, semi-persistent
Compound tepal basic color	Cream-white
Fruit shape and position	Straight, nearly ball shaped, perpendicular to peduncle
Fruit apex	Blunt or round
Fruit quantity	Approximately 7–10 hands, 10–16 fingers per hand in two rows
Seed size and shape	Unknown, but presumed to be similar to <i>M. maclayi</i>
Other traits of importance	Fruits are very densely packed on bunch and angular with very short pedicels. Mature fruit is red-orange. Purple-red sap



NOTES:

Musa jackeyi was described by Hill in 1874 along the banks of the Johnstone River in North Queensland, Australia. It has been noted as being quite rare and even as far back as 1956, Simmonds noted that he suspected the species could already be extinct, but it has been documented around Mossman in Far North Queensland as recently as 1996 (Sankowsky, n.d.).

It is similar in all respects to *M. maclayi*, and both Stover & Simmonds (1987) as well as Argent (1976) noted the relationship, but no taxonomic revisions had been performed in either case due to lack of living specimens with which to compare at the time, and with herbarium specimens being of little help. Morphologically, it is most similar to Argent’s *M. maclayi* subsp. *ailuluai* from Ferguson Island, Milne Bay Province of Papua New Guinea some 900km NE from the type locality of *M. jackeyi* (Argent, 1976). Curiously, should the link be proven and a taxonomic revision undertaken, *M. jackeyi* would have priority as a name over *M. maclayi* (Argent, 1976).

It is named after the “faithful and affectionate attendant of the explorer Kennedy”, an aboriginal by the name of Jackey (Hill, 1874).

Musa jackeyi



A, B, C, D, E, F: Garry Sankowski.

Musa johnsii



Section: *Callimusa*
Geographical range: Indonesia: Papua
Publication:

Argent G. 2001. Contributions to the Flora of Mount Jaya VI. A New Banana, *Musa johnsii* (Musaceae) from New Guinea. *Gardens' Bulletin Singapore* 53:1–7.

CRITICAL MORPHOLOGICAL TRAITS

Pseudostem height (m)	Up to 4m
Petioles	Green with brown blotches, margins erect
Inflorescence position	Bunch horizontal or pendent, rachis always pendent
Male bud shape	Rounded
Bract imbrication	Imbricate
Color and texture of bract external face	Yellow with green tips, polished
Bract behavior before falling	Non-revolute
Compound tepal basic color	Cream with yellow tips
Fruit shape and position	Irregularly shaped, the entire bunch nearly spherical
Fruit apex	Blunt/truncate
Fruit quantity	Up to 14 fingers per hand
Seed size and shape	4–5mm, irregular with rounded angles, dark brown
Other traits of importance	Fruits are very densely packed on bunch and splitting open at maturity (schizocarpic). A sterile cavity is present in the fruits at the distal end. Mature fruit is red-orange with yellow pulp



NOTES:

Musa johnsii was described by Argent in 2001 by the Freeport mining concession above Timika in the province of Papua Indonesia on the island of New Guinea. In the original description, the bunches were observed to be nearly spherical in overall shape, though the following photographs of a more recently documented specimen suggest there is variation, with some being more cylindrical. The fruits are densely packed, ripen orange at maturity and are irregularly schizocarpic (Argent, 2001). The plants were cultivated in at least one village where the inner pseudostem was eaten as a raw vegetable, and grow at elevations between 1000m–1600m.

It is similar to *M. arfakiana* in that they both have highly angled fruits which contain a non-seed bearing mucilaginous pithy chamber in the distal portion of the fruit which may be up to one third the total volume of the fruit. It notably differs from *M. arfakiana* in that the bunch is horizontal-pendulous, and not erect (Argent, 2010).

Named for Professor Robert “Bob” James Johns for his contributions to the flora of New Guinea and for bringing the plant to the attention of Argent.

Musa johnsii



A, B: Courtesy of rarepalmseeds.com.

Musa juwiniana



Section: *Callimusa*
Geographical range: Malaysia: Sarawak
Publication:

Meekiong K; Ipor I; Tawan C; Bulan P. 2008. A new species of wild banana from Sarawak. *Folia Malaysiana* 9(2):109–116.

CRITICAL MORPHOLOGICAL TRAITS

Pseudostem height (m)	Up to 3m
Petioles	Green with sparse purple-brown blotches, margins curved inward
Inflorescence position	Variably horizontal to erect
Male bud shape	Ovoid
Bract imbrication	Slightly imbricate
Color and texture of bract external face	Dark red or red-pink, smooth
Bract behavior before falling	Non-revolute
Compound tepal basic color	Yellow
Fruit shape and position	Straight or slightly curved, perpendicular to peduncle
Fruit apex	Unknown
Fruit quantity	6–12 hands, 6–8 fruits per hand, typically in two rows, occasional hands with one row
Seed size and shape	3–3.5mm, cylindrical, tuberculate
Other traits of importance:	Similar to <i>M. voonii</i> but with fruits in two rows per hand as opposed to one, and locules with ovules in two rows instead of four



NOTES:

Musa juwiniana was described in 2008 and can be found growing in secondary forests, open spaces and along riverbanks in Sarawak. Populations have been observed in Bintulu, Kapit, Lawas, Limbang, and Miri. *M. juwiniana* is similar to *M. voonii* in appearance, but can be differentiated by the ovule arrangement within the locules. *Musa voonii* is the only species in Borneo with ovules in four rows per locules. In addition, the fruits of *M. juwiniana* are in a biseriate (two-row) arrangement, whereas *M. voonii* is always in a uniseriate (one-row) arrangement (Meekiong et al., 2008).

M. juwiniana is often found growing sympatrically with *M. campestris* and *M. acuminata*, particularly along the side of logging roads (Meekiong et al., 2008).



Musa juwiniana



A, B, C, D: Kalu Meekiong.

Musa lawitiensis



Section: *Callimusa*



Geographical range: Malaysia: Sabah, Sarawak, Indonesia: West Kalimantan, East Kalimantan



Publications:

Argent G. 2000. Two interesting wild *Musa* species (Musaceae) from Sabah, Malaysia. *Gardens' Bulletin Singapore* 52:203–210.

Häkkinen M. 2006b. *Musa lawitiensis* Nasution & Supard. (Musaceae) and its intraspecific taxa in Borneo. *Adansonia* 28(1):55–65.

Nasution R; Supardiyono E. 1998. New species: *Musa lawitiensis* Nasution & Supardiyono spec. nova. From Bentuang - Karimun National Park, West Kalimantan. *Bulletin Kebun Raya Indonesia* 8(4):128–130.

CRITICAL MORPHOLOGICAL TRAITS

Pseudostem height (m)	1.5–4
Petioles	Extensive brown-black blotches, margins curved inward
Inflorescence position	Pendent
Male bud shape	Lanceolate
Bract imbrication	Highly imbricate
Color and texture of bract external face	Orange-red to red-yellow, waxy
Bract behavior before falling	Non-revolute
Compound tepal basic color	Yellow-green
Fruit shape and position	Straight or slightly curved, curved upwards
Fruit apex	Bottle necked
Fruit quantity	Up to 10 hands, 5–12 fruits per hand in 1 or 2 rows
Seed size and shape	1.5mm, round, tuberculate
Other traits of importance	Exceptionally slender plant and fruit, leaf undersides often heavily waxy



NOTES:

Musa lawitiensis was first described by Nasution and Supardiyono in 1998 from plants growing in the Bentuang-Karimun National Park in West Kalimantan, Indonesia at elevations around 150m–200m. A population was also mentioned from West Kutai in East Kalimantan where it was found growing at 1600m (Nasution & Supardiyono, 1998). Häkkinen (2006b) notes it can be a higher altitude species and is often found growing along river banks.

It is a very distinct species, being perhaps the most slender of the genus, with pseudostems attaining heights up to 3m–4m while remaining around 10cm in diameter at the base, and has been compared more to the appearance of a *Heliconia* than a typical *Musa*. The fruits are notably skinny and contain the smallest known seeds in the genus, typically measuring just 1mm–2mm in diameter (Häkkinen, 2006b).

In 2006, Häkkinen described four distinct varieties: var. *lawitiensis*, var. *kapitiensis*, var. *sarawakensis*, and var. *suratii*. The most basic distinguishing traits for the varieties as described by Häkkinen (2006b) are given in the following table:



NOTES:

VARIETY	KNOWN RANGE	HEIGHT	BRACTS	MALE BUD	BUNCH SIZE	SPECIAL TRAITS
var. <i>lawitiensis</i>	West Kalimantan: Bentuan Karimun Natl. Park	3–4 m	not waxy	orange-red	6–8 fruits in 2 rows	
var. <i>kapitiensis</i>	Sarawak: Kapit, river banks of Mengiong River	1.8 m	not waxy	orange-red	5 in 1 row	short plants
var. <i>sarawakensis</i>	Sarawak: Kapit	2 m	waxy	orange-yellow	5–8 fruits in 2 rows	female bud bright yellow
var. <i>suratii</i>	Sabah: Tenom, Kapit	≥3.5m	not waxy	orange-pink	4–6 fruits in 1 row	sharply pointed male bud

Musa lawitiensis var. lawitiensis



A, B, C: Markku Häkkinen.

Musa lawitiensis var. *kapitensis*



A, B, C: Markku Häkkinen.

Musa lawitiensis var. *sarawakensis*



A, B, C, D: Markku Häkkinen.

Musa lokok



Section: *Callimusa*
Geographical range: Malaysia: Sarawak
Publication:
Geri C; Ng F. 2005. *Musa lokok* (Musaceae), a new species of banana from Bario, Borneo. *Gardens' Bulletin Singapore* 57:279–283.

CRITICAL MORPHOLOGICAL TRAITS

Pseudostem height (m)	1–2m
Petioles	Yellow-green, margins overlapping
Inflorescence position	Pendent
Male bud shape	Oblong-ovoid
Bract imbrication	Highly imbricate
Color and texture of bract external face	Pink-purple, glossy
Bract behavior before falling	Non-revolute
Compound tepal basic color	Yellow-green
Fruit shape and position	Straight, pointing downwards
Fruit apex	Bottle necked
Fruit quantity	3–5 hands, 1–7 fruits per hand in 1 row
Seed size and shape	3–5mm, cylindrical, tuberculate
Other traits of importance	Exceptionally slender plant



NOTES:

Musa lokok is a rare species found in wet low-lying areas in undisturbed forests, so far only known from Bario in the Kelabit Highlands of Sarawak, Malaysia at elevations around 1000m.

It is somewhat similar in appearance to *M. lawitiensis*, having a slender pseudostem and highly imbricate male bud, but differs in that the fruits point downward as they mature (as opposed to curling upwards), the male bud is pink-purple (as opposed to orange-red), seeds are larger and more typical of other Bornean *Callimusa*, and the plant is mostly waxless. It is most similar to *M. sakaiana*, but differs from that species by its fruits which hang downwards, as opposed to the fruits of *M. sakaiana* which are held at a nearly 90° angle to the stalk (Meekiong et al., 2005).

Suspected hybrids with *M. textilis* were observed in the vicinity of its original type locality.

The specific epithet “lokok” is derived from a word used by locals of the area for “cigarette”, because the leaves of this species are preferred to be used as paper for rolling cigarettes (Geri & Ng, 2005).

Musa lokok



A: Kalu Meekiong.

Musa lolodensis



Section: *Callimusa*



Geographical range: Indonesia: North Maluku, West Papua, Papua, Papua New Guinea: West Sepik



Publications:

Argent G. 1976. The wild bananas of Papua New Guinea. *Notes from the Royal Botanic Garden, Edinburgh* 35(1):77–114.

Cheesman EE. 1950. Classification of the bananas: Critical notes on species: *Musa lolodensis*. *Kew Bulletin* 5(1):27–28.



NOTES:

Musa lolodensis was first collected by David Fairchild while on an expedition in Halmahera, Indonesia in 1940. Seeds were sent to Cheesman in Trinidad where the plants were grown out and the species described along with notes passed along by Fairchild (Cheesman, 1950). Later in 1976, Argent noted the plants growing abundantly within the Biwani-Torricelli Mountain chain in West Sepik, Papua New Guinea. Argent again noted it's presence at elevations from 100m–500m near the type locality of *M. johnsii* near Timika in Papua, Indonesia.

Considerable variation in male bud shapes and color were noted in Halmahera, as well as unusually small plants which were cultivated in gardens and said to be used for medicinal purposes (Hermanto et al., 2012).

The fruit ripens to a bright orange color with yellow pulp, and the sap is variable from clear, to pinkish or purple, as is common with a number of *Callimusa* species in the New Guinea region. It is one of the few species in which the fruit is schizocarpic and splits open upon ripening (Argent, 1976).

Argent notes that on New Guinea some hybrids with *M. boman* were commonly seen in areas where the populations overlap (Argent, 1976).

CRITICAL MORPHOLOGICAL TRAITS

Pseudostem height (m)	Up to 7m
Petioles	Green with black markings
Inflorescence position	Sub-horizontal to pendent
Male bud shape	Ovoid
Bract imbrication	None or only slightly imbricate
Color and texture of bract external face	Pale pink to creamy-white or yellow, with occasional purple streaks
Bract behavior before falling	Non-revolute
Compound tepal basic color	Cream with yellow apex
Fruit shape and position	Straight, irregularly perpendicular to stem, long tapered pedicel
Fruit apex	Blunt
Fruit quantity	Up to 8 hands, 7–14 fruits per hand in 2 rows
Seed size and shape	6mm, irregularly angular, flattened, black
Other traits of importance:	Schizocarpic, fruits self-peel upon maturity, bright orange when ripe

Musa lolodensis



A: Agus Sutanto/ITFRI-IAARD.

Musa lutea



Section: *Callimusa*

Geographical range: Vietnam: Yen Bai, Ha Giang, Thai Nguyen, Tuyen Quang

Publication:
Valmayor R; Danh L; Häkkinen M. 2004. Rediscovery of *Musa splendida* A. Chevalier and Description of Two New Species (*Musa viridis* and *Musa lutea*). *The Philippine Agricultural Scientist* 87(1):110–118.

CRITICAL MORPHOLOGICAL TRAITS

Pseudostem height (m)	2–3m
Petioles	Green with small brown-black blotches, margins erect
Inflorescence position	Erect
Male bud shape	Ovoid
Bract imbrication	Slightly imbricate
Color and texture of bract external face	Red with yellow apices, dull
Bract behavior before falling	Non-revolute
Compound tepal basic color	Reddish-yellow with green apex
Fruit shape and position	Straight, pointing downward
Fruit apex	Blunt
Fruit quantity	5–12 hands, 2–5 fruits per hand in one row
Seed size and shape	Unknown
Other traits of importance	Fruits are yellow when immature/unripe and do not change color upon ripening



NOTES:

Musa lutea was described in 2004 from plants growing in the Yen Bai province of northern Vietnam. It normally grows on slopes near streams at elevations between 150m–600m. It is very similar to *M. splendida* in general appearance, but is easily distinguished by the color of its fruit which is a bright yellow for the entirety of its growth, a trait shared by *M. coccinea*, *M. exotica*, and *M. haekinnenii*, also from Vietnam. However, it can be distinguished from *M. coccinea*, *M. exotica*, and *M. haekinnenii* by the significantly larger and more robust plants, and fruits which quickly turn downwards after emergence and remain so through maturity.

Musa lutea



A, B, C, D, F: Gabriel Sachter-Smith; E: Markku Häkkinen.

Musa maclayi



Section: *Callimusa*



Geographical range: Papua New Guinea: Morobe, N. Dist, Cent. Dist, New Ireland, New Britain, Bougainville, Milne Bay



Publications:

Argent G. 1976. The wild bananas of Papua New Guinea. *Notes from the Royal Botanic Garden, Edinburgh* 35(1):77–114.

Mueller FV. 1885. Edible fruits from the Maclay-Coast, New Guinea. In *Proceedings of the Linnean Society of New South Wales*. Sydney. pp 355–356.

Simmonds NW. 1953. Classification of the bananas. *Kew Bulletin* 8(4):571–572. <https://doi.org/10.2307/4117384>

Simmonds NW. 1956. Botanical results of the banana collecting expedition, 1954–5. *Kew Bulletin* 11(3):463–489. <https://doi.org/10.2307/4109131>

CRITICAL MORPHOLOGICAL TRAITS

Pseudostem height (m)	Up to 10m
Petioles	Green, margins not overlapping
Inflorescence position	Erect
Male bud shape	Ovoid
Bract imbrication	Imbricate
Color and texture of bract external face	Green to brownish-yellow, polished
Bract behavior before falling	Non-revolute (sometimes dry-persistent)
Compound tepal basic color	Cream
Fruit shape and position	Straight, perpendicular to stem
Fruit apex	Blunt to bottle necked
Fruit quantity	Up to 15 hands, up to 15 or more fruits per hand in two rows
Seed size and shape	6–7mm, irregularly angular, wrinkled, black
Other traits of importance	Sap variable in color from clear, to pink or red/purple



NOTES:

Musa maclayi was first described by the Baron Ferdinand von Mueller from Morobe, Papua New Guinea, at that time referred to as the “Maclay-Coast” (Mueller, 1885). It often grows in large stands in open areas along roadsides, on slopes near rivers, and in abandoned garden sites. The plants may reach immense heights and are relatively easy to identify among the other wild *Musa* of Papua New Guinea by their erect inflorescence and typically green male buds. The fruits ripen to a bright orange-red color, and have intensely yellow pulp. It is assumed, though not yet unequivocally proven, that *M. maclayi* is the primary ancestral parent to the Fe'i series of domesticated edible bananas found throughout the Indo-Pacific region.

Simmonds described *M. erecta* from Bougainville in 1953, and subsequently himself reduced it under *M. maclayi* later in 1956 having seen more specimens in the field, as his *M. erecta* had only been observed as plants grown in Trinidad from seed (Simmonds, 1956).

The species is quite variable and poorly understood, as even Argent noted in 1976 as he attempted to classify the range of forms he saw into four, somewhat, loose taxa after rather extensive field studies throughout Papua New Guinea. He characterized them as follows: ssp. *maclay* var. *maclayi* as the taxon from mainland Papua New Guinea with green bracts which completely reflex to the rachis before falling, ssp. *maclayi* var. *namatani* as a form from New Ireland with green bracts which do not reflex completely to the rachis before falling, ssp. *maclayi* var. *erecta* which was Simmonds' previous taxon reclassified with some whitish-cream color in the bracts from Bougainville, and ssp. *ailuluai*

from Fergusson Island, Milne Bay province which has persistent bracts along the entire length of the rachis (Argent, 1976).

Ssp. *ailuluai* bears extreme similarity to *M. jackeyi*, which at the time was not available for close comparison, but may prove to be synonymous (Argent, 1976). It should also be noted that var. *namatani* and ssp. *ailuluai* were only ever observed in single small populations at their type locality and were known to not be definitively representative of expansive populations across many islands. Var. *erecta* individuals were observed to also occasionally have persistent bracts (Gabriel Sachter-Smith, personal observation). Curiously, should the link between *M. jackeyi* and *M. maclayi* be definitively proven and a taxonomic revision undertaken, *M. jackeyi* would have priority as the species name over *M. maclayi* should they all be regarded as a single species (Argent, 1976).

M. maclayi is named in honor of Russian scientist and ethnographer Nicholas Miklouho-Maclay (Mueller, 1885).

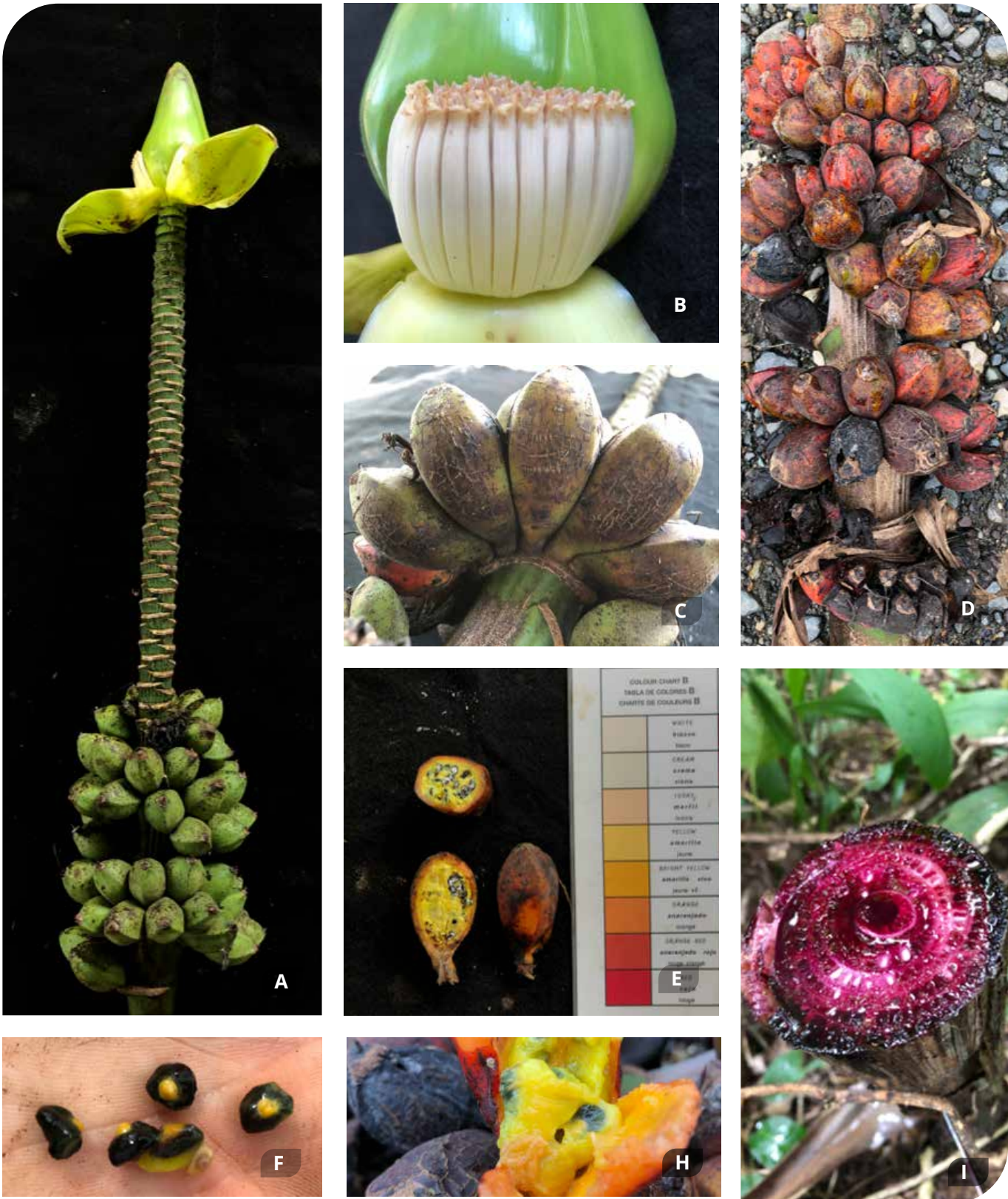
Musa maclayi subsp. maclayi var. maclayi



A, B: Steven Janssens.

Musa maclayi subsp. *maclayi*

Potential var. *namatani* observed in West New Britain



A, B, C, D, E, F, G, H, I: Gabriel Sachter-Smith.

Musa maclayi subsp. *maclayi* var. *erecta*



A, B, C, D: Gabriel Sachter-Smith.

Musa monticola



Section: *Callimusa*
Geographical range: Malaysia: Kinabalu Sabah
Publication:

Argent G. 2000. Two interesting wild *Musa* species (Musaceae) from Sabah, Malaysia. *Gardens' Bulletin Singapore* 52:203–210.

CRITICAL MORPHOLOGICAL TRAITS

Pseudostem height (m)	1–2m
Petioles	Mostly brown, margins erect
Inflorescence position	Erect or slightly leaning
Male bud shape	Conical, often terminating before maturity
Bract imbrication	Imbricate
Color and texture of bract external face	Orange-brown with black-purple margins, polished
Bract behavior before falling	Non-revolute (sometimes dry-persistent)
Compound tepal basic color	Cream
Fruit shape and position	Straight, very short pedicels, perpendicular to stem
Fruit apex	Pointed to bottle necked
Fruit quantity	5–7 hands, up to 13 fruits per hand in two rows
Seed size and shape	4–5mm, sub-spherical, weakly angled, tuberculate
Other traits of importance	Hemaphrodite basal flowers



NOTES:

Musa monticola was described by Argent in 2000 from plants growing at the Mt. Kinabalu Park headquarters in Sabah, Malaysia and along Sinsuron Road in the Crocker Range. It grows between elevations of 1200m–1700m making it one of the highest growing banana species on Borneo.

It is a distinctive and small species which rarely grows more than 2m in height, with a dark brown pseudostem and petioles, dark orange-purple bracts and a bunch which is held semi-erect at an angle often with a male bud which degenerates by maturity. It is the only known *Musa* species to grow at such high elevation in the Mt. Kinabalu area of Sabah (Argent, 2000).



Musa monticola



A, B, C, D, E, F: Markku Häkkinen.

Musa muluensis



Section: *Callimusa*
Geographical range: Malaysia: Sarawak
Publication:
Hotta M. 1967. Notes on the wild banana of Borneo. *The Journal of Japanese Botany* 42(11):344–351.

CRITICAL MORPHOLOGICAL TRAITS

Pseudostem height (m)	3–4m
Petioles	Green, margins erect or slightly curved inward
Inflorescence position	Bunch horizontal, rachis pendent
Male bud shape	Lanceolate-oblong
Bract imbrication	Imbricate
Color and texture of bract external face	Brownish-red, polished
Bract behavior before falling	Non-revolute
Compound tepal basic color	Unknown
Fruit shape and position	Slightly curved, pointing upwards
Fruit apex	Strongly bottle necked
Fruit quantity	5–7 hands, up to 10 fruits per hand in two rows
Seed size and shape	4mm, rounded, tuberculate
Other traits of importance	



NOTES:

Musa muluensis was described by Mitsuru Hotta in 1967 from the area near Gulung Mulu National Park in Sarawak. It is a lowland species, reported to grow at elevations from 50m–100m in open spaces near rivers (Hotta, 1967). Little is known about this species, and it along with the allied *M. tuberculata* may be confused for *M. textilis* which Häkkinen suspected was introduced from the Philippines but has since naturalized in some areas and may be producing hybrids with native species, making the delineation between them difficult to ascertain (Häkkinen, pers. commun.). The few diagnostic traits that Hotta gives are that compared to *M. textilis*, *M. muluensis* is a smaller and more slender plant, with smaller seeds which are tuberculate. He also specifically distinguishes it from *M. tuberculata* by it having short free tepals with a rounded or truncate apex, as opposed to the long free tepal with an acute apex in *M. tuberculata* (Hotta, 1967).



Musa muluensis



A, B, C, D: Markku Häkkinen.

Musa peekelii



Section: *Callimusa*

Geographical range: Papua New Guinea: Madang, New Ireland

Publications:

Argent G. 1976. The wild bananas of Papua New Guinea. *Notes from the Royal Botanic Garden, Edinburgh* 35(1):77–114.

Cheesman EE. 1949. Classification of the bananas: Critical notes on species: *Musa peekelii*. *Kew Bulletin* 4(4):450–452.

Lauterbach C. 1914. Eine neue Musacee Papuasiens. In *Botanische Jahrbücher für Systematik* 50. pp 306–307.

Simmonds NW. 1953. Classification of the bananas. *Kew Bulletin* 8(4):571–572. <https://doi.org/10.2307/4117384>

CRITICAL MORPHOLOGICAL TRAITS

Pseudostem height (m)	Up to 10m
Petioles	Yellowish-green, margins curved inwards
Inflorescence position	Pendent
Male bud shape	Lanceolate
Bract imbrication	Imbricate
Color and texture of bract external face	Green to yellow-brown, polished
Bract behavior before falling	Non-revolute
Compound tepal basic color	Cream, sometimes with yellow at apex
Fruit shape and position	Straight, perpendicular to stem
Fruit apex	Blunt or bottle necked
Fruit quantity	5–7 hands, up to 10 fruits per hand in two rows
Seed size and shape	6–7mm, irregularly angled, flattened
Other traits of importance	Mature fruit orange in color, flesh bright yellow



NOTES:

Musa peekelii was described by German botanist Carl Lauterbach in 1914 from plants growing on the island of New Ireland, Papua New Guinea. Simmonds received seeds in Trinidad from the Rai coast, Madang, which he subsequently grew out and described as a new species, *M. angustigemma*. Though he knew about *M. peekelii* and recognized the close affinity of it and his new species, the differences between the samples he was familiar with were enough to justify species status for each at the time (Simmonds, 1953).

In 1967, Argent was able to conduct enough comparative field work to decide that Simmonds’ *M. angustigemma* should be elevated to the rank of subspecies within *M. peekelii*. Argent separated the subspecies based on the simple characteristics that subsp. *peekelii* is said to often have fissuring on the skins of the ripe fruit and bracts which are predominantly green with purplish apices, whereas subsp. *angustigemma* has ripe fruits which are smooth and never has purple coloration at the bract apices. Variation in bract persistence, and certainly other traits, exist within both subspecies populations (Argent, 1967).

M. peekelii can grow to be massive plants, with a long rachis which may extend some 3m or more as the male bud develops. Like a number of it’s close relatives in Papua New Guinea, *M. peekelii* develops bright orange fruit when ripe, with bright yellow pulp, with certain specimens having red-purple sap (Argent, 1976).

Occasional instances of seedlessness and apparent parthenocarpy have been observed in certain specimens as a seemingly random occurrence. Whether or not this trait is indicative of the possibility that *M. peekelii* has contributed to the domestication of the Fe’i bananas remains unknown (Gabriel Sachter-Smith, personal observation).

Musa peekelii subsp. peekelii



A, D, E: Steven Janssens; B, C: Jeff Daniells.

Musa peekelii subsp. *peekelii*

Specimen at Waimea Valley, Hawaii, collected in Madang



A, B, C, D: Gabriel Sachter-Smith.

Musa peekelii subsp. *angustigemma*



A, C: Jeff Daniells; B: Steven Janssens.

Musa sakaiana



Section: Callimusa

Geographical range: Malaysia: Lawas Sarawak

Publication: Meekiong K; Ipor IB; Tawan CS. 2005. A new banana: *Musa sakaiana* (Musaceae) from Sarawak, Malaysia. *Folia Malaysiana* 6(3&4):131–138.

CRITICAL MORPHOLOGICAL TRAITS

Pseudostem height (m)	3–4m
Petioles	Purple-blue with black-purple blotches, margins curved inward
Inflorescence position	Pendent
Male bud shape	Oblong-lanceolate
Bract imbrication	Highly imbricate
Color and texture of bract external face	Red-pink, polished
Bract behavior before falling	Non-revolute
Compound tepal basic color	Cream, light green at apex
Fruit shape and position	Straight or slightly curved, perpendicular to stem
Fruit apex	Blunt
Fruit quantity	8–10 hands, 8–10 fruits per hand in one row
Seed size and shape	4–6mm, round-obpyriform, wrinkled, brown
Other traits of importance	



NOTES:

Musa sakaiana was described in 2005 from plants growing in Ravenscourt, Limbang division, Lawas district, Sarawak. They were reported to be commonly found along abandoned logging roads, and on the banks of streams in forested areas at an elevation of 600m–1000m (Meekiong et al., 2005). It is noted as being similar to *M. lokok* in being a very slender plant which establishes itself in small groups. The two species have some overlapping populations, but they can be distinguished by the orientation of the fruit which is held perpendicular to the stalk at maturity in *M. sakaiana*, compared to *M. lokok* in which the mature fruits hang downwards. Additionally, the bract colors are different with *M. sakaiana* having mostly red-pink bracts with purple-pink coloration at the base, and *M. lokok* displaying lighter colored pink-purple bracts which are white at the base.

M. sakaiana is named in honor of Dr. Judson Sakai Tagal.



Musa sakaiana



A, B, C: Kalu Meekiong.

Musa salaccensis



Section: Callimusa
Geographical range: Indonesia: Sumatra, Java
Publications:

Häkkinen M; Väre H. 2009b. Typification of *Musa salaccensis* and nomenclatural notes on *Musa* (Musaceae). *Adansonia* 31(1):41–46. <https://doi.org/10.5252/a2009n1a3>

Veldkamp JF; Sulistyaningsih LD. 2016. Nomenclature and typification of *Musa salaccensis* Zoll. ex Kurz (musaceae). *Reinwardtia* 14(2):299–302. <https://doi.org/10.14203/reinwardtia.v14i2.1674>

Zollinger H. 1854. Systematisches Verzeichniss der im indischen archipel in den Jahren 1842-1848 gesammelten so wie der aus japan Empfangenen Pflanzen. Zürich, E. Kiesling. <https://doi.org/10.5962/bhl.title.53656>

CRITICAL MORPHOLOGICAL TRAITS

Pseudostem height (m)	1–3m
Petioles	Green with purple blotches, margins curved inward
Inflorescence position	Erect
Male bud shape	Oblong-lanceolate
Bract imbrication	Highly imbricate
Color and texture of bract external face	Pink-purple with green apex, polished
Bract behavior before falling	Non-revolute
Compound tepal basic color	Green
Fruit shape and position	Straight or slightly curved, pointing upward
Fruit apex	Blunt
Fruit quantity	Up to 10 hands, 1–5 fruits per hand in one row
Seed size and shape	Obpyriform, half-smooth and half-tuberculate
Other traits of importance	Fruits white or greenish-white with purple striations



NOTES:

Musa salaccensis, first described from Java by Swiss botanist Heinrich Zollinger in 1854, has like a number of *Musa* species a long and complicated taxonomic history which has been reviewed in depth by Häkkinen & Väre (2009b), as well as more recently and thoroughly by Veldkamp & Sulistyaningsih (2016).

For a time it was considered to possibly be extinct from Java, but as of 2009 populations have been recorded in West Java in Bodogol and Cimelati on the flanks of Mt. Salak and Mt. Halimun. It is also found on the island of Sumatra with populations reported from Ulu Gadut, around Mt. Sago and in Bukit Barisan Selatan National Park (Veldkamp & Sulistyaningsih, 2016).

The species is highly reminiscent of *M. campestris* of Borneo, but most notably differs in having a bud which is more lanceolate as opposed to ovoid, and fruits which are always in one row in each hand.



Musa salaccensis



A, B, C, D: Markku Häkkinen.

Musa splendida



Section: *Callimusa*



Geographical range: Vietnam: northern provinces.
China: Yunnan



Publications:

Chevalier A. 1934. Observations sur quelques bananiers sauvages et cultivés. *Revue De Botanique Appliquée Et D'agriculture Coloniale* 14(155):506–521. <https://doi.org/10.3406/jatba.1934.5394>

Ly N; Lowry PP; Haevermans T. 2018. Typification and an emended description of *Musa splendida* (Musaceae). *Phytotaxa* 351(4). <https://doi.org/10.11646/phytotaxa.351.4.4>

Valmayor R; Danh L; Häkkinen M. 2004. Rediscovery of *Musa splendida* A. Chevalier and description of two new species (*Musa viridis* and *Musa lutea*). *The Philippine Agricultural Scientist* 87(1):110–118.



NOTES:

Musa splendida was first described by Auguste Chevalier in 1934 from plants growing in the Lao Cai province of northern Vietnam. The name fell into uncertainty and the species remained mostly ignored and unknown until 2004 when it was reviewed by Valmayor et. al, and further again by Ly et al. (2018). It commonly grows in many locations throughout northern Vietnam, as well as in the southern areas of Yunnan province in China close to the Vietnam border. Inflorescences are commonly collected from the wild and used as ornamental floral displays (Ly et al., 2018).

It is normally found growing on sloping terrain in moist ravines and open canopy areas of forest at elevations between 50m–700m (Ly et al., 2018).

It is similar to the closely related *M. lutea*, with both species being rather robust in habit and having erect inflorescences with red male buds and fruits which points downwards, but notably differs in having waxy green fruits which only turn yellow upon ripening.



Musa splendida



A, B, C, D, E, F: Gabriel Sachter-Smith; G: Markku Häkkinen.

CRITICAL MORPHOLOGICAL TRAITS	
Pseudostem height (m)	3–4m
Petioles	Green to brown with brown blotches, margins erect or slightly curved inward
Inflorescence position	Erect
Male bud shape	Ovoid
Bract imbrication	Not imbricate, or only slightly
Color and texture of bract external face	Red or pink-red, with ridges
Bract behavior before falling	Non-revolute
Compound tepal basic color	Yellow often with red pigmentation, green at apex
Fruit shape and position	Straight, hanging downwards
Fruit apex	Blunt or slightly bottle necked
Fruit quantity	5–10 hands, 1–5 fruits per hand in one row
Seed size and shape	8–10mm, mushroom shaped with distinct wavy-flattened top, wrinkled, black
Other traits of importance	Fruit often waxy, appearing blue-green when immature

Musa textilis



Section: *Callimusa*



Geographical range: Philippines, Borneo



Publications:

Copeland EB. 1927. Nomenclature of the abaca plant. *The Philippine Journal of Science* 33:141–153.

Cheesman EE. 1949. Classification of the bananas: Critical notes on species: *M. textilis*. *Kew Bulletin* 4(3):267–272.

Christenhusz MJ. 2009. Typification of ornamental plants: *Musa textilis* (Musaceae). *Phytotaxa* 2(1). <https://doi.org/10.11646/phytotaxa.2.1.10>

Hotta M. 1967. Notes on the wild banana of Borneo. *The Journal of Japanese Botany* 42(11):344–351.

Née DL. 1801. De la abacá, que es la *Musa textilis*. *Anales De Ciencias Naturales* 4:123–130.

CRITICAL MORPHOLOGICAL TRAITS

Pseudostem height (m)	2.5–4m
Petioles	Green to purple-brown, margins curved inward
Inflorescence position	Typically horizontal, occasionally pendent
Male bud shape	Oblong-ovoid
Bract imbrication	Highly imbricate
Color and texture of bract external face	Greenish-brown to purple-brown, polished
Bract behavior before falling	Non-revolute
Compound tepal basic color	Cream
Fruit shape and position	Curved, pointing upwards
Fruit apex	Bottled necked
Fruit quantity	5–10 hands, up to 12 fruits per hand in two rows
Seed size and shape	2–4 mm, irregularly rounded, smooth
Other traits of importance	Pesudostems variable in color from green to black



NOTES:

Musa textilis, commonly known as abacá or Manila hemp, is a species cultivated extensively in the Philippines for its pseudostem fibers which are used for cordage and cloth. The original description by Née in 1801 was rather scant on detail and with no type specimen, and was at the time taken to refer to any and all of the various *Musa* grown and used for fiber at that time in the Philippines which were numerous in form (Copeland, 1927). Though many cultivars, forms, and even hybrids with other species such a *M. balbisiana* exist, the true taxonomic identity of *M. textilis* is surprisingly vague considering how well known it is in cultivation. Due to it’s long and continued history of cultivation and use in the Philippines, it is not precisely clear what the nature of true wild populations may be. Cheesman (1949), recognizing this conundrum, succinctly stated ‘*that whatever Née’s type may have been, and however mixed the material on Philippine plantations, the name Musa textilis as generally used today outside the Philippines is attached to one particular species, quite well defined in major characters. This species has been introduced from the Philippines and grown in botanic gardens and experiment stations all round the tropics, and is the entity with which we are here concerned*’.

Currently, two botanical varieties are recognized, var. *textilis* which refers to common cultivated abacá, and var. *tashiroi* which was described from Lanyu island Taiwan, but it is a poorly understood taxon which may have represented recently introduced cultivated *M. textilis*, or another species, but no plants have been found in recent times and it is suspected to no longer occur on Lanyu (Phil Markey, pers. commun.).

Christenhauz selected a type specimen in 2009 to settle the underlying taxonomic issue, but acknowledged the continuing problem of uncertainty on exactly where

M. textilis originates and what may represent true wild populations of the species. Allied specimens have been observed on Borneo in many forms, suggesting a center of origin there. Additionally, the species seems closely allied to other species described from Borneo, namely *M. muluensis* and *M. tuberculata* (Hotta, 1967). Considerable additional field study, both in the Philippines and in Borneo, is needed to clarify the natural origins of this species and it’s relation to other *Callimusa* species, particularly on Borneo.

Musa textilis

Forms seen on Borneo



A, B, C: Markku Häkkinen.

Musa textilis

Forms seen on Borneo



D, E, F, G, H: Markku Häkkinen.



Musa textilis

Representative sample of a cultivated form



A, B, C, D, E: Gabriel Sachter-Smith.

Musa tuberculata



Section: *Callimusa*

Geographical range: Brunei

Publication:

Hotta M. 1967. Notes on the wild banana of Borneo. *The Journal of Japanese Botany* 42(11):344–351.

CRITICAL MORPHOLOGICAL TRAITS

Pseudostem height (m)	4–5m
Petioles	Unknown
Inflorescence position	Horizontal
Male bud shape	Oblong-ovoid
Bract imbrication	Highly imbricate
Color and texture of bract external face	Red with darkened margins and apex, polished
Bract behavior before falling	Non-revolute
Compound tepal basic color	Cream
Fruit shape and position	Curved, pointing upwards
Fruit apex	Blunt to bottle necked
Fruit quantity	5–10 hands, up to 9 fruits per hand in two rows
Seed size and shape	4–6mm, depressed obpyriform, heavily tuberculated
Other traits of importance	Free tepals



NOTES:

Musa tuberculata was described in 1967 by Mitsuru Hotta in Brunei. Initially, Hotta thought the specimen was *M. textilis*, but upon close examination decided it represented a new species due to the flowers being larger, and the seed being larger and tuberculate when compared to Cheesman’s description of cultivated *M. textilis*. It is interesting to note that although Hotta distinguishes his *M. tuberculata* from *M. textilis* based partly on seed morphology, the specimen he identified as *M. textilis* on Borneo apparently did not have mature seed at the time of examination. *M. tuberculata* is said to be distinguished from the closely related *M. muluensis* and *M. textilis* by its long free tepals with an acute apex (Hotta, 1967).



Musa tuberculata



A, B, C, D, E, F: Markku Häkkinen.

Musa violascens



Section: *Callimusa*

Geographical range: Malaysia: Peninsular

Publications:

Cheesman EE. 1950. Classification of the bananas: Critical notes on species: *M. violascens* and *M. gracilis*. *Kew Bulletin* 5(2):152–155

Ridley HN. 1893. On the flora of the Eastern Coast of the Malay Peninsula. *Transactions of the Linnean Society of London* 3(9):267–408.

Simmonds NW. 1956. Botanical results of the banana collecting expedition, 1954–5. *Kew Bulletin* 11(3):463–489.
<https://doi.org/10.2307/4109131>

CRITICAL MORPHOLOGICAL TRAITS

Pseudostem height (m)	1–2m
Petioles	Green, with a corrugated wings at the base
Inflorescence position	Erect
Male bud shape	Lanceolate-ovoid
Bract imbrication	Highly imbricate
Color and texture of bract external face	Pink-purple to white with colored margins, green at apex, polished
Bract behavior before falling	Non-revolute, commonly persistent
Compound tepal basic color	White, green towards apex
Fruit shape and position	Straight or slightly curved, mostly perpendicular to stem or pointing slightly upward
Fruit apex	Blunt
Fruit quantity	4–8 hands, 4–10 fruits per hand in two rows
Seed size and shape	4–6mm, cylindrical, tuberculated, black
Other traits of importance	Immature fruit variable from green to purple-white



NOTES:

Musa violascens was first described by English botanist Henry Nicholas Ridley from plants growing in Pahang, Malaysia (Ridley, 1893). The initial description was somewhat vague and incomplete, but it was enough for Cheesman to identify the species from seeds he grew out in Trinidad where he subsequently gave it a more robust description (Cheesman, 1950). Simmonds was the first to publish an extensive report on it’s status in the wild where he noted variation in bract persistence and color, as well as fruit color.

It may be found in a broad swath of the west-central region of peninsular Malaysia where it grows in elevations up to 1200m. It is somewhat similar to the only other *Callimusa* species known from peninsular Malaysia, *M. gracilis*, but notably differs from it in being a typically larger plant, with stubbier fruits in two rows per hand as opposed to one, and with commonly (though not always) persistent bracts.



Musa violascens



A, B, C, D: Markku Häkkinen.

Musa viridis



Section: Callimusa
Geographical range: Vietnam: Yen Bai
Publication:

Valmayor R; Danh L; Häkkinen M. 2004. Rediscovery of *Musa splendida* A. Chevalier and description of two new species (*Musa viridis* and *Musa lutea*). *The Philippine Agricultural Scientist* 87(1):110–118.

CRITICAL MORPHOLOGICAL TRAITS

Pseudostem height (m)	2–3m
Petioles	Green with small brown-black blotches
Inflorescence position	Erect
Male bud shape	Lanceolate-ovoid
Bract imbrication	Slightly imbricate
Color and texture of bract external face	Pink with yellow apex, somewhat dull and with grooves
Bract behavior before falling	Non-revolute
Compound tepal basic color	Yellow, green at apex
Fruit shape and position	Straight, hanging downwards
Fruit apex	Blunt or slightly bottle necked
Fruit quantity	5–10 hands, 1–5 fruits per hand in one row
Seed size and shape	8–10mm, mushroom shaped with distinct wavy-flattened top, wrinkled, black
Other traits of importance	Fruit waxy, appearing blue-green when immature



NOTES:

Musa viridis was described by Valmayor et al. in 2004 from plants collected in the Van Tran district of Yen Bai province, northern Vietnam, and subsequently grown out at the Phu Ho Fruit Research Center. It is much the same as *M. splendida* in all aspects, only differing appreciably in bract color which is pink, as opposed to the typically red bracts of *M. splendida*. Further studies may warrant its reduction under *M. splendida* (Ly et al., 2018).

Musa viridis



A, B: Gabriel Sachter-Smith; C, D, E: Markku Häkkinen.

Musa voonii



Section: *Callimusa*



Geographical range: Malaysia: Sarawak. Brunei



Publication:

Häkkinen M. 2004. *Musa voonii*, a new *Musa* species from Northern Borneo and discussion of the section *Callimusa* in Borneo. *Acta Phytotaxonomica Et Geobotanica* 55(2):79–88.

CRITICAL MORPHOLOGICAL TRAITS

Pseudostem height (m)	1.5–3m
Petioles	Light green with large red to brown blotches at base, margins curved inward
Inflorescence position	Horizontal or slightly pendent
Male bud shape	Ovoid
Bract imbrication	Highly imbricate
Color and texture of bract external face	Red-purple, green and apex
Bract behavior before falling	Revolute
Compound tepal basic color	Orange, cream-green at base
Fruit shape and position	Curved, pointing upward
Fruit apex	Lengthily pointed
Fruit quantity	Up to 8 hands, 6–8 fruits per hand in two rows
Seed size and shape	4mm, depressed obpyriform, tuberculate
Other traits of importance	



NOTES:

Musa voonii was described by Markku Häkkinen in 2004 from plants growing in Lawas, Sarawak. In addition to the initial population in Lawas, it was encountered in isolated instances within 200km in Limbang, Brunei and Sabah. Plants in these isolated areas were similar morphologically to the Lawas population, but were smaller in size, being about 1.5m high, compared with the plants in the main population, which are about 3m high.

Musa voonii is most similar to *Musa beccarii*, which occurs in northeast Sabah some 350km from Lawas, but differs in the following respects: *Musa voonii* has horizontal to pendulous inflorescences, and uniquely arranged ovules in 4 rows per loculus whereas, *M. beccarii* and other small lowland species of section *Callimusa* have upright inflorescences and seeds in two rows per loculus.

M. voonii is named in honour of Senior Research Officer Boon Hoe Voon from Sarawak Agriculture Research Centre who has made a lifetime study of the useful plants of Sarawak (Häkkinen, 2004).



Musa voonii



A, B, C: Markku Häkkinen.

Bibliography

Andrews HC. 1797. The Botanist's Repository. Bensley, London.

Argent G. 1976. The Wild Bananas of Papua New Guinea. *Notes from the Royal Botanic Garden, Edinburgh* 35(1):77–114.

Argent G. 2000. Two interesting wild *Musa* species (Musaceae) from Sabah, Malaysia. *Gardens' Bulletin Singapore* 52:203–210.

Argent G. 2001. Contributions to the Flora of Mount Jaya VI. A new banana, *Musa johnsii* (Musaceae) from New Guinea. *Gardens' Bulletin Singapore* 53:1–7.

Argent G. 2010. A new species of wild banana *Musa arfakiana* (Musaceae) from Papua (Formerly Irian Jaya) of Indonesia. *Gardens' Bulletin Singapore* 61(2):243–248.

Argent G; Kiew R. 2002. *Musa coccinea*. *PlantsmanGeor* 1(2):103–105.

Baker JG. 1893. A synopsis of the genera and species of Museae. *Annals of Botany* 7(2):189–222.
<https://doi.org/10.1093/aob/os-7.2.189>

Baker JG. 1984. Scitamineae. In: Hooker JD. Flora of British India. Reeve & CO, London. pp 198–264. <https://bit.ly/3Cio4YQ>

Beccari O. 1902. Nota sui banani selvatici di Borneo. *Nelle foreste di Borneo* 611–624 Tipografia di Salvatore Landi.

Cheesman EE. 1948a. Classification of the bananas. *Kew Bulletin* 3(2):145. doi:10.2307/4119749

Cheesman EE. 1948b. Classification of the bananas, III. Critical notes on species: *Musa balbisiana*. *Kew Bulletin* 3(1):1–17.

Cheesman EE, 1948c. Classification of the bananas. Critical notes on *Musa acuminata*. *Kew Bulletin* 3(1):17–28.
<https://doi.org/10.2307/4118909>

Cheesman EE. 1948d. Classification of the bananas: Critical notes on species: *Musa Nagensium*. *Kew Bulletin* 3(3):325–328.
<https://doi.org/10.2307/4108836>

Cheesman EE. 1949a. Classification of the bananas, III. Critical notes on species: *M. itinerans*. *Kew Bulletin* 4:23–24.

Cheesman EE. 1949b. Classification of the bananas: Critical notes on species: *Musa ornata*. *Kew Bulletin* 4(1):24–28.
<https://doi.org/10.2307/4119031>

Cheesman EE. 1949c. Classification of the bananas: Critical notes on species: *Musa Laterita*. *Kew Bulletin* 4(3):265–267.
<https://doi.org/10.2307/4109188>

Cheesman EE. 1949d. Classification of the bananas. III. critical notes on species. *Musa sanguinea*. *Kew Bulletin* 4(2):133–135.
<https://doi.org/10.2307/4113662>

Cheesman EE. 1949e. Classification of the bananas: Critical notes on species: *M. textilis*. *Kew Bulletin* 4(3):267–272.

Cheesman EE. 1949f. Classification of the bananas: Critical notes on species: *Musa peekelii*. *Kew Bulletin* 4(4):450–452.

Cheesman EE. 1950a. Classification of the bananas. Critical notes on species: *Musa borneensis*. *Kew Bulletin* 5(2):152–155.
<https://doi.org/10.2307/4117212>

Cheesman EE. 1950b. Classification of the bananas: critical notes on species: *M. violascens* and *M. gracilis*. *Kew Bulletin* 5(2):152–155. <https://doi.org/10.2307/4117213>

Cheesman EE. 1950c. Classification of the bananas: Critical notes on species: *Musa lolodensis*. *Kew Bulletin* 5(1):27–28.

Chen W; Häkkinen M; Ge X. 2014. *Musa ruiliensis* (Musaceae, section *musa*), a new species from Yunnan, China. *Phytotaxa* 172(2):109. <https://doi.org/10.11646/phytotaxa.172.2.6>

Chevalier A. 1934. Observations sur quelques bananiers sauvages et cultivés. *Revue De Botanique Appliquée Et D'agriculture Coloniale* 14(155):506–521. <https://doi.org/10.3406/jatba.1934.5394>

Chiu H; Shii C; Yang TY. 2015. *Musa itinerans* var. *chiumei* (Musaceae), A New Addition to the Taiwan Flora. *Taiwania* 60(3):133–136.

Chiu H; Shii C; Yang TY. 2011. A new variety of *Musa itinerans* (Musaceae) in Taiwan. *Novon: A Journal for Botanical Nomenclature* 21(4)405–412. <https://doi.org/10.3417/2009051>

Christenhusz MJ. 2009. Typification of ornamental plants: *Musa textilis* (Musaceae). *Phytotaxa* 2(1).
<https://doi.org/10.11646/phytotaxa.2.1.10>

Colla LA. 1820. *Musa*. In Memorie dell'accademia reale del lescienze di Torino. 384 p.

Copeland EB. 1927. Nomenclature of the abaca plant. *The Philippine Journal of Science* 33:141–153.

Dey S; Jamir NS; Gogoi R; Chaturvedi SK; Jakha H; Kikon Z. 2014. *Musa Nagalandiana* Sp. Nov. (Musaceae) from Nagaland, Northeast India. *Nordic Journal of Botany* 32(5):584–588. <https://doi.org/10.1111/njb.00516>

Geri C; Ng F. 2005. *Musa lokok* (Musaceae), a new species of banana from Bario, Borneo. *Gardens' Bulletin Singapore* 57:279–283.

Gogoi R. 2014. *Musa aurantiaca* (Musaceae) and Its Intraspecific Taxa in India. *Nordic Journal of Botany* 32(6):701–709.
<https://doi.org/10.1111/j.1756-1051.2013.00480.x>

Gogoi R; Borah S. 2013. *Musa markkui* (Musaceae), a new species from Arunachal Pradesh, India. *Gardens' Bulletin Singapore* 65(1):19–26.

Gogoi R; Borah S. 2014a. *Musa argentii* (Musaceae), a new species from Arunachal Pradesh, India. *Edinburgh Journal of Botany* 71(2):181–188. <https://doi.org/10.1017/S0960428614000079>

Gogoi R; Borah S. 2014b. *Musa mannii* var. *namdangensis* (Musaceae) from Arunachal Pradesh, India. *Taiwania* 59(2):93–97.

Gogoi R, Häkkinen M. 2013a. *Musa kamengensis* (Musaceae), a new species from Arunachal Pradesh, India. *Acta Phytotaxonomica Et Geobotanica* 64(3):149–153.

Gogoi R; Häkkinen M. 2013b. *Musa puspanjaliae* sp. nov. (Musaceae) from Arunachal Pradesh, India. *Nordic Journal of Botany* 31(4):473–477. <https://doi.org/10.1111/j.1756-1051.2013.00182.x>

Gogoi R; Häkkinen M; Borah S; Satyanarayana P. 2014. Taxonomic identity of *Musa Cheesmanii* (Musaceae) in Northeast India. *Nordic Journal of Botany* 32(4):474–478. <https://doi.org/10.1111/j.1756-1051.2013.00429.x>

Hareesh VS; Joe A; Sreejith PE; Sabu M. 2017. *Musa markkuana* Stat. Nov. (Musaceae) — A reassessment of *Musa velutina* subsp. *markkuana*. *Phytotaxa* 303(3):279–284. <https://doi.org/10.11646/phytotaxa.303.3.8>

Hareesh V; Joe A; Alappatt J; Sabu M. 2017. Musaceae of Andaman and Nicobar Islands with two new synonyms and one distributional record. *Rheede* 27(2):71–78. <https://doi.org/10.22244/rheede.2017.27.2.12>

Hermanto C; Sutanto A; HS E; Nasution F; Riska; Nofriarjasri; Malia E; Daniells JW; Hilman Y. 2014a. Triangle Banana Exploration Report, North Sulawesi and North Maluku, Indonesia. 6–24 October 2012. Bioversity International, Montpellier, France. 14 p.

Hermanto C; Sutanto A; HS E; Nasution F; Riska; Nofriarjasri; Malia E; Daniells JW; Hilman Y. 2014b. Triangle Banana Exploration Report, Central Maluku and Lesser Sunda Islands, Indonesia. 16 February–6 March 2013. Bioversity International, Montpellier, France. 18 p.

Hill W. 1874. Report on the Brisbane Botanic Garden. 7 p.

Hooker JD. 1872. *Musa sanguinea* tab 5957. *Curtis's Botanical Magazine* 98. <https://bit.ly/3dvwCkz>

Hotta M. 1967. Notes on the Wild Banana of Borneo. *The Journal of Japanese Botany* 42(11):344–351.

Häkkinen M. 2003. *Musa campestris* Beccari varieties in Northern Borneo. *The Philippine Agricultural Scientist* 86(4):424–435.

Häkkinen M. 2004. *Musa voonii*, a new *Musa* Species from Northern Borneo and discussion of the section *Callimusa* in Borneo. *Acta Phytotaxonomica Et Geobotanica* 55(2):79–88.

- Häkkinen M. 2005. *Musa azizii*, a new *Musa* Species (Musaceae) from Northern Borneo. *Acta Phytotaxonomica Et Geobotanica* 56(1):27–31.
- Häkkinen M. 2006a. *Musa barioensis*, a new *Musa* species (Musaceae) from Northern Borneo. *Acta Phytotaxonomica Et Geobotanica* 57(1):57–62.
- Häkkinen M. 2006b. *Musa lawitiensis* Nasution & Supard. (Musaceae) and its intraspecific taxa in Borneo. *Adansonia* 28(1):55–65.
- Häkkinen M. 2008a. *Musa chunii* Häkkinen, a new species (Musaceae) from Yunnan, China and taxonomic identity of *Musa rubra*. *Journal of Systematics and Evolution* 46(6):87–91. <https://doi.org/10.1111/j.1759-6831.2009.00005.x>
- Häkkinen M. 2008b. Taxonomic identity of *Musa nagensium* (Musaceae) in Southeast Asia. *Novon: A Journal for Botanical Nomenclature* 18(3):336–339. <https://doi.org/10.3417/2006181>
- Häkkinen M. 2013. Reappraisal of sectional taxonomy in *Musa* (Musaceae). *Taxon* 62(4):809–813. <https://doi.org/10.12705/624.3>
- Häkkinen M; Meekiong K. 2004. A new species of the wild banana genus, *Musa* (Musaceae), from Borneo. *Systematics and Biodiversity* 2(2):169–173. <https://doi.org/10.1017/S1477200004001434>
- Häkkinen M; Meekiong K. 2005. *Musa borneensis* Becc. (Musaceae) and its Intraspecific Taxa in Borneo. *Acta Phytotaxonomica Et Geobotanica* 56(3):213–230. <https://doi.org/10.18942/apg.KJ00004623253>
- Häkkinen M; Teo C. 2008. *Musa rubinea*, a new *Musa* species (Musaceae) from Yunnan, China. *Folia Malaysiana* 9(1):23–33.
- Häkkinen M; Väre H. 2008a. Typification and check-list of *Musa* L. names (Musaceae) with nomenclatural notes. *Adansonia* 30(3):63–112.
- Häkkinen M; Väre H. 2008b. A taxonomic revision of *Musa aurantiaca* (Musaceae) in Southeast Asia. *Journal of Systematics and Evolution* 46(1):89–92.
- Häkkinen M; Väre H. 2008c. Taxonomic history and identity of *Musa dasycarpa*, *M. velutina* and *M. assamica* (Musaceae) in Southeast Asia. *Journal of Systematics and Evolution* 46(2):230–235. <https://doi.org/10.3724/SP.J.1002.2008.07115>
- Häkkinen M; Väre H. 2009a. Typification of *Musa mannii*, *M. sanguinea* and *M. x kewensis* (Musaceae). *Kew Bulletin* 64(3):559–564. <https://doi.org/10.1007/s12225-009-9145-z>
- Häkkinen M; Väre H. 2009b. Typification of *Musa salaccensis* and nomenclatural notes on *Musa* (Musaceae). *Adansonia* 31(1):41–46. <https://doi.org/10.5252/a2009n1a3>
- Häkkinen M; Wallace R. 2006. *Musa siamensis*, a new *Musa* species (Musaceae) from S.E. Asia. *Folia Malaysiana* 8(2):61–70.
- Häkkinen M; Wang H. 2007. New species and variety of *Musa* (Musaceae) from Yunnan, China. *Novon* 17:440–446.
- Häkkinen M; Wang H. 2008a. *Musa yunnanensis* (Musaceae) and its intraspecific taxa in China. *Nordic Journal of Botany* 26(5–6):317–324. <https://doi.org/10.1111/j.1756-1051.2008.00305.x>
- Häkkinen M; Wang H. 2008b. *Musa zaifui* sp. nov. (Musaceae) from Yunnan, China. *Nordic Journal of Botany* 26(1–2):42–46. <https://doi.org/10.1111/j.0107-055X.2008.00267.x>
- Häkkinen M; Gogoi R; Borah S. 2013. A Taxonomic study of *Musa flaviflora* and *M. thomsonii* (Musaceae). *Nordic Journal of Botany* 32(5):578–583. <https://doi.org/10.1111/j.1756-1051.2013.00370.x>
- Häkkinen M; Hong W; Ge X. 2008. *Musa itinerans* (Musaceae) and its intraspecific taxa in China. *Novon: A Journal for Botanical Nomenclature* 18(1):50–60. <https://doi.org/10.3417/2006162>
- Häkkinen M; Suchuankova P; Dolezelova M; Hribova E; Dolezel J. 2007. Karyological Observations in *Musa beccarii* var. *hottana* (Musaceae). *Acta Phytotaxonomica Et Geobotanica* 58(2/3):61–67.
- Häkkinen M; Suleiman M; Gisil J. 2005. *Musa beccarii* (Musaceae) Varieties in Sabah, Northern Borneo. *Acta Phytotaxonomica Et Geobotanica* 56(2):135–140.
- Häkkinen M; Meekiong K. 2005. *Musa borneensis* Becc. (Musaceae) and its Intraspecific Taxa in Borneo. *Acta Phytotaxonomica Et Geobotanica* 56(3):213–230. <https://doi.org/10.18942/apg.KJ00004623253>
- Joe A; Sabu M. 2016. Wild ornamental bananas in India: An overview. *South Indian Journal of Biological Sciences* 2(1):213–221.
- Joe A; Sabu M; Sreejith P. 2013. On the rediscovery of *Musa ochracea* K. Sheph. (Musaceae) from North-East India. *Taiwania* 58(4):321–325. <https://doi.org/10.6165/tai.2013.58.321>
- Joe A; Sabu M; Ashfak A; Sreejith P. 2013. *Musa laterita* Cheesman (Musaceae): A new record for India from the wild, with a Key to the *Musa* (Section Rhodochlamys) in India. *Folia Malaysiana* 14(1):37–44.
- Joe A; Sreejith PE; Sabu M. 2014. On the rediscovery and extended distribution of *Musa Cheesmanii* Musaceae from North-East India. *International Journal of Plant, Animal and Environmental Sciences* 4(2):1–4.
- Joe A; Sreejith PE; Sabu M. 2013. Notes on the rediscovery and taxonomic status of *M. flaviflora* N.W. Simmonds and *M. thomsonii* (King Ex Schumann) A.M. Cowan & Cowan (Musaceae) From India. *Annals of Plant Sciences* 2(8):260–267.
- Joe A; Sreejith PE, Sabu M. 2014. *Musa cylindrica*, a new species of *Musa* (Musaceae) from North-East India. *Phytotaxa* 172(2):137–140. <https://doi.org/10.11646/phytotaxa.172.2.11>
- Joe, A., Sreejith, P., & Sabu, M. (2014). Notes on the rediscovery, taxonomic history and conservation of *Musa mannii* H. Wendl. ex Baker (Musaceae). *Journal of Plant Taxonomy and Geography*, 69(1), 117–122. doi:10.1080/00837792.2014.893603
- Joe A; Sreejith PE; Sabu M. 2014. Notes on the rediscovery, taxonomic history and conservation of *Musa mannii* H. Wendl. Ex Baker (Musaceae). *Journal of Plant Taxonomy and Geography* 69(1):117–122.
- Joe A; Sreejith P; Sabu M. 2016. A new variety of *Musa sikkimensis* Kurz and notes on the taxonomic identity and history of *Musa sikkimensis* (Musaceae) from north-East India. *Webbia* 71(1):53–59. <https://doi.org/10.1080/00837792.2015.1113721>
- Joe A; Sreejith P; Sabu M. 2016. Notes on *Musa rubra* Kurz (Musaceae) and reduction of *M. laterita* Cheesman as conspecific. *Taiwania* 61(1):34–40. <https://doi.org/10.6165/tai.2016.61.34>
- Joe A; Sreejith P; Ashfak O; Sabu M. 2014. Regarding the identity, rediscovery and taxonomic history of *Musa nagensium* (Musaceae) from India. *Rheede* 24(1):5–11.
- Kurz S. 1867. Note on the plantains of Indian archipelago. *The Journal Agricultural and Horticultural Society of India* 14:295–301.
- Kurz S. 1877. *Journal of Agricultural and Horticultural Society of India*, 5, nova series part 1(5):164.
- Lauterbach C. 1914. Eine neue Musacee Papuasians. In *Botanische Jahrbücher für Systematik* 50. pp 306–307.
- Li L; Häkkinen M; Yuan Y; Hao G; Ge X. 2010. Molecular phylogeny and systematics of the banana family (Musaceae) inferred from multiple nuclear and chloroplast DNA fragments, with a special reference to the genus *musa*. *Molecular Phylogenetics and Evolution* 57(1):1–10. doi:10.1016/j.ympev.2010.06.021
- Ly N; Le C; Trieu T; Haevermans A; Lowry PJ; Haevermans T. 2012. A distinctive new species of wild banana (*Musa*, Musaceae) from northern Vietnam. *Phytotaxa* 75(1):33–42. <https://doi.org/10.11646/phytotaxa.75.1.3>
- Ly N; Lowry PP; Haevermans T. 2018. Typification and an emended description of *Musa splendida* (Musaceae). *Phytotaxa* 351(4). <https://doi.org/10.11646/phytotaxa.351.4.4>
- Meekiong K; Ipor IB; Tawan CS. 2005. A new banana: *Musa sakaiana* (Musaceae) from Sarawak, Malaysia. *Folia Malaysiana* 6:131–138.
- Meekiong K; Ipor I; Tawan C; Bulan P. 2008. A new species of wild banana from Sarawak. *Folia Malaysiana* 9(2):109–116.
- Mueller FV. 1885. Edible fruits from the Maclay-Coast, New Guinea. In *Proceedings of the Linnean Society of New South Wales*. Sydney. pp 355–356.
- Nasution R. 1990. A Taxonomic Study of the Species *Musa acuminata* Colla with its Intraspecific Taxa in Indonesia. *Memoirs of the Tokyo University of Agriculture* 32:122
- Nasution R; Supardiyono E. 1998. New species: *Musa lawitiensis* Nasution & Supardiyono spec. nova. From Bentuang - Karimun National Park, West Kalimantan. *Bulletin Kebun Raya Indonesia* 8(4):128–130.
- Née DL. 1801. De la abacá, que es la *Musa* textilis. *Anales De Ciencias Naturales* 4:123–130.

Noltie HJ. 1994. Notes relating to the flora of Bhutan: XXVIII. Eriocaulaceae (Eriocaulon), Musaceae (*Musa*), Cyperaceae (Actinoscirpus). *Edinburgh Journal of Botany* 51(2):169–174. <https://doi.org/10.1017/S09604286000086X>

Norfazlina B; Wickneswari R; Choong CY. 2016. Geographical distribution of *Musa gracilis* Holttum in Peninsular Malaysia. AIP Conference Proceedings. <https://doi.org/10.1063/1.4966869>

Perrier X. 2009. Combining biological approaches to shed light on the evolution of Edible Bananas. *Ethnobotany Research and Applications* 7:199–216. <https://doi.org/10.17348/era.7.0.199-216>

Prain D. 1904. An undescribed Indian *Musa*. *Journal of the Asiatic Society of Bengal* 73:21–22.

Prasad K; Joe A; Bheemalingappa M; Rao BR. 2013. *Musa sabuana* (Musaceae): A new species from Andaman and Nicobar Islands, India. *Indian Journal of Forestry* 36(1):151–153.

Ridley HN. 1893. On the flora of the Eastern Coast of the Malay Peninsula. *Transactions of the Linnean Society of London* 3(9):267–408.

Ridley HN. 1924. The Flora of the Malay Peninsula. L. Reeve & CO, London. 918 p.

Roxburgh W. 1814. Hortus Bengalensis or a catalogue of the plants growing in the Honourable East India Company's Botanic Garden at Calcutta. Mission Press, Serampore.

Roxburgh W; Care W. 1824. Flora Indica. pp. 484–494. <https://bit.ly/3BM2wCL>

Sabu M; Joe A; Sreejith PE. 2013. *Musa chunii* Häkkinen (Musaceae): An addition to the wild banana flora of India and notes on conservation of a critically endangered species. *Annals of Plant Sciences* 2(5)160–162.

Sabu M; Joe A; Sreejith PE. 2013. *Musa velutina* subsp. *markkuana* (Musaceae): A new subspecies from Northeastern India. *Phytotaxa* 92(2):49–54. <https://doi.org/10.11646/phytotaxa.92.2.3>

Sankowsky G. (n.d.). Garry and Nada Sankowsky. <http://www.rainforestmagic.com.au/> (Accessed on 18 November 2019).

Shepherd K. 1964. A new species of banana. *Kew Bulletin* 17(3): 461–463. <https://doi.org/10.2307/4113815>

Shepherd K. 1999. Cytogenetics of the genus *Musa*. INIBAP. Montpellier, France. 160 p.

Siebold & Zucc. ex linuma. 1874. *Musa basjoo*. Sinte Somoku Dzusestu [Illustrated Flora of Japan], ed. 2. <https://bit.ly/3K9vgrU>

Simmonds NW. 1953. Classification of the bananas. *Kew Bulletin* 8(4):571–572. <https://doi.org/10.2307/4117384>

Simmonds NW. 1956. Botanical results of the banana collecting expedition. *Kew Bulletin* 11(3):463–489. <https://doi:10.2307/4109131>

Simmonds NW. 1960. Notes on banana taxonomy. *Kew Bulletin* 14(2):198–212. <https://doi.org/10.2307/4114778>

Singh LJ. 2014. *Musa indandamanensis* L. J. Singh: A new species (Musaceae) from the Bay Islands, India. *Taiwania* 59(1):26–36. <https://doi.org/10.6165/tai.2014.59.26>

Sreejith PE; Joe A; Sabu M. 2013. *Musa arunachalensis*: A new species of *Musa* section Rhodochlamys (Musaceae) from Arunachal Pradesh, Northeastern India. *Phytotaxa* 134(1):49. <https://doi.org/10.11646/phytotaxa.134.1>

Stover RH; Simmonds NW. 1987. Bananas. Burnt Mill, Harlow: Longman Scientific & Technical. 468 p. <https://catalogue.nla.gov.au/Record/523128>

Sulistyaningsih LD. 2017. Newly described and newly recorded of infraspecific taxa of *Musa borneensis* BECC. (Musaceae) from Sulawesi, Indonesia. *Reinwardtia* 16(1):19–24. <https://doi.org/10.14203/reinwardtia.v16i1.2744>

Swangpol SC; Traiperm P; Somana J; Sukkaewmanee N; Srisanga P; Suksathan P. 2015. *Musa nanensis*, a new banana (Musaceae) species from northern Thailand. *Systematic Botany* 40(2):426–432. <https://doi.org/10.1600/036364415x688790>

Tanaka N; Naiki A; Murata J. 2018. Contributions to the flora of Myanmar I: nine taxa of monocots newly recorded from Myanmar. *Bulletin of the National Museum of Nature and Science* 44(1):31–39.

Valmayor R. 2001. Classification and characterization of *Musa exotica*, *Musa alinsanaya* and *Musa acuminata* ssp. *errans*. *The Philippine Agricultural Scientist* 84(3):325–331.

Valmayor R; Danh L; Häkkinen M. 2004. Rediscovery of *Musa splendida* A. Chevalier and description of two new species (*Musa viridis* and *Musa lutea*). *The Philippine Agricultural Scientist* 87(1):110–118.

Veldkamp JF; Sulistyaningsih LD. 2016. Nomenclature and typification of *Musa salaccensis* Zoll. ex Kurz (musaceae). *Reinwardtia* 14(2):299–302. <https://doi.org/10.14203/reinwardtia.v14i2.1674>

Väre H; Häkkinen M. 2009. (1903) proposal to conserve the name *Musa velutina* against *M. dasycarpa* (Musaceae). *Taxon* 58(3):1008–1009.

Wendland H; Drude G. 1875. *Musa valutina*. *Gartenflora* 24:65–67.

Yeh C; Chen J; Yeh C; Lee S; Hong C; Chiu T; Su Y. 2008. *Musa yamiensis* C. L. Yeh & J. H. Chen (Musaceae), a new species from Lanyu, Taiwan. *Gardens Bulletin Singapore* 60(1):165–172.

Zollinger H. 1854. Systematisches Verzeichniss der im indischen archipel in den Jahren 1842-1848 gesammelten so wie der aus japan Empfangenen Pflanzen. Zürich, E. Kiesling. <https://doi.org/10.5962/bhl.title.53656>

Acknowledgements

This work could not have been completed without the immense help of many friends and colleagues, first and foremost, Markku Häkkinen, who was always more than willing to share information, photos, and stories anytime I would ask him over the 10 plus years of our correspondence. An additional special acknowledgement goes to Henry Väre for sending me what he could round up of Markku's old computer files I may not have had, which ended up being a treasure of information.

The most precious aspect this work has to offer is the photos presented, many are Markku's or my own, but the rest all came from the generosity of the following contributors:

Agus Sutanto

Anthony Basil Rodriguez

Chien Lee

Chiu Hui-Lung

Garry Sankowski

Jeff Daniells

Kalu Meekiong

Lal Ji Singh

Lia Hapsari

Ong Jyh Seng

Rajib Gogoi

Remko Beuving

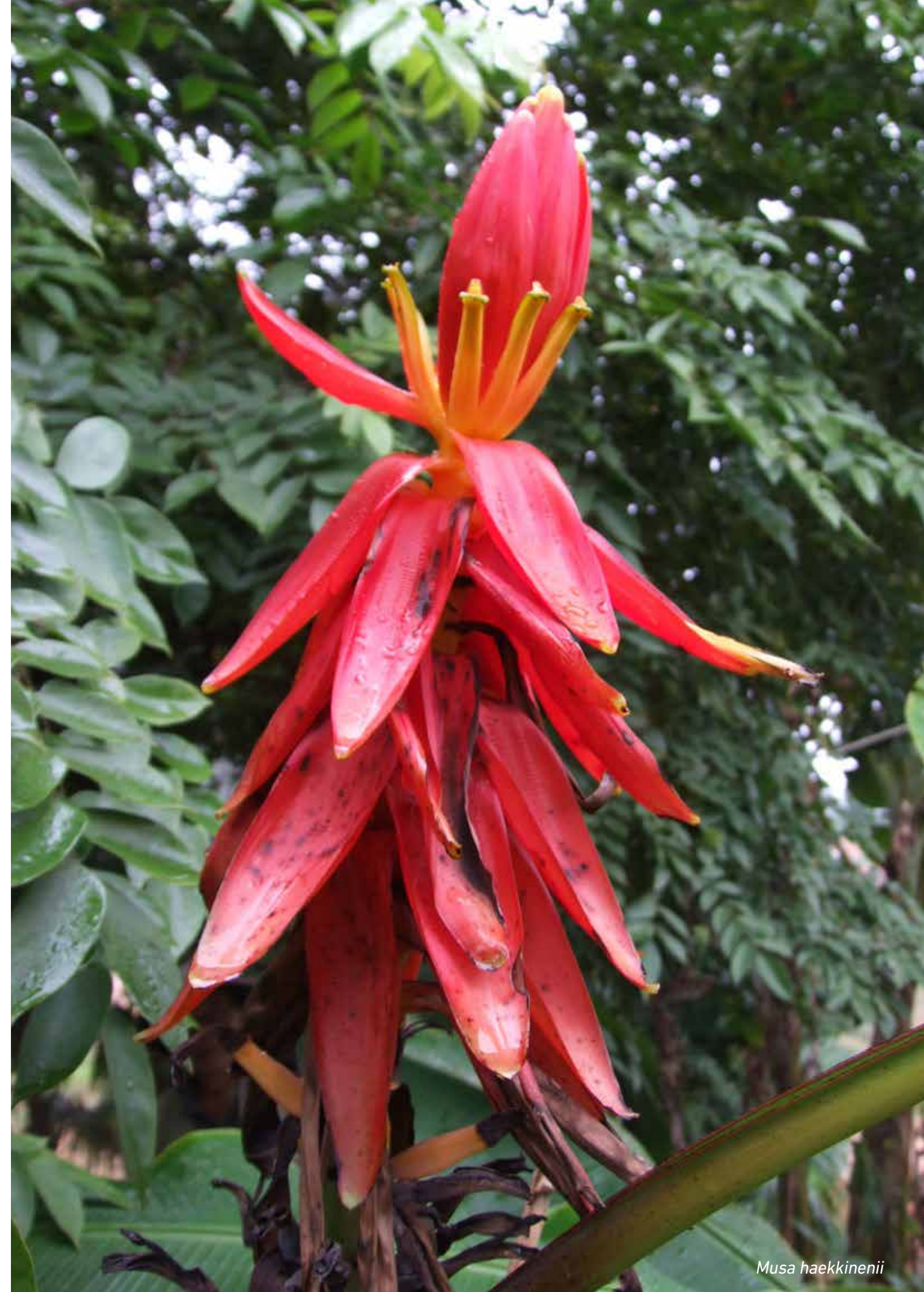
Sasivimon Swangpol

Steven Janssens

Xue-Jun Ge

Lastly, thank you to Rachel Chase, Julie Sardos, Max Ruas and Nicolas Roux of the Alliance of Bioversity International and CIAT for proof reading the catalogue.

All photos belong to the owners as detailed on each photo and may not be reproduced or used for commercial purposes without the permission of the owner.





ISBN: 978-92-9255-260-2



The Alliance of Bioversity International and the International Center for Tropical Agriculture (CIAT) is part of CGIAR, a global research partnership for a food-secure future. Bioversity International is the operating name of the International Plant Genetic Resources Institute (IPGRI).

Alliance Headquarters
Via di San Domenico, 1
00153 Rome, Italy
Telephone: (+39) 066 1181
Fax: (+39) 0661979661

<https://alliancebioversityciat.org>
www.cgiar.org