SHORT COMMUNICATION

Chromosome counts of some Zingiberaceous species from Thailand

Ladda Eksomtramage¹, Puangpen Sirirugsa², Prasert Jivanit³ and Charun Maknoi⁴

Abstract Eksomtramage, L., Sirirugsa, P., Jivanit, P. and Maknoi, C. Chromosome counts of some Zingiberaceous species from Thailand Songklanakarin J. Sci. Technol., 2002, 24(2) : 311-319

The data on chromosome numbers of 22 species belonging to 10 genera of Zingiberaceae distributed in Thailand were investigated. The somatic numbers range from 20 to 48 showing diploidy and polyploidy. Ten of these species are firstly reported here, i.e. *Alpinia purpurata* (Vielli) K. Schum. (2n = 48), *Boesenbergia* aff. *rotunda* (2n = 20), *Cornukaempferia aurantiflora* J. Mood & K. Larsen (2n = 46), *Curcuma* aff. *oligantha* Trimen (2n = 42), *C. rhabdota* Sirirugsa & M.F. Newman (2n = 24), *Etlingera elatior* (Jack.) R.M. Smith (white form) (2n = 48), *E. hemisphaerica* (Bl.) R.M. Smith (2n = 48), *Hedychium gomezianum* Wall. (2n = 34), *H. longicornutum* Bak. (2n = 34) and Zingiber aff. wrayi (2n = 22)

Key words : chromosome number, Thai Zingiberaceae

¹M.Sc. (Botany), Assoc. Prof., ²M.S. (Botany), Prof., ³B.Sc. (Biology), ⁴M.Sc. (Ecology), Department of Biology, Faculty of Science, Prince of Songkla University, Hat Yai, Songkhla 90112 Thailand. Corresponding e-mail : eladda@ratree.psu.ac.th Received, 1 November 2001 Accepted, 25 December 2001

บทคัดย่อ

้ลัดดา เอกสมทราเมษฐ์ พวงเพ็ญ ศิริรักษ์ ประเสริฐ จิวานิจ และ จรัญ มากน้อย การนับจำนวนโครโมโซมของพืชวงศ์ขิงบางชนิดของไทย ว. สงขลานครินทร์ วทท. 2545 24(2) : 311-319

้จำนวนโครโมโซมของพืชวงศ์ขิงในประเทศไทย จำนวน 22 ชนิด จาก 10 สกุล พบว่า มีจำนวนโครโมโซม ้ตั้งแต่ 20-48 ซึ่งมีทั้งดิพลอยด์และโพลีพลอยด์ จากการศึกษาครั้งนี้ มีพืช 10 ชนิด ที่มีการรายงานจำนวนโครโมโซม เป็นครั้งแรก คือ Alpinia purpurata (Vielli) K. Schum. (2n = 48), Boesenbergia aff. rotunda (2n = 20), Cornukaempferia aurantiflora J. Mood & K. Larsen (2n = 46), Curcuma aff. oligantha Trimen (2n = 42), C. rhabdota Sirirugsa & M.F. Newman (2n = 24), Etlingera elatior (Jack.) R.M. Smith (white form) (2n = 48), E. hemisphaerica (Bl.) R.M. Smith (2n = 48), Hedychium gomezianum Wall. (2n = 34), H. longicornutum Bak. (2n = 34) และ Zingiber aff. wrayi (2n = 22)

ภากวิชาชีววิทยา คณะวิทยาศาสตร์ มหาวิทยาลัยสงขลานครินทร์ อำเภอหาดใหญ่ จังหวัดสงขลา 90112

Zingiberaceous plants vary a great deal in morphology and chromosome numbers, 2n = 20 -96 ($\times = 10-26$) (Darlington & Wylie, 1955; Goldblatt, 1981; 1984; 1985; 1988 and Goldblatt and Johnson, 1990; 1991; 1994; 1996). This family is represented by approximately 200 species in 21 genera in Thailand (Larsen, 1996).

Chromosome numbers of Thai Zingiberaceae were previously reported by several authors, namely : Mahanty (1970), Larsen (1972) (see Beltran & Kiew, 1984), Sirisawad and Apavatjrut (1995), Eksomtramage and Boontum (1995), Eksomtramage et al. (1996; 2001), Weerapukdee and Krasaechai (1997) and Saensouk (2000). However, many more species of this family have not yet been studied cytologically. In this paper, the somatic chromosome numbers of 22 species of Zingiberaceae from Thailand are reported.

Materials and Method

Specimens of Zingiberaceous plants were collected from Thai forests then transplanted into pots prior to being placed in the nursery at the Department of Biology, Prince of Songkla University. Voucher specimens were deposited in the PSU herbarium.

Actively growing apical root tips at about

1 to 2 cm in length were used for chromosome counts. They were pretreated in saturated paradichlorobenzene (PDB) solution for 4 hours at 12 °C and fixed in Carnoy's fluid (3 parts 95% ethanol and 1 part glacial acetic acid) for 24 hours at 12 °C and stored in 70% ethanol at 12 °C. Slides were prepared by Feulgen squash method (Sharma and Sharma, 1980) and examined under the light microscope (Olympus, model CH30). Chromosome numbers of 20 cells of each species were determined at well spread metaphase stage. Photographs were taken using a Nikon OPTIPHOT-2 phase-contrast microscope at 100x magnification with a Nikon FX series model UFX-DX II camera attached.

Results and Discussion

The somatic chromosome numbers (2n) of twenty two Thai species of Zingiberaceae including the data reported by other authors are presented in Table 1.

Not only the basic number but also ploidy level of each Zingiberaceous species are different (Darlington & Wylie, 1955 and Beltran & Kiew, 1984). Chen (1989) reported that several polyploids exist in tropical Asian Zingiberaceae, especially in Globbeae and Alpineae.

Vol. 24 No. 2 Apr.-Jun. 2002

Table1. Chromosome numbers in 22 species of Thai Zingiberaceae in this study including
the data reported by other authors.

	<i>a</i> .	2n	Previous studies			Collection
Species		(this study)	n*	2n	Authors	numbers
	Tribe Alpineae					
1.	Alpinia henryi K. Schum.	48	-	48	Chen&Huang, 1996	AA19
2.	A. purpurata (Vielli) K. Schum.	48	-	-	-	AA3
3.	Etlingera elatior (white form) (Jack)				
	R.M. Smith	48	-	-	-	PS1805
4.	E. hemisphaerica (Bl.) R.M. Smith	48	-	-	-	T23
5.	Hornstedtia leonurus (Koenig) Retz	z 48	24	-	Beltran & Kiew, 1984	T64
	Tribe Hedychieae					
6.	Boesenbergia aff. rotunda	20	-	36	Eksomtramage & Boontum, 199	5 T38
7.	B. longipes (King & Plain) Schltr.	20	-	20	Newman et al., 1986 (see	J.F.M.84-
					Goldblatt & Johnson, 1991)	375
8.	B. plicata (yellow form) (Ridl.) Hol	ltt. 20	-	-	-	T28
9.	B. xiphostachya Loes.	20	-	20	Saensouk, 2000	PS1454
10.	Cornukaempferia aurantiflora J.					
	Mood & K. Larsen	46	-	-	-	AA53
11.	Curcuma aff. oligantha Trimen	42	-	-	-	AA40
12.	C. parviflora Wall.	32	-	32	Weerapukdee & Krasaechai, 199	7 PS1103
13.	C. rhabdota Sirirugsa &					
	M.F. Newman	24	-	-	-	AA54
14.	Hedychium gomezianum Wall.	34	-	-	-	AA9
15.	H. longicornutum Bak.	34	-	-	-	AA20
16.	Kaempferia elegans Wall. ex Bak.	22	11	22	Mahanty,1970	AA18
	K. elegans (variegated leaf)	22	-	-	-	AA11
	Tribe Globbeae					
17.	Globba cernua Bak.	32	16,24	32,48	Lim,1972	T70
					(see Beltran & Kiew, 1984)	
18.	G. pendula Roxb.	32	16,24	32,48	Lim,1972	T63
					(see Beltran & Kiew, 1984)	
19.	Globba sp.	32	-	-	-	T98
	Tribe Zingibereae					
20.	Zingiber aff. wrayi	22	-	-	-	AA21
21.	Z. officinale Rosc.	22		22	Datta & Biswas, 1977 (see Goldblatt, 1981)	PS603
22.	Zingiber sp.	22	-	-	- -	AA13

*n = gametic number

Tribe Alpineae

In the tribe Alpineae, of which about 46 species in 10 genera are found in Thailand (Larsen, 1996), the chromosome numbers of 5 species in three genera, *Alpinia, Etlingera* and *Hornstedtia* were investigated in this study.

Alpinia : On the basis of cytotaxonomy, Chen & Huang (1996) recognized 35 species in Alpinia and found that most of them have 2n = 4x = 48. In this study, *A. henryi* and *A. purpurata* have somatic chromosome number of 2n = 48(Figures 1 and 2), suggesting that both are tetraploid. The somatic chromosome number of A. purpurata is newly recorded.

Etlingera : *E. elatior* can be distinguished in two forms : pink lip and white lip. According to Eksomtramage et al. (2001), the chromosome number of *E. elatior* (pink lip) is 2n = 48. Chromosome number of E. elatior (white lip) herein is 2n = 48 (Figure 3), suggesting that two forms of Etlingera may differ in a colour-coding gene. In addition, *E. hemisphaerica* with 2n = 48 (Figure 4) from this study is also firstly recorded.

Hornstedtia : The gametic number, n = 24, was found in *H. leonurus* (Beltran & Kiew, 1984) which Chen & Huang (1996) concluded has x =12. In this study, the somatic chromosome number of *H. leonurus* is 2n = 48 (Figure 5), indicating the tetraploid condition.

Tribe Hedychieae

In Thai Zingiberaceae, about 102 species in 9 genera were found in this tribe (Larsen, 1996). Chromosome numbers of 11 species in the five genera are reported here.

Boesenbergia : Four species of Boesenbergia; B. aff. rotunda, B. longipes, B. plicata (lip yellow), and B. xiphostachya were studied and all of them found to have the same chromosome numbers, 2n = 20 (Figures 6-9).

According to the work reported by Beltran & Kiew (1984), Boesenbergia plicata from the Malay Peninsula shows 10 bivalents at the first metaphase and has a basic number x = 10. Thus, it can be concluded that the four species of Thai Boesenbergia are diploid. Boesenbergia plicata (lip red) also has chromosome number, 2n = 20(Eksomtramage & Boontum, 1995), as well as the "lip yellow" species, suggesting that B. plicata varies in colours of the lips. Although the morphology of *B*. aff. *rotunda* is similar to that of *B*. rotunda, the chromosome count for the former herein is 2n = 20 which differs from the latter, 2n =36 as reported by Eksomtramage & Boontum (1995). These suggest no close relation between the two species.

Cornukaempferia : Cornukaempferia was recently established by Mood and Larsen (1997) and belongs to the tribe Hedychieae. C. aurantiflora was cytologically studied and it was found that 2n = 46 (Figure 10), which is a new record for the chromosome numbers of this species and this number is also a new record for the family Zingiberaceae. This may not be surprising since the tribe Hedychieae has more variations in chromosome numbers (2n = 20 to 68) than others (Beltran & Kiew, 1984). In addition, the chromosome sizes of C. aurantiflora are relatively similar to those two species of the genus, H. gomezianum and H. longicornutum (Figures 14 and 15). There is fair support that this new genus appropriately belongs to the tribe Hedychieae.

Curcuma : The somatic chromosome numbers found in Curcuma sp. (C. aff. oligantha), C. parviflora and C. rhabdota are 2n = 42, 32 and 24, respectively (Figures 11-13).

In Curcuma, the chromosome numbers of 2n = 20, 24, 28, 32, 36, 42, 56, 62, 63 and 64 with x = 16 and 21 were previously reported (Beltran & Kiew, 1984; Darlington & Wylie, 1955; Eksomtramage et al., 1996 and Weerapakdee & Krasaechai, 1997). The variation in chromosome numbers of Curcuma shows that this genus has both polyploid and aneuploid. This result corresponds to chromosome numbers of the Curcuma group. This study provides the first reports for C. aff. oligantha and C. rhabdota.

Hedychium : The somatic number of 2n = 34 was found in H. gomezianum and H. longicornutum (Figures 14 and 15).

Mahanty (1970) reported that the basic number of *Hedychium* was 17, suggesting that *H*. gomezianum and H. longicornutum are diploid. The chromosome numbers of these two species are newly recorded.

Kaempferia: K. elegans could be recognized in two forms : normal leaves and variegated leaves, both have 2n = 22 (Figures 16 and 17) which is consistent with K. elegans from Burma (Mahanty ,1970). Since Kaempferia has a basic number of 11 and shows 11 bivalents at the first metaphase (Mahanty, 1970), the chromosome num-

Vol. 24 No. 2 Apr.-Jun. 2002



10µ

Figures 1-8. Mitotic chromosomes (2n) from root tips of 8 Thai Zingiberaceous speciesFigure 1. Alpinia henryi, 2n = 48Figure 2. A. purpurata, 2n = 48Figure 3. Etlingera elatior, 2n = 48Figure 4. E. hemisphaerica, 2n = 48Figure 5. Hornstedtia leonurus, 2n = 48Figure 6. Boesenbergia aff. rotunda, 2n = 20Figure 7. B. longipes, 2n = 20Figure 8. B. plicata, 2n = 20

Vol. 24 No. 2 Apr.-Jun. 2002



10µ

Figure 9-16. Mitotic chromosomes (2n) from root tips of 8 Thai Zingiberaceous speciesFigure 9. Boesenbergia xiphostachya, 2n = 20Figure 10. Cornukaempferia aurantiflora, 2n = 46Figure 11. Curcuma aff. oligantha, 2n = 42Figure 10. Cornukaempferia aurantiflora, 2n = 46Figure 13. C. rhabdota, 2n = 24Figure 14. Hedychium gomezianum, 2n = 34Figure 15. H. longicornutum, 2n = 34Figure 16. Kaempferia elegans (normal leaf), 2n = 22

bers of these two forms of K. elegans are diploid.

Tribe Globbeae

In this tribe, only the genus *Globba* was found in Thailand (Larsen, 1996). In this investigation, three *Globba* species : *G. cernua*, *G. pendula* and *Globba* sp. have the same chromosome number of 2n = 32 (Figures 18-20).

According to previous reports (Mahanty, 1970; Beltran & Kiews, 1984), *Globba* shows a wide range of chromosome numbers, 2n = 22, 24, 28, 32, 44, 48, 64 and 80 (x = 8, 11, 12 and 16) and both *G. cernua* and *G. pendula* have the same chromosome numbers of 2n = 32 (Lim, 1972 cited in Beltran & Kiew, 1984), indicating that these three species are tetraploid (x = 8) or diploid (x = 16).



10μ

Figures 17-22. Mitotic chromosomes (2n) from root tips of 6 Thai Zingiberaceous speciesFigure 17. Kaempferia elegans (variegated leaf), 2n = 22Figure 19. G. pendula, 2n = 32Figure 21. Zingiber aff. wrayi, 2n = 22Figure 22. Z. officinale, 2n = 22

Vol. 24 No. 2 Apr.-Jun. 2002

Tribe Zingibereae

The tribe comprises only a single genus, *Zingiber*, of which about 25 species occur in Thailand (Larsen, 1996). Counts on most Thai *Zingiber* indicate it is a diploid with 2n = 22 (Eksomtramage *et al.*, 2001 and Saensouk, 2000). According to this study the somatic number of 2n = 22 was found in *Z*. aff. *wrayi* (Figure 21), *Z*. *officinale* (Figure 22) and *Zingiber* sp., confirming that these three *Zingiber* species are diploid. In addition, the 2n = 22 count for *Z*. aff. *wrayi* is also newly recorded for Thai species.

Conclusion

Chromosome numbers of 22 Zingiberaceous species from Thailand were determined in this study. All species investigated are distributed in four tribes; Alpineae, Hedychieae, Globbeae and Zingibereae. The chromosome numbers of 5 species in Alpineae (2n = 48) is tetraploid (2n = 4x = 48) and of 3 species in Zingibereae (2n = 22) is diploid (2n = 2x = 22). The Hedychieae show a wide range of somatic numbers from 20 to 46 while 3 species of Globbeae have the same number, 2n = 32. The chromosome numbers of the 10 species of Thai Zingiberaceae have not been recorded before.

References

- Beltran, I.C. and Kiew, K.Y. 1984. Cytotaxonomic studies in the Zingiberaceae. Notes RBC Edinb., 41 (3) : 541-559.
- Chen, Z-Y. 1989. Evolutionary patterns in cytology and pollen structure of Asian Zingiberaceae.
 In : Holm-Nielsen, B., Nielsen, I.C. & Balslev, H. (eds), Tropical Forests. Academic Press Limited, New York. pp. 185-191.
- Chen, Z.Y. and Huang, X-X. 1996. Cytotaxonomy of the tribe Alpineae. Proceedings of The second symposium on the family Zingiberaceae. Zhongshan University Press, Guangzhou, China. pp. 112-121.
- Darlington, C.D. and Wylie, A.P. 1955. Chromosome Atlas. Ruskin House Museum Street, London. pp. 345-346.

- Eksomtramage, L. and Boontum, K. 1995. Chromosome counts of Zingiberaceae. Songklanakarin J. Sci. Technol., 17(3) : 291-297.
- Eksomtramage, L., Sirirugsa, P. and Mayakul, S. 1996. Chromosome numbers of some Thai Zingiberaceae. Songklanakarin J. Sci. Technol., 18(2) : 153-159.
- Eksomtramage, L., Sirirugsa, P., Sawangchote, P., Jornead, S., Saknimit, T. and Leeratiwong, C. 2001. Chromosome numbers of some monocot species from Ton-Nga-Chang Wildlife Sanctuary, Southern Thailand. Thai For. Bull (Bot)., 29:63-71.
- Goldblatt, P. 1981. Index to plant chromosome numbers 1975-1978. Monographs in Systematic Botany from the Missouri Botanical Garden, No. 5.
- Goldblatt, P. 1984. Index to plant chromosome numbers 1979-1981. Monographs in Systematic Botany from the Missouri Botanical Garden, No. 8.
- Goldblatt, P. 1985. Index to plant chromosome numbers 1982-1983. Monographs in Systematic Botany from the Missouri Botanical Garden, No. 13.
- Goldblatt, P. 1988. Index to plant chromosome numbers 1984-1985. Monographs in Systematic Botany from the Missouri Botanical Garden, No. 23.
- Goldblatt, P. and Johnson, DE. 1990. Index to plant chromosome numbers 1986-1987. Monographs in Systematic Botany from the Missouri Botanical Garden, No. 30.
- Goldblatt, P. and Johnson, DE. 1991. Index to plant chromosome numbers 1988-1989. Monographs in Systematic Botany from the Missouri Botanical Garden, No. 40.
- Goldblatt, P. and Johnson, DE. 1994. Index to plant chromosome numbers 1990-1991. Monographs in Systematic Botany from the Missouri Botanical Garden, No. 51.
- Goldblatt, P. and Johnson, DE. 1996. Index to plant chromosome numbers 1992-1993. Monographs in Systematic Botany from the Missouri Botanical Garden, No. 58.
- Larsen, K. 1996. A preliminary checklist of the Zingiberaceae of Thailand. Thai For. Bull (Bot.)., 24:35-49.

Vol. 24 No. 2 Apr.-Jun. 2002

319 Eksomtramage, L., *et al.*

- Mahanty, H.K. 1970. A cytological study of the Zingiberales with special reference to their taxonomy. Cytologia., 35 :13-49.
- Saensouk, S. 2000. A study on Morphology, Chromosome and Pollen of the Family Zingiberaceae in Phu Phan National Park. A Thesis for the degree of Master of Science in Biology, Graduate school Khon Kaen University, Khon Kaen province.
- Sharma, A.K. and Sharma, A. 1980. Chromosome Techniques: Theory and Practice. 3rd ed. Butter worths & Co. Ltd. London. pp. 9-27.
- Sirisawad, T. and Apavatjrut, P. 1995. A study on chromosome of some Thai indigeneous *Curcuma* species. The ninth national genetics seminar abstract on "Genetics for life quality and environment," Chiengmai, Thailand, March 22-24, 1995 : 22-23.
- Weerapakdee, W. and Krasaechai, A. 1997. Collection and development studies of certain *Curcuma* spp. J. of Agri., 13(2) : 127-136.