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A CONTRIBUTION TO THE CHROMOSOME NUMBERS OF COMPOSITAE FROM PAKISTAN

ZEENAT ABDUL RAZAQ, SURAYYA KHATOON AND S.I. ALI

Department of Botany,
University of Karachi, Karachi-75270, Pakistan.

Abstract

Chromosome counts are reported for 32 species belonging to 23 genera (in 8 tribes) of the family Compositae from Pakistan. Of these, counts for 4 taxa viz., *Lactuca remotiflora* DC., *Pluchea arguta* Boiss., *Pulicaria boissieri* Hook. f. and *Pulicaria hookeri* Jafri are new to science.

Introduction

Compositae (Asteraceae) is the largest and one of the most widely distributed families of flowering plants with 1000 genera and 20,000 species (Good, 1956; Stebbins 1974). In flora of Pakistan, it is represented by 110 genera and c. 604 species (Ali, 1978). Of these, only 10 species (i.e. 1.6% of the total species) have been subjected to cytological studies by previous workers like Baquar & Askari (1970) and Khatoon & Ali (1982). In the present study, meiotic chromosome numbers of 32 species belonging to 23 genera of the family Compositae are reported. Of these, counts for 4 taxa are reported for the first time and counts for 21 taxa are new to flora of Pakistan.

Materials and Methods

Young capitula were collected and fixed in freshly prepared Carnoy's solution (3:1 absolute alcohol: glacial acetic acid). The slides were prepared by routine squash technique using acetocarmine or propionic carmine as stain. Counts were made at diakinesis, metaphase-I and metaphase-II. Most of the photographs were taken from temporary mounts, the slides were later made permanent. Voucher specimens are deposited in Karachi University Herbarium (KUH).

Results and Discussion

The results are summarized in Table 1. Informations about the earlier counts are also referred to along with the basic number reported for the genus.

The chromosome counts that confirm the earlier reports have not been commented upon, but obviously they add substantially to the range of material that has been examined cytologically. However, counts for *Pulicaria angustifolia* DC., and *Iphiona grantioi-*

Table 1. Chromosome numbers in Compositae.

Taxon	Habit	Voucher specimen	Basic No x	Present Count n	No. of Cells Studied	Previous counts with authority n	2n		Ploidy Level
TRIBE ANTHEMIDEAE									
1. **Chrysanthemum coronarium* L.	Annual	K.U. Campus,	9	9	12	9	—	Gupta in Moore, 1973	Diploid
(Fig. I, H)	Herb	*Razaq* 109				—	18	Tahara in Fedorov, 1974	"
						—	"	Borgan in Moore, 1973	"
						—	"	Sampathkumar & Ayyangar, 1981	"
TRIBE ASTEREAE									
2. **Conyza aegyptiaca* Dryand.	Perennial	K.U. Campus	9	9	10	9	18	Mehra *et al.*, in Fedorov, 1974	Diploid
(Fig. I, D)	Herb	*Razaq* 74				"	—	Turner & Lewis in Fedorov, 1974	"
						"	18	Turner & Lewis in Fedorov, 1974	"
3. **Conyza bonariensis* (L.) Cronq.	Perennial	K.U. Campus,	9	27	5	c. 27	—	Powell & King in Moore, 1973	Hexaploid
	Herb	*Razaq* 67				27	—	Solbrig *et al.*, in Moore, 1973	"
	"	K.U. Campus,	9	27	14	27	54	Löve & Löve in Fedorov, 1974	"
		Razaq 116				—	"	Powell & Turner in Fedorov, 1974	"
						—	32	Torres & Liogier, 1970	?
TRIBE CARDUEAE									
4. **Centaurea cyanus* L.	Annual	K.U. Campus,	12	12 +1B	5	12	—	Mehra *et al.*, in Ornduff, 1967	Diploid
	Herb	*Razaq* 110		chromosome		—	24	Morinaga *et al.*, in Fedorov, 1974	"
		K.U. Campus,	12	12	4				
		Razaq 119							
5. **Echinops echinatus* Roxb.	Annual	K.U. Campus,	7	14	6	14	—	Mehra *et al.*, in Ornduff, 1967	Diploid
	Herb	*Razaq* 114				—	28	Malik in Fedorov, 1974	"
	"	K.U. Campus,	7	14	11	—	"	Mehra *et al.*, in Fedorov, 1974	"
		Razaq 115							

TRIBE HELIANTHEAE									
6. **Blainvillea latifolia* (L.f.) DC.	Annual Herb	K.U. Campus, *Razaq* 95	17	17	4	39	—	Mehra et al., in Ornduff, 1967	?
						17	—	Mehra & Remanandan, 1969	Diploid
	"	K.U. Campus, *Razaq* 96	17	17	10	—	72	Mehra *et al.*, in Fedorov, 1974	?
						—	36	Nirmala & Rao, 1981	?
7. **Coreopsis atkinsoniana* Douglas (Fig. 1, A)	Annual Herb	K.U. Campus, *Razaq* 102	12	12	38	12	—	Parker, 1972	Diploid
						—	24	Smith, 1969	"
8. *Eclipta prostrata* (L.) L.	Annual Herb	K.U. Campus, *Razaq* 17	11	11	17	11	—	Subramanyam & Kamble, 1967	Diploid
						"	—	Baquar & Askari, 1970	"
						"	—	Fernandes & Queiros in Moore, 1973	"
						—	18, 22	Mohan *et al.*, in Fedorov, 1974	?
						—	22	Arano in Fedorov, 1974	Diploid
						—	"	Torres & Liogier, 1970	"
						—	"	Nirmala & Rao, 1981	"
9. **Flaveria trinervia* (Spreng.) C.Mohr.	Annual Herb	NIPA Chowrangi Karachi *Razaq* 87	18	c.17	12	18	—	Keil & Stuessy in Goldblatt, 1981	Diploid
						"	—	Powell & Powell in Goldblatt, 1981	"
						"	—	Gupta & Gill, 1980	"
		NIPA Chowrangi, Karachi *Razaq* 88	18	c.17	34				
10. **Gaillardia pulchella* Fougeroux. (Fig. 1, J)	Annual Herb	K.U. Campus, *Razaq* 108	17, 18	17	47	17	—	Mehra *et al.*, in Ornduff, 1967	Diploid
						"	—	Jones in Moore, 1973	"
						"	—	Urbatsch, 1974	"
						—	36	Morinaga *et al.*, in Fedorov, 1974	"
						—	34, 68	Schnack in Fedorov, 1974	"
							34	Biddulph in Fedorov, 1974	Tetraploid
						—	12	Covas & Schnack in Fedorov,1974	?
11. *Tridax procumbens* L. (Fig. 1, Q)	Perennial Herb	K.U. Campus, *Razaq* 20	9	18	34	18	—	Powell, 1965	Tetraploid
						"	—	Gupta in Moore, 1973	"
						"	—	Powell & King in Moore, 1973	"
						"	—	Hsu in Moore, 1973	"
						"	—	Torres & Liogier, 1970	"
						"	—	Nirmala & Rao, 1981	"

(Table 1. Continued)

Taxon	Habit	Voucher specimen	Basic No x	Present Count n	No. of Cells Studied	Previous counts with authority n	2n		Ploidy Level
						"	—	Khatoon & Ali, 1982	"
						—	36	Turner, Ellison & King in Fedorov, 1974	"
						—	"	Powell, 1965	"
						—	"	Hervey, 1966	"
12. **Zinnia angustifolia*	Annual	K.U. Campus,	12	11	27	12	—	Bose & Panigrahi in Moore, 1973 (as *Z. linearis*)	Diploid
H.B. et K. (Fig. 1, E)	Herb	*Razaq* 107				—	22	Turner, Beaman & Rock in Fedorov, 1974	?
						—	"	Koul & Gohil, 1973	?
13. **Zinnia elegans* Jacq.	Annual	K.U. Campus,	12	12	22	—	24	Ishikawa in Darlington & Wylie, 1955	Diploid
(Fig. 1, G)	Herb	*Razaq* 106				—	"	Turner, 1962	"
						—	"	Torres, 1963	"
						—	"	Ramalingam *et al.*, in Moore, 1973	"
						—	"	Koul & Gohil, 1973	"
TRIBE INULEAE									
14. **Blumea lacera* DC.	Annual	K.U. Campus,	10	10	6	11	—	Mehra *et al.* in Omduff, 1967	?
(Fig. 1, B)	Herb	*Razaq* 5				9	—	Subramanyam & Kamble, 1967	?
						10	—	Hsu in Moore, 1973	Diploid
	"	K.U. Campus,	"	10	20	—	18	Subramanyam & Kamble, 1966	?
		Razaq 49				—	"	Miyagi in Moore, 1973	?
15. **Blumea obliqua* (L.)	Annual	K.U. Campus,	10	10	21	10	—	Bhandari & Singhvi, 1977	Diploid
Druce (Fig. 1, R)	Herb	*Razaq* 22							
	"	K.U. Campus,	10	10	27	—	—		"
		Razaq 82							
16. **Gnaphalium americanum*	Annual	K.U. Campus,	7	14	11	—	c.28	Turner & King in Fedorov, 1974	Tetraploid
Mill. (Fig. 1, O)	weedy herb	*Razaq* 98							
	"	K.U. Campus,	7	14	20	—	—		"
		Razaq 99							

17. *Iphiona grantioides* (Boiss.) A. Anderb.	Perennial Shrub	K.U. Campus, *Razaq* 12	9	9	5	10	—	Baquar & Askari, 1970	Diploid
(Syn. *Inula grantioides* Boiss.) (Fig. 1, U).	"	K.U. Campus, *Razaq* 13	9	9	43	—	—		
18. **Pegolettia senegalensis* Cass. (Fig. 1, I)	Annual Herb	K.U. Campus, *Razaq* 103	10	10	4	10	—	Bhandari & Singhvi, 1977	Diploid
	"	K.U. Campus, *Razaq* 104	10	10	15	—	—		"
19. ***Pluchea arguta* Boiss. (Fig. 1, M.)	Perennial Shrub	Super Highway, *Razaq* 89	5	10	15	—	—		Tetraploid
	"	Super Highway, *Razaq* 90	5	10	27	—	—		"
	"	K.U. Campus, *Razaq* 112	5	10	21	—	—		"
20. **Pluchea indica*(L.) Less.	"	K.U. Campus, *Razaq* 66	5	30	3	—	—		12 Ploid
						—	20	Cooperrider & Galang in Fedorov, 1974	Tetraploid
	"	K.U. Campus, *Razaq* 117	5	30	19	15	—	Sarkar *et al.*, 1982	Hexaploid
21. **Pluchea lanceolata* (DC.) Clarke (Fig. 1, N)	"	K.U. Campus, *Razaq* 73	5	10	15	—	20	Koul in Fedorov, 1974	Tetraploid
	"	K.U. Campus, *Razaq* 84	5	10	8	—	—		"
22. *Pulicaria angustifolia* DC. (Fig. 1, V)	Annual Herb	K.U. Campus, *Razaq* 14	7	7	17	9	—	Baquar & Askari, 1970	Diploid
						7	—	Bhandari & Singhvi, 1977	Diploid
	"	K.U. Campus, *Razaq* 76	7	7	10	—	—		"
23. ***Pulicaria boissieri* Hook. f. (Fig. 1, F)	Perennial Shrub	Super Highway, *Razaq* 91	7	7	16	—	—		"
	"	Super Highway, *Razaq* 92	7	7	9	—	—		"
24. ***Pulicaria hookeri* Jafri (Fig. 1, K)	Perennial Shrub	Paradise Point, *Razaq* 113	7	7	8	—	—		"

(Table 1. Continued)

Taxon	Habit	Voucher specimen	Basic No x	Present Count n	No. of Cells Studied	Previous counts with authority n	2n		Ploidy Level
TRIBE LACTUCEAE									
25. **Crepis sancta* (L.) Babc.	Perennial	Sur Range	5	5	12				
ssp. *bifida* (Vis.) Thell.	Shrub	Spin Karez				—	6	Mehra *et al.*, in Fedorov, 1974	Diploid
ex Babc.		Quetta, *Ghafoor*	—	—	—	—	6	Kumari in Goldblatt, 1985	
(Fig. 1, C)		1039						(as *Pterotheca falconeri* Hook. f.)	
26. ***Lactuca remotiflora* DC.	Annual	K.U. Campus,	9	9	10	—	—		Diploid
(Fig. 1, T)	Herb	*Razaq* 10							
		K.U. Campus,	9	9	9	—	—		"
		Razaq 19							
27. **Launaea nudicaulis*(L.)	Perennial	K.U. Campus,	9	9	12	9	—	Mehra *et al.*, in Ornduff, 1967	"
Hook.f. (Fig. 1, L)	Herb	*Razaq* 6				"	—	Subramanyam & Kamble, 1966	
						"	—	Gupta in Moore, 1973	
	"	K.U. Campus,	9	9	10	—	18	Stebbins *et al.*, in Fedorov, 1974	"
		Razaq 37				—	"	Mohan *et al.*, in Fedorov, 1974	"
						—	"	Mehra *et al.*, in Fedorov, 1974	"
28. *Sonchus asper* (L.) Hill	Annual	K.U. Campus,	9	9	14	9	—	Mehra *et al.*, in Ornduff, 1967	"
	Herb	*Razaq* 105				"	—	Subramanyam & Kamble, 1967	
	"	K.U. Campus,	9	9	12				
		Razaq 111				"	—	Hsieh *et al.*, in Moore, 1973	"
						—	18	Rutland in Fedorov, 1974	"
						—	"	Heiser & Whitaker in Fedorov, 1974	"
						—	"	Stebbins *et al.*, in Fedorov, 1974	"
						—	"	Koul in Fedorov, 1974	"
						—		Larsen, 1965	"
						—	"	Kuzmanov & Georgieva, 1976	"
						—	"	Strid & Franzen, 1981	"

29. **Sonchus oleraceus* L.	Annual Herb	K.U. Campus, *Razaq* 100	8	16	19	16	—	Mehra *et al.*, in Ornduff, 1967	Tetraploid
						"	—	Powell & King in Moore, 1973	"
						"	—	Alam in Moore, 1974	"
	"	K.U. Campus, *Razaq* 101	8	16	10	18	—	Hsieh *et al.*, in Moore, 1974	?
						9	—	Sharma & Sarkar in Moore, 1973	?
						—	18	Ohno in Moore, 1973	?
						—	32	Ishikawa in Darlington & Wylie, 1955	Tetraploid
						—	"	Heiser & Whitaker in Fedorov, 1974	"
						—	"	Mulligan in Fedorov, 1974	"
TRIBE MUTISIEAE									
30. *Dicoma tomentosa* Cass. (Fig. 1, S)	Annual Herb	K.U. Campus, *Razaq* 59	11	11	13	11	—	Bhandari and Singhvi, 1977	Diploid
		K.U. Campus, *Razaq* 97	11	11	5	—	—		"
TRIBE VERNONIEAE									
31. *Vernonia cinerascens* Sch. Bip.	Perennial Herb	K.U. Campus, *Razaq* 93	10	20	18				Tetraploid
						10	—	Mehra *et al.*, in Ornduff, 1967	Diploid
	"	K.U. Campus, *Razaq* 94	10	20	5	—	20	Mehra *et al.*, in Fedorov, 1974	"
						—	40	Mangenot & Mangenot in Fedorov, 1974	Tetraploid
32. **Vernonia cinerea* (L.) Less. (Fig. 1, P)	Annual Herb	National College, Karachi *Razaq* 38	9	9	4	9	—	Turner & Lewis in Fedorov, 1974	Diploid
						"	—	Mehra *et al.*, in Ornduff, 1967	"
						"	—	Subramanyam & Kamble, 1966	"
						"	—	Shetty, 1967	"
		National College, Karachi *Razaq* 39	9	9	2	—	18	Mengenot *et al.*, in Fedorov, 1974	"
						—	"	Chung *et al.*, in Fedorov, 1974	"
						—	"	Mehra *et al.*, in Fedorov, 1974	"

**First chromosome number report for species.

*Chromosome number being reported for the first time from Pakistan.

K.U. = Karachi University

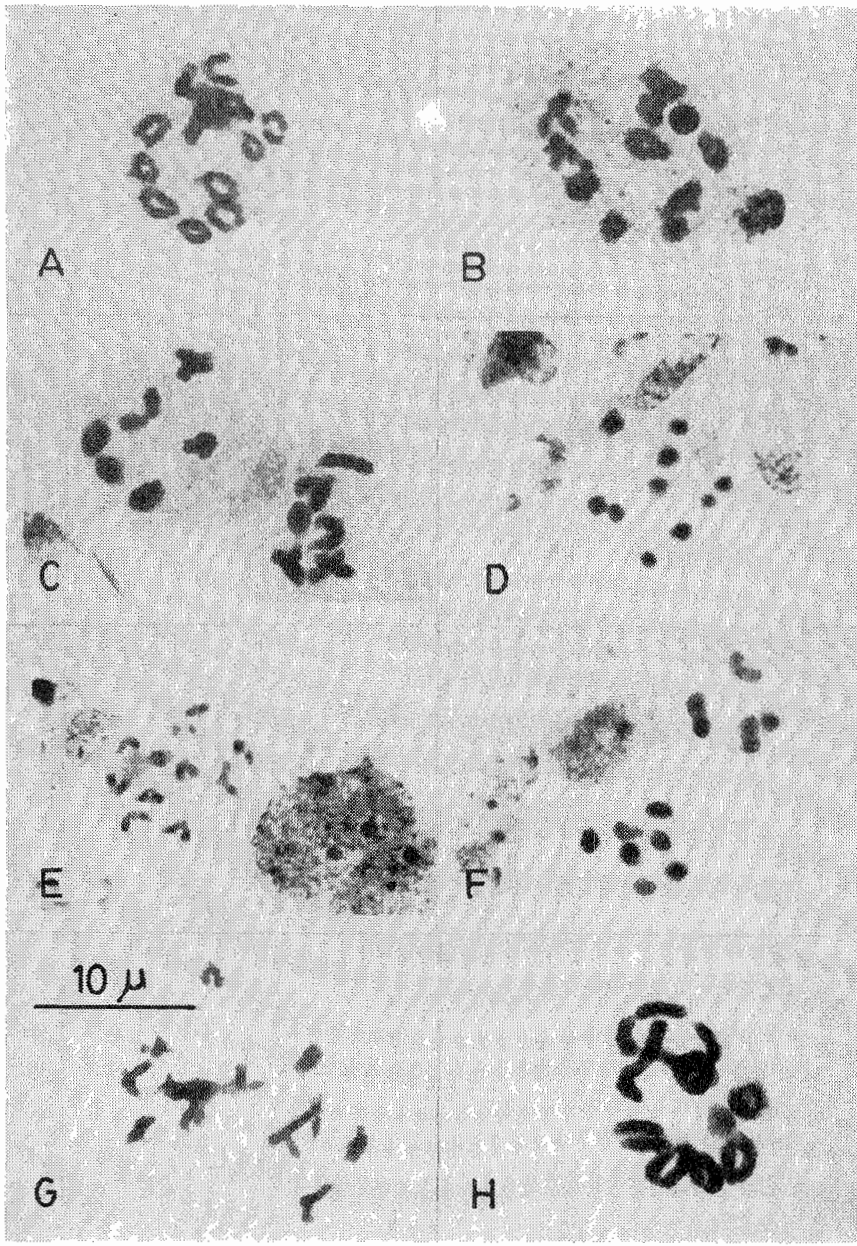

Fig. 1. Pollen mother cell meiosis in members of Compositae. A. *Coreopsis atkinsoniana* (diakinesis): n = 12, B. *Blumea lacera* (diakinesis): n = 10, C. *Crepis sancta* ssp. *bifida* (diakinesis): n = 5, D. *Conyza aegyptiaca* (diakinesis): n = 9, E. *Zinnia angustifolia* (diakinesis): n = 11, F. *Pulicaria boissieri* (metaphase-I): n = 7, G. *Zinnia elegans* (diakinesis): n = 12, H. *Chrysanthemum coronarium* (diakinesis) n = 9 (7 bivalents and one quadrivalent).

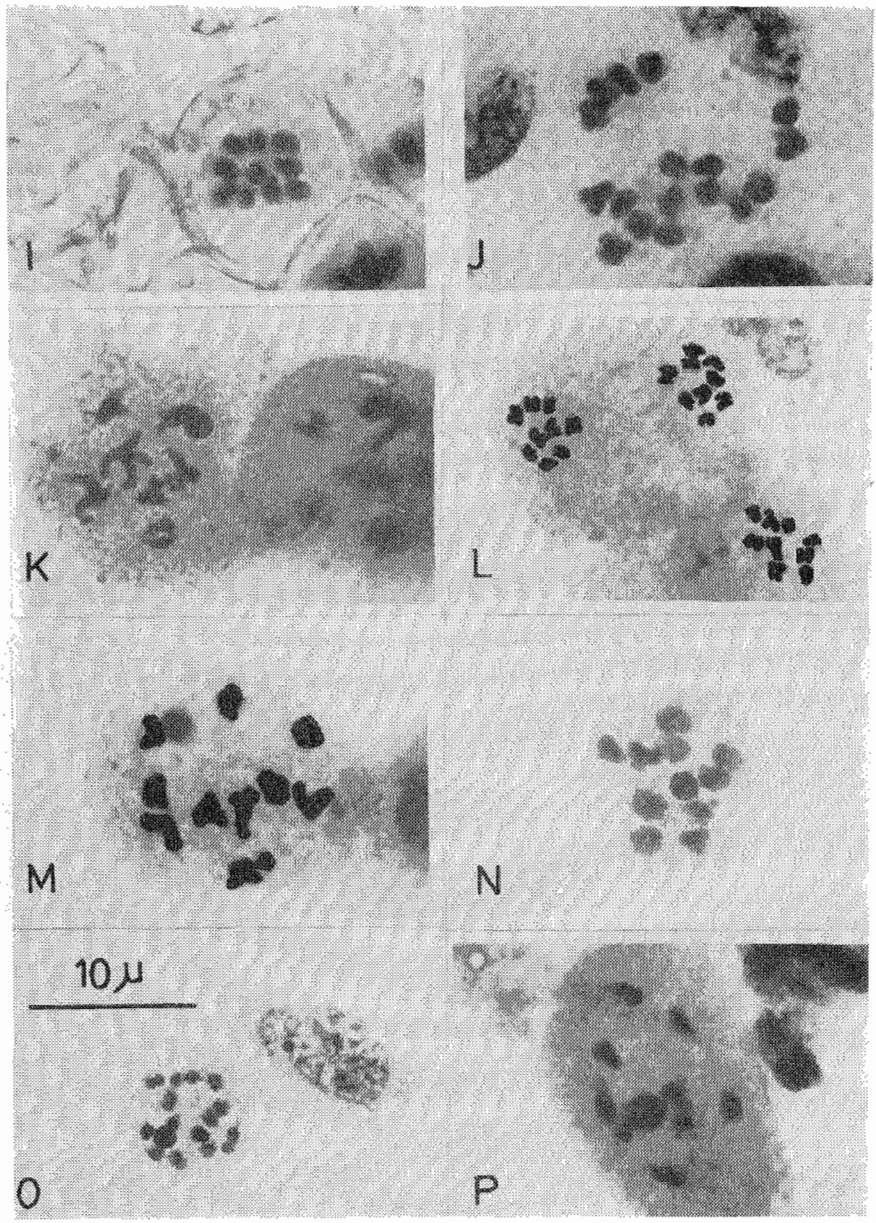

Fig. 1. (Cont'd). I. *Pegolettia senegalensis* (metaphase-I): n = 10, *J. Gaillardia pulchella* (metaphase-I): n = 17, K. *Pulicaria hookeri* (diakinesis): n = 7, L. *Launaea nudicaulis* (metaphase-II): n = 9, M. *Pluchea arguta* (diakinesis): n = 10, N. *Pluchea lanceolata* (diakinesis): n = 10, O. *Gnaphalium americanum* (diakinesis): n = 14, P. *Vernonia cinerea* (diakinesis): n = 9.

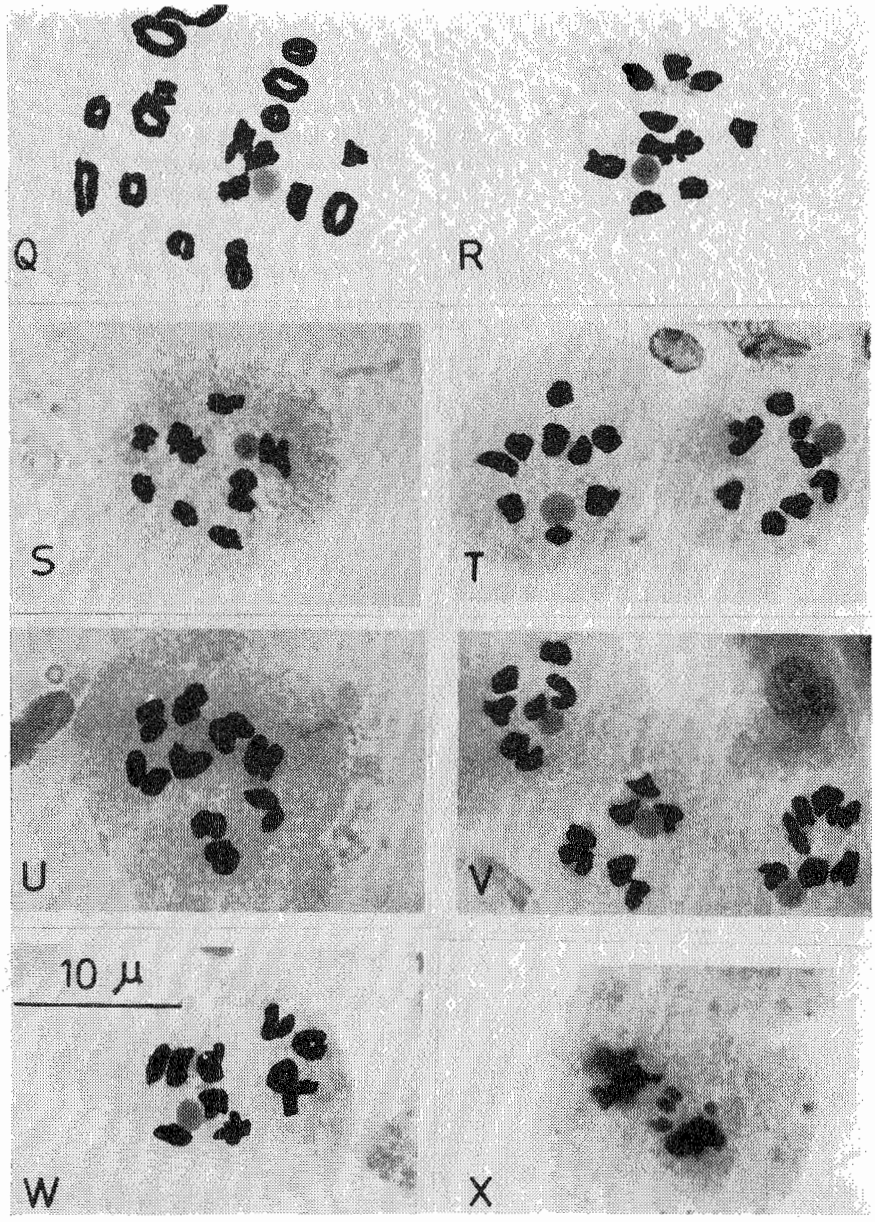

Fig. 1. (Cont'd). Q. *Tridax procumbens* (diakinesis): n = 18, R. *Blumea obliqua* (diakinesis): n = 10, S. *Dicoma tomentosa* (diakinesis): n = 11, T. *Lactuca remotiflora* (diakinesis): n = 9, U. *Iphiona grantioides* (diakinesis): n = 9, V. *Pulicaria angustifolia* (diakinesis): n = 7, W. *Pluchea lanceolata* (diakinesis with multivalent), X. *Vernonia cinerascens* (Anaphase-I with laggards).

des (Boiss.) A. Anderb. (Syn. *Inula grantioides* Boiss.) seem to be debatable as they do not agree with the earlier determinations. For *Pulicaria angustifolia* DC., Baquar & Askari (1970) reported n = 9, which is contrary to the present report of n = 7 (Table 1, Fig. 1, V). There are some other reports of n = 7 in the genus *Pulicaria*, such as *P. wightiana* (DC.) Clarke (Chopde in Fedorov, 1974), *P. undulata* (L.) C.A. Mey. [syn. *P. crispa* (Forssk.) Benth. & Hook.f. ex Oliv. & Hiern] (Khatoon & Ali, 1988), *P. boissieri* Hook.f. and *P. hookeri* Jafri (present report) and also *P. angustifolia* (Bhandari & Singhvi, 1977). Moreover, Merxmüller *et al.*, (1977) have mentioned 7 as one of the gametic numbers in this genus. Baquar & Askari (1970) have reported n = 10 for *Iphiona grantioides* (Boiss.) A. Anderb., whereas we observed n = 9 (Table 1, Fig. 1, U.), which agrees with the basic number x = 9 proposed by Darlington & Wylie (1955). The count for *Crepis sancta* subsp. *bifida* (Vis.) Thell. ex Babc. also is found contradictory to the previous reports (Table 1). However, our count agrees with the count for the other subsp. *nemausensis* (Gouan) Babc. reported by Natarajan (in Goldblatt, 1981).

Cooperrider & Galang (in Fedorov, 1974) reported 2n = 20 for *Pluchea indica* (L.) Less., whereas Sarkar *et al.*, (1982) reported n = 15, though our material shows n = 30 (Table 1). On the basis of x = 5 proposed by Darlington & Wylie (1955) it seems that tetraploid, hexaploid and 12-ploid are met with in nature.

In general, Compositae shows a great array of chromosome numbers, varying from as low as n = 2 in *Haplopappus gracilis* (Nutt.) Gray and *Brachycome lineariloba* (DC.) Druce to as high as n = 110-120 in *Melanthera aspera* (Solbrig, 1977). The gametic number of taxa so far studied from Pakistan ranges from n = 5 to n = 30. However, the most common base number is x = 9 found in 28.12% of species examined. According to Raven (1975) the basic number for Asteraceae is x = 9. According to Solbrig (1977) n = 9 is also the modal number for the family. Our studies also support these contentions. Of the 32 taxa sampled, 23 (i.e. 71.87%) were diploid and nine (i.e. 28.12%) were polyploid. (Table 1).

Regular bivalent formation was observed at meiosis in all taxa, and no suggestion of structural heterozygosity or irregularity at any stage was detected except in the few taxa, in which pollen mother cells showed a disturbed meiosis, with laggards [in *Vernonia cinerascens* Sch. Bip., (Fig. 1, X)] and multivalents [in *Chrysanthemum coronarium* L. (Fig. 1, H) and *Pluchea lanceolata* (DC.)Clarke (Fig. 1, W)].

Chromosomes of 36 species (including the previous works) of Compositae have so far been counted from Pakistan. The present contribution (i.e. meiotic counts for 32 taxa) has raised the percentage of cytologically known species of Compositae from Pakistan from 1.6% to 5.6%. There is thus a great need for further cytological studies particularly in the unexplored taxa.

References

Ali, S.I. 1978. The Flora of Pakistan: Some general and analytical remarks. *Notes Roy. Bot. Gard. Edinb.*, 36: 427-439.

Baquar, S.R. and S.H.A. Askari. 1970. Chromosome studies in some flowering plants of West Pakistan-II. *Genet. Iber.*, 22: 41-51.

Bhandari, M.M. and D.M. Singhvi. 1977. In: Löve, A. IOPB Chromosome number reports LV. *Taxon*, 26: 107-109.

Darlington, C.D. and A.P. Wylie. 1955. *Chromosome Atlas of Flowering Plants*. George Allen & Unwin Ltd. London. (pp. 519).

Fedorov, A.A. 1974. *Chromosome Numbers of Flowering Plants*. Otto Koeltz Science Publishers, W. Germany. (pp. 1-926).

Good, R. 1956. *Features of Evolution in Flowering Plants*. Longmans. (pp. 405).

Goldblatt, P. 1981. *Index to Plant Chromosome Numbers 1975-1978*. Missouri Botanical Garden, (pp. 553).

Goldblatt, P. 1985. *Index to Plant Chromosome Numbers 1982-1983*. Missouri Botanical Garden, (pp. 224).

Gupta, C. and B.S. Gill. 1980. In: Löve, A. IOPB chromosome number reports LXVII. *Taxon*, 29: 351-352.

Harvey, M.J. 1966. In: Löve, A. IOPB chromosome number reports VII. *Taxon*, 15: 155.

Khatoon, S. and S.I. Ali. 1982. Chromosome numbers of some plants of Pakistan. *Pak. J. Bot.*, 14: 117-129.

Khatoon, S. and S.I. Ali. 1988. Chromosome numbers in Compositae from Pakistan. *Candollea*, 43: 455-465.

Koul, A.K. and R.N. Gohil. 1973. Cytotaxonomical conspectus of the flora of Kashmir (1) Chromosome numbers of some common plants. *Phyton (Austria)*, 15: 57-66.

Kuzmanov, B.A. and S. Georgieva. 1976. In: Löve, A. IOPB chromosome number reports. LIII, *Taxon*, 25: 500.

Larsen, K. 1965. In: Löve, A. IOPB chromosome number reports IV. Taxon, 14: 92.

Mehra, P.N. and P. Remanandan. 1969. In: Löve, A. IOPB chromosome number reports XXII. Taxon, 18: 438.

Merxmüller, H., P. Leins and R. Roessler. 1977. Inuleae - Systematic review. In: V.H. Heywood, J.B. Harborne & B.L. Turner (Eds.) *The Biology and Chemistry of Compositae* vol. I. Academic Press, London, New York (pp. 619).

Moore, R.J. 1973. Index to plant chromosome numbers for 1967-71. *Regnum Vegetabile*, 90: 1-539.

Moore, R.J. 1974. Index to plant chromosome numbers for 1972. *Regnum Vegetabile*, 91: 1-108.

Nirmala, A. and R.N. Rao. 1981. In: Löve, A. IOPB chromosome number reports. LXX. *Taxon*, 30: 78.

Ornduff, R. 1967. Index to plant chromosome numbers for 1965. *Regnum Vegetabile*, 50: 1-128.

Parker, H.M. 1972. In: Löve, A. IOPB chromosome number reports XXXV. Taxon, 21: 161-166.

Powell, A.M. 1965. Taxonomy of *Tridax* (Compositae). *Brittonia*, 17: 47-96.

Raven, P.H. 1975. The bases of Angiosperm phylogeny: Cytology. *Ann. Missouri Bot. Gard.*, 62: 724-764.

Sampath Kumar, R. and K.P. Ayyangar. 1981. In: Löve, A. IOPB chromosome number reports LXXII. Taxon, 30: 695.

Sarkar, A.K., N. Datta, U. Chatterjee and D. Hazra. 1982. In: Löve, A. IOPB chromosome number reports, LXXVI. *Taxon*, 31: 576-579.

Shetty, B.V. 1967. In: Löve, A. IOPB chromosome number reports XIV. *Taxon*, 16: 571.

Smith, E.B. 1969. In: Löve, A. IOPB Chromosome number reports XXIV. *Taxon*, 18: 684.

Solbrig, O.T. 1977. Chromosomal cytology and evolution in the family Compositae. In: V.H. Heywood, J.B. Harborne & B.L. Turner (Eds.) *The Biology and Chemistry of Compsitae*. Vol. I. Academic Press. London, New York. (pp. 619).

Stebbins, G.L. 1974. *Flowering Plants: Evolution above the Species Level*. Edward Arnold, New York (pp. 399).

Strid, A. and R. Franzen. 1981. In: Löve, A. IOPB chromosome number reports LXXIII. *Taxon*, 30: 842.

Subramanyam, K. and N.P. Kamble. 1966. In: Löve, A. IOPB chromosome number reports VII. *Taxon*, 15: 155.

Subramanyam, K. and N.P. Kamble. 1967. In: Löve, A. IOPB chromosome number reports XII. *Taxon*, 16: 349-350.

Torres, A.M. 1963. Taxonomy of *Zinnia*. *Brittonia*, 15: 1-25.

Torres, A.M. and A.H. Liogier. 1970. Chromosome numbers of the Dominican Compositae. *Brittonia*, 22: 240-245.

Turner, B.L. 1962. Taxonomy of *Hymenothrix* (Helenieae: Compositae). *Brittonia*, 15: 17-47.

Urbatsch, L.E. 1974. In: Löve, A. IOPB chromosome number reports XLIV. *Taxon*, 23: 380.

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