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Chromosome numbers for selected Thailand plant species

CHADAPORN SENAKUN[1]

ABSTRACT

A cytogenetic study of 30 species from 26 genera and 19 families of Thailand native plants, some endemic or rare, was conducted. All plants were collected from natural wild populations. Chromosomes of the pollen mother cells were stained with propionocarmine and observed at diakinesis, first metaphase and first anaphase stage. The study found that chromosome numbers ranged from 2n = 16 to 80. Chromosome numbers of 22 taxa are reported for the first time. Almost all taxa in this study are diploid and have bivalent configuration, which indicates that they are stable in nature. The two exceptions are *Polyalthia debilis* and *Smilax micro-china*, both being polyploid with a multivalent configuration, indicating that they have a high probability of genetic variation.

KEYWORDS: cytogenetic study, pollen mother cells, native plants, diploid, polyploid.

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INTRODUCTION

Fundamental and classical cytological techniques are still excellent starting points for plant cytogenetic studies. Chromosome number and other chromosome features can be used to identify genetic diversity and evolutionary lines (Jahier, 1996; Guerra, 2008; Figueroa & Bass, 2010).

Chromosome numbers are now reported on the database of the Index of Plant Chromosome Numbers (IPCN, Missouri Botanical Garden, 2017) and in the Chromosome Atlas of Flowering Plants (Darlington & Wylie, 1955). These show that there can be variation of chromosome number within a genus (e.g. *Betula and Impatiens*), while other genera show no variation (e.g. *Lilium*, *Lyonia* and *Pinus*). The chromosome numbers of some Thai species have been previously reported, including Euphorbiaceae (Soontornchainaksaeng & Jenjittikul, 2003; Soontornchainaksaeng *et al.*, 2003a, 2003b & 2007), Fagaceae (Chokchaichamnankit *et al.*, 2007), Zingiberaceae (Eksomtramage *et al.*, 2002), and five other families (Soontornchainaksang & Chaiyasut, 1996). However, many species remain to be studied.

MATERIAL AND METHODS

Plant material was collected from different areas of Thailand. The chromosome numbers reported here are the gametic numbers determined by observation of the meiotic configuration of pollen mother cells. For meiotic studies, floral buds were fixed in 3:1 absolute alcohol-glacial acetic acid for 24–48 hours, then preserved in 70% ethanol at 4° C and stained by the propinocarmine smear technique. Cells with dispersed chromosome were observed and digitally photographed with an Axiostar Plus (Zeiss) light microscope at 100x magnification. Voucher specimens have been deposited in the herbarium at Walai Rukhavej Botanical Research Institute, Mahasarakham University, Thailand.

RESULT AND DISCUSSION

Meiotic pairing of the chromosome was studied in 30 species from 26 genera and 19 families. Chromosome numbers were in the range of 2n= 16–80 and chromosome size was small. Of the 30 species, eight had chromosome numbers previously reported (*Betula alnoides*, *Butea monosperma*, *Carallia brachiata*, *Croton hutchinsonianus*, *C. stellatopilosus*, *Helicteres hirsuta*, *Phyllanthus recticulatus* and *Polyalthia suberosa*). For seven, the chromosome numbers were the same as previously reported in IPCN (Missouri Botanical Garden, 2017), while *Carallia brachiata* had a different chromosome number. The chromosome numbers of the 30 species are reported in Table 1 and Figs. 1–2.

[1] Biodiversity and Conservation Research Unit, Walai Rukhavej Botanical Research Institute, Mahasarakham University, Maha Sarakham 44150, Thailand. Email: Chadaporn.sen@gmail.com

Table 1. Chromosome numbers of 30 plants in Thailand

Family	Species	Chromosome number (2n)	Meiotic figure	Chromosome number within the genus (2n)**
Achariaceae	*Hydnocarpus castaneus* Hook.f. & Thomson*	24	12II	24 48
Annonaceae	*Artabotrys spinosus* Craib*	16	8II	10 16 18
	Goniothalamus laoticus (Finet & Gagnep.) Bân*	16	8II	16
	Polyalthia debilis Finet & Gagnep.*	36	-	14 16 18 36
	Polyalthia suberosa (Roxb.) Thwaites	18	9II	14 16 18 36
	Uvaria rufa Blume*	22	11II	16 22
	Uvaria siamensis (Scheff.) L.L.Zhou, Y.C.F.Su & R.M.K.Saunders*	16	8II	16 22
Apocynaceae	*Holarrhena curtisii* King & Gamble*	22	11II	22
Balsaminaceae	*Impatiens* aff. *noei* Craib	24	12II	10 12 14 16 16+0-1B 18 20 32 36 40 60
Betulaceae	*Betula alnoides* Buch.-Ham.	28	14II	28 28-38 30 37-42 42 56 56-58 58 63 70 84 112
Capparaceae	*Crateva magna* DC.*	24	12II	26
Ericaceae	*Lyonia ovalifolia* (Wall.) Drude var. *foliosa* (H.R.Fletcher) Judd*	24	12II	24
Euphorbiaceae	*Croton krabas* Gagnep.*	20	10II	16 18 20 28 64 88 102
	C. hutchinsonianus Hosseus	20	10II	-
	C. stellatopilosus H.Ohba	20	10II	-
	Mallotus thorelii Gagnep.*	22	11II	22 44 66
Fabaceae	*Butea monosperma* (Lam.)Taub.	18	9II	18 18+0-1B 32
Magnoliaceae	*Magnolia garrettii* (Craib) V.S.Kumar*	38	19II	38 76 114
Malvaceae	*Decaschistia crotonifolia* Wight & Arn.*	24	12II	30
	Helicteres hirsuta Lour.	24	12II	18 24
Nepenthaceae	*Nepenthes* sp.*	80	40II	80
Phyllanthaceae	*Phyllanthus reticulatus* Poir.	26	13II	7 12 14 18 24 26 28 36 40 50 52 56 88 100 104
Rhizophoraceae	*Carallia brachiata* (Lour.) Merr.	24	12II	48 112
Rubiaceae	*Ixora cibdela* Craib *	22	11II	22
	Morinda pandurifolia Kuntze*	22	11II	10 22 44
	Pavetta gracilliflora Wall. ex Ridl. *	22	11II	11 44 22 22-24
Rosaceae	*Rhaphiolepis indica* (L.) Lindl. *	28	14II	No report
Sapindaceae	*Lepisanthes senegalensis* (Poir.) Leenh.*	28	14II	No report
Simaroubaceae	*Eurycoma longifolia* Jack*	24	12II	No report
Smilacaceae	*Smilax micro-china* Koyama*	ca 64	-	26 28 30 32 64 90 96 128

* First report of chromosome number

** Recent chromosome number report within the genus from Index of Plant Chromosome Numbers (IPCN)

The chromosome characteristics of 28 of the studied species were diploid and contained bivalent configuration which indicates that they are stable in nature. Two species, *Polyalthia debilis* and *Smilax micro-china*, were polyploid. Polyploidy is a major mechanism of adaptation and speciation in plants (Yu *et al.*, 2010). Thus these two plants have additional probability to have high genetic variation.

Analysis of the chromosome number variation on the database of the Index of Plant Chromosome Number or IPCN (Missouri Botanical Garden, 2017) compared with the genera in this study found that *Betula*, *Croton*, *Impatiens* and *Phyllanthus* have high variability in chromosome number whereas genera *Ixora*, *Lyonia* and *Nepenthes* have no variation in chromosome number. Three genera in this study,

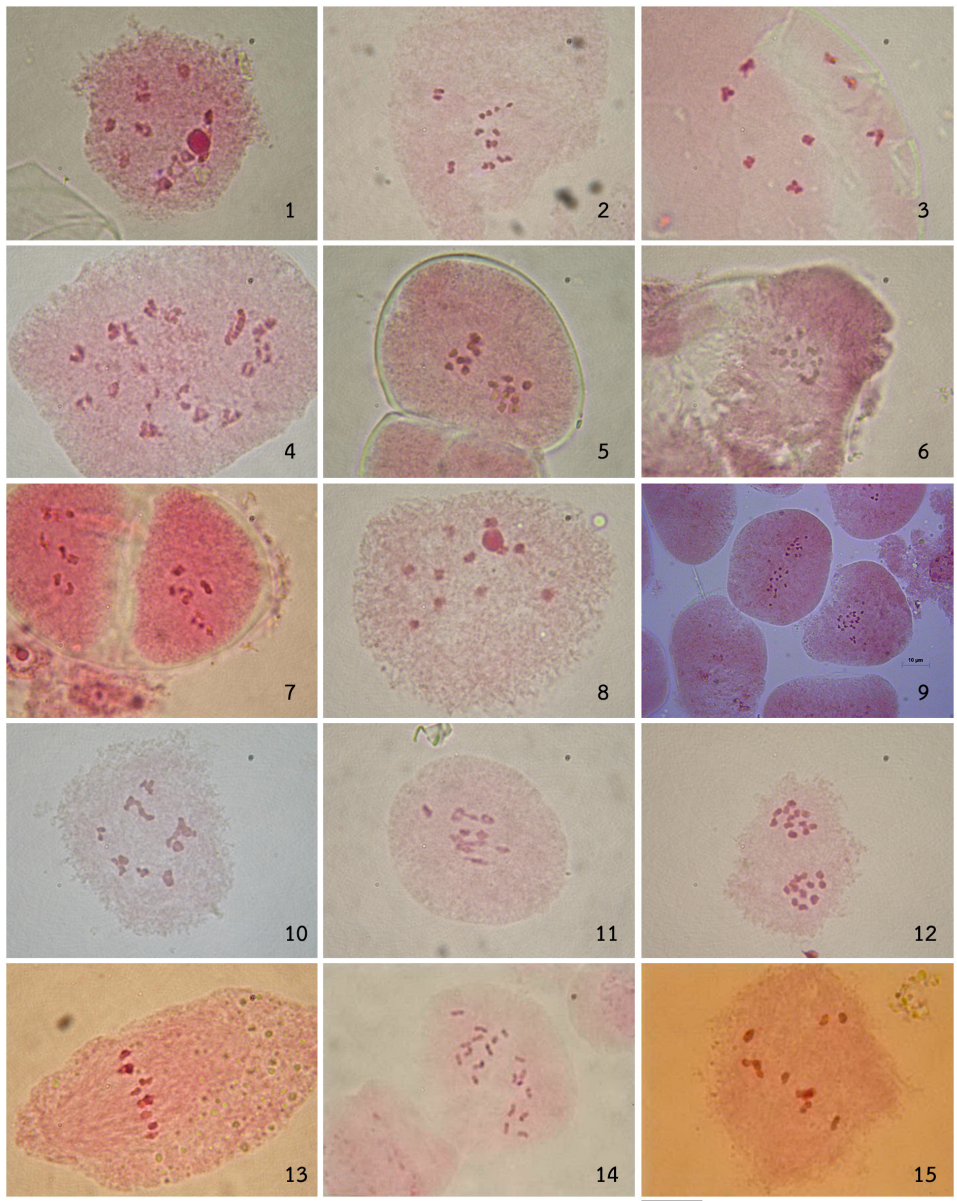

Figure 1. Chromosome number variation: 1. *Hydnocarpus castaneus*; 2. *Artabotrys spinosus*; 3. *Goniothalamus laoticus*; 4. *Polyalthia debilis*; 5. *Polyalthia suberosa*; 6. *Uvaria rufa*; 7. *Uvaria siamensis*; 8. *Holarrhena curtisii*; 9. *Impatiens* aff. *noei*; 10. *Betula alnoides*; 11. *Crateva magna*; 12. *Lyonia foliosa*; 13. *Croton krabas*; 14. *C. hutchinsonianus*; 15. *C. stellatopilosus*. Scale bar = 10 µm

namely *Eurycoma*, *Lepisanthes* and *Rhaphiolepis*, have no records of chromosome number in the IPCN database. Few cytogenetic studies of Thai plants are reported in the IPCN database and, more generally, this study provides the first report of the chromosome number for 22 species. Two species are listed on the IUCN Red list of threatened species (International Union for Conservation of Nature and Natural Resources, 2017), *Betula alnoides* (LC ver 3.1) and *Magnolia garrettii* (DD ver 3.1). In addition, six of the species in this study are listed as rare and threatened plants in Thailand, namely *Impatiens noei* (Pooma, 2008), *Uvaria siamensis*, *Lyonia ovalifolia* var. *foliosa*, *Croton hutchinsonianus*, *C. stellatopilosus* and *Smilax micro-china* (Chamchumroon *et al.*, 2017).

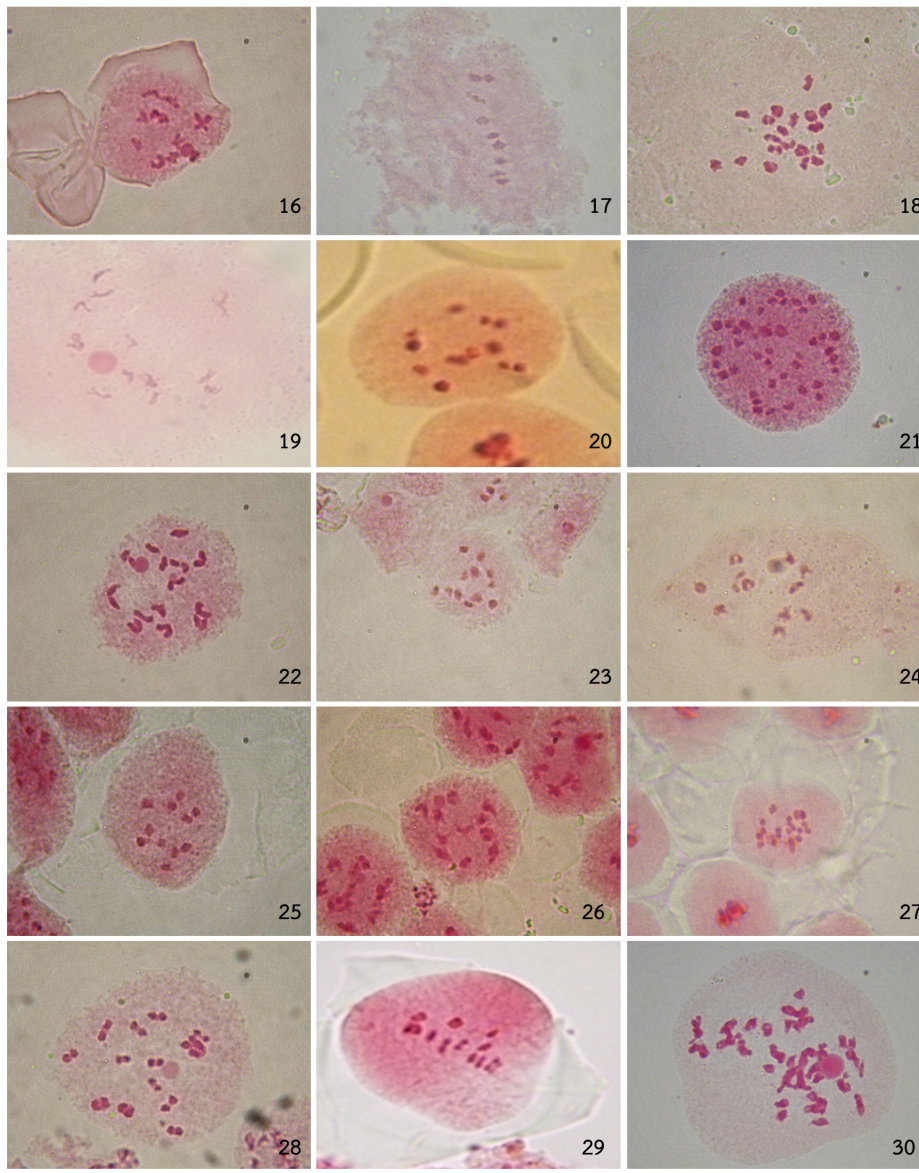

Figure 2. Chromosome number variation: 16. *Mallotus thorelii*; 17. *Butea monosperma*; 18. *Magnolia garrettii*; 19. *Decaschistia crotonifolia*; 20. *Helicteres hirsuta*; 21. *Nepenthes* sp.; 22. *Phyllanthus reticulatus*; 23. *Carallia brachiata*; 24. *Ixora cibdela*; 25. *Morinda pandurifolia*; 26. *Pavetta gracilliflora*; 27. *Rhaphiolepis indica*; 28. *Lepisanthes senegalensis*; 29. *Eurycoma longifolia*; 30. *Smilax micro-china*. Scale bar = 10 µm

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