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CHROMOSOME NUMBERS OF SOME *GENTIANACEAE* FROM THE CAUCASUS

by

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WITH 1 TABLE

INTRODUCTION

Gentianaceae is a fairly cosmopolitan family comprizing about 80 genera and 900 species, mostly represented in temperate zones and mountainous regions of the tropics. Various aspects of most species belonging to the genus *Gentiana* have been extensively studied throughout the world. According to HO and LIU (1990), the genus consists of 15 sections and 361 species with the highest concentration of species in SW China and NE Burma. However, the European sections namely *Gentiana* and *Ciminalis* (Adams.) Dumort. are very different from the Asiatic ones. Chromosome numbers of all the European species have been determined (e.g. FAVARGER 1949, 1952; RORK 1949; SKALINSKA 1951; LÖVE 1953; LÖVE and LÖVE 1975, 1986; KÜPFER 1980; MÜLLER 1982). Some regional karyological studies in Asia have also been carried out, in Japan (SHIGENOBU 1983, 1984), the Himalayas (VASUDEVAN 1975) and China (KÜPFER and YUAN, YUAN, YUAN and KÜPFER, to be published). Nevertheless, some transitional areas have been less studied, though detailed studies of these regions may reveal more concerning the relationships among taxa of different regions. The Caucasus linking W.Asia and E.Europe, is a typical transitional area. About 40 *Gentianaceae* have been recorded in this area (GROSSHEIM 1967). Very few of them have been observed karyologically. $2n = 42$ has been reported for *Swertia iberica* Fisch. and Mey. from this area (SOKOLOVSKAYA and STRELKOVA 1948 cited from AGAPOVA 1990), but recently it has been counted as $2n = 26$ (GAGNIDZE et *al.* 1986). $2n = 26$ has also been reported for *Gentiana pyrenaica* L. from this area by the above two authors (cited from AGAPOVA 1990).

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The present short report is a summary of our preliminary observations on the karyology of *Gentianaceae* from the Caucasus, concerning 11 species from 3 genera. Chromosome numbers for 6 species were determined for the first time.

MATERIALS AND METHODS

The species examined along with their origins are listed in Table 1. All the voucher specimens have been deposited in the Herbarium of the University of Neuchâtel (NEU). Chromosome numbers were determined from mitosis of root-tips, young ovaries and meiosis of pollen mother cells as well as from pollen mitosis. For observations on mitosis of root-tips, seeds collected in the field were germinated in petri dishes following a 24 hour treatment with 0,3 % gibberellic acid (GA_3) (MÜLLER 1977). Root-tips pretreated with a saturated aquaeous solution of α-bromonaphthalene for 1 hour and 20 minutes, were stained and squashed with the aceto-orcein method (KRÄHENBÜHL and KÜPFER, to be published). SNOW'S (1963) method was used for observations on meiosis and the mitosis of young ovaries and pollens.

RESULTS AND DISCUSSION

The chromosome numbers of the species examined are shown in Table 1. Among them, chromosome numbers for *Gentiana angulosa* ($2n = 30$), *Gentiana gelida* ($2n = 26$), *Gentiana kolakovskyi* ($2n = 26$), *Gentianella caucasea* ($2n = 36$), *Gentianella biebersteinii* ($2n = 36$) and *Gentianella umbellata* ($2n = 18$) were determined for the first time. The other numbers confirmed previous reports.

In the genus *Gentiana*, $2n = 48$ has been reported for *G. aquatica* from Siberia (BELAEVA and SIPLIVINSKY 1977 cited from AGAPOVA 1990) and *G. atlantica* Litard. and Maire from North Africa (KÜPFER 1980). Our present observations revealed that *G. aquatica* was fairly stable karyologically with the same number of $2n = 48$ in individuals from three populations in the Caucasus, the western limits of this species' geographical distribution. Although *G. aquatica* and *G. atlantica* share the same chromosome number and belong to the same section (*Chondrophyllae* Bunge), they are quite distinct geographically and morphologically. Whether the same number arised independently in the two species still needs to be confirmed by more studies. *G. pyrenaica* of the section *Chondrophyllae* was confirmed as $2n = 26$ from the Caucasus, near the eastern limit of its distribution. Different numbers of $2n = 36$ and 44 have been reported for *G. asclepiadea*. Our results revealed $2n = 44$, a figure consistent with most reports on the species. *G. gelida*, *G. kolakovskyi* and *G. septemfida* were all $2n = 26$ confirming the fairly uniform chromosome number of the section *Pneumonanthe* (Gled.) Gaudin to which the above three species belong. *G. angulosa* was shown to have $2n = 30$ similar to other parapatrically distributed taxa of the section *Calathianae* Froelich in that area, such as *G. verna* subsp. *balcanica* Pritchard, *G. pontica* Soltok. and *G. oschtenica* (Kusn.) G. Woron. (MÜLLER 1982).

TABLE 1 *Chromosome numbers of some* Gentianaceae *from the Caucasus*

Taxon	Origin and altitude	Material	Chrom. No.	Previous report
Gentiana aquatica L.	C, Kazbegi, 2900 m	root-tips	$2n=48$	$2n=48$ (cited from AGAPOVA 1990)
	C, Djvari Pass, 2400 m	root-tips	$2n=48$	
	C, vicinity of Djvari, 2500 m	root-tips	$2n=48$	
G. asclepiadea L.	T, Bakuriani, 1900 m	ovaries	$2n=44$	$2n=44$ (FAVARGER 1949, RORK 1949, SKALINSKA 1951, MAJOVSKY; 1974*a*) $2n=36$ (SKALINSKA 1950, MAJOVSKY 1974*b*)
G. angulosa Bieb.	C, E. of Djvari Pass, 2900 m	root-tips	$2n=30$*	
G. gelida Bieb.	T, between Tbilisi and Tsalka, Trialetskiy Range, 1600 m	ovaries	$2n=26$	
G. kolakovskyi Doluch.	C, Inguri Valley, 1000 m	ovaries	$2n=26$*	
G. pyrenaica L.	C, E. of Djvari Pass, 2900 m	root-tips	$2n=26$	$2n=26$ (FAVARGER and KÜPFER 1968, KÜPFER and FAVARGER 1967, LÖVE and LÖVE 1975, 1986)
	C, Terek Valley, 2100 m	ovaries, anthers	$2n=26$, $n=13$	
G. septemfida Pall.	C, Terek Valley, 2100 m	root-tips	$2n=26$	$2n=26$ (ZHUKOVA 1967, AGAPOVA 1990)
		ovaries, anthers	$2n=26$, $n=13$	
Gentianella caucasea (Loddiges ex Sims) Holub		root-tips	$2n=36$*	
	C, Kazbek, 3200 m	root-tips	$2n=36$*	
G. biebersteinii (Bunge) Holub	C, Terek Valley, 2100 m	root-tips	$2n=36$*	
G. umbellata (Bieb.) Holub	C, Djvari Pass, 2150 m	root-tips	$2n=18$*	
		root-tips	$2n=18$*	
Lomatogonium carinthiacum (Wulfen) A. Braun	C, Terek Valley, 2100 m	root-tips	$2n=48$	$2n=40$ (FUERNKRANZ 1965); $2n=32$ (KROGULEVICH 1978, LÖVE and LÖVE 1986); $n=24$ (VASUDEVAN 1975)

C: Caucasus (Bolshoy Kavkaz) T: Transcaucasia * first report of chromosome number for the species.

In the genus *Gentianella*, most of the previous reports are of $2n = 36$ for most species (e.g. WEAVER and RÜDENBERG 1975), except that $2n = 18$ has been reported for *G. acuta* Michx. from Siberia (KROGULEVICH 1978), *G. amarella* L. from California (POST 1983) and *G. moorcroftiana* from the Himalayas (MEHRA and VASUDEVAN 1972; VASUDEVAN 1975). Our present study revealed $2n = 36$ for *G. caucasea* and *G. biebersteinii* and $2n = 18$ for *G. umbellata*. About *G. caucasea* FAVARGER (personal communication) found, but did not publish, the same number of $2n = 36$ in *Gentiana caucasica* Bieb. from Erevan (Armenia). Therefore *Gentianella caucasea* would be synonymous to *Gentiana caucasica* var. *markoviczii* Kusn. The relationship between *Gentianella caucasea* and *Gentiana caucasica* would be close.

The basic number of $x = 9$ for the genus *Gentianella* is now well established. Most species known karyologically are tetraploid, a few of them are diploid. Tetraploid species are distributed in North America, the Himalayas and Caucasus, which suggests that the polyploidisation is polytopical.

Our present observation confirmed the chromosome number of $2n = 48$ for *Lomatogonium carinthiacum* which was previously reported as $n = 24$ from Kashmir in the western Himalayas (VASUDEVAN 1975). A similar but not published result of $n = 23$-24 was obtained by FAVARGER (personal communication) on material from the Swiss Alps (Grisons, Val-d'Avers, Bergalgabach, 2000 m). Some other results were also published: $2n = 40$ from the Austrian Alps (FUERNKRANZ 1965), $2n = 32$ from Siberia (KROGULEVICH 1978) and the Mts Bucegi in Roumania (LÖVE and LÖVE 1986). We suppose the basic number of the species to be $x = 8$ instead of $x = 6$ as was suggested by VASUDEVAN (1975), and furthermore, an intraspecific polyploidy exists; the tetraploid cytotype ($2n = 32$) and the hexaploid cytotype ($2n = 48$) may be distributed parapatrically. The number $2n = 40$ from the Austrian Alps would represent a pentaploid type. The phytogeographical value of this result has yet to be demonstrated.

Summary

Chromosome numbers were determined for the first time for *Gentiana angulosa* ($2n = 30$), *Gentiana gelida* ($2n = 26$), *Gentiana kolakovskyi* ($2n = 26$), *Gentianella caucasea* ($2n = 36$), *Gentianella biebersteinii* ($2n = 36$) and *Gentianella umbellata* ($2n = 18$); chromosome numbers were confirmed for *Gentiana aquatica* ($2n = 48$), *Gentiana asclepiadea* ($2n = 44$), *Gentiana pyrenaica* ($2n = 26$) and *Gentiana septemfida* ($2n = 26$). The chromosome number $2n = 48$ was confirmed for *Lomatogonium carinthiacum* and the basic number of $x = 8$ was suggested for the species.

Résumé

Les nombres chromosomiques de *Gentiana angulosa* ($2n = 30$), *Gentiana gelida* ($2n = 26$), *Gentiana kolakovskyi* ($2n = 26$), *Gentianella caucasea* ($2n = 36$), *Gentianella biebersteinii* ($2n = 36$) et *Gentianella umbellata* ($2n = 18$) ont été déterminés pour la première fois. Dans le domaine eurasiatique, *Gentianella umbellata* représente l'espèce la plus occidentale du genre à être diploïde. Toutes les espèces européennes étudiées jusqu'ici se sont révélées tétraploïdes. Le nombre chromosomique ($2n = 48$) du *Lomatogonium carinthiacum* laisse penser que les populations caucasiennes sont hexaploïdes, avec $x = 8$ comme nombre de base, comme les populations du Cachemire et peut-être aussi comme celles des Alpes, en partie tout au moins.

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