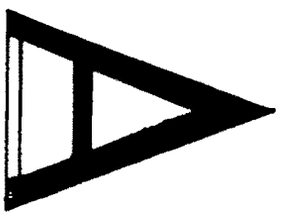
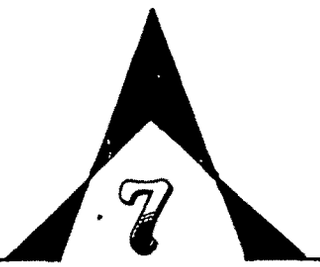




CYTOLOGY

CYTOLOGY

It has now been realised that the data regarding chromosome numbers, morphology and behaviour is a must for understanding the plant taxa under consideration in totality. The data regarding chromosome number (base No., n and 2n numbers) and their other details for number of angiospermic taxa are metwith in published books viz. Chromosome atlas of flowering plants Ed. by Darlington & Wylie (1955), Chromosome number of flowering plants Ed. by Federov (1969) and Chromosome atlas of flowering plants of the Indian subcontinent by Kumar & Subramaniam (1986) and periodicals; 'Index to Plant chromsome number (1956-1964); IOPB chromosome number reports in Taxon (1965 - onwards) and Journal of Cytology and Genetics (1980 - onwards) for Indian species. The cytological data have been profitably used for the taxonomic and systematic evaluation of plant taxa under consideration. Notable among them are Babcock (1942) for

Crepis; Goodspeed (1954) for Nicotiana; Chennaveeraiah (1960,1962) for Agilops and Love A.(1960) etc.

In the present work, cytological data for 14 selected plant species belonging to families; Capparidaceae, Malvaceae, Zygophyllaceae, Fabaceae, Asteraceae, Boraginaceae, Convolvulaceae and Verbenaceae have been presented. These have been studied for n number and meiotic behaviour and 6 taxa have also been investigated for 2n number and karyomorphology.

In the present investigation based on the length and position of centromere, chromosomes are classified into number of types. This is done with a view to describe the karyotype and represent the same by karyotype formulae.

For all the plant taxa in the present study the adopted classification for chromosomes types is as follows.

1 Chromosomes - 6 µm or more in length
- With median centromere . . . . . A
- With nearly median centromere . . . . B
- With nearly submedian centromere . . . C

2 Chromosomes - 4 µm to less than 6 µm in length
- With median centromere . . . . . D
- With nearly median centromere . . . . E
- With nearly submedian centromere . . . F

3 Chromosomes - 2 µm to less than 4 µm in length
- With median centromere . . . . . G
- With nearly median centromere . . . . H
- With nearly submedian centromere . . . I

4 Chromosomes - less than 2 µm in length
- With median centromere . . . . . J
- With nearly median centromere . . . . K
- With nearly submedian centromere . . . L

Superscript :

S - denotes satellited chromosome.

Capparis cartilaginea Decne.

As far could be ascertained from the available literature, there is no report of n and 2n number for the species. Chromosome number n = 9 and 2n = 18 have been reported for the first time.

Coll No. 11

Karyotype formula :

$$2n = 18 = G_2 + J_6 + K_{10}$$

The analysis of somatic cell revealed the presence of 2n = 18 chromosomes. Among the 9 pairs, 6 pairs are with nearly median centromere and 3 paris are with median centromere represented by G, J and K types. The chromosomes within the complement are short sized, varying in length from 1.928 µm to 3.022 µm with a mean length 1.25 µm. The determined values for absolute length and S% are 22.661 µm and 65.20 respectively. The apparent symmetry of karyotype is evident from the calculated values of TF% (45.34%) and ratios (Table No.5). The same is evident in the smooth gradation of the idiogram (Pl. 47-c).

Coll No. 18

Karyotype formula :

$$2n = 18 = J_6 + K_{12}$$

The karyotype of the population greatly resembles that of

Table 5: Details of the karyotype analysis of Capparis cartilaginea Decene Coll No. (11)

Chromosome pair	Length in μm			Arm ratio		Relative Length	TCL %	Centro-mere	Type
	Long arm	Short arm	Total length	R_1	R_2				
1	1.736	1.286	3.022	0.74	1.34	100	13.33	nm	G
2	1.414	1.414	2.828	1	1	93	12.47	M	J
3	1.414	1.286	2.700	0.90	1.24	89	11.91	nm	K
4	1.736	0.964	2.700	0.55	1.80	89	11.91	nm	K
5	1.286	1.286	2.572	1	1	85	11.34	M	J
6	1.286	1.125	2.411	0.60	1.14	79	10.63	nm	K
7	1.286	0.964	2.250	0.74	1.33	74	9.93	nm	K
8	1.286	0.964	2.250	0.74	1.33	74	9.93	nm	K
9	0.964	0.964	1.928	1	1	65	8.50	M	J
	12.408	10.253	22.661						

L/S ratio = 1.56

TF % = 45.34%

Mean length = 1.25 μm

karyotype formula = $G_2 + J_6 + K_{10}$

Table 6: Details of the karyotype analysis of Capparis cartilaginea Decene Coll No (18)

Chromosome pair	Length in µm			Arm ratios		Relative length	TCL %	Centro-mere	Type
	Long arm	Short arm	Total length	R_1	R_2				
1	1.697	1.350	2.957	0.84	1.19	100	13.5	nm	K
2	1.414	1.286	2.700	0.90	1.24	91	12.3	nm	K
3	1.286	1.286	2.572	1	1	86	11.8	M	J
4	1.286	1.286	2.572	1	1	86	11.8	M	J
5	1.286	1.125	2.411	0.87	1.14	81	11.06	nm	K
6	1.350	0.964	2.314	0.74	1.33	78	10.60	nm	K
7	1.286	0.964	2.250	0.71	1.40	76	10.32	nm	K
8	1.125	0.964	2.089	0.85	1.16	70	9.58	nm	K
9	0.964	0.964	1.928	1	1	65	8.88	M	J
	11.604	10.189	21.793						

L/S ratio = 2.29

TF % = 46.75 %

Mean length = 1.21 µm

karyotype formula = $J_6 + K_{12}$

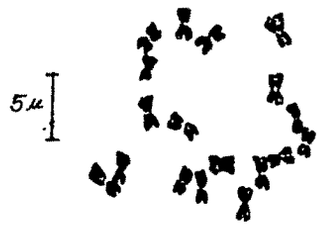
Plate No. 47

Capparis cartilaginea Decne.

Coll. No. 11

b - Camera lucida drawings of somatic metaphase complement showing 2n = 18 chromosomes

c - Idiogram



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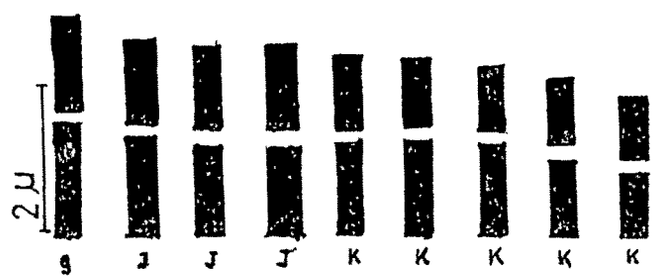


c

Plate No. 47

Plate No. 48

Capparis cartilaginea Decne.

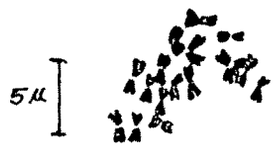
Coll. No. 18

a - Photomicrograph of somatic metaphase plate

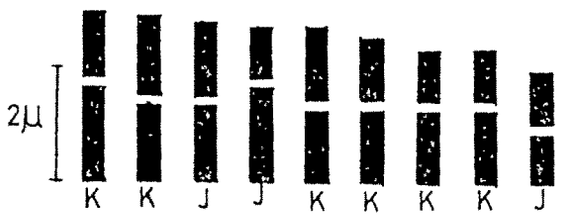
b - Camera lucida drawings of somatic metaphase complement showing 2n = 18 chromosomes

c - Idiogram

a



b



c

Plate No 48

Plate No. 49 Capparis cartilaginea

PMC's showing

a - Diakinesis with 9 bivalents.

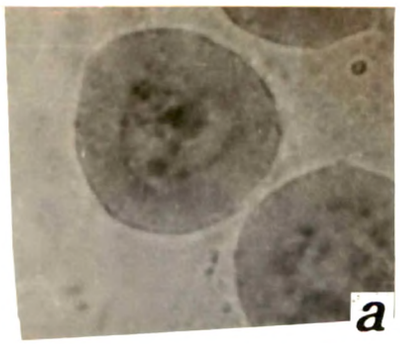
b - Meta-I.

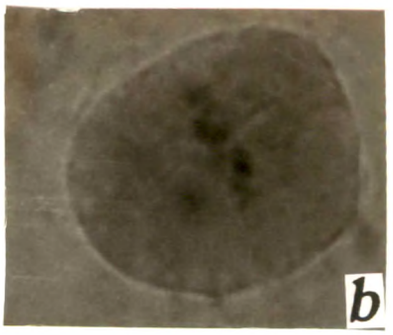
c - Meta-I with prominent nucleolus.

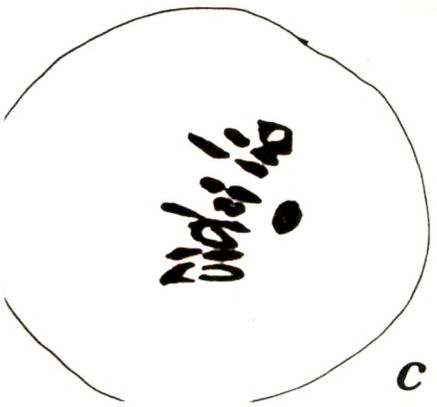
d - Ana-I normal distribution.

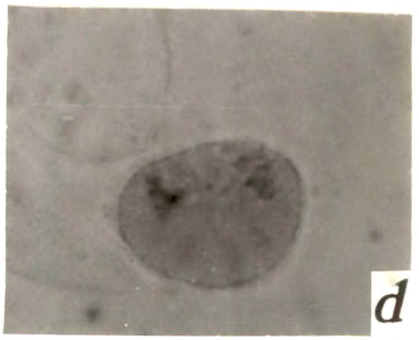
e - Ana-I bridge formation.

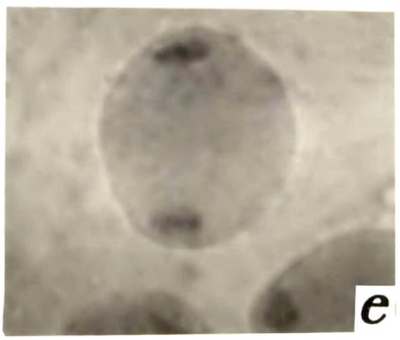
f - Isobilateral Tetrad.











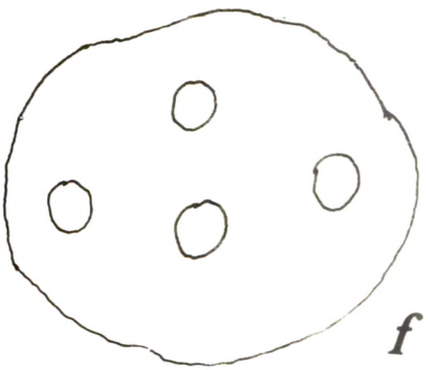


Plate No. 49

the preceeding population. However, differences in distribution of different types of chromosomes have been noticed. Within the complement, there are 3 pairs of J type and 6 pairs of K type chromosomes. G type of chromosome observed in preceeding population is altogether absent. TF%, S%, mean length, relative length values are more or less comparable to those for (Coll No.11) recorded above (Table No.6). Higher values of TF% and idiogram clearly depict the smooth gradation and more or less symmetrical nature of the karyotype (Pl. 48-a,b,c).

Both the populations studied, revealed more or less regular meiotic behaviour, showing 9 distinct bivalents at diakinesis and metaphase-I (Pl.49-a,b). In majority of PMC's regular distribution of chromosomes was also noticed at anaphase-I and anaphse-II (Pl. 49-c,d). Except for secondary grouping of the bivalents in few PMC's at late diakinesis, no other abnormality was noticed (Pl.49-f). Tetrahedral and isobilateral type of tetrads have been recorded in both the populations. The determined pollen fertility for the species is 58%.

Abutilon pannosum (Forsk.f) Schelect.

Coll NO. 13

Karyotype formula :

$$2n = 32 = F_8 + G_2 + H_{18} + I_4$$

The somatic complement of the species contains 32 chromosomes, all the chromosomes are of median to short sized ranging in between 5.006 µm and 2.635 µm. The calculated absolute chromatin length is 56.437 um, with a mean length 1.76 µm. The karyotype includes 6 pairs with nearly submedian centromere (F and I type), 9 pairs having nearly median centromere (H-type) and only one pair with median centromere. The calculated values of arm ratios, relative length and TF% indicate the asymmetrical and graded nature of the karyotype (Table No.7). The same is evident in the calculated values of L/S ratio (Table No.7) and the idiogram (Pl. 50-a,b,c).

The study of pollen mother cells revealed the presence of 16 distinct bivalents at diakinesis and metaphase-I (Pl. 51-a,b,e,f). Majority of bivalents are ring type (Pl. 51-c) subsequent divisional stages are fairly normal. At anaphase-I and Metaphase-II (Pl. 51-g) equal number of chromosomes are present at the two poles. Certain abnormalities like grouping of chromosomes, early separation of chromosomes, and laggards at late diakinesis, metaphase-I and anaphase-I (Pl. 51-c,d, 52-a). At anaphase-II due to non-congressional movement, unequal distribution of chromosomes was also noticed (Pl. 52-b, 52-c). Types of tetrads includes mostly isobilateral ones with very few of linear type (Pl. 52-b,d). 45% pollens are found to be fertile.

Meiotic study also revealed the presence of persistent tapetal

Plate No. 50

Abutilon pannosum (Forst. f.) Schelect.

Coll. No. 13

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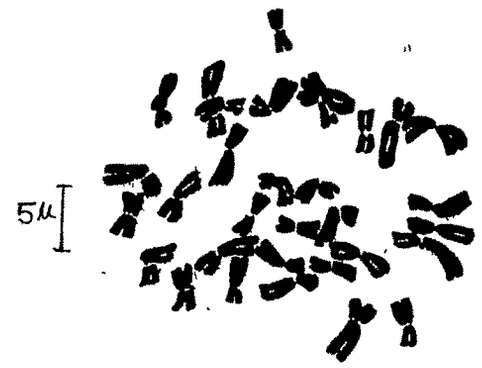
b - Camera lucida drawings of somatic metaphase complement showing 2n = 32 chromosomes

c - Idiogram



b

c

Plate No. 50

Table 7 : Details of the Karyotype analysis of

Abutilon pannosum (Forst. f.) Schelect. Coll. No. (13)

Chromosome pair	Length in µm			Arm ratio		Relative length	TCL%	Centromere	Type
	Long arm	Short arm	Total	R_1	R_2				
1	3.162	1.844	5.006	0.58	1.71	100	8.87	nsm	F
2	3.162	1.581	4,743	0.50	2.0	94	8.40	nsm	F
3	3.162	1.581	4.743	0.50	2.0	94	8.40	nsm	F
4	2.898	1.317	4.215	0.45	2.2	84	7.46	nsm	F
5	2.371	1.581	3.952	0.66	1.49	78	7.00	nm	H
6	2.635	1.054	3.689	0.40	2.5	73	6.53	nsm	I
7	2.108	1.581	3.689	0.75	1.33	73	6.53	nm	H
8	2.108	1.317	3.425	0.62	1.60	68	6.06	nm	H
9	2.108	1.054	3.162	0.50	2.0	63	5.60	nsm	I
10	1.581	1.581	3.162	1.0	1.0	63	5.60	M	G
11	1.581	1.422	3.003	0.89	1.11	59	5.32	nm	H
12	1.581	1.317	2.898	0.83	1.20	57	5.13	nm	H
13	1.686	1.054	2.740	0.62	1.59	54	4.85	nm	H
14	1.686	1.054	2.740	0.62	1.59	54	4.85	nm	H
15	1.581	1.054	2.635	0.66	1.5	52	4.66	nm	H
16	1.581	1.054	2.635	0.66	1.5	52	4.66	nm	H
	34.991	21.446	56.437						

L/S ratio = 1.89

TF % = 37.99

Mean length = 1.76 µm

Karyotype formula= $2n = 32 = F_8 + G_2 + H_{18} + I_4$

Plate No. 51 *Abutilon pannosum*

PMC's showing

a,b,c - PMC's showing 16 bivalents at diplotene, early and late diakinesis.

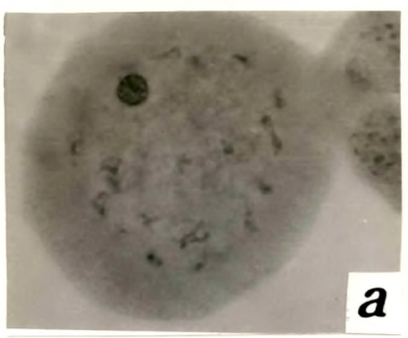
d - Secondary groupings at diakinesis.

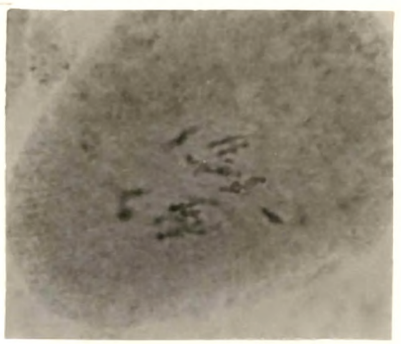
e - Metaphase - I (side view)

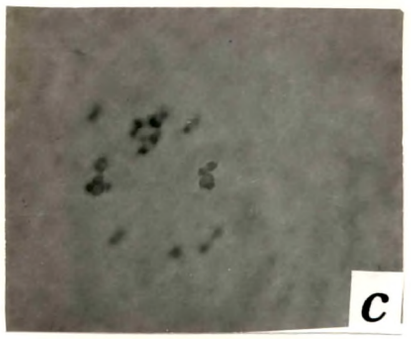
f - Meta - I, non-congressional movement of chromosomes.

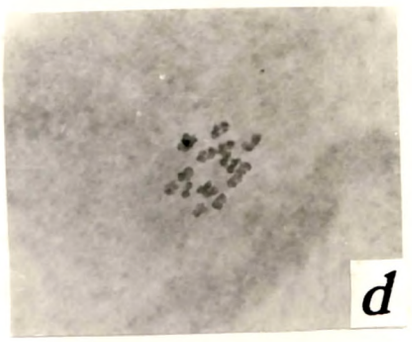
g - Meta - II.

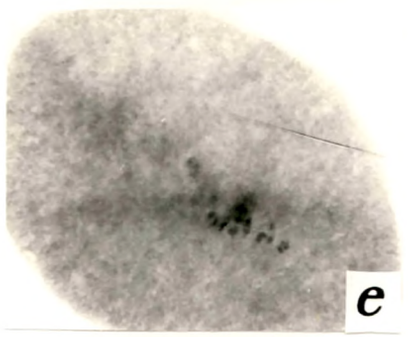
h - Prometa - II, with prominant nucleolii.

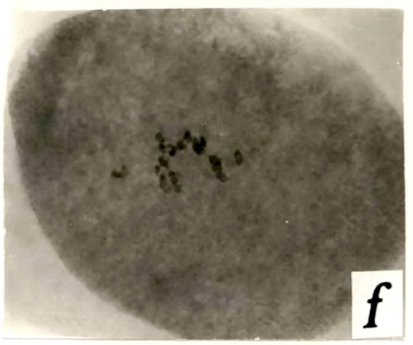


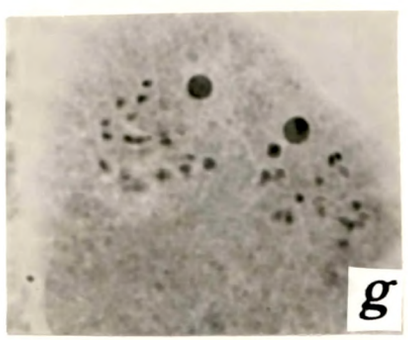


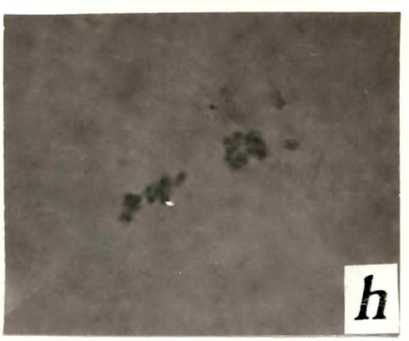












51

Plate No. 51

Plate No. 52

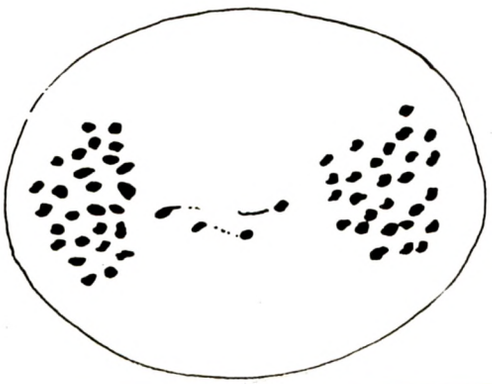
PMC's showing

a - Meta - II, Bridge formation.

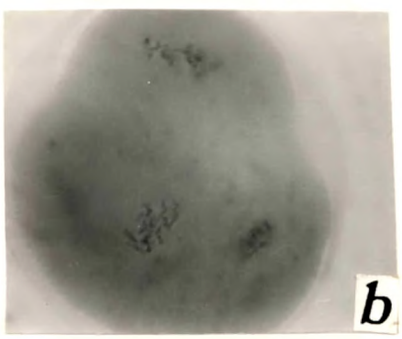
b,c - Telo - II, nonsynchronised movements of chromosomes.

d - Isobilateral tetrad.

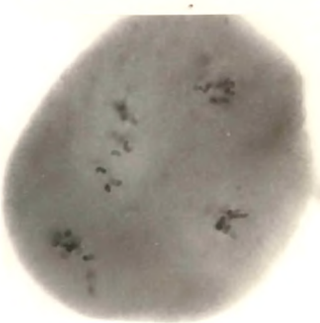
e - Anaphase - Tapetal cells.



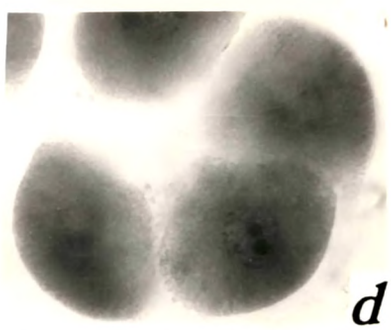
a



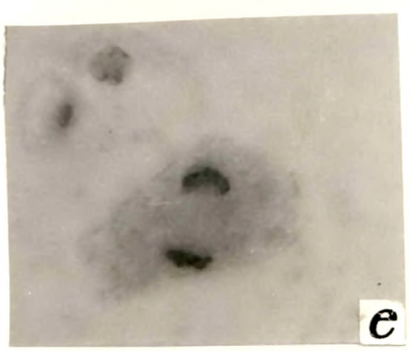
b



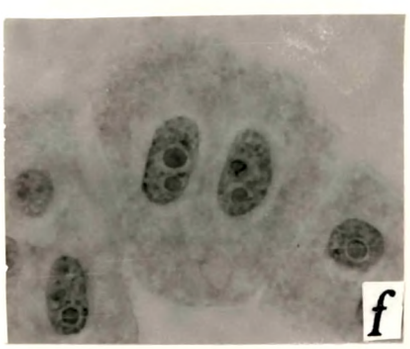
c



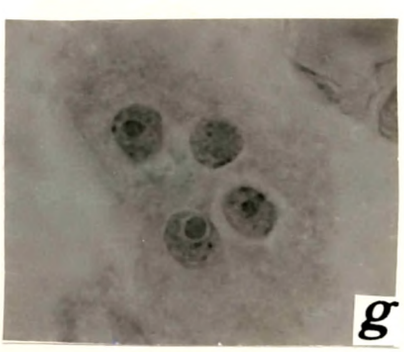
d



e



f



g

Plate No. 52

cells, which were large sized (130 x 10 um to 22 x 18 um) and uni or binucleate ones. At late meiotic stages (IInd division) tetranucleate tapetal cells were predominant. Different divisional stages of tapetal cells were also recorded (Plate No. 71 and Plate No. 72).

Pavonia arabica Hochst & Steud.

On the whole, meiosis is found to be fairly regular showing 7 distinct bivalents at early and late diakinesis (Pl. 53-a,b). Only ring bivalents were noticed. Pollen mother cells depicting metaphase-I and anaphase-I stages showed normal segregation of chromosomes at two poles (Pl. 53-c,d). However, a few pollen mother cells depicted abnormalities such an early separation and non-congressional movement of chromosomes, presence of 1-2 laggards and abnormal orientation of metaphase plates (Pl. 53-c,d). These abnormalities were recorded at anaphase-I, metaphase-II, anaphase-II and Telophase II stages (Pl. 53-g,h). Except linear or obliquely linear oriented type of tetrads most of tetrads are of isobilateral type. The pollen fertility for the species is found to be 50% only.

The presence of persistent, large, squarish to rectangular shape tapetal cells were also noticed during meiotic preparations. Usually they are darkly stained having binucleate to tetranucleate condition. Tapetal cells depicting divisional stages were recorded during Ist and IInd meiotic

Plate No. 53 Pavonia arabica

PMC's showing

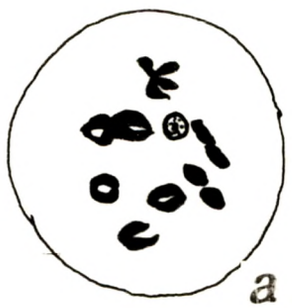
a,b - Early and late diakinesis 7 bivalents.

c - Meta-I showing 7 distinct bivalents.

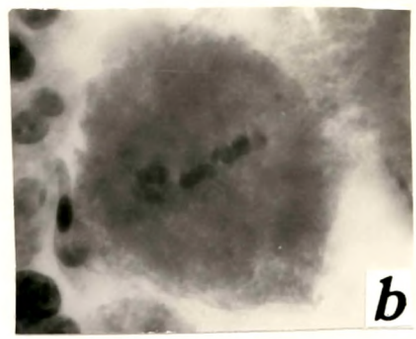
d - Ana-I showing laggard.

e - Meta-II showing equal distribution of chromosomes.

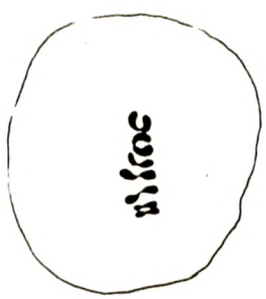
f,g - Isobilateral and tetrahedral tetrad.



a



b



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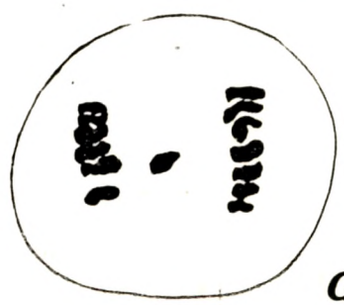

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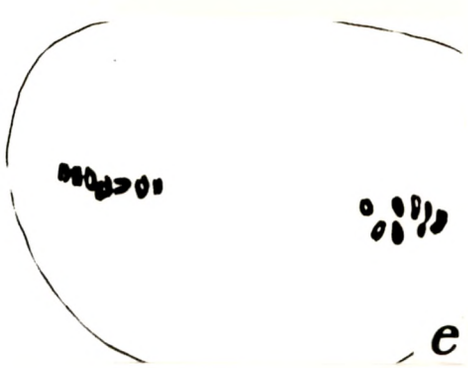

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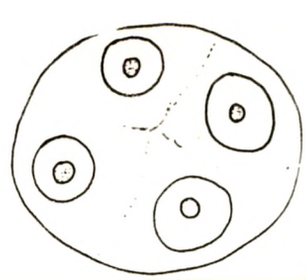

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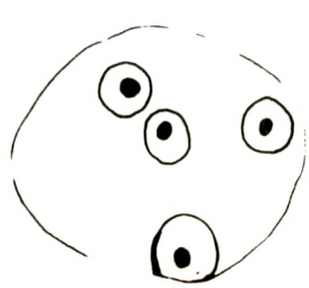


g

Plate No. 53

divisions of pollen mother cells. Stickiness of chromosomes was also observed in tapetal cells. (Pl. 71).

Pavonia zeylanica (Linn.) Cav.

Coll No. 7

Karyotype formula :

$$2n = 56 = E_2 + F_8 + F_2^S + H_{18} + I_{26}$$

The somatic metaphase plate of the species consists of 56 chromosomes. The chromosomes within the complement are medium to short sized varying in length from 4.772 µm to 2.898 µm with a mean length of 1.865 µm. Chromosomes having nearly median centromere are represented by 1 pair of E type and 9 pair with H type. While, chromosomes with submedian centromeres are represented by 5 pairs of F type and 13 pairs of I type. The noteworthy feature of the complement is the presence of 1 pair of satellited chromosomes (F^S type). The calculated values for absolute chromosome length and S% are 105.475 and 60% respectively. The evolved nature of the karyotype is also substantiated by the determined values of L/S ratio (1.64) and TF % (36.08%). The same can also be noticed in the smooth gradation of the idiogram and relative length (Pl. 54-a,b,c and Table No.8).

The meiosis of the species is more or less regular showing presence of 28 bivalents at diakinesis (Pl. 55-a,b). In the

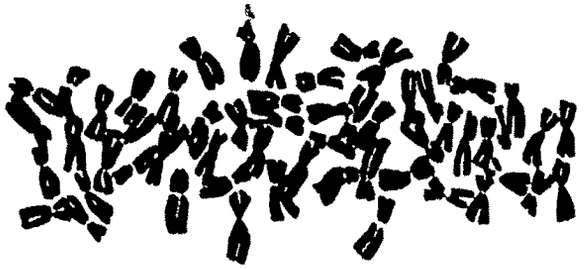
Plate No. 54

Pavonia zeylanica (Linn.) Cav.

Coll. No. 7

b - Camera lucida drawings of somatic metaphase complement showing 2n = 56 chromosomes

c - Idiogram



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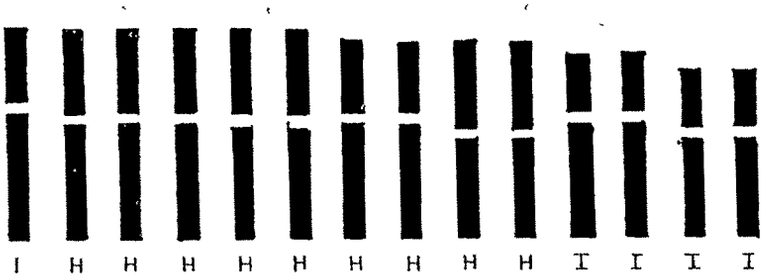


c

Plate no. 54

Table 8 : Details of the Karyotype analysis of

Pavonia zeylanica (Linn.) Cav. Coll. No. (7)

Chromosome pair	Length in µm: Long arm	Short arm	Total length	Arm ratio: R_1	R_2	Relative length	TCL%	Centromere	Type
1	2.898	1.844	4.772	0.63	1.57	100	4.56	nm	E
2	2.898	1.581	4.479	0.54	1.83	93	4.28	nsm	F
3	2.635	1.581	4.216	0.60	1.66	88	4.03	nsm	F
4	2.635	1.581	4.216	0.60	1.66	88	4.03	nsm	F
5	2.635	1.581	4.216	0.60	1.66	88	4.03	nsm	F
6	2.635	1.581	4.216	0.60	1.66	88	4.03	nsm	F^S
7	2.898	1.054	3.952	0.36	2.74	82	3.78	nsm	I
8	2.898	1.054	3.952	0.36	2.74	82	3.78	nsm	I
9	2.635	1.317	3.952	0.5	2.00	82	3.78	nsm	I
10	2.740	1.054	3.794	0.38	2.59	79	3.63	nsm	I
11	2.635	1.054	3.689	0.40	2.5	77	3.53	nsm	I
12	2.635	1.054	3.689	0.40	2.5	77	3.53	nsm	I
13	2.635	1.054	3.689	0.40	2.5	77	3.53	nsm	I
14	2.635	1.054	3.689	0.40	2.5	77	3.53	nsm	I
15	2.371	1.317	3.689	0.55	1.8	77	3.53	nsm	I
16	2.108	1.581	3.689	0.75	1.33	77	3.53	nm	H
17	2.108	1.581	3.689	0.75	1.33	77	3.53	nm	H
18	2.108	1.581	3.689	0.75	1.33	77	3.53	nm	H
19	2.108	1.581	3.689	0.75	1.33	77	3.53	nm	H
20	2.108	1.581	3.689	0.75	1.33	77	3.53	nm	H
21	2.108	1.317	3.425	0.62	1.60	71	3.27	nm	H
22	2.108	1.317	3.425	0.62	1.60	71	3.27	nm	H
23	1.844	1.581	3.425	0.85	1.16	71	3.27	nm	H
24	1.844	1.581	3.425	0.85	1.16	71	3.27	nm	H
25	2.108	1.054	3.162	0.5	2.0	66	3.02	nsm	I
26	2.108	1.054	3.162	0.5	2.0	66	3.02	nsm	I
27	1.844	1.054	2.898	0.57	1.74	60	2.77	nsm	I
28	1.844	1.054	2.898	0.57	1.74	60	2.77	nsm	I
	66.779	37.696	104.475						

L/S ratio = 1.64

TF % = 36.08

Mean length = 1.865 µm

Karyotype formula = $E_2 + F_2^S + F_8 + H_{18} + I_{26}$

Plate No. 55 Pavonia zeylanica

PMC's showing

a - Early diakinesis with nucleolus.

b - Late diakinesis with 28 bivalents.

c - Early separation of bivalents.

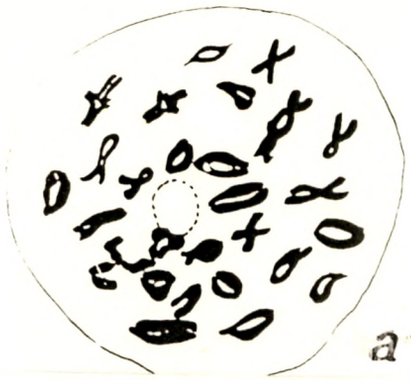
d - Grouping of bivalents.

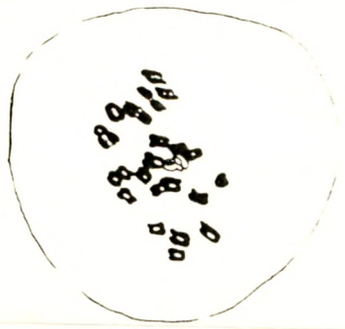
e - Interbivalent connections and

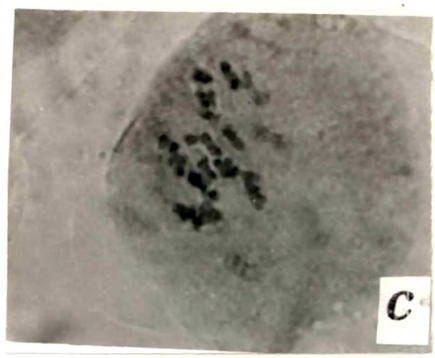
f - 28 bivalents with prominent nucleolus.

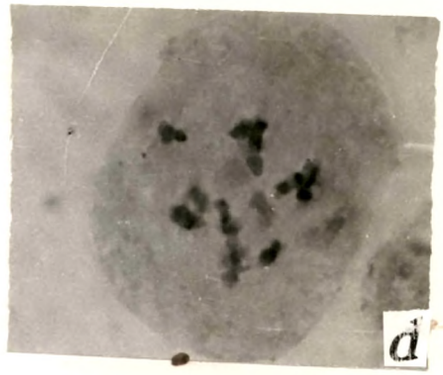
g - Ana-II, with laggard.

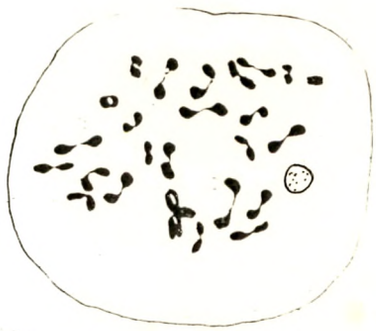
h - Tetrahedral tetrad.

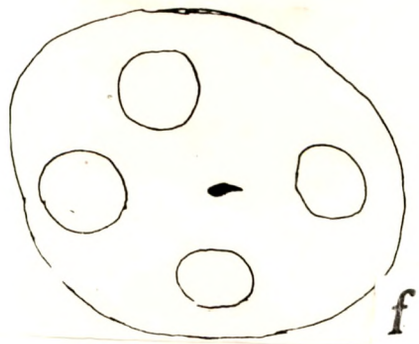












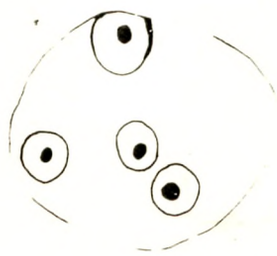


Plate No. 55

complement, majority of bivalents are ring bivalents except 4-6 rod bivalents (Pl. 55-b). At subsequent divisional stages i.e. metaphase-I and anaphase-I regular chromosomal segregation is noticed. However, persistent nucleoli (Pl. 55-c,a) interbivalent connections and grouping of bivalents at diakinesis were observed in few pollen mother cells (Pl. 55-d). At anaphase-I and telophase-I non congressional movement of chromosomes (Pl. 55-e) and occurrence of laggards were also observed (Pl. 55-f). Pollen tetrads of only isobilateral type were recorded (Pl. 55-g). 57% is the determined pollen fertility of the species.

The smear preparation for meiotic study showed the occurrence of persistent tapetal cells like the preceeding species. Few divisional stages of tapetal cells were also noticed alongwith the abnormalities. The cell size, shape and other features are more or less similar to species described above (Pl. 72).

Pavonia grewioides Hochst ex. Boiss.

Meiotic study of pollen mother cells revealed the presence of 28 distinct bivalents at diakinesis and metaphase-I (Pl. 56-a,b). In subsequent stages of division normal behaviour of the meiotic chromosomes is observed in majority of the pollen mother cells. In few PMC's grouping of bivalents at late diakinesis (Pl.56-c) and early separation of few bivalents

Plate No. 56 *Pavonia grewioides*

PMC's showing

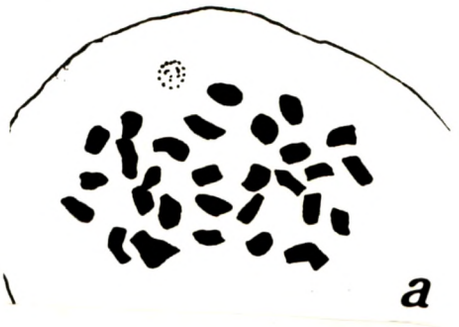
a - Late diakinesis with prominent nucleolus.

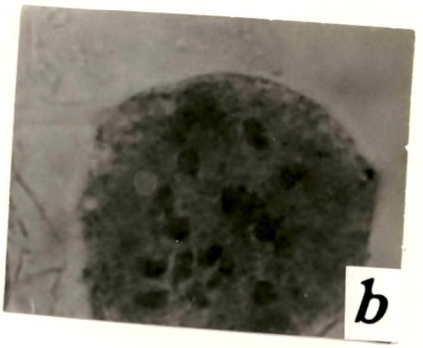
b - Early metaphase with 28 bivalents.

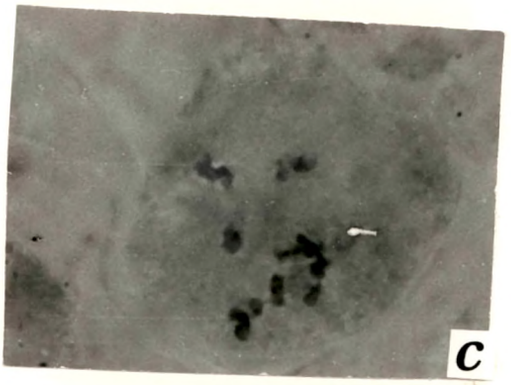
c - IIry groupings of chromosomes.

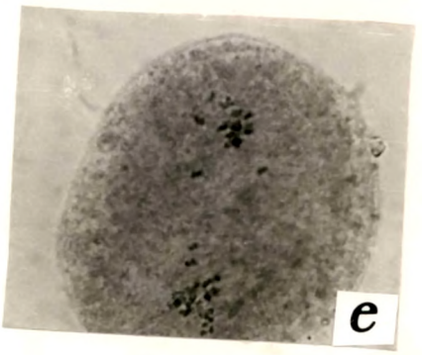
e - Ana-I laggard.

f - Telo-II.









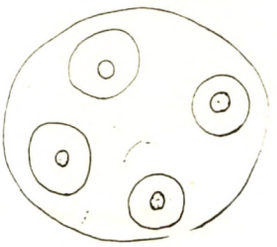


Plate No. 56

at anaphase-I were observed (Pl. 56-d). Moreover, the abnormal orientation of chromosomes at telaphase-II is also recorded (Pl. 56-e). Most of the tetrads are isobilateral type. (Pl. 56-f).

The smear preparation revealed the presence of persistent tapetal cells. Large, rectangular to variable shaped cells having size ranging in between 24 x 10 µm to 34 x 18 µm. Different divisional stages recorded for Ist and IInd division were metaphase, anaphase and telophase. Few cells showed abnormal orientation and stickiness of chromosomes at anaphase and telophase. Binulceate, tetranucleate and few plurinucleate cells are recorded for this taxon. (Pl.71).

Senra incana Cav.

Coll No. 15

Karyotype formula :

$$2n = 34 = E_2 + F_2^S + F_{10} + H_6 + I_2^S + I_{12}$$

The somatic complement of the populations is comprised of 34 chromosomes. Which includes, 4 pairs with nearly median centromere and remaining 13 paris with nearly submedian centromeres. The chromosomes are of long to medium sized, ranging in length in between 3.600 µm and 6.558 µm with a mean length 2.42 µm. The calculated absolute length of the complement is 82.485 µm. The determined values of arm ratio,

Plate No. 57

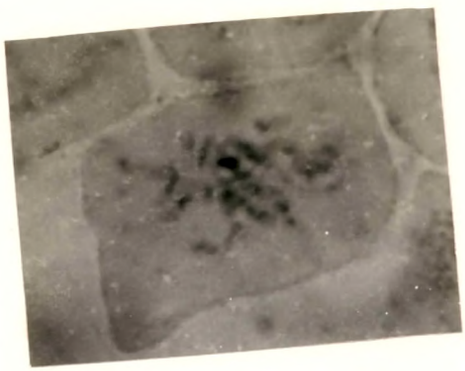
Senra incana Cav.

Coll. No. 15

a - Photomicrograph of somatic metaphase plate

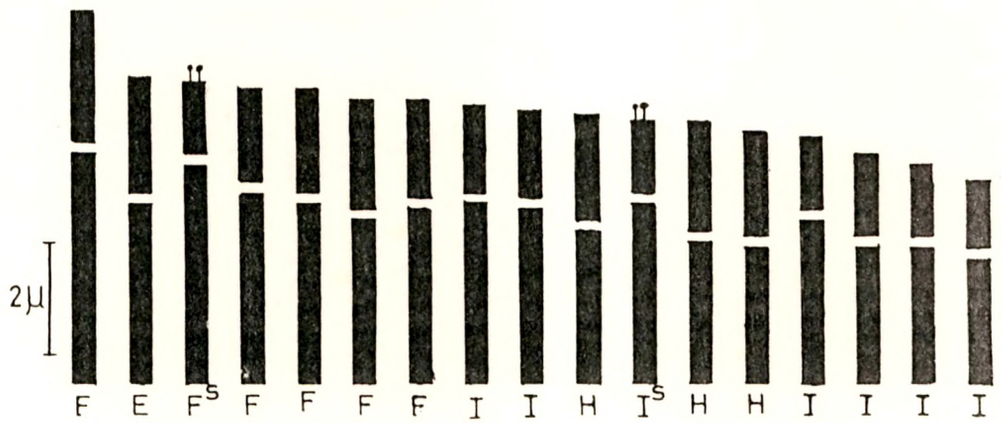
b - Camera lucida drawings of somatic metaphase complement showing 2n = 34 chromosomes

c - Idiogram



a

b



c

Plate No. 57

Plate No. 58

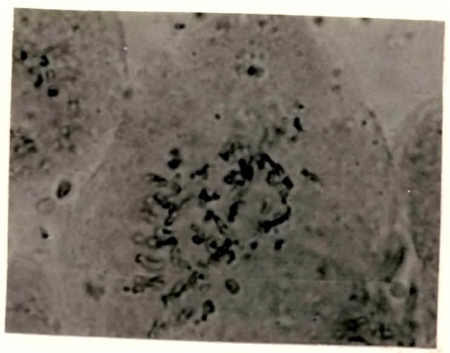
Senra incana Cav.

Coll. No. 26

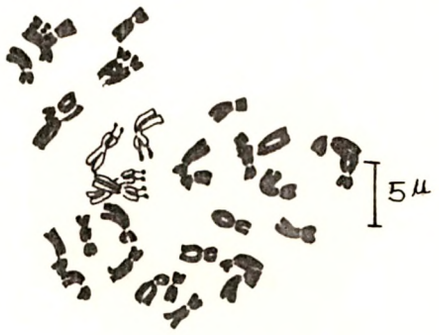
a - Photomicrograph of somatic metaphase plate

b - Camera lucida drawings of somatic metaphase complement showing 2n = 34 chromosomes

c - Idiogram



a



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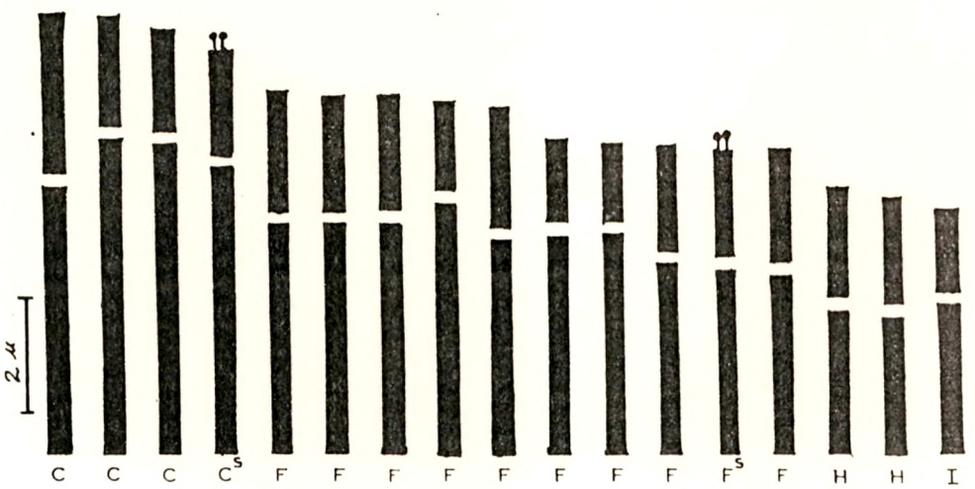


c

Plate No. 58

relative length, and TF % indicate the asymmetrical and abruptly graded nature of the karyotype. (Table No.9). L/S ratio value (1.928) and idiogram also indicate the evolved and asymmetrical nature of the karyotype (Pl. 57-a,b,c).

Coll No. 26

Karyotype formula :

$$2n = 34 = C_6 + C_2{}^S + F_{18} + F_2{}^S + H_4 + I_2$$

The karyotype of this population differs from the preceeding one in having more pairs i.e. 15 pairs with nearly submedian centromere distributed in C, F and I type and only 2 pairs with nearly median centromere represented by H type. E type of chromosome are totally absent in this population. Two pairs of satellited chromosomes are also recorded (C^S and F^S type). The determined values of absolute length (100.631) mean length (2.59) S% (55.93) are comparatively higher. While, TF % (31.66), L/S ratio (1.787) values are lower (Table No.10). Both populations share common feature of having 2 pairs of satellited chromosomes. The karyotype of this population appears slightly more asymmetrical and abruptly graded than the preceeding one. The same is also evident in the values of the relative length (Table No.9 and 10) and Idiogram (Pl. No.58-a,b,c).

The regular meiotic division is noticed in the pollen mother cells of both the populations analysed. At early and late

Table 10 : Details of the Karyotype analysis of

Senra incana Cav. Coll. No. (26)

Chromosome pair	Length in µm: Long arm	Short arm	Total length	Arm ratio: R_1	R_2	Relative length	TCL%	Centromere	Type
1	4.822	2.764	7.586	0.57	1.74	100	7.53	nsm	C
2	5.626	1.929	7.555	0.34	2.91	99	7.50	nsm	C
3	5.536	1.929	7.465	0.34	2.86	98	7.41	nsm	C
4	5.144	1.929	7.073	0.37	2.66	93	7.02	nsm	C^S
5	4.179	2.250	6.429	0.53	1.85	84	6.38	nsm	F
6	4.340	1.929	6.269	0.44	2.24	82	6.22	nsm	F
7	4.115	2.121	6.236	0.51	1.94	82	6.19	nsm	F
8	3.858	2.250	6.108	0.58	1.71	80	6.06	nsm	F
9	4.501	1.607	6.108	0.35	2.80	80	6.06	nsm	F
10	3.922	1.543	5.465	0.39	2.54	72	5.43	nsm	F
11	3.986	1.446	5.432	0.36	2.75	71	5.39	nsm	F
12	3.407	1.993	5.400	0.58	1.70	71	5.36	nsm	F
13	3.343	1.993	5.336	0.59	1.67	70	5.30	nsm	F^S
14	3.215	1.607	4.822	0.49	2.00	63	4.79	nsm	F
15	2.636	2.057	4.693	0.78	1.28	61	4.66	nm	H
16	2.572	1.929	4.501	0.75	1.33	59	4.47	nm	H
17	2.700	1.543	4.243	0.57	1.74	55	4.21	nsm	I
	68.812	31.819	100.631						

L/S ratio = 1.787

TF % = 31.6%

Mean length = 2.959 µm

Karyotype formula = $C_6 + C_2^S + F_{18} + F_2^S + H_4 + I_2$

Table 9: Details of the karyotype analysis of Senra incana Cav.

Coll. No. (15)

Chromosome pair	Length in µm			Arm ratios		Relative length	TCL %	Centro-mere	Type
	Long arm	Short arm	Total length	R_1	R_2				
1	4.179	2.379	6.558	0.56	1.75	100	7.95	nsm	F
2	3.343	2.057	5.400	0.61	1.62	82	6.54	nm	E
3	3.986	1.350	5.336	0.34	2.95	81	6.46	nsm	F^S
4	3.536	1.736	5.272	0.49	2.03	80	6.39	nsm	F
5	3.343	1.864	5.207	0.55	1.79	79	6.31	nsm	F
6	3.086	2.057	5.143	0.66	1.50	78	6.23	nsm	F
7	3.215	1.864	5.079	0.57	1.72	77	6.15	nsm	F
8	3.343	1.607	4.950	0.48	2.08	75	6.00	nsm	I
9	3.215	1.607	4.822	0.50	2.00	73	5.84	nsm	I
10	2.829	1.929	4.758	0.68	1.46	72	5.76	nm	H
11	3.343	1.350	4.693	0.40	2.47	71	5.68	nsm	I^S
12	2.636	2.057	4.693	0.78	1.28	71	5.68	nm	H
13	2.572	1.929	4.501	0.75	1.33	68	5.45	nm	H
14	3.086	1.30	4.436	0.43	2.28	67	5.37	nsm	I
15	2.572	1.543	4.115	0.59	1.66	62	4.98	nsm	I
16	2.572	1.350	3.992	0.52	1.90	59	4.75	nsm	I
17	2.314	1.286	3.600	0.55	1.79	54	4.36	nsm	I
	53.170	29.315	82.485						

L/S ratio = 1.82

TF % = 35.53 %

Mean length = 2.42 µm

karyotype formula $E_2 + F_2^S + F_{10} + H_6 + I_2^S + I_{12}$

Plate No. 59 Senra incana

a,b - PMC showing 17 distinct bivalents at early and late diakinesis.

c - Early separation of few bivalents.

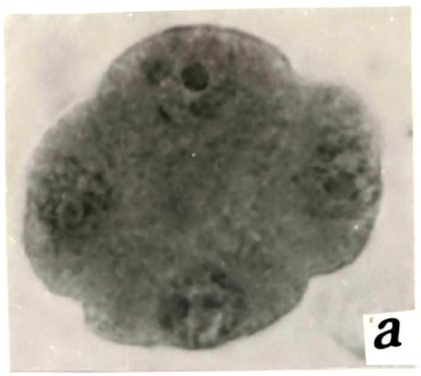
d - Ana-I showing unequal distribution and laggards.

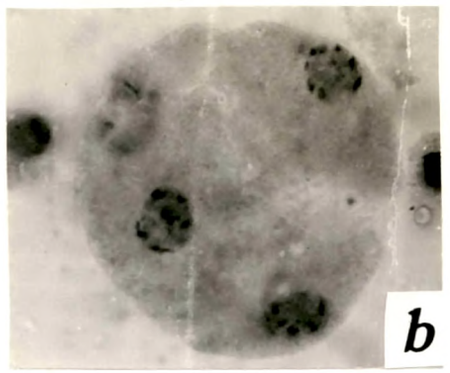
e -

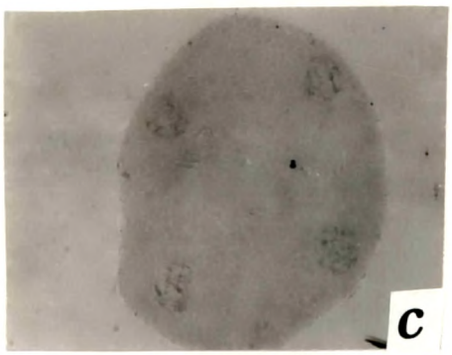
f - Ana-II abnormal arientation.

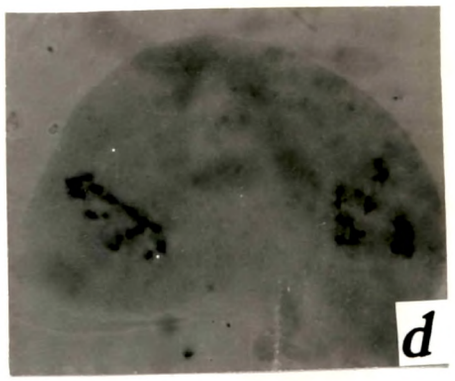
g - Telo-II.

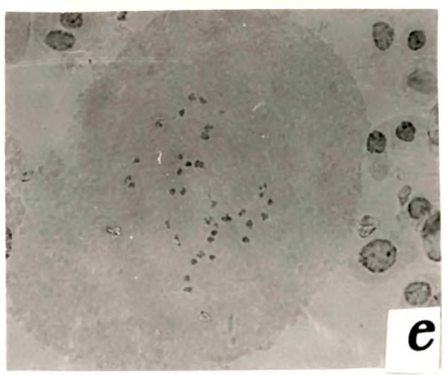
,h - Tetrahedral and Isobilaternal tetrad.

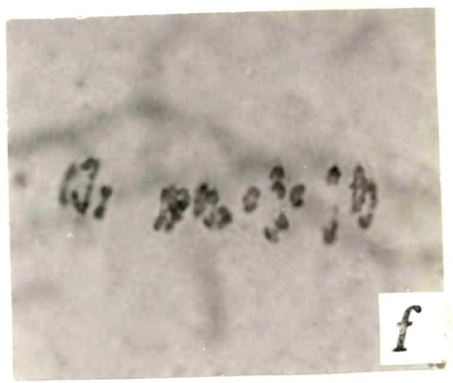


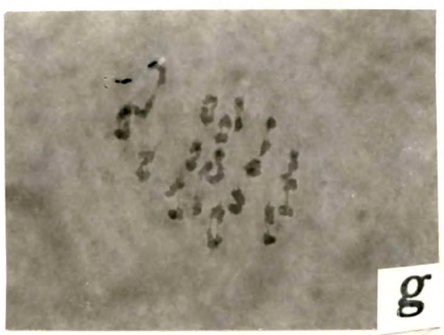












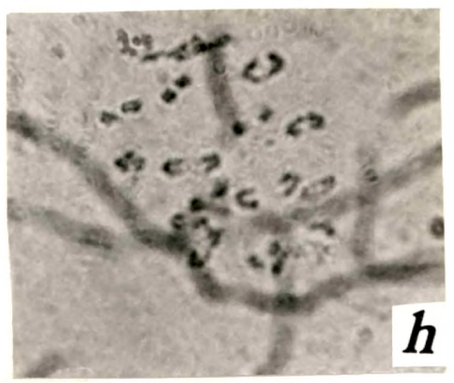


Plate No. 59

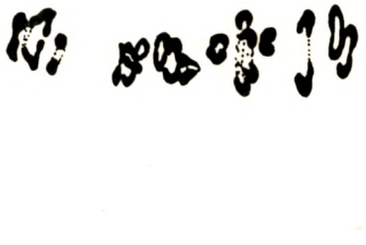
Plate No. 60 *Senra incana*

PMC showing

a - Meta-I, showing inter bivalent connections.

b - Meta-I interbivalent connections and grouping of chromosomes.

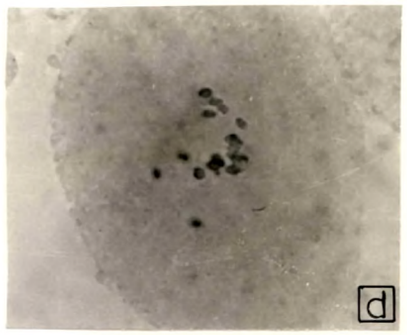
c - Diakinesis IIry grouping of chromosomes.



a

b

c



d

Plate No. 60

diakinesis 17 distinct bivalents are noticed (Pl. 59-a,b). With an exception of 2/3 rod bivalents, all others are ring bivalents (Pl.59-c). At metaphase-I and anaphase-I normal segregation is observed in majority of PMC's (Pl.59-d). However in few PMC's at anaphase-I non-congressional bivalents and at anaphase-I and anaphse-II, variable number of laggards were observed (Pl.59-e,f). At diad stage nucleus along with persistent nucleolus was noticed. Majority of the pollen tetrads are of tetrahedral type with few isobilateral type (Pl. 59-g,h). The pollen fertility for the species is found to be 65%.

In smear preparation persistent tapetal cells of squarish or rectangular shapes were recorded. They exhibit binucleate or tetranucleate condition, varying in size in between 90 μ to 210 μ. Different divisional stages of tapetal cells observed were prophase, prometaphase, late anaphase and telophase. In certain cells, non-separation of chromosomes at anaphase; dumpbell shaped nuclei and stickiness of chromosomes were recorded. Divisional stages of these were observed when pollen mother cells were at Ist or IInd meiotic divisional stages. (Pl.71).

Fagonia indica Burm. f. var. **schweinfurthii** Hadidi.

The analysis of pollen mother cells revealed the presence of 9 bivalents at early and late diakinesis, and metaphase-I

(Pl.62-a,b). The second division of PMC's is found to be regular in majority of cells analysed. However, in few PMC's non-syncromised movement of chromosomes and early separation of chromosomes is noticed at metaphase-I (Pl.62-c,d). Inter bivalent connections are also noticed at late diakinesis which reflects in various groupings of bivalents at later stages (Pl.62-b). Due to stickiness of chromosomes in few pollen mother cells chromosomal bridge formation was recorded (Pl. 62-f). Tetrads of tetrahedral types are of common occurrence except few obliquely oriented linear ones (Pl.62-g.h). The determined pollen fertility for the species is 61%.

Study of pollen mother cells are also revealed the presence of persistent tapetal cells. Cells are of elliptic oblong shaped, darkly stained and showing divisional stages. The size of cells varies from 30 x 6 μ to 20 x 3 μ. Most of the cells depict tetranucleate condition at 2nd meiotic division (Pl.71).

Tribulus rajasthanensis Bhandari et. Sharma.

Meiotic study of the taxon depict the presence of 6 distinct bivalents at early and late diakinesis and metaphase-I (Pl. 61-a,b,c). Anaphase-I and Metaphase-II showed the regular separation of chromosomes and subsequent divisional stages were fairly normal. In few PMC's. of Metaphase-I, bivalents were separated and arranged in slightly irregular manner,

Plate No. 61 *Tribulus rajasthanensis*

PMC's showing

a,b - Early and late diakinesis with 6 bivalents.

c - Meta-I.

d - Meta-II.

e - Ana-II bridge formation.

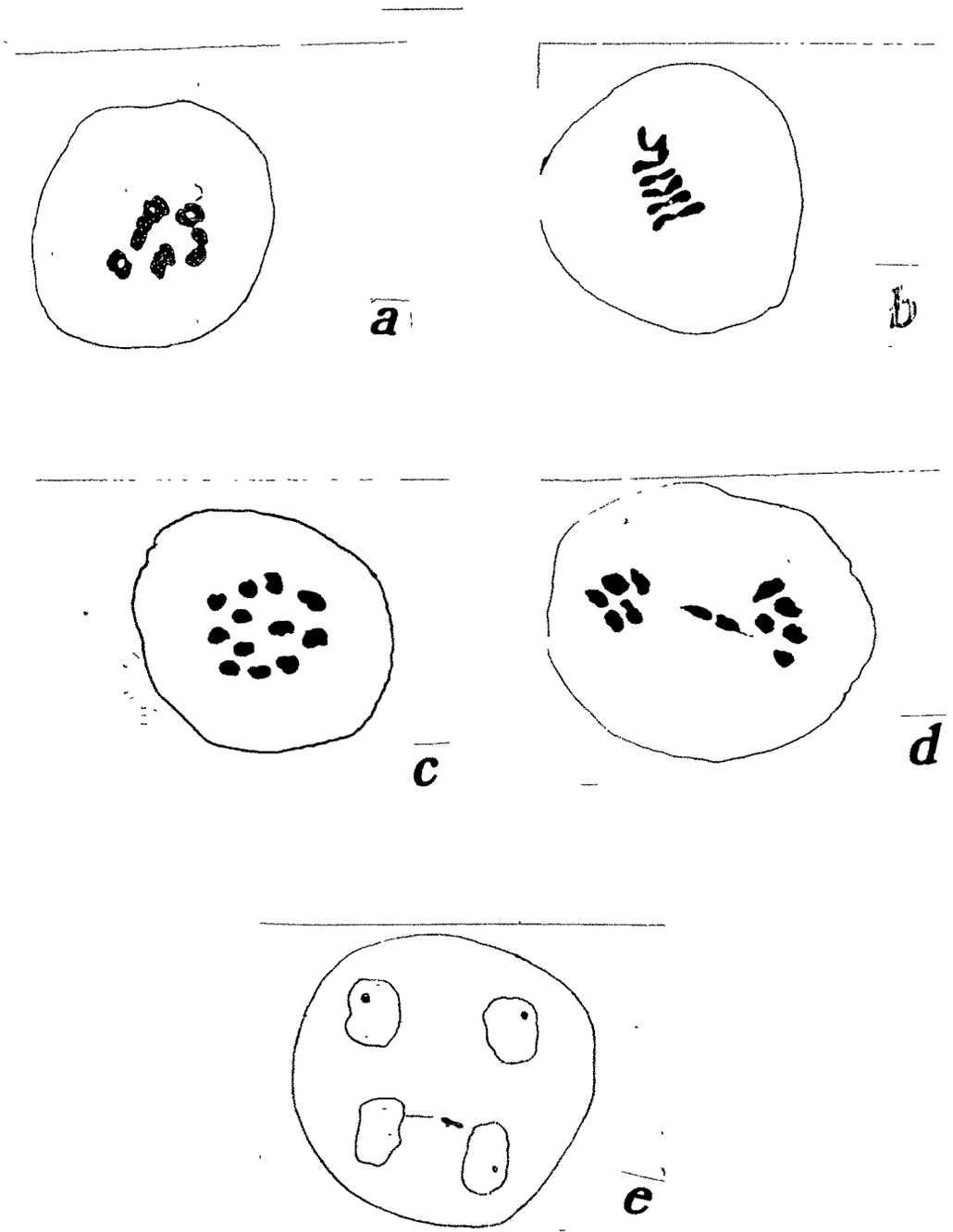


Plate No. 61

Plate No. 62 *Fagonia indica* var. *schweinfurthii*

PMC's showing

a,b - 9 distinct bivalents at early and late diakinesis.

c - Meta-II showing early separation of chromosomes at one pole.

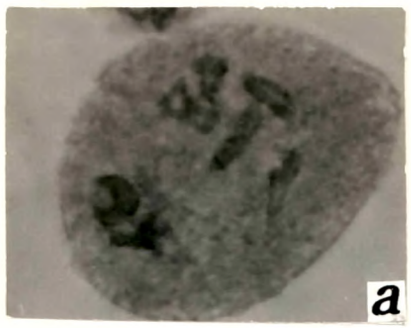
d - Meta-II.

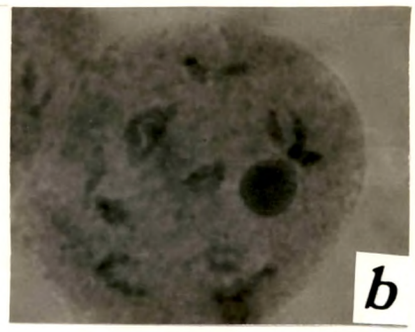
e - Meta-II and Ana-II

f - Ana-II normal distribution of chromosomes.

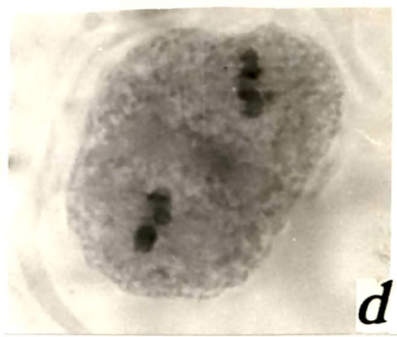
g - Tetrahedral tetrad.

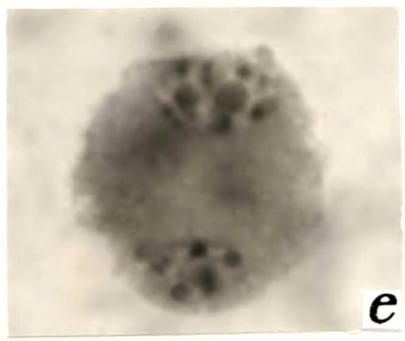
h - Ana-II showing laggard.

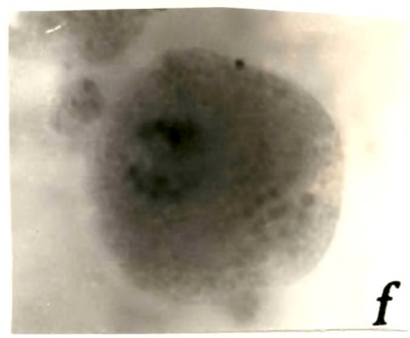

a

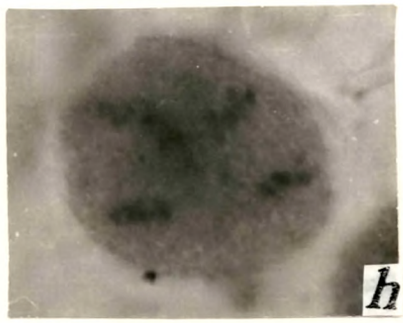

b


c


d


e


f


h

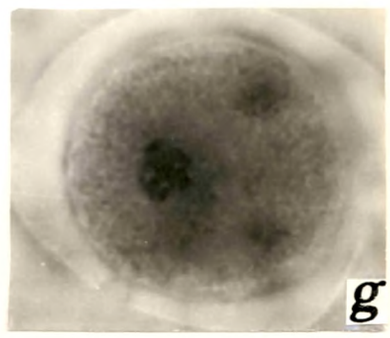

g

Plate No. 62

among them few are non-congressional one (Pl. 61-d,e). Except for few abnormalities such as bridge formation and abnormal disposition of chromosomes at Anaphase-I (Pl.61-f,g) and Anaphase-II, meiosis was fairly normal. (Pl. 61-f,g). Isobilateral tetrads were commonly observed. 48% pollens are found to be fertile ones.

The presence of unusually long or rectangular persistent tapetal cells were recorded in scrutinised meiotic preparations. Divisional stages and abnormalities were noticed at Ist and IInd meiotic divisions of PMC's. Tetranucleate cells are of common occurrence than binucleate or uninucleate ones (Pl. 71).

Indigofera argentea Burm. f.

On the whole, meiotic behaviour is more or less fairly normal. At early and late diakinesis 8 distinct divalents are noticed. Rod bivalents are predominantly noticed (Pl.63-a,b). In majority of pollen mother cells subsequent stages of meiotic division leading to formation of tetrads exhibited normal behaviour. Abnormalities such as early separation to chromosomes at metaphase-I (Pl.63-c), grouping of bivalents at late diakinesis (Pl.63-b), are recorded in few pollen mother cells. At anaphase-I and telophase-II non-congressional movement and stickiness of chromosome leading to bridge formation is also observed in few PMC's (Pl.63-d). Tetrads

Plate No. 63 Indigofera argentea

PMC's showing

a,b - Early and late diakinesis with 8 bivalents.

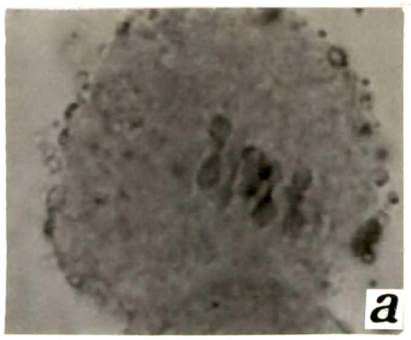
c - Meta - I, 8 distinct bivalents.

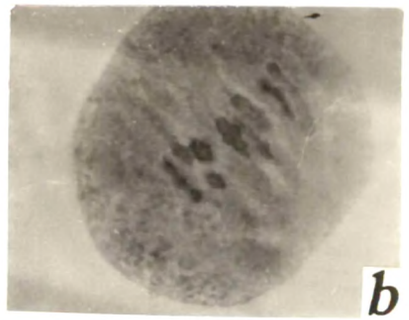
d - Ana - I, showing bridge formation.

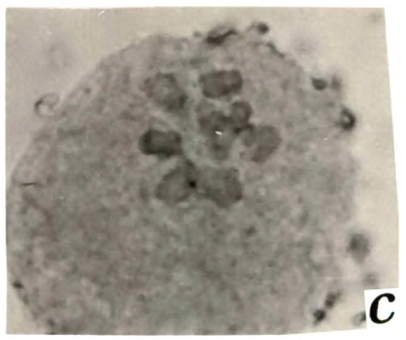
e - Meta - II, showing abnormal orientation of poles.

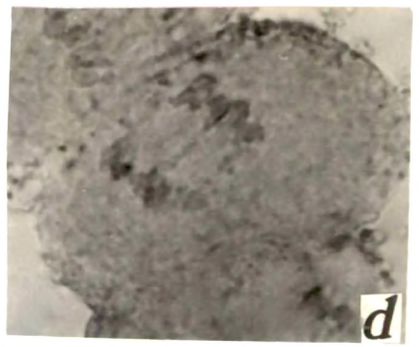
f - Meta - II, showing normal orientation.

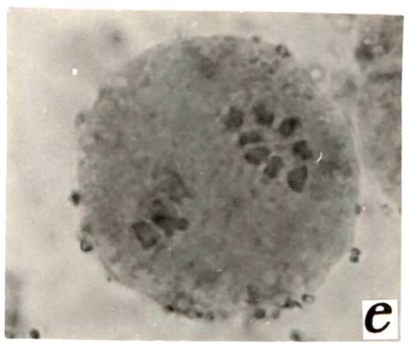
g - Tetrahedral Tetrad.

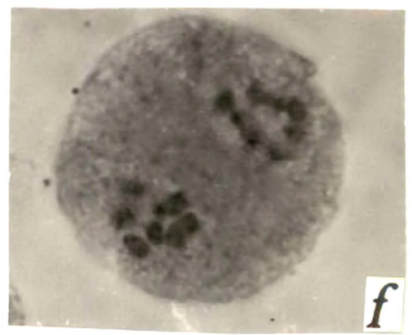












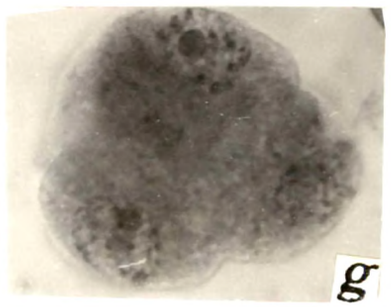


Plate No. 63

of different types were recorded, from the meiotic preparations, among them isobilateral tetrads are of common occurrence (Pl.63-g,h). The determined pollen fertility of the species is 71%.

Meiotic slide preparations showed the presence of somewhat large rectangular to elongated persistent tapetal cells. Tapatal cells depicting divisional stages and few abnormalities were recorded during Ist and IInd division. Most of them are binucleate to tetranucleate ones (Pl.No.72).

Helichrysum cutchicum (C.B.Clarke) Rao et. Deshpande.

Meiotic study of the taxon depict the presence of 14 distinct bivalents at diakinesis and metaphase-I (Pl.64-a,b,c). Anaphase-I and Metaphase-II showed the regular separation of chromosomes and subsequent divisional stages were fairly normal. In few PMC's persistent nucleolus is often noticed at diakinesis. At metaphase I the 14 bivalents are separated and arranged in slightly irregular manner, among them few are non-congressional ones (Pl.64-c). Except for few abnormalities like interbivalent connections, stickiness of chromosomes and abnormal disposition of chromosomes at diakinesis, anaphase-I and anaphase-II, (Pl.64-d,e,f) meiosis was fairly normal (Pl.64-g). Isobilateral and tetrahedral types of tetrads were commonly observed. 58% pollens are found to be fertile one.

Plate No. 64 Helichrysum cutchicum

PMS's showing

a,b - Early and late diakinesis.

c - Meta-I.

d - Ana-I inter bivalent connections.

e - Ana-I laggards.

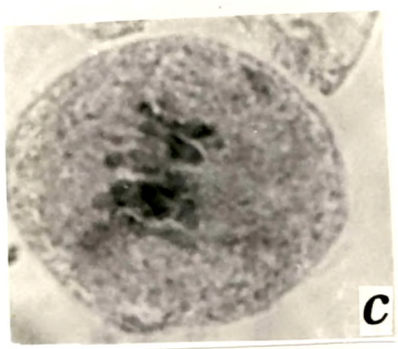
f - Meta-II unequal distribution.

g - Telo-II equal distribution.

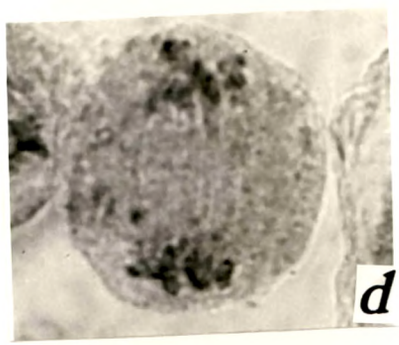
h - Isobilateral tetrad.

a

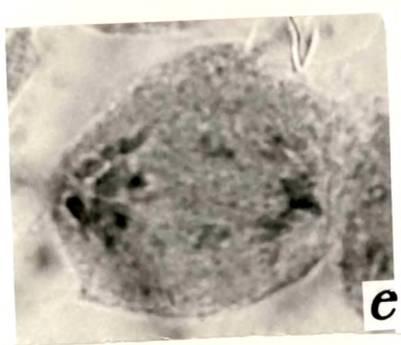
b



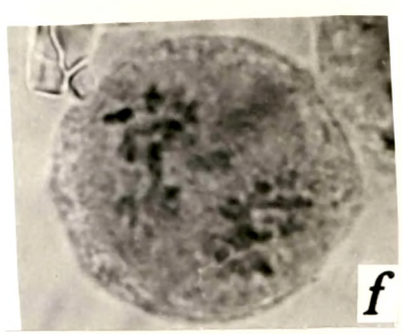
c



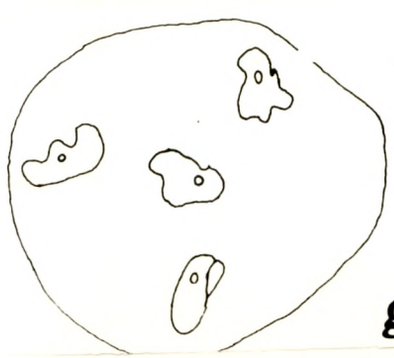
d



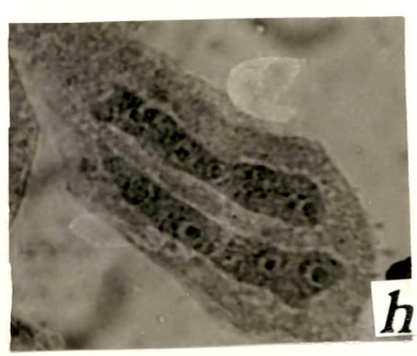
e



f



g



h

Plate No. 64

The presence of unusually long, elongated persistent cells were recorded in analysed meiotic slides. They are of elliptic, elliptic-ablong and rarely irregular shape and darkly stained having 40 x 15 u to 25 x 7 u size. Divisional stages of tapetal cells such as prometaphase, metaphase, anaphase and telophase are observed at Ist and IInd meiotic division of PMC's. Plurinucleate cells are of common occurrence than binucleate or tetranucleate one (Pl.No.73).

Launaea resedifolia (Linn.) O. Kuntze.

Coll. No. 23, 41

Karyotype formula :

$$2n = 16 = E_2 + F_2 + H_6 + I_6$$

The somatic metaphase plates of both the populations showed the presence of 16 chromosomes. The karyotypes contain only medium sized chromosomes ranging in between 5.270 μ and 3.054 μ. The position of centromere is nearly median for 4 pairs distributed in E and H types. While, the remaining 4 pairs are with nearly submedian centromere distributed in F and I types. The calculated values for absolute chromatin length, mean length and S% are more or less comparable (Table No. 11 & 12). The asymmetrical and smooth gradation of the karyotypes are also reflected in the calculated values of relative length and the asymmetry of the karyotype is also

Table 11 : Details of the karyotype analysis of Launaea resedifolia (Linn.) O. Kuntze Coll.No. (23)

Chromosome pair	Length in µm			Arm ratio		Relative length	TCL %	Centro-mere	Type
	Long arm	Short arm	Total length	R_1	R_2				
1	3.162	2.188	5.270	0.66	1.50	100	13.74	nm	E
2	3.162	1.844	5.006	0.58	1.71	95	12.41	nsm	F
3	3.162	1.581	4.743	0.50	2.00	90	12.41	nsm	I
4	2.635	1.686	4.321	0.63	1.56	82	11.30	nsm	I
5	2.635	1.581	4.216	0.60	1.66	80	11.30	nsm	I
6	2.371	1.581	3.952	0.66	1.49	75	10.94	nm	H
7	2.213	1.581	3.794	0.71	1.39	72	9.93	nm	H
8	1.844	1.371	3.215	0.74	1.34	60	8.41	nm	H
	21.184	13.333	34.517						

L/S ratio = 1.63

TF % = 38.62

mean length = 2.15 µm

karyotype formula = $E_2 + F_2 + H_6 + I_6$

Table 12: Details of the karyotype analysis of Launaea resedifolia Coll. (Linn.) O. Kuntze Coll. No. (41)

Chromosome pair	Length in um			Arm ratios		Relative length	TCL %	Cetro-mere	Type
	Long arm	Short arm	Total length	R_1	R_2				
1	3.162	2.108	5.270	0.66	1.50	100	13.3	nm	E
2	3.162	1.844	5.006	0.58	1.71	95	12.6	nsm	F
3	2.898	1.686	4.584	0.58	1.71	86	11.9	nsm	I
4	2.898	1.581	4.479	0.54	1.83	84	11.3	nsm	I
5	2.635	1.844	4.479	0.69	1.42	84	11.3	nm	H
6	2.635	1.581	4.216	0.60	1.66	80	10.6	nsm	I
7	2.371	1.581	3.952	0.66	1.49	74	9.99	nm	H
8	1.686	1.370	3.056	0.81	1.23	57	7.73	nm	H
	21.447	13.599	35.042						

L/S ratio = 1.72

TF % = 38.80%

Mean length = 2.19 μm

karyotype formula = $E_2 + F_2 + H_6 + I_6$

Plate No. 65

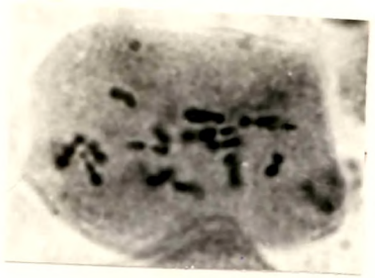
Launaea resedifolia (Linn.) O. Kuntze.

Coll. No. 23

a - Photomicrograph of somatic metaphase plate

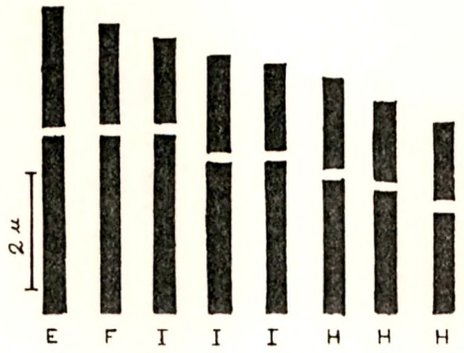
b - Camera lucida drawings of somatic metaphase complement showing 2n = 16 chromosomes

c - Idiogram



a

b



c

Plate No. 65

Plate No. 66

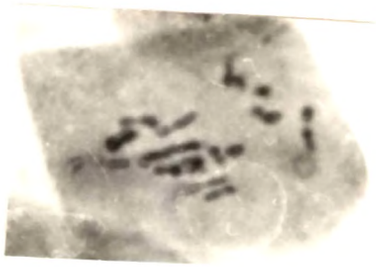
Launaea resedifolia (Linn.) O. Kuntze.

Coll. No. 41

a - Photomicrograph of somatic metaphase plate

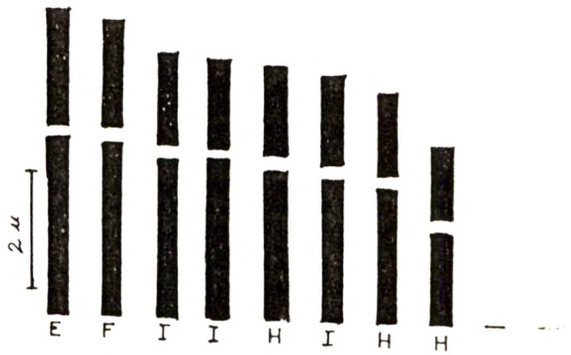
b - Camera lucida drawings of somatic metaphase complement showing 2n = 16 chromosomes

c - Idiogram



a

b



c

Plate No. 66

evident in the idiogram (Pl. 65-a,b,c, and 66-a,b,c).

The somatic complement number n = 16 is confirmed by the observation of 8 distinct bivalents at early and late diakinesis and metaphase-I (Pl.67-a,b) and depicts the regular meiotic behaviour of the pollen mother cells. Bivalents by and large are ring bivalents (Pl.67-c) with an exception of 1 or 2 rod bivalents. In the IInd meiotic division also segregation and separation of chromosomes resulting in the formation of tetrads is fairly uniform (Pl.67-d). Only abnormality recorded was early separation of bivalents at late diakinesis. The pollen tetrads were of isobilateral type only (Pl.67-f). 54% pollen were scored as fertile ones.

Smear preparation also revealed the presence of persistent tapetal cells. Which were of size ranging from 70x14 μ and 120x10 μ depicting elliptic-along or linear shapes. These cells exhibited uninucleate to plurinucleate conditions (Pl.73).

(Heliotropium bacciferum Forsk.

Analysis of smear preparation revealed more or less regular meiotic behaviour. At late diakinesis and metaphase-I, 13 distinct bivalents were noticed (Pl. 68-a,b). In majority of PMC's regular segregation and distribution of chromosomes is recorded. Abnormalities viz. secondary grouping bridge

Plate No. 67 Launaea resedifolia

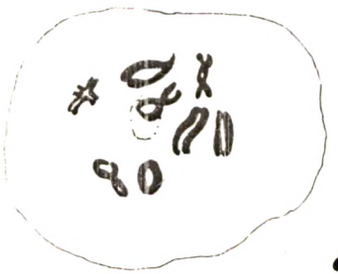
PMC's showing

a,b,c - Early and late diakinesis with 8 bivalents and prominent nucleolus.

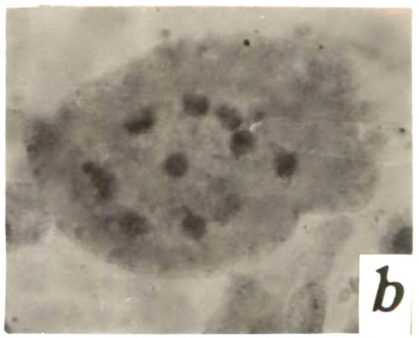
d - Ana-I (late)

e - Ana-II showing bridge formation.

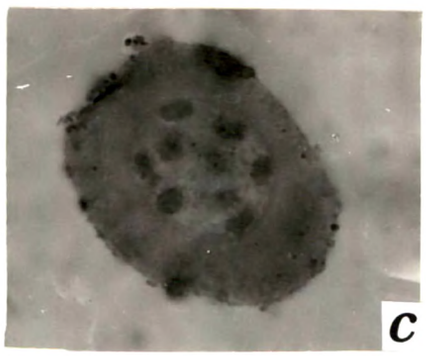
f - Isobilateral tetrad.



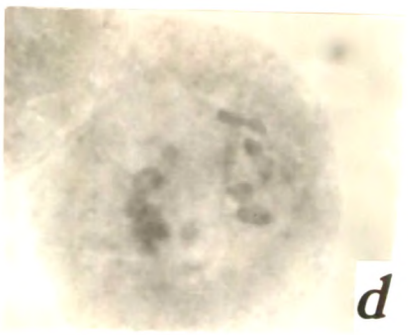
a



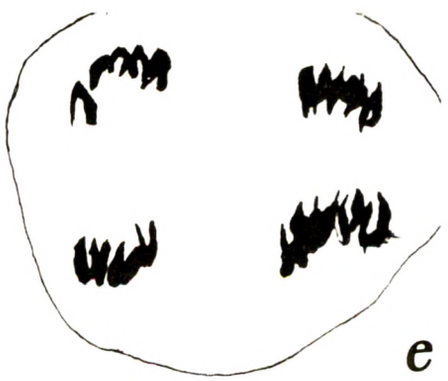
b



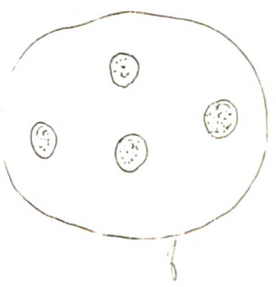
c



d



e



f

Plate No. 67

Plate No. 68 *Heliotropium bacciferum*

PMC's showing

a - Diakinesis.

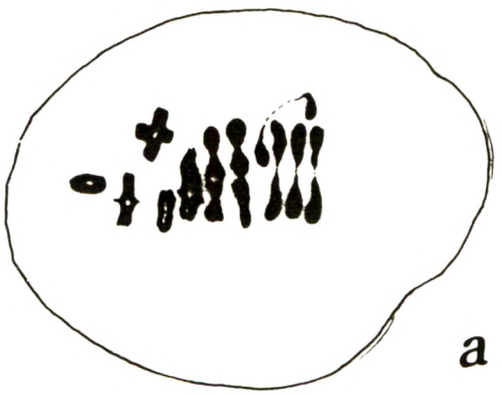
b - Meta-I.

c - Ana-I normal distribution.

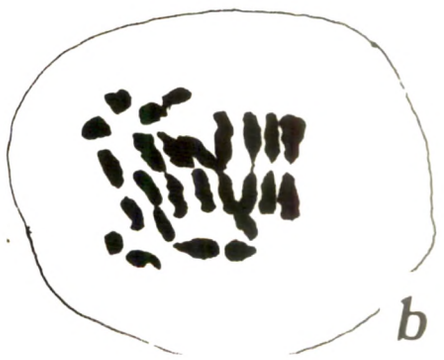
d - Meta-II.

e - Telo-II normal orientation.

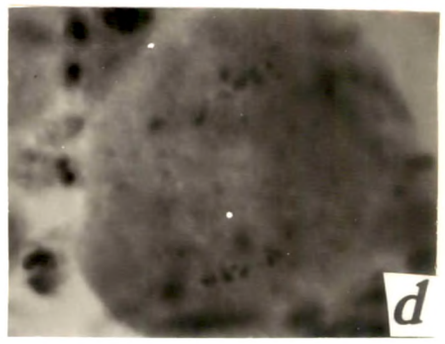
f - Isobilateral tetrad.



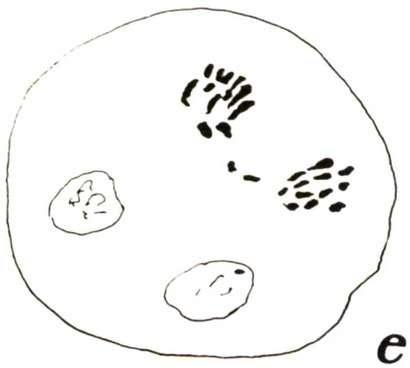
a



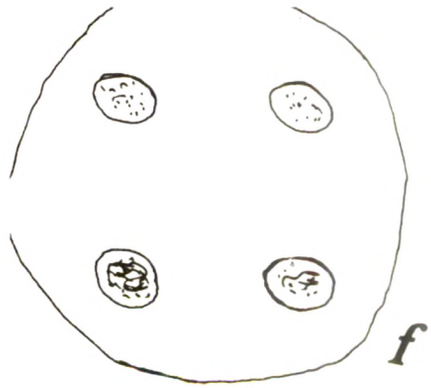
b



d



e



f

Plate No.68

formation and abnormal orientation of chromosomes at two poles no other abnormality were recorded at Metaphase-I, Anaphase-I, Anaphase-II and Telophase-II. (Pl. 68-c,d,e). Tetrahedral and isobilateral tetrads have been noticed in majority of preparations (Pl.68-f). The determined pollen fertility for the taxon was 46% only.

Smear preparation also revealed the presence of persistent tapetal cells, Which were elongated to irregular shaped, and size ranges in between 70 x 15 µm to 120 x 18 µm. The cells usually exhibitted tetranucleate conditions and exceptionally plurinucleate one (Pl.73).

Chascanum marrubifolium Fenzel ex. Walp.

Regular behaviour of chromosomes is observed in majority of pollen mother cells analysed. At late diakinesis and metaphase-I 12 distinct bivalents are observed (Pl.69-a,b). The regular segregation and distribution of chromosomes is noticed during Ist division of meiotic division. The IInd meiotic division is by and large regular, resulting into regular tetrad formation (Pl.69-f). Abnormalities such as persistent nucleolus and interbivalent connections resulting into grouping of bivalents at diakinesis (Pl.69-d,e). Stickiness of chromosome resulting into bridge formation at anaphase-I and telophase-I and early separation of chromosomes at metaphase-I are observed in few PMC's (Pl.69-d). Moreover,

Plate No. 69 Chascanum marrubifolium

PMC showing

a - Late diakinesis showing 12 distinct bivalents.

b - Meta-I.

c - Ana-I with laggard and interchromosomal connection.

d - Ana-I various number of laggards and inter-bivalent connections.

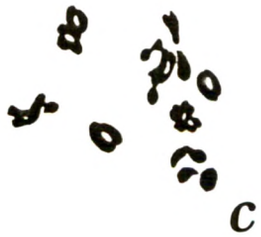
e - Normal distribution of chromosome, Meta-II.

f - Isobilateral tetrad.

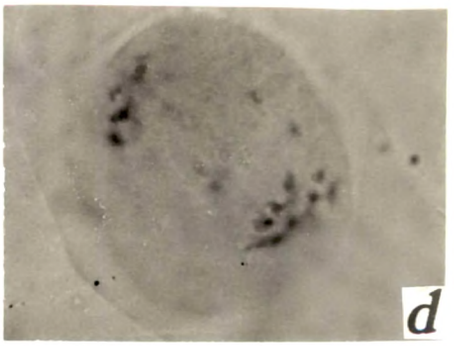
g - Ana-I bridge formation.

a

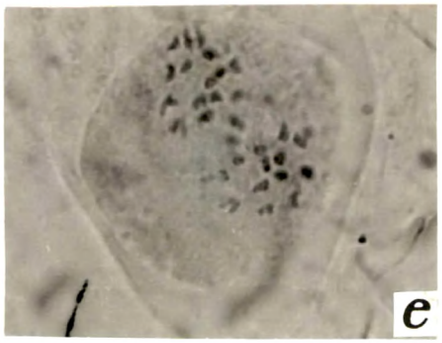
b



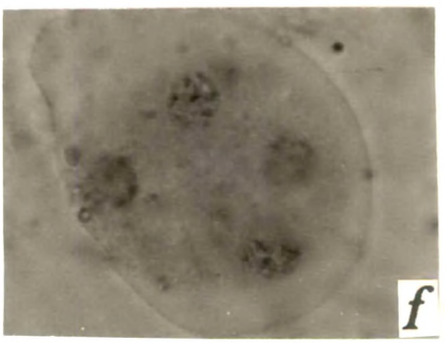
c



d



e



f

g

Plate No. 69

laggards at Telophase-I and non-synchronised movement of metaphase-plates and abnormal orientation during IInd meiotic division is of rare occurrence in pollen mother cells.

Meiotic slides showed the presence of persistent tapetal cells. They were by and large similar to Senra incana and only few divisional stages were recorded. Most of them were at tetranucleate condition of Ist and IInd meiotic division (Pl.71).

Premna resinosa (Hochst.) Schau.

Meiotic study of the pollen mother cells revealed the presence of 19 distinct bivalents at diakinesis and metaphase-I (Pl. 70-a,b). In subsequent stages of division, normal meiotic behaviour was noticed in majority of the pollen mother cells. In few PMC's early separation of bivalents and bridge formation were observed (Pl 70-c,d). Moreover, the abnormal orientation of chromosomes at metaphase-II and telophase-II were also recorded, which resulted into linear or 'T' shaped tetrad (Pl. 70 e,f,g). The determined pollen factility was 57% only.

In smear preparation, persistent topetal cells were recorded. They exhibit binucleate or tetranucleate conditions varying in size from 70 µ to 120 µm. Different divisional stages of tapetal cells were recorded (Pl. 72).

Plate No. 70 Premna resinosa

PMC's showing

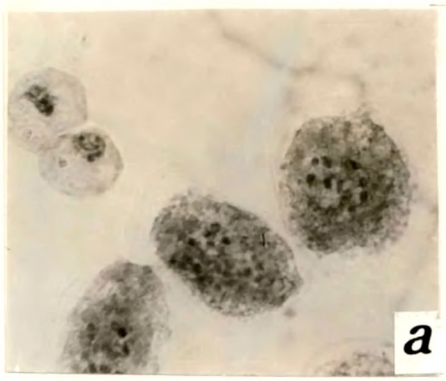
a,b - Early and late diakinesis.

c - Meta-I.

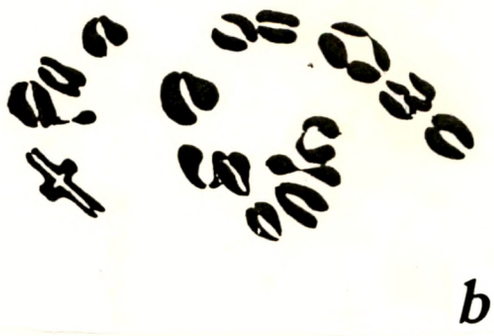
d - Ana-I laggards.

e - Ana-II. bridge formation.

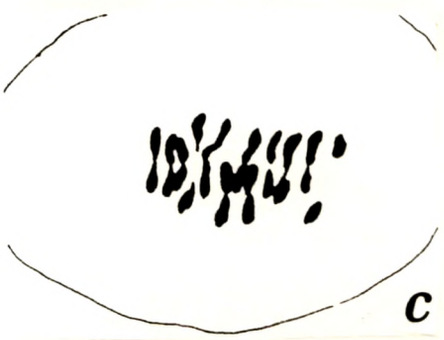
f - Tetrahedral tetrad.



a



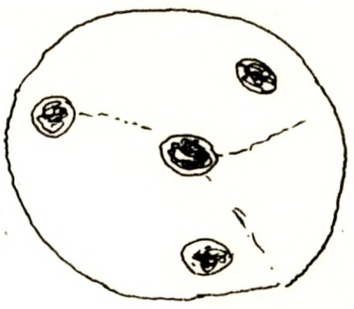
b



c

d

e



f

Plate No. 70

Plate No. 71 Divisional stages of tapetal cells.

Ist Division

a - Uninucleate condition.

b - Uninucleate condition with prominent nucleolus.

c - Prometaphase with nucleolus.

d - Metaphase (side view)

e - Anaphase (Bridge formation)

f - Telophase (Binucleate condition)

IInd Division

g - Metaphase - (side view)

h - Anaphase abnormal orientation.

i - Tetranucleate condition.

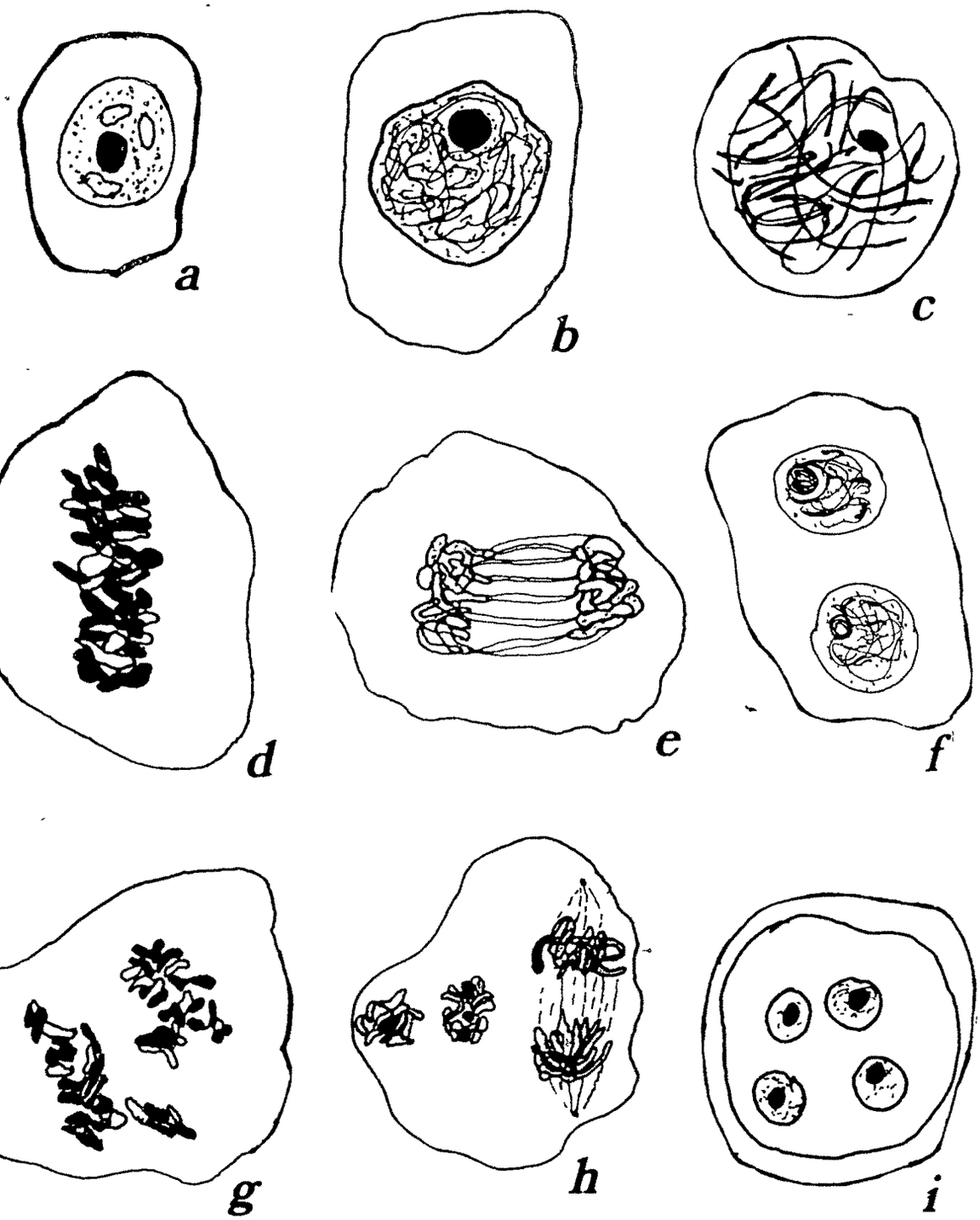


PLATE NO. 71

Plate No. 72 Divisional stages of tapetal cells.

I Division

a - Uninucleate condition.

b - Prometaphase showing prominent nucleolus.

c - Metaphase (side view)

d,e - Binucleate condition showing distinct nucleolii.

IInd Division

f - Prometaphase with disintegrating nucleolii.

g - Metaphase (polar view)

h - Showing anaphase bridges and telophase.

i - Elongated cell with tetranucleate condition.

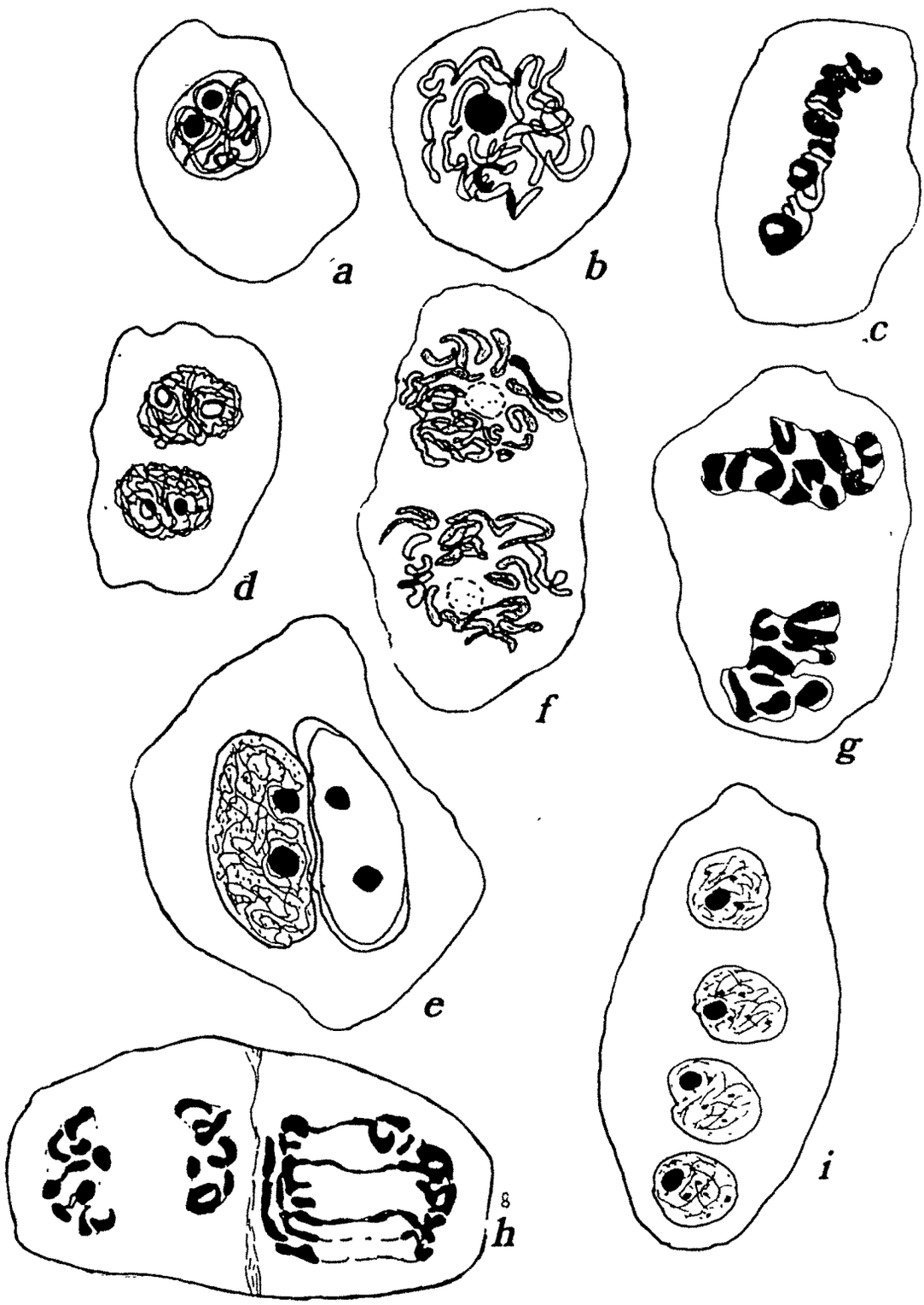


Plate No. 72

Plate No. 73 Divisional stages of tapetal cells.

Ist Division

a - Uninucleate condition.

b - Prometaphase with prominant nucleolus.

c - Elongated cell with two nucleolii.

d - Elongated cell with five micronucleoli.

IInd Division

e - Metaphase (side and polar view).

f - Metaphase (side view)

g - Binucleate condition with variable micronucleii.

h - Binucleate condition with variable micronucleii.

i - Tetranucleate condition.

j - Tetranucleate condition with variable micronucleii.

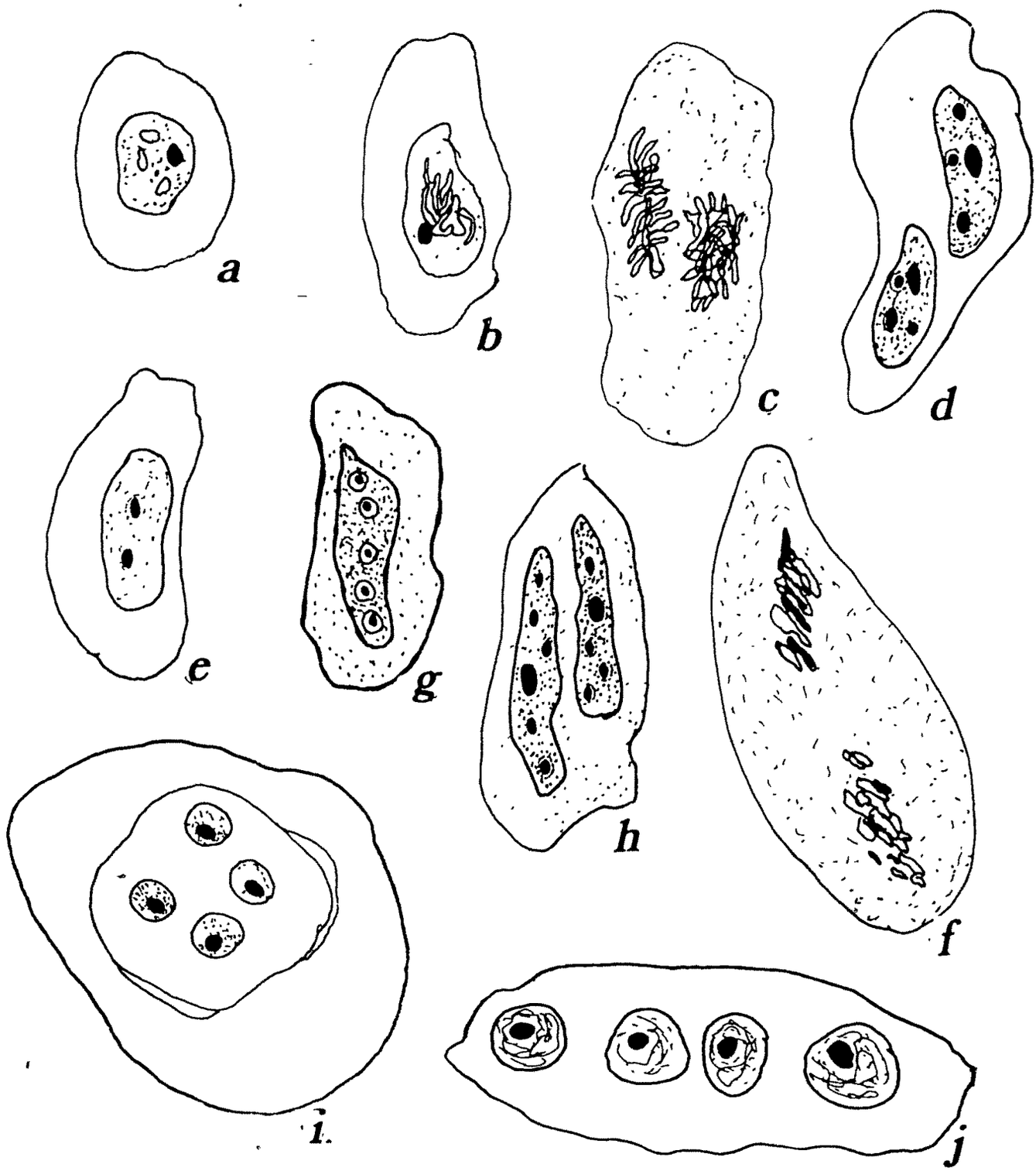


PLATE NO.73

Different species of Capparis have been earlier worked out by Schiller (1926); Raghavan (1938; 1940), Raman & Keshavan (1963) and Baquar et al (1966). The presently studied species viz Capparis cartilaginea (Syn. Capparis spinosa var.galeata) revealed the presence of n=9 in gametic complement and the base number x=9, proposed earlier for the genus is substantiated. Other base number x=19 proposed for the genus is not metwith in the present study. Based on the scrutiny of available data it appears that the species has been worked out earlier by Baquar et al (1966) and reported 2n=40 in somatic complement. While, the present study of the species revealed n=9 and 2n=18 chromosomes. The karyomorphological details of the somatic complement has been worked out for the first time.

Reference to genera Abutilon, Pavonia and Senra of family Malvaceae are metwith in the publications of Skovested (1935,1941); Krapovikas & Christobal (1962); Raman & Keshavan (1963); Islam & Imam (1959); Bates (1967), Bates & Ballanchard (1970); Rehmatullah (1970); Dasgupta (1976); Dasgupta & Bhatt (1976, 1981, 1982);Krishnappa & Munirajappa (1982) and Sidhu et al. (1990).

In earlier works, base number x=7,8 and 9 have been proposed for the genus Abutilon. The present study of A. pannosum revealed the presence of n = 16 and 2n=32, which

supports the earlier proposed base number x=8 for the genus. This is the first report of n & 2n number and karyomorphology of the species.

Skovested (1935, 1941), Bates & Ballanchard (1970), Dasgupta & Bhatt (1976, 1981, 1982) and Krishnappa & Munirajappa (1982), based on their studies of different species of Pavonia consider x = 7 as the deep seated base number for the genus. The present study of 3 species of Pavonia also supports the same base number. While, sidhu et al (1990) based on their study of 7 species of the genus have suggested that the genus is dibasic having x = 13 and 14. Among the 3 species worked out presently, only P.zeylanica was scrutinised earlier by Dasgupta (1976). While, the other 2 species viz.P.arabica and P.grewioides remained cytologically unexplored. The present findings of n=28 and 2n=56 for P.zeylanica are in accordance with the earlier reports of Dasgupta & Bhatt (1976, 1981, 1982). The meiotic study of P.arabica and P. grewioides depicted the presence of n=7 and n=28 chromosomes respectively.

The genus Senra has been earlier worked out for n and 2n numbers by Islam & Imam (1959), Bates & Ballanchard (1970) and Rehmatullah (1970), which indicate that the base number for the genus could be x=17 or 18. Sidhu et al (1990) in their recent publication consider the genus to be dibasic

having x=17 and 18. Present study of Senra incana revealed the presence of x=17 and 2n=34 in their gametic and somatic complement. Form the review of literature, it appears that, the species remained unexplored for detailed karyomorphological characteristics of the somatic complement.

Reference to the species of genera Fagonia, Tribulus and Zygophyllum of family Zygophyllaceae are metwith in the earlier works of Warberg (1938); Negodi (1939); Baquar et al (1966); Bhandari & Sharma (1977); Bhansali (1974); Lessani and Panach (1970) and Hila (1979). The present study of Fagonia indica var. schweinfurthii (Syn. Fagonia cretica) revealed the presence of 9 bivalents, confirming the earlier proposed base number x=9 for the genus.Earlier,Warburg (1938); Negodi (1939); Baquar et al (1966) and Bhansali (1974) studied the genus Tribulus and reported base number of x = 6 and 12 for the genus. The present meiotic study of Tribulus rajasthanensis revealed the presence of 6 distinct bivalents which supports x=6 for the genus and the same was reported for the species by Bhandari & Sharma (1977).

Quite a large number of taxa of Fabaceae have been earlier scrutinised from cytological view points. Prominent among them are Frahm-leliveld (1960, 1962, 1966); Singh & Roy(1970); Bhatt (1972, 1974);Bhatt & Sanjappa (1975, 1977); Singh & Yadav (1978);Sanjappa (1983); Pandit & Kulkarni

(1984) and Kumari & Bir (1990); who have worked out different species of genus Indigofera in particular. The presently scrutinised species Viz. I.argentea was earlier worked out by Sanjappa (1983) & Pandit & Kulkarni (1984). Their observations regarding n=8 and 2n=16 numbers have been supported by the present work.

Different species of genera Helichrysum and Launaea have been earlier scrutinised by Stebbins et al (1953); Tongiorgi (1935); Turner & Lewis (1965); Mehra & Remanandan (1975); Mehra et al (, 1975, 1976); Sharma & Banerjee (1974);Singh (1974); Singhvi (1974);Mohan et al (1962) and Love & Love (1982). Based on the above mentioned studies of different species of the two genera x=7 and x=8,9 and 10 have been proposed for Helichrysum & Launaea respectively. The present findings n=14 for Helichrysum cutchicum supports the proposed base number x=7. The cytological study of L. resedefolia revealed the presence of n=8 and 2n=16 in their gametic & Somatic complement which supports the base number x=8 for the genus.

Based on the earlier works of Britton (1951); Ahuja & Natrajan (1957); Pal (1957, 1963); Bhattacharya (1968) and few others for different species of Heliotropium, different base number ranging from x=7 to 13 have been proposed. However, the presently worked out species viz. H. bacciferum

is not included in above mentioned works. The present study of the species revealed the presence of 9 distinct bivalents indicating the base number x=9 for the genus. The above mentioned base number for the genus was proposed earlier by Britton and Pal on their studies of H.arborescence and H.peruvianum respectively.

In the works of Jinno (1956); Mehra & Gill (1968); Mehra (1972, 1976), Sharma & Mukhopadhyay (1963) and Gill (1983) for the family Verbenaceae reference to genera Premna & Chascanum (Syn. Bouchea) are metwith. The presently worked out P.resinosa and Chascanum marrubifolium have been cytologically investigated for the first time. The present study of P.resinosa revealed n=19 which confirms the earlier proposed base number x=19 for the genus. The species C.marrubifolium revealed the presence of n=12 Chromosomes in gametic complement.