Karyology of Ten Species of *Impatiens* (Balsaminaceae) from SW. Yunnan, China

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Abstract. Ten species of *Impatiens* collected from southwest Yunnan were examined karyologically. Eight of them were analyzed for the first time. As a result, five different chromosome numbers were counted: $2n = 12$ in *I. aureliana*; $2n = 16$ in *I. begonii-folia*, *I. mengtszeana*, *I. yingjiangensis*; $2n = 17$ in *I. mengtszeana*; $2n = 18$ in *I. racemosi*, *I. rullen-sis*, *I. sicilifera*, *I. tongbhguanensis*, *I. uliginosa*; $2n = 20$ in *I. rubrostriata*. No significant difference in karyotype was found among species with the same chromosome number. The karyotypes of species with $2n = 12$, $2n = 17$, $2n = 18$, and $2n = 20$ are bimodal, while those with $2n = 16$ are monomodal. On the basis of these karyological characteristics, relationships of these Chinese species to other species occurring in adjacent regions are discussed.

Key words: Balsaminaceae, chromosome number, *Impatiens*, karyotype, Yunnan.

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*Impatiens* L. (Balsaminaceae) is a large genus comprising more than 500 species mainly distributed in tropical and subtropical regions of Asia and Africa (Heywood, 1978; Shimizu, 1984; Akiyama et al., 1991). Southwestern China appears to be one of the centers of species diversification. About 190 species are known from China (Chen, 1978), and approximately 80 species are from Yunnan (Wu, 1984). Recently, four species were newly added to the Chinese flora from southwest Yunnan (Akiyama et al., 1994).

Previous karyological studies have been concentrated on species occurring in Africa, India, the Himalaya, Thailand, Europe and North America (Jones and Smith, 1966; Govindarajan and Subramanian, 1986; Rao et al., 1986; Akiyama et al., 1992; Oginuma and Tobe, 1992), and various chromosome numbers, i.e., $n = 3-14$, 16, 17, 22, 24, and 33, and karyotype variation were reported (Shimizu, 1984 for review). No karyological information is available, however, for Chinese species.

In this paper we present the karyological characteristics of ten species of *Impatiens* collected from southwest Yunnan, and discuss the karyological relationships among the ten species and other species occurring in adja-
cent regions.

Materials and Methods

The specimens examined in this study were collected from Yingjian and Jingdong Counties, southwest Yunnan, during our botanical expedition in 1993. Their localities and voucher specimens are presented in Table 1. Voucher specimens are deposited in the Kunming Institute of Botany (KUN), China, and University of Tokyo (TI), Japan.

Among the ten species listed in Table 1, Impatiens aureliana is also known from Burma, and I. mengtszeana from Thailand and Vietnam. Impatiens racemosa is distributed widely in Asia ranging from Kashmir to Assam, southwest China and South Tibet (Chen, 1978; Akiyama et al., 1991, 1994). The seven other species are known only from China, and four of them, I. begoniifolia, I. yingjiangensis, I. tonbiguianensis, and I. ruillianensis, are newly described taxa from Tonbiguan, Yingjian (Akiyama et al., 1994; see also Chen, 1978).

For observation of metaphase chromosomes, root tips were pretreated in the field with a 0.002M 8-hydroxyquinoline solution for about 3 hr and fixed with 45 % acetic acid solution for 25–30 min. After fixation the root tips were preserved in 70 % ethanol. The root tips were macerated with 1N HCl at 60°C for 30 sec, and stained overnight with a 1 % acetic orcein solution. They were then squashed in the standard way and observed using a light microscope.

Results

The chromosome numbers of ten species of Impatiens are summarized in Table 1. With the exception of I. mengtszeana and I. racemosa, none had been analyzed previously. On the basis of their karyotypes, the species concerned fall into four groups. Their karyological characteristics are described below.

The chromosome number of Impatiens aureliana was 2n = 12 (Fig. 1A, A'). In its karyotype, two chromosomes are easily distinguished from the others; they are obviously longer (2.2 μm), and possess centromeres at the submedian region, while the 10 remaining chromosomes are shorter, ranging from 1.6 μm to 1.0 μm, and have centromeres at the median region.

The chromosome numbers of Impatiens begoniifolia, I. mengtszeana, and I. yingjiangensis were 2n = 16. Their karyotypes are very similar in being highly symmetrical. In the karyotype of I. begoniifolia (Fig. 1B) the chromosomal length is gradually reduced from 2.0 μm to 1.0 μm, and almost all of the chromosomes have centromeres at the median region.

The number 2n = 16 of I. mengtszeana agrees with the earlier report of Shimizu (1984). In this study, however, a count of 2n = 17 was also observed in this species from Wuliangshan. This number may be an aneuploid of the diploid 2n = 16, or may be due to the presence of a single B-chromosome. We could not determine that number with certainty.
The chromosome numbers of *Impatiens racemosa*, *I. ruiliensis*, *I. siculifera*, *I. tongbiguanensis*, and *I. uliginosa* were $2n = 18$ (see Tab. 1). No significant difference was found in the karyotypes among the four species (Fig. 1C, C', D). The karyotype of *I. siculifera* is shown in Figure 1C and C'. In its karyotype, two chromosomes are obviously longer (3.3 $\mu$m length) than the others, and they have centromeres at the submedian region. The 16 remaining chromosomes are distinctly shorter and are reduced in length from 1.7 $\mu$m to 1.2 $\mu$m, and they possess centromeres at the median region.

As stated above, *Impatiens racemosa* occurs widely in Asia. Previous counts of its chromosome number have been made with plants from the Himalaya, and two different chromosome numbers, $n = 9$ and $n = 10$, have been reported for the species (Shimizu, 1984; see also Akiyama et al., 1992). In this study, however, only the number $2n = 18$ was observed.

The chromosome number of *I. rubrostriata* was $2n = 20$. Its meta-
Fig. 1. Photomicrograph and/or drawing of metaphase chromosomes of five Impatiens species from SW. Yunnan. A, A': I. aureliana (2n = 12). Two longer submetacentric chromosomes are indicated with arrows. B: I. begonifolia (2n = 16). C, C': I. sicalifera (2n = 18). The two longest submetacentric chromosomes (arrows) are visible. D: I. ruliiensis (2n = 18). The two longest submetacentric chromosomes are indicated with arrows. E, E': I. rubrostriata (2n = 20). Two longer submetacentric (arrows) and two longer metacentric chromosomes (dots) are distinguishable. Scale bar represents 5 μm.
phase chromosomes are shown in Figure 1E and E'. Of the 20 chromosomes, four are slightly longer than the others. Of those four chromosomes, the two largest (1.8–1.9 μm in length) have centromeres at the submedian region, and two others (1.5 μm in length) have centromeres at the median region. The 16 remaining chromosomes are smaller, ranging from 1.2 μm to 0.9 μm in length, and have centromeres at the more or less median region.

Discussion

Although our observations were limited to ten species occurring in southwest Yunnan, we were able to determine that the Chinese species of Impatiens have diversified in chromosome number. In considering the constitution of their metaphase chromosomes, all of the species examined may be considered to be diploid. Furthermore, species with the same number exhibit the same karyotype, although it is known that species from southeastern India are conspicuously diversified in their karyotypes (Govindarajan and Subramanian, 1986).

It is notable from karyological aspects that the species indigenous to southwest Yunnan have a close relationship to species from the Himalaya and/or adjacent regions. In the central and eastern Himalaya, the number n(x) = 9 is the most common, and the metaphase chromosomes are characterized by a bimodal karyotype composed of one long submetacentric and eight shorter chromosomes (Akiyama et al., 1992). In this study, the number 2n = 18 was found in five species from southwest Yunnan (four of them indigenous to China), and their karyotypes are very similar to those of species having 2n = 18 chromosomes from the central and eastern Himalaya. This suggests that these species may be closely related.

The chromosome number n(x) = 8 is rare in the Himalaya, but this number is more prevalent in three different regions: Africa, southern India and southeastern Asia (Jones and Smith, 1966; Govindarajan and Subramanian, 1986; Rao et al., 1986; cf. Shimizu, 1984; Akiyama et al., 1992). The three Chinese species with 2n = 16 are considered to be close to each other because no significant difference is found in their karyotypes. In considering that one of the species, I. mengtszeana, occurs also in Thailand and Vietnam, these species may have a relationship to the species from southeastern Asia.

The chromosome number n(x) = 10 is widely found in species from Africa, the Himalaya, India, eastern Asia, Europe, and North America (Jones and Smith, 1966; cf. Shimizu, 1984). The Chinese species, I. rubrostriata (2n = 20) was regarded to be allied with I. discolor of the Himalaya on the basis of morphology, especially in the shape of the flower and inflorescence architecture (Akiyama et al., 1994). The similarity of the two species is supported also by their chromosome numbers.

The chromosome number n(x) = 6 has been confined to species from northern India, the Himalaya and northern Thailand (cf. Shimizu, 1986). This number in I. aureliana is the first report from China (Akiyama et al., 1994). It (n = 6) may be characteristic of these adjacent regions, and sug-
gests a group of species closely allied to each other.

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References


摘 要

菅原 敬1・秋山 忍2・邑田 仁3・楊 永平4: 中国雲南省南西部産ツリフネソウ属10種の核型

中国雲南省からはこれまでに80種ほどのツリフネソウ属植物が報告されているが、昨年(1993年9月)行なわれた南西部地域の調査で新たに4新種が確認された。本報では、これら4新種と同地域周辺で採集できた6種の核型について報告する。なお、中国産ツリフネソウ属植物の染色体については初めての報告である。ツリフネソウ属では染色体数に大きな変異(基本数n = 3–14, 16, 17, 22, 24, 33)が認められることが知られていたが、今回調査した雲南省産10種においても、2n = 12 (I. aureliana), 2n = 16 (I. begoniifolia, I. mengtszeana, I. yingjiaogensis), 2n = 17 (I. mengtszeana), 2n = 18 (I. racemosa, I. ruelliensis, I. siculifera, I. tonbiquianensis, I. uliginosa), 2n = 20 (I. rubrostriata) という染色体数が各種で確認され、複雑な変異の様相を示していることが明らかになった。しかし、同じ染色体数をもつ種間では、核型に違いが認められず、染色体数2n = 12, 17, 18, 20の核型はいずれもbimodal(核型を構成する染色体の2本が目だって大きく、残りは小さい)で、2n = 16のmonomodal(染色体数がほぼ同様な大きさ)な核型とは異なっていた。最後に、これらの種と周辺地域分布種との類縁関係について考察した。
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