タイワンクサイチゴの染色体，花，及び分布

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journal or publication title	The journal of phytogeography and taxonomy
volume	47
number	2
page range	139-143
year	1999-12-30
URL	http://doi.org/10.24517/00055265

Journal of Phytogeography and Taxonomy 47 : 139-143, 1999

Naohiro Naruhashi[1], Yoshikane Iwatsubo[1] and Ching-I Peng[2] : **Cytology, flower morphology and distribution of *Fragaria hayatai* Makino (Rosaceae)**

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The genus *Fragaria* consists of about 15 species (Airy Shaw 1973) that are distributed mainly in the northern temperate regions. Since they are well-known as delicious strawberries, wild species are widely cultivated in botanical gardens in many temperate countries. As a result, biological features of most species of *Fragaria* have been subjected to scientific studies. *Fragaria hayatai* Makino, endemic to Taiwan (Makino 1912), however, is one of the few species that received little attention outside its natural habitat. To further our understanding of the unique features of this interesting species, we report in this paper on number and morphology of its chromosomes, on color and UV pattern of its flowers, and on habitat and geographical distribution of the species.

Materials and methods

The plant for chromosome study was grown from seeds collected from the following voucher. Taiwan : Chiayi Hsien, Alishan Hsiang, Chusan Road, between Chushan Station of Forest Railway and entrance of Alishan footpath, T. Kawasaki 948 (TNS). Adventitious root tips from nodes of runners were pretreated in 2 mM 8-hydroxyquinoline solution at room temperature (ca. 25℃) for one hour and then kept at ca. 5℃ for 15 hours. The root tips were then fixed in a solution of acetic acid : ethanol (1 : 3) for one hour at room temperature, soaked in 1 N HCl for a few hours, hydrolyzed in 1 N HCl at 60℃ for 11.5 min, and immersed in tap water. The root tips were stained and squashed in 1.5% lacto-propionic orcein and fully spread metaphase chromosomes were examined. The nomenclature of centromere position follows Levan et al. (1964).

The plants in cultivation at Toyama University, Japan, for normal visible spectrum photography and UV photography were the same as those used in the chromosome study. Normal visible spectrum photographys were taken using a Nikon F4 camera with UV-Nikkor 105 mm lens and UV absorbing filter (Kenko MC UV) mounted on a tripod. UV photographys of the same flower were taken using the same camera with UV transmitting filter (Kenko U360) instead of the UV absorbing filter. The absorption spectrum of the Kenko U360 filter ranges from 300 to 400 nm. It shows 70% transmittance at about 350 nm maximum point.

To make the distribution map, specimens deposited in the following herbaria were consulted : HAST, KANA, KYO, TAI, TAIF, TCF, TI, TNM and TNS.

Results and discussion

1) Cytology

Our observation revealed that *F. hayatai* was diploid with 2n=14 chromosomes (Fig. 1 A). Somatic metaphase chromosomes ranged from 1.0 to 1.8 μm long and 1.0 to 4.5 in arm ratio (Table 1). These were classified into three groups : two metacentric pairs, three submetacentric pairs and two subtelocentric pairs. One subtelocentric pair had a satellite on the short arm (Fig. 1 B).

The karyotype of this plant was formulated as 2n=14=4m+6sm+4st. In comparison with the karyotypes of *F. daltoniana, F. iinumae, F. nipponica, F. nubicola* and *F. vesca* we examined (Iwatsubo and Naruhashi 1989, 1991), *F. hayatai* is unique in having two subtelocentric pairs. The other species have only one or lack subtelocentric pairs.

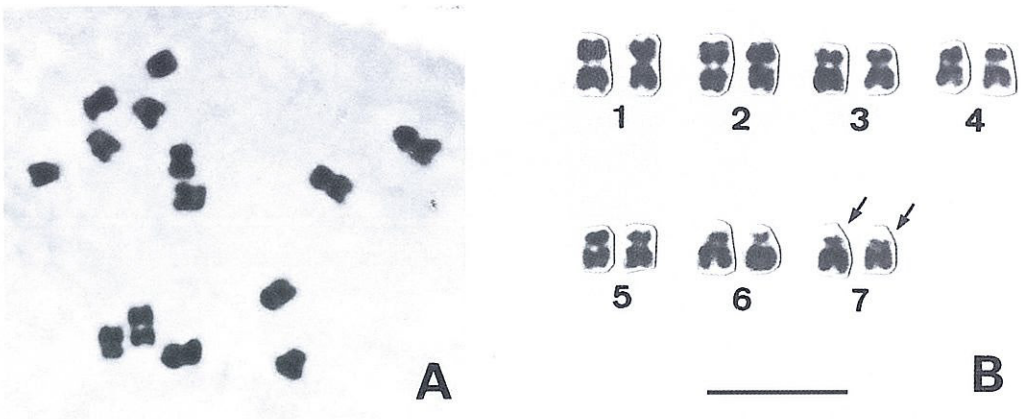

Fig. 1. Somatic metaphase chromosomes (A) and karyotype (B) of *Fragaria hayatai*. Arrows indicate satellite chromosomes. Bar equals 5 μm.

Table 1. Measurements of somatic metaphase chromosomes in *Fragaria hayatai*

No.	Length (μm)	Total (μm)	Arm Ratio	Form
1	0.9 + 0.9	1.8	1.0	M
2	0.9 + 0.9	1.8	1.0	M
3	0.9 + 0.9	1.8	1.0	M
4	0.8 + 0.9	1.7	1.1	m
5	0.5 + 0.9	1.4	1.8	sm
6	0.5 + 0.9	1.4	1.8	sm
7	0.4 + 0.8	1.2	2.0	sm
8	0.4 + 0.8	1.2	2.0	sm
9	0.4 + 0.8	1.2	2.0	sm
10	0.3 + 0.8	1.1	2.7	sm
11	0.2 + 0.9	1.1	4.5	st
12	0.2 + 0.9	1.1	4.5	st
13	t-0.2 + 0.9	1.1	4.5	st
14	t-0.2 + 0.8	1.0	4.0	st

t: satellite.

2) Flower morphology

Flowers of the genus *Fragaria* have white petals, with the exception of *F. nipponica*, showing rarely pinkish and one cultivated race of *F. ananassa* showing red petals. *Fragaria hayatai* is very unique in having white petals with a reddish purple base (Fig. 2).

UV photographys of the flowers of several plants of *F. hayatai* were taken three times (Fig. 3). The flowers showed fundamentally the same UV behavior pattern. Pistils (except for stigmas),

Fig. 2. Plant and flower of *Fragaria hayatai* (A: potted plant; B: flower).

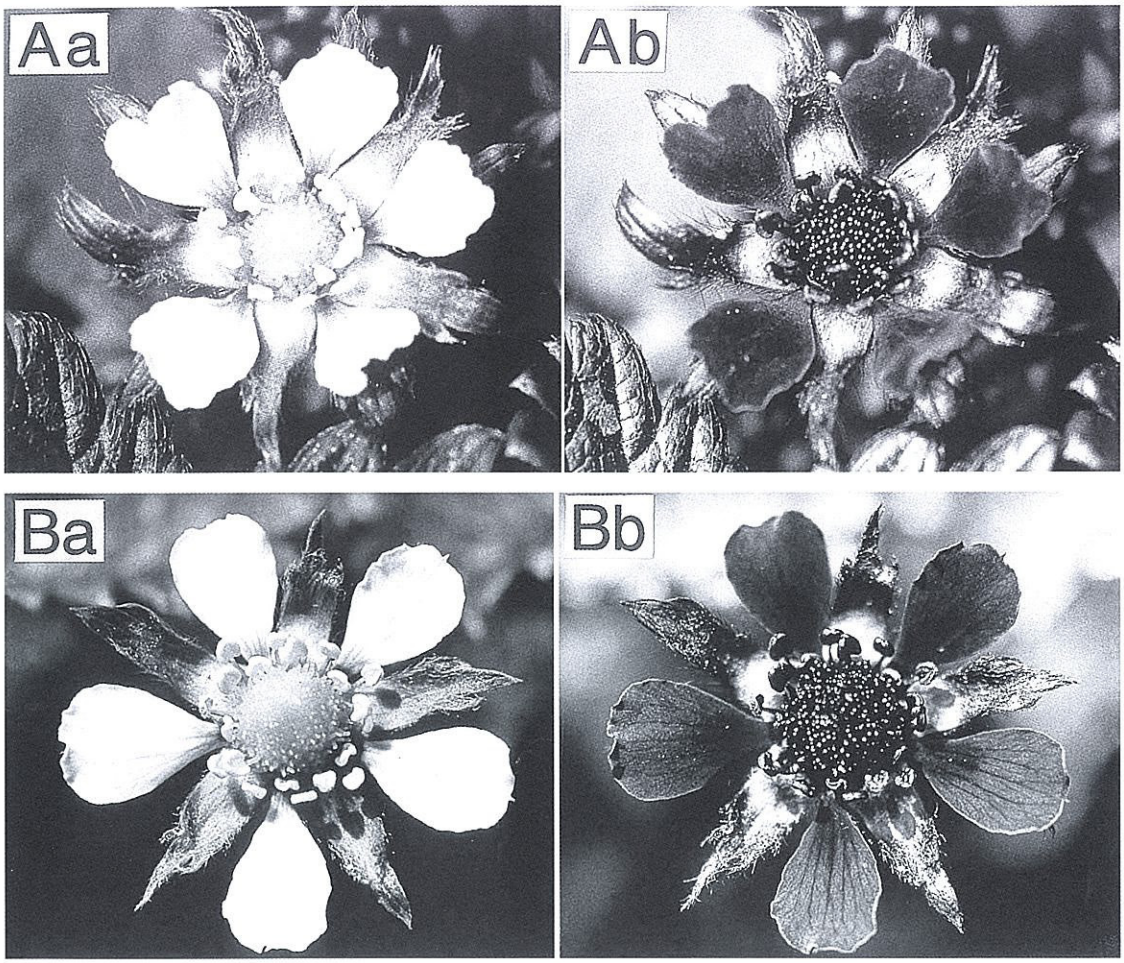

Fig. 3. Flowers of *Fragaria hayatai* (A: photo taken on May 29, 1996; B: photo taken on June 5, 1996; a: visible light photo; b: UV photo).

stamens (except for lateral sides of the anthers) and the entire petals were absorbing. Inner sepals, however, had basal reflecting spots and outer absorbing parts. Such remarkable contrast of absorbing petals to reflecting basal part of sepals results in unique, star-shaped flowers . This UV pattern of flowers was similar to other species of *Fragaria*, namely *F. ananassa*, *F. chiloensis*, *F. iinumae*, *F. moschata*, *F. nilgerensis*, *F. nipponica*, *F. nubicola*, *F. vesca*, *F. virginiana* and *F. viridis* (Naruhashi et al., unpublished).

3) Distribution and habitat

Fragaria hayatai is endemic to Taiwan, found at 2,000 to 3,700m altitude in the Central Mountain Range. Plants occur in mixed broadleaf and coniferous zone (ca. 2,000–2,600m alt.) through coniferous forest zone (ca. 2,500–3,600m alt.) to alpine zone (ca. 3,600–3,950m alt.), usually in somewhat moist, open places such as exposed slopes along road cut, hiking trails or mountain meadows (Fig. 4). They are relatively common in Taiwan and do not belong to any of the IUCN threat categories (cf. Walter and Gillett 1998).

Acknowledgements

We are grateful to Mr. Tetsuya Kawasaki for kindly supplying seeds of *Fragaria hayatai*, to Ms. Shu-Hui Wu for technical assistance with the distribution map, and curators of the following herbaria for permission to examines specimens of *F. hayatai*: HAST, KANA, KYO, TAI, TAIF, TCF, TI, TNM and TNS.

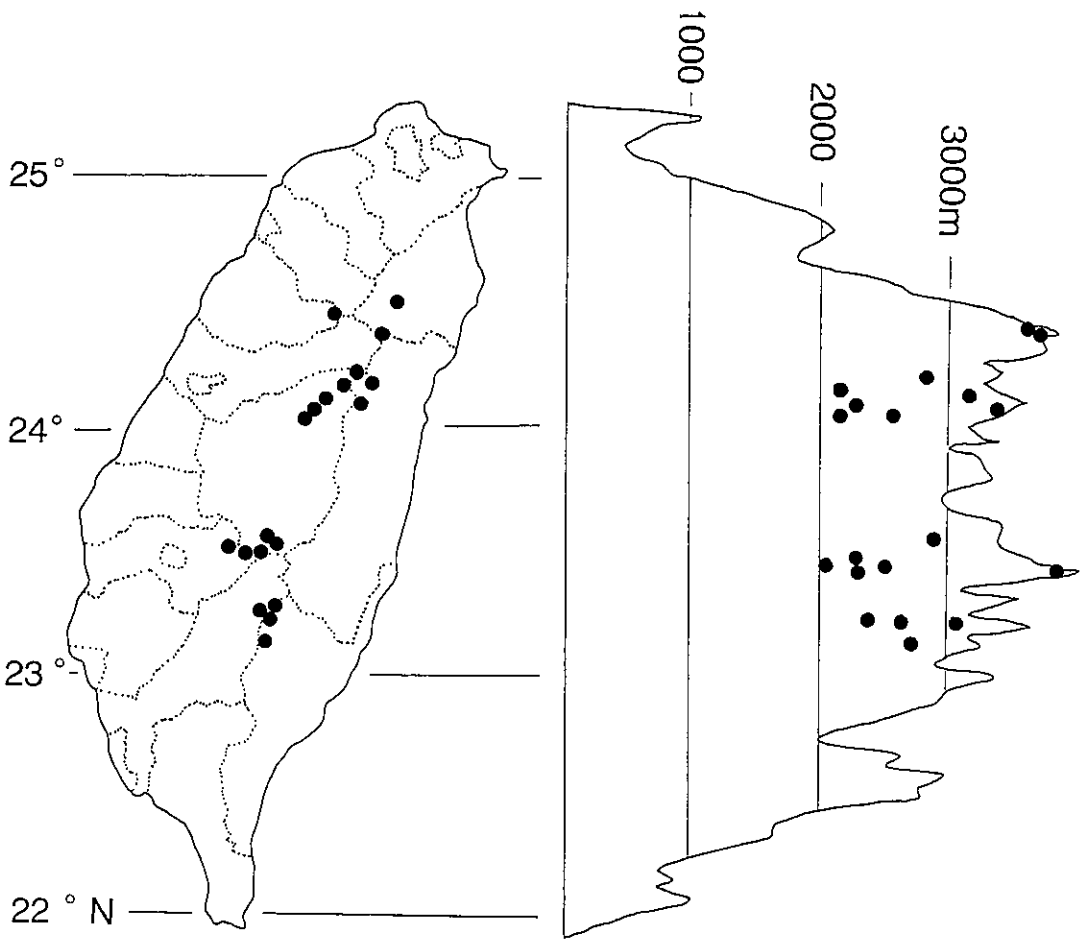

Fig. 4. Distribution map of *Fragaria hayatai* in Taiwan.

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(Received September 28, 1999; accepted November 29, 1999)

鳴橋直弘[1]・岩坪美兼[1]・彭　鏡毅[2]：タイワンクサイチゴの染色体，花，及び分布

オランダイチゴ属の野生種は，有用植物としての利用から，世界的によく研究されてきた。しかし，台湾に固有のタイワンクサイチゴ（*Fragaria hayatai* Makino）はほとんど研究報告がない。ここでは本種の染色体，花，及び水平・垂直分布について報告した。

1）タイワンクサイチゴの核型は，2n=14=4m+6sm+4stであり，それらのうち2本の次端部動原体型

染色体には，サテライトが存在する。これまで，核型分析を行った *Fragaria daltoniana, F. iinumae, F. nipponica, F. nubicola, F. vesca* のいずれにも，次端部動原体型染色体を4本もつ種は知られていない（Iwatsubo and Naruhashi 1989, 1991）。したがって，タイワンクサイチゴは特異な核型をもつことが明らかになった。

2）花の紫外線の反射と吸収では，他のオランダイチゴ属植物の花と同じく，雌しべ，雄しべ，花弁は吸収で，ガク片基部には強い反射が見られた。ところが肉眼ではオランダイチゴ属の花弁は全体が白色で，このタイワンクサイチゴの花弁も白色であるが，その基部は赤紫色を帯びていた。これはオランダイチゴ属中この種だけの特徴である。

3）タイワンクサイチゴの水平分布と垂直分布は Fig. 4 に示した。台湾の中央部標高 2,000～3,700m の高い山地に見られ，その主な生育地は針葉樹林帯の道路沿いなどである。

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