Pak. J. Bot., 20(2): 191–199, 1988.

CYTOLOGICAL INVESTIGATIONS IN *ABUTILON* MILL., FROM PAKISTAN

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Abstract

Chromosome numbers are reported for 12 species of *Abutilon* Mill., from Pakistan of which four species are cytologically investigated for the first time viz., *A. Alii* S. Abedin (n = 21), *A. figarianum* Webb (n = 21), *A. karachianum* S.A. Hus. & S.R. Baq. (n = 21), and *A. pakistanicum* Jafri & Ali (n = 21, 2n = 42).

Introduction

Fifteen species of *Abutilon* occur in Pakistan (Abedin, 1979) out of which 11 are found in Karachi and adjoining areas. Ample opportunities therefore, exist for hybridization between these species. It is also well known that intra-specific chromsome variants or cytotypes occur in nature either in different localities or in the same locality (Davis & Heywood, 1963; Stebbins, 1971; Khatoon & Ali, 1982). Investigations were therefore undertaken to identify if there are natural hybrids, chromosomal variants or polyploids within these species. Previous records show that chromosome numbers were counted in only 2 species from Pakistan, viz., *A. fruiticosum* Guill. and Perr. (Baquar & Afaq-Husain, 1967) and *A. sepalum* S.A. Hus. & S.R. Baq. (Baquar *et al.*, 1966; misidentified as *A. graveolens* (Roxb. & Hornem.) W. & A. ex W.). In the present work, chromosome numbers are reported for 12 species. Investigations about the aberrations in chromosome behaviour and pollen formation are in progress and will be published separately.

Materials and Methods

Meiotic counts were made from pollen mother cell squash preparations. Buds were fixed in Carnoy's solution (Alcohol, Chloroform, Acetic acid, 6:3:1) for 24h and preserved in 70% alcohol.

The buds of *A. grandifolium* were collected from the plants grown in PCSIR Laboratories, Karachi which were raised from seeds obtained from the Peshawar University. For other species, collections were made from wild plants. Anthers were squashed in acetocarmine. Mitotic study was made from temporary squashes of root tips. The wild plants were dug out alongwith root system, soil was removed by washing in water and the plants transferred to wide mouth bottles keeping the roots submerged in water, which was changed daily. After one week some new roots emerged, their tips were removed and treated with paradichlorobenzene for 90 minutes before fixing in 1:3 acetic alcohol for 24

Table 1.

S. No.	Species	Date of collection	Locality and collection No.	Present counts n	Present counts 2n	Previous counts with authority n	Previous counts with authority 2n			Ploidy Level
1.	*A. Alii* S. Abedin	29.10.85	Karachi Univ. Campus A-108	21	—	—	—			Hexaploid
2.	*A. bidentatum* A. Rich	15.08.84	Mangopir A-9	21	42	21	—	Bir & Sidhu, 1978, 1979, Sidhu, 1979		Hexaploid
	var. *bidentatum*			—	—	—	42	Bir & Sidhu, 1980	in Goldblatt, 1984	"
3.	*A. figarianum* Webb,	30.09.85	Karachi Univ. Campus A-34	21	—	—	—	—	—	"
		16.10.85	Malir A-57	21	—	—	—	—	—	"
4.	*A. fruticosum* Guill. & Perr.	30.09.85	Karachi Univ. Campus A-36	21	42	21	—	Baquar and Husain, 1967	—	"
	var. *fruticosum*	16.10.85	Malir A-70	21	—	—	—	—	—	"
5.	*A. grandifolium* (Wild.) Sweet	11.11.84	PCSIR Campus Experimental Plot Karachi A-13	21	—	—	—	—	—	"
	= *A. molle* (Ortega) Sweet			—	—	—	42	Skovsted, 1935		"
	= *A. tortuosum* Guill. & Perr.			—	—	—	42	Skovsted, 1941	in Fedorov, 1974	"
	= *A. mollissimum*			—	—	—	14	Ford, 1938		Diploid
6.	*A. hirtum* (Lamk.) Sweet	06.10.85	PCSIR Campus	21	42	—	—	—	—	Hexaploid
	var. *hirtum*		Karachi A-38	—	—	—	42	Krishnappa & Munirajappa (1980)	in Goldblatt, 1984	"
	= *A. graveolens* (Roxb. ex Hornem.) W. & A. ex W.			—	—	—	14	Ford (1938) in Fedorov, 1974		Diploid
7.	*A. indicum* (Linn.) Sweet	27.02.85	PCSIR, Campus Karachi A-20	21	42	—	—	—		Hexaploid
		03.11.85	Memon Goth,	21	42	—	—	—		"

			Karachi A-112	—	—	21	42	Hazra & Sharma (1971) in Moore 1974		"
				—	—	21	—	Bir & Sidhu (1979), Sidhu 1979	in Goldblatt, 1984	"
				—	—	—	42	Bir & Sidhu 1980	" " "	"
				—	—	21	—	Baquar, S.R. 1968		"
				—	—	—	72	Krishnappa & Munirajappa (1982)	in Goldblatt, 1985	Octaploid(?)
				—	—	—	36	Roy, R.P. & R.P. Sinha, 1961		Tetraploid(?)
				—	—	—	42	Skovsted, 1935, 1941, Medvedeva 1938	in Fedorov, 1974	Hexaploid
								Subramanyam K. & N.P. Kamble, 1966	" " "	
8.	*A. karachianum* S.A. Hus. & S.R. Baq.	23.10.85	Karachi Univ. Campus A-93	21	—	—	—	—		"
9.	*A. muticum* (Del. ex DC.) Sweet	06.07.84	PCSIR, Campus, Karachi A-7	21	—	—	—	—		"
		16.10.85	Jam Goth,	21	—	—	—	—		"
	= *A. asiaticum* Guill.			—	—	—	28	Skovsted, 1941		Tetraploid
				—	—	—	14	Ford, 1938	in Fedorov, 1974	Diploid
				—	—	—	42	Skovsted, 1941		Hexaploid
10.	*A. pakistanicum* Jafri & Ali	16.10.85	Jam Goth, Karachi A-72	21	42	—	—	—		"
11.	*A. pannosum* (Forst. f.) Schlecht	16.10.85	Malir, Karachi A-76	21	42	—	—	—		Hexaploid
		06.10.85	PCSIR Campus, Karachi A-44	21	42	—	—	—		"
	= *A. galaucum* (Cov.) Sweet			—	—	21	—	Sanjapa (1979) in Goldblatt, 1984		"
				—	—	—	28	Skovsted (1935, 1941) in Fedorov, 1974		Tetraploid
12.	*A. sepalum* S.A. Hus. & S.R. Baq.	06.10.85	PCSIR Csmpus, Karachi A-49	18	—	—	—	—		Tetraploid(?)
				21	—	—	—	—		Hexaploid
	= *A. graveolens* sensu Baquar et al. 1966)			—	—	18	—	Baquar S.R., S.A. Husain & S. Akhter, 1966		Tetraploid(?)

hours. The squashing was done using Feulgen squash technique. Taxonomic works of Afaq-Husain and Baquar (1974) and S. Abedin (1979) were consulted for identification and nomenclature. Camera lucida drawings were made at 2000 magnification approx. Voucher specimens are deposited in the herbaria of PCSIR Laboratories, Karachi and Karachi University (KUH).

Results

The results are summarized in Table 1. Ploidy level has been calculated according to the basic numbers given by Darlington & Wylie (1955).

Discussion

The genus *Abutilon* Mill., comprises about 150 species distributed in the tropics and subtropics of both the hemispheres (Abedin, 1979); 15 species have been reported from Pakistan (Abedin, 1979) out of which 12 species have been investigated in the present work. All are found to bear n = 21 except *A. sepalum* which also bears n = 18 besides n = 21; somatic counts have also been made in 6 of the species (Table 1); 5 of the species namely *A. Alii* S. Abedin, *A. krachianum* S.A. Hus. and S.R. Baq., *A. pakistanicum* Jafri and Ali, *A. Sepalum* S.A. Hus. and S.R. Baq. and *A. figarianum* Webb do not appear to have been studied before and the present counts are new reports. The first 4 species are endemic to Pakistan and are confined to Karachi and adjoining areas where as *A. figarianum* also extends to lower parts of Sind and Baluchistan. Counts for *A. bidentatum* A. Rich., *A. grandifolium* (Willd.) Sweet, *A. hirtum* (Lamk.) Sweet, *A. indicum* (Linn.) Sweet, *A. muticum* (Del. ex DC.) Sweet and *A. pannosum* (Forst.f.) Schlecht, were not reported previously from Pakistan and the prsent counts are in conformity with the previous reports from outside Pakistan (Table 1). A. fruticosum Guill. and Perr. was studied previously from the same study area (Baquar & Afaq-Husain, 1967) and present gametic number confirms the former. *A. grandifolium* is reported only from Northern areas of Pakistan while *A. pannosum* and *A. hirtum* are found in Karachi and adjoining areas (the latter also in some of the lower parts of Baluchistan); the remaining 4 species occur throughout Pakistan. Thus 11 species of *Abutilon* are found in Karachi, geographycally comprising a very small area with more or less same habitat.

Darlington and Wylie (1955) have mentioned 7 and 8 as basic numbers for the genus. A survey of the literature reveals that in *Abutilon* chromosome counts have been investigated in 60 species only (after including the present work, the number reaches to 65). Of these, only 38 species are found to be consistently at diploid level with n = 7 or n = 8, all other species exhibit various levels of polyploidy, though some of them also have diploid individuals besides polyploids (Table 2).

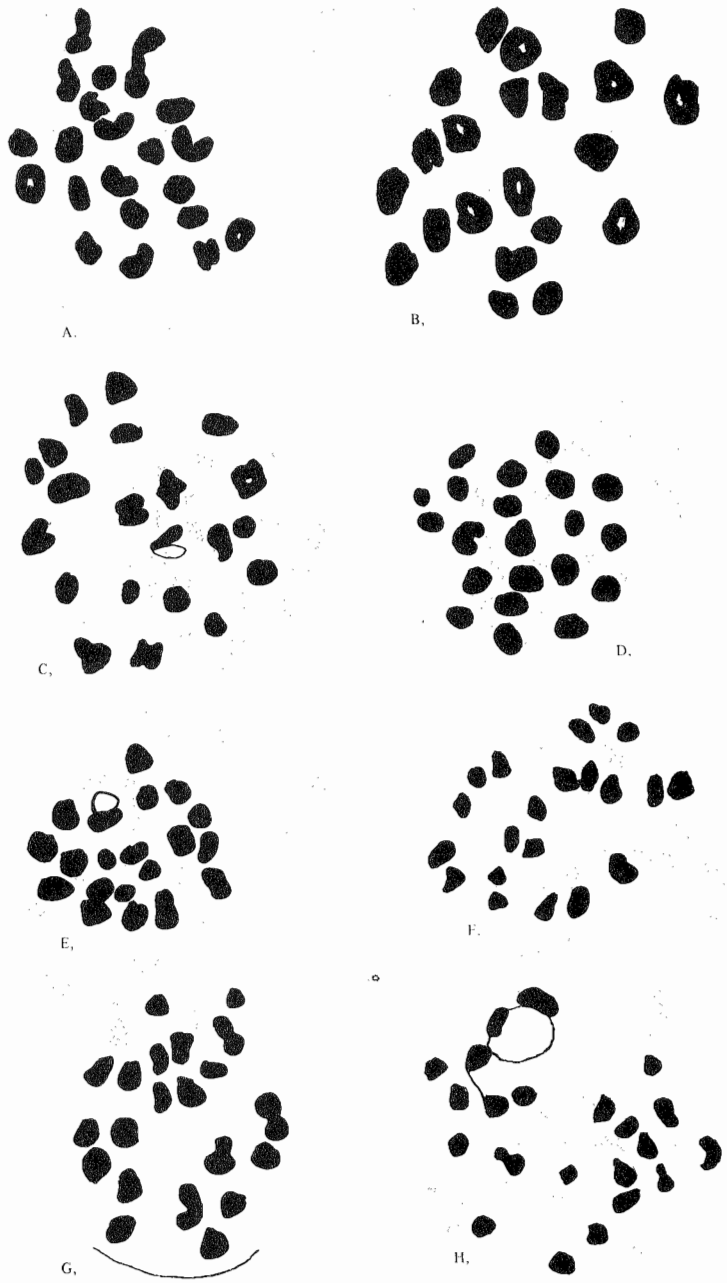

Fig. 1. A-H Microsporogenesis. *Abutilon alii* metaphase-I, n = 21. B. *A. bidentatum* metaphse-I, n = 21. C. *A. figarianum* metaphase-I, n = 21. D. *A. fruticosum* metaphase-I, n = 21. E. *A. grandifolium* metaphase-I, n = 21. F. *A. hirtum* metaphase-I, n = 21. G. *A. indicum* metaphas-I, n = 21. H. *A. krachianum* diakinesis, n = 21.

Table 2. Pattern of chromosome numbers in the species of *Abutilon*.

Basic Number	x = 7				x = 8				x = 9			
Ploidy level	2x	4x	6x	Total	2x	4x	6x	Total	4x	6x	8x	Total
Number of species with chromosomal constancy	21	3	13	37	17	—	—	17	—	—	—	—
No. of species with chromosomal variation	4	3	11	11	2	1	—	3	2	—	1	2
Total = 65	25	6	24	48	19	1	—	20	2	—	1	2

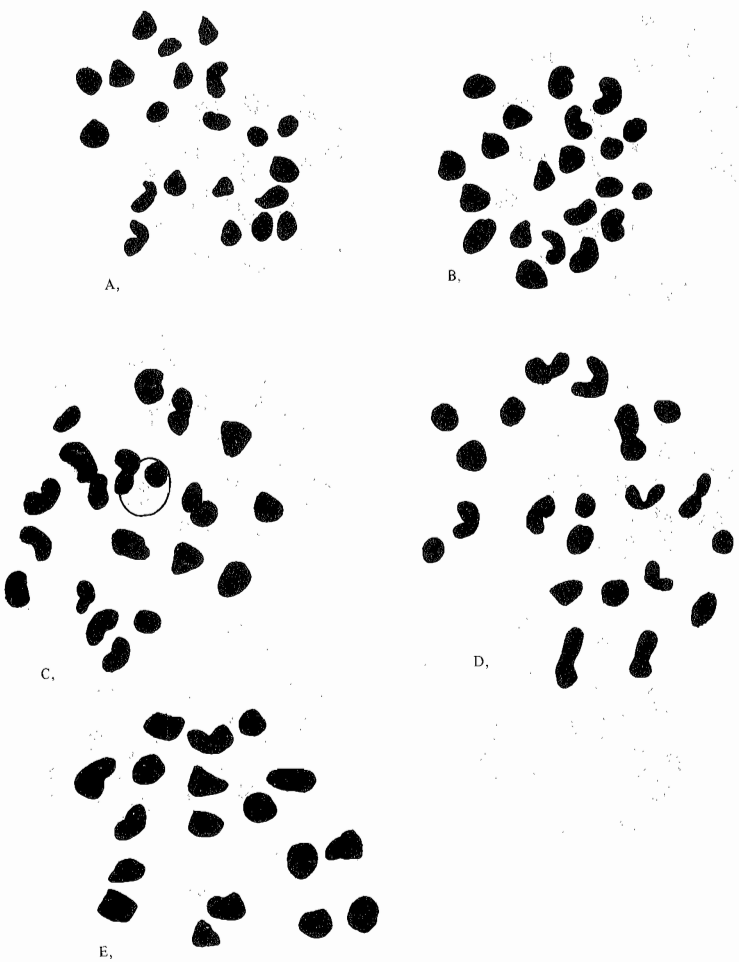

Fig. 2. A-E Microsporgenesis. *A. muticum* metaphase-I, n = 21. B. *A. pakistanicum* metaphase-I, n = 21. C. *A. pannosum* diakinesis n = 21. D. *A. sepalum* metaphaes-I, n = 21. E. *A. sepalum* metaphase-I, n = 18.

A review of literature of chromosome counts shows that the genus exhibits 7 different gametic numbers distributed in its 65 species investigated so far (including the present work) as follows:

Gametic number(n)	7	8	14	16	18	21	36
No.of species	25	19	6	1	2	24	1

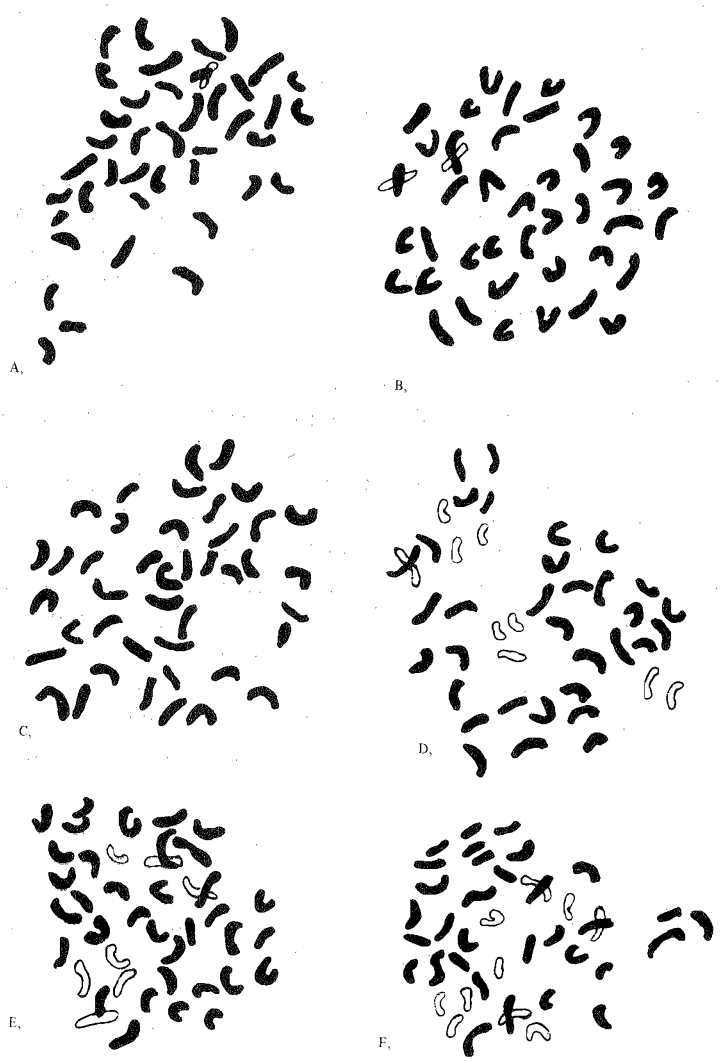

Fig. 3. A-F Mitosis in root tip cells. A. *A. bidentatum* 2n = 42, B. a. fruticosum 2n = 42, C. A. hirtum 2n = 42, D. *A. indicum* 2n = 42, E. *A. pakistanicum* 2n = 42, F. A. pannosum 2n = 42.

All except n = 18 and 36 agree with either of the 2 basic numbers (7 & 8) mentioned above. Gametic number 18 is reported to occur in *A. sepalum* (iuncluding present study) and n = 18 and 36 in *A. indicum* (Table 1). These counts suggest the existence of a third basic number within the genus. This number could most probably be 9. Although there is no report of n = 9 in the genus *Abutilon*, this number exists in some other members of the family, such as *Sida acuta* Burm. (Roy and Sinha in Fedorov 1974). *Modiola caroliniana* (L) G. Don (Krishnappa and Munirajappa in Goldblatt, 1984) and *M. multifida* Moench (Skovsted in Fedorov, 1974). Therefore x = 9 could be regarded as the third basic number in *Abutilon*. Alternately, x = 18 could be the basic number derived from n = 16 through addition of two chromosomes, but it is less probable because the tendency of aneupolidal changes is usually towards reduction rather than addition.

Cytotypes are reported to occur in *A. grandipolium*, *A. hirtum*, *A. indicum*, *A. muticum* and *A. pannosum* (Table 1). However, we have not recorded any cytotype in our study and all species studied by us are hexaploids with n = 21. All reports of cytotypes are from areas other than Pakistan, therefore either the cytotypes of these species do not occur here or they are still undetected.

According to the existing informations (including the present work) x = 7 is represented in 48 species, x = 8 in 20 and x = 18 in 2 only (Table 2), which show that the chromosome complements arising from x = 7 are most successful; moreover polyploidy (euploidy) is seen in x = 7 group, in x = 8 group all stand at diploid level except *A. polyandrum* which is reported to be tetraploid (Sanjappa in Goldblatt, 1984). Thus x = 7 complement is more plastic to produce successful polyploids where as in x = 8 it seems either polyploidy does not occur (which looks unnatural) or the polyploids are not successful (which is more convincing). In x = 7 group diploidy is represented in 25 species, hexaploidy in 24 but tetraploidy in 6 only which show that diploids and hexaploids are best fitted in the present environment but tetraploids are least successful. In nature all levels of ploidy might have equal chance of formation but the presence of only hexaploids in the local material show that 6x ploidy level seems to be the best fitted to survive in the region of study.

Acknowledgement

We should like to thank Miss Sorayya Khatoon of the Botany Department, University of Karachi for suggestions in the preparation of the manuscript.

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(Received for publication 29 September 1987)