Genetic Diversity of *Croton* L. (Euphorbiaceae) in Thailand

Puangpaka Soontornchainaksaeng^{1,*}, Pranom Chantaranothai²
and Chadaporn Senakun³

¹ Department of Plant Science, Faculty of Science, Mahidol University,
Rama VI Rd., Pyathai, Bangkok, Thailand, 10400

² Applied Taxonomic Research Center, Department of Biology, Faculty of Science, Khon Kaen University,
Khon Kaen 40002, Thailand

³ Walairukhavaj Botanical Research Institute, Maharakam University,
Maharakam, Thailand

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Summary Genetic diversity of *Croton* 15 species were investigated. The results revealed that chromosome numbers of *Croton* are quite unique of $2n=20$, except *C. hirtus* which contains $2n=16$. Chromosome numbers of 9 species are the first recorded. The genus *Croton* has base number of 8 and 10. Chromosomes of microsporocytes of *Croton* are very well stained with propionocarmine. Most of them are clearly paired in bivalent of $1.00\text{--}6.00\text{ }\mu\text{m}$ at metaphase I cells of $26.67\text{--}63.33\text{ }\mu\text{m}$ (ϕ). Chromosomes are balanced disjunction at anaphase I. The results show that *Croton* are very good fertile and stable in natural habitat and it has a small genome which could be manipulated or improved simply. *C. hirtus* is probably more advanced than the others.

The genus *Croton* L. comprises over 800 species, it is one of the most widely distributed genus in pantropics, mainly in the Neotropics and Madagascar. Thirty species of *Croton* found in Thailand (Chayamarit *et al.* 2001). Most of them are used as medicinal plants except *C. delpyi* which is used as wood.

The chromosome number can provide significant information about the plant modes of reproduction, evolutionary history and the genetic relationships between closely related species. As Thailand is a fast growing of the population therefore, rapid of road development and the demand for using land are increasing. Deforestation causes rapidly number of wild useful species decrease. To prevent the extinction of species and loss of genetic diversity, conservation and the study of genetic diversity, of available species is needed. The data from genetic diversity will support to plant improvement, phylogenetic and taxonomic studies and the trend of conservation strategies. There are 12 previous records of chromosome numbers of *Croton* (Table 1).

Materials and methods

Genetic diversity of 15 Thai *Croton* species was studied. Young flower buds were obtained from natural populations in several sites of Thailand and fixed in Carnoy's solution. The chromosomes were made by propionocarmine squash technique. Cytogenetic study was made from well spread chromosomes in various stages of pollen mother cells. Chromosome number and meiotic figures were determined from 25 cells, examined using $\times 100$ magnification (Olympus-BHA, LM) and the best cells were photographed using an oil emersion objective. Voucher specimens are deposited at the herbaria of Department of Plant Science, Mahidol University, Department of Biology, Khon Kaen University and the Royal Garden Suanluang, Rama IX, Bangkok.

* Corresponding author, e-mail: scpsi@mahidol.ac.th

Results

Chromosomes of microsporocytes of *Croton* are very well stained with propionocarmine. Most of them are clearly paired in bivalent about $1.00\text{--}6.00\ \mu\text{m}$ in first metaphase cells of $26.67\text{--}63.33\ \mu\text{m}$. The chromosome numbers of the species studied are presented in Table 2, and Fig. 1. All species studied have $2n=20$, except *C. hirtus* which contains $2n=16$. Their base numbers are concluded for $x=8$ and 10 .

Fig. 1. 1–15) Pollen mother cells of *Croton* at metaphase I and anaphase I. 1) *C. hirtus* ($2n=16$), 2–14) $2n=20$; 2) *C. bonplandianus*, 3) *C. cascarilloides*, 4) *C. caudatus*, 5) *C. hutchinsonianus*, 6) *C. kerrii*, 7) *C. kongensis*, 8) *C. poilanei* (10:10) at anaphase I, 9) *C. robustus*, 10) *C. roxburghii*, 11) *C. stellatopilosus*, 12) *C. thorellii*, 13) *C. tigilium*, 14) *Croton* sp. 1, 15) *Croton* sp. 2. Bar represents $10\ \mu\text{m}$.

Table 1. Previous records of chromosome numbers of *Croton*

Species	Chromosome number		Authors
	G	S	
1. <i>C. bonplandianus</i>	—	20	MBG (1999)
	10	—	Soontornchainaksaeng and Chaiyasut (1999)
2. <i>C. dioicus</i>	14	—	MBG (1999)
3. <i>C. glandulosa</i>	—	16	Perry (1943)
4. <i>C. rorentzii</i>	10	—	MBG (1999)
5. <i>C. monanthogynus</i>	—	16	Perry (1943)
6. <i>C. palmeri</i>	—	16	Perry (1943)
7. <i>C. robustus</i>	10	—	Soontornchainaksaeng and Chaiyasut (1999)
8. <i>C. sarcopetalus</i>	32	—	MBG (1999)
9. <i>C. spatiflorus</i>	10	—	MBG (1999)
10. <i>C. subblyratus</i> *	10	—	Soontornchainaksaeng and Chaiyasut (1999)
11. <i>C. tiglium</i>	10	—	Soontornchainaksaeng and Chaiyasut (1999)
12. <i>C. wigginsii</i>	14	—	MBG (1999)

G: gametophytic count, S: sporophytic count.

* *C. subblyratus*=*C. stellatopilosus*.

Table 2. Chromosome numbers and meiotic figures of Thai *Croton*

Species	Chromosome number			Meiotic figure	Record	Locality	Coll. no.
	2n	n	x				
1. <i>C. bonplandianus</i> Baillon	20	10	10	10II	Prev.	Prachuap Khiri Khan, Kalasin	087, 161*
2. <i>C. cascarilloides</i> Raeusch.	20	10	10	10II	1st	Songkhla	285
3. <i>C. caudatus</i> Geiseler	20	10	10	10II	1st	Sa Kao	
4. <i>C. hirtus</i> L. Her.	16	8	8	8II	1st	Ubon Ratchathani	160*
5. <i>C. hutchinsonianus</i> Hosseus	20	10	10	10II	1st	Kanchanaburi, Phrae	051, 215
6. <i>C. kerrii</i> Airy Shaw	20	10	10	10II	1st	Phrae	212
7. <i>C. kongensis</i> Gagnep.	20	10	10	10II	1st	Nakhon Ratchasima	4
8. <i>C. poilanei</i> Gagnep.	20	10	10	10II	1st	Sakon nakhon	337
9. <i>C. robustus</i> Kurz.	20	10	10	10II	Prev.	Chiang Mai	024
10. <i>C. roxburghii</i> N. P. Balakr.	20	10	10	10II	1st	Kanchanaburi	047
11. <i>C. stellatopilosus</i> Ohba	20	10	10	10II	Prev.	Chacheongsao	046
12. <i>C. thorellii</i> Gagnep.	20	10	10	10II	1st	Sakon Nakhon	124, 175
13. <i>C. tiglium</i> L.	20	10	10	10II	Prev.	Nakhon Pathom	183
14. <i>Croton</i> sp. 1	20	10	10	10II	—	Nakhon Ratchasima	255
15. <i>Croton</i> sp. 2	20	10	10	10II	—	Chaiyaphum	81

Coll. No.: P. Soontornchainaksaeng *et al.*, * C. Senakun and W. Thongpuban, Prev.: Previous record, II: bivalent.

Discussion

The chromosome numbers of the species studied are presented in Table 2 and Fig. 1. All species studied have $2n=20$, except *C. hirtus* which contains $2n=16$. Chromosome numbers of *C. caudatus*, *C. cascarilloides*, *C. hutchinsonianus*, *C. hirtus*, *C. kerrii*, *C. kongensis*, *C. poilanei*, *C. roxburghii* and *C. thorellii* are reported for the first time. The chromosome number revealed for *C. bonplandianus*, *C. robustus*, *C. stellatopilosus* and *C. tiglium* support the previous studied reports (Perry 1943, Missouri Botanical Garden 1999, Soontornchainaksaeng and Chaiyasut 1999). As it is clear from chromosome numbers reported here, that *Croton* has base number 8 and 10. Chromosomes of microsporocytes of *Croton* are very well stained with propionocarmine. Most of them are

clearly paired in bivalent about 1.00–6.00 μm in first metaphase cells of 26.67–63.33 μm . According to most of *Croton* are used as medicinal plants. The results from the present study are of good interest to point out that *Croton* has a small genome which could be manipulated or improved simply to obtain high medicinal yield. Moreover, it is quite stable with high fertility in natural habitat. If there is no deforestation, it will continuously be propagated and available for sustainable use.

It seems that decrease in chromosome number has occurred during the course of speciation in the genus, shrub or tree except herbaceous species *C. bonplandianus* have $2n=20$. But *C. hirtus* an herbaceous species of this genus shows $2n=16$ which its might be the most advanced than the others.

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