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CYTOLOGY OF SPECIES OF *GLORIOSA* LINN

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Cytology of four morphotypes of *Gloriosa superba* (n=11 and 2n=22) and *G. rothschildiana* (2n=66) is reported. Meiosis in *G. superba* was not normal due to high degree of secondary association of bivalents. The karyotype of *G. superba* was graded and symmetrical (1B), while that of *G. rothschildiana* was asymmetrical (3C). In gross karyomorphology the four morphotypes of *G. superba* show in finer details obvious difference. This may have some bearing on the plant morphological difference.

Key words: Cytology, *Glorosa*.

Gloriosa Linn (Liliaceae) is a small genus of mostly tropical African and Asiatic distribution. The plants are climbing herbs characterised by their leaf tips modified into tendrils. The rhizomes and seeds yield a variety of alkaloids.Cytology of about a dozen species is known previously (Fedorov, 1969; Goldblatt, 1984). Only one species occurs indigenously in South India, namely *G. superba* (Hooker, 1894). Recognisable morphological differences are noticed in different populations of the species especially in size of the plant and size and form of leaves. Detailed chromosome study of four morphotypes of this species from South India and of another species of East Himalayan distribution (*G. rothschildiana*) is reported here.

MATERIALS AND METHODS

Plants of the four morphotypes of *G. superba* were collected from different altitude regions in South India such as Trivandrum (morphotype I), Vattakottai (morphotype II), Peermedu (morphotype III) and Kodaikanl (morphotype IV). The plants of the Trivandrum population were by and large erect with shorter and stouter internodes and with their leaves shorter and broader than those of the others. The Vattakottai plants had distinctly larger, but narrower leaves. The plants of the relatively high altitude region of Peermedu possessed slender stem and longer internodes, and they grow to several feet climbing on nearby supporting trees. The Kodaikanal plants were very robust and profusely spreading, and their leaves were distinctly larger in length and breadth.

Chromosomes were studied from PMCs and root tip cells. Flower buds and root tips were fixed in 3:1 Carnoy's fluid. Root tips were pretreated in 0.002 M solution of 8-hydroxy-quinoline for 2 hrs at 4°C. Simple acetocarmine smear and squash technique was followed for making chromosome preparations. Karyotype analysis was made following the system proposed by Levan *et al.* (1964), and karyotype asymmetry and TF% determined after Stebbins (1958) and Huziwara (1962) respectively.

OBSERVATIONS

Meiotic behaviour in all the morphotypes of *G. superba* was apparently abnormal due to high degree of clumping of chromosomes at metaphase I as a result of secondary association of bivalents. Adequately spread out bivalents were noticed in only a small proportion (20-30%) of PMCs (Figs. 1&2). Anaphase I separation was irregular resulting in significant fall in pollen fertility (40-50%). Root tips cells showed 22 chromosomes in all the morphotypes, and they ranged in length from 9.67 - 2.84 um. The karyotypes of all of them were graded and symmetrical (1B). The karymorphological details are summarised in Table I.

In morphotype I, all the chromosomes were of m-type (Fig. 3 & Table I). One pair was clearly larger in size, 4 pairs medium sized and the rest smaller chromosomes. Chromosome No.1 exhibited size heteromorphism, while No.5 was structurally heteromorphic with one of its members possessing a large heterochromatic segment on its short arm near the centromere. Chromosome 7 showed a large segment of heterochromatin near the median region in both its members. The karyotype of morphotype II consisted of one sm-type and the rest m-type chromosome pairs (Fig.4). Chromosome No.1 showed a large heterochromatic segment on either side of the centromere which is absent in all the other morphotypes. The

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Table 1: Summary of Karyomorphology of *Gloriosa superba* and *G. rothschildiana*.

Name of taxa		Chromosome No		TCL	ACL	Chromosome types					Karyo-	TF%
		n	2n	mm	mm	M	m	sm	st	t	type	
G. Superba												
Morphotype	I	11	22	110.00	5.00	-	11	-	-	-	1B	43.80
"	II	11	22	98.64	4.48	-	10	1	-	-	1B	44.00
"	III	11	22	121.00	5.50	-	10	1	-	-	1B	44.00
"	IV	11	22	129.00	5.86	-	11	-	-	-	1B	43.67
G. rothschildiana		-	66	431.20	6.53	-	12	11	10	-	3C	30.10

TCL : Total chromosome length; ACL : Average chromosome length

large segement of heterochromatin noticed in the short arms of chromosomes 5 and 7 in the other morphotypes was absent in this. In morphotype III, both the members of chromo some 5 & 7 showed prominent heterochromatic segments in the short arm near the centromere (Fig.5). Chromosomes 1 & 2 in morphotype IV showed size heteromorphism (Fig.6). In chromosome 5, the heterochromatic region in one of the members was much larger.

G. rothschildiana O Brien

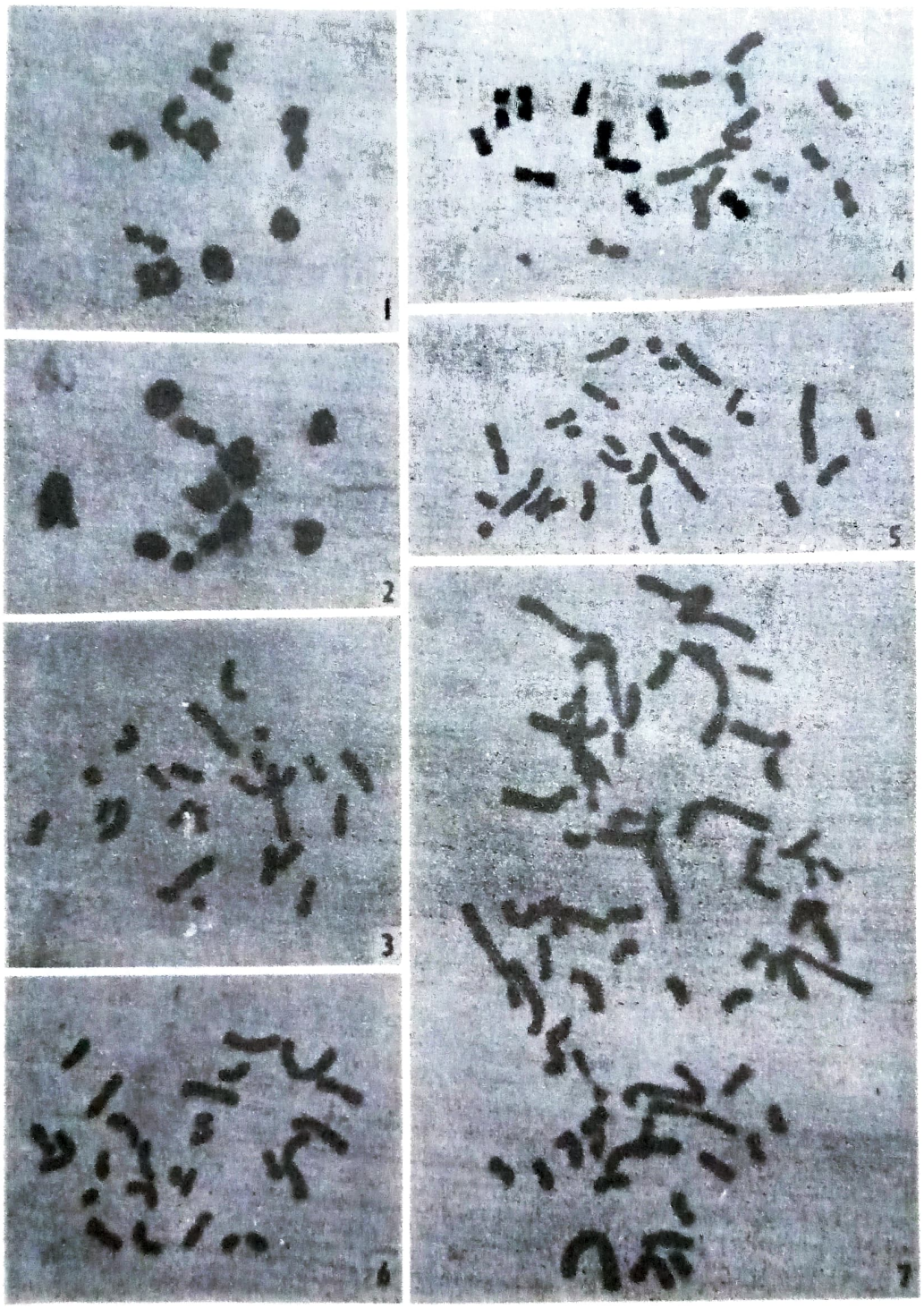
Plants of this species were considerably larger than *S. superba,* and they were more robust also. Meiosis was not normal due to association of chromosomes at diakinesis and metaphase I leading to irregular separation at anaphase. Root tip cells showed 2n=66 chromosomes (Fig.7). The karyotype was asymmetrical (3C), and consisted of 12 pairs of m-type, 11 sm-type and 10 of st-type chromosomes. Chromosome 2 showed size heteromorphism. Previous workers have reported different numbers such as 2n=22 (Tijio, 1948), 2n=66 (La Cour, 1951) and 2n=84 & 88 (Sharma and Sharma, 1961).

DISCUSSION

Chromosome data so far known on 12 species of *Gloriosa* (Fedorov, 1969; Goldblatt, 1984) shows that they constitute a polyploid series based on x=11 (2n=22, 44, 66, 88). Some of the species exhibit intraspecific polyploidy and aneuploidy at polyploid levels, including the two species reported here, namely *S.superba* (2n=22, 88, 90) and *G. rothschildiana* (2n=22, 66, 84, 88). In all the four morphotypes of the present diploid species *G. superba,* there was high degree of secondary association of bivalents at meiosis. Since secondary association of bivalents is often considered as indication of ancestral homology (Philip & Mathew, 1987), it may be possible that the n=11 in the species might contain two basic genomes, possibly arisen by amphidiploidy from related ancestral taxa, either both of which with n=6 followed by descending aneuploidy (6+6-1) or one with n=5 and the other 6. However, in the absence of such low chromosome numbered species in any of the related genera, the above contention is only tentative. Chromosome data indicate that polyploidy as well as aneuploidy have played notable role in the evolution of the genus.

The chromosomes of *G. superba* are almost exclusively metacentrics, and its karyotype is graded and symmetrical (1B & TF%: above 43), while in the hexaploid *S. rothschildiana* the karyotype is specialised and asymmetrical (3C & TF%:30) with sm- and st-type chromosomes predominating. This appears to be suggestive that chromosome numerical evolution by polyploidy and structural changes leading to intrakaryotypic size difference of chromosomes and shift of centromere from median to submedian and subterminal positions have been concomitantly operating in the genus.

In gross karyomorphology the four morphotypes of *S. superba* are apparently similar. But, with respect to finer aspects of karyomorphology, obvious difference exists between and among the different morphotypes. The differences noticed mainly concern total chromosome size (TCL: 110.0, 98.6, 121 & 129 μm), chromosome size hettromorphism (Nos. 1 & 2), size and distribution of heterochromatin (Nos. 1,5 & 7) and position of centromere (No.10) in some of the individual chromosome pairs. The type of karyomorphological difference noticed in the different morphotypes not only provides a cytological basis for the plant morphological difference among them, but also shed light on the probable pattern of intraspecific karyotype evolution within this species complex.



Figs. 1 -7. Chromosomes of species of *Gloriosa* (All Figs. x 1070) Figs. 1 & 2. PMCs of *G. superba* showing 11 bivalents Fig. 3. Morphotype I of *G. superba*, 2n=22 Fig. 4. Morphotype II of *G. superba*, 2n=22 Fig. 5. Morphotype III of *G. superba*, 2n=22 Fig. 6. Morphotype IV of *G. superba*, 2n=22, Fig.7. *G. rothschildiana*, 2n=66.

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