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Miscellaneous notes

POACEAE

CHROMOSOME STUDIES ON AFRICAN PLANTS. 14. PANICOIDEAE

Various papers from our laboratories presented cytogenetic data on chromosome numbers of South African representatives of the grass subfamily, Panicoideae (Spies 1982; Spies & Du Plessis 1986a, b; Spies & Du Plessis 1987a, b; Spies *et al.* 1991, 1994). In this paper miscellaneous chromosome numbers of the subfamily Panicoideae are presented. The numbers reported present mainly new localities for the species studied. In this way it will contribute to our understanding of the geographical distribution of polyploidy in the species studied.

MATERIALS AND METHODS

For this study cytogenetic material was collected and fixed in the field. The material used and their localities are listed in Table 1. Voucher specimens are housed in the Geo Potts Herbarium, Department of Botany and Genetics, University of the Orange Free State, Bloemfontein (BLFU), or in the National Herbarium, Pretoria (PRE).

Anthers were squashed in aceto-carmine and meiotically analysed (Spies *et al.* 1996). Chromosome numbers are presented as gametic chromosome numbers to conform with previous papers on chromosome numbers in this journal (Spies & Du Plessis 1986b).

RESULTS AND DISCUSSION

Fifty-seven specimens, representing 25 species (as well as four infraspecific taxa) and 15 genera, were studied (Table 1). The species will be discussed alphabetically under the appropriate tribe.

Tribe Andropogoneae

The genus *Bothriochloa* consists of 35 species (Clayton & Renvoize 1986) worldwide, with three indigenous species in southern Africa (Gibbs Russell *et al.* 1990). The somatic chromosome number of 2n = 20 (Table 1) is the lowest ploidy level yet observed for this species in South Africa. The formation of bivalents only in this specimen with 2n = 4x = 20 indicate that this species is either an alloploid, or it has a secondary basic chromosome number of ten, as is observed in most representatives of the tribe Andropogoneae (De Wet 1954, 1958; De Wet & Anderson 1956; Celarier & Harlan 1957; Olorode 1975; Dujardin 1978; Spies & Du Plessis 1986a, b, 1987a, b; Sinha *et al.* 1990; Spies *et al.* 1994).

The genus *Cymbopogon* consists of 40 species (Clayton & Renvoize 1986) worldwide, with six indigenous species in southern Africa (Gibbs Russell *et al.* 1990). The *C. plurinodis* specimen is diploid (2n = 2x = 20) with normal meiotic chromosome behaviour. Diploid, tetraploid and octoploid levels in this species have been reported (De Wet 1954; Spies & Du Plessis 1987a; Du Plessis & Spies 1988; Spies *et al.* 1994).

The genus *Dichanthium* consists of 20 species (Clayton & Renvoize 1986) worldwide, with one indigenous and one naturalized species in southern Africa (Gibbs Russell *et al.* 1990). The specimen of *D. aristatum* is tetraploid with n = 2x = 20 (Figure 1A, B). The formation of bivalents only indicates that this species is an alloploid. Previous reports indicated diploid, tetraploid and hexaploid levels (De Wet 1954; Spies & Du Plessis 1986b; Sinha *et al.* 1990).

The genus *Elionurus* comprises 15 species (Clayton & Renvoize 1986) worldwide. Two of these species are indigenous to southern Africa (Gibbs Russell *et al.* 1990), with only *E. muticus* representing the genus in this study. Both specimens studied have a gametic chromosome number of n = 3x = 15 (Figure 1C–H). Up to two putative B-chromosomes are present, resulting in laggards or late segregating chromatids during anaphase (Figure 1F, G). Although several laggards during anaphase I were observed, no micronuclei during telophase I (Figure 2H) were observed. This is the highest ploidy level yet described for this species in South Africa. The formation of bivalents in these specimens with 30 somatic chromosomes, clearly indicate that five is the basic chromosome number for this species.

The genus *Eulalia* consists of 30 species (Clayton & Renvoize 1986) worldwide. Two of these species are indigenous to southern Africa (Gibbs Russell *et al.* 1990). The *E. villosa* specimen has a gametic chromosome number of n = x = 5. This is, to the best of our knowledge, the first chromosome number report on this species. This chromosome number confirms the basic number of five for the tribe Andropogoneae.

The genus *Miscanthus* consists of 20 species (Clayton & Renvoize 1986) worldwide, with two indigenous species in southern Africa (Gibbs Russell *et al.* 1990). The specimen of *M. capensis* has a chromosome number of n = 15 (Figure 1I). There were no meiotic abnormalities observed in this specimen. This appears to be the first chromosome number report for this species.

The genus *Trachypogon* consists of three species (Clayton & Renvoize 1986) worldwide, with one indigenous species in southern Africa (Gibbs Russell *et al.* 1990). The specimen of *T. spicatus* has a chromosome number of n = 10 (Figure 1J, K) and exhibited bivalent formation during meiosis, indicating that the species is either an alloploid or has a secondary basic chromosome number of ten.

TABLE 1.—Gametic chromosome numbers (n) of representatives of subfamilies Panicoideae in southern Africa with their voucher specimen numbers and specific localities. Species are listed alphabetically and the localities are presented according to the system described by Edwards & Leistner (1971)

Taxon	Voucher	n	Locality
Andropogoneae			
Bothriochloa insculpta (A.Rich.) A.Camus	*H. du Plessis 119*	10	KWAZULU-NATAL.—2931 (Stanger): Verulam, (–CA).
Cymbopogon plurinodis (Stapf) Stapf ex Burtt Davy	*Spies 4809*	10	FREE STATE.—2827 (Senekal): 25 km from Clocolan to Ficksburg, (–DC).
Dichanthium aristatum (Poir.) C.E.Hubb.	*Spies 2007*	20	GAUTENG.—2528 (Pretoria): Sphinx station, (–CA).
Elionurus muticus (Spreng.) Kunth	*Spies 2115a, 2117a*	15	GAUTENG.—2528 (Pretoria): Klipspruit, (–BD).
Eulalia villosa (Thunb.) Nees	*Spies 5085*	5	FREE STATE.—2729 (Volksrust): 99 km from Harrismith to Normandien, (–DC).
Miscanthus capensis (Stapf) Pilg.	*Spies 5242*	15	EASTERN CAPE.—3224 (Graaff-Reinet): 48 km from Graaff-Reinet to Middelburg, (–BC).
Trachypogon spicatus (L.f.) Kuntze	*Spies 2107*	10	GAUTENG.—2528 (Pretoria): between Cullinan and Sybrandskraal at Tweedespruit turnoff, (–DA).
Arundinelleae			
Loudetia simplex (Nees) C.E.Hubb.	*Spies 1981b*	18	MPUMALANGA.—2430 (Pilgrim's Rest): above Mac-Mac Falls, (–DD).
Tristachya leucothrix Nees	*Spies 5148*	12	MPUMALANGA.—2530 (Lydenburg): 49 km from Lydenburg to Machadodorp, (–CB).
	Spies 2335	12	MPUMALANGA.—2629 (Bethal): 46 km from Ermelo to Piet Retief, (–DB).
	Spies 5108	12	MPUMALANGA.—2630 (Carolina): 32 km from Carolina to Belfast, (–AA).
	H. du Plessis 152	12	MPUMALANGA.—2729 (Volksrust): 10 km from Volksrust to Newcastle, (–BD).
	Spies 5070	12	FREE STATE.—2729 (Volksrust): 92 km from Harrismith to Normandien, (–DC).
	Spies 5061	12	FREE STATE.—2829 (Harrismith): 28 km from Harrismith to Verkykerskop, (–AC).
	Spies 4698	12	EASTERN CAPE.—3128 (Umtata): 69 km from Rhodes to Maclear, (–AB).
	Spies 4711	12	EASTERN CAPE.—3128 (Umtata): 38 km from Maclear to Elliot, (–AB).
Paniceae			
Alloteropsis semialata (R.Br.) Hitchc.	*Spies 5068*	9	FREE STATE.—2729 (Harrismith): 92 km from Harrismith to Normandien, (–DC).
	Spies 4715	9	EASTERN CAPE.—3128 (Umtata): 38 km from Maclear to Elliot, (–AC).
Anthephora pubescens Nees	*Spies 5500*	18	FREE STATE.—2925 (Jagersfontein): 45 km from Bloemfontein to Petrusburg, (–BB).
	Spies 5503	18	NORTHERN CAPE.—2824 (Kimberley): 4 km from Kimberley to Griekwastad, (–DA).
Axonopus affinis Chase	*Spies 2561*	20	SWAZILAND.—2631 (Mbabane): 18 km northeast of Mbabane, (–AC).
	Spies 2645	20	SWAZILAND.—2631 (Mbabane): at Moimba Beacon, (–AD).
Brachiaria bovonei (Chiov.) Robyns	*Spies 2652*	9	SWAZILAND.—2631 (Mbabane): 16 km from Mbabane to Oshoek, (–AC).
B. brizantha (A.Rich) Stapf	*Spies 2582*	9+2B	SWAZILAND.—2631 (Mbabane): 13 km from Manzini to Siteki, (–AD).
B. nigropedata (Ficalho & Hiern) Stapf	*Spies 5552*	9	FREE STATE.—2825 (Boshof): 15 km from Hertzogville to Bultfontein, (–BA).
B. serrata (Thunb.) Stapf	*Spies 5075*	9+B	FREE STATE.—2729 (Harrismith): 97 km from Harrismith to Normandien, (–DC).
B. xantholeuca (Schinz) Stapf	*Spies 4812*	9+B	FREE STATE.—2827 (Senekal): 25 km from Ficksburg to Clocolan, (–BC).
Paspalum dilatatum Poir.	*Spies 4838*	20	FREE STATE.—2827 (Senekal): 6 km from Nebo to Fouriesburg, (–DB).
	H. du Plessis 87	20	FREE STATE.—2829 (Harrismith): near Sterkfontein Dam, (–CA).
	Spies 1789	20	FREE STATE.—2829 (Harrismith): Kaity Nilgris, (–CA).
	H. du Plessis 98	20	KWAZULU-NATAL.—2829 (Harrismith): Cathedral Peak, (–CC).
	Spies 2363	50/2	KWAZULU-NATAL.—2832 (Mtubatuba): Cape Vidal, (–CB).
	Spies 1917	20	EASTERN CAPE.—3227 (Stutterheim): Kabusie Forest, (–DA).
P. scrobiculatum L.	*Saayman 70*	20	MPUMALANGA.—2530 (Lydenburg): 10 km from Sabie to Graskop, (–BB).
P. urvillei Steud.	*Spies 1980*	20	MPUMALANGA.—2430 (Pilgrim's Rest): Mac-Mac Falls, (–DD).
	Saayman 67	20	MPUMALANGA.—2530 (Lydenburg): 10 km from Sabie to Graskop, (–BB).
Setaria incrassata (Hochst.) Hack.	*Spies 2628*	9	SWAZILAND.—2631 (Mbabane): Pikiti, (–BB).
	Spies 2439	9	KWAZULU-NATAL.—2832 (Mtubatuba): 3 km from Hluhluwe to Valsbaai, (–AB).
	Spies 2590	27	SWAZILAND.—2631 (Mbabane): 13 km from Manzini to Siteki, (–AD).
S. nigrirostris (Nees) T.Durand & Schinz	*Spies 2553*	9	SWAZILAND.—2631 (Mbabane): 18 km northeast of Mbabane, (–AC).
	Spies 1514	9	MPUMALANGA.—2530 (Lydenburg): 13 km from Lydenburg to Roossenekal, (–AB).
	H. du Plessis 32	18	MPUMALANGA.—2530 (Lydenburg): 55 km from Machadodorp to Lydenburg, (–AD).
	H. du Plessis 71	9	MPUMALANGA.—2629 (Bethal): Bethal, (–AD).
	Spies 2334	9	MPUMALANGA.—2630 (Carolina): 46 km from Ermelo to Piet Retief, (–CD).
S. pallide-fusca (Schumach.) Stapf & C.E. Hubb.	*Spies 2971*	18	WESTERN CAPE.—3118 (Vanrhynsdorp): 31 km from Nuwerus to Bitterfontein, (–AB).
	Spies 2772	18	WESTERN CAPE.—3118 (Vanrhynsdorp): 3 km from Lutzville to Koekenaap, (–CB).
S. plicatilis (Hochst.) Engl.	*Spies 2420*	9	KWAZULU-NATAL.—2832 (Mtubatuba): Fanie's Island, (–AB).
S. sphacelata (Schumach.) Moss var. *sericea* (Stapf) Clayton	*Spies 1946*	9	EASTERN CAPE.—3227 (Stutterheim): 5 km from Macleantown to Kei Road, (–DC).
	Spies 2589	18	SWAZILAND.—2631 (Mbabane): 13 km from Manzini to Siteki, (–AD).
S. sphacelata var. *sphacelata*	*Spies 3316*	9	FREE STATE.—2826 (Brandfort): Soutpan, (–CA).
	H. du Plessis 133	9	KWAZULU-NATAL.—2930 (Pietermaritzburg): 2 km from Greytown to Colenso, (–BA).
S. sphacelata var. *splendida* (Stapf) Clayton	*H. du Plessis 125*	18	KWAZULU-NATAL.—2931 (Stanger): 18 km from Umpumulo to Kranskop, (–AA).
	Spies 5572	27	EASTERN CAPE.—3327 (Peddie): Seaborne, (–BB).
S. sphacelata var. *torta* (Stapf) Clayton	*H. du Plessis 33, 34*	9	MPUMALANGA.—2530 (Lydenburg): 55 km from Machadodorp to Lydenburg, (–AD).
	H. du Plessis 73	9	MPUMALANGA.—2629 (Bethal): 31 km from Bethal to Ogies, (–AD).

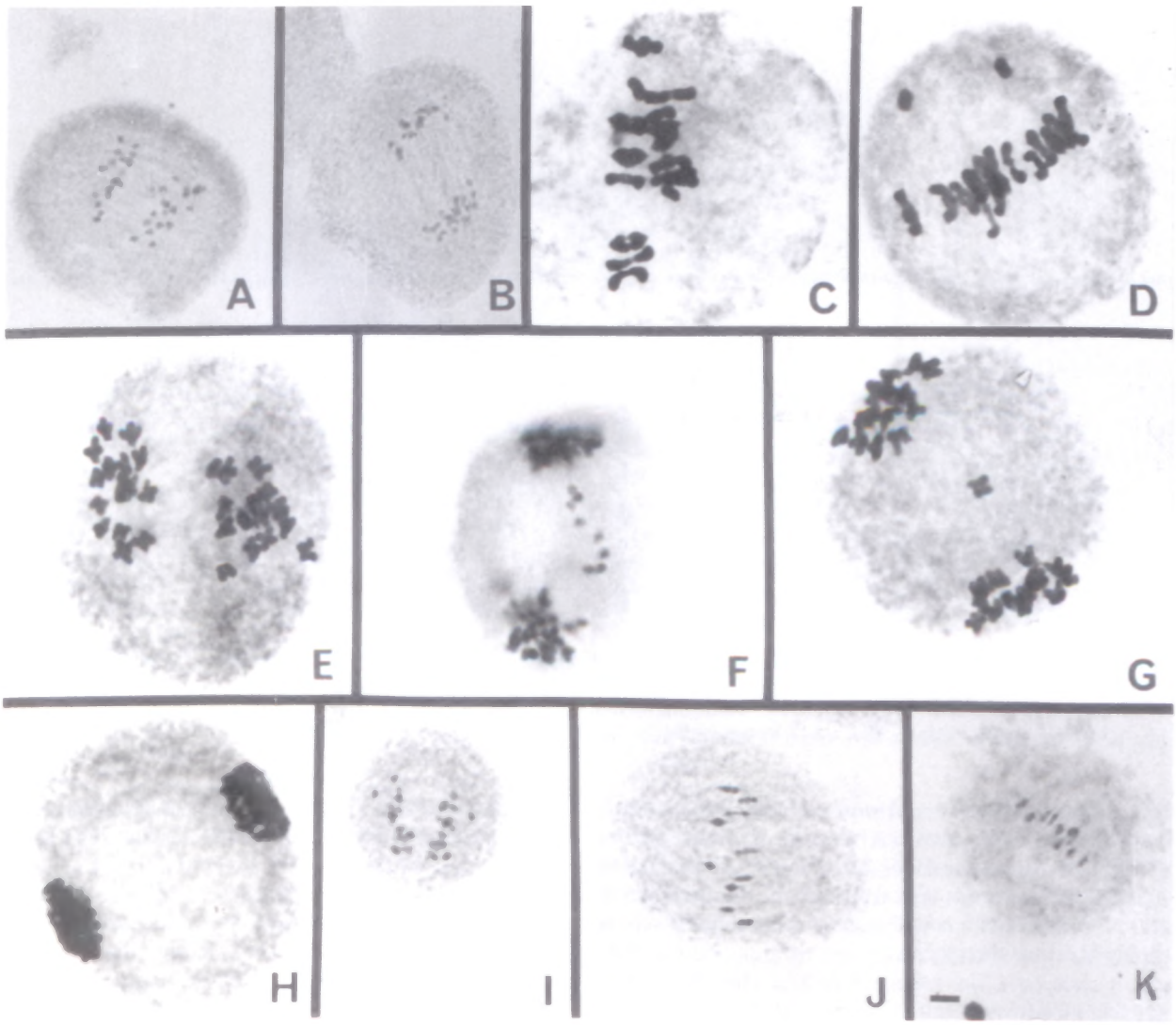

FIGURE 1.—Meiotic chromosomes in some specimens of the genera *Dicanthium*, *Elionurus*, *Miscanthus* and *Trachypogon*. A, B, *Dicanthium aristatum*, *Spies 2007*, n = 20, anaphase I with a 20-20 chromosome segregation. C–H, *Elionurus muticus*, both specimens with n = 3x = 15. C–E, G, H, *Spies 2117a*: C, D, metaphase I with 15_{II}; E, anaphase I with a 15-15 chromosome segregation; G, anaphase I with one chromosome laggard; H, telophase I. F, *Spies 2115a*, anaphase I with laggards. I, *Miscanthus capensis*, *Spies 5242*, n = 15, anaphase I with a 15-15 chromosome segregation. J, K, *Trachypogon spicatus*, *Spies 2107*, n = 10, metaphase I with 10_{II}. Scale bar: 40 µm.

All the specimens studied have either a basic chromosome number of five or a secondary basic number of ten, conforming with previous reports on these genera (De Wet 1954; De Wet & Anderson 1956; Celarier & Harlan 1957; De Wet 1958; Olorode 1975; Dujardin 1978; Spies & Du Plessis 1986a, b, 1987a, b; Sinha *et al.* 1990; Spies *et al.* 1994). The fact that the chromosome numbers of two of the species studied (28.6%) are published for the first time and that two new ploidy levels (28.6%) are described for the seven species studied, indicate that more cytogenetic studies of the Andropogoneae are needed (57.1% of the studied specimens presented new data). More specimens should be studied to determine the ploidy levels present and the geographical distribution of these ploidy levels.

Tribe Arundinelleae

The genus *Loudetia* consists of 26 species (Clayton & Renvoize 1986) worldwide, six of which are indigenous to southern Africa (Gibbs Russell *et al.* 1990). *L. simplex* is tetraploid with n = 2x = 18 (Figure 2A–C). Laggards and micronuclei were observed (Figure 2B, C). Chromosome numbers based on 6 (De Wet 1958) and 10 were reported previously (Moffett & Hurcombe 1949; Dujardin & Beyne 1975; Dujardin 1978). The basic chromosome numbers observed in this study (x = 9) differ from those previously reported. However, the results of this study can also be interpreted as x = 6 with a high ploidy level (hexaploid). More studies are needed to determine the real basic chromosome number of this species and whether those studied included an aneuploid specimen.

The genus *Tristachya* consists of 22 species (Clayton & Renvoize 1986) worldwide. Six of these species are indigenous to southern Africa (Gibbs Russell *et al.* 1990). The specimens of *T. leucothrix* (Figure 2D–I) are tetraploid with n = 2x = 12. Meiosis was normal and only bivalents were observed, indicating that the species is an allotetraploid. This is a new ploidy level for this species. Previously an octoploid specimen was observed (Spies & Du Plessis 1987a).

The overwhelming presence of x = 6 observed in *Tristachya* suggests that the basic chromosome number

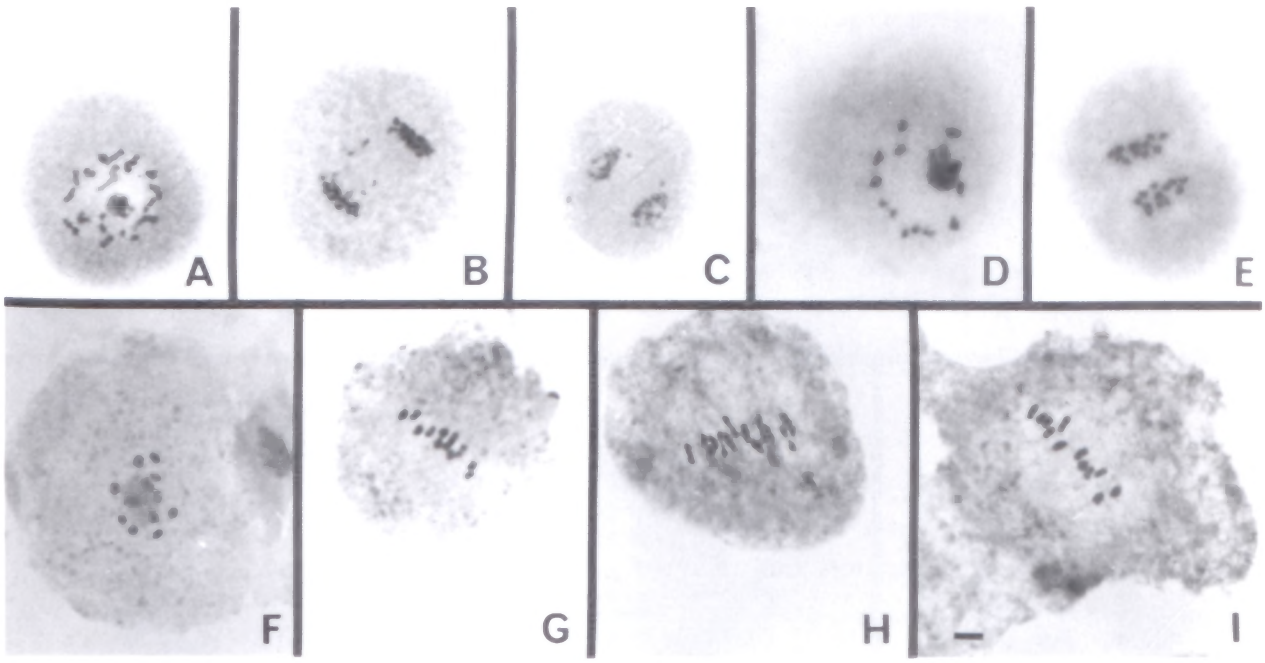

FIGURE 2.—Meiotic chromosomes in one specimen each of the genera *Loudetia* and *Tristachya*. A–C, *L. simplex*, *Spies 1981b*, n = 18: A, diakinesis with 18_{II}; B, anaphase I with two laggards; C, telophase I with micronuclei. D, E, *T. leucothrix*, *H. du Plessis 152*, n = 12: D, diakinesis with 12_{II}; E, anaphase I with a 12-12 chromosome segregation. F, G, *T. leucothrix*, *Spies 5148*, n = 12: F, diakinesis; G, metaphase I with 12_{II}. H, *T. leucothrix*, *Spies 5061*, n = 12, metaphase I with 12_{II}. I, *T. leucothrix*, *Spies 4711*, n = 12, metaphase I with 12_{II}. Scale bar: 40 µm.

of the Arundinelleae should most probably be six, which conforms to some previous reports on these genera (Moffett & Hurcombe 1949; De Wet 1958; Spies & Du Plessis 1987a). In this tribe 100% of the species studied proved to be either a new chromosome number or a new ploidy level for the species.

Tribe Paniceae

The genus *Alloteropsis* consists of five to eight species worldwide and three species are indigenous to southern Africa (Clayton & Renvoize 1986; Gibbs Russell *et al.* 1990). *Alloteropsis semialata* is diploid (n = x = 9) with normal meiosis (Figure 3A, B) and this confirms previous reports (Moffett & Hurcombe 1949; De Wet & Anderson 1956; De Wet 1958). A hexaploid level has also been reported (Moffett & Hurcombe 1949; De Wet & Anderson 1956).

The genus *Anthephora* consists of 12 species (Clayton & Renvoize 1986) worldwide, with four indigenous to southern Africa (Gibbs Russell *et al.* 1990). The *A. pubescens* specimens are n = 2x = 18 (Figure 3C) which conforms to previous reports on this genus and confirms the tetraploid level in the specimens studied (Spies 1982; Spies & du Plessis 1986a).

The genus *Axonopus* has 110 species (Clayton & Renvoize 1986) worldwide, with one naturalized species in southern Africa (Gibbs Russell *et al.* 1990). The *Axonopus affinis* specimens are n = 2x = 20 (Figure 3D) which conforms to previous reports (Burton 1942;

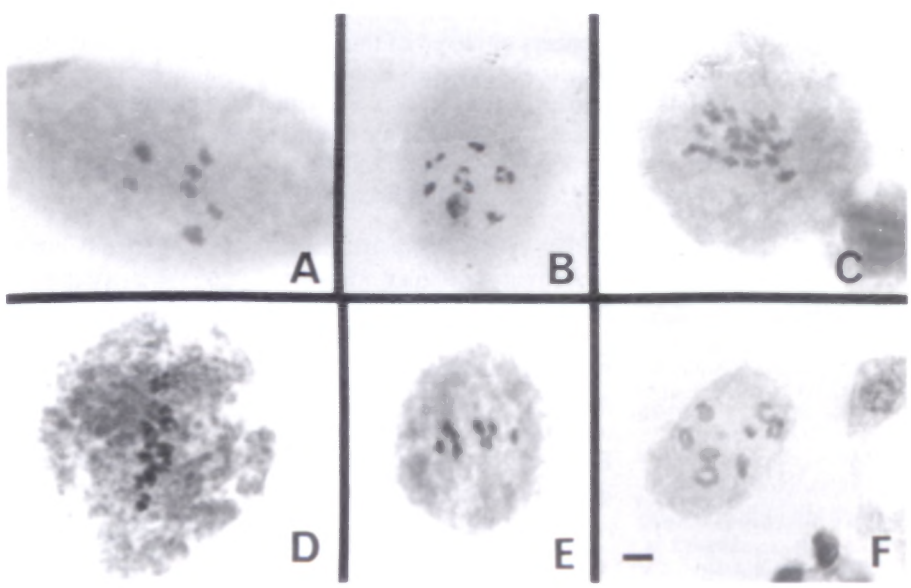

FIGURE 3.—Meiotic chromosomes in some specimens of *Alloteropsis*, *Anthephora*, *Axonopus* and *Brachiaria*. A, *Alloteropsis semialata*, *Spies 4715*, n = 9, metaphase I with 9_{II}. B, *A. semialata*, *Spies 5068*, n = 9, diakinesis with 9_{II}. C, *Anthephora pubescens*, *Spies 5500*, n = 18, diakinesis with 18_{II}. D, *Axonopus affinis*, *Spies 2561*, n = 20, metaphase with 20_{II}. E, *Brachiaria serrata*, *Spies 5075*, n = 9, metaphase I with 9_{II}. F, *B. xantholeuca*, *Spies 4812*, n = 9, diakinesis with 9_{II}. Scale bar: A, 26.6 µm; B, D–F, 40µm; C, 32 µm.

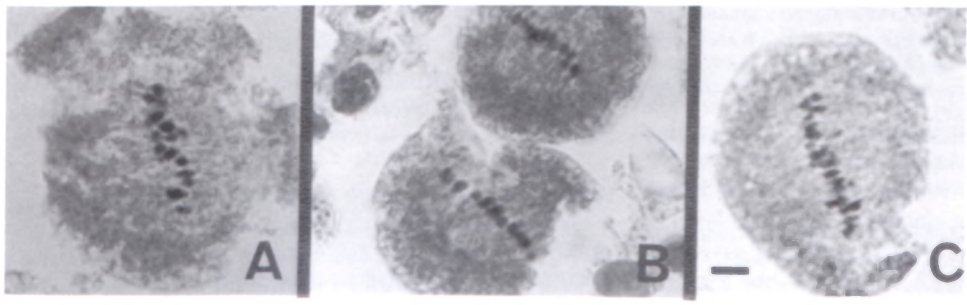

FIGURE 4.—Meiotic chromosomes. A, *Paspalum urvillei, Spies 1980*, n = 20, metaphase I with 20_{II}. B, *P. urvillei, Saayman 67*, n = 20, metaphase I with 20_{II}. C, *Setaria pallide-fusca, Spies 2772*, n = 18, metaphase I with 18_{II}. Scale bar: 40 µm.

Brown 1948; Hickenbick 1975; Mehra 1982). However, chromosome numbers of 2n = 54 and n = 25 have been previously reported (Brown 1946; Mehra 1982). Diploid levels for this species have also been observed (Burton 1942; Brown 1948; Hickenbick 1975; Mehra 1982).

The genus *Brachiaria* consists of 100 species worldwide (Clayton & Renvoize 1986), with 19 indigenous and one naturalised species in southern Africa (Gibbs Russell *et al.* 1990). Five of these species are included in this study (Table 1). All the specimens of *B. bovonei, B. brizantha, B. nigropedata, B. serrata* (Figure 3E) and *B. xantholeuca* (Figure 3F) are n = x = 9, which conforms with previous results (Moffet & Hurcombe 1949; De Wet & Anderson 1956; Nath & Swaminathan 1957; De Wet 1958, 1960; Nassar 1977; Dujardin 1978, 1979; Sharma & Kaur 1980; Basappa & Muniyamma 1981; Mehra 1982; Spies & du Plessis 1986a, b, 1987b; Sinha *et al.* 1990; Spies *et al.* 1991), the exception being *B. xantholeuca*, for which this is the first chromosome number report. To the best of our knowledge, this is the first report on the presence of B-chromosomes in *Brachiaria*. Chromosome numbers of n = 18, 27 or 45 have also been previously observed in *B. nigropedata* and *B. serrata* (Dujardin 1978, 1979; Sharma & Kaur 1980; Mehra 1982; Spies & du Plessis 1986b, 1987b; Sinha *et al.* 1990; Spies *et al.* 1991).

The genus *Paspalum* consists of 330 species (Clayton & Renvoize 1986) worldwide, with three indigenous species and three naturalised species in southern Africa (Gibbs Russell *et al.* 1990). All the specimens of *P. dilatatum, P. scrobiculatum* and *P. urvillei*, except *Spies 2362*, are tetraploids, with n = 2x = 20 (Figure 4A, B). Only bivalents were observed, indicating that these species are alloploids. Meiotic abnormalities such as laggards and micronuclei were observed in some specimens of *P. dilatatum*. Laggards were also observed in a few cells of one specimen of *P. urvillei*. Chromosome numbers of n = 21, 25 or 27 and 2n = 50 or 63 have been previously reported in *P. dilatatum* and *P. scrobiculatum* (Tateoka 1954; Bashaw & Forbes 1958; Singh & Godward 1960; Mehra & Sharma 1975; Mehra & Chaudhary 1976, 1981; Dandin & Chennaveeraiah 1977, 1983; Rao Sindhe 1977; Sharma *et al.* 1978; Mehra 1982; Hickenbick *et al.* 1987; Spies & Du Plessis 1987a).

The last genus included in this study, *Setaria*, consists of 110 species (Clayton & Renvoize 1986), with 19 indigenous and two naturalised species in southern Africa (Gibbs Russell *et al.* 1990). Five of these species are included in this study (Table 1). All the studied specimens of *S. incrassata, S. nigrirostris, S. pallide-fusca* (Figure 4C) and *S. plicatilis* are diploid with n = x = 9 which conforms with previous reports (Krishnaswamy & Ayyangar 1935; De Litardière 1948; Moffett & Hurcombe 1949; Krishnaswamy 1951; De Wet 1954; Singh & Godward 1960; Olorode 1975; Gupta & Singh 1977; Sharma *et al.* 1978; Dujardin 1979; Mehra 1982; Bir & Sahni 1984; Spies & du Plessis 1986a, b). The *S. sphacelata* specimens studied have diploid, tetraploid and hexaploid levels, which conforms to previous reports (Spies & du Plessis 1986b, 1987a). Meiotic abnormalities, particularly laggards during anaphase I, were observed in one *S. sphacelata* var. *splendida* specimen. All the other specimens of *S. sphacelata* var. *sericea*, var. *sphacelata*, var. *splendida* and var. *torta* exhibited normal bivalent formation during meiosis I. No chromosome numbers have been previously reported for *S. sphacelata* var. *sphacelata* and var. *splendida*.

This study provided new reports for three species and two interspecific taxa (10%) of the tribe Paniceae and helped to confirm the basic chromosome number of *Axonopis* as 10. It is also the first report on the presence of B-chromosomes in *Brachiaria*. This indicates that chromosome number reports on grasses should be done more frequently and such studies will contribute to the knowledge of these grasses. At this stage the knowledge is insufficient to determine the correlation between ploidy level and geographical distribution.

This study confirms a basic chromosome number of 5 and a secondary basic chromosome number of 10 for the tribe Andropogoneae, a basic chromosome number of 6 for the tribe Arundinelleae and 10 for the genera *Axonopus* and *Paspalum* of the tribe Paniceae.

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