CHROMOSOME NUMBERS IN SOME MEXICAN GRASSES¹

by

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INTRODUCTION — The basic pattern of chromosome numbers in the grass family was first outlined by Aydukov in 1931. In the relatively short time since the appearance of this highly significant treatment, many chromosome records and other cytological data pertaining to grasses have been published and the general aspects of cytology as applied to grass taxonomy are now well known.

Existing grass chromosome records, however, are inadequate to contribute significantly to systematic studies of many genera and species complexes. Chromosome numbers and associated cytological data for many grass species are based on single collections. Some records have been reported without reference to definite collection locality or herbarium voucher specimen and are of little or no value in the correlation of cytological characteristics with other plant characters. Series of well-documented cytological records, based on plants throughout the range of the taxa involved, are highly desirable in the determination of phylogenetic relationships and patterns of plant dispersal.

The relatively high incidence of polyploidy in the Gramineae is well known. Stebbins (1950) has estimated that about two-thirds of all grass species are polyploid. Two or more levels of ploidy are present in most large genera. Also, hybridization followed by doubling of chromosome number and the return of fertility is an especially important evolutionary phenomenon in the Gramineae. Differences in chromosome number not only exist between closely related species but also occur within populations of the same species. Such variation may or may not be associated with intercrossing, and also may or may not affect sexual reproduction.

Although Mexico is noted for its diverse grass flora and its extensive areas of natural grasslands, chromosome records based on Mexican grasses are relatively few. Beaman *et al.* (1962), in an article reporting studies of alpine and subalpine plants, listed chromosome counts for 6 genera and 11 species of Mexican grasses. In the same year (1962), Tateoka reported counts for 27 genera and 38 species of Mexican grasses. The writer has reported counts, based on Mexican collections, for 14 genera and 26 species (Gould, 1953, 1956, 1958, 1963; Gould, and Kapadia, 1964).

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In the present article, chromosome numbers are given for 120 collections, representing 30 genera and 64 species. The counts for 41 species are the first for the taxon or are different from those previously reported. The chromosome records for species of *Aegopogon*, *Cathestecum*, *Microchloa*, and *Ixophorus* are the first for these genera.

The grouping of genera into subfamilies and tribes follows the system presented by Stebbins and Crampton (1961) and is essentially the same as that used by the writer in two papers reporting chromosome numbers for grasses of southwestern U. S. A. (1958, 1960).

MATERIALES AND METHODS — All chromosome studies were made from meiotic division of pollen mother cells (PMC). Sporocyte material was taken from plants growing in their natural sites and also from greenhouse and garden plants grown from seed. The material was killed and fixed in the standard 3:1 absolute alcohol-glacial acetic acid for 24 hours and then transferred to 70 per cent alcohol for storage in the refrigerator. Satisfactory chromosome preparations were made by using the regular aceto-carmin technique even after more than 12 months storage. Voucher specimens for the chromosome records are on file in the Tracy Herbarium of Texas A & M University. A duplicate series of most of the collections also has been deposited in the herbarium of the University of California.

RESULTS AND DISCUSSION — The chromosome counts for Mexican grasses recorded in the present study are listed in Table 1.

Subfamily FESTUCOIDEAE.—Tribe *Avenae*. Chromosome counts of $2n=28$ were obtained for *Trisetum deyeuxoides* (fig. 1) and *T. evolutum*. The count for the former is the same as obtained by Tateoka (1962), and the count for the latter was the first for this taxon.

Tribe *Stipeae*. The count of $2n=22$ was the first recorded for *Piptochaetium brevicalyx* (fig. 2). A plant of *P. fimbriatum* from near San Luis Potosí was determined to have $2n=42$ chromosomes (fig. 3). Brown (1951) apparently obtained $2n=44$ for *P. fimbriatum*; his chart and camera lucida drawing show this number but in the text the count is listed as $2n=22$.

A record of $2n=44$ was obtained for *Stipa eminens*. Although this number appears to be euploid on the basis of $x=11$, the two previous counts for the taxon were $2n=46$ (Love, 1947; Brown, 1951).

Subfamily ERAGROSTOIDEAE.—Tribe *Eragrosteae*. Counts of $2n=60$ for *Eragrostis diffusa* (fig. 4) and *E. plumbea* are the first for these taxa. Two counts of $2n=16$ (fig. 5) were made for *Erioneuron avenaceum* and one count of $2n=16$ was made for *E. nealleyi*. Tateoka (1961) had reported $2n=32$ for the former and $2n=16$ for the latter. A count of $2n=ca. 40$ was obtained for *Lycurus phleoides* (fig. 6). This was the same as reported for an Argentinian collection of the species (Avdulov, 1931) but Brown (1951) reported $2n=28$ for U.S.A. plants. The writer has obtained a count (unpublished) of $2n=40$ from a Texas collection. In this

material multivalents and univalents were numerous at prophase and metaphase stages of PMC division I.

Counts of $2n=40$ were obtained for *Muhlenbergia pubescens*, *M. rigens* and *M. rigida* (fig. 7). One collection of *M. rigida* had $2n=44$ and irregular meiosis. Previous counts of $2n=40$ had been made for *M. rigens* (Stebbins and Love, 1941) and for *M. rigida* (Gould, 1958).

Counts of $2n=24$ were obtained for *Sporobolus indicus* and *S. trichodes* (fig. 9). Tateoka (1962), reported $2n=36$ for the former and there are no previous records for the latter. Considerable irregularity was observed in PMC divisions of *S. indicus* from near Cordoba, Veracruz. In telophase I of one division, 12 chromosomes had gone to one pole and 10 to the other, with two chromosomes lagging on the equatorial plate. About one-fourth of the pollen tetrads had cells with one or more micronuclei. The record of $2n=36$ for *S. poiretii* (fig. 8) was the same as reported for this species by Brown (1951) and Bowden and Senn (1962).

The chromosome count of $2n=60$ for *Aegopogon tenellus* is the first record for this genus. The relatively high chromosome number, presumably hexaploid, is especially interesting in view of the uncertain systematic and phylogenetic relationships of *Aegopogon*.

A total of 48 counts are reported for 10 species of *Bouteloua*. The record of $2n=20$ for *B. barbata* (fig. 10) was the same as previously reported for this species (Gould, 1958). Records of $2n=40$ for *B. breviseta* and *B. chasei* (fig. 11) are the first for these taxa. The tetraploid count of $2n=40$ also was obtained for a collection of *B. chondrosioides*. Records of $2n=14$ (Brown, 1950), $2n=20$ (Freter and Brown, 1955), and $2n=40$ (Gould, 1958) previously had been reported for this species.

Nine diploid ($2n=20$), 8 tetraploid, one hexaploid, and two aneuploid counts were obtained for collections referable to *B. filiformis* (fig. 12-14). This species is closely interrelated with *B. radicata* for which six $2n=60$ counts are reported (fig. 20). Previous records of *B. filiformis* were $2n=14$ (Brown, 1950), $2n=20$, 21, 22, (Snyder and Harlan, 1953), and $2n=46$ (Tateoka, 1962). Records of $2n=20$ for *B. radicata* (Freter and Brown, 1955) may have been based on plants of *B. filiformis*.

Chromosome numbers of $2n=20$, $2n=40$ and $2n=60$ were obtained for collections of *B. gracilis* (fig. 15-16). Avdulov (1931) reported $2n=50$ for this species and Fults (1942) published 5 aneuploid counts. In a study of plants of southwestern U.S.A., Snyder and Harlan (1953) reported counts of $2n=20$, 40, 42, 60, and 84. The tetraploid collection Gould 9595, from near Toluca, showed a strong tendency towards multivalent formation during PMC division I, prophase and metaphase, with all chromosomes entering into quadrivalent associations in some cases (fig. 16).

Four of five records of *B. hirsuta* were aneuploid ($2n=24$, 28, ca. 46, and ca. 52) and one was tetraploid, $2n=40$ (fig. 17-19). Diploids have been reported

for this species (Gould, 1958) but published records (Fults, 1942; Brown, 1950 and 1951; Gould, 1958) and unpublished counts of the writer indicate a predominance of aneuploids in this species complex.

Counts of $2n=20$ and $2n=40$ were obtained for *B. simplex* (fig. 21). The $2n=20$ number has been reported for two Texas collections (Gould, 1960) and an Argentinian collection (Covas, 1945). Fults (1942) reported $2n=28$ for this species. The single record of *B. trifida* was $2n=20$. A count of $2n=28$ has been reported by Brown (1950).

The count of $2n=60$ for *Buchloe dactyloides* (fig. 22) was the same as obtained by Avdulov (1931) and Nielsen (1939). Records for three species of *Cathes- tecum* apparently are the first for this genus. Counts of $2n=20$ were obtained for *C. annuum* and *C. multifidum* and $2n=60$ for *C. erectum*.

Counts of $2n=80$ were recorded for *Chloris chloridea* (fig. 23) and *C. sub- mutica*. Previous records for *C. submutica* were $2n=80$ (Avdulov, 1931; Gould, 1960) and $2n=ca. 65$ (Krishnaswamy, 1940). Two $2n=100$ counts for *C. rufescens* (fig. 24) are the same as reported by Tateoka (1962). This is the highest chromo- some number recorded for the genus *Chloris*.

The record of $2n=74$ for *Hilaria belangeri* was the first of this aneuploid number for the species. One count of $2n=72$ has been reported for this taxon (Brown & Cole, 1951). Counts of $2n=72$ for *H. cenchroides* (fig. 26) were the same as reported by Tateoka (1962). Records of $2n=72$ and $2n=74$ are the first for *H. ciliata*. In PMC division I prophase of the aneuploid $2n=74$ plant, one ring of 4 was always prominent, and at metaphase I one pair of chromosomes separated from the others in about half of the cells. The chromosomes of the extra pair, however, separated normally and were incorporated in the daughter cells.

A count of $2n=80$ for *Leptochloa dubia* is the same as previously reported for Texas plants (Gould, 1960). Tetraploids ($2n=40$) also have been reported (Covas, 1949; Gould, 1960). Counts of $2n=40$ were obtained for *Microchloa kunthii* (fig. 27) and *Opizia stolonifera* (fig. 28). The record of *Microchloa* is the first for this monotypic genus. Tateoka (1962) has reported a count of $2n=43$ for a plant of *O. stolonifera* from Chiapas, México.

Subfamily PANICOIDEAE — Tribe *Paniceae* — The count of $2n=36$ for *Brachiaria meziana* (fig. 29) was the first for this species. Records for $2n=70$ were obtained for *Cenchrus brownii*, *C. echinatus* (fig. 33), and *C. myosuroides*, and $2n=34$ for *C. ciliare* (*Pennisetum ciliare* (L.) Link fig. 30-31). Avdulov (1931) reported $2n=34$ for *C. brownii* and *C. echinatus* and $2n=70$ for *C. myosu- roides*. Nunez (1952) and Tateoka (1962) reported $2n=68$ for *C. echinatus* and Brown (1950, 1951) reported $2n=54$ for *C. myosuroides*. DeLisle (1963) reported $2n=34$ for *C. brownii* and $2n=68$ for *C. echinatus*. Many and varied chromosome numbers have been listed for the economically important *C. ciliare*. DeLisle (1963) has reviewed these counts which are listed as $2n=32, 34, 35, 36, 40, 43, 44, 48, 52$, and 54.

Digitaria badia from near Hidalgo and *D. leucites* (fig. 37) from Cuernavaca both had chromosome numbers of $2n=108$. These counts, the first for both species, are the highest yet reported in the genus. Records of $2n=36$, 70, and 72 were obtained for *D. californica* (*Trichachne californica* (Benth.) Chase (fig. 34-36)). Previous counts were $2n=18$ (Krishnaswamy, 1940, as *Panicum californicum* Benth.) and $2n=36$ (Brown, 1951 and Bowden and Senn, 1962, both as *Trichachne californica* (Benth.) Chase). The count of $2n=36$ for *D. insularis* was the same as reported (as *Trichachne insularis* (L.) Nees) by Brown (1951) and Tateoka (1962).

The count of $2n=36$ for *Eriochloa aristata* (fig. 38) was the first for this species and the record of $2n=34$ was the first for *Ixophorus unisetus* (fig. 39) and the genus *Ixophorus*. It is interesting to note that $2n=34$ has been reported for many species of the closely related genus *Cenchrus*. This number presumably has been derived from the basic number $x=9$, with loss or fusion of two chromosomes at the tetraploid level.

A count of $2n=70$ was obtained for *Leptoloma cognatum*. Previous records of $2n=36$ and $2n=72$ were reported by Brown (1951) and $n=18$, 35, and 36 by Gould (1960). Diploid ($2n=18$) records were obtained for three species of *Panicum*, *P. bulbosum*, *P. hallii*, and *P. hirticaule* (fig. 40). Previous counts for *P. bulbosum* were $2n=54$ (Brown, 1951), $2n=70$ (Krishnaswamy, 1940) and $2n=72$ (Brown, 1951). The diploid count for *P. hallii* was earlier reported by Gould (1958) and the record for *P. hirticaule* was the first for the species. A count of $2n=36$ for *P. jorii* (fig. 41) also was the first for the species. Re-examination of voucher specimens for previous *Panicum* chromosome counts by the writer has brought to light a misidentification of the collection Gould 7950 from Chihuahua. This is *P. arizonicum* and not *P. fasciculatum* Swartz var. *reticulatum* (Torr.) Beal as reported (Gould, 1958).

The first record for *Paspalum mutabile* was obtained from a collection made near Valles, S. L. P. This was a tetraploid with $2n=40$.

The count of $2n=78$ for *Pennisetum setosum* is the second record for this species, Avdulov (1931) having reported $2n=54$. In the present study, irregular PMC meiosis was noted in the plant from Guerrero from which the count was obtained. Figure 32 is an anaphase I with 35 chromosomes going to each pole from disjunction of the homologous chromosomes of metaphase bivalent associations. Also present in a different plane are 8 chromosomes interpreted as univalents being distributed to either pole at random. Three counts of $2n=36$ for *Rhynchelytrum roseum* were the same as reported by de Wet (1954) and Tateoka (1962). Records of $2n=36$ and $2n=72$ were obtained for plants of *Setaria geniculata*. Previous records were $2n=36$ (Gould, 1960) and $2n=72$ (Brown, 1948; Gould, 1960).

Tribe *Andropogoneae*.—A count of $2n=60$ was recorded for plants from Taxco tentatively identified as *Andropogon hirtifolius* (Fig. 44). This was the first record for the species. The count of $2n=40$ was recorded for *Andropogon ischaemum* L.

var. *ischaemum* (*Bothriochloa ischaemum* (L.) Keng.). (Fig. 42). Numerous counts of $2n=40$ have been reported for this species and variety but none from plants growing spontaneously in North America. *Andropogon ischaemum* var. *son-garicus* Rupr., with $2n=50$ chromosomes, has become common as an introduction in pastures and on roadsides throughout much of Texas. The record of $2n=120$ for a collection of *A. reevesii* (Fig. 43) from Zimapán, Hidalgo, was the same as reported in the original description of this species (Gould, 1957). The Zimapán collection provided a second known station for this apparently rare grass which was described from plants grown from seed collected near Saltillo, Coahuila. The count of $2n=20$ for *Elyonurus tripsacoides* var. *ciliaris* was the first for this variety and the same as reported for the typical variety by Brown (1951).

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TABLE 1. **Chromosome counts of Mexican grasses**

Genus Species	2n=	Collection Number	Locality
SUBFAMILY FESTUCOIDEAE			
Tribe Aveneae			
Trisetum			
deyeuxioides (Kunth) Kunth	28	9614	Michoacán. Hidalgo.
evolutum (Fourn.) Hitchc.*	28	9260	Veracruz. Jalapa.
Tribe Stipeae			
Piptochaetium			
brevicalyx (Fourn.) Ricker*	22	9211	México. San Juan del Río.
fimbriatum (Kunth) Hitchc.*	42	9661	San Luis Potosí. San Luis Potosí
Stipa			
emines Cav.*	44	9660	San Luis Potosí. San Luis Potosí
SUBFAMILY ERAGROSTOIDEAE			
Tribe Eragrosteae			
Eragrostis			
diffusa Buckl.*	60	9604	México. Toluca
plumbea Scribn.*	60	9612	Michoacán. Hidalgo.
Erioneuron			
avenaceum (Kunth) Tateoka*	16	9564	Hidalgo. Ixmiquilpan.
"	16	10157	Hidalgo. Pachuca.
nealley (Vasey) Tateoka	16	9307	Hidalgo. Ixmiquilpan.
Lycurus			
phlecidides Kunth	ca. 40	9663	San Luis Potosí. San Luis Potosí.
Muhlenbergia			
pubescens (Kunth) Hitchc.*	40	R3412¹	Durango. Durango.
rigida (Kunth) Kunth	ca. 40	10193	México. Cd. Satélite.
" *	ca. 44	9662	San Luis Potosí. San Luis Potosí.
Sporobolus			
indicus (L.) R. Br.*	24	9238	Veracruz. Córdoba.
poiretii (Roem. & Schult.) Hitchc.	36	9599	México. Toluca.
trichodes Hitchc.*	24	9627	Jalisco. South of Jiquilpan.
Tribe Chlorideae			
Aegopogon*			
tenellus (DC.) Trin.*	60	9258	Veracruz. Jalapa.

* First report for taxon or count differing from previous reports.

Genus Species	2n=	Collection Number	Locality
Bouteloua			
barbata Lag.	20	10120	San Luis Potosí. South of Matehuala
breviseta Vasey*	40	R3276	Coahuila Castaños.
chasei Swallen*	40	10121	San Luis Potosí. South of Matehuala.
"	40	10261	San Luis Potosí. 85 miles north of San Luis Potosí.
chondrosioides (Kunt) Benth.	40	9284	Oaxaca. Oaxaca.
filiformis (Fourn.) Griffiths	20	9308	Hidalgo. Ixmiquilpan.
"	20	9554	San Luis Potosí. Valles.
"	20	10124	San Luis Potosí. Ciudad del Maíz.
"	20	10129	San Luis Potosí. Ciudad del Maíz.
"	20	10148	Hidalgo. Zimapán.
"	20	10188	México. Cd. Satélite.
"	20	10222	Querétaro. Querétaro.
"	20	10237	Guanajuato. Irapuato.
"	20	10243a	Guerrero. Silao.
"	22	10222a	Querétaro. Querétaro.
" *	40	7908	Durango. Durango.
"	40	9267	Puebla. Atlixco.
"	40	9283	Oaxaca. Oaxaca.
"	40	9552	Tamaulipas. Cd. Mante.
"	40	9634	Jalisco. Tamazula.
"	40	9578	Guerrero. Taxco.
"	40	10322	Morelos. Cuernavaca.
" *ca.	45	10252a	Jalisco. Lagos de Moreno.
" *	60	10366	Guerrero. Acapulco.
gracilis (Willd. ex Kunth) Lag. ex Griffiths	20	7913	Durango. Durango.
"	20	10216	México. San Juan del Río.
"	20	10225	Querétaro. Querétaro.
"	40	8896a	Chihuahua. Cd. Juárez
"	40	9595	México. Toluca.

¹ Numbers starting with the prefix R refer to collection of Dr. John R. Reeder. The chromosome counts for those collections also were made by Dr. Reeder.

Genus Species	2n=	Collection Number	Locality
Bouteloua (continued)			
"	40	9659	San Luis Potosí. San Luis Potosí.
"	40	10150	Hidalgo. Pachuca.
"	40	10186	México. Cd. Satélite.
"	40	10255	San Luis Potosí. East of Lagos de Moreno.
"	60	9265	Ver. Perote.
hirsuta Lag.*	24	9592	México. Toluca.
"	28	10147	Hidalgo. Zimapán.
"	40	9655	Jalisco. Lagos de Moreno.
"	ca. 46	10223	Querétaro. Querétaro.
"	ca. 52	10257	Jalisco. Lagos de Moreno.
radicosa (Fourn.) Griffiths*	60	9008	Jalisco. Lagos de Moreno.
"	60	9011	Jalisco. San Juan de los Lagos.
"	60	9015	Jalisco. Lagos de Moreno.
"	60	9651	Jalisco. Tepatitlán.
"	60	9656	Jalisco. Lagos de Moreno.
"	60	10248	Guanajuato. León.
simplex Lag.	20	10112	Nuevo León. South of Saltillo.
" *	40	10151	Hidalgo. Pachuca.
trifida Thurb.*	20	9666	Nuevo León. China.
Buchloe			
dactyloides (Nutt.) Engelm.	60	10158	Hidalgo. Pachuca.
Cathestecum *			
annum Swallen*	20	9274	Oaxaca. Huajuapán de León.
"	20	9579	Guerrero. Iguala.
erectum Vasey*	60	9648	Jalisco. Santa Ana.
multifidum Griffiths*	20	9276	Oaxaca. Huajuapán de León.
"	20	9590	Guerrero. Grutas de Cacahuamilpa.
Chloris			
chlorides (Presl.) Hitchc.*	80	10411	San Luis Potosí. Valles.
rufescens Lag.	100	9303	Hidalgo. Ixmiquilpan.
submutica Kunth	80	9615	Michocán. Hidalgo.
Hilaria			
belangeri (Steud.) Nash*	74	9583	Guerrero. Chilpancingo.

Genus Species	2n=	Collection Number	Locality
Hilaria (continued)			
cenchroides Kunth	72	10189	México. Cd. Satélite.
"	72	9654	Jalisco. Tepatitlán.
"	74	9608	México. West of Toluca.
"	72	10144	Hidalgo. Jacala.
"	72	10215	Hidalgo. Tepeji del Río.
"	72	10219	México. South of San Juan del Río.
"	72	10220	México. South of San Juan del Río.
ciliata (Scribn.) Johns*	72	10137	San Luis Potosí. Valles.
"	72	10412	San Luis Potosí. Valles.
"	74	9639	Jalisco. Guzmán.
Leptochloa			
dubia (Kunth) Nees	80	10516	Coahuila. San Antonio.
Microchloa			
kunthii Desv.*	40	9585	Guerrero. Chilpancingo.
Opizia			
stolonifera Presl.*	40	10321	Morelos. Cuernavaca.
"	40	R3743	Puebla. Atlixco.

SUBFAMILY PANICOIDEAE

Tribe Paniceae

Brachiaria			
Meziana Hitchc.*	36	10195	México. Cd. Satélite.
Cenchrus			
brownii R. & S.*	70	9577	Morelos. Cuernavaca.
ciliare L.	34	9572	Hidalgo. Ixmiquilpan.
" *	78	10337	Guerrero. Taxco.
Cenchrus (continued)			
echinatus L.*	70	9560	San Luis Potosí. Tamazunchale.
myosuroides Kint	70	7562	Durango. Durango.
Digitaria			
badia (Scribn. & Merr.) Fern.*	108	9616	Michoacán. Hidalgo.
californica (Benth.) Henr.*	36	8902	Chihuahua. Cihuhua.
"	70	10431	Nuevo León. Linares.
"	72	10122	San Luis Potosí. South of Matehuala.

Genus Species	2n=	Collection Number	Locality
insularis (L.) Mez ex Eckman	36	9241	Veracruz. Córdoba.
leucites (Trin.) Henr.*	108	10388	Morelos. Cuernavaca.
Eriochloa			
aristata Vasey*	36	9598	Guerrero. Grutas de Cacahuamilpa.
Ixophorus *			
unisetus (Presl.) Schlecht.*	34	9635	Jalisco. Tamazula.
Leptoloma			
cognatum (Schult.) Chase	70	9565	Hidalgo. Ixmiquilpan.
Panicum			
arizonicum Scribn. & Merr.*	36	7950	Chihuahua. North of Chihuahua.
bulbosum Kunth*	18	9620	Michoacán. Hidalgo.
hallii Vasey	18	10540	Coahuila. Saltillo.
hirticaule Presl.*	18	9555	San Luis Potosí. Valles.
" "	18	9558	San Luis Potosí. Valles.
joorii Vasey*	36	9621	Michoacán. Hidalgo.
Paspalum			
mutabile Chase*	40	10415	San Luis Potosí. Valles.
Pennisetum			
setosum (Swartz) Rich.*	78	10337	Guerrero. Taxco.
Rhynchelytrum			
roseum (Nees) Stapf. & Hubb.	36	9236	Veracruz. Córdoba.
" "	36	9285	Oaxaca. Oaxaca.
" "	36	9640	Jalisco. Guzmán.
Setaria			
geniculata (Lam.) Beauv.	36	9239	Veracruz. Córdoba.
" "	72	9630	Jalisco. South of Jiquilpan.
" "	72	9646	Jalisco. Guzmán.
Tribe Andropogoneae			
Andropogon			
hirtifolius Presl.*	60	10326	Guerrero. Taxco.
ischaemum L.			
var. ischaemum	40	10135	San Luis Potosí. Valles.
reevesii Gould	120	10145	Hidalgo. Zimapán.
Elyonurus			
tripsacoides Humb. & Bonpl.		9224	Puebla. Puebla.
var. ciliaris (Kunth) Hack.*	20

Figures 1 - 25. PMC meiosis, stages of division 1. (x 600).

Figure 1. *Trisetum deyeuxoides* $2n=28$. Diakinesis. Figure 2. *Piptochaetium brevicalyx* $2n=29$. Anaphase. Figure 3. *Piptochaetium fimbriatum* $2n=42$. Diakinesis. Figure 4. *Eragrostis difusa* $2n=60$. Metaphase. Figure 5. *Erioneuron avenacea* $2n=16$. Anaphase. Figure 6. *Lycurus phleoides* $2n=ca. 40$. Diakinesis. Figure 7. *Muhlenbergia rigida* $2n=ca. 44$. Anaphase. Figure 8. *Sporobolus poiretii* $2n=36$. Metaphase. Figure 9. *Sporobolus trichoides* $2n=24$. Telophase. Figure 10. *Bouteloua simplex* $2n=20$. Prometaphase. Figure 22. *Buchloe chasei* $2n=40$. Metaphase. Figure 12. *Bouteloua filiformis* $2n=20$. Anaphase. Figure 13. *Bouteloua filiformis* $2n=22$. Prometaphase. Figure 14. *Bouteloua filiformis* $2n=40$. Early anaphase. Figure 15. *Bouteloua gracilis* $2n=20$. Diakinesis; note the quadrivalents. Figure 17. *Bouteloua hirsuta* $2n=24$. Anaphase. Figure 18. *Bouteloua hirsuta* $2n=24$. Telophase, showing lagging chromosomes. Figure 19. *Bouteloua hirsuta* $2n=40$. Diakinesis. Figure 20. *Bouteloua radicata* $2n=60$. Diakinesis. Figure 21. *Bouteloua simplex* $2n=20$. Prometaphase. Figure 22. *Buchloe dactyloides* $2n=60$. Diakinesis. Figure 23. *Chloris chloridea* $2n=40$. Metaphase. Figure 24. *Chloris rufescens* $2n=100$. Diakinesis. Figure 25. *Chloris submutica* $2n=80$. Diakinesis.

Figures 26-44. PMC meiosis, stages of division 1. (x 680)

Figure 26. *Hilaria cenchroides* $2n=72$. Anaphase. Figure 27. *Microchloa kunthii* $2n=40$. Diakinesis. Figure 28. *Opizia stolonifera* $2n=40$. Diakinesis. Figure 29. *Brachiaria meziana* $2n=36$. Metaphase. Figure 30. *Cenchrus ciliare* $2n=34$. Anaphase. Figure 31. *Cenchrus ciliare* $2n=34$. Telophase, note micronuclei. Figure 32. *Pennisetum setosum* $2n=78$. Anaphase, with 35 chromosomes going to each pole from disjunction of the homologous chromosomes of metaphase bivalents and 8 chromosomes (white center) interpreted as univalents being distributed to the poles at random. The latter were in a different plane. Figure 33. *Cenchrus echinatus* $2n=70$. Diakinesis. Figure 34. *Digitaria californica* $2n=36$. Diakinesis. Figure 35. *Digitaria californica* $2n=70$. Metaphase. Figure 36. *Digitaria californica* $2n=72$. Anaphase. Figure 37. *Digitaria leucites* $2n=108$. Diakinesis. Figure 38. *Eriochloa aristata* $2n=36$. Diakinesis. Figure 39. *Ixophorus unisetus* $2n=34$. Diakinesis. Figure 40. *Panicum hirticaule* $2n=18$. Metaphase. Figure 41. *Panicum joorii* $2n=36$. Anaphase. Figure 42. *Andropogon ischaemum* var. *ischaemum* $2n=40$. Diakinesis. Figure 43. *Andropogon reevesii* $2n=120$. Diakinesis. Figure 44. *Andropogon hirtifolius* $2n=60$. Metaphase.