

Cytotaxonomical Studies of *Rubus* (Rosaceae) I. Chromosome Numbers of 20 Species and 2 Natural Hybrids

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キイチゴ属（バラ科）の細胞分類学的研究 I.

20種ならびに2自然雑種の染色体数

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Chromosome numbers are presented for 20 species and 2 natural hybrids of *Rubus*. Chromosome numbers were determined for the first time for *Rubus chingii* ($2n=14$), *R. croceacanthus* ($2n=14$), *R. ichangensis* ($2n=28$), *R. ikenoensis* ($2n=14$), *R. lambertianus* ($2n=28$), *R. pungens* ($2n=14$), *R. sumatranus* ($2n=14$), *R. × tawadanus* ($2n=21$) and *R. × toyorensis* ($2n=14$). Previously published chromosome numbers for *R. acuminatus*, *R. crataegifolius*, *R. ellipticus*, *R. hirsutus*, *R. microphyllus*, *R. nishimuranus*, *R. palmatus*, *R. pedatus*, *R. peltatus*, *R. sieboldii*, *R. spectabilis* and *R. trifidus* were verified. *Rubus rugosus*, previously reported as diploid ($2n=14$), showed a new count of $2n=56$.

Polyploidy is predominantly an irreversible trend from lower to higher levels (Stebbins 1971), and ploidy level offers useful information for considering plant phylogeny. *Rubus* is known as a genus having a polyploid series, based on $x=7$, from diploid ($2n=14$) to dodecaploid ($2n=84$) (Fedorov 1969) with the subgenus *Rubus* especially abundant in polyploids (Grant 1981). However, chromosome numbers of many species in the genus remain unexamined. This paper is the first report of our chromosome counts on *Rubus* and deals with the somatic numbers of 20 species and 2 natural hybrids.

Materials and methods

Twenty species and two natural hybrids of *Rubus* cultivated in the botanic garden of Toyama University were used for this investigation. The taxa studied and the original collection localities are listed in Table 1. For the observation of chromosomes, root tips were collected from potted plants, pretreated in a 2mM 8-hydroxyquinoline solution for one hour at room temperature, and subsequently held at 5°C for 15 hours. After fixation in a 1:3 acetic acid and ethyl alcohol mixture for one hour, the root tips were hydrolyzed in 1N HCl at 60°C for 6 minutes, and then immersed in distilled water. The meristematic cells

Table 1. Collection locality or source of studied taxa in *Rubus*.

Species or hybrid	Collection locality or source
<i>R. acuminatus</i> Smith	Godawari, Kathmandu Valley, Lalitpur, Nepal
<i>R. chingii</i> Hu	Tokuji-cho, Saba-gun, Yamaguchi Pref.*
<i>R. crataegifolius</i> Bunge	Kakizaki-cho, Nakakubiki-gun, Niigata Pref.* Ao, Himi-shi, Toyama Pref.* Yamada-mura, Nei-gun, Toyama Pref.*
<i>R. croceacanthus</i> Lévl.	Nishikitoge, Kisei-cho, Watarai-gun, Mie Pref.*
<i>R. ellipticus</i> Smith	Pakhribas, Sankhuwa Sabha Dist., Koshi Zone, Nepal
<i>R. hirsutus</i> Thunb.	Makino-cho, Takashima-gun, Shiga Pref.* Yamakamimachi, Otsu-shi, Shiga Pref.* Ao, Himi-shi, Toyama Pref.*
<i>R. ichangensis</i> Hemsl. et Kuntze	Mt. Omei, Sichuan sheng, China
<i>R. ikenoensis</i> Lévl. et Vnt.	Osaka-cho, Mashita-gun, Gifu Pref.*
<i>R. lambertianus</i> Ser.	Mayuyama, Shimabara-shi, Nagasaki Pref.*
<i>R. microphyllus</i> L. f.	Yamakamimachi, Otsu-shi, Shiga Pref.*
<i>R. nishimuranus</i> Koidz.	Chichijima, Ogasawara-shicho, Tokyo Pref.*
<i>R. palmatus</i> Thunb. ex Murray	Makino-cho, Takashima-gun, Shiga Pref.* Yamakamimachi, Otsu-shi, Shiga Pref.* Ao, Himi-shi, Toyama Pref.*
<i>R. pedatus</i> Smith	Amakazariyama, Itoigawa-shi, Niigata Pref.*
<i>R. peltatus</i> Maxim.	Osaka-cho, Mashita-gun, Gifu Pref.* Ootaki-mura, Kiso-gun, Nagano Pref.*
<i>R. pungens</i> Camb.	Oomi-cho, Nishikubiki-gun, Niigata Pref.* Kunego, Yuzawa-shi, Akita Pref.*
<i>R. rugosus</i> Smith	Godawari, Kathmandu Valley, Lalitpur, Nepal
<i>R. sieboldii</i> Blume	Mogi, Nagasaki-shi, Nagasaki Pref.*
<i>R. spectabilis</i> Pursh	New Port, Oregon State, USA
<i>R. sumatranus</i> Miq.	Gifu-shi, Gifu Pref.*
<i>R. × tawadanus</i> Koidz.	Kanegadan, Gushikawa-shi, Okinawa Pref.*
<i>R. × toyorensis</i> Koidz.	Marunouchi, Kanazawa-shi, Ishikawa Pref.* Maruyama-cho, Shimonoseki-shi, Yamaguchi Pref.*
<i>R. trifidus</i> Thunb. ex Murray	Marunouchi, Kanazawa-shi, Ishikawa Pref.* Sumiyoshi, Ryotu-shi, Niigata Pref.*

*: in Japan

were stained in 1.5% lacto-propionic orcein and squashed in the usual method.

Results and discussion

The somatic chromosome numbers found in the present observation were: $2n = 14$ in *R. chingii*, *R. crataegifolius*, *R. croceacanthus*, *R. ellipticus*, *R. hirsutus*, *R. ikenoensis*, *R. microphyllus*, *R. palmatus*, *R. pedatus*, *R. peltatus*, *R. pungens*, *R. spectabilis*, *R. sumatranus*, *R. × toyorensis* and *R. trifidus*; $2n = 21$ in *R. × tawadanus*; $2n = 28$ in *R. acuminatus*, *R. ichangensis*, *R. lambertianus*, *R. nishimuranus* and *R. sieboldii*; $2n = 56$ in *R.*

rugosus (Fig. 1, Table 2). As the basic chromosome number of the *Rubus* is $x = 7$ (Fedorov 1969), these counts were interpreted as diploid, triploid, tetraploid and octoploid levels, respectively. These are the first chromosome counts to be published for 7 species and 2 natural hybrids: *Rubus chingii*, *R. croceacanthus*, *R. ichangensis*, *R. ikenoensis*, *R. lambertianus*, *R. pungens*, *R. sumatranus*, *R. × tawadanus* and *R. × toyorensis*. Counts for 12 species substantiate those previously reported. *Rubus rugosus* had been reported by Malla et al. (1975) and Subramanian (1987) to be a diploid with $n = 7$ and $2n = 14$, respectively, whereas our plant

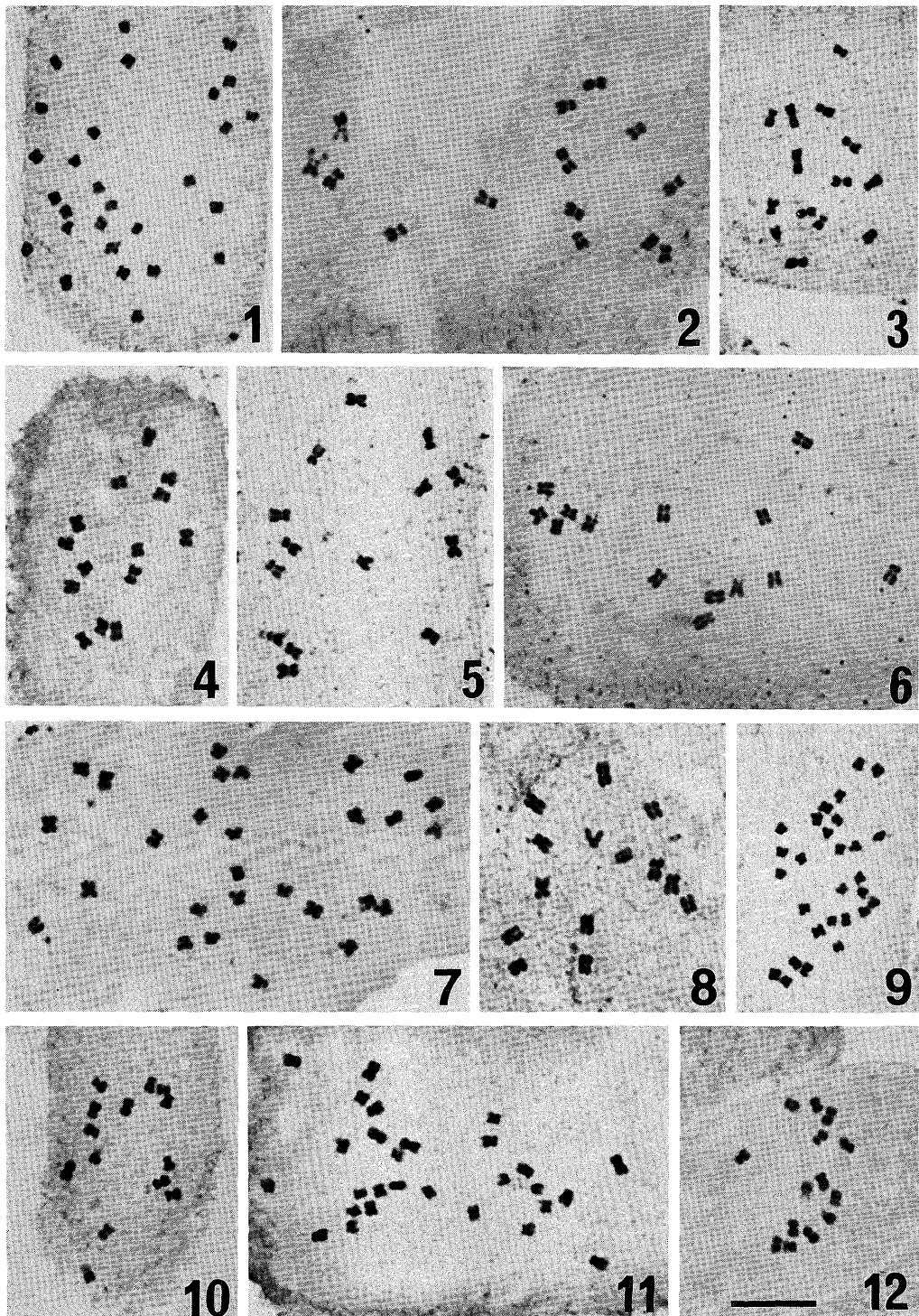


Fig. 1. Somatic metaphase chromosomes of 20 species and 2 natural hybrids of *Rubus*. 1. *R. acuminatus* ($2n=28$). 2. *R. chingii* ($2n=14$). 3. *R. crataegifolius* ($2n=14$). 4. *R. croceacanthus* ($2n=14$). 5. *R. ellipticus* ($2n=14$). 6. *R. hirsutus* ($2n=14$). 7. *R. ichangensis* ($2n=28$). 8. *R. ikenoensis* ($2n=14$). 9. *R. lambertianus* ($2n=28$). 10. *R. microphyllus* ($2n=14$). 11. *R. nishimuranus* ($2n=28$). 12. *R. palmatus* ($2n=14$). Bar represents $7\ \mu\text{m}$.

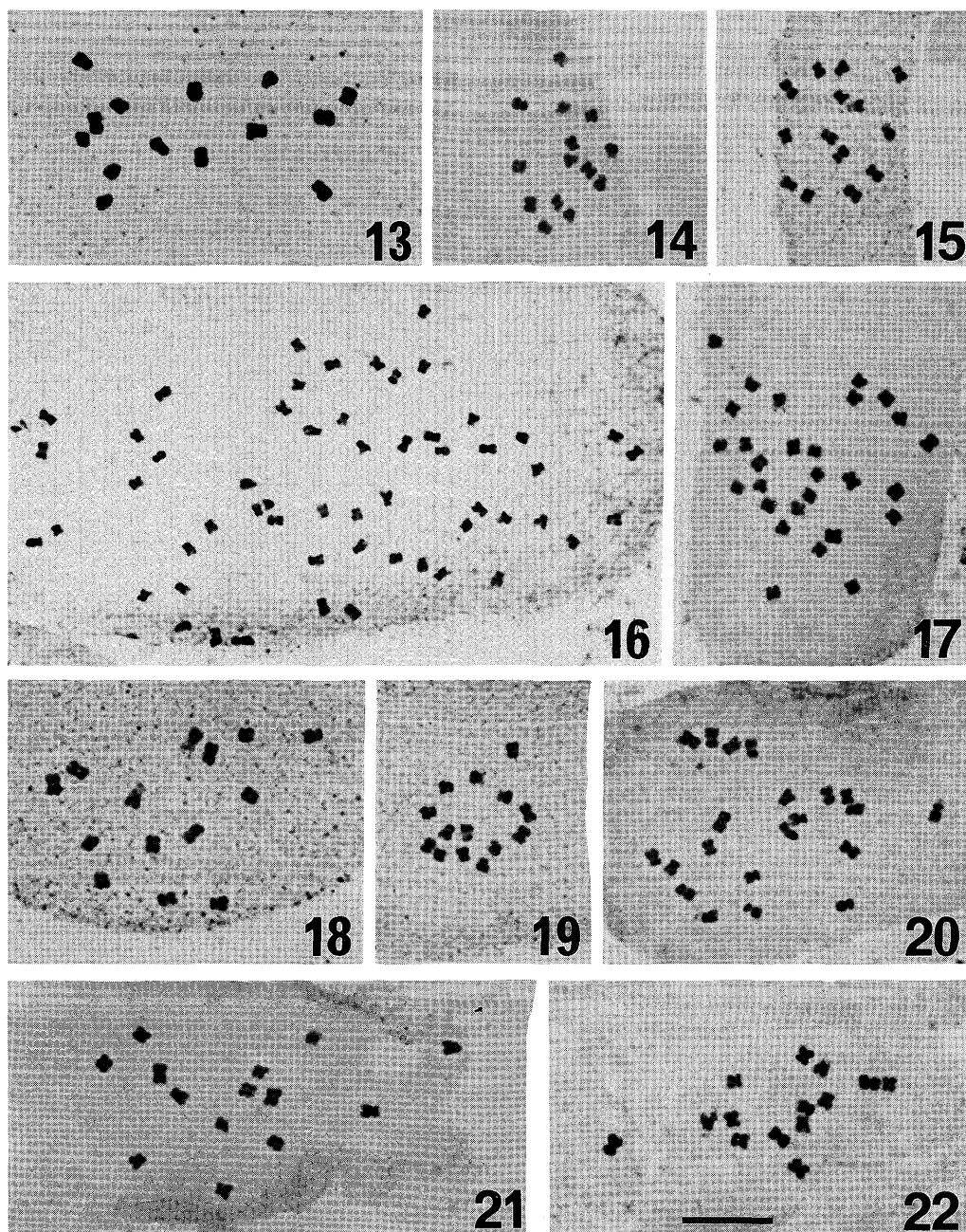


Fig. 1 (continued). 13. *R. pedatus* ($2n=14$). 14. *R. peltatus* ($2n=14$). 15. *R. pungens* ($2n=14$). 16. *R. rugosus* ($2n=56$). 17. *R. sieboldii* ($2n=28$). 18. *R. spectabilis* ($2n=14$). 19. *R. sumatranus* ($2n=14$). 20. *R. × tawadanus* ($2n=21$). 21. *R. × toyorensis* ($2n=14$). 22. *R. trifidus* ($2n=14$). Bar represents 7 μm .

Table 2. Present and previous cytological studies of examined taxa in *Rubus*.

Species	Present counts (2n)	Previous counts (n) (2n)	References
<i>R. acuminatus</i> Smith	28	28	Gustafsson (1933)
<i>R. chingii</i> Hu	14*		
<i>R. crataegifolius</i> Bunge	14	14	Petrov and Dgironkina in Fedorov (1969)
<i>R. croceacanthus</i> Lévl.	14*		
<i>R. ellipticus</i> Smith	14	14	Malik (1965)
<i>R. hirsutus</i> Thunb.	14	14	Jinno (1958a, 1958b)
<i>R. ichangensis</i> Hemsl. et Kuntze	28*		
<i>R. ikenoensis</i> Lévl. et Vnt.	14*		
<i>R. lambertianus</i> Ser.	28*		
<i>R. microphyllus</i> L. f.	14	14	Jinno (1958a)
<i>R. nishimuranus</i> Koidz.	28	28	Ono (1977)
<i>R. palmatus</i> Thunb. ex Murray	14	14**	Jinno (1951b, 1958a, 1958b)
<i>R. pedatus</i> Smith	14	14	Sokolovskaya and Probatoba (1985)
<i>R. peltatus</i> Maxim.	14	14	Jinno (1958a)
<i>R. pungens</i> Camb.	14*		
<i>R. rugosus</i> Smith	56*	7	Malla et al. (1975)
		14	Subramanian (1987)
<i>R. sieboldii</i> Blume	28	28	Jinno (1951a, 1958a, 1958b)
<i>R. spectabilis</i> Pursh	14	14	Darrow and Logley (1933)
<i>R. sumatranus</i> Miq.	14*		
<i>R. × tawadanus</i> Koidz.	21*		
<i>R. × toyorensis</i> Koidz.	14*		
<i>R. trifidus</i> Thunb. ex Murray	14	14	Jinno (1951b, 1958a, 1958b)

*: First record of chromosome numbers. **: Given as the name, *Rubus palmatoides* O. Kuntze by Jinno.

collected in Nepal had $2n = 56$ chromosomes. The chromosome number of *R. palmatus* cited herein is consistent with that reported for *R. palmatoides* by Jinno (1951b, 1958a, 1958b). *Rubus palmatus* is considered to be synonymous with *R. palmatoides* (Ohwi 1965, Kitamura and Murata 1981).

In general, the chromosome number of natural hybrids is intermediate between that of the two parents when parents have different numbers and the same as the parents when both parents have the same number. In this study, two natural hybrids were investigated. *Rubus × toyorensis*, considered to be a natural hybrid between two diploid

species, *R. hirsutus* and *R. trifidus* (Hatushima 1938, Ohwi 1965), is diploid. *Rubus × tawadanus*, considered to be a hybrid between the diploid *R. parvifolius* and the tetraploid *R. sieboldii* (Migo 1970, Hatushima 1971), is triploid. Thus, each of the chromosome counts of the two natural hybrids were coincided with the expected numbers, $2n = 14$ in *R. × toyorensis* and $2n = 21$ in *R. × tawadanus*.

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要旨

キイチゴ属20種ならびに2自然雑種について染色体数を調査した。それぞれの染色体数は、*Rubus acuminatus* ($2n=28$), *R. chingii* ($2n=14$), *R. crataegifolius* ($2n=14$), *R. croceacanthus* ($2n=14$), *R. ellipticus* ($2n=14$), *R. hirsutus* ($2n=14$), *R. ichangensis* ($2n=28$), *R. ikenoensis* ($2n=14$), *R. lambertianus* ($2n=28$), *R. microphyllus* ($2n=14$), *R. nishimuranus* ($2n=28$), *R. palmatus* ($2n=14$), *R. pedatus* ($2n=14$), *R. peltatus* ($2n=14$), *R. pungens* ($2n=14$), *R. rugosus* ($2n=56$), *R. sieboldii* ($2n=28$), *R. spectabilis* ($2n=14$), *R. sumatranus* ($2n=14$), *R. × tawadanus* ($2n=21$), *R. × toyorensis* ($2n=14$), *R. trifidus* ($2n=14$)であった。このうち*Rubus chingii*, *R. croceacanthus*, *R. ichangensis*, *R. ikenoensis*, *R. lambertianus*, *R. pungens*, *R. sumatranus*, *R. × tawadanus*, *R. × toyorensis*の染色体数は、今回初めて明らかにされた。さらに*R. rugosus*については、従来 $n=7$, $2n=14$ と報告されていたが、新たに $2n=56$ の8倍体が確認された。その他の12種は従来報告と一致した。