

CHROMOSOME COUNTS IN ARUNDINOIDEAE, CHLORIDOIDEAE, AND POOIDEAE (POACEAE) FROM PAKISTAN¹

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ABSTRACT

A total of 85 chromosome counts representing 45 species belonging to 29 genera in three subfamilies of Poaceae, viz., Arundinoideae, Chloridoideae, and Pooideae from Pakistan, are reported. The chromosome counts for six species, viz.: *Leptothrium senegalense* ($n = 10$); *Piptatherum gracile* ($n = 12$); *Poa sinaica* ($n = 7$); *Sporobolus arabicus* ($n = 18$); *Sporobolus nervosus* ($n = 18$); and *Stipagrostis plumosa* ($n = 22$), are new determinations. Chromosome counts for an additional 34 species are new for the flora of Pakistan. New cytotypes were detected in *Aeluropus lagopoides* ($n = 20$), *Avena barbata* ($n = 21$), *Diplachne fusca* ($n = 20$), and *Ochthochloa compressa* ($n = 10$).

The Poaceae are one of the largest families of flowering plants, comprising 620 genera and 10,000 species. Its members are widely dispersed in all regions of the world, occupying almost every type of habitat, often dominating the vegetation in savannas, prairies and steppes (Willis, 1973). In Pakistan, the family is represented by 158 genera and 492 species (Cope, 1982). Up to now chromosome numbers are known for 39 species (i.e., 7.92%) from Pakistan (Baquar & Anjum, 1969; Baquar & Saeed, 1969; Faruqi et al., 1979). The present contribution records the chromosome numbers of 45 species belonging to 29 genera in three subfamilies.

MATERIALS AND METHODS

For meiotic counts, young unopened inflorescences were fixed in Carnoy's solution (3 parts absolute alcohol:1 part glacial acetic acid) for at least 24 hr., then stored at -4°C . Slides were prepared by ordinary squash technique using 1.0% acetocarmine or 1.8% aceto-orcein.

For mitotic counts, young and healthy root tips from germinating seeds were pretreated either with 0.002 M 8-hydroxyquinoline (for 4–6 hr.) or with cold water (at $1-2^{\circ}\text{C}$ for 24 hr.), fixed in Carnoy's solution for 1 hr., hydrolysed in 1 N HCl for 6–12 min. at 60°C , and squashed in 1.8% aceto-orcein.

In most of the cases photomicrographs were taken from temporary preparations. Desired slides were made permanent in euparal or Canada balsam. Voucher specimens are deposited in Karachi University Herbarium (KUH).

OBSERVATIONS AND RESULTS

Information regarding the counts made, along with the basic number for the genus, are presented in Table 1. Basic numbers of genera were calculated from the lowest known gametic number in the genus. Chromosome numbers for six species are new to science and counts for thirty-four species are new to the flora of Pakistan, as they were not found to be reported in IPCN (Fedorov, 1974; Goldblatt, 1981, 1984, 1985, 1988; Moore, 1973, 1974).

DISCUSSION

In the present study most of the chromosome counts that are in conformity with earlier reports have not been commented upon.

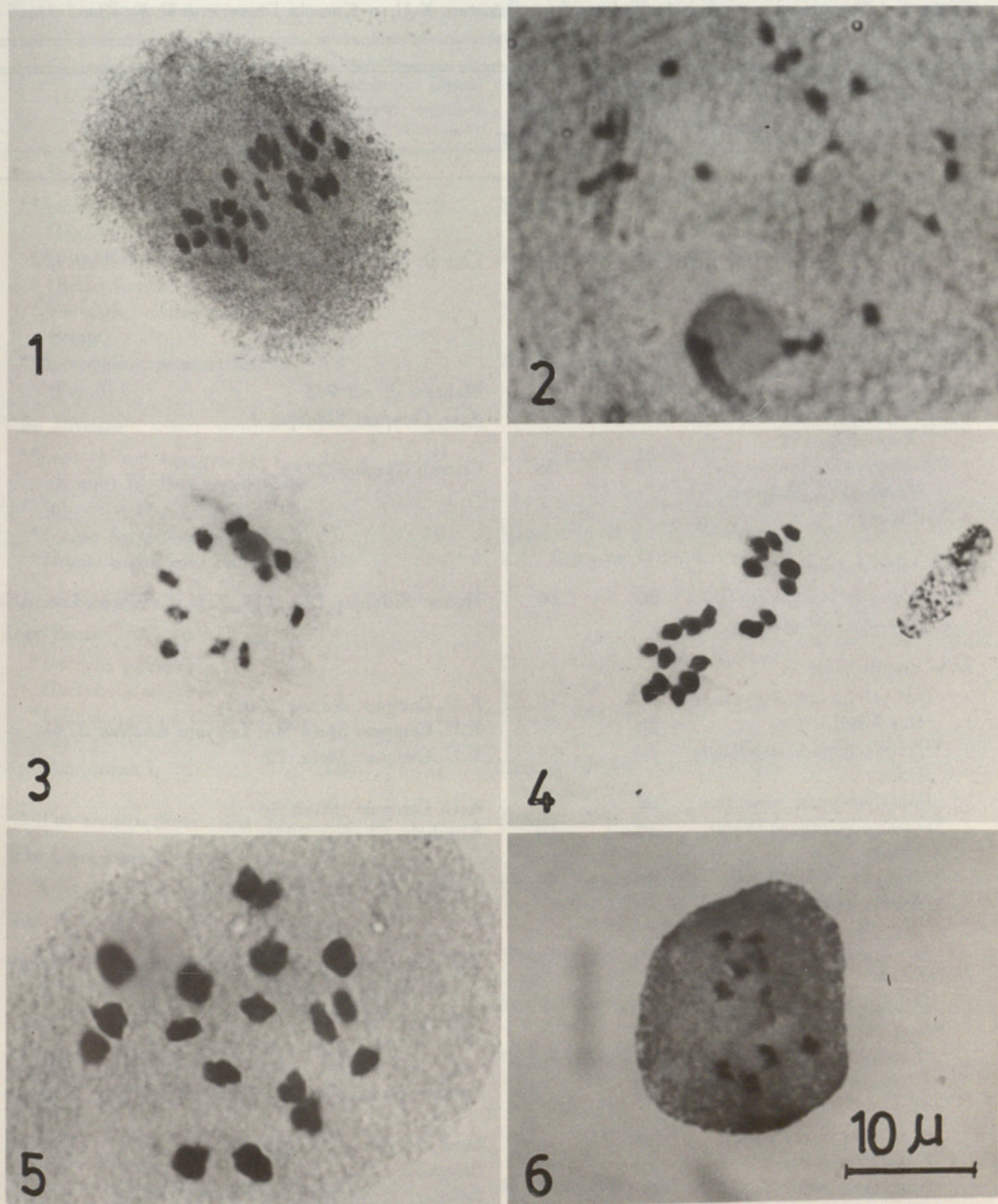
In the tribe Aristideae, counts for *Stipagrostis plumosa* ($n = 22$, Fig. 1) are reported here for the first time.

In the tribe Aeluropodeae, *Aeluropus lagopoides* ($n = 20$, Fig. 20) is found to be tetraploid on the basis of $x = 10$. Diploid and pentaploid

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FIGURES 1-6. Pollen mother cell meiosis in members of Poaceae.—1. *Stipagrostis plumosa* (Ghafoor 2776), metaphase-I $n = 22$.—2. *Diplachne fusca* (Siddiqui 101), diakinesis $n = 20$.—3. *Ochthochloa compressa* (T. Ali 752), diakinesis $n = 10$.—4. *Sporobolus arabicus* (T. Ali 842), metaphase-I $n = 18$.—5. *Sporobolus nervosus* (Siddiqui 131), diakinesis $n = 18$.—6. *Leptothrium senegalens* (Ahsan 68), diakinesis $n = 10$.

individuals have previously been reported for this species (Sindhe, 1980; Baquar & Saeed, 1969).

In tribe Eragrostideae, chromosome numbers for ten species (belonging to 6 genera) were determined. In *Dactyloctenium aegyptium*, we found $n = 20$ in two and $n = 23$ in one accession. On the basis of proposed basic numbers ($x = 10, 12$)

it can be suggested that individuals with $n = 20$ were tetraploid, whereas $n = 23$ represents a hypopaneuploid based on $x = 12$. Our observations ($n = 10, 20$), in two different specimens of *D. scindicum*, indicate the presence of cytotypes in this species.

Larsen (1963) had reported $2n = 20$ ($2x$) for

TABLE 1. Chromosome numbers in Poaceae from Pakistan. K.U. = Karachi University. D. G. Khan = town of Dera Ghazi Khan.

Taxon	Chromosome number <i>n</i>	Basic number <i>x</i>	Voucher
Subfamily Arundinoideae			
Tribe Arundineae			
* <i>Schismus barbatus</i> (L.) Thell. (Fig. 13)	6	6	Chitral: <i>Ghafoor</i> 2693, 3071; Makran: <i>T. Ali</i> 834
Subfamily Chloridoideae			
Tribe Aristideae			
* <i>Aristida adscensionis</i> L.	11	11	Makran: <i>T. Ali</i> 945
* <i>Aristida funiculata</i> Trin. & Rupr. (Fig. 19)	11		K.U. Campus: <i>Siddiqui</i> 4
** <i>Stipagrostis plumosa</i> (L.) Munro ex T. Anderson (Fig. 1)	22	22	Chitral: <i>Ghafoor</i> 2776
Tribe Aeluropodeae			
<i>Aeluropus lagopoides</i> (L.) Trin. ex Thwaites (Fig. 20)	20	10	Thatta: <i>Siddiqui</i> 150, 119; K.U. Campus: <i>Moin.</i> 71
Tribe Eragrostideae			
<i>Dactyloctenium aegyptium</i> (L.) Willd.	23 20	10, 12	K.U. Campus: <i>Razaq</i> 126 K.U. Campus: <i>Moin.</i> 46; Layyah: <i>Ghafoor</i> 3744
* <i>Dactyloctenium scindicum</i> Boiss.	10		K.U. Campus: <i>Moin.</i> 72
<i>Dactyloctenium scindicum</i>	20		K.U. Campus: <i>Ahsan</i> 56
* <i>Dinebra retroflexa</i> (Vahl) Panzer	10	10	Khushab: <i>Ghafoor</i> 3836
* <i>Diplachne fusca</i> (L.) P. Beauv. ex Roem & Schult. (Fig. 2)	20	10	Thatta: <i>Siddiqui</i> 101
<i>Eleusine indica</i> (L.) Gaertn.	9	9	K.U. Campus: <i>Ahsan</i> 6; Swat: <i>Ghafoor</i> 3977; Islama- bad: <i>Ghafoor</i> 3469a
<i>Eleusine indica</i>	18		Makran: <i>Omer</i> 2112
* <i>Eragrostis cilianensis</i> (All.) Lutati ex F. T. Hubbard	10	10	K.U. Campus: <i>Moin.</i> 42
* <i>Eragrostis japonica</i> (Thunb.) Trin.	10		Lahore: <i>Ghafoor</i> 4358
* <i>Eragrostis minor</i> Host	10		Hasilpur: <i>Ghafoor</i> 3583
<i>Eragrostis minor</i>	20		Sargodha: <i>T. Ali</i> 1719
<i>Eragrostis pilosa</i> (L.) P. Beauv.	20		Sakesar: <i>T. Ali</i> 1605
* <i>Ochthochloa compressa</i> (Forssk.) Hilu (Fig. 3)	10	10	Makran: <i>T. Ali</i> 752
<i>Ochthochloa compressa</i>	20		Makran: <i>Omer</i> 2166, <i>T. Ali</i> 710; Safari Park, Karachi: <i>Ahsan</i> 38; K.U. Campus: <i>Razaq</i> 144; D. G. Khan: <i>Ghafoor</i> 3608
Tribe Chlorideae			
<i>Chloris barbata</i> Sw.	20	10	K.U. Campus: <i>Siddiqui</i> 11; Sajawal: <i>Ahsan</i> 26
* <i>Cynodon dactylon</i> (L.) Pers. (Fig. 14)	9	9	K.U. Campus: <i>Siddiqui</i> 31, 76, 90, <i>Moin.</i> 12; Dir: <i>Ghafoor</i> 2491
* <i>Tetrapogon tenellus</i> (Koen. ex Roxb.) Chiov. (Fig. 21)	10	10	K.U. Campus: <i>Moin.</i> 53
* <i>Tetrapogon villosus</i> Desf.	10		D. G. Khan: <i>Ghafoor</i> 3699; Makran: <i>T. Ali</i> 969

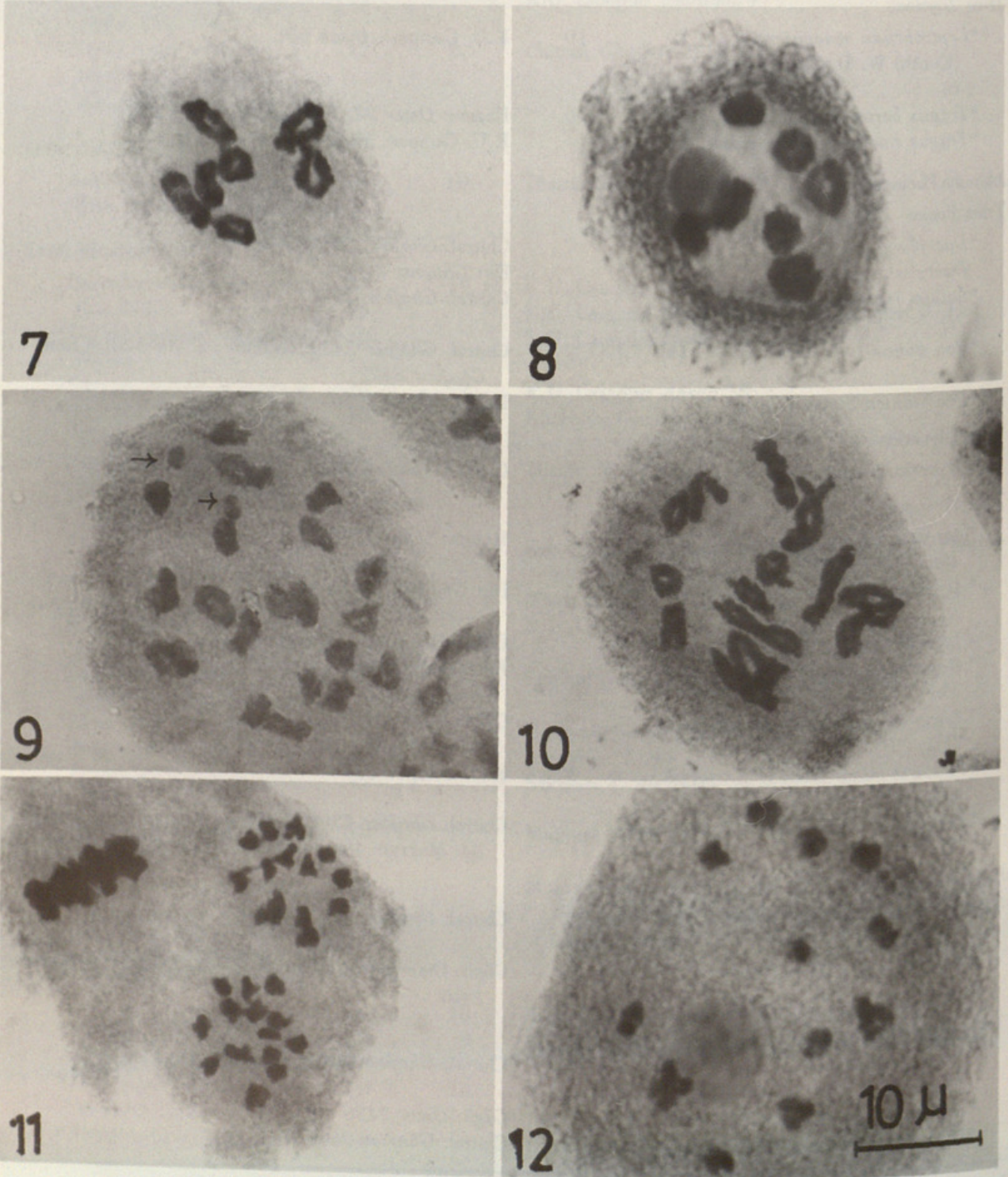
TABLE 1. Continued.

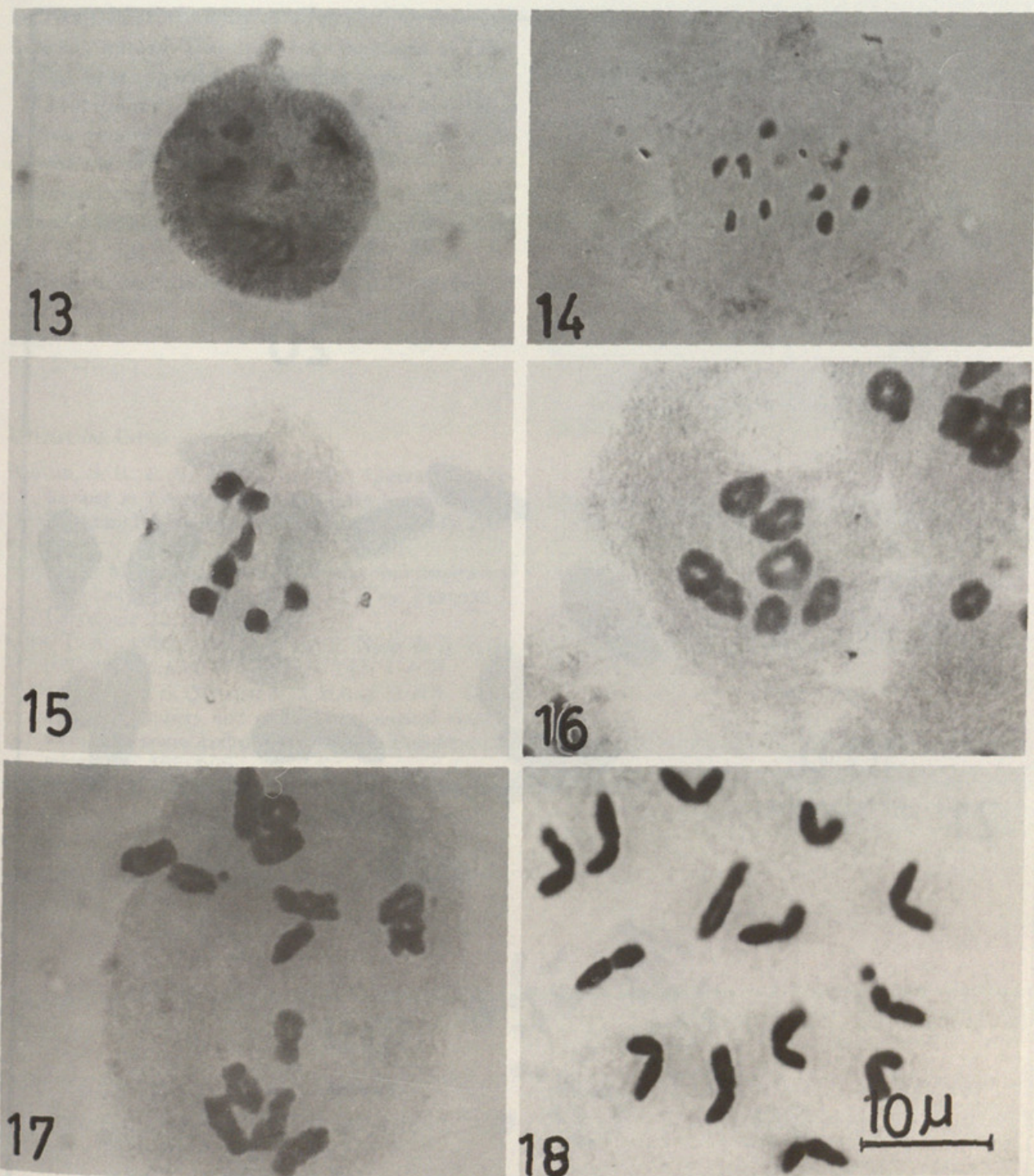
Taxon	Chromosome number <i>n</i>	Basic number <i>x</i>	Voucher
Tribe Sporoboleae			
** <i>Sporobolus arabicus</i> Boiss. (Fig. 4)	18	9	Makran: T. Ali 842, 846; Cholistan: Ghafoor 3550
* <i>Sporobolus coromandelianus</i> (Retz.) Kunth	18		K.U. Campus: Moin. 56
* <i>Sporobolus diander</i> (Retz.) P. Beauv.	18		Pail: Ghafoor 3776
** <i>Sporobolus nervosus</i> Hochst. (Fig. 5)	18		Thatta: Siddiqui 131; Darsanocho: Siddiqui 80
Tribe Zoysieae			
** <i>Leptothrium senegalense</i> (Kunth) W. D. Clayton (Fig. 6)	10	10	K.U. Campus: Ahsan 68
* <i>Tragus berteronianus</i> Schult.	10	10	Hazara: Omer 2221; Mianwali; T. Ali 1856
* <i>Tragus roxburghii</i> Panigrahi	10		K.U. Campus: Moin. 55
Subfamily Pooideae			
Tribe Poeae			
* <i>Dactylis glomerata</i> L.	7	7	Chitral: Ghafoor 2450, 3286
<i>Dactylis glomerata</i>	14		Dir: Ghafoor 2421
* <i>Lolium rigidum</i> Gaudin (Fig. 7)	7	7	Chitral: Ghafoor 3274
* <i>Poa annua</i> L.	14	7	Chitral: Ghafoor 2430; Kashmir: T. Ali 573; Kalam: Ghafoor 3422
** <i>Poa sinaica</i> Steud. (Fig. 8)	7		Hazara: Omer 2720
Tribe Glycerieae			
* <i>Glyceria plicata</i> (Fries) Fries	20	5	Chitral: Ghafoor 2850
Tribe Aveneae			
* <i>Agrostis munroana</i> Aitch. & Hemsl. (Fig. 22)	21	7	Hazara: Omer 2778
* <i>Agrostis viridis</i> Gouan (Fig. 9)	21+2B		Dir: Ghafoor 2337
<i>Agrostis viridis</i>	14		Chitral: Ghafoor 2698, 2513, 3325, 2608
* <i>Alopecurus arundinaceus</i> Poir.	14	7	Hazara: Omer 2722
* <i>Avena barbata</i> Pott ex Link (Fig. 23)	21	7	Gilgit: Omer 2559
* <i>Phalaris minor</i> Retz. (Fig. 10)	14	7	K.U. Campus: Jahan 19
* <i>Polypogon monspeliensis</i> (L.) Desf. (Fig. 11)	14	7	Chitral: Ghafoor 2598, 3249; K.U. Campus: Siddiqui 34; Makran: Omer 2143
Tribe Stipeae			
** <i>Piptatherum gracile</i> Mez (Fig. 12)	12	12	Chitral: Ghafoor 3093
* <i>Piptatherum munroi</i> (Stapf) Mez	12		Gilgit: Omer 2464; Swat: Ghafoor 3412; Dir: Ghafoor 2407
Tribe Bromeae			
* <i>Bromus danthoniae</i> Trin. (Fig. 15)	7	7	Chitral: Ghafoor 2916
* <i>Bromus pectinatus</i> Thunb.	7		Gilgit: Omer 2426
* <i>Bromus tectorum</i> L. (Fig. 16)	7		Chitral: Ghafoor 2606

TABLE 1. Continued.

Taxon	Chromo- some number <i>n</i>	Basic number <i>x</i>	Voucher
Tribe Triticeae			
* <i>Elymus dahuricus</i> Turcz. ex Griseb.	21	7	Gilgit: Omer 2570
* <i>Elymus semicostatus</i> (Nees ex Steud.) Melderis (Fig. 17)	14		Chitral: Ghafoor 2707, 2975
* <i>Hordeum vulgare</i> L. (Fig. 18)	2 <i>n</i> = 14	7	K.U. Campus: Moin. 31 (seed obtained from NARC, Is- lamabad)

* Count new to flora of Pakistan.
** Count reported for the first time.





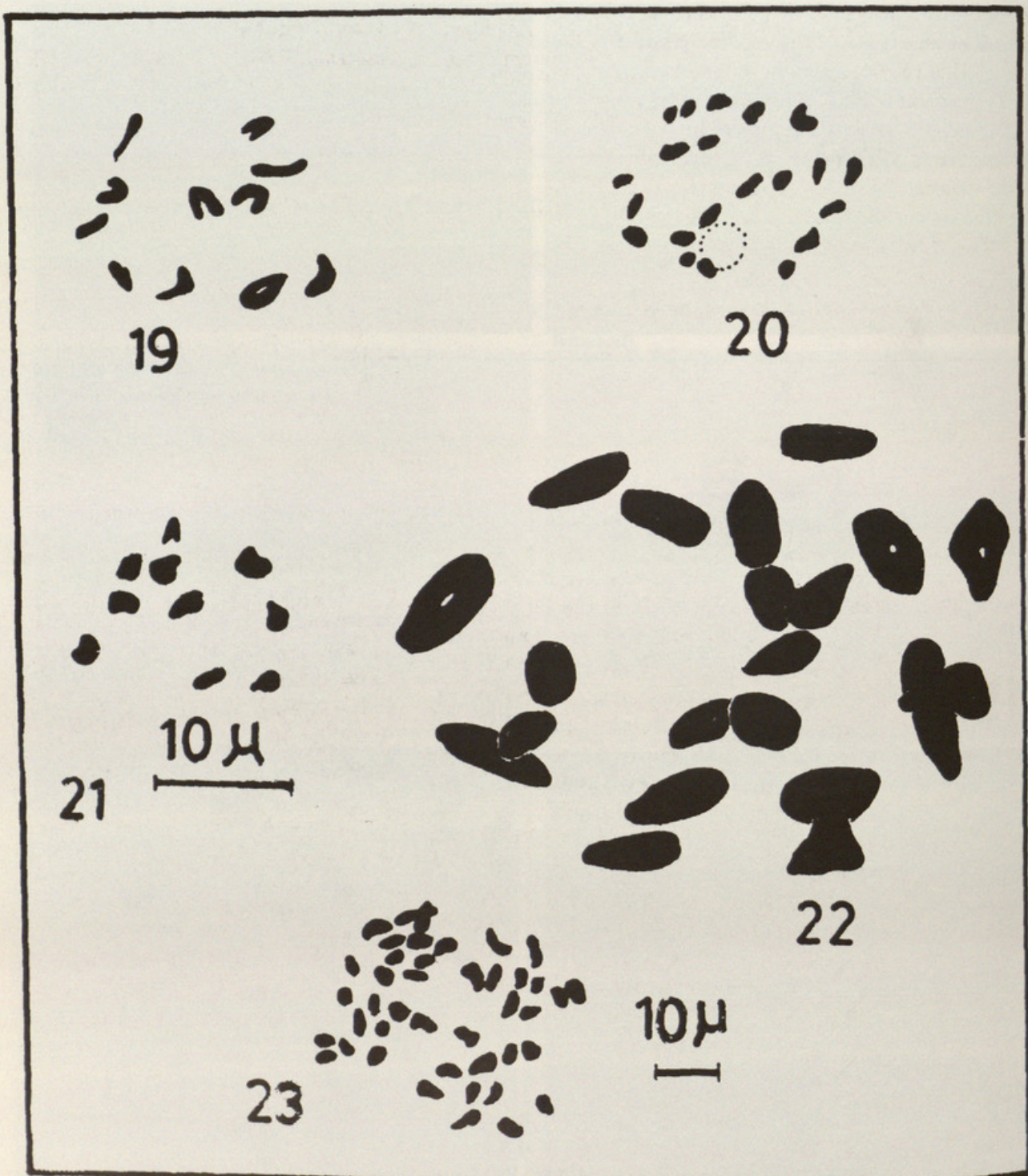
FIGURES 13-18. Chromosomes in members of Poaceae.—13. *Schismus barbatus* (Ghafoor 2693), diakinesis $n = 6$.—14. *Cynodon dactylon* (Siddiqui 90), metaphase-I $n = 9$.—15. *Bromus danthoniae* (Ghafoor 2916), metaphase-I $n = 7$.—16. *Bromus tectorum* (Ghafoor 2606) diakinesis $n = 7$.—17. *Elymus semicostatus* (Ghafoor 2707), diakinesis $n = 14$.—18. *Hordeum vulgare* (Moin. 31), mitotic metaphase $2n = 14$.

Diplachne fusca, whereas our material showed $n = 20$ (Fig. 2). This 4x cytotype in *D. fusca* is a new report.

In *Ochthochloa compressa* only tetraploids were

reported previously (Hiremath & Chennaveeraiah, 1982). One of the present reports of $n = 10$ (diploid) for this species establishes a new ploidy level (Fig. 3).

FIGURES 7-12. Pollen mother cell meiosis in members of Poaceae.—7. *Lolium rigidum* (Ghafoor 3274), diakinesis $n = 7$.—8. *Poa sinaica* (Omer 2720), diakinesis $n = 7$.—9. *Agrostis viridis* (Ghafoor 2337), diakinesis. [Arrows indicate B-chromosomes.] $n = 21 + 2B$.—10. *Phalaris minor* (Jahan 19), diakinesis $n = 14$.—11. *Polypogon monspeliensis* (Ghafoor 2598), metaphase-II $n = 14$.—12. *Piptatherum gracile* (Ghafoor 3093), diakinesis $n = 12$.



FIGURES 19-23. Pollen mother cell meiosis in members of Poaceae.—19. *Aristida funiculata* (Siddiqui 4), diakinesis $n = 11$.—20. *Aeluropus lagopoides* (Siddiqui 150), diakinesis $n = 20$.—21. *Tetrapogon tenellus* (Moin. 53), metaphase-I $n = 10$.—22. *Agrostis munroana* (Omer 2778), diakinesis $n = 21$.—23. *Avena barbata* (Omer 2559), anaphase-I $n = 21$.

In the genus *Tetrapogon*, chromosome numbers in two species were observed. The count for *Tetrapogon tenellus* is contrary to a previous report, $n = 18$ (Singh & Godward, 1960), however our count agrees with basic number ($x = 10$) for the genus (Table 1, Fig. 21).

Chromosome numbers of four species of *Sporobolus* were determined in the tribe Sporoboleae;

all of them have $n = 18$. The counts for *Sporobolus arabicus* (Table 1, Fig. 4) and *S. nervosus* (Table 1, Fig. 5) are reported as new to science.

In Zoysieae, chromosome numbers of three species belonging to two genera were determined. The count for *Leptothrium senegalense* (Table 1, Fig. 6) is reported for the first time.

In subfamily Pooideae, chromosome numbers



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