

plants of Hokkaido (13). J. Hokkaido Univ. Educ., Sec. 2B 40: 19–30 (in Japanese).

Nishikawa T. 1997. Chromosome counts of flowering plants of Hokkaido (19). J. Hokkaido Univ. Educ., Sec. 2B 47: 7–19 (in Japanese).

Nishikawa T. and Ito K. 1992. Flora of higher plants and cytogeography of mire plants. In: Ito Ko. (ed.), The Studies on the Biocommunities and the Reasonable Use of Kushiro Mire. pp. 151–157. Graduate School of Environmental Science, Hokkaido University (in Japanese).

Yamazaki T. 1993. *Polemoniaceae*. In: Iwatsuki K., Yamazaki T., Boufford D. and Ohba H. (eds.), Flora of Japan IIIa: 242–243. Kodansha, Tokyo.

ハナシノブ *Polemonium kiushianum* Kitam. は、日本で初めて“絶滅のおそれのある野生動植物の種の保存に関する法律”が適用された絶滅危惧植物の一種で、阿蘇山周辺の半自然草原に数個体群のみが分布している。ハナシノブの染色体数及び核型 ($2n = 18 = 16m + 2sm$) は

今回初めて報告されるものである。染色体測定及び核型の観察結果は、ハナシノブとそれに近縁な危急種のエゾハナシノブ *P. caeruleum* subsp. *yezoense* var. *yezoense* にほとんど違いがないことを示した。

^(a)Cultural Affairs Division,
Kumamoto Prefectural Board of Education,
6-18-1, Suizenji, Kumamoto, 862-8609 JAPAN;
^(b)熊本県教育庁文化課,

^(b)Department of Applied Biological Science,
College of Bioresource Sciences, Nihon University,
1866, Kameino, Fujisawa,
Kanagawa, 252-8510 JAPAN;

E-mail: uchiyama@brs.nihon-u.ac.jp

^(b)日本大学生物資源科学部応用生物科学科,

^(c)Department of Plant Science,

School of Agriculture, Tokai University,
Minamiaso, Kumamoto, 869-1404 JAPAN;

^(c)東海大学農学部応用植物科学科)

J. Jpn. Bot. 85: 121–125 (2010)

Norihito MIURA^a and Yoshikane IWATSUBO^b: **Karyotype of *Coleus formosanus* (*Labiatae*)**

ケサヤバナ (シソ科) の核型 (三浦憲人^a, 岩坪美兼^b)

Summary: We examined the karyotype of *Coleus formosanus* Hayata (*Labiatae*) collected from Yonaguni Island, Okinawa Prefecture. This plant had $2n = 50$ chromosomes, confirming the count reported previously from Taiwan (Hsieh and Huang 1998). The metaphase chromosomes ranged from 1.1 μm to 2.5 μm in length and 1.0 to 2.3 in arm ratio. The longest four pairs were all submetacentric and the other 21 pairs were all metacentric. The karyotype is formulated as $2n = 50 = 42m + 4sm + 2^{sc}sm + 2^{l}sm$, and shows that this species has a new basic chromosome number of $x = 25$.

Coleus formosanus Hayata (*Labiatae*) is a perennial herb distributed between Japan, Taiwan and the Philippines. In Japan this species occurs

only in Yonaguni Island, Okinawa Prefecture (Murata and Yamazaki 1993). Chromosome number of this species is reported to be $2n = 50$ in Taiwanese *C. formosanus* (Hsieh and Huang 1998). As listed in Table 1, the genus *Coleus* has various chromosome numbers of $n = 12, 14, 15, 16, 17, 24, 25, 34,$ and $36,$ and $2n = 24, 28, 30, 32, 34, 48, 49, 50, 51, 52, 56, 60$ and 64 . On the basis of these counts, basic chromosome numbers of this genus had been proposed as $x = 6, 7, 8, 9, 12, 14, 15, 16, 17$ and 18 (Darlington and Wylie 1955, Bir and Saggoo 1982, Gill 1984, Singh 1995). The somatic chromosome count of $2n = 50$ in *C. formosanus* reported by Hsieh and Huang (1998), however, does not

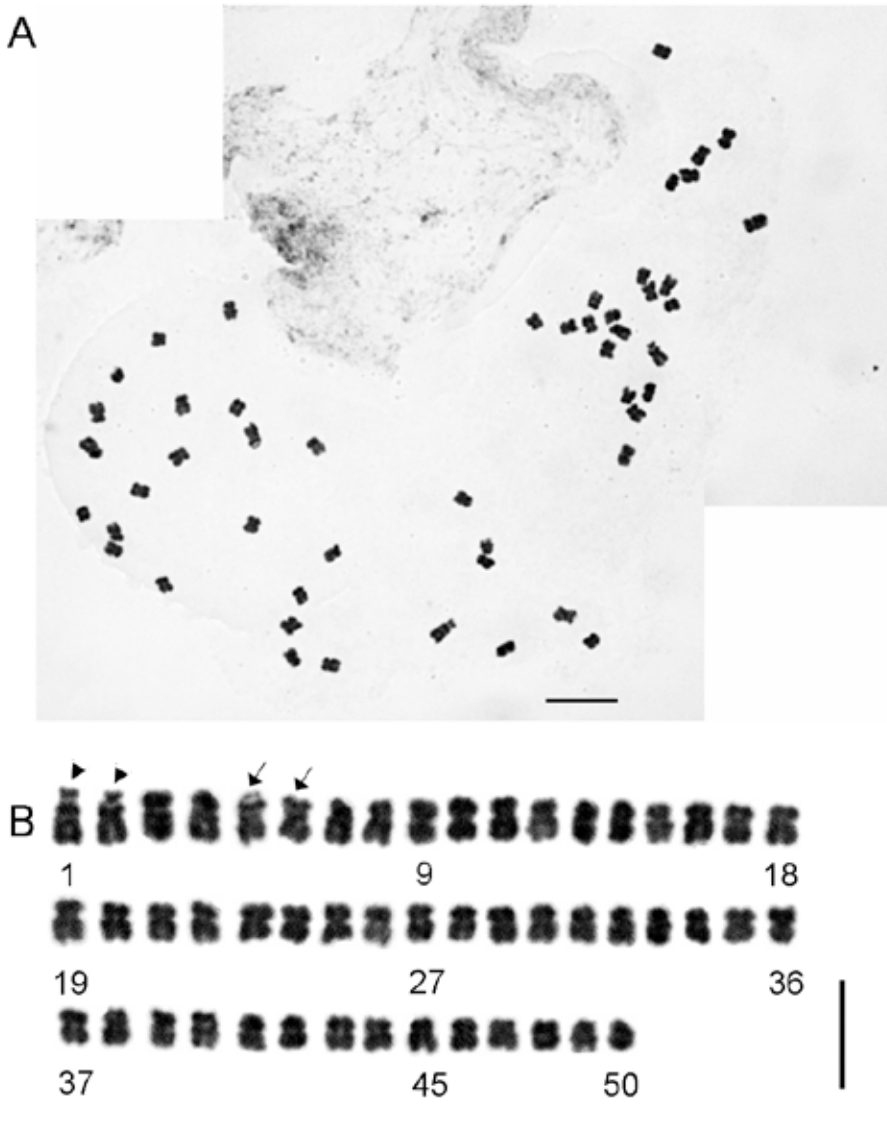


Fig. 1. Photograph at somatic metaphase chromosome of *Coleus formosanus*. A. Somatic metaphase. B. Karyotype. Arrows indicate chromosome arms with satellites and arrowheads indicate chromosome arms with second constrictions. Bars indicate 5 μ m.

correspond to any base number in these basic chromosome numbers. *Coleus formosanus* with $2n = 50$ chromosomes may be an aneuploid plant. Thus, in order to elucidate the basic chromosome number of this species, this study was performed to clarify the karyotype of *C. formosanus*.

A plant of *C. formosanus* collected in

Yonaguni Island, Yonaguni-cho, Yaeyama-gun, Okinawa Prefecture, and then cultivated in the experimental garden at the Faculty of Science, University of Toyama was used for the study. The karyotype was determined using a meristematic cell obtained from a root tip subjected to the ordinal squash technique. Newly formed root tips sprouted from the

Table 1. Previous reports for the chromosome numbers in *Coleus*

Taxon	Chromosome number		Reference
	n	2n	
<i>C. amboinicus</i> Lour.	34		Mehra and Gill (1968, 1972), Gill (1984)
		34	Hsieh and Huang (1998)
		56	Krishnappa and Basavaraj (1982)
<i>C. aromaticus</i> Benth.	16		Scheel (1931)
	17		Saggoo and Bir (1983), Bir and Saggoo (1985)
<i>C. barbatus</i> Benth.	17		Bir and Saggoo (1979, 1982)
		30	Cherian and Kuriachan (1981)
		32	Riley and Hoff (1961), Hakeen and Rife (1966)
var. <i>verschaffeltii</i> (Lem.) Lem.		48–52	Huang et al. (1989)
<i>C. blumei</i> Benth.	12		Koul et al. (1976)
	24		Furusato (1940), Reddy (1952), Hakeen and Rife (1966), Mehra and Gill (1972), Bir and Saggoo (1985), Gill (1984)
	25	(48+1)	Reddy (1952)
	36		Reddy (1952)
		30	Singh (1985)
		48	Reddy (1952), Hakeen and Rife (1966), Huziwara (1968)
		ca.48	Morton (1962)
<i>C. carnosus</i> Hassk.		28	Morton (1962)
<i>C. comosus</i> Hochst. ex Gurke		32	de Wet (1958)
<i>C. esculentus</i> (N. E. Br.) G. Taylor		24	de Wet (1958)
<i>C. formosanus</i> Hayata		50	Hsieh and Huang (1998)
<i>C. forskohlii</i> Briq.	15		Mehra and Gill (1972), Saggoo and Bir (1983), Gill (1984), Bir and Saggoo (1985), Bahl and Tyagi (1988)
	17		Saggoo and Bir (1983)
		28	Reddy (1952)
		30	Krishnappa and Basavaraj (1982)
<i>C. frederici</i> G. Taylor		28	Morton (1962)
<i>C. ×hybridus</i> Hort.		48	Reddy (1952)
<i>C. laciniatus</i> Benth.	24		Reddy (1952)
<i>C. lanuginosus</i> Hochst. ex Benth.		30	Morton (1962)
<i>C. malabaricus</i> Benth.	14		Saggoo and Bir (1982, 1983), Bir and Saggoo (1985)
		28	Krishnappa and Basavaraj (1982), Cherian and Kuriachan (1984)
<i>C. parviflorus</i> Benth.	24	48	Vasudevan et al. (1967)
		56	Mukherjee (1959)
		64	Raghavan (1958)
<i>C. pentheri</i> Gurke ex Zahlbr.		32	de Wet (1958), Riley and Hoff (1961)
<i>C. rehmannii</i> Briq.		48, 60	de Wet (1958)
<i>C. rehnelianus</i> A. Berger	ca.24		Scheel (1931)
<i>C. scutellarioides</i> (L.) Benth.		48	Borgmann (1964)
<i>C. shirensis</i> Gurke		34	Morton (1962)
<i>C. spicatus</i> Benth.		30	Cherian and Kuriachan (1984)
<i>C. thyrsoideus</i> Baker	14		Cherian and Kuriachan (1984)
<i>C. vagatus</i> E. A. Bruce		32	de Wet (1958)

Table 2. Measurements of somatic metaphase chromosomes in *Coleus formosanus*

Chromosome pair	Length (μm)	Arm ratio	Form
1	$0.5 + 0.6 + 1.4 = 2.5$	2.3	sm
2	$0.8 + 1.4 = 2.2$	1.8	sm
3	$t + 0.7 + 1.3 = 2.0$	1.9	sm
4	$0.6 + 1.4 = 2.0$	2.3	sm
5	$1.0 + 1.0 = 2.0$	1.0	M
6	$0.9 + 1.0 = 1.9$	1.1	m
7	$0.9 + 0.9 = 1.8$	1.0	M
8	$0.8 + 0.9 = 1.7$	1.1	m
9	$0.8 + 0.9 = 1.7$	1.1	m
10	$0.8 + 0.9 = 1.7$	1.1	m
11	$0.8 + 0.9 = 1.7$	1.1	m
12	$0.8 + 0.9 = 1.7$	1.1	m
13	$0.8 + 0.9 = 1.7$	1.1	m
14	$0.7 + 0.9 = 1.6$	1.3	m
15	$0.7 + 0.8 = 1.5$	1.1	m
16	$0.7 + 0.8 = 1.5$	1.1	m
17	$0.6 + 0.8 = 1.4$	1.3	m
18	$0.6 + 0.8 = 1.4$	1.3	m
19	$0.6 + 0.8 = 1.4$	1.3	m
20	$0.6 + 0.7 = 1.3$	1.2	m
21	$0.6 + 0.7 = 1.3$	1.2	m
22	$0.6 + 0.7 = 1.3$	1.2	m
23	$0.6 + 0.7 = 1.3$	1.2	m
24	$0.6 + 0.6 = 1.2$	1.0	M
25	$0.5 + 0.6 = 1.1$	1.2	m

cultivated plant were collected, pretreated in 2mM 8-hydroxyquinolin at room temperature (ca. 25°C) for 1 hour, and incubated at 5°C for 15 hours. Then the root tip was fixed with a mixture of glacial acetic acid and ethyl alcohol (1:3) for 1 hour, soaked in 1N hydrochloric acid at room temperature for 1 hour, macerated in 1N hydrochloric acid at 60°C for 10 minutes, washed in tap water, and then stained in a drop of 2% lacto-propionic orcein on a slide glass. Chromosome forms were described based on the nomenclature proposed by Levan et al. (1964).

This plant had $2n = 50$ chromosomes (Fig.

1A), in consistent with Taiwanese *C. formosanus* by Hsieh and Huang (1998). The chromosomes at metaphase ranging from 1.1 μm to 2.5 μm in length and 1.0 to 2.3 in arm ratio (Fig. 1B, Table 2). In the chromosome complement, the longest four pairs were all submetacentric and the other 21 pairs were all metacentric (Table 2). Within the four longest submetacentric pairs, the first and the third longest pairs had second constrictions and satellites on their short arms. The karyotype is thus formulated as $2n = 50 = 42m + 4sm + 2^{sc}sm + 2^t sm$, and shows that this species has a new basic chromosome number of $x = 25$. This basic chromosome number is the largest within the basic chromosome numbers known in this genus.

This work was supported in part by a Reserch Fellowship for Young Scientists from the Japan Society for the Promotion of Science (no. 20011439).

References

- Bahl J. R. and Tyagi B. R. 1988. Pachytene chromosomes of *Coleus forskohlii*. *Curr. Sci.* **57**: 326–328.
- Bir S. S. and Saggoo M. I. S. 1979. IOPB chromosome number reports LXXV. *Taxon* **28**: 630–631.
- Bir S. S. and Saggoo M. I. S. 1982. Cytology of some members of *Labiatae* from Central India. *Proc. Natl. Acad. Sci. India B.* **52**: 107–112.
- Bir S. S. and Saggoo M. I. S. 1985. Cytological studies on members of family *Labiatae* from Kodaikanal and adjoining areas (South India). *Proc. Indian Acad. Sci. Pl. Sci.* **94**: 619–626.
- Borgmann E. 1964. Anteil der polyploidien in der flora des Bismarckgebirges von Ostneuguinea. *Z. Bot.* **52**: 118–172.
- Cherian M. and Kuriachan P. I. 1981. IOPB chromosome number reports LXXII. *Taxon* **30**: 707–708.
- Cherian M. and Kuriachan P. I. 1984. IOPB chromosome numbers reports LXXXII. *Taxon* **33**: 127–128.
- Darlington C. D. and Wylie A. P. 1955. *Chromosome Atlas of Flowering plants*. 2nd ed. p. 325. George Allen and Unwin, London.
- de Wet J. M. J. 1958. Chromosome numbers in *Plectranthus* and related genera. *S. African. J. Sci.* **54**(6): 153–156.
- Furusato K. 1940. Polyploid plants produced by colchicine. *Bot. & Zool.* **8**: 1303–1311 (in Japanese with English résumé).

- Gill L. S. 1984. The incidence of polyploidy in the West-Himalayan *Labiatae*. *Rev. Cytol. Biol. Botaniste* **7**: 5–16.
- Hakeem H. and Rife D. C. 1966. Cytogenetic studies on *Coleus*. *U. A. R. J. Bot.* (9): 35–44.
- Hsieh T.-H. and Huang T.-C. 1998. Notes on the flora of Taiwan (32) –Miscellaneous notes on *Lamiaceae* of Taiwan. *Taiwania* **43**(1): 38–58.
- Huang S.-F., Zhao Z.-F., Chen Z.-Y., Chen S.-J. and Huang X.-X. 1989. Chromosome counts on one hundred species and infraspecific taxa. *Acta Bot. Austro Sin.* (5): 161–176 (in Chinese with English abstract).
- Huziwara Y. 1968. Chromosome studies on some species of angiospermae II. *La Kromosomo* (72-73): 2360–2363 (in Japanese with English summary).
- Koul A. K., Wakhlu A. K. and Karihaloo J. L. 1976. Chromosome numbers of some flowering plants of Jammu (Western Himalayas). II. *Chromosome Infor. Serv.* (20): 32–33.
- Krishnappa D. G. and Basavaraj I. 1982. IOPB chromosome number reports LXXV. *Taxon* **31**: 361–362.
- Levan A., Fredga K. and Sandberg A. A. 1964. Nomenclature for centromeric position on chromosomes. *Hereditas* (Lund) **52**: 201–220.
- Mehra P. N. and Gill L. S. 1968. IOPB chromosome number reports XVIII. *Taxon* **17**: 420–421.
- Mehra P. N. and Gill L. S. 1972. Cytology of West Himalayan *Labiatae*: tribe *Ocimoideae*. *Cytologia* **37**: 53–57.
- Morton J. K. 1962. Cytotaxonomic studies on the West African *Labiatae*. *J. Linn. Soc. Bot.* **58**(372): 231–283, pls. 1–2.
- Mukherjee S. 1959. A note on the chromosomes of *Coleus parviflora*. *Indian J. Genet. Pl. Breed.* **19** (1): 116–118.
- Murata G. and Yamazaki T. 1993. *Coleus* Lour. In: Iwatsuki K., Yamazaki T., Boufford D. E. and Ohba H. (eds.), *Flora of Japan IIIa*: 309. Kodansha, Tokyo.
- Raghavan R. S. 1958. A note on *Coleus parviflorus* Benth. *Curr. Sci.* **27**: 448.
- Reddy N. S. 1952. Chromosome numbers in *Coleus*. *J. Heredity* **43**(5): 233–237.
- Riley H. P. and Hoff V. J. 1961. Chromosome studies in some South African Dicotyledons. *Canad. J. Genet. Cytol.* **3**: 260–271.
- Saggoo M. I. S. and Bir S. S. 1982. IOPB chromosome number reports LXXVI. *Taxon* **31**: 593–595.
- Saggoo M. I. S. and Bir S. S. 1983. Cytopalynological studies on Indian members of *Acanthaceae* and *Labiatae*. *J. Palynol.* **19**: 243–277.
- Scheel M. 1931. Karyologische Untersuchung der Gattung *Salvia*. *Bot. Arch.* **32**: 148–208.
- Singh T. P. 1985. Improved technique for chromosome study in some members of *Labiatae*. *Curr. Sci.* **54**: 242–243.
- Singh T. P. 1995. Alterations in the basic chromosome numbers as a means of speciation in *Labiatae*. *Feddes Report* **106**: 39–47.
- Vasudevan K. N., Jos J. S. and Magoon M. L. 1967. Studies on desynapsis in *Coleus*. *J. Cytol. Genet.* **2**: 69–75.

ケサヤバナ *Coleus formosanus* は日本、台湾、フィリピンに分布し、日本では与那国島にのみ知られている (Murata and Yamazaki 1993)。染色体数は台湾産で $2n = 50$ (Hsieh and Huang 1998) が報告されている。本属はさまざまな染色体数が報告され (Table1)、基本数も $x = 6, 7, 8, 9, 12, 14, 15, 16, 17, 18$ とさまざまである。本種の基本数を明らかにすることを目的にケサヤバナの核型を観察した。その結果、ケサヤバナの染色体数は $2n = 50$ であり、台湾産のものによる Hsieh and Huang (1998) の報告と一致した。中期の染色体長は $1.1\text{--}2.5\ \mu\text{m}$ 、腕比は $1.0\text{--}2.3$ であった。最初の 4 対 (1–8 番目) は次中部動原体型で、残りの 21 対は中部動原体型であった。第 1 対では二次狭窄、第 3 対では付随体が観察された。染色体構成は $2n = 50 = 42m + 4sm + 2^{sc}sm + 2^{st}sm$ であった。染色体基本数は $x = 25$ と考えられた。

^aGraduate School of Science and Engineering,
University of Toyama,
3190, Gofuku, Toyama, 930-8555 JAPAN;
930-8555 富山市五福 3190
富山大学大学院理工学教育部,
^bDepartment of Biology, Faculty of Science,
University of Toyama,
3190, Gofuku, Toyama, 930-8555 JAPAN;
E-mail: iwatsubo@sci.u-toyama.ac.jp
930-8555 富山市五福 3190
富山大学理学部生物学科)