

Chromosome number in germplasm accessions of *Paspalum notatum* (Gramineae)

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ABSTRACT

Chromosome numbers are reported for 127 germplasm accessions of *Paspalum notatum* maintained by EMBRAPA (Empresa Brasileira de Pesquisa Agropecuária) in two research centers in Brazil. Most accessions were collected in their natural habitats in Southern Brazil.

Tetraploidy ($2n = 40$ chromosomes) was predominant (91% of the accessions studied), confirming previous reports for the species. Eleven accessions with $2n = 20$ chromosomes, although collected in the wild, are possibly derived from 'Pensacola' bahiagrass, commonly cultivated in the area since its introduction from the United States in the 60's, for the establishment of permanent pastures.

INTRODUCTION

The botanical composition of natural grassland communities in Brazil shows a high contribution of species of the genus *Paspalum*. A high proportion of livestock production is based on natural pastures containing species of this genus.

Paspalum notatum Flüge is the most common species of this genus in Southern Brazil. Its importance as a forage plant in the subtropics is widely recognized. The center of origin of the species, as suggested by Parodi (1937), covers Southern Brazil, Uruguay, Northeastern Argentina and Paraguay. Distinct biotypes are found in Brazil, according to climatic and/or soil factors. Several such biotypes dominate in the botanical composition of large areas of natural pastures, especially in the State of Rio Grande do Sul (Barreto, 1974). Many of them produce good quality

forage and are highly resistant to grazing and trampling. However, part of these natural pastures are being progressively transformed for grain production. Inadequate agricultural systems are frequently leading to erosion and soil losses, and the reestablishment of a dense sward, with productive lines of *P. notatum*, may be a future necessity.

Tetraploid biotypes of *P. notatum* are obligate apomitics (Burton, 1948; Bashaw *et al.*, 1970). Sexuality is restricted to *P. notatum* var. *saurae* ($2n = 20$), of which one cultivar, known as 'Pensacola' bahiagrass, was selected and improved (Burton, 1990) from plants accidentally introduced into the United States from South America. All the variation observed in 'Pensacola' bahiagrass in the Southern United States was also observed in plants naturally growing on a small island of the Paraná river in Argentina (Burton, 1967).

No native diploid plants of this species have been found in Brazil. In Rio Grande do Sul, tetraploid forms (most probably all apomitic) are predominant. Tetraploids are found up to the north of the country,

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and are known in Central and Southeastern Brazil as "Grama Batatais" (Valls and Pozzobon, 1987).

The breeding potential of distinct biotypes of *P. notatum* is being studied through intra- and interspecific hybridization (Urbani, 1987). Some biotypes have already been included in breeding programs (Forbes Jr. and Burton, 1961). Information on the phylogenetic relationships among different species of *Paspalum* has been obtained from such studies (Burson *et al.*, 1973; Quarín and Burson, 1983; Quarín *et al.*, 1984). Agronomic studies have identified promising biotypes and some of them have become commercial cultivars, such as 'Pensacola' bahiagrass. The Empresa Brasileira de Pesquisa Agropecuária (EMBRAPA) has accumulated germplasm with a broad array of morphotypes of *P. notatum* through field collection, especially in Southern Brazil. Such germoplasm is, presently, under morphological characterization and preliminary agronomic evaluation at the Centro de Pesquisa de Pecuária dos Campos Sul-brasileiros (CPPSUL), Bagé, Rio Grande do Sul State.

Apomitic reproduction has been considered normal for tetraploid *P. notatum*, while the sexuality of diploids has been linked to alogamy (Burton, 1955). As a consequence, basic information on the ploidy level of any new accession is important for the establishment of breeding programs, and also for determination of the most adequate procedures for multiplication of each accession.

The objective of this study was a thorough survey of chromosome numbers of the available accessions.

MATERIAL AND METHODS

Almost all accessions studied were collected in Southern and West Central Brazil. A few of them are old introductions, from Paraguay and the United States; one is of unknown origin and another is from Amapá State, in Northern Brazil (Table I). Voucher specimens of most accessions are deposited in the Centro Nacional de Pesquisa de Recursos Genéticos e Biotecnologia (CENARGEN) herbarium. Some accessions are maintained in a screenhouse at CENARGEN, and most of them are kept in field plots at CPPSUL.

Chromosome numbers were determined in meristematic cells of root tips taken from potted plants maintained in the screenhouse. Roots were pre-treated in a saturated solution of 1-bromonaphthalene for 2 h, and fixed in 3:1 (alcohol:glacial acetic acid) for 24 h. They were then hydrolyzed in 1 N HCl at 60°C for 10 min, and

transferred to a 2% pectinase solution for 45 min at room temperature. Staining followed the Feulgen technique. Roots were squashed on a slide in a drop of 2% aceto-orcein.

RESULTS AND DISCUSSION

More than 90% of the accessions had $2n = 40$ chromosomes, and the remaining ones were diploid ($2n = 20$) (Table I). This species was initially reported to be tetraploid (Burton, 1940); however, diploid ($2n = 20$) as well as tetraploid ($2n = 40$) cytotypes were later found in Argentina (Saura, 1948). Triploids were also cited by Gould (1966) in a study of Mexican grasses. Until now only the tetraploid level had been reported for Brazilian accessions. This was confirmed for 16 *P. notatum* accessions from Rio Grande do Sul State (Fernandes *et al.*, 1974) and for one accession from Rio Grande do Sul and four from Mato Grosso do Sul State (Honfi *et al.*, 1990).

Natural occurrence of the diploid 'Pensacola' bahiagrass is so far considered to be restricted to Argentina, on the margins and islands of the Paraná river and its tributaries, east of Santa Fé and west of Entre Ríos and Corrientes provinces (Burton, 1967). Native diploid forms of *P. notatum* could bring additional variability to breeding programs.

Although the native germplasm studied is predominantly tetraploid and shows characteristics of apomitic lines, elite genotypes can also be selected through agronomic evaluation aiming at good forage-producing accessions. On the other hand, apomitic forms could also be used as a source of variability, as pollen donors in crosses with artificially duplicated tetraploid sexual plants of 'Pensacola', to produce new cultivars, well adapted to Brazil and eventually more competitive in Southern Brazil.

The diploid accessions were originally collected (Figure 1) in areas of Rio Grande do Sul increasingly occupied by annual crops during the last three decades, especially in the Northern and Northwestern regions of the state. These are the Planalto Médio and Missões regions (Barreto, 1974), where permanent pastures of 'Pensacola' bahiagrass are eventually incorporated into the crop rotation. Given the widespread cultivation of this grass in other areas of Southern Brazil and possible seed transportation by floods down the Uruguay and Jacuí rivers, it is likely that all the diploid accessions now found are just escapes from areas of cultivated pastures of 'Pensacola' bahiagrass located at high altitude in the northern parts of Rio Grande do Sul State.

Table I - Chromosome numbers of *Paspalum notatum* accessions: 2n = 20, first 12; 2n = 40, all the rest.

Brazilian accession code (BRA-)	Accession identification*	Country**, state***, and locality	Latitude	Longitude	Elevation (m)
2n = 20					
001112	IAPAR-PG 6915	USA	N.A.	N.A.	N.A.
007641	VNSh 4067	BRA, RS, Bom Jesus	28°40'S	050°26'W	1000
007803	VBoPrOl 4669	BRA, RS, Itaqui	28°56'S	056°16'W	70
007901	VBoPrLg 4768	BRA, RS, Osório	29°57'S	050°18'W	25
012351	VBoSnSv 10036	BRA, RS, Mostardas	31°08'S	050°55'W	5
017205	VZnMrOvW 12342	BRA, RS, Dom Pedrito	31°13'S	050°58'W	180
017361	VZnW 12370	BRA, RS, Santana do Livramento	30°20'S	056°15'W	210
017507	VZnW 12391	BRA, RS, Uruguaiiana	29°54'S	057°17'W	70
017647	VZnW 12409	BRA, RS, Uruguaiiana	29°34'S	056°48'W	90
017680	VZnW 12414	BRA, RS, Uruguaiiana	29°24'S	056°42'W	90
017701	VZnW 12416	BRA, RS, Uruguaiiana	29°24'S	056°42'W	90
018627	VGoMrOv 12830	BRA, RS, Uruguaiiana	29°24'S	056°42'W	90
2n = 40					
001015	IAPAR-PG 68107	PRY	N.A.	N.A.	N.A.
001074	IAPAR-PG 6925	PRY	N.A.	N.A.	N.A.
001082	IAPAR-PG 6924	PRY	N.A.	N.A.	N.A.
001139	IAPAR-PG 6907	BRA, PR, Curitiba	N.A.	N.A.	N.A.
001147	IAPAR-PG 6906	BRA, SP	N.A.	N.A.	N.A.
001155	IAPAR-PG 6905	BRA	N.A.	N.A.	N.A.
006271	VGzLeBo 9667	BRA, RS, Uruguaiiana	30°12'S	057°33'W	70
006301	VGzLeBo 9684	BRA, RS, Uruguaiiana	29°43'S	057°01'W	80
006467	VMrFrLw 9747	BRA, RS, Alegrete	29°50'S	055°35'W	190
006513	VMrFrLw 9782	BRA, RS, Uruguaiiana	29°33'S	056°47'W	90
006599	VMrFrLw 9822	BRA, RS, Santo Ângelo	28°24'S	054°18'W	260
006629	VMrFrLw 9828	BRA, RS, Santo Ângelo	28°18'S	054°15'W	260
006637	VMrFrLw 9829	BRA, RS, Santo Ângelo	28°18'S	054°15'W	260
006645	VMrFrLw 9830	BRA, RS, Santo Ângelo	28°18'S	054°15'W	260
007668	VNSh 4077	BRA, RS, Bom Jesus	28°39'S	050°28'W	1000
007676	VNSh 4093	BRA, RS, Vacaria	28°22'S	050°50'W	900
007684	VNSh 4121	BRA, RS, Vacaria (cult.)	28°27'S	050°58'W	900
007731	VNSh 4186	BRA, RS, Tupanciretá	29°03'S	053°50'W	480
007773	VCoBu 4385	BRA, RS, Ivoti	29°36'S	051°07'W	200
007820	VBoPrOl 4700	BRA, RS, Uruguaiiana	29°56'S	057°10'W	70
007838	VBoPrOl 4701	BRA, RS, Uruguaiiana	29°56'S	057°10'W	70
007854	VBoPrOl 4736	BRA, RS, Santana do Livramento	30°27'S	055°07'W	120
007889	VBoPrLg 4752	BRA, RS, Osório	30°07'S	050°36'W	25
007935	BdBoMi 211	BRA, RS, São Miguel das Missões	N.A.	N.A.	N.A.
007943	BdBoMi 227	BRA, RS, S. Antônio das Missões	N.A.	N.A.	N.A.
007951	BdBoMi 229	BRA, RS, Itaqui	N.A.	N.A.	N.A.
007978	BdBoMi 235-B	BRA, RS, São Borja	N.A.	N.A.	N.A.
007986	EEA 673	BRA, RS, Guaíba	N.A.	N.A.	N.A.
008028	EEL 2735	BRA, SC, Lages	N.A.	N.A.	N.A.
008052	AReVi 1827	BRA, RS, Bagé	N.A.	N.A.	N.A.
008061	AReVi 1941	BRA, RS Uruguaiiana	N.A.	N.A.	N.A.
010006	VDBdSv 10137	BRA, SC, Laguna	28°22'S	048°46'W	15
010944	VBdZa 10629	BRA, RS, Iraí	27°15'S	053°17'W	200
011011	VGnMrBd 10648	BRA, RS, São Luiz Gonzaga	28°26'S	054°36'W	200
011657	DGoMi 263	BRA, SC, Campo Belo do Sul	27°55'S	050°38'W	1000
011703	DGoMi 302	BRA, SC, Campo Belo do Sul	27°47'S	050°54'W	850
011754	DGoMi 316	BRA, SC, Capinzal	27°24'S	051°31'W	600
012254	VMcRb 11664	BRA, AP, Macapá	00°01'N	051°03'W	15
012271	GnMr 1	BRA, RS, Dom Pedrito	31°12'S	054°50'W	180
012297	GnMr 5	BRA, RS, Dom Pedrito	31°15'S	054°52'W	220
012301	GnMr 6	BRA, RS, Dom Pedrito	31°08'S	054°47'W	120

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Table I - Continued.

Brazilian accession code (BRA-)	Accession identification*	Country**, state***, and locality	Latitude	Longitude	Elevation (m)
2n = 40					
012335	GnMr 9	BRA, RS, Dom Pedrito	31°20'S	054°53'W	175
012491	VQFdSv 11741	BRA, MS, Três Lagoas	20°46'S	051°40'W	330
012505	VQFdSv 11742	BRA, MS, Três Lagoas	20°46'S	051°40'W	330
012564	VQFdSv 11795	BRA, MS, Sidrolândia	21°05'S	054°19'W	470
012637	VQFdSv 11808	BRA, MS, Caarapó	22°25'S	054°41'W	310
012815	VQFdSv 11853	BRA, MS, Iguatemi	23°33'S	054°15'W	310
012891	VQFdSv 11883	BRA, MS, Ponta Porã	22°30'S	055°26'W	720
013005	VQFdSv 11914	BRA, MS, Amambaí	23°16'S	055°27'W	600
013374	VGoSv 11149	BRA, PR, Quatro Barras	25°19'S	049°03'W	920
014206	VGoSv 11376	BRA, PR, Guarapuava	25°25'S	051°47'W	980
014231	VGoSv 11387	BRA, SC, São Lourenço do Oeste	26°23'S	051°46'W	950
014249	VGoSv 11388	BRA, SC, São Lourenço do Oeste	26°23'S	051°46'W	950
014265	VGoSv 11414	BRA, PR, Pato Branco	26°14'S	052°40'W	650
014401	VGoSv 11452	BRA, PR, Palmas	26°31'S	051°55'W	1050
014583	VGoSv 11538	BRA, SC, Campos Novos	27°21'S	051°16'W	880
014656	VGoSv 11553	BRA, SC, Curitibaanos	27°19'S	050°44'W	850
016381	VMrCaW 12121	BRA, SC, São Joaquim	28°14'S	049°58'W	1200
016390	VMrCaW 12122	BRA, SC, São Joaquim	28°14'S	049°58'W	1200
016454	VMrCaW 12156	BRA, SC, Lages	28°08'S	050°39'W	930
016489	VMrCaW 12160	BRA, RS, Vacaria	28°21'S	050°50'W	910
016497	VMrCaW 12161	BRA, RS, Vacaria	28°21'S	050°50'W	910
016501	VMrCaW 12164	BRA, RS, Vacaria	28°20'S	050°18'W	880
016551	VZnMrCaW 12178	BRA, RS, Soledade	28°51'S	052°26'W	610
016560	VZnMrCaW 12179	BRA, RS, Soledade	28°51'S	052°26'W	610
016586	VZnMrCaW 12203	BRA, RS, Santa Barbara do Sul	28°29'S	053°08'W	570
016608	VZnMrCaW 12208	BRA, RS, Ijuí	28°22'S	053°14'W	410
016705	VZnMrCaW 12234	BRA, RS, S. Antônio das Missões	28°30'S	055°14'W	270
016781	VZnMrCaW 12248	BRA, RS, São Borja	28°55'S	055°36'W	210
016811	VZnMrCaW 12253	BRA, RS, Itaquí	28°59'S	055°18'W	200
016845	VZnMrCaW 12260	BRA, RS, Itaquí	29°02'S	055°15'W	200
016900	VZnMrCaW 12267	BRA, RS, Santiago	29°08'S	054°53'W	440
016926	VZnMrCaW 12273	BRA, RS, Santa Maria	28°49'S	053°45'W	180
016934	VZnMrCaW 12274	BRA, RS, Santa Maria	28°49'S	053°45'W	180
016942	VZnMrCaW 12275	BRA, RS, Santa Maria	28°49'S	053°45'W	180
017019	VZnMrCaW 12286	BRA, RS, São Sepé	29°00'S	053°40'W	250
017051	VZnMrCaW 12293	BRA, RS, Caçapava do Sul	30°25'S	053°31'W	250
017132	VZnMrOvW 12324	BRA, RS, Dom Pedrito	31°00'S	054°35'W	130
017248	VZnW 12353	BRA, RS, Santana do Livramento	30°48'S	055°38'W	140
017281	VZnW 12359	BRA, RS, Santana do Livramento	30°22'S	056°03'W	140
017299	VZnW 12360	BRA, RS, Santana do Livramento	30°22'S	056°03'W	140
017302	VZnW 12361	BRA, RS, Santana do Livramento	30°22'S	056°03'W	140
017345	VZnW 12368	BRA, RS, Santana do Livramento	30°20'S	056°15'W	220
017353	VZnW 12369	BRA, RS, Santana do Livramento	30°20'S	056°15'W	220
017396	VZnW 12374	BRA, RS, Quaraí	30°14'S	056°28'W	210
017400	VZnW 12375	BRA, RS, Quaraí	30°14'S	056°28'W	210
017418	VZnW 12376	BRA, RS, Quaraí	30°14'S	056°28'W	210
017436	VZnW 12377	BRA, RS, Quaraí	30°14'S	056°28'W	210
017434	VZnW 12378	BRA, RS, Quaraí	30°14'S	056°28'W	210
017442	VZnW 12379	BRA, RS, Quaraí	30°14'S	056°28'W	210
017512	VZnW 12392	BRA, RS, Uruguaiana	29°53'S	057°19'W	70
017523	VZnW 12393	BRA, RS, Uruguaiana	29°53'S	057°19'W	70
017531	VZnW 12394	BRA, RS, Uruguaiana	29°53'S	057°19'W	70
017582	VZnW 12401	BRA, RS, Uruguaiana	29°55'S	057°19'W	70
017591	VZnW 12402	BRA, RS, Uruguaiana	29°55'S	057°19'W	70

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Table I - Continued.

Brazilian accession code (BRA-)	Accession identification*	Country**, state***, and locality	Latitude	Longitude	Elevation (m)
2n = 40					
017604	VZnW 12403	BRA, RS, Uruguaiiana	29°55'S	057°19'W	70
017612	VZnW 12405	BRA, RS, Uruguaiiana	29°51'S	057°07'W	80
017639	VZnW 12408	BRA, RS, Uruguaiiana	29°34'S	056°48'W	90
017655	VZnW 12410	BRA, RS, Uruguaiiana	29°29'S	056°42'W	110
017663	VZnW 12411	BRA, RS, Uruguaiiana	29°29'S	056°42'W	110
017671	VZnW 12412	BRA, RS, Uruguaiiana	29°29'S	056°42'W	110
017698	VZnW 12415	BRA, RS, Uruguaiiana	29°24'S	056°42'W	90
017744	VZnW 12426	BRA, RS, São Luíz Gonzaga	28°17'S	054°56'W	200
017817	VW 12448	BRA, SC, Água Doce	26°48'S	051°42'W	1140
018210	VMrLe 12472	BRA, RS, Bagé	31°18'S	054°04'W	250
018350	VGoMrOv 12750	BRA, RS, São Gabriel	30°24'S	054°19'W	150
018368	VGoMrOv 12751	BRA, RS, São Gabriel	30°24'S	054°19'W	150
018376	VGoMrOv 12752	BRA, RS, São Gabriel	30°24'S	054°19'W	150
018384	VGoMrOv 12753	BRA, RS, São Gabriel	30°24'S	054°19'W	150
019232	DBoMi 275	BRA, SC, Campo Belo do Sul	27°54'S	050°44'W	900
019259	IAPAR-PG 6912	USA	N.A.	N.A.	N.A.
019267	IAPAR-PG 6928	PRY	N.A.	N.A.	N.A.
019275	IAPAR-PG 6942	N.A.	N.A.	N.A.	N.A.
019283	IAPAR-PG 6998	PRY	N.A.	N.A.	N.A.
019321	EEL 1244	USA	N.A.	N.A.	N.A.

*Collectors (or Institutions): A = A.C. Allem, Bd = I.I. Boldrini, Bo = S.C. Boechat, Bu = B.L. Burson, Ca = T.S. Canto, Co = L. Coradin, D = M. Dall'Agnol, EEA = Estação Experimental Agronômica da Universidade Federal do Rio Grande do Sul, EEL = Estação Experimental de Lages da Empresa Catarinense de Pesquisa Agropecuária, Fd = M.S. França Dantas, Fr = J.M.O. Freitas, Gn = J.O.N. Gonçalves, Go = K.E. Gomes, Gz = S.O. Gonzaga, IAPAR-PG = Estação Experimental de Ponta Grossa do Instituto Agronômico do Paraná, Le = E. Lemos, Lg = H.M. Longhi, Lw = H.M. Longhi-Wagner, Mc = S. Mochiutti, Mi = S.T.S. Miotto, Mr = C.O.C. Moraes, N = C. Nabinger, Ol = M.L.A.A. Oliveira, Ov = J.C. Oliveira, Pr = A.I.C. Pereira, Q = C.L. Quarin, Rb = B. Rabelo, Re = J.C.L. Reis, Sh = V.P. Schell da Silva, Sn = A.M.P.V. Santos, Sv = G.P. Silva, V = J.F.M. Valls, Vi = J.G.A. Vieira, W = W.L. Werneck, Za = A.C.A. Zanatta, Zn = A. Zanin.

**Countries: BRA = Brazil, PRY = Paraguay, USA = United States of America.

***States: AP = Amapá, MS = Mato Grosso do Sul, PR = Paraná, RS = Rio Grande do Sul, SC = Santa Catarina, SP = São Paulo.

N.A.: Not available.

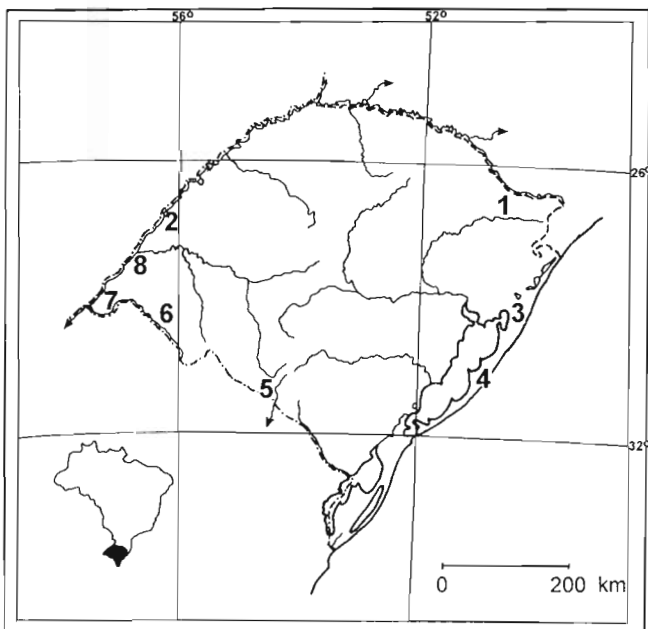


Figure 1 - Rio Grande do Sul State with approximate sites of origin in nature of diploid *Paspalum notatum* accessions studied: 1. VNSh 4067, 2. VBoPrOl 4669, 3. VBoPrLg 4768, 4. VBoSnSv 10036, 5. VZnMrOvW 12342, 6. VZnW 12370, 7. VZnW 12391, VZnW 12409, 8. VZnW 12414, VZnW 12416, VGoMrOv 12830.

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RESUMO

Números cromossômicos são relatados para 127 acessos de *Paspalum notatum* mantidos pela EMBRAPA (Empresa Brasileira de Pesquisa Agropecuária) em coleções de germoplasma em dois centros de pesquisa, no Brasil. A maioria dos acessos foi coletada em seus habitats naturais no Sul do Brasil.

O nível tetraplóide ($2n = 40$) é predominante entre os acessos estudados (91%), confirmando ser esta a situação mais normal para a espécie. Onze acessos com $2n = 20$ cromossomos, embora coletados na natureza, provavelmente descendem de populações exóticas da grama Pensacola, comumente cultivadas desde sua introdução no Sul do Brasil, vindas dos Estados Unidos, para cultivo de pastagens permanentes, na década de 60.

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