

## Reappraisal of sectional taxonomy in *Musa* (Musaceae)

Markku Häkkinen

Finnish Museum of Natural History, Botanic Garden, University of Helsinki, P.O. Box 44, 00014 Helsinki, Finland;  
markku.hakkinen@pp2.inet.fi

**Abstract** The present work is part of a continuing study on *Musa* taxa by the author. Several molecular analyses support acceptance of only two *Musa* sections, *M. sect. Musa* and *M. sect. Callimusa*. *Musa sect. Rhodochlamys* is synonymized with *M. sect. Musa* and *M. sect. Australimusa* and *M. sect. Ingentimusa* are treated as synonyms of *M. sect. Callimusa*. Species lists are provided for the two accepted sections.

**Keywords** *Musa*; *Musa sect. Australimusa*; *Musa sect. Callimusa*; *Musa sect. Rhodochlamys*; reappraisal; Southeast Asia

Received: 12 Mar. 2013; revision received: 2 June 2013; accepted: 13 June 2013. DOI: <http://dx.doi.org/10.12705/624.3>

### ■ INTRODUCTION

Linnaeus, in *Species Plantarum* (1753), was the first to assign scientific nomenclature to bananas by describing *Musa paradisiaca* (based on *Musa cliffortiana*—Linnaeus, 1736, 2007) while at the same time establishing the modern botanical nomenclature, which is still in wide use today. Numerous additional species of (wild) bananas have been described since, which botanists have categorized into sections or subgenera based on morphology. The edible bananas are also referred to by their genome groupings. The crop encompasses a range of diploids, triploids and tetraploids. These are categorized into genome groups on the basis of their ploidy levels and the genomes which they contain. Simmonds & Shepherd (1955) suggested that edible bananas originated from two wild and seedy species, *Musa acuminata* ( $2n = 2x = 22$ ) and *Musa balbisiana* ( $2n = 2x = 22$ ), which are native to Southeast Asia, resulting in a series of seedless diploid, triploid and tetraploid bananas. The resulting genome groups were classified as AA, AB, AAA, AAB, ABB, AABB, AAAB, ABBB with the letters A and B representing the contributions of *M. acuminata* and *M. balbisiana* respectively.

The earliest classification of the genus *Musa* L. was that of Sagot (1887), who divided this genus into three unnamed groups (called “sections”): (1) bananas with fleshy fruit, often edible viz. *M. paradisiaca*, *M. sapientum* and *M. troglodytarum*; (2) ornamental bananas with upright inflorescences and brightly coloured bracts viz. *M. ornata*, *M. sanguinea* and *M. coccinea*; and (3) giant bananas like *M. ensete* J.F. Gmel. Baker (1893) adopted Sagot’s division almost unaltered by defining three subgenera: (1) *M. subg. Physocaulis* Baker: stem bottle-shaped, many flowers in a bract, fruits inedible (the type is *M. ensete*, currently accepted in the genus *Ensete* Horan. as *E. edule* Horan.; Horaninov 1862: 40–41); (2) subg. *Rhodochlamys* Baker: stem cylindrical, flowers few to a bract, bracts brightly coloured, fruits usually not edible; (3) subg. “*Eumusa*” Baker: stem cylindrical, flowers many to a bract, bracts green, brown or dull violet, fruits usually edible. Cheesman (1947) developed a clear and coherent classification system for the genus *Musa* His original grouping of

the species in the genus *Musa* into four sections proved to be very useful and has, therefore, been widely accepted, viz. *M. sect. “Eumusa”* Cheesman (*M. sect. Musa*), *M. sect. Rhodochlamys* (Baker) Cheesman, *M. sect. Australimusa* Cheesman and *M. sect. Callimusa* Cheesman.

Cheesman (1947) indicated that “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*  $2n = 2x = 22$  (Cheesman & Larter, 1935; Cheesman & Dodds, 1942; Cheesman, 1947; MacDaniels, 1947; Shepherd, 1959, 1990, 1999; Simmonds, 1962; Champion, 1967; Hotta, 1967; Simmonds & Weatherup, 1990; Isobe & Hashimoto, 1994; Sharrock, 2000; Häkkinen, 2001, 2003a, b, 2004a, b, 2005a, b, 2006a, b, c, 2007, 2009a, b, c, 2011; Jong & Argent, 2001; Wu & Kress, 2001; Häkkinen & Sharrock, 2002; Häkkinen & Meekiong, 2004, 2005; Häkkinen & al., 2005, 2007a, b, 2008, 2009, 2010, 2012; Häkkinen & Wallace, 2007; Häkkinen & Wang, 2007, 2008a, b; Häkkinen & Teo, 2008; Häkkinen & Väre, 2008a, b, c, 2009a, b, 2011; Li & al., 2010; Liu & al., 2010; Nayar, 2010).

### ■ REVISION OF MUSA SECTIONS

Many molecular phylogenetic studies on the genus *Musa* (Gawel & Jarret, 1991; Gawel & al., 1992; Ude & al., 2002; Wong & al., 2002, 2003; Jarret & al., 1992; Jarret & Gawel, 1995; Shepherd, 1999; Nwakanma & al., 2003; Bartos & al., 2005; Heslop-Harrison & Schwarzacher 2007; OECD, 2009;

Li & al., 2010; Liu & al., 2010; Nayar, 2010; Christelova & al., 2011; Hřibová & al., 2011; Xavier & al., 2011) demonstrated that none of the five sections of *Musa* previously defined based on morphology was recovered as monophyletic. Only two infrageneric clades could be identified, which corresponded well to the basic chromosome numbers of  $n = x = 11$  and  $n = x = 10/9/7$ , respectively: one clade comprises species from *Musa* sect. *Musa* and sect. *Rhodochlamys* while the other contains species from *Musa* sect. *Callimusa*, sect. *Australimusa* and sect. *Ingentimusa* (i.e., Li & al., 2010: fig. 2; Christelová & al., 2011: fig. 2). Here I have restructured *Musa* species into two sections, sect. *Musa* and sect. *Callimusa*, based on the DNA analyses cited above.

***Musa* L., Sp. Pl.: 1043. 1753** – Type (designated by Green in Sprague, Nom. Prop. Brit. Bot.: 193. 1929): *M. paradisiaca* L., Sp. Pl.: 1043. 1753 – Lectotype (designated by Argent in Regnum Veg. 127: 68. 1993): [icon] “*Musa cliffortiana*” in Linnaeus, *Musa* Cliff.: unnum. pl. 1736

***Musa* L. sect. *Musa***

= *Musa* sect. *Rhodochlamys* (Baker) Cheesman in Kew Bull. 2: 110. 1948 [“1947”] ≡ *Musa* subg. *Rhodochlamys* Baker in Ann. Bot. (Oxford) 7: 205. 1893 – Type (designated by Häkkinen in Nordic J. Bot. 27: 207. 2009): *Musa ornata* Roxb.

– “*Musa* subg. *Eumusa*” Baker in Ann. Bot. (Oxford) 7: 205. 1893 (not validly published, Art. 22.2)

– “*Musa* sect. *Eumusa*” Cheesman in Kew Bull. 2: 108. 1948 [“1947”] (not validly published, Art. 22.2)

The following 33 species are assigned to this section; species marked with an asterisk (\*) were previously placed in *Musa* sect. *Rhodochlamys*.

1. *Musa acuminata* Colla in Mem. Reale Accad. Sci. Torino 25: 394. 1820
2. \**Musa aurantiaca* G. Mann ex Baker in Ann. Bot. (Oxford) 7: 222. 1893
3. *Musa balbisiana* Colla in Mem. Reale Accad. Sci. Torino 25: 384. 1820
4. *Musa basjoo* Iinuma, Somoku-Dzusetsu, ed. 2: 3, t. 1. 1874
5. *Musa celebica* Warb. ex K. Schum. in Engler, Pflanzenr. IV, 45: 22. 1900
6. *Musa cheesmanii* N.W. Simmonds in Kew Bull. 11: 479. 1957 [“1956”]
7. \**Musa chunii* Häkkinen in J. Syst. Evol. 47: 87. 2009
8. *Musa flaviflora* N.W. Simmonds in Kew Bull. 11: 471. 1957 [“1956”]
9. *Musa griersonii* Noltie in Edinburgh J. Bot. 51: 171. 1994
10. *Musa insularimontana* Hayata, Icon. Pl. Formos. 3: 194. 1913
11. *Musa itinerans* Cheesman in Kew Bull. 4: 23. 1949
12. \**Musa kattuvazhana* K.C. Jacob, Monogr. Madras Bananas: 129. 1952
13. *Musa lanceolata* Warb. ex K. Schum. in Engler, Pflanzenr. IV, 45: 19. 1900
14. \**Musa laterita* Cheesman in Kew Bull. 4: 265. 1949

15. \**Musa mannii* H. Wendl. ex Baker in Hooker, Fl. Brit. India 6: 263. 1892
16. *Musa nagensium* Prain in J. Asiat. Soc. Bengal, Pt. 2, Nat. Hist. 73: 21. 1904
17. *Musa ochracea* K. Sheph. in Kew Bull. 17: 461. 1964
18. \**Musa ornata* Roxb., Fl. Ind. 2: 488. 1824
19. \**Musa rosea* Baker in Ann. Bot. (Oxford) 7: 221. 1893
20. \**Musa rubinea* Häkkinen & C.H. Teo in Fol. Malaysiana 9: 24. 2008
21. \**Musa rubra* Wall. ex Kurz in J. Agric. Soc. India 14: 301. 1867
22. \**Musa sanguinea* Hook. f. in Bot. Mag. 98: t. 5975. 1872
23. *Musa schizocarpa* N.W. Simmonds in Kew Bull. 11: 474. 1957 [“1956”]
24. *Musa shankarii* Subba Rao & Kumari, Fl. Visakhapatnam Distr. 2: 266. 2008
25. \**Musa siamensis* Häkkinen & Rich. H. Wallace in Fol. Malaysiana 8: 62. 2007
26. *Musa sikkimensis* Kurz in J. Agric. Soc. India, n.s., 5: 164. 1878
27. *Musa thomsonii* (King ex Baker) A.M. Cowan & Cowan in J.M. Cowan & A.M. Cowan, Trees N. Bengal: 135. 1929
28. *Musa tomentosa* Warb. ex K. Schum. in Engler, Pflanzenr. IV, 45: 22. 1900
29. *Musa tonkinensis* R.V. Valmayor, L.D. Danh & Häkkinen in Philipp. Agric. Sci. 88: 240. 2005
30. \**Musa velutina* H. Wendl. & Drude in Gartenflora 24: 65. 1875
31. *Musa yamiensis* C.L. Yeh & J.H. Chen in Gard. Bull. Singapore 60: 167. 2008
32. *Musa yunnanensis* Häkkinen & H. Wang in Novon 17: 441. 2007
33. \**Musa zaifui* Häkkinen & H. Wang in Nordic J. Bot. 26: 43. 2008

***Musa* sect. *Callimusa*** Cheesman in Kew Bull. 2: 112. 1948 [“1947”] – Type (designated by Häkkinen in Nordic J. Bot. 27: 207. 2009): *M. coccinea* Andrews

= *Musa* sect. *Australimusa* Cheesman in Kew Bull. 2: 108. 1948 [“1947”] – Type (designated by Christenhusz in Phytotaxa 2: 53. 2009): *M. textilis* Née

= *Musa* sect. *Ingentimusa* Argent in Notes Roy. Bot. Gard. Edinburgh 35: 111. 1976 – Type: *M. ingens* N.W. Simmonds

The following 37 species are assigned to this section; species marked with an asterisk (\*) or a plus (+) were previously placed in *M.* sect. *Australimusa* or in *M.* sect. *Ingentimusa*, respectively.

1. \**Musa arfakiana* Argent in Gard. Bull. Singapore 61: 243. 2010
2. *Musa azizii* Häkkinen in Acta Phytotax. Geobot. 56: 29. 2005
3. *Musa barioensis* Häkkinen in Acta Phytotax. Geobot. 57: 57. 2006
4. *Musa bauensis* Häkkinen & Meekiong in Syst. Biodivers. 2: 170. 2005 [“2004”]

5. *Musa beccarii* N.W. Simmonds in Kew Bull. 14: 200. 1960
6. \**Musa boman* Argent in Notes Roy. Bot. Gard. Edinburgh 35: 108. 1976
7. *Musa borneensis* Becc., For. Borneo: 622. 1902
8. \**Musa bukensis* Argent in Notes Roy. Bot. Gard. Edinburgh 35: 101. 1976
9. *Musa campestris* Becc., For. Borneo: 622. 1902
10. *Musa coccinea* Andrews, Bot. Repos. 1: t. 47. 1799
11. *Musa exotica* R.V. Valmayor in Philipp. Agric. Sci. 87: 117. 2004
12. \**Musa fitzalanii* F. Muell., Fragm. 9: 188. 1875
13. *Musa gracilis* Holtum in Kew Bull. 5: 154. 1950
14. *Musa haekkinenii* N.S. Lý & Haev. in Phytotaxa 75: 35. 2012
15. *Musa hirta* Becc., For. Borneo: 624. 1902
16. +*Musa ingens* N.W. Simmonds in Kew Bull. 14: 198. 1960
17. \**Musa jakeyi* W. Hill, Rep. Brisbane Bot. Gard.: 7. 1874
18. \**Musa johnsii* Argent in Gard. Bull. Singapore 53: 1. 2001
19. \**Musa juwiniana* Meekiong, Ipor & Tawan in Fol. Malaysiana 9: 110. 2008
20. *Musa lawitiensis* Nasution & Supard. in Bul. Kebun Raya 8: 128. 1998
21. *Musa lokok* Geri & Ng in Gard. Bull. Singapore 57: 279. 2005
22. \**Musa lolodensis* Cheesman in Kew Bull. 5: 27. 1950
23. *Musa lutea* R.V. Valmayor, L.D. Danh & Häkkinen in Philipp. Agric. Sci. 87: 116. 2004
24. \**Musa maclayi* F. Muell. ex Mikl.-Maclay in Proc. Linn. Soc. New South Wales 10: 355. 1885
25. *Musa monticola* M. Hotta ex Argent in Gard. Bull. Singapore 52: 206. 2000
26. *Musa muluensis* M. Hotta in J. Jap. Bot. 42: 345. 1967
27. *Musa paracoccinea* A.Z. Liu & D.Z. Li in Bot. Bull. Acad. Sin. 43: 77. 2002
28. \**Musa peekelii* Lauterb. in Bot. Jahrb. Syst. 50: 306. 1913
29. *Musa sakaiana* Meekiong, Ipor & Tawan in Fol. Malaysiana 6: 132. 2005
30. *Musa salaccensis* Zoll. ex Backer, Handb. Fl. Java 3: 133. 1924
31. *Musa splendida* A. Chev. in Rev. Bot. Appl. Agric. Trop. 14: 517. 1934
32. \**Musa textilis* Née in Anales Ci. Nat. 4: 123. 1801
33. \**Musa troglodytarum* L., Sp. Pl. ed. 2: 1478. 1763
34. *Musa tuberculata* M. Hotta in J. Jap. Bot. 42: 347. 1967
35. *Musa violascens* Ridl. in Trans. Linn. Soc. London, Bot. 3: 384. 1893
36. *Musa viridis* R.V. Valmayor, L.D. Danh & Häkkinen in Philipp. Agric. Sci. 87: 115. 2004
37. *Musa voonii* Häkkinen in Acta Phytotax. Geobot. 55: 80. 2004

## ■ CONCLUSION

Beyond this revised sectional classification, the infrageneric taxonomy of *Musa* could be further clarified from additional phylogenetic studies that have a broader sampling of species. Much of the diversity in the two sections is found in

areas of continental Asia that have been, and continue to be, difficult, and sometimes even dangerous, to travel and work in. There are still new *Musa* species observed by the author in those areas awaiting description or clarification.

## ■ ACKNOWLEDGEMENT

The author greatly appreciates the help and support from Dr. John H. Wiersema, the curator of taxonomic data for the USDA's GRIN database, for valuable suggestions and revisions of this paper.

## ■ LITERATURE CITED

- Argent, G.C.G. 1976. The wild bananas of Papua New Guinea. *Notes Roy. Bot. Gard. Edinburgh* 35: 77–114.
- Baker, J.G. 1893. A synopsis of the genera and species of *Museae*. *Ann. Bot. (Oxford)* 7: 189–229.  
<http://dx.doi.org/10.1093/aob/os-7.2.189>
- Bartos, J., Alkhimova, O., Dolezelova, M., De Langhe, E. & Dolezel, J. 2005. Nuclear genome size and genomic distribution of ribosomal DNA in *Musa* and *Ensete* (*Musaceae*): Taxonomic implications. *Cytogenet. Genome Res.* 109: 50–57.  
<http://dx.doi.org/10.1159/000082381>
- Champion, J. 1967. *Notes et documents sur les bananiers et leur culture*, tome 1, *Botanique et génétique des bananiers*. Paris: Institut Française de Recherches Fruitières Outre-Mer (I.F.A.C.).
- Cheesman, E.E. 1947 [pub. 1948]. Classification of the bananas. II. The genus *Musa* L. *Kew Bull.* 2: 106–117.  
<http://dx.doi.org/10.2307/4109207>
- Cheesman, E.E. & Dodds, K.S. 1942. Genetical and cytological studies of *Musa*. *J. Genet.* 43: 337–357.  
<http://dx.doi.org/10.1007/BF02982907>
- Cheesman, E.E. & Larter, L.N.H. 1935. Genetical and cytological studies of *Musa* III. Chromosome numbers in the *Musaceae*. *J. Genet.* 30: 31–52.
- Christelová, P., Valárik, M., Hřibová, E., De Langhe, E. & Doležel, J. 2011. A multi gene sequence-based phylogeny of the *Musaceae* (banana) family. *B. M. C. Evol. Biol.* 11: 103.  
<http://dx.doi.org/10.1186/1471-2148-11-103>
- Gawel, N.J. & Jarret, R.L. 1991. Chloroplast DNA restriction fragment length polymorphisms (RFLPs) in *Musa* species. *Theor. Appl. Genet.* 81: 783–786. <http://dx.doi.org/10.1007/BF00224990>
- Gawel, N.J., Jarret, R.L. & Whittemore, A.P. 1992. Restriction fragment length polymorphism (RFLP)-based phylogenetic analysis of *Musa*. *Theor. Appl. Genet.* 84: 286–290.
- Häkkinen, M. 2001. *Musa laterita*: An ornamental banana. *Fruit Gard.* 33(4): 6–7.
- Häkkinen, M. 2003a. Taxonomic history and identity of *Musa rubra* Wall. ex Kurz. *Philipp. Agric. Sci.* 86: 92–98.
- Häkkinen, M. 2003b. *Musa campestris* Beccari varieties in northern Borneo. *Philipp. Agric. Sci.* 86: 424–435.
- Häkkinen, M. 2004a. *Musa voonii*, a new *Musa* species from northern Borneo and discussion of the section *Callimusa* in Borneo. *Acta Phytotax. Geobot.* 55: 79–88.
- Häkkinen, M. 2004b. *Musa campestris* Becc. (*Musaceae*) varieties in northern Borneo. *Fol. Malaysiana* 5(2): 81–100.
- Häkkinen, M. 2005a. *Musa azizii*, a new *Musa* species (*Musaceae*) from northern Borneo. *Acta Phytotax. Geobot.* 56: 27–31.
- Häkkinen, M. 2005b. Ornamental bananas: Notes on the section *Rhodochlamys* (*Musaceae*). *Fol. Malaysiana* 6(1–2): 49–72.
- Häkkinen, M. 2006a. *Musa barioensis*, a new *Musa* species (*Musaceae*) from northern Borneo. *Acta Phytotax. Geobot.* 57: 55–60.

- Häkkinen, M. 2006b. *Musa lawitiensis* Nasution & Supard. (*Musaceae*) and its intraspecific taxa in Borneo. *Adansonia* 28(1): 55–65.
- Häkkinen, M. 2006c. A taxonomic revision of *Musa rosea* (*Musaceae*) in Southeast Asia. *Novon* 16: 492–496. [http://dx.doi.org/10.3417/1055-3177\(2006\)16\[492:TIOMRM\]2.0.CO;2](http://dx.doi.org/10.3417/1055-3177(2006)16[492:TIOMRM]2.0.CO;2)
- Häkkinen, M. 2007. Ornamental bananas: Focus on *Rhodochlamys*. *Chron. Hort.* 47(2): 7–12.
- Häkkinen, M. 2009a. Lectotypification of two *Musa* sections (*Musaceae*). *Nordic J. Bot.* 27: 207–209. <http://dx.doi.org/10.1111/j.1756-1051.2009.00441.x>
- Häkkinen, M. 2009b. *Musa chunii*, a new *Musa* species (*Musaceae*) from Yunnan, China and taxonomic identity of *Musa rubra*. *J. Syst. Evol.* 47: 87–91. <http://dx.doi.org/10.1111/j.1759-6831.2009.00005.x>
- Häkkinen, M. 2009c. Second of three expeditions. Returning to China. Studies in Guangdong, Hunan, Yunnan and Hainan. *Fruit Gard.* 41(2): 14–19.
- Häkkinen, M. 2011. Wild *Musaceae* species in China. *Acta Hort.* 897: 81–86.
- Häkkinen, M. & Meekiong, K. 2004 (pub. 2005). A new species of the wild banana genus, *Musa* (*Musaceae*), from Borneo. *Syst. Biodivers.* 2: 169–173. <http://dx.doi.org/10.1017/S1477200004001434>
- Häkkinen, M. & Meekiong, K. 2005. *Musa borneensis* Becc. (*Musaceae*) and its intraspecific taxa in Borneo. *Acta Phytotax. Geobot.* 56: 213–230.
- Häkkinen, M. & Sharrock, S. 2002. Diversity in the genus *Musa*—Focus on *Rhodochlamys*. *Rep. Int. Network Improv. Banana Plantain* 2001: 16–23.
- Häkkinen, M. & Teo, C. 2008. *Musa rubinea*, a new *Musa* species (*Musaceae*) from Yunnan, China. *Fol. Malaysiana* 9(1): 23–33.
- Häkkinen, M. & Väre, H. 2008a. A taxonomic revision of *Musa aurantiaca* (*Musaceae*) in Southeast Asia. *J. Syst. Evol.* 46: 89–92.
- Häkkinen, M. & Väre, H. 2008b. Taxonomic history and identity of *Musa dasycarpa*, *M. velutina* and *M. assamica* (*Musaceae*). *J. Syst. Evol.* 46: 230–235.
- Häkkinen, M. & Väre, H. 2008c. Typification and check-list of *Musa* names (*Musaceae*) with nomenclatural notes. *Adansonia* 30: 63–112.
- Häkkinen, M. & Väre, H. 2009a. Typification of *Musa salaccensis* and nomenclatural notes on *Musa* (*Musaceae*). *Adansonia* 31: 41–46. <http://dx.doi.org/10.5252/a2009n1a3>
- Häkkinen, M. & Väre, H. 2009b. Typification of *Musa mannii* and *M. sanguinea* with notes on *M. kewensis* (*Musaceae*). *Kew Bull.* 64: 559–564. <http://dx.doi.org/10.1007/s12225-009-9145-z>
- Häkkinen, M. & Wallace, R. 2007. *Musa siamensis*, a new *Musa* species (*Musaceae*) from SE Asia. *Fol. Malaysiana* 8(2): 61–70.
- Häkkinen, M. & Wang, H. 2007. New species and variety of *Musa* (*Musaceae*) from Yunnan, China. *Novon* 17: 440–446. [http://dx.doi.org/10.3417/1055-3177\(2007\)17\[440:NSAVOM\]2.0.CO;2](http://dx.doi.org/10.3417/1055-3177(2007)17[440:NSAVOM]2.0.CO;2)
- Häkkinen, M. & Wang, H. 2008a. *Musa zaifuii*, a new species (*Musaceae*) from Yunnan, China. *Nordic J. Bot.* 26: 42–46. <http://dx.doi.org/10.1111/j.0107-055X.2008.00267.x>
- Häkkinen, M. & Wang, H. 2008b. *Musa yunnanensis* (*Musaceae*) and its intraspecific taxa in China. *Nordic J. Bot.* 26: 317–324. <http://dx.doi.org/10.1111/j.1756-1051.2008.00305.x>
- Häkkinen, M., Suleiman, M. & Gisil, J. 2005. *Musa beccarii* Simmonds (*Musaceae*) varieties in Sabah, northern Borneo. *Acta Phytotax. Geobot.* 56: 137–142.
- Häkkinen, M., Hu, G., Chen, H. & Wang, Q. 2007a. The detection and analysis of genetic variation and paternity in *Musa* section *Rhodochlamys* (*Musaceae*). *Fol. Malaysiana* 8(2): 71–86.
- Häkkinen, M., Suchánková, P., Doleželová, M., Hřibová, E., Doležel, J. 2007b. Karyological observations in the new variety of *Musa beccarii* (*Musaceae*). *Acta Phytotax. Geobot.* 58: 61–67.
- Häkkinen, M., Hong, W. & Ge, X.-J. 2008. *Musa itinerans* (*Musaceae*) and its intraspecific taxa in China. *Novon* 18: 50–60. <http://dx.doi.org/10.3417/2006162>
- Häkkinen, M., Teo, C., Schwarzacher, T. & Othman, R. 2009 (pub. 2010). Classification of the *Callimusa* subgroups (*Musaceae*) using IRAP markers. *Fol. Malaysiana* 10(2): 139–152.
- Häkkinen, M., Yeh, C.-L. & Ge, X.-J. 2010. A new combination and a new variety of *Musa itinerans* (*Musaceae*). *Acta Phytotax. Geobot.* 61: 41–48.
- Häkkinen, M., Väre, H. & Christenhusz, M.J.M. 2012. Identity of a pisang—historical concepts of *Musa* (*Musaceae*) and the reinstatement of *Musa troglodytarum*. *Fol. Malaysiana* 13(2): 1–14.
- Heslop-Harrison, J.S. & Schwarzacher, T. 2007. Domestication, genomics and the future for banana. *Ann. Bot. (Oxford)* 100: 1073–1084. <http://dx.doi.org/10.1093/aob/mcm191>
- Horaninov, P.F. 1862. *Prodromus monographiae scitaminearum*. St. Petersburg: Typis Academiae Caesareae Scientiarum.
- Hotta, M. 1967. Notes on the wild bananas of Borneo. *J. Jap. Bot.* 42: 344–352.
- Hřibová, E., Čížková, N., Christelová, P., Taudien, T., de Langhe, E. & Doležel, J. 2011. The ITS1-5.8S-ITS2 sequence region in the *Musaceae*: Structure, diversity and use in molecular phylogeny. *PLoS ONE* 6(3): e17863. <http://dx.doi.org/10.1371/journal.pone.0017863>
- Isobe, M. & Hashimoto, K. 1994. The chromosome count of nine taxa in *Musa* and its allied genus *Musella*. *Bull. Hiroshima Bot. Gard.* 15: 7–11.
- Jarret, R.L. & Gawel, N.J. 1995. Molecular markers, genetic diversity and systematics in *Musa*. Pp: 68–83 in: Gowen, S. (ed.). *Bananas and plantains*. London: Chapman & Hall. [http://dx.doi.org/10.1007/978-94-011-0737-2\\_3](http://dx.doi.org/10.1007/978-94-011-0737-2_3)
- Jarret, R.L., Gawel, N., Whittemore, A. & Sharrock, S. 1992. RFLP based phylogeny of *Musa* species in Papua New Guinea. *Theor. Appl. Genet.* 84: 579–584.
- Jong, K. & Argent, G.C.G. 2001. Cytology of two new species of *Musa* (*Musaceae*) and their sectional relationship. *Gard. Bull. Singapore* 53: 185–189.
- Li, L., Häkkinen, M., Yuan, Y.-M., Hao, G. & Ge, X.-J. 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*. *Molec. Phylog. Evol.* 57: 1–10. <http://dx.doi.org/10.1016/j.ympev.2010.06.021>
- Linnaeus, C. 1736. *Musa cliffortiana*. Leiden.
- Linnaeus, C. 1753. *Species plantarum*, ed. 2. Stockholm: Impensis Laurentii Salvii.
- Linnaeus, C. 2007. *Musa cliffortiana*: Clifford's banana plant. Translated into English by Stephen Freer; with an introduction by Staffan Müller-Wille. *Regnum Vegetabile* 148. Ruggell: Gantner.
- Liu, A.-Z., Kress, W.J. & Li, D.-Z. 2010. Phylogenetic analyses of the banana family (*Musaceae*) based on nuclear ribosomal (ITS) and chloroplast (*trnL-F*) evidence. *Taxon* 59: 20–28.
- MacDaniels, L.H. 1947. A study of the Fe'i banana and its distribution with reference to Polynesian migrations. *Bull. Bernice P. Bishop Mus.* 190: 1–56.
- Nayar, N.M. 2010. The bananas: Botany, origin, dispersal. *Hort. Rev.* 36: 117–164.
- Nwakanma, D.C., Pillay, M., Okoli, B.E. & Tenkouano, A. 2003. Sectional relationships in the genus *Musa* L. inferred from the PCR-RFLP of organelle DNA sequences. *Theor. Appl. Genet.* 107: 850–856. <http://dx.doi.org/10.1007/s00122-003-1340-y>
- OECD 2009. *Consensus document on the biology of bananas and plantains (Musa spp.)*. Series on Harmonisation of Regulatory Oversight in Biotechnology, No. 48. Paris: OECD.
- Sagot, P. 1887. Sur le genre bananier. *Bull. Soc. Bot. France* 34: 328–330.
- Sharrock, S. 2001. Diversity in the genus *Musa*—Focus on *Australimusa*. *Rep. Int. Network Improv. Banana Plantain* 2000: 14–19.

- Shepherd, K.** 1959. Two new basic chromosome numbers in *Musaceae*. *Nature* 183: 1539. <http://dx.doi.org/10.1038/1831539a0>
- Shepherd, K.** 1990. Observations on *Musa* taxonomy. Pp. 158–165 in: Jarret, R.L. (ed.), *Identification of genetic diversity in the genus Musa*. Proceedings of an international workshop held at Los Baños, Philippines, 5–10 September 1988. Montpellier: International Network for the Improvement of Banana and Plantain.
- Shepherd, K.** 1999. *Cytogenetics of the genus Musa*. Montpellier: International Network for the Improvement of Banana and Plantain.
- Simmonds, N.W.** 1962. *The evolution of the bananas*. London. Longmans.
- Simmonds, N.W. & Shepherd, K.** 1955. The taxonomy and origins of the cultivated bananas. *J. Linn. Soc., Bot.* 55: 302–312.
- Simmonds, N.W. & Weatherup, S.T.C.** 1990. Numerical taxonomy of the wild bananas. *New Phytol.* 115: 567–571. <http://dx.doi.org/10.1111/j.1469-8137.1990.tb00485.x>
- Ude, G., Pillay, M., Nwakanma, D. & Tenkouano, A.** 2002. Analysis of genetic diversity and sectional relationships in *Musa* using AFLP markers. *Theor. Appl. Genet.* 104: 1239–1245. <http://dx.doi.org/10.1007/s00122-001-0802-3>
- Wong, C., Kiew, R., Argent, G.C.G., Set, O., Lee, S.K. & Gan, Y.Y.** 2002. Assessment of the validity of the sections in *Musa* (*Musaceae*) using AFLP. *Ann. Bot. (Oxford)* 90: 231–238. <http://dx.doi.org/10.1093/aob/mcf170>
- Wong, C., Argent, G.C.G., Kiew, R., Set, O. & Gan, Y.Y.** 2003. The genetic relations of *Musa* species from Mount Jaya, New Guinea, and a reappraisal of the sections *Musa* (*Musaceae*). *Gard. Bull. Singapore* 55: 97–111.
- Wu, D.-L. & Kress, W.J.** 2001. *Musaceae*. Pp. 314–318 in: Wu, C.Y. & Raven, P.H. (eds.), *Flora of China*, vol. 24. Beijing: Science Press; St. Louis: Missouri Botanical Garden Press.
- Xavier, P., De Langhe, E., Donohue, M., Lentfer, C., Vrydaghs, L., Bakry, F., Carreel F., Hippolyte, I., Horry, J.-P., Jenny, C., Lebot, V., Risterucci, A.-M., Tomekpe, K., Doutrelepont, H., Balli, T., Manwaring, J., De Maret, P. & Tim Denham, T.** 2011. Multidisciplinary perspectives on banana (*Musa* spp.) domestication. *Proc. Natl. Acad. Sci. U.S.A.* 108: 11311–11318. <http://dx.doi.org/10.1073/pnas.1102001108/-/DCSupplemental>