

Sachiko KUROSAWA*: **Cytotaxonomical studies
on the genus *Aucuba***

黒澤幸子*: アオキの細胞分類学的検討

Aucuba japonica Thunberg of Japan including some cultivated strains has been cytologically investigated fully by Sugiura (1927), Meurman (1929), Sinoto (1929), Kihara & Yamamoto (1935), and Viinikka (1970), and has hitherto been known as tetraploid with 32 somatic chromosomes, although Yamamoto (1937) observed two accessory fragments in some plants. Its var. *borealis* Miyabe et Kudo from Niigata is also the same in chromosome number as the mother species (Funabiki 1955 & 58).

While *Aucuba chinensis* Benthams of Taiwan or China has been reported as diploid ($2n=16$) by Meurman (1930), and Kihara & Yamamoto (1935). In 1959 Kihara confirmed the same chromosome number for *A. himalaica* Hooker f. et Thomson cultivated in Lloyd Botanic Garden at Darjeeling.

In course of my comparative studies in the genus, I had a chance to get seeds of *A. japonica* collected on Mt. Katsûdake, a calcareous mountain, of Okinawa in the Ryukyus by Mr. I. Sasaki in Jan. 1969. To my surprise, the Ryukyu plants were proved to be diploid. Then I have tried to examine *A. japonica* from various localities in the south-western parts of Japan including the Ryukyus and southern Kyushu. In 1970 I have examined cytologically the plants from Mt. Yuwan of Is. Amami-Ôshima, and in 1971 those from Anbô and Mt. Mochomudake of Is. Yakushima collected by Dr. H. Ito and Mt. Kanmuri of Kagoshima Pref. collected by Dr. H. Ohashi. As was expected all of them were also diploid, and the results of my studies were briefly mentioned on page 358 in the second report of Flora of Eastern Himalaya compiled by Hara (1971).

All these materials from southern Japan have hitherto been identified with *A. japonica*. I have compared them in living materials with the typical tetraploid race of *A. japonica* on one hand, and with diploid *A. chinensis*

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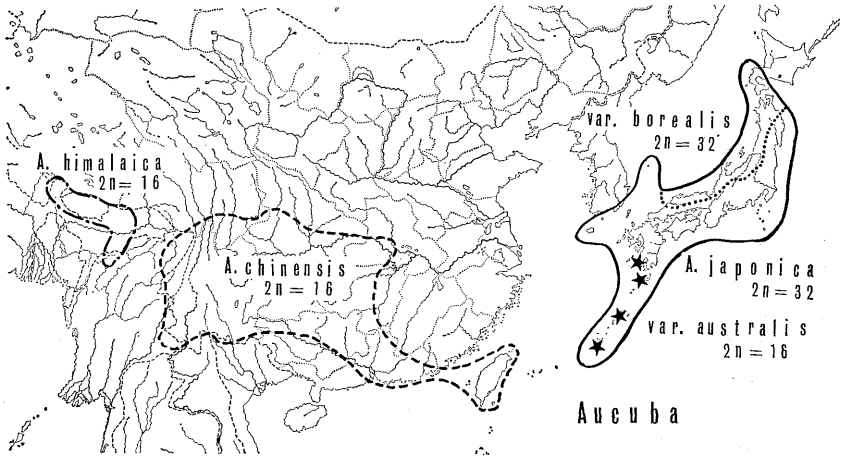


Fig. 1. Distribution map of the genus *Aucuba*. * indicates a diploid race of *A. japonica*.

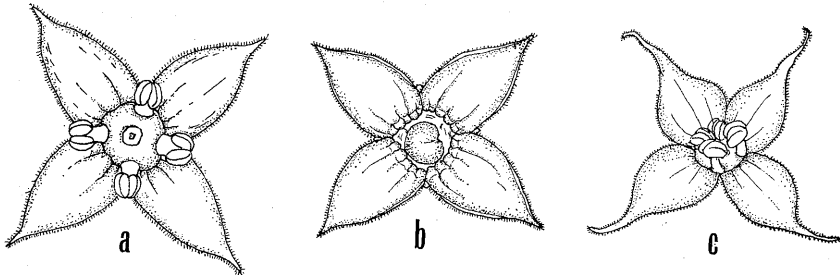


Fig. 2. Male (a) and female (b) flowers of *Aucuba japonica*, and a male flower (c) of *A. himalaica*. $\times 4$.

of Taiwan and diploid *A. himalaica* from Eastern Himalaya on the other hand.

Outer morphological differences between the three species mentioned above were clearly pointed out by Hara (1966). Typical *A. himalaica* has elongate oblong minutely serrate leaves which are hairy beneath when young, and have a caudate-acuminate apex and distinctly reticulate-impressed veins above, densely hairy rachis of inflorescences, and long-acuminate petals. Whereas typical *A. japonica* has broader and glabrescent leaves which have a shortly acuminate apex and less impressed veins, less hairy inflorescences,

Table 1. Chromosome numbers

	Number (2n)	Origin	Author
<i>Aucuba himalaica</i>	16	Darjeeling	Kihara 1959
	16	Tonglu, Singalila	Kurosawa (unpubl.)
<i>A. chinensis</i>	16	?	Meurman 1930
	16	Taihoku, Taiwan	Kihara & Yamamoto 1935
<i>A. japonica</i> var. <i>australis</i>	16	Shishikyô, Taiwan	Kurosawa 1971
	16	Mt. Katsûdake, Okinawa	Kurosawa 1971
	16	Mt. Yuwan, Amami-Ôshima	Kurosawa 1971
	16	Anbô, Is. Yakushima	Kurosawa 1971
	16	Mt. Mochomu, Is. Yakushima	Kurosawa 1971
	16	Mt. Kanmuri, S. Kyushu	Kurosawa (unpubl.)
	16	Tokyo	Sugiura 1927
var. <i>japonica</i>	32	Cult. in London	Meurman 1929
	32	Tokyo	Sinoto 1929
	32, 32+2f	Tokyo & Kyoto	Yamamoto 1937
Incl. <i>A. dentata</i> & <i>A. longifolia</i>	32	Cultivated	Meurman 1955
Several cultivars	32	Cultivated	Viinikka 1970
	32	Mt. Takao, C. Honshu	Kurosawa (unpubl.)
var. <i>borealis</i>	32	Kawadzu, Idzu, C. Honshu	Kurosawa (unpubl.)
	32	Niigata, Honshu	Funabiki 1958
	32	Akita, N. Honshu	Kurosawa (unpubl.)

and apiculate or acute petals. *A. chinensis* is morphologically similar to *A. japonica*, but its typical plants have narrower and thicker leaves.

The diploid plants from the Ryukyus and southern Kyushu have very broad glabrous leaves which are shortly acuminate at the apex, very coarsely serrate on the margin and less impressed nerves, pubescent inflorescences with short appressed hairs, ovate acute petals, and slightly appressed

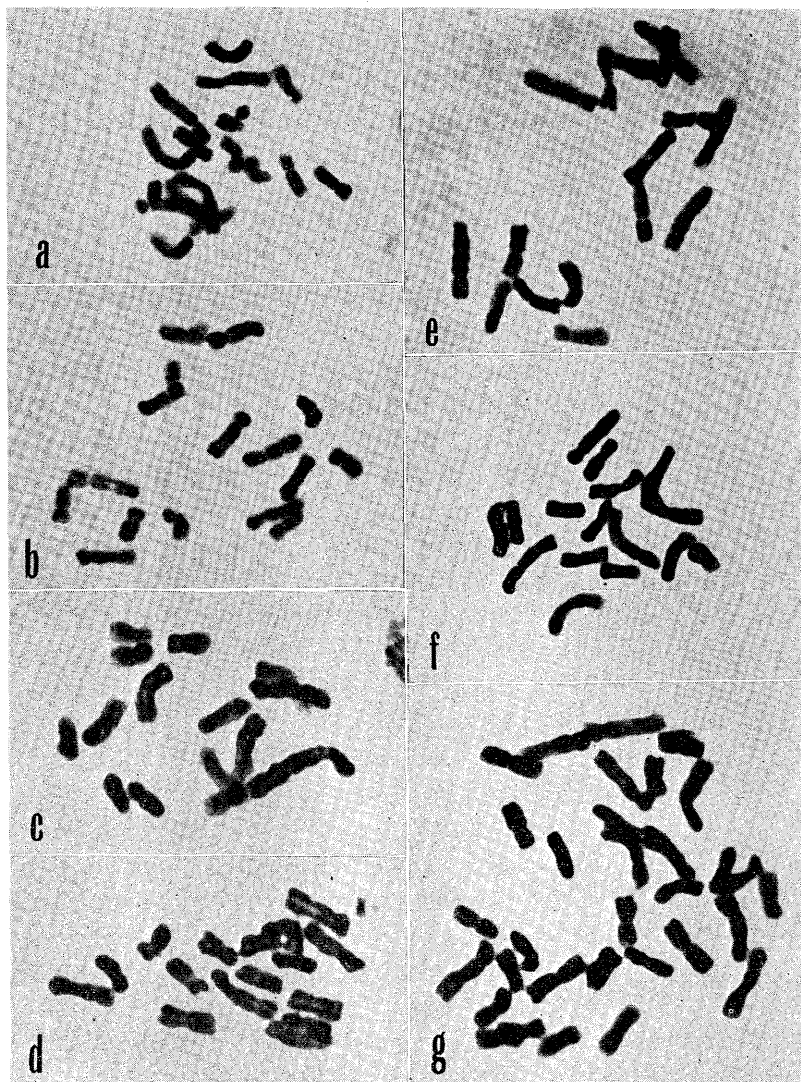


Fig. 3. Photomicrographs of somatic chromosomes. $\times 1500$. a. *Aucuba himalaica*. Tonglu, the Singalila Range. b. *A. chinensis*. Shishikyô, Koshun, Taiwan. c. *A. japonica* var. *australis*. Mt. Katsûdake, Okinawa. d. The same. Anbô, Is. Yakushima. e. The same. Mt. Yuwan, Amami-Ôshima. f. The same. Mt. Kanmuridake, Kagoshima Pref., Kyushu. g. *A. japonica* var. *borealis*. Akita, N. Honshu.

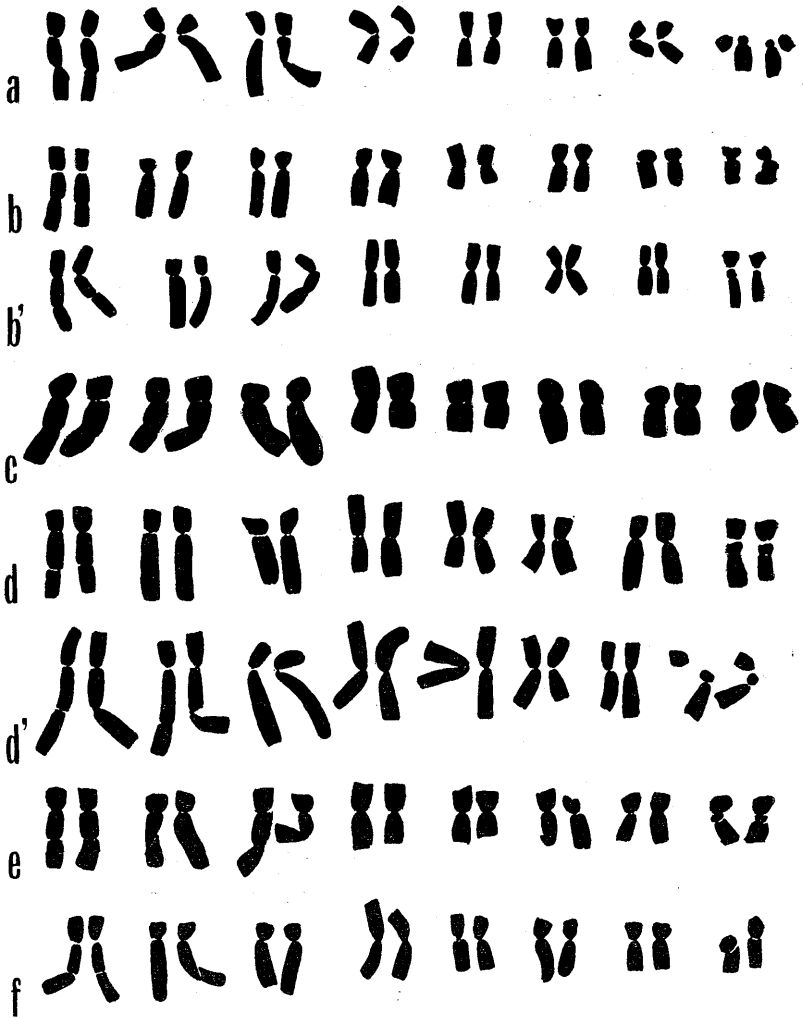


Fig. 4. Somatic chromosomes. $\times 1650$. a. *Aucuba himalaica*. Tonglu, the Singalila Range. b, b'. *A. chinensis*. Shishikyō, Koshun, Taiwan. c. *A. japonica* var. *australis*. Mt. Katsūdake, Okinawa. d, d'. The same. Mt. Yuwan, Amami-Ōshima. e. The same. Anbō, Is. Yakushima. f. The same. Mt. Kanmuridake, Kagoshima Pref. Kyushu.

pilose ovaries. In these characters they almost agree with typical tetraploid *A. japonica*.

The size of pollen grains and the size of stomata are also similar to one another as shown in Table 2. But the pollen grains of *A. himalaica* are always slightly smaller than those of the other races.

Table 2. The sizes of pollen grains and stomata

	Origin	Pollens (μ)	Stomata (μ)
<i>Aucuba himalaica</i>	Tonglu	29-34×34-39	24-31×15-22
<i>A. chinensis</i>	Taiwan		29-34×27-31
<i>A. japonica</i> var <i>australis</i>	Okinawa	34×43	31-34×26-33
	Amami-Ôshima	36×41	33-43×29-31
	Yakushima		29-31×26-29
var. <i>japonica</i>	Tokyo	38-43×39-48	34-37×29-34
var. <i>borealis</i>	Akita	33-36×43-46	34-37×28-34

The karyotype of tetraploid *Aucuba japonica* was minutely analysed by Meurman (1929), and he distinguished eight different types of chromosomes. Since then, his observation has been accepted by Kihara & Yamamoto (1935), and Viinikka (1970). The karyotype can be expressed as follows:

$$2n=32=4L_1^{st}+4L_2^{st}+4T_1+4T_2+4T_3+4V_1^m+4V_2^{sm}+4V_3^{sm}$$

The chromosomes T_1 , T_2 , and T_3 are characterized in having secondary constrictions. But Viinikka (1970) observed some deviations in the length of chromosomes and in the location of centromeres in *A. japonica*.

Kihara & Yamamoto (1935) investigated somatic and gametic chromosomes of diploid *A. chinensis* of Taiwan, and considered that it is not a direct ancestor of *A. japonica*, although both plants are closely allied.

The six diploid races which I have hitherto examined seem to have slightly different karyotypes from one another (Figs. 3,a-f & 4). However, the secondary constrictions are sometimes hardly discernible in somatic chromosomes, and the only difference between L and T is the secondary constriction, so they are liable to be confused, as already suggested by Viinikka (1970). In general we have to be very careful about the evaluation of the slight differences in chromosome types (Bentzer et al. 1971). In

my observations, the longest chromosomes often have distinct secondary constrictions, and sometimes only two pairs of chromosomes with secondary constrictions are recognizable.

In Fig. 4, I have arranged the chromosomes in the following order different from that of Meurman, denoted by the same symbols as those in the preceding page.

$$2n=16=2T_1+2L_1+2T_2+2V_1+2V_2+2V_3+2L_2+2T_3$$

A diploid race newly found in southernmost Japan closely resembles typical tetraploid *A. japonica* common in Japan, and is here described as var. *australis*. But it still remains doubtful whether diploid var. *australis* is a direct ancestral race of tetraploid *A. japonica*. In order to settle the problem, more detailed cytological studies on ample materials from various localities especially precise investigations of meiosis in diploid races are much needed.

Aucuba japonica Thunberg

var. **australis** Hara et Kurosawa, var. nov.

Folia elliptica 6–20 cm longa 3.5–9 cm lata apice breviter acuminata margine grosse pauci-serrata glabra. Rachis inflorescentiae pedicellique pilosi, pilis brevibus adpressis. Petala ovata acuta. Ovaria parce adpresse pilosa. $2n=16$.

Typus. Ryukyu: Mt. Katsūdake, Okinawa (Y. Takushi no. 11330, Jul. 25, 1968—typus in TI).

Distr. The Ryukyus, and southern Kyushu.

I am very grateful to Dr. Hiroshi Hara for his kind advice for this work. Also I am much indebted to Dr. Hiroshi Ito, Mr. Ichiro Sasaki, Dr. Hiroyoshi Ohashi, and Miss Chidzu Chûma who kindly collected the material of *Aucuba* in Amami-Ôshima, Is. Yakushima, Kagoshima Pref., Okinawa, and Taiwan for my studies.

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アオキ (*Aucuba japonica*) についてはこれまで詳しい細胞学的研究があり、いくつかの栽培品種をふくめすべて4倍体 ($2n=32$) であり、ヒメアオキ (*A. japonica* var. *borealis*) もまた同じく4倍体であることが知られている。一方台湾産のシナアオキ (*A. chinensis*) と東部ヒマラヤ産のヒマラヤアオキ (*A. himalaica*) は共に2倍体であることが報告されている。今回沖縄、奄美大島、屋久島、鹿児島県冠岳のアオキを調べたところ意外にもすべて2倍体であることが明らかになった。そこでこれらを生品について比較研究し花粉粒と気孔の大きさについても比較観察して、ここにその結果を報告する。

ヒマラヤアオキはすでに原 (1966) が指摘したように、外部形態的性質においてかなり差異が認められるが、シナアオキとアオキはよく似ていて区別がはっきりしない場合もある。今回初めて見出された沖縄、奄美大島、屋久島、鹿児島県冠岳の2倍体は、外部形態的にはアオキとほとんど区別ができず、その変種としてナンゴクアオキ (*A. japonica* var. *australis*) と名付けた。これまで知られた2倍体のアオキ類の核型を比較すると染色体の形態 (Fig. 4) に多少の変異が認められるが、さらに多数の個体について検討する必要がある。2倍体のナンゴクアオキが普通の4倍体であるアオキの祖先型とみなされるべきものであるかどうかは、減数分裂をふくめた詳細な細胞遺伝学的研究の今後の結果にまたなければならぬ。