Kazuo OGINUMA* & Ryuso TANAKA*: **Karyomorphological studies on some cherry trees in Japan**

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Cherry trees in Japan have been classified into about twenty species and over eight hundred horticultural forms of *Prunus* (Ohwi 1965, Hayashi 1968, Ohwi and Ôta 1973). Studies on the interrelationship of these taxa were carried out morphologically by several investigators (Makino 1908, Koidzumi 1913, Wilson 1916, Miyoshi 1920, 1922, Takenaka 1963). While the chromosome number and meiotic pairing have been reported in many species and horticultural forms by Ishikawa (1916), Okabe (1927 and 1928), Kobel (1927, 1928) and Darlington (1928), further karyological studies on these taxa are needed for the analysis of their interrelationship. In the present study karyotype analysis of some of Japanese cherry trees are dealt with.

The authors are grateful to Drs. H. Oka, and T.H. Yoshida and Mr. J. Tamura of National Institute of Genetics, Mishima, Drs. Y. Kobayashi and H. Taoda of Asakawa Experiment Forest, Ministry of Agriculture and Forestry, and Mr. H. Kubota of Botanical Gardens of Tokyo University at Nikko for affording the use of materials and facilities of the laboratories.

Materials and methods The materials and their sources are shown in the Table. The name of the materials was based on the classification of Ohwi and Ôta (1973). For the observations of somatic interphase nuclei and somatic chromosomes, the young leaves of the shoot apex were used. They were pretreated with aqueous 0.002 M 8-hydroxyquinoline at room temperature (about 20°C) for about four hours and fixed in modified Carnoy's solution (99% ethanol : chloroform : glacial acetic acid=2 : 1 : 1). The fixed chromosomes were then stained and macerated at the same time with a mixture of 10 parts of 2% aceto-orcein + 1 part of 1N HCl and squashed. The treatment for preparation was the same as that of the previous report

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Table 1. Results of chromosome count in cherry trees.

	Experimental number of clone*	Somatic chromosome number (2n)
Prunus apetala チョウジザクラ	A-164	16
var.*pilosa* 'Multipetala' ヒナギクザクラ	A-72	16
P. campanulata カンヒザクラ	A-152	16
P. campanulata × *P. pseudo-cerasus* フルサトザクラ	A-205	24
P. incisa マメザクラ	A-191	16
var. *kinkiensis* キンキマメザクラ	B-47	16
P. jamasakura ヤマザクラ	A	16
P. ×*kanzakura* カンザクラ	A-58	16
P. lannesiana var. *speciosa* オオシマザクラ	A-46	16
P. lannesiana 'Hayazaki-oshima' ハヤザキオオシマ	A-193	16
'Plena' ヤエオオシマ	A-39	16
P. leveilleana カスミザクラ	C-G-s-965	16
'Norioi' カタオカザクラ	A-258	16
P. maximowiczii ミヤマザクラ	C-II-s-177	16
P. ×*miyoshii* 'Ambigua' タイザンフクン	A-159	16
P. ×*parvifolia* 'Parvifolia' コバザクラ	C-G-j-818	24
P. pendula var. *koshinensis* コシノヒガンザクラ	A-102, C-306-1	24
f. *ascendens* エドヒガン	A-37	16
'Ichiki-zakura' イチキザクラ	C-199-1	16
'Keisho-zakura' ケイショウザクラ	C-203-1	16
'Kitajima-zakura' キタジマザクラ	C-202-1	16
'Kiyohideno-sakura' キヨヒデノサクラ	C-261-1	16
'Komatsunagi' コマツナギ	C-276-1	16
f. *pendula* 'Ruriderano-sakura' ルリデラノサクラ	C-262-1	16
P. sargentii エゾヤマザクラ	A-48	16
P. ×'Shikizakigenzo-zakura' シキザキゲンゾウザクラ	C-308-1	16
P. ×*subhirtella* 'Autumnalis' ジュウガツザクラ	A-131	24
'Subhirtella' コヒガンザクラ	C-148-4	24
P. ×*yedoensis* 'Amagi-yoshino' アマギヨシノ	A-13	16
'Izu-yoshino' イズヨシノ	A-19	16
'Yedoensis' ソメイヨシノ	A-150	16
P. grayana ウワミズザクラ	C-II-b-420	32
P. ssiori シウリザクラ	C-III-b-199	32

* Labelled Nos. in Nat. Inst. of Genetics (A); that in Botanical Gardens of Tokyo University at Nikko (B); those in Asakawa Experiment Forest, Ministry of Agriculture and Forestry (C).

(Tanaka and Oginuma, 1976). For the expression of morphological characteristics in the individuals of chromosome complement at mitotic metaphase, the karyographs proposed by Tanaka and Okada (1973) were used.

Results Most of the materials used were found to be diploid with 2n=16 (Fig. 1A). *Prunus pendula* Maxim. var. *koshinensis* (Koidz.) Ohwi and four horticultural forms, i. e., *P. campanulata* Maxim. × *P. pseudocerasus* Lindl., *P.* ×*parvifolia* Koehne 'Parvifolia', *P.* ×*subhirtella* Miq. 'Autumnalis' and *P.* ×*subhirtella* Miq. 'Subhirtella' were found to be triploid with 2n=24 (Fig. 1B). *P. grayana* Maxim. and *P. ssiori* Fr. Schm. were found to be tetraploid with 2n=32 (Fig. 1C).

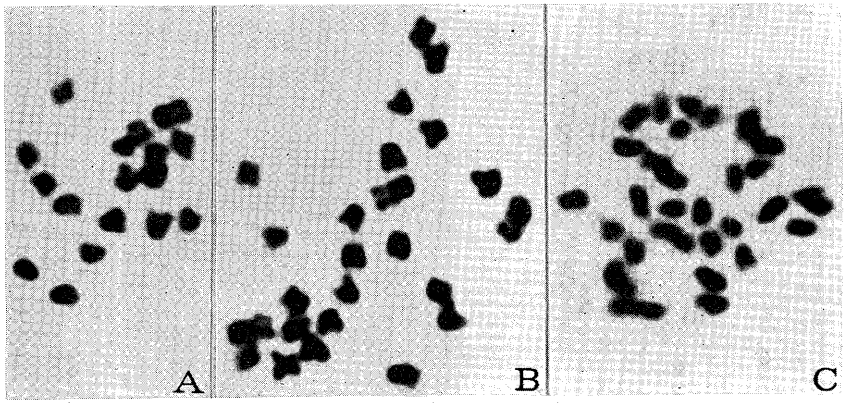

Fig. 1. Photomicrographs of metaphase chromosomes showing polyploidy (2x, 3x, 4x) in *Prunus*. A : *Prunus incisa* var. *kinkiensis* (2n=16). B : *P.* ×*parvifolia* 'Parvifolia' (2n=24). C: *P. grayana* (2n=32). × 4000.

According to Okabe (1927), the triploid forms were reported mainly in the group which is considered as the derivatives of *P. lannesiana* (Carr.) Wils. var. *speciosa* (Koidz.) Makino. The triploid forms in the present investigation were found mainly in the gruop which is presumed by Ohwi and Ota (1973) to be derived from *P. pendula* Maxim. f. *ascendens* (Makino) Ohwi. All of those triploids were the early blooming cherry trees. This property of early blooming can be seen most extremery in *P.* ×*parvifolia* 'Parvifolia' and *P.* ×*subhirtella* 'Autumnalis' which bloom unseasonably from fall to spring.

Concerning the early blooming cherry trees, there are some reports on

'Higan-zakura' which has appeared in the literature of old Japan (about 1500 AD) as an ornamental cherry tree. Makino (1908, 1935) considered that *P.* ×*subhirtella* 'Subhirtella' is 'Higan-zakura'. Recently, Ohwi and Ota (1973) allocated *P. pendula* f. *ascendens* as the 'Higan-zakura' in addition to *P.* ×*subhirtella* 'Subhirtella'. Observations on the present investigation indicated that the chromosome number of *P. pendula* f. *ascendens* was diploid with 2n=16 and that of *P.* ×*subhirtella* 'Subhirtella' triploid with 2n=24. The difference in chromosome number between the two taxa indicates that the triploid *P.* ×*subhirtella* 'Subhirtella' must have appeared after diploid *P. pendula* f. *ascendens* on a garden plant during the development of civilization in old Japan.

The morphological features of somatic chromosomes were as follows. The mitotic metaphase chromosomes of *P. apetala* (Sieb. et Zucc.) Fr. et Sav. (Fig. 2A) vary in their length gradually from the longest pair to the shortest one. The chromosomes from the first to fourth pairs were submetacentric. The fifth pair was found to be subtelocentric and had a secondary constriction located in the distal region of short arm forming a small satellite. The sixth pair was submetacentric. The seventh pair was subtelocentric. The eighth pair was submetacentric.

Most of the other taxa investigated showed a bimodal karyotype in chromosome length at mitotic metaphase. The bimodality was found between the longest pair and the other seven pairs which showed a gradual change in length. The bimodal karyotype was found in *P. incisa* Thunb., *P. jamasakura* Sieb. (Fig. 2B), *P. leveilleana* Koehne, *P. maximowiczii* Rupr., *P. sargentii* Rehder, *P. incisa* Thunb. var. *kinkiensis* (Koidz.) Ohwi., *P. lannesiana* var. *speciosa* and *P. pendula* f. *ascendens*. The centromeres in each chromosome of these taxa are located in interstitial regions similar to those of *P. apetala*, and the secondary constriction was found in the fifth pair forming a small satellite.

The chromosome of *P. campanulata* (Fig. 2C) also showed the bimodal karyotype, and it was different from the previous ones in having two long and six short pairs. The secondary constriction of this species was found in the second pair forming a large satellite.

Okabe (1927) reported in several taxa of Japanese *Prunus* that a pair of chromosomes was longer than the other chromosomes in the same

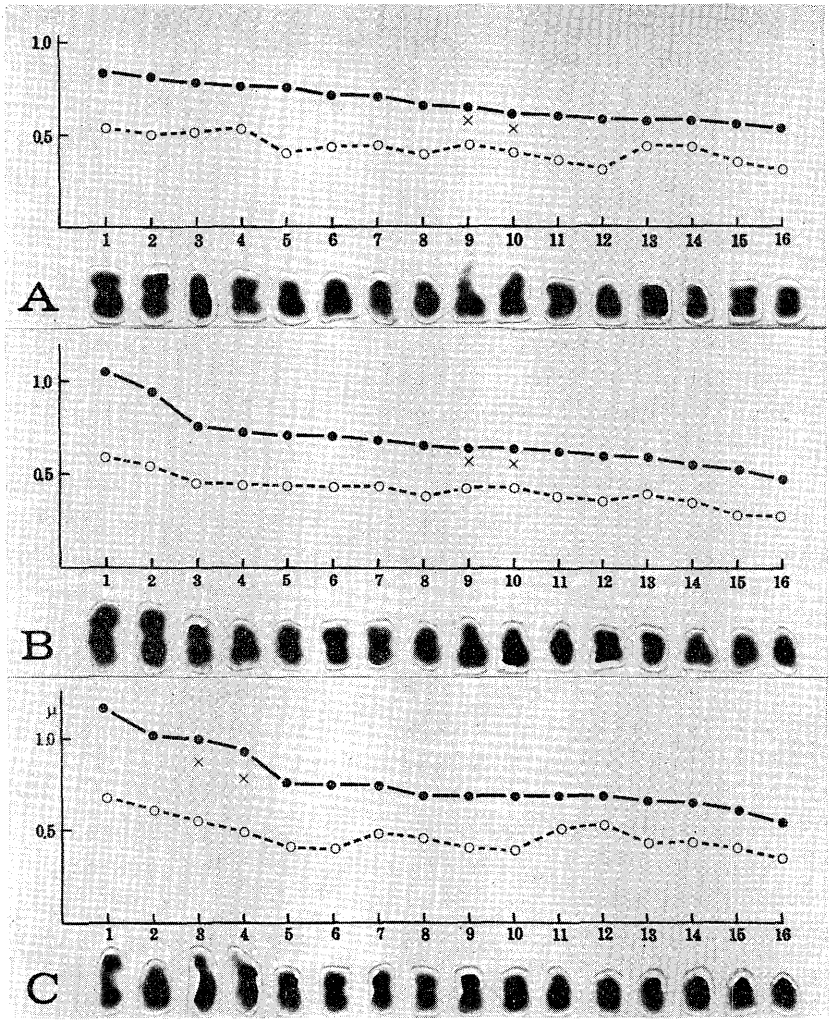

Fig. 2. Metaphase chromosomes individuals of somatic complement and its karyographs in three species of *Prunus*. The karyographs are represented by joining the values of chromosome length (—●—●—) and the position of primary constriction (---○---○---), respectively. Chromosomes are arranged laterally. A: *Prunus apetala* (2n=16). B: *P. jamasakura* (2n=16). C: *P. campanulata* (2n=16). The enlargement of chromosomes: × 6000.

complement. This agrees with the bimodal karyotype observed in *P. incisa* and other seven taxa in the present investigation.

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本邦産サクラ類9種，3変種，1品種，20園芸品種の核形態学的研究を行なった。これらの大多数は二倍体 (2n=16) であったが，コシノヒガンザクラ，フルサトザクラ，コバザクラ，ジュウガツザクラ，コヒガンザクラは三倍体 (2n=24)，ウワミズザクラおよびシウリザクラは四倍体 (2n=32) であった。三倍体は主としてヒガンザクラ系に多く，普通のサクラに比べて早く咲き，なかでもコバザクラとジュウガツザクラは共に秋から春にかけて次々と開花することが知られている。牧野 (1908, 1935) がいわゆる「彼岸桜」としたコヒガンザクラは三倍体であった。一方，大井・太田 (1973) が「彼岸桜」の一つにしたエドヒガンは二倍体であった。

体細胞染色体の核型によってサクラの二倍体野生種は次の三型に分けられた。(1) チョウジザクラ。1組を構成する染色体が漸変的な長さの変移を示す。(2) マメザクラおよび4種，2変種，1品種。1対の染色体が長い2様相型で，他の染色体の長さの変異は漸変的。(3) カンヒザクラ。2対の染色体が長い2様相型で，他の染色体の長さの変異は漸変的。