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Cytological Investigation of *Macaranga* in Comparison to *Mallotus* (Euphorbiaceae) in Thailand

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ABSTRACT. Eight species of *Macaranga* (Euphorbiaceae) in Thailand were investigated cytologically. The results indicated that, for all species, their pollen mother cells have 2n = 22 and x = 11 consistently. Chromosomes are very well stained with propionocarmine and highly distinctively paired as bivalents at diakinesis and separated to 11:11 at anaphase I. Bivalent length was found to be in the range of 1.3 to 6.0 µm in pollen mother cells of about 8.7–28.0 µm. Hence *Macaranga* species may be fertile in the wild. From a cytological point of view, *Macaranga* resembles *Mallotus* in chromosome numbers and stainability but differs in cell size. Pollen mother cells and nucleoli of *Macaranga* are on average smaller than those of *Mallotus*. Therefore, cytological data support the distinction of these two genera. Moreover the results also pointed out that *Mallotus* is more variable than *Macaranga*.

INTRODUCTION

The genera *Macaranga* Thouars and *Mallotus* Lour. belong to the tribe Rottlerinae, family Euphorbiaceae (Webster, 1994, Radcliffe-Smith, 2001). They are distributed in the tropics of the Old World. *Mallotus* resembles *Macaranga* but differs in having 2 locules per anther and terminal inflorescence. Recently, some species of *Mallotus* were separated as separate genus *Cordeyama* (Sierra et al., 2006).

Eight species of *Macaranga* were studied. Most of them have chromosome number 2n = 22. Mehra & Hans (1969) reported the gametic number of *M. denticulata* (Blume) Müll.Arg., *M. gamblei* Hook.f., *M. indica* Wight and *M. peltata* (Roxb.) Müll.Arg. as n = 11. Hans (1973) recorded chromosome numbers of 18 species from various locations which had been studied by many authors. Chromosome numbers of *Macaranga* species vary from n = 11 in *M. aleuritoides* F.Muell, *M. denticulata, M. gamblei, M. indica, M. peltata, M. pustulata* King ex Hook.f. *M. tanarius* (L.) Müll.Arg. and *M. triloba* (Thunb.) Müll.Arg., to 2n = 20 in *M. beillei* Prain and *M.* sp., and to 2n = 22 in *M. curtisii* Hook.f., *M. griffithiana* Müll.Arg., *M. heynei* I.M.Johnst., *M. hosei* King ex Hook.f., *M. hullettii* King ex Hook.f., *M. hypoleuca* (Rchb.f. & Zoll.) Müll.Arg., *M. quadriricornis* Ridl., *M. tanarius* and *M. triloba*. Whitmore (1983) found the gametic number of n = 11 in *M. hulettii, M. quadricornis*

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and *M. triloba*. In addition, *M. barteri* Müll.Arg. has n = 11 (www.mobot.org/W3T/Search/ipcn.html). On the other hand, Soontornchainaksaeng et al. (2003) studied the cytogenetics of 13 Thai *Mallotus* species. The results revealed that chromosome numbers of *Mallotus* can be divided into three groups, viz: 2n = 20 (10II), 22(11II) and 24 (12II) with x = 10, 11 and 12 respectively. These dysploid numbers may have evolved through a decrease from 2n = 22 to 2n = 20. Moreover all plants had highly distinctive chromosomes at diakinesis and first anaphase. Bivalent length was in the range1.3–6.0 µm in pollen mother cells of about 16.0–28.7 µm.

Therefore, *Macaranga* species appear similar to *Mallotus* species in many characters including chromosome numbers. This paper aims to examine not only the chromosome numbers of Thai *Macaranga* species but also to examine the difference between *Macaranga* and *Mallotus* from a generalised cytological perspective.

MATERIALS AND METHODS

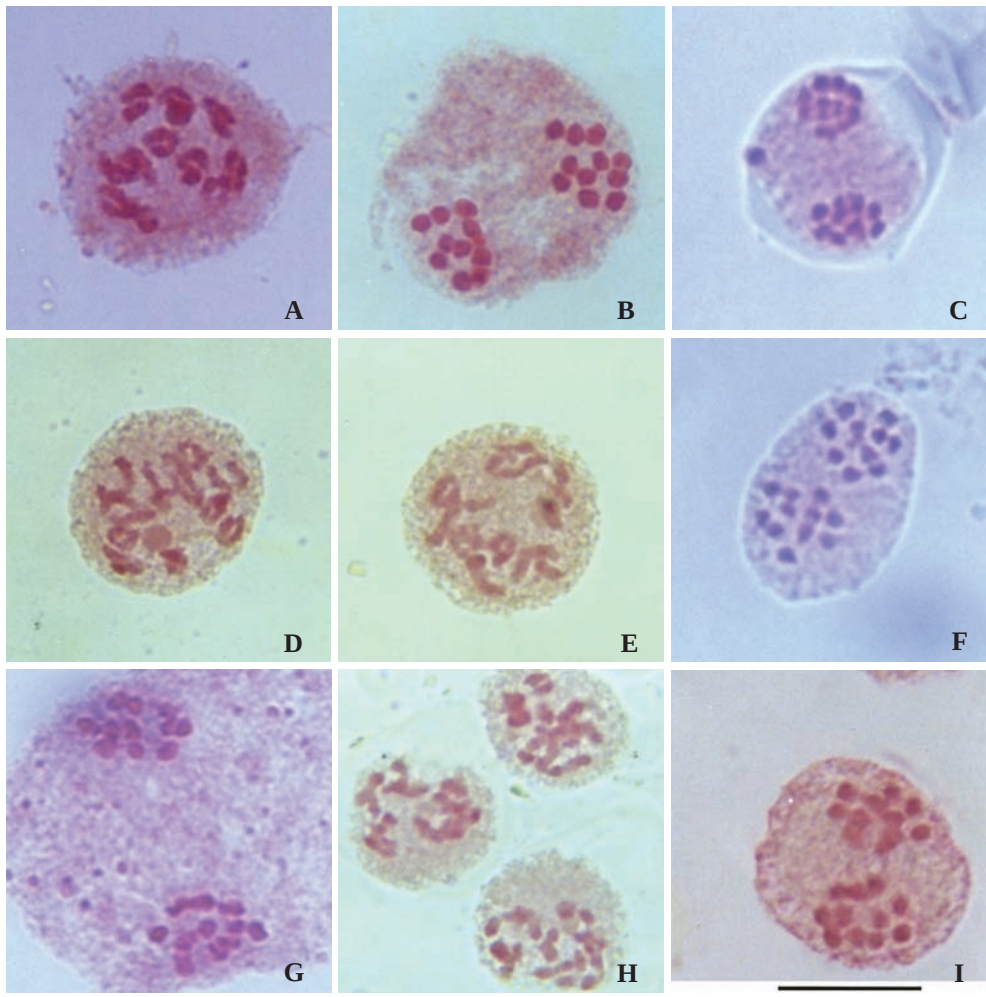
Cytological studies were made on 8 species of *Macaranga* collected at various locations in Thailand (Table 1). Young flowers were fixed in Canoy's solution for 24–48 hours. The anthers were squashed and stained with propionocarmine. Chromosomes were examined from various stages of meiotic cells, using X1000 magnification with an Olympus-BHA light microscope. Voucher specimens are deposited in the herbaria of Department of Plant Science, Mahidol University, Department of Biology, Khon Kaen University and the Royal Garden Suanluang, Rama IX, Bangkok.

RESULTS AND DISCUSSION

The results revealed that *Macaranga denticulata, M. siamensis* S.J.Davies, *M. hulettii, M. hypoleuca, M. indica, M. kurzii (Kuntze) Pax & K.Hoffm., M. laciniata* Whitmore & Airy Shaw and *M. tanarius* have consistent chromosome numbers of 2n = 22 (Table 1 and Fig.1). These counts agree with those of previous studies. For example, many authors (Mehra & Hans 1969, Hans 1973, Whitmore 1983, www.mobot.org/W3T/Search/ipcn.html) have recorded chromosome numbers in 21 species of *Macaranga*. Almost species in the genus have a base number of x = 11 except for *M. beillei* and *M.* sp. (Hans, 1973). Chromosomes of pollen mother cells of *Macaranga* are very well stained with propionocarmine. Most of the chromosomes are paired as bivalents at diakinesis and separated 11 : 11 at anaphase I. Bivalent length is 1.3–6.0 mm in pollen mother cells of about 8.7–28.0 mm (Æ) with a nucleolus of 1.0–2.0 mm. Therefore, *Macaranga* may be fertile in the wild. *Macaranga* resembles *Mallotus* in regard to chromosome number, chromosome size and chromosome stainability. Moreover, highly distinctive chromosomes are found at diakinesis and anaphase I in pollen mother cells of both genera. However, their cell sizes are different. Pollen mother cells and nucleoli of *Macaranga* are on average smaller than those of *Mallotus* (Æ of cell = 16.0–28.7 mm with a nucleolus of 1.3–3.3 mm). Consequently, cytological characters support the taxonomic separation of *Macaranga* from *Mallotus*. Moreover the data indicate that *Mallotus* is more variable than *Macaranga* in regard to chromosome number with 2n = 20, 21 and 22 (Soontornchainaksaeng et al., 2003).

Table. 1 Chromosome numbers and meiotic figures of *Macaranga* in Thailand. Coll. No.= C. Senakun & W. Thongpuban Number; Coll. No.* = P. Soontornchainaksaeng *et al*. Number; Ref. = References number; II = bivalent.

Species	Chromosome number			Meiotic figure	Record/ (ref.)	Locality	Coll. no.
	2n	n	x				
1. *M. denticulata* (Blume) Müll. Arg.	22	11	11	11:11	5	Nakhon Ratchasima	5, 253*
2. *M. siamensis* S.J. Davies	22	11	11	11II	1st	Nakhon Ratchasima	314*
3. *M. hullettii* King ex Hook.f.	22	11	11	11II	5,11	Narathiwat	51
4. *M. hypoleuca* (Rchb.f. & Zoll.) Müll. Arg.	22	11	11	11II	5	Narathiwat	58
5. *M. indica* Wight	22	11	11	11:11	5,6	Nakhon Ratchasima	29, 310*
6. *M. kurzii* (Kuntze) Pax & Hoffm.	22	11	11	11:11	1st	Chaiyaphum, Nakhon Ratchasima	12, 254*
7. *M. laciniata* Whitmore & Airy Shaw	22	11	11	11II	1st	Narathiwat	54
8. *M. tanarius* (L.) Müll. Arg.	22	11	11	11:11	5	Songkhla, Narathiwat	53, 266*



Figures 1. Chromosome of pollen mother cells of *Macaranga* (2n =22)**,** nucleolus (arrow): A.-B. *M. indica* (11II), Diakinesis; C. *M. siamensis* (11:11), Anaphase I; D. *M. hullettii* (11II), Diakinesis; E. *M. hypoleuca* (11II), Diakinesis; F. *M. indica* (11:11), Anaphase I; G. *M. kurzii*(11:11), Anaphase I; H. *M. laciniata* (11II), Diakinesis; I. *M. tanarius* (11:11), Anaphase I. Bar represents 10 μm.

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