Meiotic Studies in Himalayan Celastraceae and Rhamnaceae

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The family Celastraceae embraces 850 species belonging to 55 woody genera with wide distribution except in the arctic. About 70 species and 12 genera are met in India. Two of these, *Lophopetalum fimbriatum* from Eastern Himalayas and *L. wightianum* from South India, yield commercial timber. Several species of *Euonymus* are ornamental.

Rhamnaceae is a family of 58 genera and 900 species distributed in the tropical and temperate regions. Ten genera with roughly 40 species occur in India. *Zizyphus jujuba* and *Z. xylopyrus* yield low grade timber. Jujube is one of the most common wild fruit trees in India.

This study was part of the wider project "Cytomorphological Investigations of Himalayan Hardwoods" undertaken by us from 1962-1967. The chromosome counts of newly studied species have been published in IOPB chromosome numbers reports (Mehra and Khosla 1969, Mehra and Sareen 1969).

Table 1. Source of the material

Principal station with latitude and longitude	Specific locality with altitude in meters
Eastern Himalayas: Darjeeling (27°30'N 88°18'E)	1) Jalapahar 2300; 2) Senchal 2100; 3) Sukna 150.
Shillong (25°40'N 91°55'E) (Khasia and Jaintia hills)	4) Elephant falls 1800; 5) Garampani 760; 6) Lake garden 1500; 7) Shillong 1500; 8) Shillong peak 1800.
Western Himalayas: Nainital (29°22'N 79°29'E)	9) Enroute Cheena peak 1950; 10) Kapkote 1100; 11) Lalkuan 350; 12) Guma 1200; 13) Kandaghat 1700; 14) Kufri 2600; 15) Mahasu peak 2650; 16) Narkanda 2700; 17) Taradevi 1800; 18) Tatapani 760.

Material and methods

The material for meiotic studies was collected from wild populations in the Himalayas. The flower buds were fixed in Carnoy's fluid. After one or two days anther squashes were prepared in 1.0% aceto-carmine. The photomicrographs as also the camera lucida drawings are at a uniform magnification of $\times 1360$. The voucher specimens have been kept in the Herbarium of the Botany Department of Panjab University.

Results and discussion

The results of cytological studies on 21 species are summarized in Table 2. The genera and species under each family are arranged according to their timber/forestry importance. The specific localities of voucher specimens are designated by figures as given in Table 1. Meiosis was observed to be normal in all species.

Celastraceae: *Lophopetalum fimbriatum* is a lofty tree of Sikkim Terai. PMC's at diakinesis showed 20 bivalents which were well spread (Fig. 4). This is the first chromosomal determination in the genus and is suggestive of 20 as its basic number.

The genus *Elaeodendron* has not been investigated cytologically before. *E. roxburghii* showed a haploid number $n=17$ (Fig. 5) which may be considered as basic number of the genus.

Seven species of *Euonymus* have been cytologically studied for the first time. *E. echinatus* revealed the lowest chromosome number, $n=8$, (Fig. 2) in the genus,

Figs. 1-3. 1, *Euonymus bullatus*: $n=24$, metaphase I. 2, *E. echinatus*: $n=8$, diakinesis. 3, *Berchemia floribunda*: $n=12$, metaphase I.

thereby, establishing its basic number $x=8$ as earlier suggested by Darlington and Wylie (1955). *E. echinatus* is diploid, *E. bullatus* hexaploid (Fig. 1) while *E. grandiflorus*, *E. lacerus*, *E. frigidus*, *E. pendulus* and *E. hamiltonianus* are tetraploids. *Euonymus* is one of the few tree genera which are rich in incidence of polyploidy.

Celastrus paniculatus with $n=23$ substantiates earlier report by Adatia and Bavade (1962).

Gymnosporia acuminata (Fig. 6) and *G. rufa*, each with $n=18$, have not been earlier worked out cytologically.

The presently investigated five genera of Celastraceae display different basic numbers: *Lophopetalum* ($x=20$), *Elaeodendron* ($x=17$), *Euonymus* ($x=8$), *Celastrus* ($x=23$) and *Gymnosporia* ($x=18$). Evidently, aneuploidy has played significant role in generic differentiation of the family.

Rhamnaceae: *Zizyphus jujuba* is a morphologically variable species widely distributed in dry forests of India, also cultivated for its fruit. Our observations on materials collected from four wild populations consistently revealed $n=24$.

Previous chromosome counts in this species are $n=12$, 20, 24, 36 and $2n=60$, 96 (see Table 2). Thus, diploid, tetraploid, pentaploid, hexaploid and octaploid races based on $x=12$ exist in this species. In *Z. xylopyrus*, PMC's at diakinesis

Figs. 4-9. 4, *Lophopetalum fimbriatum*: $n=20$, diakinesis. 5, *Elaeodendron roxburghii*: $n=17$, diakinesis. 6, *Gymnosporia acuminata*: $n=18$, metaphase I. 7, *Zizyphus xylopyrus*: $n=12$, diakinesis. 8, *Z. oxyphylla*: $n=12$, diakinesis. 9, *Sageretia hamosa*: $n=12$, metaphase I.

showed 12 bivalents and a nucleolus with one bivalent showing early disjunction. Almost all bivalents appeared rod-shaped (Fig. 7). Likewise, *Z. oxyphylla* revealed 12 bivalents along with a nucleolus at diakinesis. The bivalents were of rod and

ring type (Fig. 8). No previous chromosome record is available for these two species.

Rhamnus triqueter and *R. purpureus*, each having $n=12$, are being reported here for the first time.

Table 2. Chromosome numbers in Celastraceae and Rhamnaceae

Taxon	Locality	Chromosome number	Fig. no.	Presumed level of ploidy	Previous reports
Celastraceae					
<i>Lophopetalum fimbriatum</i> Wight	3	$n=20$	4	diploid	
<i>Elaeodendron roxburghii</i> Wight and Arn.	3	$n=17$	5	diploid	
<i>Euonymus grandiflorus</i> Wall.	4	$n=16$	—	tetraploid	
<i>E. bullatus</i> Wall.	8	$n=24$	1	hexaploid	
<i>E. lacerus</i> Buch-Ham.	14	$n=16$	—	tetraploid	
<i>E. frigidus</i> Wall.	1	$n=16$	—	tetraploid	
<i>E. echinatus</i> Wall.	1	$n=8$	2	diploid	
<i>E. pendulus</i> Wall.	9	$n=16$	—	tetraploid	
<i>E. hamiltonianus</i> Wall.	16	$n=16$	—	tetraploid	
<i>Celastrus paniculatus</i> Willd.	5	$n=23$	—	diploid	$n=23$: Adatia and Bavade 1962
<i>Gymnosporia acuminata</i> Hook.f.	8	$n=18$	6	diploid	
<i>G. rufa</i> Laws.	6	$n=18$	—	diploid	
Rhamnaceae					
<i>Zizyphus jujuba</i> Lam.	3, 10, 12, 18	$n=24$	—	tetraploid	$n=12$: Morinaga <i>et al.</i> , 1929 $n=20$: Srinivasachar 1940 $n=24, 36, 48$; $2n=96$: Srinivasan 1952 $n=24, 48; 2n=60, 96$ Khoshoo and Singh 1963
<i>Z. xylopyrus</i> Willd.	11	$n=12$	7	diploid	
<i>Z. oxyphylla</i> Edgew.	18	$n=12$	8	diploid	
<i>Rhamnus triqueter</i> Wall.	17	$n=12$	—	diploid	
<i>R. purpureus</i> Edgew.	15	$n=12$	—	diploid	
<i>Sageretia hamosa</i> Brongn.	7	$n=12$	9	diploid	
<i>S. oppositifolia</i> Brongn.	12	$n=12$	—	diploid	
<i>S. theezans</i> Brongn.	13	$n=12$	—	diploid	$2n=24$: Bowden 1945
<i>Berchemia floribunda</i> Wall.	2	$n=12$	3	diploid	

Sageretia hamosa (Fig. 9), *S. oppositifolia* and *S. theezans* displayed uniformity in haploid chromosome number ($n=12$). The former two species are chromosomally reported for the first time, while the latter confirms the chromosome number reported earlier by Bowden (1945).

Berchemia floribunda with gametic number 12 (Fig.3) is previously uninvestigated cytologically. On the basis of this first exact chromosome number determination in the genus, 12 is suggested as its basic number.

All species of Rhamnaceae studied by us are uniformly based on $x=12$. Most of the hitherto investigated taxa fall in line with this basic number. A few discordant chromosome records (cf. Darlington and Wylie, 1.c) need confirmation. Twelve seems to be the only or original basic number of this family. Polyploidy is infrequent in the family, eight of the nine presently studied species are diploid.

Summary

Cytological studies have been carried out in 21 woody species. The chromosome numbers of eighteen species have been presented for the first time. The basic numbers suggested for the three newly investigated genera are *Lophopetalum* ($x=20$), *Elaeodendron* ($x=17$) and *Berchemia* ($x=12$). Polyploidy is frequent in *Euonymus* but rare or unrecorded in other Celastraceae and Rhamnaceae. The role of aneuploidy is significant in Celastraceae, but it appears to be lacking or meagre in Rhamnaceae which seems to have 12 as its original basic number.

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