

新雑種ビロードゴシヨイチゴ

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Naohiro Naruhashi*, Chisato Sugibayashi**, Yoshikane Iwatsubo*
and Hisashi Masaki***: A New Natural Hybrid,
Rubus × *pseudochingii* (Rosaceae), from Japan

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新雑種ビロードゴショイチゴ

Abstract

A new hybrid of *Rubus* plant was discovered in Yamaguchi Pref., Japan. It has several morphological features intermediate between *R. chingii* and *R. corchorifolius*. Karyotype and meiotic chromosome behaviours in PMC were also studied on the putative hybrid. Based on these studies the plant named here *R. ×pseudochingii* is described.

Key words: chromosome, description, hybrid, morphology, *Rubus ×pseudochingii*.

The present new plant was discovered by Naruhashi and Masaki at Shiraidani, Tokuji-cho, in Yamaguchi Pref. in 1986, when they visited the original habitat of *Rubus ×calopalmatus* for the morphological and ecological observations. In the place where this new plant was growing, *R. chingii* and *R. corchorifolius* also occurred. The plant has been cultivated from 1986 at the Botanic Garden of Toyama University.

The new plant may be a natural hybrid between *R. chingii* and *R. corchorifolius*, because the gross morphology is intermediate between the two species. In this study, the morphology of the three taxa was critically compared. The chromosome number, karyotype and meiotic chromosomes at metaphase I in PMC were examined for the purpose of analysing hybrid nature of the plant.

The new plant is named *Rubus ×pseudochingii*, because the plant is similar to *R. chingii*.

Materials and Methods

Sampling sites of the materials are as follows:

Rubus chingii: Shitenokigawa 250m alt., Notani, Tokuji-cho, Saba-gun, Yamaguchi Pref.; Kamikawauchi 130m alt., Yasakakami, Tokuji-cho, Saba-gun, Yamaguchi Pref.; cult. at Toyama Univ. from Shiraidani, Tokuji-cho, Saba-gun, Yamaguchi Pref.

R. corchorifolius: Shinokidani, Notani, Tokuji-cho, Saba-gun, Yamaguchi Pref.; Shiraidani 200m alt., Tokuji-cho, Saba-gun, Yamaguchi Pref.; Chausuyama 210m alt., Kudamatsu-shi, Yamaguchi Pref.

R. ×pseudochingii: cult. at Toyama Univ. from Shiraidani, Tokuji-cho, Saba-gun, Yamaguchi Pref.

Height and diameter of stem, diameter of flower, length and width of petal, number of stamens and pistils per flower, size of aggregate fruit, number of stones, and size of stone were measured.

Karyotypes were examined in meristematic cells of root tips, and chromosome pairing was investigated in pollen mother cells (PMCs). For examination of the karyotype, root tips collected

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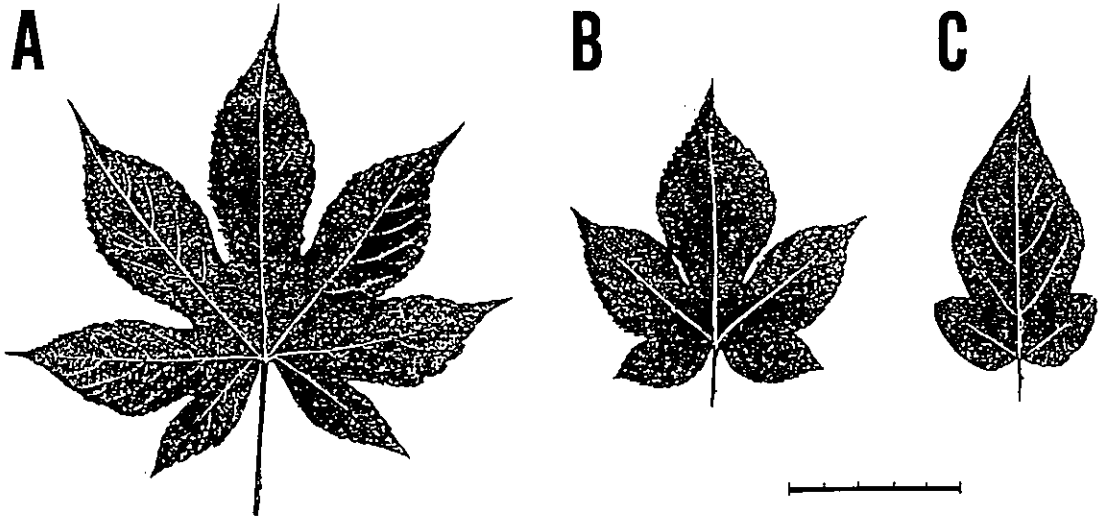


Fig. 1. Leaf shapes on primocane. A, *R. chingii*; B, *R. x pseudochingii*, C, *R. corchorifolius*. (bar represents 5cm)

from potted plants were pretreated in 0.002M 8-hydroxyquinoline solution at 25°C for one hour and then kept at 5°C for 15 hr. The root tips were fixed in a 1:3 acetic acid and ethyl alcohol mixture for one hour, soaked in 1N HCl for a few hours, macerated in 1N HCl at 60°C for 11.5 min. and then immersed in tap water. Root tips were stained and squashed in 1.5% lacto-propionic

orcein. Chromosome forms were expressed according to the nomenclature of Levan *et al.* (1964). For studies of meiotic chromosomes, young flower buds were fixed in Newcomer's fluid at 17°C for 3 hr. and macerated with the same procedure as for the root tips. After being stained with Schiff's reagent, the anthers were stained and squashed in 1.5% lacto-propionic

Table 1. Measurements of stem

	<i>R. chingii</i>	<i>R. x pseudochingii</i>	<i>R. corchorifolius</i>
Height (cm)	277.0±56.1*	252.6±52.4	191.6±56.1
(range)	165-349	185-292	113-289
	(n=21)**	(n=9)	(n=13)
Diameter (mm)	14.3±4.8	13.3±2.8	8.5±4.8
(range)	8-27	9.5-18	5-12
	(n=21)	(n=16)	(n=13)

*: Mean±SD, **: Number of samples.

Table 2. Diameter of flowers (cm)

	<i>R. chingii</i>	<i>R. x pseudochingii</i>	<i>R. corchorifolius</i>
Nodani	3.7±0.3		2.1±0.2
(range)	3.0-5.0		1.8-2.6
	(n=88)		(n=100)
Shiraidani			2.2±0.2
(range)			1.8-2.6
			(n=100)
Yasakakami	4.5±0.4		
(range)	3.8-5.2		
	(n=100)		
Toyama	4.7±0.5	3.1±0.3	2.4±0.3
(range)	3.6-6.0	2.4-3.6	1.6-3.2
	(n=120)	(n=106)	(n=99)

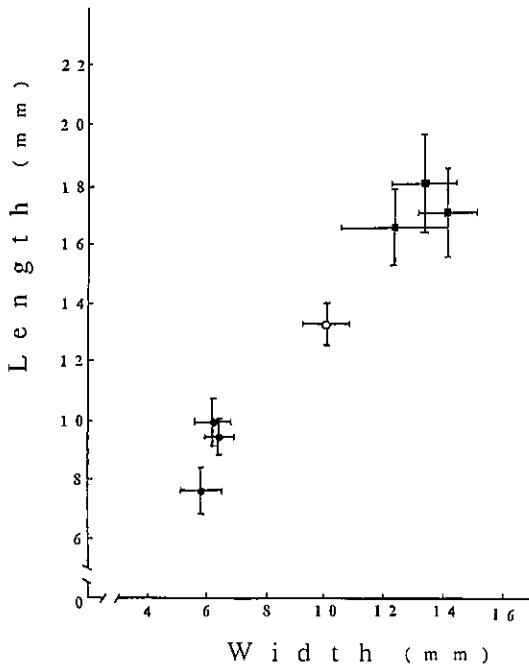


Fig. 2. Size of petal. Solid square, *R. chingii*; open circle, *R. x pseudochingii*; solid circle, *R. corchorifolius*.

orcein and chromosome pairing was examined in PMCs.

Pollen fertility was estimated on the basis of size and stainability in 1.5% lacto-propionic-orcein.

Results and Discussion

Height and diameter of the stems are shown in Table 1. Stems of *R. x pseudochingii* were intermediate between those of *R. chingii* and *R. corchorifolius*.

The primocane leaves of *R. chingii* are palmate with 7 lobes, while those of *R. corchorifolius* are palmate with 3 lobes. *Rubus x pseudochingii* has five lobed palmate simple leaves and is intermediate between that of *R. chingii* and *R. corchorifolius* (Fig. 1).

Opening pattern of flowers in *Rubus* is very variable. However, these three taxa are very similar, i.e., flowers hanging and petals horizontally opening or nearly so. Diameter of flowers for flower measurements is given in Table 2. Other measurements of flower are illustrated in Fig. 2 and Fig. 3. *Rubus x pseudochingii* is intermediate in the flower size, petal size, and number of stamens and pistils.

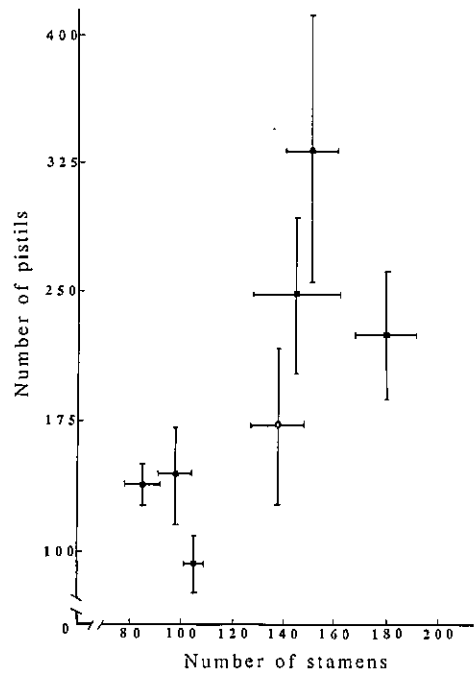


Fig. 3. Number of stamens and pistils. Solid square, *R. chingii*; open circle, *R. x pseudochingii*; solid circle, *R. corchorifolius*.

Some of *Rubus* hybrids such as *R. x tawadanus* (Iwatsubo and Naruhashi, 1993) and *R. x calopal-matus* (Masaki and Naruhashi, 1992) produce no fruits. This hybrid, however, makes fruits. *Rubus* fruits are so-called aggregate fruits consisting of small fruitlets. The aggregate fruits of *R. x pseudochingii* are ovoidal globose and reddish orange in color. Many dense short hairs occur on the surface of the fruitlet. Characters of the fruit of three taxa are very similar to each other except for the size. Sizes of aggregate fruit are shown in Fig. 4.

The fruitlet of *Rubus* is a drupelet containing lignified inner wall of carpel. One fruitlet contains one stone. Therefore stone number per flower means number of fruitlets per aggregate fruit. Number of stones per flower is shown in Table 3. *Rubus x pseudochingii* is 172 in mean number of pistils per flower and 39 in mean number of stones per flower. This means the low rate of fertility of pistils of the plant. Measurement parts for stone are shown in Fig. 5 and the result in Table 4. The stones of *R. x pseudochingii* are larger than *R. chingii* and *R. corchorifolius*. This might be related to small number of stones per flower.

Table 3. Number of stones per flower

	<i>R. chingii</i>	<i>R. × pseudochingii</i>	<i>R. corchorifolius</i>
Nodani	129.8±39.1 (n=30)		97.7±26.9 (n=30)
Shiraidani			119.3±23.2 (n=30)
Kawauchi	257.0±76.0 (n=48)		
Chausuyama			88.4±39.0 (n=30)
Nagaho			116.2±26.8 (n=30)
Toyama	204.1±44.8 (n=30)	39.0±27.9 (n=30)	

Table 4. Size of stones (mm)

	<i>R. chingii</i>	<i>R. × pseudochingii</i>	<i>R. corchorifolius</i>
Length	2.19±0.16 (n=108)	2.23±0.15 (n=30)	1.68±0.19 (n=120)
Width	1.38±0.19 (n=108)	1.43±0.14 (n=30)	0.99±0.15 (n=120)
Thickness	1.00±0.13 (n=108)	1.11±0.12 (n=30)	0.70±0.12 (n=120)

Table 5. Measurements of somatic metaphase chromosomes of *Rubus × pseudochingii*

Na	Length	Total (μm)	A.R.	Form	No	Length	Total (μm)	A.R.	Form
1	0.7+0.7	1.4	1.0	M	8	0.4+0.8	1.2	2.0	sm
2	0.6+0.8	1.4	1.3	m	9	0.5+0.7	1.2	1.4	m
3	0.6+0.8	1.4	1.3	m	10	0.5+0.7	1.2	1.4	m
4	0.5+0.8	1.3	1.6	m	11	0.5+0.6	1.1	1.2	m
5	0.5+0.8	1.3	1.6	m	12	0.5+0.5	1.0	1.0	M
6	0.5+0.8	1.3	1.6	m	13	t-0.2+0.8	1.0	4.0	st
7	0.4+0.9	1.3	2.3	sm	14	t-0.2+0.8	1.0	4.0	st

t: satellite.

Table 6. Chromosome pairing at first metaphase in PMCs of *Rubus chingii*, *R. corchorifolius* and *R. × pseudochingii*

Taxa	Chromosome pairing	No. of PMCs	Frequency(%)
<i>R. chingii</i>	7 II	177	97.3
	6 II + 2 I	5	2.7
<i>R. corchorifolius</i>	7 II	105	100.0
<i>R. × pseudochingii</i>	7 II	167	69.9
	6 II + 2 I	46	19.2
	5 II + 4 I	15	6.3
	5 II + 4 I	6	2.5
	3 II + 8 I	5	2.1
mean	6.5 II + 1.0 I		

Table 7. Pollen fertility

		Fertile(%)	Sterile	Total
<i>R. chingii</i>	1	2523 (89.8)	286	2809
	2	2631 (92.0)	228	2859
	3	2519 (81.6)	568	3087
	4	2487 (82.7)	519	3006
	5	2333 (92.0)	203	2536
	6 *	2442 (96.2)	96	2538
	mean	(89.1)		
<i>R. ×pseudochingii</i>	1	2090 (70.9)	875	2947
	2	595 (52.5)	538	1133
	3	84 (40.6)	123	207
	4	180 (36.0)	320	500
	5	154 (46.0)	181	335
	6	359 (65.5)	189	548
	7	175 (51.2)	167	342
	8	251 (40.2)	373	624
	9 *	2985 (82.4)	638	3623
	10**	1722 (74.4)	591	2313
	11**	1424 (70.5)	505	2019
mean	(57.3)			
<i>R. corchorifolius</i>	1	2126 (97.2)	62	2188
	2	1085 (96.9)	35	1120
	3	3002 (99.4)	17	3019
	4	2657 (97.6)	65	2722
	5	3114 (99.0)	33	3147
	6 *	2452 (99.8)	4	2456
mean	(98.3)			

Each flower observed in 1989, * in 1988, ** in 1992.

On cytological results, this plant had $2n = 14$ (Fig. 6A) which is the same chromosome number as *R. chingii* and *R. corchorifolius* (Iwatsubo and Naruhashi, 1992, 1993). The length of the chromosomes at somatic metaphase ranged from $1.0\mu\text{m}$ to $1.4\mu\text{m}$, and the arm ratio varied from 1.0 to 4.0 (Table 5). They consist of seven homomorphic pairs: five metacentric pairs, one submetacentric pair, and one subtelocentric pair (Fig. 6C). The subtelocentric pair had a satellite on the short arm. The karyotype was thus formulated as $2n = 14 = 10m + 2sm + 2'st$.

Chromosome pairing at first metaphase was examined in 239 PMCs. There were bivalents only or a mixture of univalents and bivalents (Fig. 6B, Table 6). The most frequent type of chromosome pairing was 7II (69.9%), followed by 6II+2I (19.2%), 5II+4I (6.3%), 4II+6I (2.5%), and 3II+8I (2.1%). The mean chromosome pairing per PMC of this plant was $6.5\text{II} + 1.0\text{I}$, while most or entire PMCs of the putative parent species showed seven bivalents (Table 6). This plant sets seeds and had the pollen fertility ranging from 36.0% to 82.4%. The mean pollen ferti-

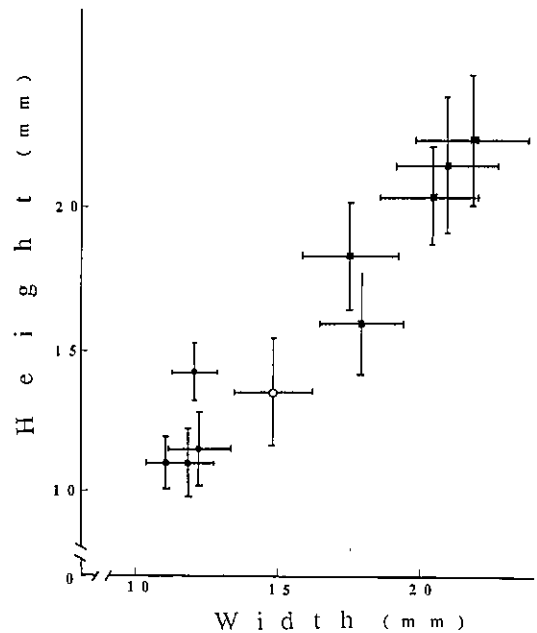


Fig. 4. Size of aggregate fruits. Solid square, *R. chingii*; open circle, *R. ×pseudochingii*; solid circle, *R. corchorifolius*.

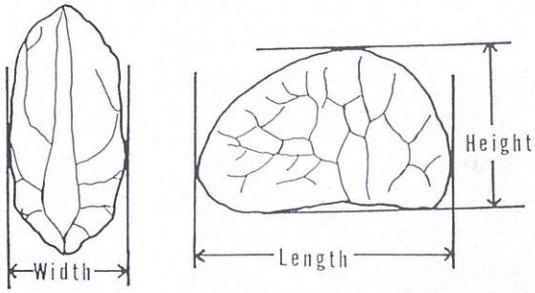


Fig. 5. Measurement parameters of stones.

ity was 57.3%. By contrast, that mean fertility of *R. chingii* and *R. corchorifolius* was 89.1% and 98.3%, respectively (Table 7).

The chromosome pairing and the pollen fertility of *R. × pseudochingii* suggest that this plant is a hybrid. The most frequent kind of chromosome pairing in PMCs of this plant, 7II, provides indirect evidence that the genomes of *R. chingii* and *R. corchorifolius* are similar each other, which is supported by the karyotype of this plant.

This new plant, *R. × pseudochingii*, possesses several morphological features which are intermediate between those of its putative parents. Moreover, distributions of *R. chingii* and *R. corchorifolius* are overlapped (Naruhashi and

Satomi, 1972) and flowering time is almost the same.

The plant propagates by vegetative means with elongated underground rhizomes as do the putative parents.

As a result of critical comparisons of morphological and phenological traits of this new plant with those of the putative parental species, and cytological analyses, we reached the conclusion that the plant no doubt represents a natural hybrid between *R. chingii* and *R. corchorifolius*.

Rubus × pseudochingii Naruhashi et Masaki, hybr. nov. (Figs. 1-B; 7-A, B, C, Db, Eb, and F)

Rubus chingii Hu × *Rubus corchorifolius* L.f.

Ab anteriore et posteriore differt: foliis primocanorum quinquepalmatis, petalis c. 1.3 cm longis.

Frutex, deciduus, erectus, 1.5-3 m altus, 10-16(-18) mm diametro basi caule, aculeatus, ramosus; ramis hornotinis 3-5(-7) foliatis. Petioli parce tomentosi recurvato-aculeolati. Folia simplicia, 3~5-nato-palmati, petiolata, viridia, duplicato-serrata, stipulis linearibus tomentosis 4-6 mm longis. Folia primocani 5

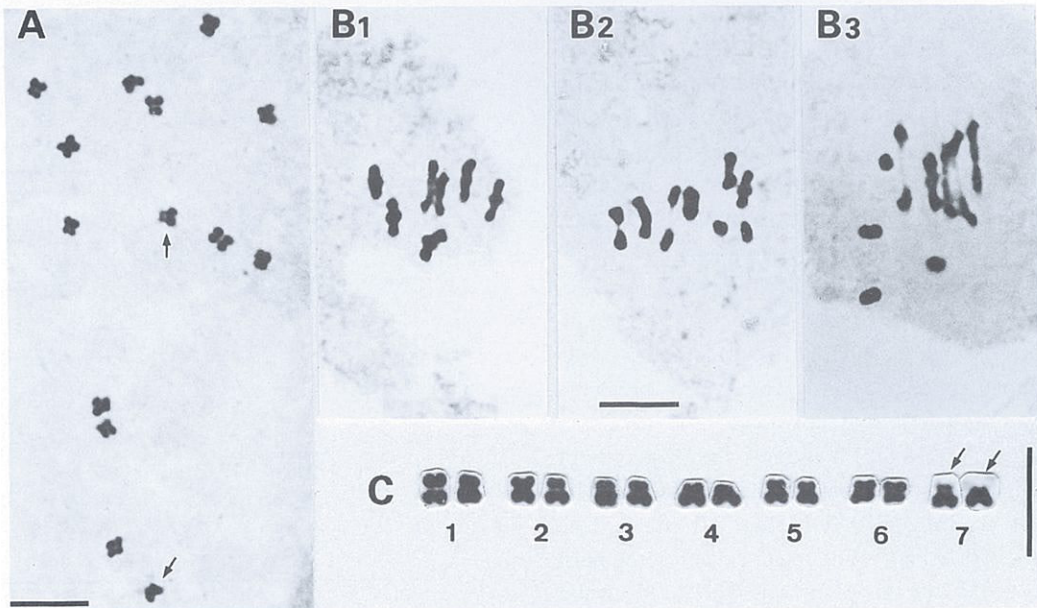


Fig. 6. Mitotic metaphase chromosomes, meiotic chromosomes at metaphase I in PMCs, and karyotype of *R. × pseudochingii* ($2n = 14$). A, mitotic metaphase chromosomes; B, first meiotic metaphase chromosomes showing 7II (B_1), 6II+2I (B_2) and 5II+4I (B_3); C, karyotype. Arrows indicate satellite chromosomes. Bars represent 5 μ m.

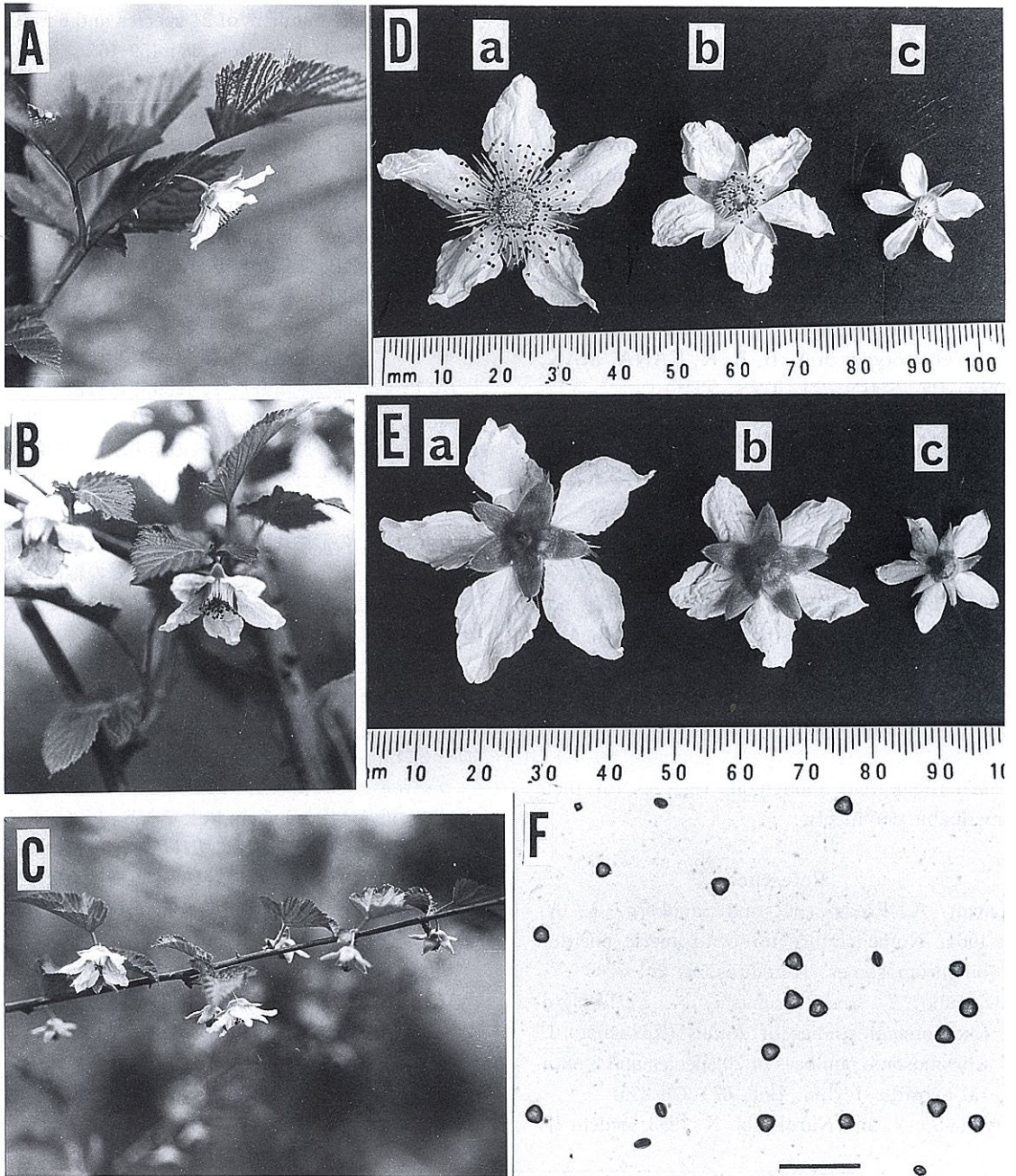


Fig. 7. A, B and C: Flowering branch of *R. ×pseudochingii*. D, Front view of flowers. a, *R. chingii*; b, *R. ×pseudochingii*; c, *R. corchorifolius*. E, Back view of flowers. a, *R. chingii*; b, *R. ×pseudochingii*; c, *R. corchorifolius*. F: Pollen grains of *R. ×pseudochingii* (bar represents 100 μm).

-nato-palmata, petiolo 2-4 cm longo; apice acutis vel acuminatis basi cordatis, lobis terminalibus ovatis 4-8 cm longis 1.5-4 cm latis. Folia floricani 3~5-nato-palmata; petiolo 1-3 cm longo, apice acuminatis vel attenuato-acuminatis basi cordatis, lobis terminalibus late ovatis. Flores 1-2 rarissime 3, nutantes, ramulos

hornotos terminantes, 2.4-3.6 cm diametro, pedicellis 5-12 mm longis, pubescentibus; calycibus ovatis longe rostratis, extus et margine tomentosis et sericeis intus tomentosis; petalis albis horizontale patentibus ovatis corrugatis apice acutis raro obtusis vel apiculatis, c. 13 mm longis c. 10 mm latis. Stamina numerosa; anth-

eris oblongis c. 0.8 mm longis; filamentis albis lineatis 3-5 mm longis, glabris. Pistilla numerosa c. 3 mm longa; ovariis superne adaxialibus longe pilosis; stigmatibus verrucatis. Pollinis grana saepe sterilia. Aggregatofructus ovoideoglobosus, rubriauranthiacus, ad paginam tomentosus, 13-19mm alto 14-19 diametro, putamine foveolato, 1.8-2.6mm longo 0.9-1.7mm alto 0.9-1.2mm lato. Numerus chromosomatum $2n = 14$.

Typus: Japan, cult. in Bot. Gard., Toyama Univ., N. NARUHASHI, no. 91060601 (**Holotype** in KYO, Isotypes in A, B, E, K, KANA, MAK, OSA, PE, SHIN, TI, TNS, TUS)

Nom. Jap. Birôdo-gosho-ichigo, *nov.*

Hab. Japonia. Honshu. Pref. Yamaguchi: Saba-gun, Tokuji-cho, Shiraidani, N. NARUHASHI & H. MASAKI, no. 86042903, Apr. 29, 1986 (Fl.); *ibidem*, cult. in Bot. Gard. Toyama Univ., N. NARUHASHI, no. 87042701, Apr. 27, 1987 (Fl.), no. 89041201, Apr. 12, 1989 (Fl.), no. 89060601, Jun. 6, 1989 (Fr.), no. 90051203, May 12, 1990 (Pfl.****), no. 91043001, Apr. 30, 1991 (Fl.), no. 91060601, Jun. 6, 1991 (Fr.) (****: after flowering)

We thank two anonymous referees for their invaluable comments.

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摘 要

山口県佐波郡徳地町野谷で、1986年に鳴橋と真崎はゴシヨイチゴに似た植物を発見した。付近に生育しているキイチゴ属植物と比較の結果、この植物はピロードイチゴとゴシヨイチゴとの雑種と考えられた。その年より富山大学で栽培され、それらの推定された両親との形態比較と細胞学的分析の結果、新植物はピロードイチゴとゴシヨイチゴとの雑種との確信をもったので、ここに学名と和名をつけて発表する。

植物体は大きく、一見ゴシヨイチゴに似るので、学名の種小名を *pseudochingii* とした。また、茎や葉にピロード状の毛が生えていることから、和名をピロードゴシヨイチゴとした。

ゴシヨイチゴは初年茎の葉が大きく、7裂片に切れ込み、花卉は長さ 1.5 cm 以上である。ピロードイチゴは葉が小さく、3裂片に切れ込み、花卉は長さ 1.1 cm 以下である。これに対し、本雑種は葉は中間の大きさで、5裂片に切れ込み、花卉は長さ 1.3 cm 前後である。

核型、花粉母細胞減数分裂第一中期及び花粉の稔性(平均 57.3%) から、本植物は自然雑種であること、また推定された両親のゲノムはかなり似ていることが示唆される。

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○ 長井真隆 とやま植物誌 B6判, 247頁, 1994年4月25日, シー・エー・ビー(〒930 富山市大手町614), 1800円。

富山県の植物の特徴を「地球の緑衣と富山の植生」で、植物に対するフィロソフィーと共に、世界の中で、また、日本の中で位置づけている。「標高0から3,000メートルの植物」では、平野部から山地、および高山へと富山の植物的自然を展開し、「富山の自然環境と植物」では、海岸、河川、水辺、峡谷、山岳、雪と植物の関係と、その富山の自然の特色を出し尽くしている。この章は著者ならではの内容であり、富山の植物誌にとって心臓部となっている。「身近な植物」は、少し趣を変えて、我々の生活と結びついた、親しみのある個々の植物を取り上げて、解説されている。富山の植物を理解するうえでの良書である。(鳴橋直弘)