Basic chromosome numbers and polyploid levels in some South African and Australian grasses (Poaceae)

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Keywords: chromosome numbers, meiosis, Poaceae, polyploidy, southern Africa

ABSTRACT

Chromosome numbers of 46 specimens of grasses, involving 24 taxa from South Africa and Australia, have been determined during the present study. For the first time chromosome numbers are given for *Eragrostis sarmentosa* (Thunb.) Trin. (n = 20), *Panicum aequinerve* Nees (n = 18), *Digitaria argyrograpta* (Nees) Stapf (n = 9) and *D. maitlandii* Stapf & C.E. Hubb. (n = 9). Additional polyploid levels are described for *Diplachne fusca* (L.) Beauv. ex Roem. & Schult. (n = 10) and *Digitaria diagonalis* (Nees) Stapf var. *diagonalis* (n = 9).

B-chromosomes were observed in several different specimens. The presence of B-chromosomes often results in abnormal chromosomal behaviour during meiosis.

UITTREKSEL

Chromosoomgetalle van 46 graseksemplare, wat 24 taksons uit Suid-Afrika en Australië behels, is bepaal. Vir die eerste keer word chromosoomgetalle vir *Eragrostis sarmentosa* (Thunb.) Trin. (n = 20), *Panicum aequinerve* Nees (n = 18), *Digitaria argyrograpta* (Nees) Stapf (n = 9) en *D. maitlandii* Stapf & C.E. Hubb. (n = 9) vermeld. Addisionele poliploiede vlakke word ook beskryf vir *Diplachne fusca* (L.) Beauv. ex Roem. & Schult. (n = 10) en *Digitaria diagonalis* (Nees) Stapf var. *diagonalis* (n = 9).

B-chromosome is by verskeie eksemplare waargeneem. Die teenwoordigheid van B-chromosome is dikwels met abnormale meiotiese chromosoomgedrag geassosieer.

INTRODUCTION

Raven (1975) regarded cytogenetics as an important element in the evaluation of relationships and in the determination of phylogenetic sequences in the angiosperms. In South Africa this useful taxonomic tool has not been used widely and plant cytogenetics can be considered to be one of the most neglected fields of botany. Thorough cytogenetic studies are restricted to a few economically important species and the most basic cytogenetic data, the chromosome numbers of the taxa, are not available for the majority of our indigenous species.

In an attempt to increase our cytogenetic knowledge of the South African flora, a cytogenetic study of the family Poaceae was initiated by the Botanical Research Institute during 1986 and is now continued at the National Botanical Institute, the Grassland Research Centre and the Department of Botany and Genetics at the University of the Orange Free State. Results were reported in previous publications in this series (Spies & Du Plessis 1986a, b, 1987a, b, 1988; Spies & Jonker 1987; Spies & Voges 1988; Du Plessis & Spies 1988; Spies *et al.* 1989). The present paper reports on miscellaneous unpublished chromosome numbers and aims to determine whether this information can contribute to our knowledge on the basic chromosome numbers and polyploid levels present in the South African Poaceae.

MATERIALS AND METHODS

Cytogenetic material was collected in two different ways for the purpose of this study. The material was either collected and fixed in the field, or living material was collected in the field and transplanted in the nursery of the National Botanical Institute, Pretoria, where cytogenetic material was later collected and fixed. The material used and localities of origin are listed in Table 1. Voucher specimens are housed in the National Herbarium, Pretoria (PRE).

Young inflorescences were fixed in Carnoy's fixative (Carnoy 1886). The fixative was replaced by 70% ethanol after 24–48 hours of fixation. Anthers were squashed in aceto-carmine (Darlington & La Cour 1976). Contrast between cytoplasm and chromosomes was enhanced by adding a small droplet of 45% acetic acid, saturated with iron acetate, to the stain immediately prior to making the squash [modification of method used by Thomas (1940)]. Slides were made permanent by freezing them with liquid CQ (Bowen 1956), followed by dehydration in ethanol and mounting in Euparal. An Olympus Vanox-S photomicroscope and Ilford Pan-F film were used for the photomicrographs. At least ten cells per specimen were studied for each meiotic stage, except where otherwise indicated.

RESULTS AND DISCUSSION

The haploid chromosome numbers observed are listed with the voucher specimen numbers and their localities in Table 1. The classification of subfamilies and tribes follows Clayton & Renvoize (1986). Unless otherwise indicated, meiotic chromosome behaviour was normal.

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TABLE 1.—List of species studied, haploid chromosome numbers, voucher specimen numbers and localities according to the degree reference system (Edwards & Leistner 1971)

Softanily Arusdinoideae Aristida congeros subp. congeros 4 1 1 1 1 1 1 1 1 1 1 2 2 1 2 2 2 2 2 2	Taxon	Haploid chromosome number	Locality and voucher number
Tribe Arsidic corregions ubbp. congenia 11 NATAL = -2930 (Phetermanizburg): 5 km from Muden to Greytown, (=-RA), Du Presito 17 Siphagrouis obtain 22 + 0-28 NAMISA = -286 (Aus): 10 km reads of Aus: 1-CEB, Spers 2935 Siphagrouis obtain 22 + 0-28 NAMISA = -286 (Mar): 10 km reads of Aus: 1-CEB, Spers 2935 Subfamily, Chloridoideae 11 NAMISA = -2830 (Phytre 2986 Subfamily, Chloridoideae 10 CAPE = -3018 (Kamileberg): 52 km from Springbok to Leeriesfonien, (=AA), Spirs 3235 Diglarburg facc 10 TRANSWAL = -2430 (Phytrem Xin eart MacMar Fails, (=DD), Spirs 2562 Subtribe Essentiae 10 CAPE = -3118 (Cape Time): reart turnoff to Selfenboch on nual between Paul and Franceh besk (= DD), Spirs 300 Barbine Sportbolinae 10 CAPE = -3232 (Mubitubai: 12 km from Cape Vidal to S1 Lucia, (=AB), Spirs 2525 Tribe Condonizee 580tribe Chombare 24 CAPE = -3028 (Matitubai: 12 km from Redes to Maclear via Naude's Pass, (=CC), Spire 3253 Subtribe Staaminee 2232. CAPE = -3028 (Matitubai: 12 km from Sheki to Mazinet, (=AC), Spire 3253 Subtribe Digitariae 18 CAPE = -3028 (Matitubai: 12 km from Sheki to Mazinet, (=AC), Spire 3253 Subtribe Digitariae 18 CAPE = -3028 (Matitubai: 12 km from Sheki to Mazinet, (=AC), Spire 3253 Subtribe Staaminee	Subfamily Arundinoideae		
Soldanily Chierdoideae Tobe Ergonsits capenas 0 CAPE = -3018 (Kamiesberg): 52 km from Springbok to Loeresfontein, (-AA), Spies 357. Engrassis capenas 0 TRANSVAAL. = 2238 (Pretoria): Stoppan Experimental Farm, (-AC), Spies 367. E. summonsa 0 CAPE = -3018 (Kamiesberg): 52 km from Springbok to Loeresfontein, (-AC), Spies 357. E. summonsa 0 CAPE = -318 (Care) Town, rear turnoff to Sellenbox: On onab between Paul and Franschheck, (-DD), Spies 320. Biother Springer Status 12 CAPE = -318 (Cape Town): near turnoff to Sellenbox: On onab between Paul and Franschheck, (-DD), Spies 320. Biother Condoniae 24 CAPE = -3028 (Matatele): D km from Cape Vidal to St Lucia, (-AB), Spies 229. Stother Scherndrage 232. Subtraction Structure Stru	Tribe Aristideae Aristida congesta subsp. congesta Stipagrostis obtusa	11 22 22+0-2B	NATAL. – 2930 (Pietermaritzburg): 5 km from Muden to Greytown, (-BA), <i>Du Plessis 137</i> . NAMIBIA. – 2616 (Aus): 10 km east of Aus, (-CB), <i>Spies 2905</i> . NAMIBIA. – 2617 (Bethanie): near bridge over Fish River on road between Seeheim and Luderitz, (-DD), <i>Spies 2898</i> .
The Explositione CAPE — 2018 (Kamite-berg): 52 km from Springbok to Locricefontein. (-AA). Spres 333. Engronsis 20 TRANSVAL. — 2330 (Pigrims). Rest: merit Mac-Mac Falls. (-DD). Spic 6. Joffe 292. E. cilianersis 10 TRANSVAL. — 2328 (Pretoria). Source Experimental Farm. (-AA). Spres 3287. E. samenosa 20 CAPE. — 318 (Cape Town): mar trendf to Stellenbwich on mad between Paarl and Franschhoek. (-DD). Spic 3. 201. Biotheb Sporoboline 12 CAPE. — 318 (Cape Town): mar trendf to Stellenbwich on mad between Paarl and Franschhoek. (-DD). Spic 3. 201. Biotheb Sporoboline 12 CAPE. — 3028 (Matatiele): 25 km from Rhodes to Maclear via Naude's Pass. (-CC). Spic 3292. The Cynadiontee 20 CAPE. — 3028 (Matatiele): 25 km from Strict to Marzin. (-AC). Spic 3203. Subtribe Starinae 2323. 2324. 2323. Subtribe Digarinae 16 SWAZILAND = 2631 (Mhabane): 18 km north-east of Mbabane. (-AC). Spic 3203. Subtribe Digarinae 18 SWAZILAND = 2631 (Mhabane): 35 km from Strict to Marzin. (-AC). Spic 323. Enchannae 18 SWAZILAND = 2631 (Mhabane): 35 km from Strict to Marzin. (-AC). Spic 3725. Subtribe Digarina argogroup 9 TRANSVAAL. = 2528 (Pretoria): Sourpan Experimental Farm. (-AC). Spics 3725. Subarrin	Subfamily Chloridoideae		
Diplochne Jaca 10 CAPE	Subtribe Eleusininae		
Engrostis capenas 20 TRANSVAL. – 2330 (Pignm's Rest): near Mac-Mac Falls, (~DD), Spie 3. Juffer S237. E. summissis 10 TRANSVAL. – 2328 (Pretoria): Sourpan Experimental Farm, (~AC), Spies 3207. Subtribe Sporobolinae 20 CAPE – 318 (Cape Town): near turnoff to Sellenbosch on road between Parl and Franschhoek, (~DD), Spies 3200. IB=0-0-6B NATAL – 2832 (Mutatuba): 12 km from Cape Vidal to S1 Locas, (~AB), Spies 2200. Subtribe Sporobolinae 24 CAPE – 3028 (Matatule): 25 km from Rhodes to Maclear via Naude's Pass, (~CC), Spies 3202. Subtribe Chondinae 20 CAPE – 3028 (Matatule): 25 km from Rhodes to Maclear via Naude's Pass, (~CC), Spies 3203. Subtribe Chondinae 20 CAPE – 3028 (Matatule): 18 km north-east of Muhane, (~AC), Spies 203. Subtribe Source 8 SWAZILAND – 2631 (Muhane): 18 km north-east of Muhane, (~AC), Spies 3203. Subtribe Digitariinae 9 CAPE – 3028 (Matatule): Antop Pask, (~CC), Spies 3725. Subtribe Digitariinae 9 CAPE – 3228 (Pretoria): Sourpan Experimental Farm, (~AC), Spies 3725. Subtribe Digitariinae 9 CAPE – 3228 (Pretoria): Colvinaed variety collected at Roodeplaat Experimental Farm, (~AC), Spies 3739. D diadoralis 9 CAPE – 3228 (Pretoria): culviviaed variety collected at Roodeplaat Experimental Farm, (~CA),	Diplachne fusca	10	CAPE 3018 (Kamiesberg): 52 km from Springbok to Loeriesfontein, (-AA), Spies 3373.
E. cilianensis 10 TRANSVAL. – 253 (Pretoria): Soutpan Experimental Farm. (-AC). Spies 3287. Subtribe Sporobolina 20 CAPE. – 318 (Cape Town): near turnoff to Stellenbosch on nud between Parl and Franschhock, (-DD). Spies 3207. Ik+0 – 6B NATAL. – 2532 (Mutatuba): 12 km from Cape Vidal to St. Lucia, (-AB). Spies 2393. Ik+0 – 6B NATAL. – 2532 (Mutatuba): 12 km from Cape Vidal to St. Lucia, (-AB). Spies 2393. Subtribe Chloridinae 20 CAPE. – 3028 (Matatube): near Antelope Park. (-CC). Spies 2529. Tribe Cynodonteae Subtribe Selarinae 20 CAPE. – 3028 (Matatube): near Antelope Park. (-CC). Spies 2529. Subtribe Selarinae 20 CAPE. – 3028 (Matatube): near Antelope Park. (-CC). Spies 2529. Subtribe Selarinae 20 CAPE. – 3028 (Matatube): near Antelope Park. (-CC). Spies 2529. Subtribe Selarinae 20 CAPE. – 3028 (Matatube): near Sinki (near Sinki (near), (-AC). Spies 2503. Bracharia Drizanha 18 CAPE. – 3028 (Pretoria). Soutpan Experimental Farm. (-AC). Spies 379. D diagandis varia. diagonalis 9 TRANSVAAL. – 2528 (Pretoria). Soutpan Experimental Farm. (-AC). Spies 379. D diagardis varia. diagonalis 9 SWAZILAND. – 2631 (Mbabane): near Sirki. (-ED). Spies 379. D diagardis varia. diagonalis varia. diag	Eragrostis capensis	20	TRANSVAAL2430 (Pilgrim's Rest): near Mac-Mac Falls, (-DD), Spies & Joffe 1973.
Labrinda CAPE. — Silk (Camp Town): mark transformation Distribute Sporobolinae CAPE. — Silk (Cape Town): mark transformation Sporobolits africanus 12 CAPE. — Silk (Cape Town): mark transformation on mal between Pauri and Franschhock. (= DD): Spice 3201. NATAL — 2832 (Mutuatuba): 12 km from Cape Vidal to St Lucia. (= AB): Spice 3292. CaPE. — 3028 (Matatele): near Antelope Park. (= CC): Spice 3223. Subtribe Chordinae Harpochloa falz Panicodes Subtribe Schordinae Panicode Subtribe Schordinae Panicode Subtribe Scharinae Panicode Panicode Backarinae Panicode Panicode	E. cilianensis	10	TRANSVAAL. – 2528 (Pretoria): Soutpan Experimental Farm, (–AC), Spies 3287. CAPE – 3118 (Vanrhynsdorp): Gifberg Pass. (–DC). Spies 3105.
Jacking Spontolinae 12 CAPE = -318 (CapE town): near turnoff to Stellenbosch on noal between Paarl and Franschbock. (-DD), Spire 320. 18+0-68 NATAL = 2328 (Matatiele): 12 km from Cape Vidal to St Lucia, (-AB), Spire 3293. 24 CAPE = -3028 (Matatiele): near Antelope Park, (-CC), Spire 3259. Tribe Cynodonicae Subtribe Chloridinae Happochlog Jab 20 Subtribe Scannae 2323 Subtribe Scannae SWAZILAND = 2631 (Mbabane): 18 km north-east of Mabane, (-AC), Spire 3255. Practimum 16 SWAZILAND = 2631 (Mbabane): 18 km north-east of Mabane, (-AC), Spire 3203. Tribe Panicam 2000 (CAPE = -3228 (Matatiel: Antiper Park, (-CC), Spire 3234. Unckloa mosambicentis 14 TRANSVAL = -2528 (Pretoria): Soutpan Experimental Farm, (-AC), Spire 3725. Subtribe Digitaria argytograph 9 D diagondits va. diagonalis 9 TRANSVAL = -2528 (Pretoria): Soutpan Experimental Farm, (-AC), Spire 3729. D diaderdia 9 TRANSVAL = -2528 (Pretoria): Cultivated variety collected at Roodeplaat Experimental Farm, (-CA), Spire 3749. D diaderdia 9 SWAZILAND = 2631 (Mbabane): near Sitekt, (-BD), Spire 3769. D diaderdia 9 TRANSVAL = -2528 (P	L. surmeniosa Subtribe Sporobolinge	20	CAT L. — 5118 (Valithylisuolp). Ottocig rass, (~DC), spics 5105.
bock, (-DD). Spies 220/. BR+0-6B NATAL2323 (Mubatuba): 12 km from Cape Vidal to St Lucu, (-AB), Spies 2393. CAPE3028 (Matatele): near Antelope Park, (-CC), Spies 2529. Tribe Cynodonteae Subtribe Chloridinae Itaryochola fait 20 Subfamily Panicoideae 2233 Subtribe Scarnnae 2233 Bancum acquirerye 18 SWAZILAND - 2631 (Mubahae): 18 km north-east of Mubahae, (-AC), Spies 2535. Praximum 16 SWAZILAND - 2631 (Mubahae): 18 km north-east of Mubahae, (-AC), Spies 2503. Bancharra brizanta 18 CAPE3028 (Matatele): Anotheope Park, (-CC), Spies 2528. Uncoling mocambicensis 14 TRANSVAAL2528 (Pretoria): Soutpan Experimental Farm, (-AC), Spies 3725. Subtribe Digitaria 2700 (Matatele): Anotheope Park, (-CC), Spies 2546. 1739. D diagonalis var. diagonalis 9 CAPE3228 (Diretoria): Soutpan Experimental Farm, (-AC), Spies 373. D diagonalis var. diagonalis 9 CAPE3228 (Pretoria): Cultivated variety collected at Roodeplaat Experimental Farm, (-AC), Spies 373. D diagonalis var. diagonalis 9 CAPE3228 (Pretoria): cultivated variety collected at Roodeplaat Experimental Farm, (-CA), Spies 375. D didi	Sporobolus africanus	12	CAPE
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Subtribe Chloridinae 20 CAPE3028 (Matatele): 25 km from Rhodes to Maclear via Naude's Pass, (-CC), Spres 2523. Subfamily Panicoideae 7 2523. Subfamily Panicoideae 7 Subtribe Setarinae 8 SWAZILAND 2631 (Mbabane): 18 km north-east of Mbabane, (-AC), Spres 2555. P maximum 16 SWAZILAND 2631 (Mbabane): 55 km from Siteki to Manzini, (-AC), Spres 2528. Urochloa mosambicensis 14 TRANSVAAL 2528 (Pretoria): Soutpan Experimental Farm, (-AC), Spres 3725. Subtribe Digitarinae Digitaria acryographa 9 TRANSVAAL 2528 (Pretoria): Soutpan Experimental Farm, (-AC), Spres 3739. D. diagonalis var. diagonalis 9 CAPE 3228 (Butterworth): near Sunrise-on-Sea. (-CC), Spres 2566. D. diadorida 9 SWAZILAND 2531 (Mbabane): near Sunrise-on-Sea. (-CC), Spres 256. D. diagonalis var. diagonalis 9 TRANSVAAL 2528 (Pretoria): cultivated varietics collected at Rosodeplaat Experimental Farm, (-CA), Spres 375. D. diadorida 9 TRANSVAAL 2528 (Pretoria): cultivated varietics collected at Rosodeplaat Experimental Farm, (-CA), Spres 3759. P-0-48 CAPE3228 (Pretoria): cultivated variety collected at Rosodeplaat Experimental Farm, (-CA), Spres 3757. TRANSVAAL 2528 (Pretoria): cultivated variety collected at Rosodeplaat Experimental Farm, (-CA), Spres 3757	Tribe Cynodonteae		
Harpochlog falx 20 CAPE3028 (Matatele): 25 km from Rhodes to Maclear via Naude's Pass, (-CC). Spies 253. Subfamily Panicoideae 253. Tribe Paniceae 500 Subtribe Scarrinae 8 Panicum acquirerve 18 Subtribe Scarrinae 18 Brachinara brizanha 18 CAPE3028 (Matatele): Antelope Park, (-CC), Spies 2528. Drochina mombucensis 14 TRANSVAAL2528 (Pretoria): Soutpan Experimental Farm, (-AC), Spies 3739. D diagonalis var. diagonalis 9 O diagonalis var. diagonalis 9 TRANSVAAL2528 (Pretoria): Soutpan Experimental Farm, (-AC), Spies 379. D diadoralis var. diagonalis 9 SWAZILAND 2631 (Mbabane): ear Sitek, (-BD), Spies 2596. D diadoralis var. diagonalis 9 TRANSVAAL2528 (Pretoria): cultivated varieties collected at Roodeplaat Experimental Farm, (-CA), Spies 3750. Farm, (-CA), Spies 3746, 3749, 3751, 3752, 3754, 3756, 3756, 3766. 9 +21B TRANSVAAL2528 (Pretoria): cultivated varieties collected at Roodeplaat Experimental Farm, (-CA), Spies 3757. Farm, (-CA), Spies 3757. 376. 9 +21B TRANSVAAL2528 (Pretoria): cultivated varieties	Subtribe Chloridinae		
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Panicum acquinerve IB SWAZILAND. – 2631 (Mbahane): IB km north-east of Mbahane. (–AC). Spies 2535. P maximum IG SWAZILAND. – 2631 (Mbahane): S km from Sitek to Manzin. (–AD). Spies 2603. Brachinaria brizantha IB CAPE. – 3028 (Matatiele): S km from Sitek to Manzin. (–AD). Spies 3735. Subtrib Digitariinae TRANSVAAL. – 2528 (Pretoria): Soutpan Experimental Farm. (–AC). Spies 3739. D diagonalis ar. diagonalis GAPE. – 3228 (Muterworth): near Surise-on-Sea. (–CC). Spies 1665. D diadonalis ar. diagonalis GAPE. – 3228 (Intervorth): near Surise. (–CD). Spies 2596. D eriantha GAPE. – 3228 (Intervorth): near Surise. (–CD). Spies 2596. D eriantha GAPE. – 3228 (Intervorth): near Surise. (–CD). Spies 2596. D eriantha GAPE. – 3228 (Intervorth): near Surise. (–CD). Spies 2596. D eriantha GAPE. – 3228 (Intervorth): near Surise. (–CD). Spies 2596. D #1–3B TRANSVAAL. – 2528 (Pretoria): cultivated variety collected at Roodeplaat Experimental Farm. (–CA). Spies 3756. 3760. G+1–3B TRANSVAAL. – 2528 (Pretoria): cultivated variety collected at Roodeplaat Experimental Farm. (–CA). Spies 3757. G+2B TRANSVAAL. – 2528 (Pretoria): cultivated variety collected at Roodeplaat Experimental Farm. (–CA). Spies 3747. D maitlandii GAPE. – 3228 (Pretoria): cultivated variety collecte	Subtribe Setariinae		
P. maximum b SWA2LLAND = 2631 (Mbabane): 25 km from Stekt 10 Matzini, (=AD), spres 263. Brachiara brizaniha IS CAPE. = 3028 (Matatele). Antelope Park. (=CC), Spres 2528. Urochloa mosambicensis IA TRANSVAAL. = 2528 (Pretoria): Soutpan Experimental Farm, (=AC), Spres 3739. Digitaria argyrograpta 9 TRANSVAAL. = 2528 (Pretoria): Soutpan Experimental Farm, (=AC), Spres 3739. D. diagonalis var. diagonalis 9 SWA2LLAND. = 2631 (Mbabane): near Siteki, (=BD), Spres 2566. D. erianiha 9 TRANSVAAL. = 2528 (Pretoria): cultivated varieties collected at Roodeplaat Experimental Farm, (=CA), Spres 3736. 9+1=3B TRANSVAAL. = 2528 (Pretoria): cultivated variety collected at Roodeplaat Experimental Farm, (=CA), Spres 3757. 9+2B TRANSVAAL. = 2528 (Pretoria): cultivated variety collected at Roodeplaat Experimental Farm, (=CA), Spres 3747. 9+10 SWA2LL_ADE. 2528 (Pretoria): cultivated variety collected at Roodeplaat Experimental Farm, (=CA), Spres 3747. 9+10 TRANSVAAL. = 2528 (Pretoria): cultivated variety collected at Roodeplaat Experimental Farm, (=CA), Spres 3747. 9+18 TRANSVAAL. = 2528 (Pretoria): cultivated variety collected at Roodeplaat Experimental Farm, (=CA), Spres 3748. D matilandii 9 SWA2LLAD. = 2631 (Mbabane): 2 km from framedored famates 25640. <t< td=""><td>Panicum aequinerve</td><td>18</td><td>SWAZILAND. –2631 (Mbabane): 18 km north-east of Mbabane, (–AC), Spies 2555.</td></t<>	Panicum aequinerve	18	SWAZILAND. –2631 (Mbabane): 18 km north-east of Mbabane, (–AC), Spies 2555.
Urochloa mosambicensis 14 TRANSVAAL. —2528 (Pretoria): Soutpan Experimental Farm. (-AC). Spies 3725. Subtribe Digitarinae 0 TRANSVAAL. —2528 (Pretoria): Soutpan Experimental Farm. (-AC). Spies 3739. D diagonalis 9 CAPE. —3228 (Butterworth): near Surrise-on-Sea. (-CC). Spies 1665. D diadocria 9 SWAZILAND. —2631 (Mbabane): near Surise-on-Sea. (-CC). Spies 1665. D diadocria 9 SWAZILAND. —2538 (Pretoria): cultivated varieties collected at Roodeplaat Experimental Farm. (-CA). Spies 3764. 3769. 9 +1-3B TRANSVAAL. —2528 (Pretoria): cultivated variety collected at Roodeplaat Experimental Farm. (-CA). Spies 3758. 9 +2B TRANSVAAL. —2528 (Pretoria): cultivated variety collected at Roodeplaat Experimental Farm. (-CA). Spies 3759. 9 +0-4B CAPE. —3225 (Pretoria): cultivated variety collected at Roodeplaat Experimental Farm. (-CA). Spies 3747. 9 +0-5B TRANSVAAL. —2528 (Pretoria): cultivated variety collected at Roodeplaat Experimental Farm. (-CA). Spies 3757. 9 +0-5B TRANSVAAL. —2528 (Pretoria): cultivated variety collected at Roodeplaat Experimental Farm. (-CA). Spies 3747. 9 +0-5B TRANSVAAL. —2528 (Pretoria): cultivated variety collected at Roodeplaat Experimental Farm. (-CA). Spies 3747. 9 +0 5 TRANSVAAL. —2528 (Pretoria): cultivated variety collected at Roodeplaat Experimental Farm. (-CA). Spies 3747. 9 trakinduiti	P. maximum Brachiaria brizantha	10	SWAZILAND 2031 (Moadane): 55 km from Siteki to Manzini, (-AD), <i>spies 2003.</i> CAPE - 3028 (Matatiele): Antelone Park (-CC) Spies 2528
Subtribe Digitariinae 9 TRANSVAAL2528 (Pretoria): Soutpan Experimental Farm. (-AC), Spies 3739. D diagonalis var. diagonalis 9 CAPE3228 (Buterworth): near Sunrise-on-Sea, (-CC), Spies 1665. D diadactyla 9 SWAZILAND -2631 (Mbabane): near Sunrise-on-Sea, (-CC), Spies 2596. D eriantha 9 TRANSVAAL2528 (Pretoria): cultivated varieties collected at Roodeplaat Experimental Farm. (-CA), Spies 3746, 3751, 3752, 3754, 3755, 3756 & 3760. 9+1-38 TRANSVAAL2528 (Pretoria): cultivated variety collected at Roodeplaat Experimental Farm. (-CA), Spies 3758, 9756 & 3760. 9+2.B TRANSVAAL2528 (Pretoria): cultivated variety collected at Roodeplaat Experimental Farm. (-CA), Spies 3759, 3756 & 3760. 9+0-48 CAPE3222 (Pretoria): cultivated variety collected at Roodeplaat Experimental Farm. (-CA), Spies 3779. 9+0-59 TRANSVAAL2528 (Pretoria): cultivated variety collected at Roodeplaat Experimental Farm. (-CA), Spies 3778. 9+0-51 TRANSVAAL2528 (Pretoria): cultivated variety collected at Roodeplaat Experimental Farm. (-CA), Spies 3748. 9 SWAZILAND -2631 (Mbabane): near beacon at Maimba, (-AD), Spies 2668. 36 SWAZILAND -2631 (Mbabane): 22 km north-east of Mbabane. (-AA), Spies 2349. 71richolaenoides 9 9 TRANSVAAL -2528 (Pretoria): cultivated in the garden of the National Botanical Institute, Pretoria. (-CA), Spies 1713.	Urochloa mosambicensis	10	TRANSVAAL. –2528 (Pretoria): Soutpan Experimental Farm, (–AC), Spies 3725.
Digitaria argyrograpta 9 TRANSVAAL2528 (Pretoria): Soutpan Experimental Farm, (-AC), Spies 3739. D diagonalis var. diagonalis 9 CAPE3228 (Burterworth): near Surises (-CC), Spies 1665. D diadoxida 9 SWAZILAND -2538 (Pretoria): cultivated varieties collected at Roxdeplaat Experimental Farm, (-CA), Spies 3746, 3749, 3751, 3754, 3754, 3755, 3756. D +1-3B TRANSVAAL2528 (Pretoria): cultivated variety collected at Roxdeplaat Experimental Farm, (-CA), Spies 3758. 9+2B TRANSVAAL2528 (Pretoria): cultivated variety collected at Roxdeplaat Experimental Farm, (-CA), Spies 3759. 9+0-4B CAPE3225 (Pretoria): cultivated variety collected at Roxdeplaat Experimental Farm, (-CA), Spies 3779. 9+10-5B TRANSVAAL2528 (Pretoria): cultivated variety collected at Roxdeplaat Experimental Farm, (-CA), Spies 3779. 9+10-8 TRANSVAAL2528 (Pretoria): cultivated variety collected at Roxdeplaat Experimental Farm, (-CA), Spies 3775. 9+10-8 TRANSVAAL2528 (Pretoria): cultivated variety collected at Roxdeplaat Experimental Farm, (-CA), Spies 377. 9 TRANSVAAL2528 (Pretoria): cultivated variety collected at Roxdeplaat Experimental Farm, (-CA), Spies 377. 9 TRANSVAAL2528 (Pretoria): cultivated variety collected at Roxdeplaat Experimental Farm, (-CA), Spies 377. 10 matilandii 9 10 matilandi 9 10<	Subtribe Digitariinae		
D. diagonalis var. diagonalis 9 CAPE3228 (Butterworth): near Sutex, (-CC), Spies 1665. D. didacryla 9 SWAZILAND -2631 (Mbabane): near Sitex, (-BD), Spies 2596. D. eriantha 9 TRANSVAAL2528 (Pretoria): cultivated varieties collected at Roodeplaat Experimental Farm. (-CA), Spies 3746, 3754, 3753, 3756, & 3760. 9+1-3B TRANSVAAL2528 (Pretoria): cultivated variety collected at Roodeplaat Experimental Farm. (-CA), Spies 3759. 9+2B TRANSVAAL2528 (Pretoria): cultivated variety collected at Roodeplaat Experimental Farm. (-CA), Spies 3759. 9+0-4B CAPE3225 (Pretoria): cultivated variety collected at Roodeplaat Experimental Farm. (-CA), Spies 3759. 9+0-5B TRANSVAAL2528 (Pretoria): cultivated variety collected at Roodeplaat Experimental Farm. (-CA), Spies 3746. 9+0-5B TRANSVAAL2528 (Pretoria): cultivated varieties collected at Roodeplaat Experimental Farm. (-CA), Spies 3747. 9+18 TRANSVAAL2528 (Pretoria): cultivated varieties collected at Roodeplaat Experimental Farm. (-CA), Spies 3757. 9-18 TRANSVAAL2528 (Pretoria): cultivated varieties collected at Roodeplaat Experimental Farm. (-CA), Spies 3757. 9 18 TRANSVAAL2528 (Pretoria): cultivated varieties collected at Roodeplaat Experimental Farm. (-CA), Spies 3746. 0 maitlandii 9 SWAZILAND -2631 (Mbabane): near beacon at Maimba. (-AA), Spies 2566. 10	Digitaria argyrograpta	9	TRANSVAAL 2528 (Pretoria): Soutpan Experimental Farm, (-AC), Spies 3739.
D didactyla 9 SWAZILAND = 2631 (Mbabane): new Stekt, (=BD), Spres 25%. D eriantha 9 TRANSVAAL. = 2528 (Pretoria): cultivated variety collected at Roodeplaat Experimental Farm, (=CA), Spres 3746, 3749, 3751, 3752, 3756, 45 3760. 9+1=3B TRANSVAAL. = 2528 (Pretoria): cultivated variety collected at Roodeplaat Experimental Farm, (=CA), Spres 3784, Spres 3759. 9+2B TRANSVAAL. = 2528 (Pretoria): cultivated variety collected at Roodeplaat Experimental Farm, (=CA), Spres 379. 9+0-4B CAPE. = 3225 (Port Elizabeth): 7 km from Somerset East to Pearston, (=CB), Spres 1130. 9+0-4B CAPE. = 3225 (Port Elizabeth): 7 km from Somerset East to Pearston, (=CB), Spres 1130. 9+0-4B CAPE. = 3225 (Pretoria): cultivated variety collected at Roodeplaat Experimental Farm, (=CA), Spres 3771. 9-18 TRANSVAAL. = 2528 (Pretoria): cultivated variety collected at Roodeplaat Experimental Farm, (=CA), Spres 3757. 3761. 18 TRANSVAAL. = 2528 (Pretoria): cultivated variety collected at Roodeplaat Experimental Farm, (=CA), Spres 3746. 19 SWAZILAND. = 2631 (Mbabane): 22 km north-east of Mbabane, (=AA), Spres 2349. 10 TRANSVAAL. = 2528 (Pretoria): cultivated in the garden of the National Botanical Institute, Pretoria, (=CA), Spres 1711. 10 TRANSVAAL. = 2528 (Pretoria): cultivated in the garden of the National Botanical Institute, Pretoria, (=CA), Spres 1713. 10 TRANSVAAL. = 2528 (Pretoria): cultivated	D. diagonalis var. diagonalis	9	CAPE 3228 (Butterworth): near Sunrise-on-Sea, (-CC), Spies 1665.
9+1-3B TRANSVAAL2528 (Pretoria): cultivated variety collected at Roodeplaat Experimental Farm. (-CA). Spies 3759. 9+2B TRANSVAAL2528 (Pretoria): cultivated variety collected at Roodeplaat Experimental Farm. (-CA). Spies 3759. 9+0-4B CAPE3225 (Port Elizabeth): 7 km from Somerset East to Pearston. (-CB). Spies 1130. 9+0-5B TRANSVAAL2528 (Pretoria): cultivated variety collected at Roodeplaat Experimental Farm. (-CA). Spies 377, 3761. 9/18 TRANSVAAL2528 (Pretoria): cultivated variety collected at Roodeplaat Experimental Farm. (-CA). Spies 377, 3761. 18 TRANSVAAL2528 (Pretoria): cultivated variety collected at Roodeplaat Experimental Farm. (-CA). Spies 3748. D maitlandii 9 SWAZILAND2631 (Mbabane): 22 km north-east of Mbabane. (-AA). Spies 2568. D natalensis 9 NATAL2828 (Pretoria): cultivated variety collected at Roodeplaat Experimental Farm. (-CA). Spies 3748. D natalensis 9 NATAL2631 (Mbabane): 22 km north-east of Mbabane. (-AA). Spies 2568. System Sorghum australiense* 10 Natalensis 9 Sorghum australiense* 10 Sitpoideum* 5 Sitpoideum* 5 Sitpoideum* 5 Sitpoideum* 5 <td>D. didactyla D. eriantha</td> <td>9</td> <td>SWAZILAND. – 2631 (Mbabane): near Siteki, (–BD), Spies 2596. TRANSVAAL. – 2528 (Pretoria): cultivated varieties collected at Roodeplaat Experimental Farm, (–CA), Spies 3746, 3749, 3751, 3752, 3754, 3755, 3756 & 3760.</td>	D. didactyla D. eriantha	9	SWAZILAND. – 2631 (Mbabane): near Siteki, (–BD), Spies 2596. TRANSVAAL. – 2528 (Pretoria): cultivated varieties collected at Roodeplaat Experimental Farm, (–CA), Spies 3746, 3749, 3751, 3752, 3754, 3755, 3756 & 3760.
9+2B TRANSVAAL 2528 (Pretoria): cultivated variety collected at Roodeplaat Experimental Farm. (-CA). Spics 3759. 9+0-4B CAPE. -3225 (Port Elizabeth): 7 km from Somerset East to Pearston. (-CB). Spics 1130. 9+0-5B TRANSVAAL. -2528 (Pretoria): cultivated variety collected at Roodeplaat Experimental Farm. (-CA). Spics 3747 9:18 TRANSVAAL. -2528 (Pretoria): cultivated variety collected at Roodeplaat Experimental Farm. (-CA). Spics 3747. 9:18 TRANSVAAL. -2528 (Pretoria): cultivated variety collected at Roodeplaat Experimental Farm. (-CA). Spics 3747. D maitlandii 9 SWAZILAND -2631 (Mbabane): 22 km north-east of Mbabane. (-AA). Spies 2568. D natalensis 9 NATAL. -2631 (Mbabane): near beacon at Maimba, (-AD). Spies 2540. D natalensis 9 NATAL. -2631 (Mbabane): 12 km from Cape Vidal to St Lucia. (-AB). Spies 2399. Tribe Andropogoneae Subtribe Sorghinae 10 TRANSVAAL. -2528 (Pretoria): cultivated in the garden of the National Botanical Institute. Pretoria. (-CA). Spies 170. S. stipoideum* 10 TRANSVAAL. -2528 (Pretoria): cultivated in the garden of the National Botanical Institute. Pretoria. (-CA). Spies 171. S. stipoideum* 5 TRANSVAAL. -2528 (Pretoria): cultivated in the garden of the Nat		9+1-3B	TRANSVAAL 2528 (Pretoria): cultivated variety collected at Roodeplaat Experimental Farm, (-CA), <i>Spies 3758</i> .
9+0-4B CAPE3225 (Port Elizabeth): 7 km from Somerset East to Pearston, (-CB), Spies 1/30. 9+0-5B TRANSVAAL2528 (Pretoria): cultivated variety collected at Roodeplaat Experimental Farm, (-CA), Spies 3747 9/18 TRANSVAAL2528 (Pretoria): cultivated variety collected at Roodeplaat Experimental Farm, (-CA), Spies 375, 3761. 18 TRANSVAAL2528 (Pretoria): cultivated variety collected at Roodeplaat Experimental Farm, (-CA), Spies 3748. D maitlandii 9 SWAZILAND2631 (Mbabane): 22 km north-east of Mbabane, (-AA), Spies 2568. 36 SWAZILAND2631 (Mbabane): near beacon at Maimba, (-AD), Spies 2399. D richolaenoides 9 Natalensis 9 NATAL2828 (Pretoria): cultivated in the garden of the National Botanical Institute, Pretoria, (-CA), Spies 1711. Sorghum australiense* 10 TRANSVAAL2528 (Pretoria): cultivated in the garden of the National Botanical Institute, Pretoria, (-CA), Spies 1713. S. stipoideum* 5 TRANSVAAL2528 (Pretoria): cultivated in the garden of the National Botanical Institute, Pretoria, (-CA), Spies 1713. S. stipoideum* 5 TRANSVAAL2528 (Pretoria): cultivated in the garden of the National Botanical Institute, Pretoria, (-CA), Spies 1713. S. stipoideum* 5 S. stipoideum* 5		9+2B	TRANSVAAL. – 2528 (Pretoria): cultivated variety collected at Roodeplaat Experimental Farm, (-CA), Spies 3759.
9+0-5B TRANSVAAL2528 (Pretoria): cultivated variety collected at Roodeplaat Experimental Farm. (-CA). Spies 3757. 3761. 18 TRANSVAAL2528 (Pretoria): cultivated varieties collected at Roodeplaat Experimental Farm. (-CA). Spies 3747. 18 TRANSVAAL2528 (Pretoria): cultivated variety collected at Roodeplaat Experimental Farm. (-CA). Spies 3748. D maitlandii 9 SWAZILAND2631 (Mbabane): 22 km north-east of Mbabane, (-AA). Spies 2568. 36 SWAZILAND2631 (Mbabane): near beacon at Maimba, (-AB). Spies 2540. D natalensis 9 D tricholaenoides 9 D tricholaenoides 9 D tricholaenoides 9 Sorghum australiense* 10 TRANSVAAL2528 (Pretoria): cultivated in the garden of the National Botanical Institute, Pretoria, (-CA). Spies 1711. S. matarunkense* 5 TRANSVAAL2528 (Pretoria): cultivated in the garden of the National Botanical Institute, Pretoria, (-CA). Spies 1740. S. stipoideum* 5 TRANSVAAL2528 (Pretoria): cultivated in the garden of the National Botanical Institute, Pretoria, (-CA). Spies 1740. S. aff. stipoideum* 5 TRANSVAAL2528 (Pretoria): cultivated in the garden of the National Botanical Institute, Pretoria, (-CA). Spies 1740. S. aff. stipoideum* 5 TRAN		9+0-4B	CAPE3225 (Port Elizabeth): 7 km from Somerset East to Pearston, (-CB), Spies 1130.
Paint: (=CA), Spits 3757, 3761.9/18TRANSVAAL. =2528 (Pretoria): cultivated varieties collected at Roodeplaat Experimental Farm. (=CA), Spies 3757, 3761.18TRANSVAAL. =2528 (Pretoria): cultivated variety collected at Roodeplaat Experimental Farm. (=CA), Spies 3748.Dmaitlandii9SWAZILAND.=2631 (Mbabane): 22 km north-east of Mbabane. (=AA), Spies 2568. 3636SWAZILAND.=2631 (Mbabane): near beacon at Maimba, (=AD), Spies 2640.Dnatalensis9D. natalensis99NATAL.=2832 (Mtubatuba): 12 km from Cape Vidal to St Lucia. (=AB), Spies 2399.D. tricholaenoides99TRANSVAAL.=2528 (Pretoria): cultivated in the garden of the National Botanical Institute, Pretoria, (=CA), Spies 1713.S. matarankense*55TRANSVAAL.=2528 (Pretoria): cultivated in the garden of the National Botanical Institute, Pretoria, (=CA), Spies 1713.5. stipoideum*55TRANSVAAL.=2528 (Pretoria): cultivated in the garden of the National Botanical Institute, Pretoria, (=CA), Spies 1713.5. aff. stipoideum*55TRANSVAAL.=2528 (Pretoria): cultivated in the garden of the National Botanical Institute, Pretoria, (=CA), Spies 1740.5. aff. stipoideum*56TRANSVAAL.=2528 (Pretoria): cultivated in the garden of the National Botanical Institute, Pretoria, (=CA), Spies 1740.6. aff. stipoideum*57TRANSVAAL.=2528 (Pretoria): cultivated in the garden of the National Botanical Institute, Pretoria, (=CA), Spies 1740.7Subtribe Ischaeminae Ischaemum afrum10		9+0-5B	TRANSVAAL. – 2528 (Pretoria): cultivated variety collected at Roodeplaat Experimental
18 TRANSVAAL. — 2528 (Pretoria): cultivated variety collected at Roodeplaat Experimental Farm. (-CA), Spies 3748. D. maitlandii 9 SWAZILAND. — 2631 (Mbabane): 22 km north-east of Mbabane, (-AA), Spies 2640. D. natalensis 9 NATAL. — 2532 (Mubatuba): 12 km from Cape Vidal to St Lucia, (-AB), Spies 2399. D. tricholaenoides 9 NATAL. — 2528 (Pretoria): cultivated in the garden of the National Botanical Institute, Pretoria, (-CA), Spies 1711. S. matarankense* 10 TRANSVAAL. — 2528 (Pretoria): cultivated in the garden of the National Botanical Institute, Pretoria, (-CA), Spies 1713. S. stipoideum* 5 TRANSVAAL. — 2528 (Pretoria): cultivated in the garden of the National Botanical Institute, Pretoria, (-CA), Spies 1713. S. aff. stipoideum* 5 TRANSVAAL. — 2528 (Pretoria): cultivated in the garden of the National Botanical Institute, Pretoria, (-CA), Spies 1738. Subtribe Ischaeminae 1 1 Spies 1740. S. aff. stipoideum* 5 TRANSVAAL. — 2528 (Pretoria): cultivated in the garden of the National Botanical Institute, Pretoria, (-CA), Spies 1740. Subtribe Ischaeminae 10 NATAL. — 2832 (Mutubatuba): 3 km from Hluhuwe to False Bay, (-AB), Spies 2431. Subtribe Andropogoninae 10 NATAL. — 2832 (Mutubatuba): 3 km from Hluhuwe to False Bay, (-AB), Spies 2431.		9/18	TRANSVAAL. -2528 (Pretoria): cultivated varieties collected at Roodeplaat Experimental Form $(-CA)$. Spice 3757, 3761
D maitlandii 9 SWAZILAND2631 (Mbabane): 22 km north-east of Mbabane. (-AA). Spies 2568. 36 SWAZILAND2631 (Mbabane): near beacon at Maimba. (-AD). Spies 2640. D. natalensis 9 NATAL2832 (Mtubatuba): 12 km from Cape Vidal to St Lucia. (-AB). Spies 2399. D. tricholaenoides 9 TRANSVAAL2630 (Carolina): 46 km from Ermelo to Piet Retief. (-CD). Spies 2349. Tribe Andropogoneae Subtribe Sorghinae 5 Sorghum australiense* 10 TRANSVAAL2528 (Pretoria): cultivated in the garden of the National Botanical Institute, Pretoria. (-CA). Spies 1711. S. matarankense* 5 TRANSVAAL2528 (Pretoria): cultivated in the garden of the National Botanical Institute, Pretoria. (-CA). Spies 1713. S. stipoideum* 5 TRANSVAAL2528 (Pretoria): cultivated in the garden of the National Botanical Institute, Pretoria. (-CA). Spies 1738 & 1741. S. aff. stipoideum* 5 TRANSVAAL2528 (Pretoria): cultivated in the garden of the National Botanical Institute, Pretoria. (-CA). Spies 1740. S. aff. stipoideum* 5 TRANSVAAL2532 (Pretoria): cultivated in the garden of the National Botanical Institute, Pretoria. (-CA). Spies 1740. S. aff. stipoideum* 10 NATAL2832 (Mtubatuba): 3 km from Hluhluwe to False Bay. (-AB). Spies 2431. Subtribe Andropogoninae 10 NATAL2830 (Pilgrim's Rest): 17 km from Graskop to		18	TRANSVAAL \rightarrow 2528 (Pretoria): cultivated variety collected at Roodeplaat Experimental Earm. (-CA). Spice 3748
36SWAZILAND. — 2631 (Mbabane): near beacon at Maimba, (-AD), Spies 2640.D. natalensis9NATAL. — 2832 (Mtubatuba): 12 km from Cape Vidal to St Lucia, (-AB), Spies 2399.D. tricholaenoides9TRANSVAAL. — 2630 (Carolina): 46 km from Ermelo to Piet Retief, (-CD), Spies 2349.Tribe AndropogoneaeSubtribe SorghinaeSorghum australiense*10TRANSVAAL. — 2528 (Pretoria): cultivated in the garden of the National Botanical Institute, Pretoria, (-CA), Spies 1711.S. matarankense*5TRANSVAAL. — 2528 (Pretoria): cultivated in the garden of the National Botanical Institute, Pretoria, (-CA), Spies 1713.S. stipoideum*5TRANSVAAL. — 2528 (Pretoria): cultivated in the garden of the National Botanical Institute, Pretoria, (-CA), Spies 1736. [778 & 174].S. aff. stipoideum*5TRANSVAAL. — 2528 (Pretoria): cultivated in the garden of the National Botanical Institute, Pretoria, (-CA), Spies 1740.S. aff. stipoideum*5TRANSVAAL. — 2528 (Pretoria): cultivated in the garden of the National Botanical Institute, Pretoria, (-CA), Spies 1740.S. aff. stipoideum*5TRANSVAAL. — 2528 (Pretoria): cultivated in the garden of the National Botanical Institute, Pretoria, (-CA), Spies 1740.S. aff. stipoideum*10NATAL. — 2832 (Mtubatuba): 3 km from Hluhluwe to False Bay, (-AB), Spies 2431.Subtribe Ischaeminae10NATAL. — 2832 (Mtubatuba): 3 km from Graskop to Sabie, (-DD), Spies 1968.Subtribe Andropogoninae10TRANSVAAL. — 2430 (Pilgrim's Rest): 17 km from Graskop to Sabie, (-DD), Spies 1968.	D. maitlandii	9	SWAZILAND. – 2631 (Mbabane): 22 km north-east of Mbabane, (–AA), Spies 2568.
D. natalensis 9 NATAL 2832 (Mtubatuba): 12 km from Cape Vidal to St Lucia, (-AB), Spies 2399. D. tricholaenoides 9 TRANSVAAL 2630 (Carolina): 46 km from Ermelo to Piet Retief, (-CD), Spies 2349. Tribe Andropogoneae Subtribe Sorghinae 5 Sorghum australiense* 10 TRANSVAAL 2528 (Pretoria): cultivated in the garden of the National Botanical Institute, Pretoria, (-CA), Spies 1711. S. matarankense* 5 S. stipoideum* 5 TRANSVAAL 2528 (Pretoria): cultivated in the garden of the National Botanical Institute, Pretoria, (-CA), Spies 1713. S. stipoideum* 5 TRANSVAAL 2528 (Pretoria): cultivated in the garden of the National Botanical Institute, Pretoria, (-CA), Spies 1713. S. stipoideum* 5 TRANSVAAL 2528 (Pretoria): cultivated in the garden of the National Botanical Institute, Pretoria, (-CA), Spies 1740. S. aff. stipoideum* 5 S. aff. stipoideum* 5 Subtribe Ischaeminae 10 Ischaemum afrum 10 NATAL 2830 (Pilgrim's Rest): 17 km from Graskop to Sabie, (-DD), Spies 1968.		36	SWAZILAND - 2631 (Mbabane): near beacon at Maimba, (-AD), Spies 2640.
Tribe Andropogoneae Subtribe Sorghinae Sorghum australiense* 10 TRANSVAAL2528 (Pretoria): cultivated in the garden of the National Botanical Institute, Pretoria, (-CA), Spies 1711. S. matarankense* 5 TRANSVAAL2528 (Pretoria): cultivated in the garden of the National Botanical Institute, Pretoria, (-CA), Spies 1713. S. stipoideum* 5 TRANSVAAL2528 (Pretoria): cultivated in the garden of the National Botanical Institute, Pretoria, (-CA), Spies 2736, 1738 & 1741. S. aff. stipoideum* 5 TRANSVAAL2528 (Pretoria): cultivated in the garden of the National Botanical Institute, Pretoria, (-CA), Spies 1740. S. aff. stipoideum* 5 TRANSVAAL2528 (Pretoria): cultivated in the garden of the National Botanical Institute, Pretoria, (-CA), Spies 1740. S. aff. stipoideum* 5 TRANSVAAL2528 (Pretoria): cultivated in the garden of the National Botanical Institute, Pretoria, (-CA), Spies 1740. Subtribe Ischaeminae 10 Ischaemum afrum 10 NATAL2832 (Mtubatuba): 3 km from Hluhluwe to False Bay, (-AB), Spies 2431. Subtribe Andropogoninae 10 Andropogon eucomus 10 TRANSVAAL2430 (Pilgrim's Rest): 17 km from Graskop to Sabie, (-DD), Spies 1968.	D. natalensis D. tricholaenoides	9	NATAL2832 (Mtubatuba): 12 km from Cape Vidal to St Lucia, (-AB), Spies 2399. TRANSVAAL -2630 (Carolina): 46 km from Ermelo to Piet Retief. (-CD). Spies 2349.
Subtribe Sorghum australiense* 10 TRANSVAAL2528 (Pretoria): cultivated in the garden of the National Botanical Institute, Pretoria, (-CA), Spies 1711. S. matarankense* 5 TRANSVAAL2528 (Pretoria): cultivated in the garden of the National Botanical Institute, Pretoria, (-CA), Spies 1713. S. stipoideum* 5 TRANSVAAL2528 (Pretoria): cultivated in the garden of the National Botanical Institute, Pretoria, (-CA), Spies 1713. S. stipoideum* 5 TRANSVAAL2528 (Pretoria): cultivated in the garden of the National Botanical Institute, Pretoria, (-CA), Spies 2736, 1738 & 1741. S. aff. stipoideum* 5 TRANSVAAL2528 (Pretoria): cultivated in the garden of the National Botanical Institute, Pretoria, (-CA), Spies 1740. S. aff. stipoideum* 5 TRANSVAAL2528 (Pretoria): cultivated in the garden of the National Botanical Institute, Pretoria, (-CA), Spies 1740. S. aff. stipoideum* 5 TRANSVAAL2528 (Pretoria): cultivated in the garden of the National Botanical Institute, Pretoria, (-CA), Spies 1740. Subtribe Ischaeminae Ischaemum afrum 10 NATAL2832 (Mtubatuba): 3 km from Hluhluwe to False Bay, (-AB), Spies 2431. Subtribe Andropogoninae Andropogon eucomus 10 TRANSVAAL2430 (Pilgrim's Rest): 17 km from Graskop to Sabie, (-DD), Spies 1968.	Tribe Andropogoneae	,	
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	Subtribe Andropogoninae Andropogon eucomus	10	TRANSVAAL2430 (Pilgrim's Rest): 17 km from Graskop to Sabie, (-DD), Spies 1968.

* Seed originally collected by M. Andrew in Australia.

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Subfamily Arundinoideae Tateoka

Tribe Aristideae C.E. Hubb.

The haploid chromosome number of n = 11 for *Aristida* congesta Roem. & Schult. subsp. congesta (Figure 1A, B) corresponds with published cytogenetic information on this taxon (De Winter 1965; Davidse *et al.* 1986; Spies & Jonker 1987). The occurrence of n = 11 as the lowest haploid chromosome number in the genus and the presence of multiples of 11 in other species of this genus (De Winter 1965; Spies & Du Plessis 1986a, 1987b; Viano & Bourreil 1987), support 11 as the basic chromosome number for both the genus Aristida L. and the tribe.

The basic number of x = 11 for the tribe Aristideae is further supported by our observation of a *Stipagrostis obtusa* (Del.) Nees specimen with a haploid chromosome number of n = 22+0-3B (Figure 1C). Chromosome laggards were frequently observed (Figure 1D) and it is suggested that the laggards represent the B-chromosomes, undergoing chromatid segregation. This is, to the best of our knowledge, the first report on the presence of B-chromosomes in this tribe. Polyploidy seems to be present in this species with our specimen being tetraploid and the one examined by Reese (1957) diploid (2n = 22).

Subfamily Chloridoideae Rouy

Tribe **Eragrostideae** Stapf Subtribe Eleusininae Dumort.

The diploid chromosome number of n = 10 for *Diplachne fusca* (L.) Beauv. ex Roem. & Schult. (Figure 1E) is the lowest chromosome number yet described for this species and it supports a basic chromosome number of x = 10 for this species, genus, subtribe, tribe and subfamily. Published results indicate the presence of tetraploidy (Bir & Sahni 1986) and aneuploidy (Spies & Voges 1988).

A basic chromosome number of x = 10 for *Eragrostis* Wolf is substantiated by the diploid *E. cilianensis* (All.) F.T. Hubb. specimen observed during this study. The presence of diploid and tetraploid specimens of this species is well documented (Fedorov 1969; Moore 1973; Goldblatt



FIGURE 1. — Meiotic chromosomes in some grass specimens. A, B, Aristida congesta subsp. congesta, Du Plessis 137, n=11, metaphase 1; C, D, Stipagrostis obtusa, Spies 2905, n=22, anaphase 1 with laggards (L); E, Diplachne fusca, Spies 3373, n=10, diakinesis; F, Eragrostis capensis, Spies 1973, n=20, diakinesis. Bar = 10 μm.

1983, 1988; Goldblatt & Johnson 1990). The tetraploid *E. capensis* (Thunb.) Trin. specimen (Figure 1F) supports observations indicating different ploidy levels for this species, i.e. diploid (De Wet 1958), tetraploid (Avdulov 1931; Pienaar 1955; Spies & Du Plessis 1986a; Davidse *et al.* 1986) and hexaploid (Moffett & Hurcombe 1949; Spies & Voges 1988). To the best of our knowledge the tetraploid level observed for *E. sarmentosa* (Thunb.) Trin. is the first report on a chromosome number for this species.

Subtribe Sporobolinae Benth.

The genus Sporobolus R. Br. is cytogenetically complex and basic chromosome numbers of x = 6, 9 and 10 seem to be present (Davidse *et al.* 1986). The haploid chromosome numbers of n = 12, 18 and 24 observed during this study in *S. africanus* (Poir.) Robyns & Tournay (Figure 2) support a basic chromosome number of x = 6for this species. Polyploid levels vary from tetraploid (2n = 4x = 24) to decaploid (2n = 10x = 60) (Fedorov 1969; Spies & Du Plessis 1986b; Spies & Jonker 1987; Spies & Voges 1988). A thorough cytogenetic investigation of this genus is necessary to determine the phylogenetic relationships.

The presence of B-chromosomes in some specimens impedes the interpretation of the results (Figure 2C). The number of B-chromosomes varied from 0 to 6 per meiotic cell in a single specimen, which indicates that they are mitotically unstable. Occasionally a B-chromosome could be distinguished by its position in the cell but the majority of B-chromosomes resembled the euchromosomes. These chromosomes are considered to be B-chromosomes, judging by the variation in their numbers in different cells.

Tribe **Cynodonteae** Dumort. Subtribe Chloridinae Presl.

This report on *Harpochloa falx* (L.f.) Kuntze corresponds with published data on this species (Fedorov 1969; Spies & Du Plessis 1986a) which seems to indicate a basic chromosome number of ten, with all the specimens studied being tetraploids.

Subfamily Panicoideae A. Br.

Tribe Paniceae R. Br.

Subtribe Setariinae Dumort.

The chromosome number of n = 18 observed for *Brachiaria brizantha* (A. Rich.) Stapf during this study, equals the lowest chromosome number reported for this species (Darlington & Wylie 1955; Ornduff 1967–1969; Fedorov 1969; Moore 1970–1977; Goldblatt 1981–1988; Goldblatt & Johnson 1990). In addition to this number, a higher ploidy level of n = 27 has also been described in Fedorov (1969) and by Spies & Du Plessis (1987b), as well as by Basappa *et al.* (1987). The basic chromosome number, however, is considered to be x = 9 (Darlington & Wylie 1955; Ornduff 1967–1969; Fedorov 1969; Moore 1970–1977; Goldblatt 1981–1985; Goldblatt & Johnson 1990). These results contradict the meiotic configuration of $12_{II}12_{I}$, observed by Nath *et al.* (1970), which suggests a basic chromosome number of 12 for the species.

This seems to be the first report on the chromosome number of Panicum aequinerve Nees. The haploid chromosome number of 18 indicates a basic chromosome number of x=9 for this genus and species. The absence of multivalents suggests an alloploid origin for this specimen (Figure 3A). In contrast to this basic number, we confirm numerous reports of a somatic chromosome number of 2n=32 for Panicum maximum Jacq. (Ornduff 1967-1969; Fedorov 1969; Moore 1970-1977; Goldblatt 1981-1988; Goldblatt & Johnson 1990). Contrary to these reports several other somatic numbers are reported in the same sources (2n=18, 28, 34, 36, 42, 48, 52, 54). We found it very difficult to obtain well-spread meiocytes in this species and this may be a reason for the discrepancies in the chromosome numbers reported for this species. A re-investigation of the phylogenetic relationship between P. maximum and other Panicum species is necessary.

Urochloa mosambicensis (Hack.) Dandy with 2n = 4x = 28, supports the deviated basic chromosome number of x = 7 for this species reported by Spies & Du Plessis (1987b). The formation of one ring quadrivalent in almost all diakinesis cells studied (Figure 3B), indicates



FIGURE 2.—Camera lucida drawings of meiotic chromosomes in *Sporobolus africanus*. A, *Spies 3201*, n = 12, metaphase I; B, *Spies 2529*, n = 24, diakinesis; C, *Spies 2393*, n = 18 + 0-6B, anaphase I with 6 B-chromosomes. Bar = 10 μ m.



a certain degree of autosyndetic chromosome pairing. The low frequency of multivalents in the presence of a high chiasma frequency (Spies 1984) indicates a segmental alloploid origin for this specimen.

Subtribe Digitariinae Butzin

This is the first report on the chromosome numbers of Digitaria argyrograpta (Nees) Stapf (n=9) and D. maitlandii Stapf & C.E. Hubb. (n=9 & 36). In addition a new level of ploidy is described for D. diagonalis (Nees) Stapf var. diagonalis [n=9, in contrast to the 2n=36 described by De Wet & Anderson (1956) and Spies & Du Plessis (1987a)]. This is also the first report on the presence of B-chromosomes in D. eriantha Steud., where four of the 15 specimens studied had up to five B-chromosomes (Table 1).

This study included several cultivated specimens of *D. eriantha*. These cultivars are currently being evaluated for possible distribution as fodder crops by the Grassland Research Centre. Two of these 'cultivars' had two different ploidy levels. This indicates the variability present in these specimens and the need for a thorough cytogenetic investigation before these cultivars are released.

A basic chromosome number of x=9 for the genus is supported by the presence of diploid specimens in all the species studied (Figure 3C).

Tribe Andropogoneae Dumort. Subtribe Sorghinae Bluff

A basic chromosome number of five in the Andro-Pogoneae is evident from both the literature and some of the Sorghum Moench specimens used during this study. A basic chromosome number of x=5 was observed in both S. matarankense Garber & Snyder and S. stipoideum Gardner & Hubb. These numbers correspond to the published numbers by Garber (1950, 1954), Garber & Snyder (1951) and Celarier (1956a, 1958). Although meiosis was normal in most specimens (Figure 5A-C), some cells formed micronuclei (Figure 5D).

Abnormal meiotic behaviour was observed in one of the *S. stipoideum* specimens, *Spies 1740.* Six bivalents were formed during diakinesis (Figure 4A). One of these bivalents was smaller than the rest and it is concluded that

FIGURE 3. — Meiotic chromosomes in some representatives of the subfamily Panicoideae. A, Panicum aequinerve, Spies 2555, n = 18, diakinesis; B, Urochloa mosambicensis, Spies 3725, n = 14, diakinesis with 1_{IV} 12_{II}; C, Digitaria argyrograpta, Spies 3739, n = 9, anaphase I. Bar = 10 μm.

this bivalent is formed by B-chromosomes. The Bchromosomes seem to be outside the spindle. Different behaviour patterns of the B-chromosomes were observed during metaphase I. They form part of the metaphase plate (Figure 4B); one stays on the metaphase plate while the other moves to one of the poles (Figure 4C); both move towards the same pole (Figure 4D) or they move to different poles (Figure 4F). Precocious chromosome segregation during late metaphase I was observed for one bivalent in one cell (Figure 4E). The result of the different movements of the B-chromosomes is that anaphase II laggards are sometimes observed (Figure 4G). The ultimate fate of the B-chromosomes was not determined by this study.

Subtribe Ischaeminae Presl

Cytogenetic studies on *Ischaemum afrum* (J.F. Gmel.) Dandy seem to be restricted to our laboratories (Spies & Du Plessis 1987b). The formation of bivalents only during meiosis and the absence of specimens with a somatic chromosome number of ten indicate that this specimen can be considered to be a diploid (2n=2x=20). These results are substantiated by reported chromosome numbers for other *Ischaemum* species (Darlington & Wylie 1955; Ornduff 1967–1969; Fedorov 1969; Moore 1970–1977; Goldblatt 1981–1985; Goldblatt & Johnson 1990). However, the same reports suggest that x=9 and x=19 should be considered secondary and tertiary basic chromosome numbers respectively in the genus.

Subtribe Andropogoninae Presl

The chromosome number of n=10 observed for *Andropogon eucomus* Nees, corresponds with the number published by Moffett & Hurcombe (1949) and Gould (1956). Previous studies by one of our laboratories revealed two different chromosome numbers for this species, i.e. n=10 and n=20 (Spies & Du Plessis 1987a, b). These numbers, in addition to the presence of multiples of ten in other *Andropogon* species, as well as the absence of 2n=2x=10 specimens in the genus (Darlington & Wylie 1955; Ornduff 1967–1969; Fedorov 1969; Moore 1970–1977; Goldblatt 1981–1985), suggest a basic chromosome number of x=10 for this species and genus. A deviation from this basic chromosome number was reported with x=9 for *A. lacunosus* J.G. Anders., *A. tectorum* Schum. & Thonn., *A. lima* (Hack.) Stapf and *A. distachyos* L.



FIGURE 4. — Meiotic chromosomes in a Sorghum stipoideum specimen with B-chromosomes, Spies 1740. A, diakinesis with five bivalents and a B-chromosome bivalent; B, metaphase I with five bivalents and both B-chromosomes on the equatorial plate; C-E, metaphase I with five bivalents and both B-chromosomes on one side of the equatorial plate; F, metaphase I with five bivalents and the B-chromosomes on different sides of the equatorial plate; G, two telophase I cells with chromatid segregation of the B-chromosomes. Bar = 10 μ m.





(Celarier 1956b; Gould 1956; Hedberg & Hedberg 1977; Okoli 1982; Spies & Du Plessis 1986a), x = 8 for *A. abyssinicus* Chippind. (Gould 1956) and x = 7 for *A. mannii* Hook. f. (Davidse *et al.* 1986).

CONCLUSIONS

Clayton & Renvoize (1986) claim that chromosome numbers can contribute little to the taxonomy of the grasses, since the karyotype is relatively constant. Yet the relevance of cytogenetics to the taxonomy of grasses is apparent in the different basic chromosome numbers present in higher taxa, in the meiotic behaviour of chromosomes and in the mode of polyploidy which may help to unravel the phylogeny of a taxon.

A correlation exists between the basic chromosome number and the tribal classification of the majority of grasses. This study confirms that the following basic chromosome numbers are found in the following tribes: Aristideae x = 11, Eragrostideae (with the exception of the genus *Eleusine* and some *Sporobolus* representatives) x = 10, Cynodonteae x = 10, Paniceae x = 9 (with some species or genera having x = 7, 8 or 10) and Andropogoneae has a primary basic chromosome number of x = 5 and, more commonly, a secondary basic chromosome number of the phylogenetic development of higher taxa is correlated with a specific basic chromosome number and deviations from these numbers may help to solve relationships in some taxa.

Polyploidy is frequently observed in the grasses (Carnahan & Hill 1961; Goldblatt 1980) and 303 of the 388 specimens studied in our laboratories were polyploids

(Spies & Du Plessis 1986a, b, 1987a, b, 1988; Spies & Jonker 1987; Spies & Voges 1988; Du Plessis & Spies 1988; Spies *et al.* 1989). Detailed cytogenetic studies are necessary to determine the mode of polyploidy as well as the extent of polyploidy in the South African grasses.

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REFERENCES

- AVDULOV, N.P. 1931. Karyo-systematische Untersuchung der Familie der Gramineen. Bulletin for Applied Botanical Genetics and Plant Breeding 44: 354–425.
- BASAPPA, G.P., MUNIYAMMA, M. & CHINNAPPA, C.C. 1987. An investigation of chromosome numbers in the genus *Brachiaria* (Poaceae: Paniceae) in relation to morphology and taxonomy. *Canadian Journal of Botany* 73: 287–296.
- BIR, S.S. & SAHNI, M. 1986. SOCGI plant chromosome number reports. IV. Journal of Cytology and Genetics 21: 152-154.
- BOWEN, C.C. 1956. Freezing by liquid carbon dioxide in making slides permanent. Stain Technology 31: 87–90.
- CARNAHAN, H.L. & HILL, H.D. 1961. Cytology and genetics of forage grasses. *The Botanical Review* 27: 1–164.
- CARNOY, J.B. 1886. La cytodiérèse de l'oeuf. Cellule 3: 1-92.
- CELARIER, R.P. 1956a. Additional evidence for five as the basic chromosome number of the Andropogoneae. *Rhodora* 58: 135-143.
- CELARIER, R.P. 1956b. Cytology of Andropogon distachyos L. Bulletin of the Torrey Botanical Club 83: 183-191.
- CELARIER, R.P. 1958. Cytotaxonomy of the Andropogoneae. III. Subtribe Sorgheae, genus Sorghum. Cytologia 23: 395–418.
- CLAYTON, W.D. & RENVOIZE, S.A. 1986. Genera graminum grasses of the World. Kew Bulletin Additional Series 13: 1– 389.

mosomes, 6th edn. Allen & Unwin, London. DARLINGTON, C.D. & WYLIE, A.P. 1955. Chromosome atlas of flowering plants. Allen & Unwin, London.

- DAVIDSE, G., HOSHINO, T. & SIMON, B.K. 1986. Chromosome counts of Zimbabwean grasses (Poaceae) and an analysis of polyploidy in the grass flora of Zimbabwe. South African Journal of Botany 52: 521–528.
- DE WET, J.M.J. 1958. Additional chromosome numbers in Transvaal grasses. *Cytologia* 23: 113-118.
- DE WET, J.M.J. & ANDERSON, L.J. 1956. Chromosome numbers in Transvaal grasses. *Cytologia* 21: 1-10.
- DE WINTER, B. 1965. The South African Stipeae and Aristideae (Gramineae). Bothalia 8: 201-404.
- DU PLESSIS, H. & SPIES, J.J. 1988. Chromosome studies on African plants. 8. Bothalia 18: 119–122.
- EDWARDS, D. & LEISTNER, O.A. 1971. A degree reference system for citing biological records in southern Africa. *Mitteilungen der Botanischen Staatssammlung, München* 10: 501-509.
- FEDOROV, A.A. 1969. Chromosome numbers of flowering plants. Academy of Science, Leningrad, USSR.
- GARBER, E.D. 1950. Cytotaxonomic studies in the genus Sorghum. University of California Publications in Botany 23: 283-361.
- GARBER, E.D. 1954. Cytotaxonomic studies in the genus Sorghum. III. The polyploid species of the subgenera Parasorghum and Stiposorghum. Botanical Gazette 115: 336-342.
- GARBER, E.D. & SNYDER, L.A. 1951. Cytotaxonomic studies in the genus Sorghum. II. Two new species from Australia. Madroño 11: 6-10.
- GOLDBLATT, P. 1980. Polyploidy in Angiosperms: Monocotyledons. In W.H. Lewis, *Polyploidy—biological relevance*. Plenum Press, New York.
- GOLDBLATT, P. 1981-1988. Index to plant chromosome numbers 1975-1985. Monographs of Systematic Botany 5; 8; 13; 23.
- GOLDBLATT, P. & JOHNSON, D.E. 1990. Index to plant chromosome numbers 1986, 1987. Monographs of Systematic Botany 30.
- GOULD, F.W. 1956. Chromosome counts and cytotaxonomic notes on grasses of the tribe Andropogoneae. *American Journal of Botany* 43: 395-404.
- HEDBERG, I. & HEDBERG, O. 1977. Chromosome numbers of afroalpine and afromontane angiosperms. *Botaniska Notiser* 130: 1-24.
- MOFFETT, A.A. & HURCOMBE, R. 1949. Chromosome numbers of

South African grasses. Heredity 3: 369-373.

- MOORE, R.J. 1970–1977. Index to plant chromosome numbers for 1968–1974. *Regnum Vegetabile* 68; 77; 84; 91; 96.
- MOORE, R.J. 1973. Index to plant chromosome numbers for 1967–1971. Oosthoek Uitgevers, Utrecht.
- NATH, J., SWAMINATHAN, M.S. & MEHRA, K.L. 1970. Cytological studies in the tribe Paniceae, Gramineae. Cytologia 35: 111– 131.
- OKOLI, B.E. 1982. In IOPB chromosome number reports LXXIV. Taxon 31: 127, 128.
- ORNDUFF, R. 1967-1969. Index to plant chromosome numbers for 1965-1967. Regnum Vegetabile 50; 55; 59.
- PIENAAR, R. DE V. 1955. The chromosome numbers of some indigenous South African and introduced Gramineae. In D. Meredith, Grasses and pastures of South Africa. CNA, Johannesburg.
- RAVEN, P.H. 1975. The bases of Angiosperm phylogeny: cytology. Annals of the Missouri Botanical Garden 62: 724-764.
- REESE, G. 1957. Über die Polyploidiespectren in der Nordsaharischen Wuestenflora. Flora 144: 598-634.
- SPIES, J.J. 1984. Determination of genome homology in polyploids. South African Journal of Science 80: 44-46.
- SPIES, J.J. & DU PLESSIS, H. 1986a. Chromosome studies on African plants. 1. Bothalia 16: 87, 88.
- SPIES, J.J. & DU PLESSIS, H. 1986b. Chromosome studies on African plants. 2. Bothalia 16: 269, 270.
- SPIES, J.J. & DU PLESSIS, H. 1987a. Chromosome studies on African plants. 3. Bothalia 17: 131-135.
- SPIES, J.J. & DU PLESSIS, H. 1987b. Chromosome studies on African plants. 5. Bothalia 17: 257-259.
- SPIES, J.J. & DU PLESSIS, H. 1988. Chromosome studies on African plants. 6. Bothalia 18: 111-114.
- SPIES, J.J. & JONKER, A. 1987. Chromosome studies on African plants. 4. Bothalia 17: 135, 136.
- SPIES, J.J., SAAYMAN, E.J.L., VOGES, S.P. & DAVIDSE, G. 1989. Chromosome studies on African plants. 9. Chromosome numbers in *Ehrharta* (Poaceae: Ehrharteae). *Bothalia* 19: 125–132.
- SPIES, J.J. & VOGES, S.P. 1988. Chromosome studies on African plants. 7. Bothalia 18: 114–119.
- THOMAS, P.T. 1940. The aceto-carmine method for fruit material. *Stain Technology* 15: 167–172.
- VIANO, J. & BOURREIL, P.J.L. 1987. Chromosome number reports. 94. Taxon 36: 283.