



## Chromosome numbers and meiotic behavior of some *Paspalum* accessions

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### Abstract

Chromosome number and meiotic behavior were evaluated in 36 Brazilian accessions of the grass *Paspalum* (which had never previously been analyzed) to determinate which accessions might be useful in interspecific hybridizations. The analysis showed that one accession of *Paspalum coryphaeum* was diploid ( $2n = 2x = 20$ ) and one accession of *Paspalum conspersum* hexaploid ( $2n = 6x = 60$ ), the remaining 34 accessions being tetraploid ( $2n = 4x = 40$ ). The pairing configuration was typical for the ploidy level *i.e.* in the diploid, chromosomes paired as 10 bivalents, in tetraploids as bi-, tri- and quadrivalents, and in hexaploid as 30 bivalents. A low frequency of meiotic abnormalities (less than 10%) was observed in the diploid, hexaploid and some tetraploid accessions, although the majority of tetraploid accessions showed a high frequency of meiotic irregularities. The use of accessions with a low frequency of meiotic abnormalities in breeding programs is discussed.

*Key words:* *Paspalum*, forage grass, chromosome numbers, meiotic behavior.

Received: December 23, 2004; Accepted: May 4, 2005.

### Introduction

The genus *Paspalum* (L.), one of the most economically important grass genera of the Paniceae tribe, includes approximately 330 species distributed in tropical and subtropical regions of America, with a few taxa growing in the Old World (Denham *et al.*, 2002). A large number of *Paspalum* species provide excellent grazing in native grasslands of the warm regions of South America (Bonilha and Quarín, 1997) and several members of the genus are also used as turf grass and for ornamental purposes (Burson and Bennett, 1971). Several species occur in the various Brazilian ecosystems, however only a few native species (especially those belonging to the Dilatata, Notata and Plicatula groups) have been cultivated as forage (Quarín *et al.*, 1996). Although great progress has been made in cytological studies of members of the genus, little or no information is available for a large number of members of species and accessions held in herbariums. However, approximately 80% of the *Paspalum* species which have been cytologically investigated are polyploids, or have polyploid

racess, with about 50% of these polyploids being tetraploids of which most are apomictic (Quarín, 1992). This type of cytology complicates breeding programs.

During the last three decades, several collection trips have been undertaken by Embrapa Cenargen throughout Brazil, Paraguay, and Argentina to establish a base *Paspalum* collection. As a result, a germplasm collection comprising more than 1500 accessions of different *Paspalum* species is available at Embrapa Cenargen (Brasília, DF), with a small part of this collection being duplicated at the Institute of Botany (IBONE) at Corrientes, Argentina (Quarín *et al.*, 1997). Part of the Cenargen *Paspalum* germplasm collection was allocated to the Embrapa/Centro de Pesquisa de Pecuária do Sudeste (CPPSE), São Carlos, São Paulo state, Brazil) where the agronomic aspects of 216 *Paspalum* accessions (known as the CPPSE collection) are currently being evaluated (Batista *et al.*, 1995) with the aim of selecting accessions for intra- and interspecific crosses to be used for obtaining new varieties.

Cytological analyses have been performed on more than 80 accessions from the CPPSE collection (Freitas *et al.*, 1997; Takayama *et al.*, 1998; Adamowski *et al.*, 1998, 2000; Pagliarini *et al.*, 1998, 1999, 2000, 2001) and the data presented in the present paper extends this study to a further 36 previously unanalyzed *Paspalum* accessions, including

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*P. notatum* Fluegge, *P. compressifolium* Swallen, *P. usterii* Hack., *P. plicatulum* Michx., *P. atratum* Swallen, *P. coryphaeum* Trin., *P. lividum*, *P. rhodopedum* L. B. Smith & Wasshausen, *P. limbatum* Henrard, *P. conspersum* Schrad and unidentified accessions belonging to the Plicatula group. The Plicatula group is an unofficial taxonomic rank created by Chase (1929) to group species related to *P. plicatulum*, this group having its geographical center of variation in central and western Brazil, eastern Bolivia and Paraguay (Quarín *et al.*, 1997). Of the informal taxonomic groups into which the genus *Paspalum* has been subdivided (Chase, 1929), the Plicatula group is of the greatest agronomic interest because it encompasses a wide variation of forms and species, several of which are well accepted by cattle (Quarín *et al.*, 1997). Since knowledge of the cytology and reproductive behavior of a species is es-

sential for interspecific hybridization programs the aim of this research was to investigate the chromosome number and meiotic behavior of 36 Embrapa CPPSE germplasm accessions which had not before been analyzed.

## Material and Methods

Cytogenetic studies were carried out on 36 accessions from the Embrapa CPPSE *Paspalum* collection, these accessions having been collected from several different regions of Brazil (Table 1). Of the 36 accessions analyzed, 18 Plicatula group accessions were not identified to species level.

Young inflorescences were collected at Embrapa CPPSE and fixed in 3:1 ethyl alcohol:acetic acid for 24 h at room temperature and then transferred to 70% (v/v) aque-

**Table 1** - Species investigated in the present study with their accession numbers and collection site details.

Species	Accession numbers	Collection sites*	Latitude (South)	Longitude (West)	Altitude (m)
Livida group					
<i>P. lividum</i>	BRA-006378	São Gabriel, RS	30°19'	54°16'	140
Malacophylla group					
<i>P. usterii</i>	BRA-022624				
Notata group					
<i>P. notatum</i>	BRA-006513	Uruguaiana, RS	29°33'	56°47'	90
<i>P. notatum</i>	BRA-008028	Lages, SC			-
Plicatula group					
<i>P. compressifolium</i>	BRA-013102	Balsa Nova, PR	25°27'	49°38'	1160
<i>P. compressifolium</i>	BRA-011282	Passo Fundo, RS	28°14'	52°18'	680
<i>P. compressifolium</i>	BRA-009105	Guaíba, RS	30°06'	51°19'	30
<i>P. compressifolium</i>	BRA-011304	Passo Fundo, RS	28°14'	52°18'	680
<i>P. atratum</i>	BRA-009661	Aquidauana, MS	20°22'	55°59'	180
<i>P. plicatulum</i>	BRA-008940	São Gabriel, RS	30°15'	54°32'	160
<i>P. plicatulum</i>	BRA-006157	São Gabriel, RS	30°24'	54°19'	360
<i>P. plicatulum</i>	BRA-009784	Rio Grande, RS	32°07'	52°21'	15
<i>P. rhodopedum</i>	BRA-006602	Santo Angelo, RS	28°24'	54°18'	260
<i>P. rhodopedum</i>	BRA-006670	Passo Fundo, RS	28°14'	52°18'	690
<i>P. limbatum</i>	BRA-012530	Ribas do Rio Pardo, MS	20°25'	53°39'	390
<i>P. limbatum</i>	BRA-009008	Campo Grande, MS	20°25'	54°40'	500
<i>Paspalum sp</i>	BRA-008486	Planaltina, DF	15°30'	47°45'	1000
<i>Paspalum sp</i>	BRA-008630	Lages, SC	27°57'	50°27'	980
<i>Paspalum sp</i>	BRA-008648	Lages, SC	27°57'	50°27'	980
<i>Paspalum sp</i>	BRA-008656	Lages, SC	27°57'	50°27'	950
<i>Paspalum sp</i>	BRA-008672	Vacaria, SC	28°20'	50°18'	980
<i>Paspalum sp</i>	BRA-009393	Ji-Paraná, RO	10°53'	61°57'	170
<i>Paspalum sp</i>	BRA-010243	Montes Claros, MS	16°30'	43°50'	700
<i>Paspalum sp</i>	BRA-011053	Sto Antônio das Missões, RS	28°30'	55°14'	120
<i>Paspalum sp</i>	BRA-011266	Passo Fundo, RS	28°15'	51°52'	630
<i>Paspalum sp</i>	BRA-012521	Três Lagoas, MS	20°46'	50°40'	400

**Table 1 (cont.)**

Species	Accession numbers	Collection sites*	Latitude (South)	Longitude (West)	Altitude (m)
<i>Paspalum sp</i>	BRA-012751	Caarapó, MS	22°25'	54°41'	320
<i>Paspalum sp</i>	BRA-013404	Balsa Nova, PR	25°27'	49°38'	1100
<i>Paspalum sp</i>	BRA-013609	Ponta Grossa, PR	25°08'	50°09'	960
<i>Paspalum sp</i>	BRA-014770	Unai, MG	16°25'	46°50'	620
<i>Paspalum sp</i>	BRA-009636	Miranda, MS	20°18'	56°25'	160
<i>Paspalum sp</i>	BRA-013951	Ponta Grossa, PR	25°08'	50°09'	820
<i>Paspalum sp</i>	BRA-008681	Lages, SC	27°57'	50°27'	900
<i>Paspalum sp</i>	BRA-011517	Bom Jesus, RS	28°40'	50°15'	1220
Quadrifaria group					
<i>P. coryphaeum</i>	BRA-000841	Anaurilândia, MS	22°25'	50°35'	200
Virgata group					
<i>P. conspersum</i>	BRA-010260	Miranda, RS	20°18'	56°25'	160

\*The two-letter code after the collection site refers to the Brazilian state, DF = Distrito Federal, MS = Mato Grosso do Sul, PR = Paraná, RG = Rio Grande do Sul, SC = Santa Catarina.

ous alcohol and stored in a freezer until needed. Microsporocytes (PMCs) were prepared from the inflorescences by squashing and staining with 1% propionic carmine. The chromosome number and the pairing configuration were determined in 20 meiocytes at diakinesis, and the meiotic behavior determined in more than 2000 microsporocytes up to this phase to the end of meiosis with a similar number of cells in each phase.

## Results and Discussion

Of the 36 CPPSE accessions examined by us, one was diploid ( $2n = 2x = 20$ ), 34 were tetraploid ( $2n = 4x = 40$ ) and one was hexaploid ( $2n = 60$ ) (Table 2), however, the chromosome numbers of specific species were not always in agreement with previously published reports. The chromo-

some number of *P. coryphaeum* was reported by Burson (1975) as  $2n = 40$  but we found *P. coryphaeum* BRA-000841 to be  $2n = 20$ . Snyder (1953) reported that *P. lividum* was  $2n = 70$  although other authors (Gould, 1958, 1968; Reeder, 1967; Burson and Bennett, 1971; Pagliarini *et al.*, 2001) reported that it was  $2n = 40$ , the same chromosome number we found for *P. lividum* BRA-006378. Chromosome numbers of  $2n = 20$  and  $2n = 40$  have been reported for *P. notatum* by various authors (Burton, 1940; Forbes and Burton, 1961; Fernandes *et al.*, 1974; Mehra and Chaudhary, 1981; Pozzobon and Valls, 1997; Pagliarini *et al.*, 2001), while we found that the two *P. notatum* accessions (BRA-006513 and BRA-008028) examined were both  $2n = 40$ . The chromosome number of *P. conspersum* has been reported as both  $2n = 40$  and  $2n = 60$

**Table 2** - Chromosome numbers and meiotic chromosome associations at diakinesis.

<i>Paspalum</i> species	Accession number	2n	N. of PMCs	Chromosome associations							
				Range				Average per cell			
				I	II	III	IV	I	II	III	IV
<i>P. coryphaeum</i>	BRA-000841	20	20	-	10	-	-	-	20.0	-	-
<i>P. lividum</i>	BRA-006378	40									
<i>P. notatum</i>	BRA-006513	40									
<i>P. notatum</i>	BRA-008028	40	20	(0-4)	(8-18)	(0-2)	(1-5)	1.10	13.55	1.40	2.15
<i>P. conspersum</i>	BRA-010260	60	20	-	30	-	-	-	30.0	-	-
<i>P. usterii</i>	BRA-011355	40	20	(0-1)	(16-20)	(0-1)	(0-3)	0.10	18.65	0.10	0.55
<i>P. compressifolium</i>	BRA-013102	40	20	(0-3)	(4-16)	(0-1)	(2-5)	0.25	11.35	0.15	4.15
<i>P. compressifolium</i>	BRA-011282	40	20	(0-2)	(5-20)	(0-2)	(0-6)	0.30	14.80	0.20	2.20
<i>P. compressifolium</i>	BRA-009105	40	20	(0-4)	(8-20)	(0-1)	(0-5)	0.60	16.45	0.10	1.45
<i>P. compressifolium</i>	BRA-011304	40	23	(0-4)	(10-20)	-	(0-5)	0.87	18.00	-	0.52

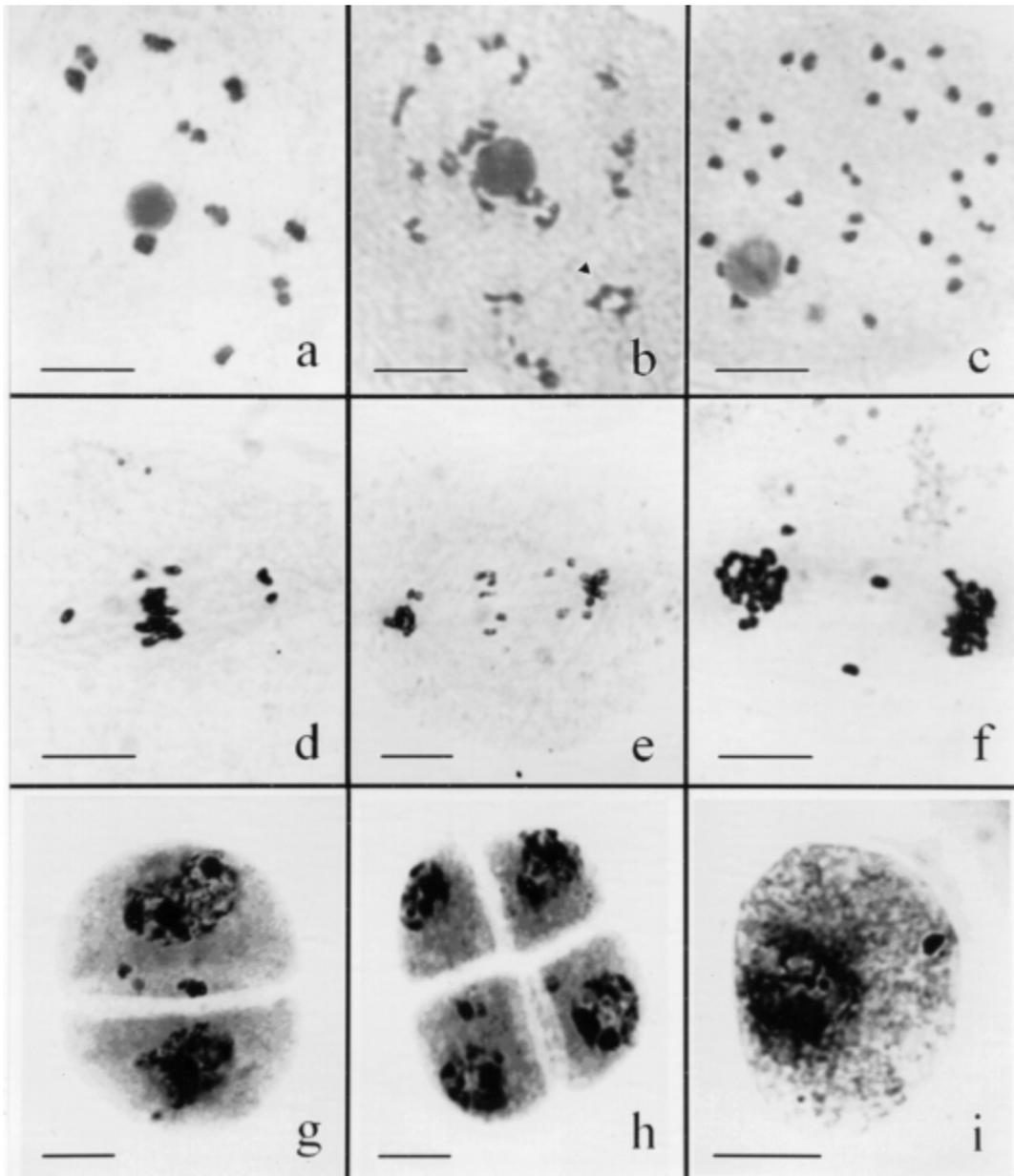
Table 2 (cont.)

<i>Paspalum</i> species	Accession number	2n	N. of PMCs	Chromosome associations									
				Range				Average per cell					
				I	II	III	IV	I	II	III	IV		
<i>P. atratum</i>	BRA-009661	40											
<i>P. plicatulum</i>	BRA-008940	40	20	(0-10)	(2-18)	(0-4)	(0-9)	2.35	8.95	0.95	4.20		
<i>P. plicatulum</i>	BRA-006157	40	20	(0-20)	(8-20)	(0-4)	(0-3)	3.20	15.50	0.80	0.90		
<i>P. plicatulum</i>	BRA-009784	40	20	(0-2)	(9-16)	(0-2)	(2-5)	0.50	13.25	0.20	3.10		
<i>P. rhodopedum</i>	BRA-006602	40	20	(0-4)	(6-20)	(0-2)	(0-7)	0.85	13.70	0.15	2.80		
<i>P. rhodopedum</i>	BRA-006670	40	20	(0-4)	(10-18)	(0-1)	(1-4)	1.9	14.25	0.20	2.25		
<i>P. limbatum</i>	BRA-012530	40	21	(0-6)	(2-20)	(0-3)	(0-9)	0.62	9.43	0.19	4.71		
<i>P. limbatum</i>	BRA-009008	40	20	(0-1)	(4-14)	(0-1)	(3-8)	0.10	10.30	0.10	5.15		
<i>Paspalum</i> sp	BRA-008486	40	20	(0-2)	(12-17)	-	(1-2)	0.90	15.70	-	2.05		
<i>Paspalum</i> sp	BRA-008630	40	20	(0-2)	(9-18)	(0-1)	(1-5)	0.60	16.00	0.20	1.70		
<i>Paspalum</i> sp	BRA-008648	40	20	(0-6)	(5-17)	(0-2)	(0-7)	1.40	11.75	0.30	3.65		
<i>Paspalum</i> sp	BRA-008656	40	22	(0-5)	(6-20)	(0-1)	(0-6)	1.27	13.41	0.27	2.73		
<i>Paspalum</i> sp	BRA-008672	40	21	(0-6)	(4-20)	(0-4)	(0-8)	1.00	15.24	0.24	2.00		
<i>Paspalum</i> sp	BRA-009393	40	40	(0-4)	(4-20)	(0-3)	(0-8)	0.40	12.25	0.60	3.55		
<i>Paspalum</i> sp	BRA-010243	40	20	(0-16)	(0-20)	(0-3)	(0-8)	3.60	12.20	0.60	2.35		
<i>Paspalum</i> sp	BRA-011053	40	21	(0-10)	(6-17)	(0-2)	(0-6)	1.76	12.05	0.14	3.33		
<i>Paspalum</i> sp	BRA-011266	40	21	(0-12)	(10-20)	(0-3)	(0-5)	1.14	13.81	0.48	2.43		
<i>Paspalum</i> sp	BRA-012521	40	21	(0-6)	(10-20)	(0-3)	(0-5)	1.86	14.33	0.52	1.43		
<i>Paspalum</i> sp	BRA-012751	40	25	(0-32)	(4-18)	(0-5)	(0-6)	6.52	11.96	0.52	2.00		
<i>Paspalum</i> sp	BRA-013404	40	20	(0-5)	(9-19)	(0-2)	(0-4)	1.20	15.50	0.60	1.50		
<i>Paspalum</i> sp	BRA-013609	40	20	(0-10)	(2-16)	(0-3)	(0-9)	3.20	11.30	0.60	3.00		
<i>Paspalum</i> sp	BRA-014770	40	20	(0-2)	(10-19)	(0-1)	(2-4)	0.30	12.90	0.20	3.40		
<i>Paspalum</i> sp	BRA-009636	40	20	(0-2)	(12-20)	-	(0-4)	0.60	16.50	-	1.60		
<i>Paspalum</i> sp	BRA-013951	40	21	(0-5)	(10-16)	(0-1)	(1-5)	0.61	16.76	0.09	2.76		
<i>Paspalum</i> sp	BRA-008681	40	21	(0-2)	(8-18)	(0-1)	(1-6)	0.38	14.90	0.09	2.38		
<i>Paspalum</i> sp	BRA-011517	40	20	(0-3)	(6-17)	(0-1)	(1-7)	0.45	10.60	0.25	4.40		

(Fernandes *et al.*, 1974; Quarín, 1977; Quarín and Hanna, 1980; Pagliarini *et al.*, 2001), and we found *P. conspersum* BRA-010260 to be  $2n = 60$ . Chromosome numbers of  $2n = 20$ ,  $2n = 40$  and  $2n = 60$  have been reported for *P. plicatulum* (Brown, 1950; Nuñez, 1952; Reeder, 1967; Burson and Bennett, 1971; Davidse and Pohl, 1972; Takayama *et al.*, 1998; Pagliarini *et al.*, 2001), but our three *P. plicatulum* accessions (BRA-008940, BRA-006157, BRA-009784) were all  $2n = 40$ . Quarín *et al.* (1997) and Takayama *et al.* (1998) both reported that the chromosome number of *P. atratum* was  $2n = 40$ , the same number which we attributed to *P. atratum* BRA-009661. The chromosome number of *P. compressifolium* has been variously reported as being  $2n = 20$ ,  $2n = 40$  and  $2n = 60$  (Honfi *et al.*, 1990; Quarín *et al.*, 1996; Takayama *et al.*, 1998; Pagliarini *et al.*, 2001), while we found that our four *P. compressifolium* accessions (BRA-013102, BRA-011282, BRA-009105, BRA-011304) were all  $2n = 40$ . No data was

found in the literature regarding the chromosome number of *P. asterii*, which for our accession (BRA-011355) was  $2n = 40$ . Our data once again reinforces the opinion that polyploidy is predominant in the genus *Paspalum* and that tetraploidy is the most prevalent form. However, in our group of 36 accessions, 34 (94%) were tetraploid, much higher than the 50% reported by Quarín (1992).

The pairing configuration at diakinesis varied among accessions with the same ploidy level (Table 2). In the diploid *P. coryphaeum* accession only bivalents were recorded (Figure 1a) but among the tetraploid accessions the pairing behavior was irregular and diverse, with uni-, bi-, tri- and quadrivalents being observed (Figure 1b). In general, tetraploid accessions showed a predominance of bivalent chromosome associations. In three accessions (BRA-009661, BRA-006378, and BRA-006513), diakinesis was not adequate for analysis of chromosome pairing. For the diploid and tetraploid levels of ploidy, the behavior of chromosome



**Figure 1** - Meiotic behavior in different *Paspalum* cytotypes. a) Diakinesis in the diploid accession of *P. coryphaeum* showing 10 II. b) Diakinesis in tetraploid accession showing 18 II and 1 IV (arrowhead). c) Diakinesis in the hexaploid accession of *P. conspersum* with 30 II. d) Metaphase I in tetraploid accession showing precocious chromosome migration to the poles. e) Anaphase I in tetraploid accession showing laggards. f) Early telophase I in tetraploid accession with micronuclei. g) Prophase II with micronuclei. h) Tetrad with micronuclei. i) Microspore with micronuclei. Scale bar = 1  $\mu$ m.

association was in agreement with previous reports on the same or other *Paspalum* species (Burson and Bennett, 1971; Quarín *et al.*, 1996; Takayama *et al.*, 1998; Pagliarini *et al.*, 2001). For the hexaploid accession of *P. conspersum*, chromosomes paired as bivalents (Figure 1c). Hexaploid accessions reported in literature presented chromosome association including uni-, bi-, tri- and quadrivalents (Burson and Bennett, 1971; Quarín and Burson, 1991; Takayama *et al.*, 1998; Pagliarini *et al.*, 2001).

The tetraploid accessions could have been produced either by chromosome duplication or by interspecific hybrid-

ization followed by duplication. The low frequency of quadrivalents in tetraploid accessions reported in several *Paspalum* species has been interpreted as resulting from segmental allopolyploidy (Burson and Bennett, 1971; Norrmann *et al.*, 1989; Quarín *et al.*, 1996; Takayama *et al.*, 1998; Pagliarini *et al.*, 2001). Although low multivalent frequency is an argument frequently used in advocating segmental allopolyploidy, Sybenga (1996a) pointed out that this character is not necessarily a reliable indication of limited pairing affinity, and thus of homology, because even true autopolyploids may form quadrivalents with frequencies

substantially lower than theoretically possible. Quarín (1992) has proposed that at least in apomictic Panicoid grasses, polyploidy is a condition for apomixis and that apomixis is associated with autopolyploidy rather than allopolyploidy. Evidence for autopolyploidy was provided by Quarín *et al.* (1998) in a tetraploid accession of *P. rufum* Ness.

It has been hypothesized that hexaploid accessions are produced by hybridization (Katayama and Ikeda, 1975) or the fertilization of unreduced eggs in apomictic tetraploid forms (Quarín and Burson, 1991). Hexaploidy in *Paspalum*, with chromosomes pairing as 30 bivalents during meiosis, has been reported in the Uruguayan biotype of *P. dilatatum* Poiret (Burson *et al.*, 1991), this biotype having I and J genomes as well as an unidentified third genome (designated X) giving it the genomic form IJJXX (Burson, 1991). The meiotic behavior at diakinesis in the hexaploid accession of *P. conspersum*, with chromosomes pairing only as bivalents, suggest that it resulted from hybridization followed by chromosome duplication to produce an amphidiploid with a diploid-like meiotic process.

Our analysis of meiotic behavior showed that it was compatible with ploidy level and the status of chromosome pairing (Table 3). In the diploid accession of *P. coryphaeum*, with chromosomes pairing as bivalents (10 II), a low frequency of abnormalities was recorded in all meiotic phases, resulting in a high frequency of normal tetrads (99.6%). In all accessions analyzed the abnormalities recorded were related to irregular chromosome segregation and resulted from precocious chiasmata termination. In the hexaploid accession of *P. conspersum*, which presented a diploid-like meiotic process, with chromosomes pairing as 30 bivalents, microsporogenesis was initially irregular. Asynchrony in chiasma termination among bivalents in this accession led to precocious chromosome migration to the poles in metaphase I and laggards in anaphase I. However, the majority of such chromosomes were included in the telophase I nuclei and the second meiotic division presented a low frequency of meiotic irregularities. For tetraploid accessions, however, meiotic behavior varied among accessions, with the percentage of abnormal tetrad ranging from 0.6% in the accession BRA-009008 to 88.5% in BRA-01252 and with only three presenting less than 10% of abnormal tetrads. Except for a few other tetraploid accessions, the frequency of abnormalities during meiosis leading to abnormal tetrads was very high. In all accessions analyzed, the meiotic abnormalities were related to irregular chromosome segregation during both meiotic divisions, such as precocious chromosome migration to the poles during the metaphases (Figure 1d) and anaphase laggards (Figure 1e), resulting in micronuclei in the telophases (Figure 1f). Unbalanced gametes generated from these irregularities could compromise pollen fertility.

Some *Paspalum* species, such as some biotypes of *P. dilatatum* (Venuto *et al.*, 2003), *P. simplex* Morong ex Britton (Urbani *et al.*, 2002), *P. atratum* (Quarín *et al.*,

1997), *P. compressifolium* (Quarín *et al.*, 1996) and *P. notatum* (Tischler and Burson, 1995) provide excellent pasture in cattle production systems in several countries, including the Brazil, Thailand and the USA. The *Paspalum* cultivars used are generally selected based on natural genetic variability, because of which any lack of diversity represents an obvious risk to the ecosystem as well as to cattle production. Therefore rational exploitation of the diversity present in the germplasm, especially for species with good forage value, is of fundamental importance in maintaining diversity in the field. New cultivars are urgently needed and intra- and interspecific hybridizations are desirable as means of introgressing genes but certain difficulties, including differences in ploidy level among accessions and reproduction by apomixis, have delayed the development of new hybrids.

Regardless of an adequate germplasm base, breeding programs demand a knowledge of the mode of reproduction, chromosome number and meiotic behavior to direct the crosses. Apomixis has been widely recognized as a common method of reproduction in the *Paspalum*. In general, diploids are sexual and most polyploids are apomictic (Quarín and Burson, 1991), however, some polyploids reproduce sexually and many apomictics are facultative (Burson, 1997). Sexual reproduction in tetraploids has invariably been reported to occur in individuals with normal meiosis (Burson and Bennett, 1971; Quarín and Normann, 1987). Despite identifying promising accessions, the *Paspalum* breeding program in effect at Embrapa CPPSE depends on sexual accessions to act as female genitors in hybridizations. Tetraploid apomictic accessions with nearly regular meiosis, such as were found in some accessions in the present study, could be used as male genitors. Thus, wide cytological screening is a pre-requisite in *Paspalum* breeding programs. Our investigation revealed that among the 36 accessions evaluated, the diploid *P. coryphaeum* accession BRA-000841 could be used as the sexual female genitor and four tetraploid accessions (*P. notatum* BRA-006513, *P. limbatum* BRA-009008, *P. rhodopedum* BRA-006602 and *Paspalum* sp BRA-008630), with less than 10% of abnormal tetrads might have a potential for use in an interspecific hybridization program as male genitors. Our cytogenetic characterization of 36 CPPSE accessions has increased the possibilities of crosses between the *Paspalum* accessions available at Embrapa CPPSE because in the first analysis of 52 CPPSE accessions only tetra- and hexaploid cytotypes were found (Freitas *et al.*, 1997; Takayama *et al.*, 1998) while in the second analysis of 24 CPPSE accessions (Pagliarini *et al.*, 2001) six were diploids. These results have implications for breeding programs and shed some more light on the genetic structure of this important grass genus.

**Table 3** - Number of microsporocytes analyzed and the percentage of cells with meiotic abnormalities.

<i>Paspalum</i> species	Accession number	2n	N. of PMCs	Phases of meiosis*							
				M I	A I	T I	P II	M II	A II	T II	Tetr.
<i>P. coryphaeum</i>	BRA-000841	20	2172	4.89	3.09	0.55	6.25	2.91	1.88	0.60	0.40
<i>P. lividum</i>	BRA-006378	40	2096	5.86	71.92	42.85	36.36	76.92	45.45	37.83	56.39
<i>P. notatum</i>	BRA-006513	40	2015	1.50	1.85	0.78	1.39	2.63	2.50	0.89	1.26
<i>P. notatum</i>	BRA-008028	40	2066	55.77	86.44	51.89	47.93	30.00	75.00	44.30	34.78
<i>P. conspersum</i>	BRA-010260	60	2078	35.91	57.14	1.78	5.38	3.22	3.84	9.28	8.04
<i>P. usterii</i>	BRA-022624	40	2004	37.93	39.13	10.76	15.18	17.20	13.18	15.90	14.28
<i>P. compressifolium</i>	BRA-013102	40	2003	84.09	87.50	56.57	34.48	90.47	57.14	54.05	51.33
<i>P. compressifolium</i>	BRA-011282	40	2110	83.87	75.03	30.00	27.77	12.50	50.00	59.61	50.00
<i>P. compressifolium</i>	BRA-009105	40	2198	20.29	26.49	15.17	37.29	10.59	29.57	16.07	26.84
<i>P. compressifolium</i>	BRA-011304	40	2061	35.96	41.75	43.45	40.34	29.17	26.42	44.65	38.04
<i>P. atratum</i>	BRA-009661	40	2255	75.00	84.84	83.67	71.69	98.36	94.33	72.72	67.88
<i>P. plicatulum</i>	BRA-008940	40	2064	89.04	69.32	66.00	43.54	27.33	29.12	55.25	30.10
<i>P. plicatulum</i>	BRA-006157	40	2000	44.96	43.33	22.22	43.57	37.57	38.81	26.74	41.58
<i>P. plicatulum</i>	BRA-009784	40	2060	86.15	84.21	68.00	80.00	69.23	88.88	52.00	54.44
<i>P. rrhodopedum</i>	BRA-006602	40	2001	23.21	31.58	16.88	27.25	48.43	12.00	3.11	3.46
<i>P. rhodopedum</i>	BRA-006670	40	2035	65.62	60.00	58.51	51.35	31.81	88.23	43.39	56.73
<i>P. limbatum</i>	BRA-012530	40	2084	33.80	52.75	43.70	46.37	30.77	46.75	55.48	54.98
<i>P. limbatum</i>	BRA-009008	40	2167	20.68	85.71	11.11	13.43	5.26	95.23	4.91	0.63
<i>Paspalum</i> sp	BRA-008486	40	2083	29.75	21.67	17.00	5.30	34.04	21.28	17.80	26.31
<i>Paspalum</i> sp	BRA-008630	40	2000	48.63	49.18	24.13	24.11	76.92	70.00	16.75	7.60
<i>Paspalum</i> sp	BRA-008648	40	2301	27.38	58.27	38.88	29.07	68.97	77.78	30.23	22.67
<i>Paspalum</i> sp	BRA-008656	40	2127	33.23	19.68	18.30	8.52	65.66	69.64	7.25	27.27
<i>Paspalum</i> sp	BRA-008672	40	2060	73.00	52.00	55.00	69.00	62.00	79.00	60.00	59.00
<i>Paspalum</i> sp	BRA-008940	40	2064	89.04	69.32	66.00	43.54	27.33	29.12	65.25	40.10
<i>Paspalum</i> sp	BRA-009393	40	2021	45.78	40.28	25.09	48.57	43.10	45.51	46.81	50.93
<i>Paspalum</i> sp	BRA-010243	40	2073	46.17	47.10	68.72	59.12	28.12	44.00	73.00	56.17
<i>Paspalum</i> sp	BRA-011053	40	2071	16.57	22.22	32.53	24.82	16.53	27.65	37.29	38.37
<i>Paspalum</i> sp	BRA-011266	40	2010	76.23	26.86	52.36	29.89	41.76	41.50	28.91	37.68
<i>Paspalum</i> sp	BRA-012521	40	2010	76.72	89.28	76.11	38.84	90.08	89.08	90.69	88.54
<i>Paspalum</i> sp	BRA-012751	40	2002	52.40	63.94	61.57	57.19	59.26	59.56	52.30	65.19
<i>Paspalum</i> sp	BRA-013404	40	2128	41.10	30.66	26.90	20.63	43.60	27.59	18.57	13.9
<i>Paspalum</i> sp	BRA-013609	40	2000	73.95	69.39	56.23	21.05	77.91	62.20	51.11	63.66
<i>Paspalum</i> sp	BRA-014770	40	2069	20.85	74.22	52.82	46.40	37.40	74.63	53.26	47.78
<i>Paspalum</i> sp	BRA-009636	40	2123	71.42	90.90	33.33	29.06	71.42	87.50	26.26	21.96
<i>Paspalum</i> sp	BRA-013951	40	2011	58.01	37.07	28.99	12.50	75.00	42.45	32.87	28.23
<i>Paspalum</i> sp	BRA-008681	40	2251	48.01	39.56	14.53	14.18	26.92	7.14	16.25	23.88
<i>Paspalum</i> sp	BRA-011517	40	2409	82.35	88.88	51.68	66.44	70.83	72.07	43.33	59.99

\*M = metaphase, A = anaphase, T = telophase, Tetr = tetrad.

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Associate Editor: Marcelo Guerra