THE PERFORMANCE OF *STYLOSANTHES GUIANENSIS* ACCESSIONS AT TWO SITES IN COASTAL NORTH AND CENTRAL QUEENSLAND

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ABSTRACT

Thirty-two accessions of Stylosanthes guianensis *were grown in small, fertilized swards with* Brachiaria decumbens *at two sites near Ingham and Mackay. The swards were mown seven times over three years to measure herbage yields. At Mackay small swards of the same accessions were sown with* Macroptilium atropurpureum *cv. Siratro and* Setaria anceps *cv. Kazungula and grazed continuously to follow persistence, regeneration and seed reserves in the soil.*

Over the three years, a number of accessions outyielded the most productive commercial cultivars (cv. Cook at Ingham and cv. Schofield at Mackay). When final year and total stylo yield were both considered, six accessions (CPI 34911*A*, 38606, 40255, 40294 *and* 41218, *and Q*8231*A*) *were identified which warrant further evaluation in these areas. Over the three years CPI* 40255 *had the largest numbers of seedlings and surviving perennial plants and the second largest soil seed reserves.*

INTRODUCTION

Stylosanthes guianensis (stylo) is an important legume in coastal areas of tropical Queensland where the annual rainfall exceeds 1500 mm (Grof *et al.* 1970). Of the available commercial cultivars, Schofield, Cook and Endeavour (Barnard 1972), Schofield has been the most widely planted in the Mackay and Ingham districts (Teske 1977, Teitzel and Mortiss 1971). However, it has shown poor persistence and consequently low productivity in these commercial pastures. The other two cultivars, Cook and Endeavour, have performed no better.

The three commercial cultivars of stylo were originally selected on their performance at South Johnstone, near Innisfail, where the rainfall is higher than at both Ingham and Mackay. The winter temperatures are lower at Mackay and frosts occur in most years. The poor persistence of the existing cultivars in the Mackay area may be due to these climatic differences which result in a shorter growing season.

There are a number of new stylo accessions which have been collected from a wide range of latitude-altitude combinations (Edye *et al.* 1974). Since these accessions include a wide range of maturity types, it is possible some will be better adapted to the shorter growing seasons than the existing cultivars.

A selection of accessions of different maturity types collected from a range of environments and including the promising accessions identified by Edye *et al.* (1976) was grown in small swards near Mackay and near Ingham to determine their potential for these areas. Cutting trials were conducted at each site to extend the productivity comparisons of Edye *et al.* (1976) to these environments. Small grazed swards were included at Mackay to follow persistence of plants, regeneration of seedlings and seed reserves in the soil.

MATERIALS AND METHODS

Accessions

The accessions sown at Mackay and Ingham are listed in Table 1, together with details of their origin, morphological-agronomic (M-A) group (Edye *et al.* 1974)

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and maturity. Fifteen accessions were grown at both sites and seventeen at one or other of the sites only.

TABLE 1

The morphological-agronomic group, origin and maturity type of S. guianensis *accessions grown at Ingham and Mackay*

CPI or Q No. or cv.	M-A Group	Origin			Maturity†	
		Country	Latitude (deg)	Altitude (m)	Ingham	Mackay
1. 34927	5A	Brazil	22S	551	M	—
2. 40256	5A	Bolivia	16S	2151	—	E
3. Q8255	7A	Surinam	5N	10	L	L
4. Schofield	7A	Brazil	22S	20	L	L
5. 27105	7A	Argentina	—	—	—	L
6. 33034	7A	Costa Rica	9N	609	L	—
7. 34662	7A	Uganda	1N	1112	L	—
8. Q8231A	8A	Brazil	1S	10	LM	LM
9. 34000	8A	Costa Rica	9N	609	—	LM
10. 34440	8A	El Salvador	13N	640	LM	—
11. 34911A	8A	Brazil	21S	500	—	M
12. 38222	8A	Peru	13S	1372	LM	LM
13. 38606	8A	Mexico	—	—	LM	—
14. Cook	8A	Colombia	4N	1250	LM	LM
15. 41209C	8A	Mexico	15N	770	LM	LM
16. Endeavour	8A	Guatemala	14N	1900	LM	LM
17. 41218	8A	Costa Rica	9N	1172	—	LM
18. T. No. 11	10A.1	Unknown	—	—	—	LM
19. Q8442	10A.1	Mexico	16N	180	—	LM
20. 47396	10A.1	Belize	—	—	L	L
21. 33706B	10A.2	Mexico	18N	181	L	L
22. 38349	10A.2	Venezuela	8N	213	L	—
23. 37204A	10A.3	Nicaragua	13N	1280	L	L
24. 38385	10B.1	Venezuela	9N	2134	—	M
25. 38391	10B.1	Venezuela	9N	1829	M	M
26. 18750A	10B.2	Paraguay	24S	600	—	E
27. 40255	10B.3	Bolivia	17S	440	M	E
28. 40294	10B.3	Brazil	20S	500	M	E
29. 40297	10B.3	Bolivia	18S	440	—	E
30. 34906	14A	Brazil	22S	663	M	M
31. 34920	14A	Brazil	21S	450	L	—
32. 40258	14A	Brazil	22S	363	M	M

†Maturity E = flowered before April 9
M = flowered between April 10 and May 8
LM = flowered between May 9 and June 7
L = flowered after June 7

Sites

The Mackay site was at Kuttabul (21°4′ S, 148°52′ E; altitude = 40 m) on a humic gley soil (Gn3.03). The Ingham site was at Bambaroo (18°53′ S, 146°12′ E; altitude = 30 m) on a solodic soil derived from granite (Dy3.41, Northcote 1971). The average annual rainfall at Kuttabul is 1625 mm and at Bambaroo, 1880 mm.

Cultural details

Mown swards

A well cultivated seedbed was prepared at each site and the seed (5 kg ha^{-1} of stylo and 1kg ha^{-1} of signal grass, *Brachiaria decumbens*) was sown on the surface. Plot size was 5 × 4 m at Ingham and 5 × 3 m at Mackay with three replicates at each site. At Ingham a fertilizer dressing of 200 kg ha^{-1} superphosphate plus molybdenum, 100 kg ha^{-1} potassium sulphate, 10 kg ha^{-1} copper sulphate and 10 kg ha^{-1} zinc

sulphate was applied at sowing with further annual applications of 200 kg ha^{-1} superphosphate. The Mackay experiment received 500 kg superphosphate plus molybdenum at sowing and annual applications of 100 kg ha^{-1} superphosphate. Single superphosphate was used in all cases. The Ingham site was sown on January 10, 1973 and the Mackay site on December 6, 1973.

The plots were sampled for three growing seasons by mowing a metre-wide strip from the centre of each plot to a height of 10 cm. The herbage was sub-sampled before hand sorting and oven drying to determine botanical composition and yield. After the sample was taken, the remainder of the plot was mown to 10 cm and herbage removed. Seven harvests were taken at each site—on April 30 and June 12, 1973; January 16, April 24, June 6 and November 6, 1974 and March 14, 1975 at Ingham—and February 21, April 9 and July 15, 1974; February 12 and April 29, 1975; January 12 and May 12, 1976 at Mackay. The data for Ingham were analyzed by analysis of variance of the actual values but the Mackay data required transformation ($\log x + 1$) to equalize the variances before it was analyzed in a similar manner.

Grazed swards

The small grazed plots at Kuttabul were established similarly to the mown swards except *Setaria anceps* cv. Kazungula was the companion grass and 2 kg ha^{-1} of *Macroptilium atropurpureum* cv. Siratro was included in the seed mixture. The plots were grazed in conjunction with a surrounding 100 ha commercial pasture of Schofield–Siratro–Kazungula which was established at the same time. A stocking rate of 2 beasts ha^{-1} was maintained during the first two years and increased to 2.5 beasts ha^{-1} in the third year.

The persistence and regeneration of the accessions were assessed by counting the number of surviving perennial plants and regenerating seedlings each year after germinating rain. Four 1.0 × 0.5 m quadrats were counted in each plot.

Soil seed reserves were measured in August 1977. Three soil cores 8.4 cm in diameter and 10 cm deep were taken from predetermined positions near the centre of each plot. Cattle tracks and obvious depressions were avoided. The samples were mixed with 1 litre of water and poured slowly onto a 1.00 mm sieve until most of the organic matter was collected on the sieve but the soil particles remained in the container. These two samples were washed and allowed to dry. The seed in the organic matter sample was recovered by rubbing it free from the organic matter then stirring the sample in a deep container of water and allowing the seeds to sink to the bottom. The soil sample was stirred in perchlorethylene to free all seed from the soil after which they rose to the surface and were collected.

RESULTS

Mackay

Rainfall received in the first summer was very high and the soil was saturated during the first six weeks of establishment. For the remainder of the period the summers were wetter and the winters drier than average. Light to moderate frosts were received during the winters of 1974 and 1976.

Good establishment occurred and in the mown swards all populations exceeded 15 plants m^{-2} by the second wet season. However, growth was slow during the first year and the plots were dominated by weeds, notably *Cyperus* species. *Brachiaria decumbens* was very slow to establish and only in the third year did it contribute to the yield of the sward.

The most productive accessions over the three years were CPI 40255 (number 27), CPI 41218 (17) and Q8231A (8) with CPI 34911A (11) yielding well in the third year (Table 2). Schofield (4) was the most productive of the commercial cultivars due to its high yield during the first two seasons. However, it performed poorly during the third season and only outyielded three accessions.

TABLE 2

Annual and total dry matter yields (kg ha^{-1}) over three years of stylo and total sward yeild for 25 accessions of S. guianensis *grown at Kuttabul, near Mackay*

Stylo									
1974		1975		1976		1974–76		Total 1974–76	
Acc.	Yield	Acc.	Yield	Acc.	Yield	Acc.	Yield	Acc.	Yield
28	2650†	4	7550	17	7810	27	14590	17	25620
4	2600	27	7490	8	5530	17	14340	8	24080
29	2540	12	6890	11	5120	8	13200	28	23590
27	2400	28	6080	9	4830	4	12760	29	23510
23	2300	8	5810	27	4700	29	12740	2	23310
11	2180	29	5640	24	4600	11	12720	24	23030
14	1980	9	5450	29	4560	12	12450	12	22910
8	1860	11	5420	20	4540	28	12440	20	22900
19	1860	26	5270	12	4090	9	11600	27	22810
17	1840	2	5250	19	3800	20	10790	19	22410
5	1610	20	5110	5	3740	24	10690	21	21930
18	1570	16	4990	28	3710	14	10200	26	21750
24	1500	25	4940	25	3650	26	9820	9	21580
12	1470	3	4930	16	3500	5	9770	16	21540
21	1450	14	4840	14	3380	2	9720	5	20850
26	1380	17	4690	18	3270	16	9710	18	20710
2	1320	15	4670	26	3170	25	9710	11	20490
9	1320	24	4590	2	3150	3	8750	25	20270
16	1220	30	4500	3	2830	19	8730	4	19930
20	1140	5	4420	21	2780	18	8720	14	19760
25	1120	18	3880	30	2780	23	8240	3	19700
3	990	21	3400	4	2610	30	7840	23	18960
15	610	23	3390	23	2550	21	7630	30	18150
30	560	32	3080	15	2050	15	7330	32	16220
32	320	19	3070	32	1200	32	4600	15	15130
Mean yields									
S‡	1590		5120		3760		10470		
G	10		640		1110		1760		
M	4890		1910		2390		9190		
T	6490		7670		7260		21420		

†Yield values connected by the same lines are not significantly different ($P < 0.05$)
‡S=Stylo; G=*B. decumbens*, M=Miscellaneous species; T=Total.

In the grazed swards there were large differences in the number of surviving perennial plants, regenerating seedlings and soil seed reserves between accessions (Table 3). CPI 40255 and CPI 40297 had the most perennial plants at the beginning of 1977. There were more than 10 seedlings m^{-2} of CPI 40255 in all years, of CPI 40297 in two years and CPI 34911A in the first year only. CPI 40297 and 40255 had the largest reserves of seed in the soil.

Ingham

The annual rainfall totals exceeded the long term mean due to above average wet season falls particularly during January 1974 when 1256 mm were recorded compared with a long term mean of 417 mm.

Brachiaria decumbens failed to establish and the stylo establishment was poor, so first year yields were low and plots were dominated by weeds (Table 4). The stylo improved subsequently and during the second and third years most plots were stylo dominant. The most productive accessions over the trial period were CPI 40255 (27), Q8231A (8) and CPI 40294 (28) with CPI 38606 (13) yielding well in the third year. The yields of the most productive commercial cultivar (Cook, 14) were high during the first two years but declined in the final year and were significantly less than those of the most productive accessions (CPI 40255 and 38606).

TABLE 3

The number of seedlings, surviving perennial plants and seeds per square metre of Stylosanthes guianensis *accessions in grazed swards at Kuttabul.*

Accession	Jan. 21, 1975		Nov. 11, 1975		Jan. 6, 1977		August 1977
	Seed-lings	Peren-nials	Seed-lings	Peren-nials	Seed-lings	Peren-nials	Seeds
40256	7	19	3	10	3	2	440 (2.55)†
Q8255	3	13	2	12	1	1	160 (2.11)
Schofield	7	17	2	17	4	2	120 (2.04)
27105	5	11	2	13	4	1	220 (2.34)
Q8231A	5	14	2	10	2	1	20 (0.59)
34000	2	7	1	4	2	1	140 (2.01)
34911A	18	19	5	13	6	3	200 (2.24)
38222	1	12	1	9	3	2	340 (2.53)
Cook	2	9	1	9	2	1	220 (2.34)
41209C	7	7	1	5	2	1	80 (1.35)
Endeavour	4	12	1	4	2	1	220 (2.25)
41218	6	10	1	10	1	1	180 (2.17)
T. No. 11	1	11	1	9	3	1	80 (1.35)
Q8442	1	12	1	9	1	1	220 (2.22)
33706B	3	7	1	5	2	1	120 (2.04)
37204A	3	25	1	14	2	1	80 (1.88)
47396	3	11	1	7	1	3	140 (2.14)
18750A	2	12	3	10	4	2	860 (2.93)
38385	6	14	8	17	5	3	300 (2.31)
38391	3	14	4	11	3	2	280 (2.31)
40255	20	24	14	21	15	7	1260 (3.07)
40294	2	15	2	14	4	2	860 (2.89)
40297	17	16	11	16	3	7	1530 (3.18)
34906	2	13	2	7	2	1	100 (1.98)
40258	1	6	1	6	2	0	40 (1.19)
Mean	5	13	3	10	3	2	330 (2.16)
L.S.D. (P=0.05)	4	3	4	8	1	2	— (0.84)

†Log (x+1) transformed values

Accession-site relationships

Fifteen accessions were grown at both Mackay and Ingham. In Table 5, yield ratios (accession yield/mean yield) for each site-year, and the regression coefficients for accession yield on mean yield (Finlay and Wilkinson 1963) are presented. Yields of accessions CPI 40255, Q8231A, CPI 38222 and CPI 40294 were always near or above average while those of Q8255, CPI 33706B and CPI 34906 were near or below average. The relative performance of CPI 39391 improved during the second and third years at both sites while that of CPI 37204A declined resulting in high and low regression coefficients respectively. The performance of the three cultivars was variable. Schofield was productive at Mackay in the first year but its performance declined subsequently while at Ingham it always produced below average yields. The performance of cultivar Cook showed no general pattern. The relative performance of Endeavour improved with time at Mackay but declined at Ingham.

DISCUSSION

When all the data parameters are considered, CPI 40255 is the outstanding accession tested.

A number of accessions outyielded the most productive commercial cultivars (Cook at Ingham and Schofield at Mackay) although the differences were not statistically significant over the three year period. However, the relative performance (ranking) of these commercial cultivars declined markedly in the final year. These results support observations made on commercial pastures, particularly in the Mackay region,

TABLE 4

Annual and total dry matter yields (kg ha^{-1}) over three years of stylo and total sward yield for 22 accessions of S. guianensis *grown at Bambaroo, near Ingham*

Stylo								Total	
1973		1974		1975		1973-75		1973-75	
Acc.	Yield	Acc.	Yield	Acc.	Yield	Acc.	Yield	Acc.	Yield
8	1730	14	8610	13	6820	27	15070	27	18910
28	1360	28	7710	27	6060	8	14460	8	18890
27	1330	27	7680	8	5480	28	14310	12	18530
16	1230	12	7570	21	5340	12	13530	13	18310
23	1100	25	7380	25	5260	25	13340	31	17850
12	1060	8	7250	28	5240	13	13210	14	17580
20	960	31	7150	32	5080	14	12500	25	17570
14	890	30	6650	12	4950	31	12270	30	17500
15	840	16	6390	30	4700	30	12000	28	16980
4	830	13	5860	31	4380	16	11360	16	16840
31	740	4	5740	22	4230	4	10630	23	16840
25	700	23	5250	3	4310	23	10530	20	16480
30	650	15	5180	7	4250	21	10330	21	16380
3	620	32	4900	23	4180	32	10120	4	15960
6	620	20	4840	4	4060	20	9590	32	15420
21	610	10	4650	20	3790	15	9420	1	15360
22	560	21	4380	16	3740	3	8920	6	15020
7	540	1	4370	14	3450	22	8730	10	14920
13	530	3	3990	15	3400	7	8640	3	14780
10	530	6	3890	10	3130	10	8310	7	14670
1	340	7	3850	6	2700	6	7210	22	14570
32	140	22	3850	1	1470	1	6180	15	14350
Mean yields									
S‡	810		5760		4370		10940		
M	1590		2240		1760		5590		
T	2400		8000		6130		16530		

†Yield values connected by the same lines are not significantly different ($P<0.05$)
‡S=Stylo; M=Miscellaneous species; T=Total.

TABLE 5

The performance of 15 S. guianensis *accessions at Mackay and Ingham. The yield ratios are the ratio of the yield of an individual accession to the mean yield for that site-year. The regression coefficient is for the yield of the individual accession on mean yield.*

Accession	Yield Ratio							Regression Coefficient
	Mackay			Ingham			Mean	
	1	2	3	1	2	3		
Q8255	0.66	0.95	0.85	0.66	0.64	0.89	0.77	0.80
Schofield	1.72	1.46	0.78	0.89	0.92	0.83	1.10	0.98
Q8231A	1.23	1.12	1.66	1.85	1.16	1.13	1.36	1.03
38222	0.97	1.33	1.23	1.13	1.21	1.02	1.15	1.25
Cook	1.31	0.93	1.02	0.95	1.38	0.71	1.05	1.13
41209C	0.40	0.90	0.62	0.90	0.83	1.52	0.86	1.10
Endeavour	0.81	0.96	1 05	1.31	1.02	0.77	0.99	0.94
47396	0.75	0.99	1.36	1.02	0.78	0.78	0.95	0.79
33706B	0.96	0.66	0.84	0.65	0.70	1.10	0.82	0.75
37204A	1.52	0.65	0.77	1.17	0.84	0.86	0.97	0.65
38391	0.74	0.95	1.10	0.75	1.18	1.08	0.97	1.20
40255	1.59	1.45	1.41	1.42	1.23	1.24	1.39	1.23
40294	1.75	1.17	1.12	1.45	1.24	1.08	1.30	1.08
34906	0.37	0.87	0.84	0.69	1.07	0.97	0.80	1.13
40258	0.21	0.59	0.36	0.15	0.79	1.04	0.52	0.96
Mean yield	1510	5180	3320	940	6230	4870	1.00	1.00

where the stylo portion has declined considerably by the third year after good growth in previous years.

When final year and total stylo yield are considered, the highest yielding accessions where CPI 40255 and Q8231A at both sites, CPI 38606 and 40294 at Ingham and CPI 34911A and 41218 at Mackay. CPI 40294 performed well at Mackay in the first two years but produced only average yields in the final year (Table 2). Of these six accessions the three sown at both sites (CPI 40255, Q8231A and CPI 40294) all had above average mean yield ratios and regression co-efficients (Table 5).

These results agree with those from a study by Edye *et al.* (1976) where CPI 34911A grew well at a range of sites and CPI 40255 and Q8231A performed well at a site with a similar length of growing season to these sites. These six accessions all belong to M-A groups 8A and 10B which Edye *et al.* concluded were the best adapted groups for tropical conditions.

The large decline in the number of perennial plants for all accessions at the final count of the grazed swards at Mackay is probably due to low autumn-winter rainfall and heavy stocking over the previous two years. These two factors would be expected to reduce the number of seedlings surviving to adult plants and adult populations would fall.

Under these severe commercial grazing conditions the seven plants m^{-2} for CPI 40255 and CPI 40297 are regarded as a considerable improvement over the one or two for the commercial cultivars. The higher seedling counts and higher soil seed reserves suggest that difference would be greater under less severe grazing pressure. Due to the heavy stocking rate the grazed swards were kept short and yield potential was not assessed. However under moderate stocking 7 plants m^{-2} would be expected to contribute significantly more dry matter than 2 plants m^{-2}. The difference would probably become less significant as grazing pressure became more lenient.

The below average autumn-winter rainfall may have favoured the early flowering accessions since the soil seed reserves were highest for the early flowering lines. The seed reserves of CPI 40255 and CPI 40297 (more than 1200 m^{-2}) were particularly satisfactory considering the stocking rate.

The general similarity of accession performance under cutting and grazing suggests that within *S. guianensis* the use of small grazed swards, and measurements of plant and seed numbers plus some estimates of herbage yield, would be a suitable method for selection of accessions for further testing.

To determine their full potential, the best accessions should then be grown under a greater range of climate, soil, cultural and management conditions. More measurements (e.g. herbage quality, persistence, seasonal growth rates, disease resistance, animal production, etc.) are needed so their value to the grazing industry can be assessed.

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