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Abstract

Three experiments are discussed in which 148 accessions representing 33 species of *Paspalum* were compared for a range of agronomic and morphological attributes at Samford, southeast Queensland. The first two experiments were replicated, and evaluated yield (4-weekly and 8-weekly cutting regimes; Experiment 1) and seed production (Experiment 2) of 43 accessions, most of which had previously been noted as having some winter-greenness. The two experiments included *Setaria sphacelata* cv. Nandi and *Panicum maximum* var. *trichoglume* cv. Petrie (green panic) as controls. Winter-greenness was rated on both experiments following a night with minimum grass temperature of -4°C. In the third experiment, which was unreplicated, 133 accessions were planted in rows, and spread, height, leaf dimensions and seed production were assessed. Yield was rated and palatability was scored after grazing. A fourth experiment, at Wolvi, near Gympie, southeast Queensland, was sown to 33 accessions (14 species) of *Paspalum* in a replicated trial and grazed over summer.

Winter-greenness showed marked differences between entries, with some accessions of *P. dilatatum*, *P. guenoarum*, *P. plicatulum* and *P. yaguaronense* showing little or no damage from frost, while *Setaria sphacelata* cv. Nandi and *Panicum maximum* var. *trichoglume* cv. Petrie showed severe damage. Dry matter yield was also very variable, but no entry yielded significantly higher than either cv. Nandi or Petrie (green panic). Seed yield of several accessions significantly exceeded that of Nandi, but not green panic. Some accessions of *P. plicatulum* (and of other species) were grazed in preference to *P. plicatulum* cv. Rodd's Bay. Based on data from Experiment 3, 26 groups and a number of sub-groups were established. A core set of accessions has been established, based on these groupings. In the fourth experiment accessions of *P. guenoarum*, *P. nicorae*, *P. plicatulum*, *P. stellatum* and *P. yaguaronense* which combined good winter-greenness and high acceptability to cattle were identified.

In a fifth experiment, variation in caryopsis proteins was analysed in 19 accessions in four species. Two major groups were identified, one including *P. nicorae* and *P. plicatulum*, the other, *P. dilatatum* and *P. notatum*. With two exceptions, all accessions tested could be distinguished on the basis of caryopsis protein banding, but the technique was not reliable for distinguishing between species.

Keywords

Tropical grasses, forage, winter-greenness, palatability, seed production, seed proteins

Introduction

The genus *Paspalum* includes several species that are widely used as sown forage. *P. dilatatum* was first introduced to Australia in the 1870s, and was widely grown in warm temperate to subtropical areas by the end of the century. *P. dilataum* has become naturalised throughout the mesic subtropics and is now the most common species of the genus in Australia. *P. wettsteinii* was released in NSW, Australia, for commercial use in 1966, but very little is now sown. *P. scrobiculatum* cv. Paltridge

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received its cultivar name in 1966. Although it had been fairly widely sown in the Burnett region before that year, again, little, if any, is now sown. *P. conjugatum* has been used as a soil binder on slopes in southern Queensland and northern NSW (A. Wynn, unpublished notes) and is now naturalised in poorly-drained situations in the Australian tropics and subtropics. *P. plicatulum* cvv. Rodd's Bay, Hartley and Bryan were commercially released in Queensland in 1963, 1963 and 1975 respectively. Rodd's Bay and Bryan were not popular with graziers as they were not very palatable to livestock (Skerman and Riveros 1990; Humphreys and Partridge 1995). Adequate commercial assessment of the cultivar Hartley is probably questionable, since much of the seed sold under that name was, in fact, cv. Rodd's Bay (Loch 1976). All are now commercially extinct. *P. notatum* has been widely grown in tropical regions of the world, and there are several 'cultivars' of the species recorded from various countries (Skerman and Riveros 1990). Seed is imported to Australia from USA and Argentina, largely for amenity purposes. The forage cultivar Competidor was registered in NSW in 1986 (Oram 1990), and the turf cultivar, Riba, in 1994. More recently, *P. atratum* cv. Suerte has been released in the southern USA; and is being marketed as cv. Hi-gane in Australia. This cultivar, and a Brazilian accession BRA 9610 are attracting considerable interest in the humid tropics of South-East Asia (W.W. Stür, personal communication). In North Sumatra, the related species *P. guenoarum* is showing considerable promise for sheep pastures (Tatang Ibrahim, personal communication). *P. nicorae* has been identified as having value for soil conservation in the USA, where cultivars Amcorae and Doncorae have been registered. In Queensland, this species has been recognised as a valuable forage and amenity species, with cv. Blue Dawn (derived from the same parental accession as cv. Amcorae) being made available commercially in 1998 (B.G. Cook, personal communication).

In the early 1960s Shaw *et al.* (1965) compared 17 accessions of *Paspalum*, representing ten species, with naturalised *P. dilatatum*, at Samford, South-East Queensland They found four accessions to be markedly higher yielding than *P. dilatatum*, and several others to have better seasonal production. Over the same decade, Mannetje (1967) and Jones (1969) reported high levels of frost tolerance and winter-greenness in accessions of *P. guenoarum*, although the latter author noted that (excluding *Chloris distichophylla*), Australian naturalised *P. dilatatum* was the most winter-green of the 13 species he studied. Subsequently, three trials were carried out at the same site from the late 1960s to early 1980s to assess the variation in the Australian Tropical Forages Genetic Resource Centre collection of *Paspalum*. This led to field trials of a selected range of accessions in the early 1990s near Gympie, also in South-East Queensland. In 1993, increasing interest in *P. nicorae* led to a laboratory study comparing caryopsis proteins of a limited number of accessions of *P. nicorae*, *P. notatum*, *P. dilatatum* and *P. plicatulum*, with the main objective of identifying banding criteria for identification of species and individual accessions. With the recent renewal of interest in the genus, it is appropriate that the results be made available to pasture agronomists concerned with cultivar development. This paper presents results from the four field trials and the study of caryopsis proteins.

Materials and Methods

The complete list of accessions planted in the three trials, together with species identification and passport information, is provided in Table 1.

Experiment 1 – Cutting trial, Samford, 1969-71

Thirty eight accessions with some cold-tolerance were selected for the trial, having survived grass temperatures of –9°C at Samford (A. Wynn unpublished data; Sept. 1968). These were compared with *Setaria sphacelata* var. *sericea* cv. Nandi, and green panic (*Panicum maximum* var. *trichoglume* cv. Petrie).

The trial was in four replicates, with two treatments, cutting at four-weekly intervals, or eight-weekly intervals. Plots were 2.4 x 1.5 m, with plants spaced at 30 cm (40 plants/plot). The trial was planted vegetatively on 13 and 14 February 1969 and fertilized on 14 January 1970 with 625 kg/ha lime, 500 kg/ha Mo super, 125 kg/ha KCl, and 8 kg/ha each of Cu and Zn. Nitrogen was applied at 112 kg/ha on 14 October and 24 December 1969 and 20 April 1970.

Harvest dates over two growing seasons for the two cutting regimes were as follows:

1969-70		1970-71	
4-weekly cutting	**8-weekly cutting**	**4 weekly cutting**	**8-weekly cutting**
29 October 1969		11 November 1970	
28 November 1969	26 November 1969	8 December 1970	8 December 1971
23 December 1969		12 January 1971	
20 January 1970	21 January 1970	11 February 11971	11 February 1971
17 February 1970		10 March 1971	
24 March 1970	20 March 1970	27 April 1971	27 April 1971
4 May 1970*	18 May 1970		

*5-week cutting interval

The area harvested was 3 x 3 plants (0.82 m^2). Harvested material was dried in a dehydrator to calculate dry weight per unit area. All plots were cut back on 31 August 1970, and the first subsequent cut was taken ten weeks later for the four-weekly harvest regime and 14 weeks later for the eight-weekly regime.

Table 1. Provenance data of accessions evaluated, and experiment(s) in which they were included (Parentheses around countries indicate accession is from an institution and not necessarily native to that country.)

Number	Species	Country	Lat.	Long	Rain (mm)	Alt. m	Expt
CPI 32424	*P. arechavalitai*	(Uruguay)					3
ATF 1146 (cv. Suerte)	*P. atratum*	Brazil	20°24'S	54°35'E			4
CPI 60055	*P. auriculatum*	Uganda	0°16'S	30°07'E	1400	1515	3
CPI 60059	*P. conjugatum*	Uganda	0°16'S	30°07'E	1400	1515	3
CPI 60060	*P. conjugatum*	Uganda	0°29'S	29°47'E	1125	820	3
CPI 17651	*P. conspersum*	(Brazil)					1,2,3
CPI 39956	*P. conspersum*	Brazil	27°35'S	48°31'W			3
CPI 13646	*P. convexum*	(Brazil)					3
CPI 21375	*P. dilatatum*	(USA)					1,2,3
CPI 27699	*P. dilatatum*	Uruguay					1,2,3
CPI 37489	*P. dilatatum*	Uruguay				20	3
CPI 37501	*P. dilatatum*	Uruguay					3
CPI 37502	*P. dilatatum*	Argentina				275	3
CPI 37521	*P. dilatatum*	Uruguay				275	3
CPI 37522	*P. dilatatum*	Uruguay				170	3
CPI 39957	*P. dilatatum*	Bolivia	14°46'S	64°50'W		300	3
CPI 39959	*P. dilatatum*	Brazil	28°31'S	50°52'W			3
CPI 39960	*P. dilatatum*	Brazil	29°45'S	57°05'W			3
CPI 39961	*P. dilatatum*	Bolivia				300	3
CPI 60061	*P. dilatatum*	S. Africa	25° S		850	1665	3
CQ 914[1]	*P. dilatatum*	Australia					1,2,3
CQ 935[1]	*P. dilatatum*	Australia					1,2,3
'Commercial'	*P. dilatatum*	Australia					5
CPI 60062	*P. distichum*	S. Africa	26° S		700	1425	3[2]
CPI 38827	*P. fimbriatum*	Venezuela				900	3
CPI 20324	*P. guenoarum*	Paraguay					1,2,3
CPI 27682	*P. guenoarum*	Uruguay					1,2,3
CPI 39054	*P. guenoarum*	(Argentina)					1,2,3,4
CPI 39056	*P. guenoarum*	(Argentina)					1,2,3,4
CPI 39962	*P. guenoarum*	Brazil				450	1,2,3,4

CPI 39964	*P. guenoarum*	Brazil	31°45'S	52°20'W		1,2,3
CPI 39965	*P. guenoarum*	Paraguay				1,2,3
CPI 39966	*P. guenoarum*	Brazil	29°05'S	53°50'W		1,2
CPI 39992	*P. guenoarum*	Brazil				3,4
CPI 43477	*P. guenoarum*	(Argentina)				2,3,4
CPI 75354	*P. guenoarum*	(Argentina)				3,4
CPI 75355	*P. guenoarum*	(Argentina)				3
ATF 1053	*P. guenoarum*	Brazil				4
CPI 37694	*P. humboldtianum*	Bolivia			2060	3
CPI 78821	*P. hydrophilum*	Argentina				3
CPI 32428	*P. indecorum*	(Uruguay)				3,4
CPI 78822	*P. lividum*	(Argentina)				3
CPI 27690	*P. malacophyllum*	Paraguay				1,3,4
CPI 37579	*P. malacophyllum*	Argentina			1900	3
CPI 39478	*P. malacophyllum*	Bolivia				3
CPI 39969	*P. mandiocanum*	Brazil	27°35'S	48°31'W		3,4
CPI 40520	*P. mandiocanum*	Venezuela	8°25'N	71°08'W	1670	3,4
CPI 21370 cv. Blue Dawn	*P. nicorae*	(Argentina)				3,5
CPI 21382	*P. nicorae*	Argentina				3,5
CPI 27657	*P. nicorae*	(Brazil)				3
CPI 27660	*P. nicorae*	Uruguay				3,5
CPI 27662	*P. nicorae*	Uruguay				3
CPI 27693	*P. nicorae*	Brazil				3,5
CPI 27707	*P. nicorae*	Brazil	29°41'S	53°47'W		3,4,5
CPI 37526	*P. nicorae*	Uruguay			170	3,4,5
CPI 39970	*P. nicorae*	Brazil	29°05'S	53°50'W		3,5
CPI 125877	*P. nicorae*	Brazil	29°45'S	57°05'W		5
cv. Doncorae 'Rappville'[3]	*P. nicorae*					5
CPI 23944	*P. notatum*					5
CPI 24940	*P. notatum*[4]	Argentina				3
CPI 27644	*P. notatum*	Uruguay				3
CPI 38824	*P. notatum*	Venezuela	10°35'N	66°56'W	900	5
CPI 39477	*P. notatum*	Bolivia				3
cv. Competidor	*P. notatum*					5
cv. Pensacola	*P. notatum*					5
'Commercial'	*P. notatum*	Argentina				5
'Zerner'[5]	*P. notatum*					5
CPI 11823	*P. paniculatum*	Brazil	29°57'S	53°52'W		3
CPI 21374	*P. paniculatum*	(Puerto Rico)				3,4
CPI 27703	*P. paniculatum*	Argentina				3,4
CPI 27709	*P. paniculatum*	Argentina	27°27'S	55°50'W		3
CPI 37878	*P. paniculatum*	Ecuador	1°27'S	78°19'W	1520	3
CPI 38224	*P. paniculatum*	Peru			1360	3,4
CPI 38762	*P. paniculatum*	Colombia			1330	3
CPI 21376	*P. platyphyllum*	(USA)				3,4
CPI 2741 (cv. Rodd's Bay)	*P. plicatulum*	Guatamala				1,2,3,4,5
CPI 7478	*P. plicatulum*	(USA)				1,2,3
CPI 11826 (cv. Hartley)	*P. plicatulum*	Brazil	15°32'S	56°05'W		1,2,4,5
CPI 18634	*P. plicatulum*	(Guyana)				3
CPI 21377	*P. plicatulum*	(Puerto Rico)				1,2,3
CPI 21378 (cv. Bryan)	*P. plicatulum*	Puerto Rico				1,2,3,4,5
CPI 21379	*P. plicatulum*	Puerto Rico				1,2,3
CPI 21380	*P. plicatulum*	(USA)				1,2,3

CPI 21381	*P. plicatulum*	Brazil					1,2,3,4
CPI 23729	*P. plicatulum*	(Trinidad)					1,2,3
CPI 26963	*P. plicatulum*	(USA)					1,2,3
CPI 27389	*P. plicatulum*	Brazil	21°16'S	50°54'W			1,2[2],3
CPI 27651	*P. plicatulum*	(Brazil)					1,2,3,4
CPI 27678	*P. plicatulum*	Uruguay					1,2,3
CPI 27680	*P. plicatulum*	Uruguay	24°30'S	54°22'W			1,2,3
CPI 27681	*P. plicatulum*	Uruguay					1,2,3,4
CPI 27687	*P. plicatulum*	Brazil	30°51'S	54°13'W			1,2,3
CPI 27708	*P. plicatulum*	Brazil	31°22'S	54°06'W			3
CPI 27711	*P. plicatulum*	Argentina	27°27'S	55°50'W			1,2,3,4
CPI 39985	*P. plicatulum*	Brazil	31°45'S	52°20'W			1,2,3,4
CPI 40000	*P. plicatulum*	Bolivia				300	1,2,3
CQ 1109	*P. plicatulum*						3
CPI 70156	*P. polystachion*	(Zimbabwe)					3
CPI 26794	*P. pubiflorum*	(USA)					3
CPI 37488	*P. quadrifarium*	Uruguay					3
ATF 1054	*P. regnellii*	Paraguay					4
CPI 24935	*P. rojassi*	Argentina					1,2,3,4
CPI 43478	*P. rojasii*	(Argentina)					3
CPI 2696 (cv. Paltridge)	*P. scrobiculatum*[6]	Zimbabwe					3
CPI 15396	*P. scrobiculatum*	Sudan					3
CPI 15705	*P. scrobiculatum*	Ethiopia			1300		3
CPI 17791	*P. scrobiculatum*	(Kenya)					3
CPI 21038.2[7]	*P. scrobiculatum*	Vietnam			2000		3
CPI 46978	*P. scrobiculatum*	(India)					3
CPI 58128	*P. scrobiculatum*	Zimbabwe	19°31'S	28°17'E			3
CPI 60054	*P. scrobiculatum*	Kenya	2°30'S	40° 10'E	1100	30	3
CPI 60056	*P. scrobiculatum*	Kenya	1° 04'N	34° 50'E	1000	1880	3
CPI 60057	*P. scrobiculatum*	Uganda	1° 54'N	33° 24'E	1200	1000	3
CPI 60058	*P. scrobiculatum*	Zimbabwe	18° 58'S	32° 40'E	900	1060	3
CPI 60064	*P. scrobiculatum*	Malawi	16° S		700	61	3
CPI 27691	*P. stellatum*	Argentina					3,4
CPI 37687	*P. unispicatum*	Bolivia	20°08'S	63°33'W			3
CPI 38829	*P. unispicatum*	Venezuela				900	3
CPI 37557	*P. urvillei*	Argentina				360	3
CPI 37561	*P. urvillei*	Argentina				360	3
CPI 16064	*P. virgatum*	(Zaire)					3,4
CPI 39958	*P. virgatum*	Bolivia				2480	3,4
CPI 89254	*P. virgatum*	Senegal					3,4
CPI 11860	*P. wettsteinii*	(Argentina)					3
CPI 27695	*P. yaguaronense*	Brazil	30°24'S	54°20'W			1,2,3,4
CPI 27698	*P. yaguaronense*	Uruguay					1,2,3
CPI 27700	*P. yaguaronense*	Uruguay					1,2,3[2]
CPI 39998	*P. yaguaronense*[4]	Brazil	29°05'S	53°50'W			3
CQ 917	*P. yaguaronense*	S. America					1,2
CPI 11829	*P.* sp.	Brazil	27°35'S	48°31'W			3
CPI 37295	*P.* sp.	Honduras	14°09'N	87°02'W		1300	3
CPI 37537	*P.* sp.	Argentina					3
CPI 37633	*P.* sp.	Bolivia				1200	3
CPI 37697	*P.* sp.	Bolivia				1450	3
CPI 37828	*P.* sp.	Ecuador	1°28'S	78°10'W		1400	3
CPI 37831	*P.* sp.	Ecuador	1°29'S	78°04'W			3
CPI 37842	*P.* sp.	Ecuador	1°28'S	78°13'W		1450	3
CPI 37847.1[7]	*P.* sp.	Ecuador				910	3
CPI 37863	*P.* sp.	Ecuador	1°27'S	78°15'W		1520	3

CPI 38177	*P.* sp.	Argentina		3
CPI 38219	*P.* sp.	Peru	1360	3
CPI 38506	*P.* sp.	Peru	820	3
CPI 39479	*P.* sp.	Bolivia[8]		3
CPI 39479.1[7]	*P.* sp.	Bolivia[8]		3
CPI 40001	*P.* sp.	Bolivia	2360	3
CPI 40517	*P.* sp.	Peru	760	3
CPI 40518	*P.* sp.	Peru	820	3
CPI 57977	*P.* sp.	Brazil		3
CQ 702	Green Panic			2
CQ 747	Nandi	Kenya		2

[1] naturalised in Australia
[2] failed
[3] a naturalised population from near Casino, northern NSW, believed to have been introduced from the USA in the 1950s
[4] uncertain identification
[5] a naturalised population from near Gympie, southern Queensland
[6] syn. *P. orbiculare, P. comersonii*
[7] off-type, or accession apparently a mixture
[8] provenance uncertain

Three nights with grass temperatures <0° occurred from 19-23 May 1970, with a minimum temperature of –4°C. Plants were rated for frost damage on a 0-10 scale on 25 May 1970. At time of frosting, the condition of the trial was described as 'short stubble'.

Experiment 2 – Seed production trial, Samford, 1969-1970

Thirty seven accessions of *Paspalum* were included in the trial (Table 1), with *Panicum maximum* var. *trichoglume* cv. Petrie and *Setaria sphacelata* cv. Nandi as controls. The trial was in three replicates, with single row plots 4 m long and 1 m wide, and with plants at 40 cm spacing.

The trial was planted vegetatively on 17 February 1969 and cut back on 23 January and 1 June 1970. Seed was collected at intervals of a few days over the seeding period from early November 1969 to 19 January 1970, and (after cutting back on 23 January) from 8 April to 15 May 1970. Plots were checked for commencement of flowering before each seeding season. Seed was cleaned using a laboratory aspirator.

Plots were scored for frost damage on a 0-10 scale (0 = total leaf death; 10 = no visible damage) on 25 May 1970, following minimum grass temperature of –4°C (see Experiment 1). At the time of frosting, plots were described as 'mature growth'. Some plots were wilted, and were not rated for frost damage as results would have been spurious; data for these plots were estimated by standard 'missing plot' procedures.

Experiment 3 – Classification trial, Samford, 1981-82

A total of 133 accessions was selected for evaluation. This did not include all *Paspalum* accessions available; 52 accessions of *P. notatum* were intentionally omitted. The few *P. notatum* accessions which were included in the trial were sown inadvertently – they had been introduced as 'species' and their identity was not known until the experiment was established.

Seed was sown into peat pots on 21 July 1981 and transplanted to the field in an unreplicated experiment on 21 September 1981. Plot size was 4 x 2 m, with a single row of ten plants (fewer where ten plants were not available) down the centre of each plot, to enable measure of spread. Accessions were subjectively classed into groups, largely on a species basis, but with some variable species including members in different groups. Date of first flowering was recorded, as were dimensions of leaf blades and growth habit. Plant height and spread were measured at the end of the season, and yield was rated on a 1-10 basis. Cattle were introduced to the area after the last seed collection, in June 1982, and plots scored after they were removed to give an index of palatability, again on a 1-10

basis. Twenty six main groups were defined and described at the time of the experiment, and these descriptions are presented in italics in Table 4. Other comments based on interpretation of the data are also included.

Experiment 4 - Growth trial at Wolvi, near Gympie, 1994-95

Fourteen species of *Paspalum,* represented by a total of 33 accessions, were sown in a replicated experiment in January 1994 at Wolvi. near Gympie, an area receiving an average annual rainfall of about 1200mm. Soil was a moderately fertile red podzolic (Dr3.21). Plots were 4 m x 1 m and seed was sown into a cultivated seedbed at a rate of 5 kg/ha. Superphosphate was applied at planting and maintenance dressings of 100 kg /ha of N were applied each year. The site was not irrigated. After the first grazing some eight weeks after sowing, plots were intermittently grazed according to the level of growth. Plots were rated for frost damage on 13 August 1994, when further frosts were unlikely, but before the onset of warmer conditions.

Plots were grazed for six weeks, between 28 February and 12 April 1995. Cattle had access to the trial area but were not enclosed. The height of the sward was measured to the top of the bulk of the leaf canopy prior to commencement of grazing and immediately following the grazing period, when accessions were also rated for palatability.

Experiment 5 – Analysis of caryopsis proteins

Crude caryopsis proteins were compared using sodium dodecyl sulphate-polyacrylamide gel electrophoresis (SDS-PAGE). Proteins were extracted from (a) bulked samples of caryopses and (b) at least ten single-caryopsis samples of each of 19 accessions (Table 1). Caryopsis samples were crushed on a glass sheet using a watchglass and the meal from each sample defatted with a 400 µl acetone rinse and air-dried. Proteins were extracted and reduced with a sodium dodecyl sulphate extractant (20 ml extractant/g meal), based on the 'final sample buffer' of Laemmli (1970), and containing 10% (w/v) glycerol, 5% ß-mercaptoethanol, 2.3% (w/v) SDS, 0.765% (w/v) tris hydroxylmethylaminomethane (Tris) adjusted to pH 6.8 with HCl, and 0.001% (w/v) bromophenol blue dye. The mixture was left to stand for one hour at 25°C, then remixed and centrifuged at 11 300 x g for 15 minutes. The extract was then placed in boiling water for three minutes and cooled before electrophoresis

Electrophoresis was performed on slab gels (14 x 16 x 0.15 cm) run in a vertical dual slab gel electrophoresis unit. The electrode buffer (tris-glycine buffer at pH 8.3) and gel solutions were prepared as described by Laemmli (1970), except that the stacking gel contained 4.6% T, 2.6% C and the separating gel contained 15% T and 3.75% C. "T" refers to the total percentage (w/v) of acrylamide and crosslinker in the gel solution, while "C" is the weight of crosslinker expressed as a percentage of the total weight of acrylamide and crosslinker. Samples were applied at a loading level of 2.0 µL per 2.5 mm wide well. Standard reference proteins were run in parallel with the caryopsis proteins to provide an estimate of apparent molecular weight, following the method of Weber and Osbourne (1969).

Gels were run at 250 v at 10°C for 8.5 or 11.5 h. Proteins were fixed at 30°C in fixative solution (40% v/v methanol and 10% v/v glacial acetic acid). They were then stained with a warm solution of Coomassie Brilliant Blue R250, 7.5% (v/v) glacial acetic acid and 25% (v/v) methanol. After destaining in a solution of 5% (v/v) ethanol and 10% v/v acetic acid, they were stained using Sigma silver stain following manufacturer's instructions.

Results

Experiments 1 and 2 – Cutting and seed production trial, Samford, 1969-71

Rainfall was above average during the latter part of 1969 and somewhat below average over late summer, 1970. For most of the 1970-71 season, rainfall was also above average. It is unlikely that low rainfall during the second season would have adversely affected yield. Mean monthly minimum temperature on the bare soil surface (terrestrial minimum) was close to or below freezing from June to August 1970, a period when mean monthly grass temperatures are below 0°C (Table 2).

Table 2. Monthly rainfall and mean monthly minimum soil surface temperature on bare ground (terrestrial minimum) close to the experimental site, together with long-term means for rainfall and grass temperature (Cook and Russell 1983).

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Rainfall (mm)	1969	66.2	57.5	68.6	28.7	232.3	18.3	20.9	235.9	19.8	229.6	144.0	61.8
	1970	147.1	105.5	156.9	41.4	11.5	18.5	13.2	15.2	37.8	200.4	133.0	468.6
	1971	318.9	314.0	102.9	46.9	26.0	2.5						
	Mean	162.8	159.9	139.0	81.4	65.9	59.9	54.6	32.1	46.0	85.1	91.0	121.6
Terrestrial min.	1969	-	-	-	-	11.0	5.4	5.0	6.3	4.7	11.6	13.2	14.9
temp. (°C)	1970	16.1	15.6	13.3	10.9	3.5	2.0	-1.2	0.9	3.8	8.0	12.5	15.8
	1971	16.3	17.8	13.8	9.1	4.4	2.9						
Lowest grass	Mean	11.5	12.6	10.3	4.9	1.0	-1.2	-3.5	-3.1	-0.6	3.1	5.5	9.7
temp. (°C)													

In Experiment 1, accessions differed in dry matter yield both in 1969-70 and 1970-71, and for both 4-weekly and 8-weekly cutting regimes (all $P < 0.001$) (Table 3). Averaged over the two seasons and cutting regimes, the highest-yielding *Paspalum* accessions were *P. malacophyllum* CPI 27690 (16.4 tonnes/ha) and *P. guenoarum* CPI 20324 and 39056 (13.9 and 13.8 tonnes/ha, respectively). In the 4-weekly cutting regime in 1969-70 no *Paspalum* accession gave a higher dry matter (DM) yield than green panic (17.2 tonnes/ha), and none had DM yields significantly higher than Nandi (11.8 tonnes/ha). In 1970-71, 13 accessions had significantly higher yield than green panic (3.6 tonnes/ha), but none significantly outyielded Nandi (8.1 tonnes/ha). In the 8-weekly regime, no *Paspalum* accession had a higher yield than either Nandi or green panic in 1969-70, and only *P. malacophyllum* CPI 27690 (19.5 tonnes/ha) outyielded the two control cultivars in 1970-71 (14.1 and 11.8 tonnes/ha).

In Experiment 2 seed yields differed significantly between accessions for November-January and April-May growth intervals, and for the combined harvest for the year (all $P < 0.001$) (Table 3). Several accessions failed to set seed, either because they flowered too late in the season, or because they were adversely affected by the mid-season cut. Three accessions (CPI 39054, 39965 and 43477) produced seed, but none was harvested owing to bird damage.

The accessions with the highest seed yield tended to be *P. plicatulum* accessions, although not all entries in this species produced high seed yields. The *P. yaguaronense* accessions produced little or no seed in either season. The accessions with the highest seed yields (> 400 kg/ha) were *P. plicatulum* CPI 27680, 27687, 27651 and 27681. No accession had a significantly higher total seed yield than green panic (378 kg/ha), although ten (including green panic) yielded significantly more seed than Nandi (77 kg/ha).

Accessions differed for frost damage in both Experiments 1 and 2 ($P < 0.001$, in each case) and 13 accessions rated above 7.5 in each experiment (cf. ratings <2.0 in Nandi and green panic (Table 3). All accessions of *P. dilatatum* and *P. yaguaronense*, most of the *P. guenoarum* accessions, and many *P. plicatulum* were frost tolerant. At the time of frosting, Experiment 1 was in a state described as 'stubble' and frosting was uniform. Experiment 2 was in a stage described as 'mature growth' at time of frosting, and it was noted that this resulted in some protection of lower-growing accessions by taller neighbours. This probably contributed to the higher level of frost tolerance of mature growth of accessions such as CPI 24935 and 40000, and the higher level of variability within accessions.

Table 3. Dry matter yield of 38 accessions of *Paspalum* under two cutting regimes, seed production and some morphological characteristics (Experiments 1 and 2) (seed size: S = small, M = medium, ML = medium-large, L = large, VL = very large; cold tolerance rated on a 0 (all leaf killed) –10 (no damage)

Species	Accession	DM yield				Seed yield			Flowering period	Ht	Seed size	Cold tolerance rating		Comments
		7x4w 1969-70	4x8w 1969-70	6x4w 1970-71	3x8w 1970-71	Nov-Jan	Apr-May	Total				Stubble	Mature	
		(t/ha)				(kg/ha)				(cm)				
P. conspersum	CPI 17651	14.5	20.7	7.0	9.3	0	347	347	Mar	122	ne	0	2	leaves broad, green; late-flowering
P. dilatatum	CPI 21375	11.4	9.8	10.0	10.9	107	0	107	Oct-Mar	51	ne	9.5	8.5	ne
P. dilatatum	CPI 27699	2.4	3.0	1.8	2.0	0	0	0	Jan	0	ne	10	9.5	green, glabrous; late flowering
P. dilatatum	CQ 935	8.5	7.9	6.6	8.4	188	0	188	Oct-Mar	122	ne	10	10	Leaves lax, green; ergot through summer 69-70
P. guenoarum	CPI 20324	14.5	17.2	8.8	14.9	71	47	118	Oct-Mar	107	L	0	8.3	broad, bright green leaves
P. guenoarum	CPI 27682	10.9	13.6	9.7	6.3	124	0	124	Oct-Dec	76	L	10	8.7	leaves broad, green, pubescent
P. guenoarum	CPI 39054	10.4	12.9	6.6	10.5	0	bd[1]	-	Mar	107	ne	5.5	9	broad, blue/ green leaves; late flowering
P. guenoarum	CPI 39056	13.2	17.2	9.7	15.2	155	38	193	Oct-Mar	76	L	0	7	broad, bright green leaves
P. guenoarum	CPI 39962	12.2	18.4	2.4	3.5	138	37	175	Nov-Apr	76	ne	0	2.7	broad, bright green leaves
P. guenoarum	CPI 39964	9.4	11.8	2.4	3.4	14	0	14	Jan-Mar	168	ne	9.9	8.3	broad, blue/green leaves
P. guenoarum	CPI 39965	10.9	14.5	9.6	9.5	0	bd	-	Mar	107	ne	7.8	8.7	broad, blue/green leaves
P. guenoarum	CPI 39966	7.6	10.6	5.6	5.1	0	0	0	Mar	51	ne	10	9	lax, blue/green hairy leaves; low, tufted; late flowering
P. guenoarum	CPI 43477	ne[2]	ne	ne	ne	0	bd	-	Mar	122	ne			broad, blue/ green leaves; late flowering
P. malacophyllum	CPI 27690	14.4	21.4	10.3	19.5	ne	ne	ne	ne	ne		0	-	
P. plicatulum	CPI 2741 (cv. Rodd's Bay)	10.8	16.9	1.7	0	30	12	43	Nov?Apr	76	M	0	2.3	broad, bright green leaves; hairy sheaths; late flowering
P. plicatulum	CPI 7478	4.1	4.7	0.2	0.4	185	63	249	Oct-Apr	76	ne	-[3]	5	blue/green leaves; rhizomatous
P. plicatulum	CPI 11826 (cv. Hartley)	13.2	18.8	5.8	4.1	0	0	0	May	76	ML	0	5	broad, bright green leaves, glabrous; late flowering
P. plicatulum	CPI 21377	7.5	12.0	3.0	4.8	301	29	330	Oct-Apr	61	ML	10	-	thin green leaves
P. plicatulum	CPI 21378	11.1	12.4	2.0	0.8	34	48	82	Nov-Apr	61	S	0	3	broad, bright green leaves
P. plicatulum	CPI 21379	10.3	15.7	2.0	2.0	87	5	92	Nov-Dec	76	S	0	4	broad, green leaves
P. plicatulum	CPI 21380	7.9	11.9	1.2	1.0	105	18	123	Oct-Apr	76	L	0	4	broad, bright green leaves; leaves narrow
P. plicatulum	CPI 21381	13.3	16.5	2.2	2.7	35	35	70	Dec-Mar	76	S	0	2.3	broad, bright green leaves; leaves erect
P. plicatulum	CPI 23729	13.2	17.0	4.2	4.8	48	0	48	Oct-Dec	61	ne	0	4.7	broad, bright green leaves
P. plicatulum	CPI 26963	4.8	8.4	4.4	2.6	90	0	90	Oct-Nov	61	L	10	6	thin, green leaves
P. plicatulum	CPI 27389	9.1	15.6	0.1	0	ne	ne	ne	ne	ne	ne	0	-	broad, bright green leaves

P. plicatulum	CPI 27651	9.3	12.2	6.2	10.7	369	44	413	Oct-Apr	76	ML	10	6.7	leaves glabrous, thin, green
P. plicatulum	CPI 27678	9.8	12.5	5.5	6.3	321	40	362	Oct-Mar	76	ML	10	8	leafy; thin blue/green leaves
P. plicatulum	CPI 27680	9.6	12.9	8.3	8.6	475	0	475	Oct-Dec	76		10	6	thin green leaves
P. plicatulum	CPI 27681	7.7	10.0	6.0	4.1	361	40	400	Oct-Mar	71	L	10	4	thin, blue/green leaves
P. plicatulum	CPI 27687	11.8	12.3	7.9	5.3	381	39	420	Oct-Mar	76	ML	10	8.3	very leafy
P. plicatulum	CPI 27708	ne	ne	ne	ne	ne	ne	ne	ne	ne	VL			very broad leaves
P. plicatulum	CPI 27711	11.1	15.5	8.9	8.8	247	37	284	Oct-Apr	76	M	10	-	leafy; thin bright green leaves; yellowish stems
P. plicatulum	CPI 39985	11.6	14.5	9.8	14.6	277	43	320	Oct-Apr	91		10	7.5	
P. rojassi	CPI 24935	12.1	16.9	4.6	4.8	98	13	111	Oct-Mar	107		0	8.3	
P. yaguaronense	CPI 27695	3.2	4.4	1.2	2.2	0	12	12	Mar	76		9.9	7.5	
P. yaguaronense	CPI 27698	2.9	4.3	1.7	2.8	0	0	0		0		10	10.5	
P. yaguaronense	CPI 27700	2.0	3.0	0.7	0.4	ne	ne	ne	ne	ne		-	-	
P. yaguaronense	CQ 917	3.1	4.5	1.4	1.0	0	0	0	Mar	76		9.9	9.7	
P. sp.	CPI 40000	14.1	15.6	2.2	1.1	0	13	13	Mar	76		0	7.7	
P. sp.	CQ 914	11.6	20.4	7.5	12.9	95	112	208	Oct-Mar	91		0	4	leaves broad, green; late flowering
Nandi	CQ 747	11.8	21.6	8.1	14.1	77	0	77	Oct-Mar	152		0	1	
green panic	CQ 702	17.2	25.4	3.6	11.8	157	221	378	Oct-Mar	137		0	1.7	
	Mean	9.9	13.4	5.0	6.3	127	36	163						
	LSD 5%	2.9	4.1	2.8	4.6	165	68	193				0.6	2.2	

[1] bd crop damaged by birds
[2] ne not evaluated
[3] no growth

Experiment 3 – Classification trial, Samford, 1981-82

Data assembled from Experiment 3 are presented in Table 4 under groupings constructed shortly after the trial. A total of 26 groups was recognised, with several subgroups within groups. In general, species occur within single groups, although better-represented species, such as *P. dilatatum* and *P. plicatulum* have members in two or more groups. Table 4 is presented with an overall heading and 27 sub-tables covering the 26 groups and a final sub-table with unclassified accessions. A core set of accessions representing the various groups has been selected, with emphasis on accessions with comparatively high yield, palatability, winter-greenness and seed production. The core set does not include groups or accessions which, from the data available, appear to have little promise as forage.

Table 4. Morphological and agronomic attributes of a collection of *Paspalum* accessions, grouped on taxonomic and morphological characters (Experiment 3) (E = erect; D = decumbent; P = prostrate; Pal = palatability score, 1-10 with 10 high). Accessions included in Experiments 1 and/or 2 indicated by superscript 1 (see Table 3), and those selected as members of a core set indicated in bold. Descriptions in italics are those recorded at the time of the experiment.

Table 4a. Group A – 12 members

Number	Group	Species	Total seed harvest	Flowering	Mature ht (cm)	Spread (cm)	Leaf length	Leaf width	Habit	Yield rating	Pal
			(kg/ha)				(cm)	(cm)			
CPI 21375[1]	**A**	***P. dilatatum***	**243**	**20/12**	**100**	**120**	**40**	**1**	**D**	**6**	**8**
CPI 37489	A	*P. dilatatum*	24	20/12	60	80	40	1.5	D	nil	nil
CPI 37501	A	*P. dilatatum*	31	10/12	30	40	45	1	D	1	1
CPI 37502	A	*P. dilatatum*	0	20/12	20	40	20	1	D	nil	nil
CPI 37521	A	*P. dilatatum*	5	30/11	20	40	20	1	D	nil	nil
CPI 37522	**A**	***P. dilatatum***	**151**	**21/1**	**50**	**70**	**52**	**1.5**	**E**	**2**	**7**
CPI 39959	A	*P. dilatatum*	186	24/11	170	150	58	1.5	D	6	4
CPI 39960	A	*P. dilatatum*	246	24/11	150	100	52	1.5	E	6	4
CPI 60061	A	*P. dilatatum*	233	24/11	150	90	47	1.5	E	4	4
CQ 914[1]	A	*P. dilatatum*	-	20/12	50	80	58	1	D	5	7
CQ 935[1]	A	*P. dilatatum*	184	24/11	80	100	50	1.5	E	6	5
CPI 27644	A/M	*P. notatum*	134	13/1	50	80	45	1	D	5	2
MEAN			130		78	83	44	1.3		4.6	4.7

Plants with lax, dark green leaves, eventually forming a tight sward. Seed is prone to ergot infection. All but two of the 12 flowered in November or December. The group varied markedly in mature height and spread. Tall-growing accessions had fairly high yield ratings, but had a low score for palatability. CPI 21375 was noteworthy as it combined good spreading ability with a high yield score, good seed production and the highest palatability score of the group.

Table 4b. Group B – 12 members

Number	Group	Species	Total seed harvest	Flowering	Mature ht	Spread	Leaf length	Leaf width	Habit	Yield rating	Pal
			(kg/ha)		(cm)	(cm)	(cm)	(cm)			
CPI 70156	B	*P. polystachion*	83	20/12	90	100	25	1	E	4	7
CPI 2696 (cv. Paltridge)	B	*P. scrobiculatum*	18	24/11	30	100	32	1	E	3	6
CPI 15396	B	*P. scrobiculatum*	21	24/11	50	100	25	1.5	D	5	5
CPI 15705	**B**	***P. scrobiculatum***	**188**	**20/12**	**100**	**100**	**30**	**1**	**E**	**6**	**8**
CPI 17791	B	*P. scrobiculatum*	24	24/11	100	100	27	1	E	6	7

CPI 58128	B	*P. scrobiculatum*	198	20/12	80	100	20	1	E	5	8
CPI 60064	B	*P. scrobiculatum*	290	10/1	150	100	20	1.5	E	3	4
CPI 60056	B/B.1	*P. scrobiculatum*	28	24/11	50	120	13	1	D	7	7
CPI 60057	B/B.1	*P. scrobiculatum*	63	15/1	50	100	27	1.5	D	4	7
CPI 46978	B.1	*P. scrobiculatum*	836	15/1	60	120	36	1	E	3	7
CPI 60054	B.1	*P. scrobiculatum*	168	20/12	160	80	40	2	E	4	6
CPI 60058	B.1	*P. scrobiculatum*	94	24/11	60	100	30	1.5	E	4	8
MEAN			168		82	102	27	1.3		4.5	6.7

Plants with lax, mid-green leaves, and soft, succulent stems. Seed ripens unevenly and sheds readily. Subgroup B1 is distinguished by the reddish-brown culms, generally more decumbent, and by its shorter and greener leaves. Seeding habit is similar.
This group flowered from November-mid-January. Most noteworthy are CPI 15705 and 17791, both with high palatability scores and acceptable yield. The former accession also had acceptable seed production.

Table 4c. Group C – 2 members

Number	Group	Species	Total seed harvest	Flowering	Mature ht	Spread	Leaf length	Leaf width	Habit	Yield rating	Pal
			(kg/ha)		(cm)	(cm)	(cm)	(cm)			
CPI 37557	C	*P. urvillei*	381	14/11	180	60	68	2	E	3	1
CPI 37561	**C**	***P. urvillei***	**206**	**24/11**	**180**	**60**	**68**	**2**	**E**	**3**	**1**
MEAN			294		180	60	68	2		3.0	1.0

Tall, strongly erect plants, unpalatable at maturity.
This group flowered in November and combined low yield with low acceptability to stock.

Table 4d. Group D – 22 members

Number	Group	Species	Total seed harvest	Flowering	Mature ht	Spread	Leaf length	Leaf width	Habit	Yield rating	Pal
			(kg/ha)		(cm)	(cm)	(cm)	(cm)			
CPI 39992	D	*P. guenoarum*	184	24/11	140	100	34	0.8	E stolon	4	7
CPI 32428	D	*P. indecorum*	235	14/11	100	80	62	0.5	E	3	6
CPI 27693	D	*P. nicorae*	139	20/12	70	100	72	0.5	E	4	3
CPI 7478[1]	D	*P. plicatulum*	164	24/11	80	100	33	1	E	4	7
CPI 21377[1]	D	*P. plicatulum*	135	24/11	100	80	45	0.5	E	4	7
CPI 26963	D/E	*P. plicatulum*	91	20/12	100	80	55	0.5	E	3	6
CPI 27680[1]	D	*P. plicatulum*	99	24/11	120	100	60	0.5	E	4	7
CPI 27681[1]	D	*P. plicatulum*	425	24/11	100	100	37	0.5	E	4	2
CPI 27687[1]	D	*P. plicatulum*	28	20/12	100	80	38	0.5	E	4	7
CPI 27711[1]	D	*P. plicatulum*	148	24/11	140	120	44	0.5	E	4	8
CPI 39985[1]	D	*P. plicatulum*	135	24/11	150	80	42	0.8	E	4	6
CPI 27682[1]	**D.1**	***P. guenoarum***	**35**	**20/12**	**160**	**150**	**60**	**1**		**8**	**9**
CPI 27651[1]	**D.1**	***P. plicatulum***	**345**	**24/11**	**160**	**120**	**70**	**0.5**	**E**	**6**	**9**
CPI 27678[1]	D.1	*P. plicatulum*	234	20/12	150	100	56	0.8	E	4	7
CPI 21370 (cv. Blue Dawn)	**D.2**	***P. nicorae***	**143**	**15/12**	**100**	**100**	**40**	**0.4**	**E rhizom**	**6**	**6**
CPI 21382	D.2	*P. nicorae*	103	3/2	80	100	40	0.7	E rhizom	4	2
CPI 27657	**D.2**	***P. nicorae***	**84**	**20/12**	**80**	**100**	**50**	**0.5**	**E rhizom**	**8**	**8**
CPI 27660	D.2	*P. nicorae*	25	20/1	50	100	52	0.8	E rhizom	5	4
CPI 27662	D.2	*P. nicorae*	34	20/1	40	80	33	0.5	E rhizom	4	6

CPI 27707[1]	D.2	*P. nicorae*	288	20/12	100	120	45	0.5	E	7	5
CPI 39970	**D.2**	***P. nicorae***	**88**	**20/1**	**60**	**100**	**33**	**0.5**	**E**	**4**	**8**
CPI 39998	D.2	*P. yaguaronense?*	208	20/12	80	80	40	1	D	4	6
MEAN			153		103	99	47	0.6		4.6	6.2

Plants with thin green or blue/green leaves, tufted and densely tillered; subgroup D1 has slightly broader leaves and is generally more palatable. Subgroup D.2 (P. nicorae) *is blue/green, rhizomatous/stoloniferous and has potential for erosion control where a highly palatable grass is not required..*

Group D, with two subgroups, included ten accessions of *P. plicatulum,* eight of *P. nicorae*, two of *P. guenoarum*, and one each of *P. indecorum* and *P. yaguaronense*. There was some doubt as to whether the latter was correctly identified The group was characteristically narrow-leaved, mostly with a low yield rating (mean 4.6/10). Palatability score within the group was extremely variable, ranging from 2 to 9. Of particular interest are *P. plicatulum* CPI 27651, which combined a moderately high yield score with exceptional palatability and good seed production, and *P. nicorae* CPI 27657, for which both yield and palatability scores were very high. *P. guenoarum* CPI 27682 also had a high yield score and exceptional palatability, although seed production was poor. At the time of the trial, the potential for erosion control of the rhizomatous *P. nicorae* (Group D2) was noted. However, this species apparently varies considerably in palatability, and unpalatable accessions such as CPI 21382 would not be appropriate for grazing situations. Also, although a high degree of palatability is not necessary for erosion control *per se*, the promotion of an unpalatable seed-producing accession for this purpose would be unacceptable because of the real danger of it becoming a weed. However, it should be pointed out that the low palatability of some *P. nicorae* accessions such as CPI 21382 is not necessarily an attribute which would be consistent throughout the season.

The identity of CPI 27693 as *P. nicorae* is questionable.

Table 4e. Group E – 11 members

Number	Group	Species	Total seed harvest	Flowering	Mature ht	Spread	Leaf length	Leaf width	Habit	Yield rating	Pal
			(kg/ha)		(cm)	(cm)	(cm)	(cm)			
CPI 39962[1]	E	*P. guenoarum*	335	15/3	150	200	45	1.5	E stolon	4	2
CPI 2741[1] (cv. Rodd's Bay)	E	*P. plicatulum*	526	20/3	160	200	42	1.5	E	5	2
CPI 21378[1] (cv. Bryan)	E	*P. plicatulum*	509	20/3	150	200	45	1.5	E	7	6
CPI 21379[1]	**E**	***P. plicatulum***	**314**	**20/3**	**180**	**120**	**54**	**1.5**	**E**	**4**	**8**
CPI 21380[1]	E	*P. plicatulum*	296	20/3	170	150	60	1.2	E	4	4
CPI 21381[1]	E	*P. plicatulum*	405	20/3	150	200	60	2	E	4	2
CPI 23729[1]	E	*P. plicatulum*	83	6/4	180	100	70	2	E	6	4
CPI 26963[1]	D/E	*P. plicatulum*	91	20/12	100	80	55	0.5	E	3	6
CPI 27389[1]	E	*P. plicatulum*	83	25/3	150	200	40	1.5	E	6	1
CQ 1109	E?	*P. plicatulum*	138	10/3	180	100	65	1.5	D	6	5
CPI 40000[1]	**E.1**	***P. plicatulum***	**21**	**4/5**	**180**	**150**	**105**	**1.5**	**E**	**10**	**8**
MEAN			235		158	154	58	1.5		5.6	4.8

Robust plants, coarse at maturity. Subgroup E.1 differs in being leafy, densely tillered, late maturing and strongly erect, to 1.8 m tall. This accession is a rather shy seeder but potentially useful as standover feed as the mature growth was well grazed.

Group E comprised 11 accessions of *P. plicatulum* (including cv. Rodd's Bay) and one of *P. guenoarum*. The group was noted as being coarse and robust, with one accession (CPI 40000, the sole member of Group E1) noted as leafy, densely tillered, erect and late-maturing. Ten of the 11 accessions flowered in March-May. The most interesting accession was CPI 40000, which combined

high yield with an exceptionally high palatability score, but seed yield was very low, in part because of very late flowering. However, this accession could have potential for humid tropical regions. The cultivar Rodd's Bay was amongst the lowest for palatability score, and also had a mediocre yield rating, but exceptionally good seed production.

Table 4f. Group F - 9 members

Number	Group	Species	Total seed harvest	Flowering	Mature ht	Spread	Leaf length	Leaf width	Habit	Yield rating	Pal
			(kg/ha)		(cm)	(cm)	(cm)	(cm)			
CPI 20324[1]	**F**	***P. guenoarum***	**289**	**3/2**	**170**	**100**	**65**	**1**	**E stolon**	**8**	**9**
CPI 39054[1]	F	*P. guenoarum*	254	3/2	180	100	63	1.8	E stolon	8	7
CPI 39056[1]	F	*P. guenoarum*	244	3/2	160	100	70	1.5	E stolon	8	8
CPI 39964[1]	F	*P. guenoarum*	81	3/2	170	100	73	2	E stolon	5	8
CPI 39965[1]	F	*P. guenoarum*	188	26/1	160	90	60	1.5	E stolon	6	8
CPI 43477[1]	**F**	***P. guenoarum***	**210**	**3/2**	**180**	**100**	**55**	**2**	**E stolon**	**8**	**8**
CPI 75354	F	*P. guenoarum*	163	3/2	160	100	73	1.5	E	6	8
CPI 24935[1]	**F**	***P. rojassi***	**195**	**3/2**	**150**	**100**	**84**	**1**	**E**	**7**	**8**
CPI 43478	F	*P. rojasii*	18	3/2	150	100	75	1.5	E	7	8
MEAN			182		164	99	69	1.5		7.0	8.0

Plants with blue/green leaves, the seeding culms collapsing after maturity exposing the lower leafy layer. Apparently cold-tolerant and very palatable.

Group F was noted as being particularly palatable (mean score 8/10) and all except three accessions also had a high yield rating (7/10 to 9/10). All accessions flowered in late January to early February, but seed yields were comparatively high. *P. guenoarum* is closely similar to, but not as vigorous as *P. atratum*. CPI 39054, 43477 and 75354 are very similar and possibly identical (B.G. Cook personal communication).

Table 4g. Group G – 2 members

Number	Group	Species	Total seed harvest	Flowering	Mature ht	Spread	Leaf length	Leaf width	Habit	Yield rating	Pal
			(kg/ha)		(cm)	(cm)	(cm)	(cm)			
CPI 18634	E/G	*P. plicatulum*	18	20/1	150	150	50	1.5	E	8	9
CPI 37295	**G.1**	***P. sp.***	**225**	**2/2**	**120**	**200**	**45**	**1**	**E**	**7**	**7**

Entirely glabrous, with shiny green succulent leaves and stems. Very palatable and considered one of the most promising accessions tested.

The above comment apparently refers to *P. plicatulum* CPI 18634, which combined high yield with an exceptionally high palatability score. However, seed yield was very low, although it flowered in January.

Table 4h. Group H – 3 members

Number	Group	Species	Total seed harvest	Flowering	Mature ht	Spread	Leaf length	Leaf width	Habit	Yield rating	Pal
			(kg/ha)		(cm)	(cm)	(cm)	(cm)			
CPI 27699[1]	H	*P. dilatatum*	T	20/3	60	80	32	1	E	8	7
CPI 27695[1]	**H**	***P. yaguaronense***	**125**	**10/3**	**80**	**100**	**50**	**1.5**	**E**	**6**	**3**
CPI 27698[1]	H	*P. yaguaronense*	8	3/2	100	60	57	1.5	E	6	4
MEAN			67		80	80	46	1.3		6.8	4.7

Mostly P. yaguaronense. *Extremely leafy with dark green tufted growth. Shy seeder. Cold tolerant.*
Group H was notable for its cold-tolerance. Flowering started from February to March, but seed yields were poor. The *P. yaguaronense* accessions were not very palatable.

Table 4i. Group I – 3 members

Number	Group	Species	Total seed harvest	Flowering	Mature ht	Spread	Leaf length	Leaf width	Habit	Yield rating	Pal
			(kg/ha)		(cm)	(cm)	(cm)	(cm)			
CPI 32424	**I**	***P. arechavalitai***	**8**	**25/1**	**160**	**160**	**80**	**1**	**E**	**4**	**1**
CPI 37488	I	*P. quadrifarium*	43	5/1	180	120	80	1	E	8	2
CPI 37537	I	*P.* sp.	28	3/2	140	100	80	1	E	4	2
MEAN			26		160	127	80	1.0		5.3	1.7

Erect, robust plants with coarse, tufted growth. Leaves blue/green, tough. Apparently of no value for forage.
Group I was noted as having no forage value, having low yield rating and low palatability. *P. quadrifarium* has recently been spreading as a weed in the Gympie district of south-east Queensland, where its unpalatability is a matter of concern.

Table 4j. Group J – 12 members

Number	Group	Species	Total seed harvest	Flowering	Mature ht	Spread	Leaf length	Leaf width	Habit	Yield rating	Pal
			(kg/ha)		(cm)	(cm)	(cm)	(cm)			
CPI 39957	**J**	***P. dilatatum***	**799**	**3/2**	**100**	**150**	**68**	**2**	**E stolon**	**6**	**4**
CPI 39961	J	*P. dilatatum*	886	15/1	130	150	80	2.5	E stolon	6	2
CPI 21376	J	*P. platyphyllum*	1166	3/2	200	200	84	2	E	6	3
CPI 16064	J	*P. virgatum*	1454	3/2	120	200	70	4	E	7	7
CPI 89254	**J**	***P. virgatum***	**1376**	**20/12**	**120**	**100**	**72**	**3**	**E**	**6**	**8**
CPI 37842	**J**	***P.* sp.**	**1158**	**15/2**	**200**	**150**	**105**	**3**	**E**	**8**	**5**
CPI 11829	J	*P.* sp.	249	20/3	150	150	47	3	E	4	7
CPI 40518	J	*P.* sp.	684	10/3	220	200	98	3	E	8	3
CPI 17651[1]	**J.1**	***P. conspersum***	**1221**	**3/2**	**200**	**100**	**65**	**3**	**E**	**6**	**6**
CPI 39956	J.1	*P. conspersum*	903	20/3	200	150	70	3	E	7	5
CPI 11823	J.1	*P. paniculatum*	289	10/3	100	100	56	2.5	D	6	6
CPI 57977	J.1	*P.* sp.	1109	10/3	240	150	52	3	D	6	4
MEAN			941		165	150	72	2.8		6.3	5.0

Plants with robust, erect culms, coarse, broad leaves and purplish seed heads. Heavy seeders. Subgroup J.1 is similar, but less coarse.
Group J included 12 accessions in five different species (and three unidentified accessions). Plants were noted as being coarse and robust. Seed yields averaged 941 kg/ha, considerably higher than any other group. Palatability scores were low; only *P. virgatum* had acceptable yield and palatability.

Table 4k. Group K – 16 members

Number	Group	Species	Total seed harvest	Flowering	Mature ht	Spread	Leaf length	Leaf width	Habit	Yield rating	Pal
			(kg/ha)		(cm)	(cm)	(cm)	(cm)			
CPI 27690[1]	**K**	***P. malacophyllum***	**269**	**20/12**	**120**	**60**	**35**	**1**	**E**	**6**	**2**
CPI 27703	**K**	***P. paniculatum***	**408**	**15/12**	**120**	**80**	**32**	**2**	**E**	**6**	**8**

CPI 27709	K	*P. paniculatum*	31	10/1	30	50	22	2	E	2	8
CPI 38224	K	*P. paniculatum*	183	20/12	60	80	45	2.5	E	5	6
CPI 40001	K	*P.* sp.	248	3/1	120	150	24	2.5	E stolon	4	4
CPI 37828	K	*P.* sp.	104	3/2	80	150	27	2.5	E	4	7
CPI 37831	K	*P.* sp.	398	3/2	120	100	30	2.5	E	3	6
CPI 37847.1	K	*P.* sp.	369	30/12	120	60	50	3	E	5	7
CPI 38219	K	*P.* sp.	64	20/12	80	100	25	2	D	2	6
CPI 38506	K	*P.* sp.	390	23/1	60	100	36	2.8	D	6	8
CPI 37579	K.1	*P. malacophyllum*	141	20/12	120	30	29	2	E	2	0
CPI 21374	K.1	*P. paniculatum*	491	24/11	150	80	40	3	E	8	5
CPI 37878	K.1	*P. paniculatum*	178	2/2	100	100	22	2	E	3	6
CPI 39478	K.2	*P. malacophyllum*	203	20/12	160	80	20	2	E	4	6
CPI 27691	K.2	*P. stellatum*	749	15/12	120	100	32	2	D	6	6
CPI 37697	K.2	*P.* sp.	124	3/2	80	100	40	2	E	8	5
MEAN			272		103	89	32	2.2		4.6	5.6

Plants with erect, reddish-brown stems, moderately leafy and palatable, with a distinctly paniculate seedhead and small seed. Subgroup K.1 has strongly erect but rather sparse, papery leaves and was considered to have little promise as a forage. Subgroup K.2 has generally broader leaf blades and growth is more decumbent.

Group K, together with its two subgroups, included seven unidentified accessions, five of *P. paniculatum*, three of *P. malacophyllum* and one of *P. stellatum*. Yield and palatability scores were variable. Noteworthy accessions with high values for both were CPI 27703 (*P. paniculatum*) and 38506 (*Paspalum* sp.).

Table 4l. Group L – 3 members

Number	Group	Species	Total seed harvest	Flowering	Mature ht	Spread	Leaf length	Leaf width	Habit	Yield rating	Pal
			(kg/ha)		(cm)	(cm)	(cm)	(cm)			
CPI 39958	**L**	***P. virgatum***	**411**	**24/11**	**170**	**150**	**55**	**2**	**E stolon**	**6**	**5**
CPI 39479.1	L	*P.* sp.	291	24/11	180	120	43	2	E	4	3
CPI 39479	L	*P.* sp.	300	24/11	180	150	43	2	E	6	2
MEAN			334		177	140	47	2.0		5.3	3.3

Erect plants with glabrous stems and leaves, which are mid-green in colour, and purple seed heads. Unpalatable at maturity.

The three Group L accessions included two which were unidentified and one of *P. virgatum*. They were noted as unpalatable at maturity, having a mean score of 3.3/10.

Table 4m. Group M – 2 members

Number	Group	Species	Total seed harvest	Flowering	Mature ht	Spread	Leaf length	Leaf width	Habit	Yield rating	Pal
			(kg/ha)		(cm)	(cm)	(cm)	(cm)			
CPI 24940	M	*P. notatum?*	163	20/12	40	120	48	1	D rhizom	7	6
CPI 39477	**M**	***P. notatum***	**255**	**20/1**	**50**	**100**	**37**	**1**	**D rhizom**	**8**	**7**
MEAN			209		45	110	43	1		7.5	6.5

No original comment.

Group M included two accessions, probably both *P. notatum*. As noted previously, there was no intention of including this species in the trial; these two entries were unclassified when sown. Both combined fairly high yield and palatability scores.

Table 4n. Group N – 1 member

Number	Group	Species	Total seed harvest	Flowering	Mature ht	Spread	Leaf length	Leaf width	Habit	Yield rating	Pal
			(kg/ha)		(cm)	(cm)	(cm)	(cm)			
CPI 13646	N	*P. convexum*	5	20/12	50	150	20	1	P	4	6

Decumbent plants with stoloniferous, reddish stems.
Group N included a single accession of *P. convexum*. It was low-yielding and only moderately palatable.

Table 4o. Group O – 1 member

Number	Group	Species	Total seed harvest	Flowering	Mature ht	Spread	Leaf length	Leaf width	Habit	Yield rating	Pal
			(kg/ha)		(cm)	(cm)	(cm)	(cm)			
CPI 60055	O	*P. auriculatum*	11	30/1	70	200	28	2.5	E	7	2

Plants with broad, brittle leaves, the sheaths and leaf margins reddish, the blades tending to break across the midrib, the distal portion turning reddish. A shy seeder and unpalatable.
Group O included a single accession of *P. auriculatum*. Yield was acceptable, but palatability and seed production were low.

Table 4p. Group P – 1 member

Number	Group	Species	Total seed harvest	Flowering	Mature ht	Spread	Leaf length	Leaf width	Habit	Yield rating	Pal
			(kg/ha)		(cm)	(cm)	(cm)	(cm)			
CPI 11860	P	*P. wettsteinii*	463	20/3	50	150	27	2	D	3	2

No original comment.
Group P included a single accession of *P. wettsteinii*. Yield and palatability were poor, but seed production was high.

Table 4q. Group Q – 2 members

Number	Group	Species	Total seed harvest	Flowering	Mature ht	Spread	Leaf length	Leaf width	Habit	Yield rating	Pal
			(kg/ha)		(cm)	(cm)	(cm)	(cm)			
CPI 39969	**Q**	***P. mandiocanum***	**574**	**20/12**	**20**	**150**	**10**	**2**	**P**	**4**	**8**
CPI 37863	Q	*P.* sp.	186	1/11	150	150	27	2.5	E	4	6
MEAN			380		85	150	19	2.3		4.0	7.0

Decumbent plants with short, broad leaf blades with a crinkled margin. Prolific seeders.
Group Q included an accession of *P. mandiocanum* (CPI 39969) and one of an unidentified species. The former was noted as a prolific seeder and it was highly palatable, although low-yielding. Later

studies with CPI 39969 have shown it to have potential as a ground cover in orchards in the humid subtropics (B.G. Cook and R.M. Jones personal communication).

Table 4r. Group R – 3 members

Number	Group	Species	Total seed harvest	Flowering	Mature ht	Spread	Leaf length	Leaf width	Habit	Yield rating	Pal
			(kg/ha)		(cm)	(cm)	(cm)	(cm)			
CPI 60059	R	*P. conjugatum*	?	3/2	60	150	8	1.5	D	4	2
CPI 60060	R	*P. conjugatum*	?	3/2	60	150	8	1.5	D	4	2
CPI 38177	R	*P.* sp.	-	10/3	40	90	18	1.5	D	1	4
MEAN					53	130	11	1.5		3.0	2.7

Strongly stoloniferous plants with short, bright green leaves.
Group R included two accessions of *P. conjugatum*, and one of an unidentified species. Yield and palatability were both low.

Table 4s. Group S – 1 member

Number	Group	Species	Total seed harvest	Flowering	Mature ht	Spread	Leaf length	Leaf width	Habit	Yield rating	Pal
			(kg/ha)		(cm)	(cm)	(cm)	(cm)			
CPI 27708[1]	S	*P. plicatulum*	25	3/1	50	50	31	1.5	E	1	9

Small, tufted plants with vegetative growth to 25 cm, the leaves dark green. Culms erect, to 1 m.
The single accession in Group S (*P. plicatulum*) was notable for its extremely low yield, but it had an exceptionally high palatable score.

Table 4t. Group T – 1 member

Number	Group	Species	Total seed harvest	Flowering	Mature ht	Spread	Leaf length	Leaf width	Habit	Yield rating	Pal
			(kg/ha)		(cm)	(cm)	(cm)	(cm)			
CPI 38827	T	*P. fimbriatum*	180	24/11	50	40	9	1.5	D stolon	1	3

Unproductive plants, probably annual, with sparse growth and reddish brown leaves. Free seeding,
Group T comprised the single accession of *P. fimbriatum*. It had low yield and palatability.

Table 4u. Group U – 1 member

Number	Group	Species	Total seed harvest	Flowering	Mature ht	Spread	Leaf length	Leaf width	Habit	Yield rating	Pal
			(kg/ha)		(cm)	(cm)	(cm)	(cm)			
CPI 40520	U	*P. mandiocanum*	731	20/12	100	120	38	3	D	6	8

Plants with decumbent growth and short, broad leaf blades with a crinkled margin. Stems glabrous, reddish on exposure, the culms to 80 cm tall. Well grazed.
The one accession in Group U, *P. mandiocanum*, combined a high yield and high palatability score. It also produced a much higher seed yield than most entries in the trial.

Table 4v. Group V – 2 members

Number	Group	Species	Total seed harvest	Flowering	Mature ht	Spread	Leaf length	Leaf width	Habit	Yield rating	Pal
			(kg/ha)		(cm)	(cm)	(cm)	(cm)			
CPI 37687	V	*P. unispicatum*	4	24/11	120	150	36	1.5	E	4	6
CPI 38829	V	*P. unispicatum*	18	24/11	120	150	36	1.5	E	4	6
MEAN			11		120	150	36	1.5	E	4.0	6.0

Plants with bright green glabrous leaves and stems, the leaves rather papery.
Palatability was acceptable, but yield and seed production were both poor

Table 4w. Group W – 1 member

Number	Group	Species	Total seed harvest	Flowering	Mature ht	Spread	Leaf length	Leaf width	Habit	Yield rating	Pal
			(kg/ha)		(cm)	(cm)	(cm)	(cm)			
CPI 37694	W	*P. humboldtianum*	25	20/12	100	100	14	2	E	5	2

Erect plants with culms to 60 cm and fluffy, white seed heads. Little potential as forage.
Group W comprised a single accession, of *P. humboldtianum*. It was unpalatable and low-yielding.

Table 4x. Group X – 1 member

Number	Group	Species	Total seed harvest	Flowering	Mature ht	Spread	Leaf length	Leaf width	Habit	Yield rating	Pal
			(kg/ha)		(cm)	(cm)	(cm)	(cm)			
CPI 21038.2	X	*P. scrobiculatum*	-	-	70	60	50	1	E	3	8

Robust, glabrous plants with reddish stems and seeds. Shy seeder.
The one accession in Group X was very palatable but low-yielding and also a shy seeder.

Table 4y. Group Y – 1 member

Number	Group	Species	Total seed harvest	Flowering	Mature ht	Spread	Leaf length	Leaf width	Habit	Yield rating	Pal
			(kg/ha)		(cm)	(cm)	(cm)	(cm)			
CPI 78821	Y	*P. hydrophilum*	31	3/2	60	80	38	1	E	5	2

Plants with erect, tufted growth, glabrous stems and leaves with a pronounced white midrib. Flowers over a limited period.
Yield, palatability and seed production all poor – no potential as a forage.

Table 4z. Group Z – 1 member

Number	Group	Species	Total seed harvest	Flowering	Mature ht	Spread	Leaf length	Leaf width	Habit	Yield rating	Pal
			(kg/ha)		(cm)	(cm)	(cm)	(cm)			
CPI 78822	Z	*P. lividum*	8	20/1	60	100	18	0.5	D	2	5

Plants at maturity with fine, stoloniferous growth, resembling a giant Cynodon. *Stems reddish and leaf blades short and bright green. A shy seeder.*
The stoloniferous habit of this species suggests it could have value in erosion control, although its shyness of seeding and apparently low yield would be a limitation.

Table 4aa. Unclassified – 5 members

Number	Group	Species	Total seed harvest	Flowering	Mature ht	Spread	Leaf length	Leaf width	Habit	Yield rating	Pal
			(kg/ha)		(cm)	(cm)	(cm)	(cm)			
CPI 75355	-	*P. guenoarum*	34	3/2	150	100	50	1	E	4	5
CPI 37526	**-**	***P. nicorae?***	**T**	**2/2**	**40**	**60**	**34**	**0.5**	**E**	**4**	**9**
CPI 26794	-	*P. pubiflorum*	4	20/12	50	30	9	1	P	1	0
CPI 37633	-	*P. sp.*	18	10/3	60	60	30	1	E	-	-
CPI 40517	-	*P. sp.*	96	3/2	200	150	83	3	E	6	7

The only notable unclassified accession was *P. nicorae* CPI 37526, which had an outstanding palatability score, although yield and seed production were poor. It has similarities to *P. plicatulum*.

Experiment 4 – Growth trial at Wolvi, near Gympie, 1994-95

Rainfall during the experimental period was mostly below average. There was considerable variation in frost rating, with 4 accessions showing no damage (Table 5). A number of accessions, including those which were undamaged by frost, were also recorded as having considerable cool season growth. All accessions exhibiting good cool season growth, with the exception of *P.yaguaronense*, were fine leaved tussocks and bore a strong resemblance to one another. Plants were occasionally moisture stressed but not at the time of grazing assessment.

Canopy height was reduced by 50% or more over the grazing period (Table 5). Three accessions scored the top ranking for palatability (5); *P. guenoarum* ATF 1053, *P. mandiocanum* CPI 39969 and *P. nicorae* CPI 27707.

Table 5. Frost tolerance ratings, height before and after six weeks grazing, and palatability of a range of *Paspalum* species at Wolvi, near Gympie, south-east Queensland.

Species	Accession	Frost rating[1]	Height before grazing	Height after grazing	Palatability rating.[2]
			(cm)	(cm)	
Paspalum atratum	ATF 1146	1.5	45	11	4
Paspalum guenoarum	CPI 39054	2.5	55	18	3.5
Paspalum guenoarum	CPI 39056	2.5	60	20	2.5
Paspalum guenoarum	CPI 39962	1.5	45	18	3.5
Paspalum guenoarum	CPI 39992	3 [3]	60	11	4
Paspalum guenoarum	CPI 43477	2	55	10	4.5
Paspalum guenoarum	CPI 75354	2	60	12	4
Paspalum guenoarum	ATF 1053	1.5	52	10	5
Paspalum indecorum	CPI 32428	3 [3]	45	22	2.5
Paspalum malacophyllum	CPI 27690	1	55	45	1.5
Paspalum mandiocanum	CPI 39969	1	15	5	5
Paspalum mandiocanum	CPI 40520	1	23	6	4
Paspalum nicorae	CPI 27707	2	20	5	5
Paspalum nicorae?	CPI 37526	1	40	11	4

Paspalum paniculatum	CPI 21374	0.5	38	10	3.5
Paspalum paniculatum	CPI 27703	2	25	17	3
Paspalum paniculatum	CPI 38224	1	50	23	3.5
Paspalum platyphyllum	CPI 21376	1	60	30	2.5
Paspalum plicatulum	cv. Bryan	1	45	11	3.5
Paspalum plicatulum	cv. Hartley	1	40	11	4
Paspalum plicatulum	cv. Rodd's Bay	1	55	18	3
Paspalum plicatulum	CPI 21381	1	40	17	4
Paspalum plicatulum	CPI 27651	2 [3]	45	19	3.5
Paspalum plicatulum	CPI 27681	2 [3]	38	14	4.5
Paspalum plicatulum	CPI 27711	3 [3]	53	20	2.5
Paspalum plicatulum	CPI 39985	3 [3]	60	25	2.5
Paspalum regnellii	ATF 1054	1	75	27	4
Paspalum rojassi	CPI 24935	2	55	16	3.5
Paspalum stellatum	CPI 27691	2	18	11	4
Paspalum virgatum	CPI 16064	0.5	60	28	3
Paspalum virgatum	CPI 39958	0.5	57	27	3
Paspalum virgatum	CPI 89254	1	65	31	3.5
Paspalum yaguaronense	CPI 27695	2.5 [3]	33	14	4

[1] Frost tolerance ratings 0 to 3, with 0= severely affected and 3= unfrosted
[2] Palatability ratings 0 to 5, with 0=uneaten and 5=well eaten 12 April 1995
[3] These accessions exhibited considerable cool season growth

Experiment 5 – Analysis of caryopsis proteins

A low level of variation was evident within all accessions, as seen in minor differences between banding patterns derived from single-caryopsis extracts. However, variation was small, and characteristic bands were identified which could be used to identify the accessions.

Table 6. Accessions grouped according to seed protein characteristics, and, where available, morphology (see Table 4)

Caryosis protein Pattern Type 1			Caryopsis protein Pattern Type 2		
Species	Accession	Group	Species	Accession	Group
P. nicorae	'Rappville'		*P. dilatatum*	'Commercial'	-
	CPI 21370 cv. Blue Dawn	D.2			
	CPI 21382	D.2	*P. notatum*	CPI 23944	-
	CPI 27660	D.2		CPI 38824	-
	CPI 27693	D		cv. Pensacola	-
	CPI 27707	D.2		cv. Competidor	-
	CPI 37526	-		'Commercial'	-
	CPI 39970	D.2		'Zerner'	-
	CPI 125877 cv. Doncorae	-			
P. plicatulum	CPI 2741 (cv. Rodd's Bay)	E			
	CPI 11826 (cv. Hartley)	-			
	CPI 21378 (cv. Bryan)	E			

The pattern of caryopsis proteins with a molecular weight below 27.5 kD divided the entries into two major types, one with a three major band set, including all accessions of *P. nicorae* and *P. plicatulum*, and the other, with a two major band set, including the *P. dilatatum* and *P. notatum* accessions (Table 6). Within the two types, no band was characteristic of all accessions within a species.

All accessions evaluated could be distinguished from one another, with the exception of, in Pattern Type 1, *P. nicorae* CPI 27707 and 125877, and, in Pattern Type 2, *P. notatum* cv. Competidor and Argentine Commercial. Only accessions in Pattern Type 1 had previously been grouped on morphological grounds, and these were all in Groups D, D.2 and E.

Discussion

The results from Experiments 1 and 2 show a high level of variation in both yield and seed production within the genus *Paspalum*, but no clear advantage for the subtropics of South-east Queensland of any accession over the control cultivars *Setaria sphacelata* cv. Nandi and *Panicum maximum* var. *trichoglume* cv. Petrie (green panic). This could have been associated with the nutrition levels of the trials, and lower fertilizer inputs could have resulted in a comparative advantage for *Paspalum* spp. Some species of *Paspalum*, e.g. *P. plicatulum*, persist and are productive on infertile soils (Mannetje and Kirsten 1992). With rare exception, the 8-week cutting regime gave the higher yields in 1969-70, but there was no consistent advantage to the longer cutting interval in 1970-71, when yields were considerably lower than the previous year.

Twelve accessions had frost tolerance ratings similar to or little less than that of the Australian naturalised *P. dilatatum* CQ 935, which was much more frost-tolerant than Nandi or green panic. For subtropical and tropical montane regions, these could provide alternatives to *P. dilatatum* as sown forages. They provide a range with variable flowering date and yield potential, and field notes taken at the time of the experiments indicate that some are very leafy.

Palatability of *Paspalum* species is known to be variable, with the released accessions of *P. plicatulum* generally considered not to be particularly palatable to cattle (Humphreys and Partridge 1995), whereas naturalised Australian *P. dilatatum* is palatable to livestock. Palatability scores of several of the frost-tolerant accessions included in Experiments 1 and 2 are available from Experiment 3. These indicate that CPI 39964, 39965, both *P. guenoarum*, and CPI 27678 (*P. plicatulum*), with scores of 7 or 8 are readily grazed in comparison with cv. Rodds Bay (palatability score, 2) and also with naturalised *P. dilatatum* (palatability score, 5). It should be noted, however, that palatability scores were for mature, end-of-season growth, and if palatability had been assessed early in the growing season, results could have been very different.

Twenty nine accessions were tested for palatability in Experiments 3 and 4, but there was little relationship ($R^2 = 0.10$). In part, this was due to the low ratings in Experiment 3 of *P. guenoarum* CPI 39962 and *P. plicatulum* cv. Rodd's Bay and CPI 21381 and 27681, all of which scored 2 at Samford and 7, 6, 8 and 9 (out of a possible 10), respectively, at Wolvi. Deleting these accessions, the relationship improved to $R^2 = 0.37$. Palatability scores in Experiment 4 that are at variance with relative ratings in Experiment 3, are possibly more realistic. In Experiment 4 plots were grazed when comparatively young and in accordance with that in commercial grazing systems, whereas in Experiment 3 grazing was at the end of the growing season, and plots had not been defoliated. Accessions which scored highly at both sites were *P. guenoarum* CPI 43477, 75354, *P. mandiocanum* CPI 39969, 40520 and *P. nicorae* CPI 37526.

A number of accessions were evaluated for frost tolerance in Experiment 4 at Wolvi, and Experiment 1 (13 accessions) and/or Experiment 2 (11 accessions) at Samford. Experiments 4 and 1 were relatively young growth at time of frosting, whereas Experiment 2 was described as 'mature growth'. Ratings from Wolvi were correlated with the rating for mature growth from Samford ($R^2 = 0.64$, $P < 0.05$) but less closely related to the rating for young growth ($R^2 = 0.51$, $P < 0.10$) at Samford. With the exception of CPI 27651, which was placed in group D.1, all accessions which exhibited good cool-season growth in Experiment 4 were placed in group D in Experiment 3. A number of the accessions with good frost tolerance in Experiment 4 had low palatability, and some of the more palatable species were seriously damaged by frost. Accessions possessing a useful balance of both characteristics were *P. guenoarum* CPI 39054, 39992, 43477, and 75354, *P. nicorae* CPI 27707, *P. plicatulum* CPI 27681, *P. stellatum* CPI 27691, and *P. yaguarononse* CPI 27695. The visually similar *P. atratum* ATF 1146 and *P. guenoarum* ATF 1053 also warrant further assessment.

The binomial *Paspalum atratum* does not appear in the list of entries for the first three experiments. This is a relatively recently-described species (Swallen 1967), and it is possible that accessions of this taxon could have been included under *P. plicatulum* or *Paspalum* sp. Some high-yielding and

palatable accessions evaluated in these experiments, for example CPI 40000 (*Paspalum* sp.), could provide alternatives to the accession of *P. atratum* cv. Suerte and the accession currently being promoted in south-east Asia.

A previous clipping study on annual and cool season production of a range of grasses showed *P. nicorae* CPI 39970 (Group D2) to be outstanding, with 150% higher annual production than pangola (*Digitaria eriantha*) in the cool season, and 54% higher annual production (Strickland 1978). In Experiment 3 reported in this paper, its yield rating was comparatively low, although it did have an excellent rating for palatability.

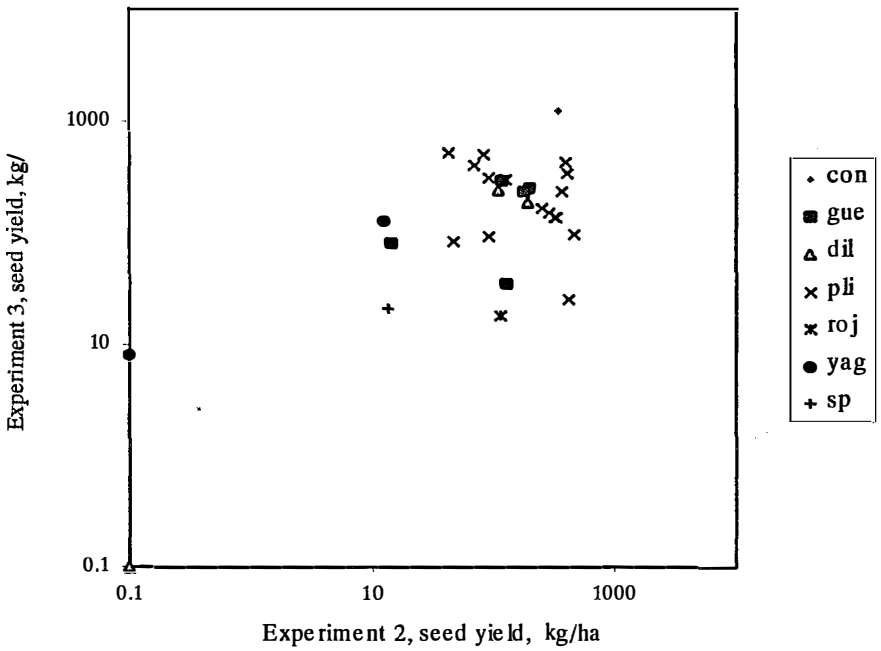

Figure 1. A comparison of harvested seed yields in Experiments 2 and 3.
(con = *Paspalum conspersum*; gue – *P. guenoarum*; dil = *P. dilatatum* ; pli = *P. plicatulum*; roj = *P. rojasii*; yag = *P. yaguaronense*; sp = *Paspalum* sp.)

A comparison of seed harvest yields from Experiments 2 and 3 shows little or no relationship (Figure 1) between the two sets of data. Experiment 2 was cut back in late January, whereas Experiment 3 was not defoliated during the growing season and seed was harvested when ripe from early January to May, depending on the accession. The different treatments of the two experiments would inevitably have had a considerable effect on seed production. B.G. Cook has found several accessions of *P. nicorae* to be heavy and reliable seed producers under semi-commercial conditions, whereas in the present trials comparatively low amounts of seed were harvested (personal communication).

The analysis of caryopsis proteins clearly showed the potential of the technique to differentiate between accessions within and across *Paspalum* species. Only in two instances were pairs of accessions indistinguishable on electrophoretic grounds, in Type 1, *P. plicatulum* CPI 27707 and 125877, and, in Type 2, *P. notatum* cv. Competidor and Argentine Commercial. In both cases, there are phytogeographic grounds for believing that these could be closely related. CPI 27707 is recorded as having been collected at Santa Maria, Rio Grande do Sul, Brazil. CPI 125877 was introduced from the USA, but (as PI 310131) originates from Uruguaiana, just 300 km to the west of Santa Maria. In *P. notatum*, the collecting site for cv. Competidor is unknown, although it was introduced to NSW, Australia, as 'Argentine Bahia grass' (Oram 1990). It could possibly be closely related to the population analysed as Argentine Commercial.

P. notatum showed a distinctive 2 major band set pattern that differed from that shown by *P. dilatatum*, allowing these two species to be distinguished. However, no bands were found to characterise *P. nicorae* and *P. plicatulum*. Such bands need to be common to all lines within each species but show consistent qualitative differences across species. By contrast, the morphological study of these *P. nicorae* and *P. plicatulum* accessions was able to distinguish three distinct groups (Group D,D.2 and E). Unless the fine protein banding contains bands that characterise these groupings, this suggests that crude protein analysis may be of limited benefit in identifying seed of *Paspalum* seeds at the species level.

The analysis of caryopsis proteins revealed variation within all accessions tested. The genus *Paspalum* includes apomictic and sexual species, as well as species which exhibit variation in breeding system, for example *P. dilatatum* and *P. notatum* (Hacker 1995). The intraspecific variation in caryopsis proteins should not be taken as evidence of sexuality, as apomixis in *Paspalum* is pseudogamous. Even where the embryo is of apomictic origin, and identical to the mother plant, the endosperm, which comprises the major part of the caryopsis, is hybrid in origin, and would hence exhibit variation in a progeny.

The subjective grouping of the accessions provides a basis for identifying a core set for the genus. The core set includes only representatives of groups which have some potential as forage, and a comparatively high yield, palatability and seed production were considered important criteria in selecting core accessions from within groups. Not all species are included in the core set, as some clearly have no agronomic potential. Further, some larger groups include two or more core set members, where there appear to be differences and where agronomic potential is potentially high. Accession in the core set will be made available by the Australian Tropical Forages Genetic Resource Centre to bona fide researchers.

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