Karyomorphology of *Corylopsis glabrescens* and *C. gotoana* endemic to Japan (Hamamelidaceae; Hamamelidoideae)

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**ABSTRACT.** Chromosome numbers and karyotypes of *Corylopsis glabrescens* and *C. gotoana* in the Hamamelidaceae were investigated. *Corylopsis glabrescens* was diploid with 2n=24=14m+8sm+2st, while *C. gotoana* was tetraploid with 2n=48=36m+8sm+4st. The karyotype of the diploid *C. glabrescens* was different from that of the diploid *C. pauciflora* previously reported in Japan, suggesting a heterogeneous origin of the two species. The karyotype of the tetraploid *C. gotoana* seemed to share a homogenous karyotype composition with the hexaploid *C. spicata* previously reported in Japan.

**KEYWORDS:** Chromosome number, *Corylopsis*, Hamamelidaceae, karyotype

Plants of *Corylopsis*, the Hamamelidaceae are small deciduous trees that tend to grow at forest edges on rocky terrain in mountains or gorges of the warm temperate zone. This genus comprises 26-29 species that are widely distributed in the Sino-Japanese region (Yamazaki 1989; Mabberley 1997; Hsieh 2003; Zhang and Zhang 2003) from the Himalayas, China, Taiwan, Korea to Japan. Four species of the genus such as *C. spicata* Sieb. et Zucc., *C. pauciflora* Sieb. et Zucc., *C. gotoana* Makino, and *C. glabrescens* Franch. et Savat. are found in the western part of the islands in the Japanese Archipelago in the eastmost distribution of the genus. *Corylopsis spicata*, *C. gotoana* and *C. glabrescens* are endemic to Japan, while *C. pauciflora* also occurs in the high mountains of Taiwan as well as Japan.

Eight species of *Corylopsis* showed the chromosome numbers of n=12, 24, 36, and 2n=24 and 2n=72, that suggested a polyploid series with the basic chromosome number of x=12 (Anderson and Sax 1935; Santamour 1965; Mehra and Khosla 1969, 1972; Mehra 1976; Oginuma 1991; Oginuma and Tobe 1991). Among the Japanese species, only *C. pauciflora* (2n=24) and *C. spicata* (2n=72) have reported their karyotypes (Oginuma 1991; Oginuma and Tobe 1991). Karyomorphological characters of *C. glabrescens* and *C. gotoana* are here studied and discussed on the trend in chromosome diversity and speciation of this genus.

**RESULTS AND DISCUSSION**

Chromosome number and karyotype of *C. glabrescens*

The chromosome number of *C. glabrescens* was firstly reported as n=24 (Santamour 1965) that might be of tetraploid if the basic chromosome number was decided to be x=12. In contrast, our present observation showed 2n=24 for this species that could be diploid. Thus, the diploid chromosome number of 2n=24 for this species was reported here for the first time. The chromosome lengths of the chromosome complement (2n=24) in this species studied at mitotic metaphase gradually varied from 1.4-0.8 µm. Among the 24 chromosomes, 14 had the centromere at median position (m), eight had the centromere at submedian position (sm) and two had the centromere at subterminal position (st) (Figs. 1 and 2). The secondary constriction was (sc) observed in the interstitial region of the long arm of a pair of submedian centromeric chromosomes (arrowheads in Figs. 1 and 2). Thus, the karyotypic formula was 2n=24=14m+8sm+6st.

**MATERIALS AND METHODS**

A plant of *C. glabrescens* was collected in Tenkawa-mura, Nara Prefecture, Japan (Voucher: H. Setoguchi JP2701) and that of *C. gotoana* was collected in Nantan City, Kyoto Prefecture, Japan (Voucher: H. Setoguchi JP2701). Somatic chromosomes were examined in meristematic cells of their young leaves. The methods of pretreatment, fixation and staining followed Oginuma et al. (1992). Terminology of chromosome morphology on the basis of the position of the centromeres followed Levan et al. (1964), Voucher specimens were deposited in the Herbarium of Kyoto University (KYO).
The chromosome number of *C. gotoana* was 2n=48 that could be tetraploid after the basic chromosome number of x=12. The finding of a tetraploid of 2n=48 for this species was reported here for the first time. The chromosome lengths of the chromosome complement (2n=48) in *C. gotoana* studied at mitotic metaphase gradually varied from 1.1-0.7 µm. Among the 48 chromosomes, 36 had the centromere at median position, eight had the centromere at submedian position, and four had the centromere at subterminal position (Figs. 3 and 4). No sat-chromosome was observed. Thus, the karyotypic formula was 2n=48=36m+8sm+4st.

Implications for the phylogenetic relationships among the Japanese species of *Corylopsis* The present study suggested that the Japanese *Corylopsis* comprised two diploid species (2n=24; *C. glabrescens* and *C. pauciflora*), one tetraploid (2n=48; *C. gotoana*), and one hexaploid species (2n=72; *C. spicata*). However, the two diploid species possessed heterogeneous karyotypes, whereas the tetraploid *C. gotoana* and the hexaploid *C. spicata* showed very similar chromosome composition to each other.

The karyotype of *C. pauciflora* was reported previously to be 2n=24=12m+4sm+8st (Oginuma and Tobe 1991). The karyotype of *C. glabrescens* in this study was 2n=24=14m+8sm+2st. The compositions of the chromosome types regarding the centromeres at the median, submedian and subterminal positions were 50.0%, 16.7%, and 33.3% respectively in *C. pauciflora* and 58.3%, 33.3%, and 8.3% respectively in *C. glabrescens*. Thus, the two diploid species had mutually heterogeneous karyotypes. Therefore, these two diploid species might have been derived from different ancestors.

The karyotype of *C. gotoana* (tetraploid) in the present study was 2n=48=36m+8sm+4st, while that of *C. spicata* (hexaploid) in the previous study was 2n=72=54m+12sm+6st (Oginuma 1991). The chromosome compositions represented by the positions of median, submedian and subterminal centromeres in the two species were 75.0%, 16.7% and 8.3%, respectively. Thus, *C. gotoana* (2n=48) and *C. spicata* (2n=72) might be originated from a diploid with the same frequencies of chromosome types. For instance, the karyotype origin could be speculated as 2n=24=18m+4sm+2st which has not been discovered yet. In contrast, another possibility could be that *C. spicata* (2n=72) might be derived from fertilization between a normal gamete with n=24 and an unreduced gamete with n=48 such as that of *C. gotoana* (2n=48) or its allied tetraploid.

A recent phylogeographic study resulted that 60 individual plants from nine populations of *C. gotoana*
examined from Kyoto to Shimane Prefectures in Western Honshu, Japan and 41 individuals from six populations in *C. spicata* in Kochi Prefecture, Shikoku District, Japan had common single chloroplast DNA haplotype and ITS genotype, while the other species had different types of cpDNA and ITS (Yamanaka *et al.* in press). These molecular data supported the karyotype homogeneity between *C. gotoana* and *C. spicata* that led the hypothesis on the existence common single ancestor.

**LITERATURE CITED**


