

## Cytological explorations of Indian woody legumes

V K SINGHAL, B S GILL and M S SIDHU

Department of Botany, Punjabi University, Patiala 147 002, India

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**Abstract.** Cytological exploration of 47 woody leguminous species have been made from the forests of northern, central and southern India. Of these, *Acacia canescens* (n=13), *Dichrostachys cinerea* (n=26), *Erythrina caffra* (n=21), *Millettia brandisiana* (n=11), *Mucuna hirsuta* (n=11), *Pahudia martabanica* (n=12) and *Phanera glauca* (n=14) are explored for the first time. Additional and/or variable cytotypes are recorded in *Bauhinia acuminata* (n=13) and *Prosopis glandulosa* (n=28). Existence of B-chromosomes has been recorded in *Erythrina caffra* (n=21+0–3B), *Millettia brandisiana* (n=11+0–2B), *Pongamia pinnata* (n=11+0–7B) and *Tamarindus indica* (n=13+0–4B). Besides these cytomorphological variabilities, structural heterozygosity for translocations/inversions (*Ougeinia oojeinensis*, *Pongamia pinnata*, *Saraca indica*) and cytomixis (*Caragana brevispina*) are also existent.

**Keywords.** Legumes; heterozygosity; translocations; inversions; cytomixis.

### 1. Introduction

Leguminosae, one of the largest and cosmopolitan families, has a special status in Indian forestry. Its members are well represented in various forest types. As many as 37 species provide commercial timber (Pearson and Brown 1932). *Leucaena leucocephala* (Lam.) de Wit., an exotic species with multipurpose use is quite important in social forestry in India. Besides, several species yield minor forest products and raw materials for forest based industries.

Exploration of germplasm of forest species of such a family is, therefore, desirable. The proper analysis of morphological and/or cytological-variation could provide a base for future tree improvement programmes. With this object, the present studies are undertaken from the forests of northern, central and southern India. Some exotics and cultivated members are also included.

### 2. Materials and methods

Chromosomal explorations have been made through meiotic studies for which flower buds were fixed in Carnoy's fluid. Smears were prepared using standard acetocarmine techniques. Pollen fertility was estimated on the basis of their well-filled nature and stainability with glycerol-acetocarmine (1:1) mixture.

### 3. Results and discussion

Information on specific locality, chromosome number, ploidy level, pollen fertility and previous reports of the presently investigated 47 species is provided in table 1. Voucher specimens are available in the Herbarium, Department of Botany, Punjabi

Table 1. Chromosomal data of the presently investigated species.

Taxa	Locality	Voucher specimen number	Chromosome number	Previous reports*
<i>Acacia</i> Willd. (x = 13)				
<i>A. caesia</i> W. and A.	Pachmarhi: Duchess Fall, 800 m <sup>a</sup>	23191	n = 13	2n = 26: Bir and Kumari (1978)
<i>A. canescens</i> Grah.	Kodaikanal: Fall's view, 800 m <sup>a</sup>	29292	n = 13	
<i>A. dealbata</i> Link.	Kodaikanal: Pillar Rocks, 800 m <sup>a</sup>	29296	n = 13	2n = 26: Ghimpu (1929c,d,1930); Atchison (1948)
<i>A. decurrens</i> Willd.	Kodaikanal: Pillar Rocks, 800 m <sup>a</sup>	28355	n = 13	2n = 26: Ghimpu (1929c,d,1930); Atchison (1948); Brigs vide Fedorov (1969)
<i>Albizia durazz.</i> (x = 13)				
<i>A. lebbeck</i> Benth.	Kodaikanal: Kodai Road, 250 m <sup>a</sup>	29177	n = 13	2n = 26: Patil (1958); Mehra and Hans (1971, 1972); Mehra (1972); Mehra and Sareen (1973)
<i>Bauhinia</i> Linn. (x = 13, 14)				
<i>B. acuminata</i> Linn.	Dehra Dun: F.R.I., 600 m (cult.) <sup>a</sup>	23001	n = 13	2n = 28: Pantulu (1942); Atchison (1951); Sharma and Raju (1968); Bir and Kumari (1979)
<i>B. galpini</i> N. E. Brown	Dehra Dun: F.R.I., 600 m (cult.) <sup>a</sup>	23502	n = 14	2n = 28: Atchison (1948); Rao (1954); Sharma and Raju (1968)
<i>B. retusa</i> Buch.- Ham.	Mussoorie: Jharipani, 1,500 m <sup>a</sup>	23281	n = 14	2n = 24, 26, 28: Sharma and Raju (1968); 2n = 28: Pantulu (1942); Atchison (1951); Rao (1967); Mehra and Sareen (1973); Sandhu and Mann (1988).
<i>Butea</i> Roxb. ex Willd. (x = 9)				
<i>B. monosperma</i> (Lam.) Taub. (= <i>B. frondosa</i> Roxb.)	Pachmarhi: Matkuli, 450 m <sup>a</sup>	25947	n = 9	2n = 18: Rao (1954); Raghavan and Arora (1958); Nanda (1962); Tixier (1965); Bir and Sidhu (1967); Mitra and Datta (1967); Mehra and Sareen (1973); Sanjappa and Bhatt (1976); Sinha and Kumar (1978); Anis (1983); Sandhu and Mann (1988); 2n = 18 + 1f: Kedharnath (1950); 2n = 18 + 1B: Anis (1983)
	Patiala Theri, 250 m <sup>a</sup>	25946	n = 9	
<i>Caesalpinia</i> Linn. (x = 11, 12)				
<i>C. decapetala</i> (Roth.) Alston	Pachmarhi: Jambu Dwip, 1,000 m <sup>a</sup>	25951	n = 12	2n = 22: Malla <i>et al</i> (1977); 2n = 24: Rao (1967); Bir and Kumari (1973, 1977);

(table 1 contd.)

Taxa	Locality	Voucher specimen number	Chromosome number	Previous reports*
(= <i>C. sepiaria</i> Roxb.)	Dehra Dun: Lachhiwala, 600 m <sup>a</sup> Kodaikanal: Dolmen Circle, 1400 m <sup>a</sup>	— 29357	n = 12 n = 12	Gill <i>et al</i> (1982); Sandhu and Mann (1988)
<i>Campylotropis</i> Bunge (x = 9, 11) <i>C. Stenocarpa</i> (Koltz.) Schind. (= <i>Lespedeza stenocarpa</i> Maxim.)	Saharangpur: Mohand, 400 m <sup>a</sup>	22811	n = 11	2n = 18: Mehra and Dhawan (1971); 2n = 22: Sandhu and Mann (1988)
<i>Caragana</i> Lam. (x = 8) <i>C. brevispina</i> Royle	Chamoli: Gobind Dham, 3,000 m <sup>a</sup> Yamnotri, 3,300 m <sup>b</sup>	22800 26329	n = 8 n = 8	2n = 16: Fedorov (1969); Sandhu and Mann (1988)
<i>Cassia</i> Linn. (x = 7, 8) <i>C. auriculata</i> Linn.	Kodaikanal: Periyakulum, 800 m <sup>c</sup>	29347	n = 14	2n = 14, 16: Jacob (1940); 2n = 14, 16, 28: Irwin and Turner (1960); 2n = 28: Pantulu (1940, 1960a); Tandon and Bhat (1970)
<i>C. fistula</i> Linn.	Kodaikanal: Otthu, 1,300 m <sup>c</sup> Dolmen Circle, 1,400 m <sup>c</sup>	29137 29139	n = 14 n = 14	2n = 24: Tischler (1921–22); Irwin and Turner (1960); Nanda (1962); 2n = 26: Bir and Sidhu (1967); 2n = 28: Pantulu (1946, 1960a); Irwin and Turner (1960); Tandon and Bhat (1970); Mehra and Hans (1971); Bir and Kumari (1973); Datta and Datta (1973); Mehra and Sareen (1973)
<i>C. occidentalis</i> Linn.	Kodaikanal: Tiger Shola, 1,800 m <sup>c</sup>	29129	n = 12	2n = 26: Muto (1929); Frahm-Leliveld (1960); Irwin and Turner (1960); Miège (1962); Bir and Sidhu (1967); Gupta and Gupta (1971); Sinha <i>et al</i> (1972); Sinha and Prasad (1973) 2n = 28: Senn (1938b); Pantulu (1940, 1960); Turner (1956); Irwin and Turner (1960); Miège (1962); Hsu (1967); Tandon and Bhat (1970); Randell (1970); Gupta and Gupta (1971); Larsen (1971); Sareen <i>et al</i> (1974)

(table 1 contd.)

Taxa	Locality	Voucher specimen number	Chromosome number	Previous reports*
<i>Crotalaria</i> Linn.				
(x = 7, 8)				
<i>C. verrucosa</i> Linn.	Kodaikanal: Fall's view, 800 m <sup>a</sup>	—	n = 8	2n = 16: Raghavan and Venkatasubban (1943); Atchison (1950); Datta and Biswas (1963); Tandon and Bhat (1970); Subramanian (1972); Bairiganjan and Patnaik (1989)
<i>Dalbergia</i> Linn. f.				
(x = 10)				
<i>D. lanceolaria</i> Linn.f.	Rishikesh: Narendra Nagar, 600 m <sup>a</sup>	22999	n = 10	2n = 20: Atchison (1951); Mehra and Hans (1972); Sarkar <i>et al.</i> (1974);
	Kodaikanal: Fall's View, 800 m <sup>a</sup>	29152	n = 10	Bir and Kumari (1975); Sanjappa and Dasgupta (1977); Sinha and Kumar (1978)
<i>D. latifolia</i> Roxb.	Dehra Dun: F.R.I., 600 m (cult.) <sup>d</sup>	23271	n = 10	2n = 20: Atchison (1951); Mehra and Hans (1971, 1972); Sanjappa and Dasgupta (1981)
<i>D. paniculata</i> Roxb.	Pachmarhi 1,050 m <sup>a</sup>	26057	n = 10	2n = 20: Atchison (1951); Bir and Kumari (1977)
<i>D. sericea</i> G. Don. (= <i>D. hircina</i> Benth.)	Dehra Dun: Sahasradhara, 600 m <sup>a</sup>	22993	n = 10	2n = 20: Rao (1967); Mehra and Hans (1971, 1972); Mehra and Sareen (1973)
<i>D. sissoo</i> Roxb.	Dehra Dun: Ballupur, 600 m <sup>a</sup>	23029	n = 10	2n = 20: Patil (1958); Nanda (1962); Rao (1967); Mehra and Hans (1971, 1972); Mehra and Sareen (1973); Bir and Kumari (1977); Sandhu and Mann (1988); Bairiganjan and Patnaik (1989)
<i>Delonix</i> Rafin				
(x = 12, 14)				
<i>D. regia</i> (Boj.) Rafin.	Kodaikanal, 2,050 m <sup>a</sup>		n = 12	2n = 24: Poucques (1945a); 2n = 28: Jacob (1940); Atchison (1951); Berger <i>et al.</i> (1958); Mehra and Sareen (1973)
<i>Desmodium</i> Desv.				
(x = 10, 11)				
<i>D. elegans</i> DC. (= <i>D. tiliacifolium</i> G. Don)	Mussoorie, 2,050 m <sup>a</sup>	23241	n = 11	2n = 22: Bir and Sidhu (1967); Rao (1967); Rotar and Urata (1967); Koui and Gohil (1973); Mehra and Sareen (1973); Sanjappa and Bhatt (1977); Bir and Kumari (1979); Sandhu and Mann (1988)
<i>D. latifolium</i> DC.	Dehradun:	23150	n = 11	2n = 22: Young (1940); Rotar

(table 1 contd.)

Taxa	Locality	Voucher specimen number	Chromosome number	Previous reports*
(= <i>D. velutinum</i> (Willd.) DC.)	Lachhiwala, 600 m <sup>a</sup>			and Urata (1967); Mehra and Dhawan (1971); Bir and Kumari (1973, 1977); Sanjappa and Bhatt (1977)
<i>D. rufescens</i> DC. (x = 13)	Kodaikanal: Periyar Shola, 1,000 m <sup>a</sup>	29350	n = 11	2n = 22: Bir and Sidhu (1967)
<i>D. cinerea</i> W. and A.	Kodaikanal: Otthu, 1,300 m <sup>c</sup>	29447	n = 26	
<i>Erythrina</i> Linn. (x = 21)				
<i>E. caffra</i> Thunb.	Dehra Dun: F.R.I., 600 m (cult.) <sup>d</sup>	22832	n = 21 + 0-3B	2n = 42: Atchison (1947); Krukoff (1969)
<i>E. indica</i> Linn.	Kodaikanal, 2,100 m <sup>e</sup>	29281	n = 21	2n = 42: Rao (1945); Atchison (1947); Nanda (1962); 2n = 44: Poucques (1945a),
<i>Indigofera</i> Linn. (x = 7, 8)				
<i>I. gerardiana</i> R. Grah. (= <i>I. heterantha</i> Wall.)	Chakrata: Jadi, 2400 m <sup>e</sup>	23441 23441	n = 24 n = 24	2n = 16: Bir and Sidhu (1967); Baquar and Abid Askari (1970a,b); Bir and Kumari (1979); Sandhu and Mann (1988); 2n = 32: Kumari <i>et al</i> (1989); 2n = 48: Kreuter (1929, 1930); Fram-Leliveld (1957, 1960); Sanjappa and Bhatt (1977); Bir <i>et al</i> (1982).
<i>I. hebeptala</i> Benth. ex Baker	Yamnotri, 3,300 m <sup>e</sup>	26322	n = 8	2n = 16: Bir <i>et al</i> (1982); Sandhu and Mann (1988)
<i>I. pulchella</i> Roxb. (= <i>I. cassioides</i> Rottl. ex DC.)	Dehra Dun: F.R.I., 600 m <sup>e</sup> (cult.)	22976	n = 8	2n = 16: Patil (1958); Bir and Sidhu (1967); Mitra and Datta (1967); Rao (1967); Bir and Kumari (1977); Sareen and Trehan (1977); Sandhu and Mann (1988)
<i>Lonchocarpus</i> Kunth (x = 11)				
<i>L. neuroscapha</i> Benth.	Dehra Dun: F.R.I., 600 m <sup>a</sup> (cult.)	22802	n = 11	2n = 22: Atchison (1949)
<i>Millettia</i> W. and A. (x = 8, 10, 11, 12)				
<i>M. brandisiana</i> Kurz.	Dehra Dun: F.R.I., 600 m <sup>b</sup> (cult.)	22830	n = 11 + 0-2B	
<i>M. extensa</i> Benth. ex Baker	Dehra Dun: Mothronwala,	22997	n = 11	2n = 20: Atchison (1951); Sanjappa and Dasgupta (1977);

(table 1 contd.)

Taxa	Locality	Voucher specimen number	Chromosome number	Previous reports*
(= <i>M. auriculata</i> Baker ex. Brandis)	600 m <sup>a</sup> Saharanpur: Mohand, 400 m <sup>a</sup>	23010	n = 11	2n = 22: Bir and Kumari (1973, 1977).
<i>M. ovalifolia</i> Kurz.	Dehra Dun: F.R.I., 600 m (cult.) <sup>a</sup>	23000	n = 11	2n = 20: Atchison (1951); Sanjappa and Dasgupta (1977) 2n = 22: Pal (1960); Findley and McNeil (1974); Sareen <i>et al</i> (1974, 1980); Sanjappa and Dasgupta (1977); Bir and Kumari (1979)
<i>Mimosa</i> Linn. (x = 13)				
<i>M. himalayana</i> Gamble	Dehra Dun: Bindaal, 600 m <sup>a</sup>	23292	n = 13	2n = 26: Bir and Kumari (1978)
<i>Mucuna</i> Adans. (x = 11)				
<i>M. hirsuta</i> W. and A.	Kodaikanal: Perumalmalai, 1000 m <sup>a</sup>	29293	n = 11	
<i>Ougeinia</i> Benth. (x = 11, 12)				
<i>O. oojeinensis</i> (Roxb.) Houch. (= <i>O. dalbergioides</i> Benth.)	Pachmarhi: Matkuli, 450 m <sup>d</sup>	23554	n = 11	2n = 22: Sareen and Trehan (1976, 1977); 2n = 24: Mehra and Sareen (1973); Bir and Kumari (1977)
<i>Pahudia</i> Miq. (x = 12)				
<i>P. martabanica</i> prain	Dehra Dun: F.R.I., 600 m <sup>a</sup> (cult.)	22828	n = 12	
<i>Peltophorum</i> Vogel (x = 13, 14)				
<i>P. africanum</i> Sond.	Dehra Dun: F.R.I., 600 m <sup>f</sup> (cult.)	23009	n = 13	2n = 26: Turner and Fearing (1959); Bir and Kumari (1979)
<i>Phanera</i> Lour. (x = 14)				
<i>P. glauca</i> Wall. ex (= <i>Bauhinia glauca</i> Wall. ex. Benth.)	Dehra Dun: F.R.I., 600 m <sup>a</sup> (cult.)	22812	n = 14	
<i>Poinciana</i> Linn. (x = 11, 12)				
<i>P. pulcherrima</i> Linn.	Kodaikanal: Palni, 400 m <sup>a</sup>	29171	n = 12	2n = 22: Bir and Sidhu (1967); 2n = 24: Senn (1938); Jacob (1940); Atchison (1951); Berger <i>et al</i> (1958); Bir and Kumari (1973); Sareen <i>et al</i> (1974)

(table 1 contd.)

Taxa	Locality	Voucher specimen number	Chromosome number	Previous reports*
<i>Pongamia</i> Vent. ( $x = 11$ )				
<i>P. pinnata</i> (Linn.) Pierre (= <i>P. glabra</i> Vent.)	Pachmarhi:  Matkuli, 450 m (cult.) <sup>b</sup>	22538	$n = 11 +$  0-7B	2n = 20: Atchison (1951);  2n = 22: Patel and Narayana (1937); Raghavan and Arora (1958); Mehra and Hans (1971), Sanjappa and Bhatt (1976); Bir and Kumari (1977), Sarbhoy (1977); Bairiganjan and Patnaik (1989)
<i>Prosopis</i> Linn. ( $x = 13, 14$ )				
<i>P. glandulosa</i> Torr. var. <i>torreyana</i>	Kodaikanal: Kodai road, 250 m <sup>c</sup>	29529	$n = 28$	2n = 26: Ramanathan (1950); 2n = 28: Baquar <i>et al</i> (1966)
<i>Saraca</i> Linn. ( $x = 12$ )				
<i>S. indica</i> Linn.	Dehra Dun: F.R.I., 600 m (cult.) <sup>d</sup>	26315	$n = 12$	2n = 24: Pantulu (1943); Atchison (1951); Simmonds (1954); Mehra and Hans (1971, 1972); Bir and Kumari (1979); Sanjappa and Dasgupta (1981)
<i>Tamarindus</i> Linn. ( $x = 12$ )				
<i>T. indica</i> Linn.	Pachmarhi: Singhanama, 500 m <sup>a</sup>	26313	$n = 12 +$ 0-4B	2n = 24: Paul (1937); Atchison (1951); Mehra and Hans (1971); Mehra and Sareen (1973); Bir and Kumari (1977); Sanjappa (1978); Hussaini and Gill (1985)
<i>Wisteria</i> Nutt. ( $x = 8$ )				
<i>W. sinensis</i> (Sims) DC.	Dehra Dun: F.R.I., 600 m (cult.) <sup>i</sup>	22977	$n = 8$	2n = 16: Roscoe (1927); Bir and Kumari (1975)

\*Darlington and Wylie (1955); Index to plant chromosome numbers (1956-1974); Löve and Löve (1961, 1974, 1975); Fedorov (1969); Chromosome number reports published in Taxon and Journal of Cytology and Genetics and Biological Abstracts.

Ploidy level and pollen fertility: <sup>a</sup>2x, 100%; <sup>b</sup>2x, 80%; <sup>c</sup>4x, 100%; <sup>d</sup>2x, 82%; <sup>e</sup>6x, 100%; <sup>f</sup>2x, 98%; <sup>g</sup>2x, 57%; <sup>h</sup>2x, 30%; <sup>i</sup>2x, 51%.

University, Patiala with PUN as abbreviation. Features of cytological and/or morphological interest discussed under each genus.

### 3.1 *Acacia* Willd.

A genus with 750-800 species is of considerable forestry importance. Of the 25

Indian species, 5 yield commercial timber. Besides, several species are introduced for afforestation. Of the 4 species studied, *A. canescens* with  $n=13$  is counted for the first time. Whereas in *A. dealbata*, *A. decurrens* and *A. caesia* the chromosome report of  $n=13$  agrees with the earlier reports (table 1).

### 3.2 *Albizia* Durazz.

A genus of forestry importance with 6 species provide commercial timber. *A. lebbeck* is widely distributed in India up to 1,600 m. Also, it is planted as an avenue tree. All the presently studied populations from south India are diploid with  $n=13$  and it agrees with the earlier reports from eastern and western Himalaya.

### 3.3 *Bauhinia* Linn.

A genus of 300 species of trees and shrubs is of some forestry importance. Of the 3 species explored chromosomally, the count of  $n=13$  for *B. acuminata* from cultivated plants establishes a new cytotype against the earlier record of  $n=14$  whereas for *B. galpini* and *B. retusa*, the present count of  $n=14$  agrees with the earlier reports.

### 3.4 *Butea* Roxb. ex Willd.

Of the 3 Indian species, *B. monosperma* is distributed throughout India in the plains and up to 900 m in the hills. Various forms on the basis of flower colour as red, yellow and orange, as reported presently and white flowered as reported by Kamran (1989) are existent. However, cytologically all the Indian populations inclusive of the present one are diploid with  $n=9$ . However, B-chromosomes exist in some populations of Gwalior forests (Anis 1983).

### 3.5 *Caesalpinia* Linn.

*C. decapetala*, a large straggling thorny shrub, is widely distributed in the tropical and sub-tropical forests. All the Indian populations inclusive of those studied presently are diploid with  $n=12$ . However, a cytotype with  $n=11$  also exists in Nepal (Malla *et al* 1977).

### 3.6 *Campylotropis* Bunge

*C. stenocarpa* is widely distributed in the western Himalaya. The presently studied population from Dehradun forests and those studied by Sandhu and Mann (1988) from Shimla hills are diploid with  $n=11$ . However, a cytotype with  $n=9$  also exist in Nainital hills (Mehra and Dhawan 1971).

### 3.7 *Caragana* Lam.

Of the 10 Indian species, *C. brevispina* forms the important constituent of cold



temperate forests. Majority of the populations studied presently show the same chromosome number  $n=8$  and normal meiosis resulting into good pollen and seed fertility. However, some individuals in the forests of Gobind Ghat show cytotoxicity resulting in the variation of chromosome number ( $n=4$  to  $n=15$ ) and meiotic irregularities. The populations studied from Shimla hills by Sandhu and Mann (1988) are also diploid ( $n=8$ ).

### 3.8 *Cassia* Linn.

A genus with 500 species of trees, shrubs and herbs, is of considerable forestry importance. All the 3 species, *C. auriculata*, *C. fistula* and *C. occidentalis* explored presently are variable chromosomally (table 1). In *C. auriculata* the presently studied plants from Palni hills and from other parts of India are tetraploid with  $n=14$ . Outside India, the species is also known to have diploid cytotypes with  $2n=14$  and  $2n=16$ . Majority of the Indian populations of *C. fistula* inclusive of the present one are counted to have  $n=14$ . Other chromosomal races with  $n=12$  and  $n=13$  also exist in India. However, for *C. occidentalis*, the present count of  $n=12$  from south India establishes a new cytotype to the already existing cytotypes with  $n=13$  and  $n=14$ .

### 3.9 *Crotalaria* Linn.

*C. verrucosa* is distributed in the tropical regions. All the populations inclusive of the present one are diploid with  $n=8$ .

### 3.10 *Dalbergia* Linn. f.

A large woody genus with 300 species is important in Indian forestry. Five species, *D. lanceolaria*, *D. latifolia*, *D. paniculata*, *D. sericea* and *D. sissoo* are studied presently. Of these, morphological variations based on growth and habit are recorded in *D. sissoo*. Cytologically all the species inclusive of the morphotypes of *D. sissoo* are counted to have the same chromosome number ( $n=10$ ) and regular meiosis. Other Indian populations of these species studied so far are also diploid with  $2n=20$  (table 1).

### 3.11 *Delonix* Rafin.

*D. regia*, a native of Malagasy is commonly planted as an avenue tree. The present count of  $n=12$  from south India adds a new cytotype to the already existing cytotype with  $n=14$ .

### 3.12 *Desmodium* Desv.

A genus of herbs and shrubs is of forestry importance as its members are well represented in Indian tropical, subtropical and temperate forests. The present counts of  $n=11$  for *D. elegans*, *D. latifolium* and *D. rufescens* agree with the earlier records from other populations (table 1).

3.13 *Dichrostachys* DC.

*D. cinerea*, a woody shrub is explored from the Palni hills. The species which is at tetraploid level ( $n=26$ ) shows normal meiosis and high pollen and seed fertility. It is counted chromosomally for the first time.

3.14 *Erythrina* Linn.

A genus of shrubs and trees is of some forestry importance. The present count of  $n=21$  for *E. indica* from south India agrees with the earlier records. However, cytotype with  $2n=44$  (Poucques 1945) exists outside India. *E. caffra* an exotic species which is counted for the first time from India is also diploid with  $n=21$ . During meiosis 21 bivalents are regularly constituted at M-I. These trees show 1-3 B-chromosomes in some PMCs. Although Bs show pairing, they lag at A-I. Pollen sterility (23%) in these trees could be attributed to these lagging Bs.

3.15 *Indigofera* Linn.

A genus of herbs and shrubs form the constituent of ground vegetation in tropical, subtropical and temperate forests. Three species are counted chromosomally. Of these *I. gerardiana* is variable cytologically with diploid ( $2n=16$ ), tetraploid ( $2n=32$ ) and hexaploid ( $2n=48$ ) cytotypes. The presently explored populations from Garhwal Himalaya are hexaploid ( $n=24$ ) with regular meiosis and 100% pollen fertility. Other two species, *I. hebeptala* and *I. pulchella* counted presently ( $n=8$ ) and by other workers do not show any chromosomal diversity.

3.16 *Lonchocarpus* Kunth

*L. neuroscapha*, an exotic species, is diploid with  $n=11$  and is the first record from India.

3.17 *Millettia* W. and A.

The genus is represented by 180 species of shrubs and trees in tropics and subtropics. Of the 3 species studied presently, *M. brandisiana* ( $n=11$ ) is counted for the first time, whereas *M. extensa* and *M. ovalifolia* which are also diploid with  $n=11$ , earlier records are confirmed. However in both the species, cytotype with  $n=10$  also exists in Indian populations. In *M. brandisiana* besides 11 bivalents, some pollen mother cells (PMCs) have two univalents which lag during A-I. B-chromosomes are also present in some PMCs. Some pollen sterility (20%) in these trees could be attributed to these lagging chromosomes.

3.18 *Mimosa* Linn.

It is a large genus with 450-500 species of diverse habit ranging from herbs, shrubs to trees. *M. himalayana*, studied from Dehra Dun and Saharanpur is counted to

have  $n=13$  and agrees with the earlier records from Pachmarhi hills (Bir and Kumari 1979).

### 3.19 *Mucuna* Adans.

*M. hirsuta*, a woody climber with ferruginous hairs is counted chromosomally for the first time and is diploid with  $n=11$ .

### 3.20 *Ougeinia* Benth.

A monotypic genus represented by *O. oojeinensis* provides excellent commercial timber. The presently studied populations from Pachmarhi hills unequivocally reveal 11 bivalents at M-I. Some pollen sterility (23%) in these populations is due to chromatin bridges, laggards and fragments in some PMCs. Bir and Kumari (1977) reported the cytotype with  $2n=24$  from the same area. These cytotypes with  $2n=22$  and  $2n=24$  also exist in north India indicating that these chromosomal races have been well stabilized in India.

### 3.21 *Pahudia* Miq.

*M. martabanica*, an exotic species is counted to be diploid with  $n=12$ . The genus is counted chromosomally for the first time.

### 3.22 *Peltophorum* Vogel.

The diploid count of  $n=13$  for *P. africanum* agrees with earlier records from India and elsewhere.

### 3.23 *Phanera* Lour.

*P. glauca*, an exotic species is counted from the cultivated individuals. The meiotic count of  $n=14$  is a first report for the species. High pollen sterility (43%) is attributed to some genic reasons as meiotic course is perfectly regular.

### 3.24 *Poinciana* Linn.

*P. pulcherrima* treated earlier as *Cassia pulcherrima*, is commonly cultivated. All the individuals explored so far including the present one are diploid with  $n=12$ . However, a cytotype with  $2n=22$  also exist in India (Bir and Sidhu 1967).

### 3.25 *Pongamia* Vent.

*P. pinnata*, a tree species of commercial timber importance is also planted in avenues. Explorations from north and central Indian plantations revealed that the species is variable morphologically and two forms based on flower colour exist in the Punjab plains. Though cytotype with  $2n=20$  (Atchison 1951) exist elsewhere,

the Indian plants invariably have  $n=11$ . Multiple association of chromosomes have been frequently observed earlier (Sarbhoy 1977; Bir and Kumari 1979) and in the present study. This suggests that the species is quite amenable to structural changes of chromosomes. B-chromosomes have also been observed in the present investigations.

### 3.26 *Prosopis* Linn.

*P. glandulosa*, an exotic species is introduced for afforestation purposes. The presently studied plantations fall under the var. *torreyana* and are found to be tetraploid with  $n=28$  having normal meiosis and high pollen fertility. This is the first record of tetraploid cytotype to the already existing diploid cytotypes with  $n=13$  (Ramanathan 1950) and  $n=14$  (Baquar *et al* 1966).

### 3.27 *Saraca* Linn.

*S. indica* a tree of eastern Himalaya as counted from cultivated individuals show  $n=12$  as reported by other workers. Mehra and Hans (1971) however, located some structural hybrids in Khasi hills.

### 3.28 *Tamarindus* Linn.

A monotypic genus represented by *T. indica*, is indigenous to tropical Africa. However it has naturalized in all parts of India. All the Indian populations inclusive of the present one are diploid with  $n=12$ . However, some individuals in Pachmarhi have 1-4 B-chromosomes. These individuals show pollen malformation up to 30%.

### 3.29 *Wisteria* Nutt.

*W. sinensis*, an exotic ornamental species is counted to have  $n=8$  as reported earlier. High pollen sterility (49%) in spite of regular meiotic course could be attributed to various genic or ecological factors as is the case in several exotic species.

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