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SMALL SWARD COMPARISON OF *STYLOSANTHES* AND *DESMODIUM* SPECIES GROWN IN ASSOCIATION WITH GUINEA

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RINGKASAN

Tiga puluh empat aksesi (accessions) yang mengandungi *Stylosanthes guianensis* (Aubl.) SW., *S. hamata* (L) Taub. dan *S. scabra* Vog. serta dua jenis Desmodium telah dibuat penilaian bersama-sama rumput 'common guinea' (*Panicum maximum* Jacq.) di MARDI, Serdang. Di peringkat permulaan, campuran rumput-rumput tersebut telah dipotong (harvest) setiap enam minggu sekali, tetapi kemudiannya padang rumput tersebut telah dibiarkan untuk diragut berterusan pada kadar 3.8 ekor lembut sehektar. Penilaian telah dijalankan selama tiga tahun dengan berasaskan kepada hasil bahan kering yang tinggi, peratus kekacang, ketahanan, kesuburan dan daya penutupan mukabumi dan didapati aksessi yang bermutu dan baik terdiri daripada CPI, 40294, 40255, 33437, Q8231, 33978, 41218 dan 33706B. Aksessi-aksessi ini tergulung dalam kumpulan MA-8A dan 10B. Walaupun, *Desmodium ovalifolium* (Linn.) DC memperlihatkan pertumbuhan yang lambat tetapi menampakkan mutu kesuburan dan daya penutupan mukabumi yang baik. Di dalam keadaan ragutan pula didapati *S. scabra* CPI 40205 and 40292 mempunyai daya ketahanan yang baik. Bagi kultivar-kultivar Stylo Cook, Endeavour dan Scholfield pula menunjukkan hasil bahan kering yang semakin merosot mengikut peredaran masa, tetapi *S. hamata* cv. Verano pula telah menunjukkan mutu yang paling rendah sepanjang percubaan.

INTRODUCTION

The inclusion of a legume in farming systems has the aims to increase soil fertility through biological nitrogen fixation, to serve as good quality livestock feed and to provide green manure in rotational cropping. Such utilization of forage legumes has thus offered a new perspective for livestock production in developing countries of the tropics.

In Peninsular Malaysia, *Stylosanthes guianensis* (Aubl.) SW, a legume native to Central and South America, had been introduced for use of a plant cover and fodder legume as early as in 1949 (VIVIAN 1959). Its vigorous growth, good persistence under grazing and compatibility with guinea have made the legume a valuable forage for grass/legume pastures (NG 1976, ENG *et al.* 1978, WONG and MANNETJE, 1980).

However, recent experiments have indicated a number of *Stylosanthes* accessions better adapted to the wet tropics (EDYE *et al.* 1974a,b). In the search for more *Stylosanthes* species or ecotypes agronomically suited to the local environment, 33 accessions of *Stylosanthes* comprising three species were introduced from Australia and evaluated together with local Schofield stylo (control), *Desmodium ovalifolium* (Linn.) DC (Ovalifolium desmodium) and *D. heretophyllum* (Willd.) DC. (hetero desmodium) at MARDI, Serdang.

In this paper, a comparison of 34 *Stylosanthes* accessions together with two *Desmodium* species grown in association with *Panicum maximum* Jacq. (common guinea) in small plots under a 6-weekly cutting frequency in the first 18 months and subsequently grazed continuously at a stocking rate of 3.8 Kedah/Kelantan cattle ha^{-1} is reported.

MATERIALS AND METHODS

I. Accessions

The origin, CPI or Q. Nos of selected together with their morphologi-

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cal and agronomic (MA) groupings are listed in *Table 1*. (The origin of each accession and a detailed description of each MA group and its response to *Rhizobium* CB 756 have been published (EDYE *et al.* 1974a,b).)

TABLE 1. ORIGIN AND MORPHOLOGICAL — AGRONOMIC (M—A) CLASSIFICATION OF STYLOSANTHES

CPI or* Q No.	M—A Group	Country and place of origin	Lat	Act. (m)
S. Guinnensis				
34927	5A	Brazil, ex Matao, Sao Paulo	22°S	551
33034	7A	Costa Rica, ex Turrialba	9°N	609
5630A—I	7A	Brazil, Deodora, Rio de Janeiro	22°S	20
5630A—II	7A	Brazil, Deodora, Rio de Janeiro	22°S	20
5630A—III	7A	Brazil, Deodora, Rio de Janeiro	22°S	20
Q8255	7A	Surinam, ex Paramaribo	5°N	10
34662	7A	Uganda, Serere	1°N	1112
33437	7A	Surinam, Lelydrop	5°N	5
17210A	7A	Nigeria ex Ibadon	7°N	40
37512	7B	Argentina, nea-Rio Ceballos	31°S	457
34440	8A	El Salvador, Ciudad Universitaria	13°N	640
38754	8A	Colombia, Bogota, 83 km to Villavicencio	4°N	1250
41211B	8A	Guatemala, near Quezaltenango	14°N	1900
Q8231	8A	Brazil, Bela'm, Para	1°A	10
33978	8A	Costa Rica, near San Ramon	10°N	609
3400	8A	Costa Rica, near San Isidro del General	9°N	609
34911	8A	Brazil, Rio Mogi Guacu, Sao Paulo	21°S	500
38222	8A	Pem, near Quillabambo	13°S	1372
41209C	8A	Mexico, Comitan	15°N	770
41218	8A	Costa Rico, San Jose	9°N	1172
34659	8C	Uganda, Serere Res. Stn. Soroti	1°N	1112
47396	10A.1	British Honduras	—	—
*T.No. 11	10A.1	Unknown		
33706B	10A.2	Mexico, Loma Bonita, Oaxaca	18°N	181
37204A	10A.3	Nicaragua, Managua	13°N	1280
38391	10B.1	Venezuela, Merida	9°N	1829
40294	10B.3	Brazil, 90 km N.N. Campo Granda	20°S	500
	Mato Grosso			
40255	10B.3	Bolivia, Muyurina, Santa Cruz	17°S	440
34906	14A	Brazil, Nova Campinas, Sao Paulo	23°S	440
34920	14A	Brazil, Guarapes, Sao Paulo	21°S	450
34749	14A	Brazil, Matao Quarry, Sao Paulo	22°S	551
S. Scabra				
40205	17	Brazil, ex Cruz Das Almas, Bahia	12°S	36
40292	18	Brazil near Gravata, Pernambuco	8°S	300
S. hamata				
38842A	28A	Venezuela, Matacaibo Airport	10°N	30

TABLE 1. ORIGIN AND MORPHOLOGICAL – AGRONOMIC (M–A) CLASSIFICATION OF STYLOSANTHES–(*cont.*)

CPI or* Q No.	M–A Group	Country and place of origin	Lat	Act. (m)
Desmodium				
D. heterophyllum		Serdang, West Malaysia	3°N	60
D. ovalifolium	—	Sri Lanka	—	—
*CPI	—	Commonwealth Plant Introduction		
Q	—	Queensland Plant Introduction		
T	—	Townsville Plant Introduction		

TABLE 2. MONTHLY RAINFALL (MM) FOR THE EXPERIMENTAL SITE AND AVERAGE RAINFALL FOR THE NEAREST LONG TERM RECORDING STATION

Month	1974/75	1975/76	1976/77	1977/78	Long-term average
July	82.6	232.3	102.6	78.3	140.2
August	10.2	196.8	168.3	214.4	200.8
September	90.2	156.4	184.7	156.7	206.7
October	40.4	165.0	480.0	325.2	202.7
November	204.5	147.3	402.8	194.8	208.1
December	151.9	143.0	365.1	128.0	124.5
January	122.9	35.7	204.3	205.0	111.4
February	251.2	156.4	111.9	99.3	139.1
March	193.4	373.1	101.6	234.8	157.1
April	277.5	281.7	116.0	199.3	242.1
May	93.3	82.5	170.4	271.4	184.0
June	46.9	279.6	225.3	44.6	164.5
Total	1518.2	2249.7	2633.0	2151.8	2041.7

*Federal Experiment Station.
Department of Agriculture (2 km from experimental site) 21 year average (1958–78).

II. Site and climate

The accessions were assessed in sward in combination with common guinea at Serdang (lat. 3°N, long. 101° 41′E) beginning from June 1974 to February 1978. The soil type is sandy clay loam (orthoxic tropudult) with a pH 4.2. The long term mean rainfall for the recording station nearest to the experimental site is shown in *Table 2.*

III. **Design and treatments**

The accessions were laid out as a 6 × 6 complete lattice square design with three replications. *Rhizobium* CB 756 was used to inoculate all the *Stylosanthes guianensis* accessions except CPI 34927 which was inoculated with CB 82, CPI 34906 with CB 2534, CPI 34749 and 34920 with CB 2248. The two *Desmodium* species were inoculated with CB 2085 and CPI 38842A (*S. hamata* cv. Verano) with CB 2126. It was necessary to use different rhizobial strains as some of the *Stylosanthes* accessions were specific (EDYE *et al.* 1974a,b). The inoculated seed was broadcast on cultivated plots 3 m × 5 m in June 1974 at a sowing rate of 5 kg ha^{-1} of naked seed for all the legumes and common guinea at 3 kg ha^{-1}.

IV. **Management**

After sowing, the plots were watered daily to assist germination but watering ceased with the onset of monsoonal rain in late October 1974. A basal fertilizer dressing of 30 kg P ha^{-1} as triple super-phosphate and 50 kg K ha^{-1} as muriate of potash was applied after sowing and thereafter 20 kg P ha^{-1} and 50 kg ha^{-1} were applied every six months.

V. **Measurement**

Seedling number from four random quadrats (0.5 m × 0.5 m) per plot was taken in August 1974 (a month after sowing). During the establishment phase, the date of first floral production was noted together with their growth habit, flowering behaviour and growth vigour score (See below for details). The swards were later harvested with a cutter-bar mower at 15 cm height about 4½ months after sowing. Subsequently, all plots were harvested every six weeks until January 1976. At such harvest, two strips of 1 m × 0.5 m were hand-cut through the centre of each plot, the cut material weighed and sub-sampled for dry matter determination and botanical composition. The remainder of the plots was then mowed to the standard height of 15 cm except in the last three harvests where the plots were mob-grazed by 20 cattle for 2—3 days after sampling. Any ungrazed herbage was then cut to the standard height.

From January 1976 onwards, some 18 months after establishment, the plots were grazed communally and continuously at a stocking rate of 3.8 cattle ha^{-1}. Feed-on-offer in each plot was sampled as before in July 1976, January 1977 and February 1978. The sampled material was then separated into sown grass, legume and other volunteer species, dried overnight at 70°C and weighed. Dry matter yield and yield ratio expressed as accession D.M. yield/mean accession D.M. yield for each harvest were determined for each accession.

Prior to the termination of the trial in March 1978, a rating scale of 1—10 was used, with 10 being the best and 1 the worst for assessing regrowth vigour (size and bulk of plant), ground cover (area covered by the canopy) of the sown legume and the interaction of vigour with ground cover (vigour × ground cover) was determined.

The yield data and rating scores of the legumes were analysed by the analysis of variance of the actual values but square root transformations of total pasture yield data were made prior to statistical analysis.

The overall comparison of the accession performance was that of rank comparison and mean rank. If all accessions were ranked (1 best to 36 worst) with respect to all desirable attributes, the accessions were thus selected to ascertain that they contained the best of all desirable characters namely emergence count, legume yield, legume percentage, total mixture (grass + legume) yield, vigour, ground cover and vigour × ground cover. The best assessions are those with the lowest mean rank for all the characters evaluated.

RESULTS

1. Climate

The rainfall recorded every month at Serdang is depicted in *Table 2.* The site recorded low rainfall from July to October 1974 during the establishment period but otherwise was close to average in most of the other years except for the unusual high rainfall during October to December 1976.

Mean daily maximum (32.7°C) and minimum (21.8°C) temperatures were normal with no distinct seasonal variations. Daily relative humidity fluctuated from as high as 98% in the morning to 65% in the late afternoon.

II. Establishment

Many of the *Stylosanthes* accessions established well (*Table 3*). The average legume plant density 1 month after sowing was 21.2 plants m^{-2}. Nevertheless, significant differences ($P < 0.05$) were obtained among the accessions.

Stylosanthes guianensis CPI 40255 had the highest plant density (75.2 plants m^{-2}) and was significantly higher ($P<0.05$) from all the others. This was followed by CPI 33437, 40294 and 34927. These accessions established significantly ($P<0.05$) better than the remaining accessions. Local Schofield stylo (CPI 5630A-II) together with CPI 40292, 34659, 337068, 38842A, 17210A and 33034 had less than 10 plants m^{-2}. The two *Desmodium* species had virtually no seedlings at the time of emergence count, but their seedlings were observed eventually toward the end of the second month after sowing. The growth vigour of the legumes in the mixtures was generally good (*Table 3*). The best scores were from accession CPI 38754 (Cook cultivar), 33978, 40205, 38391 and 33437. Accessions CPI 33034, 34659, 34906, 40292, 38842A and the *Desmodium* species were below average.

III. Flowering

During the establishment period, the number of days to initial floral production was noted and is shown in *Table 3.* The accessions belonging to MA-groups 7A and 7B were non-flowering even at the commencement of the first harvest except CPI 33437 and 17210A which bloomed in 130 and 123 days after sowing. The other accessions flowered readily especially CPI 34927, 40255, 38842A, 47396, 41209C and 38222 but CPI 34000, 34906, 337068, 34920, 34749 and 38391 flowered late and sparingly. The two *Desmodium* species, being slow in establishment, failed to flower within the observational period.

IV. Dry Matter Yield and Botanical Composition

(A) Legume

(i) Cutting Management

Generally, legume yield declined with frequent defoliation. The mean legume yield of the accessions at each harvest under the cutting management declined from 1960 kg ha^{-2} $harvest^{-1}$ at commencement to as low as 240 kg ha^{-1} $harvest^{-1}$ at the end of the last cut (*Figure 1*). Likewise, the average legume component in the mixtures also decreased from 51.5 to 12.2%.

The legume dry matter production average over the eight harvests of the accessions varied significantly ($P < 0.05$) (*Table 4*). Though the mean legume yield of the 36 accessions was 597 kg ha^{-1} $harvest^{-1}$, individual accession yield mean varied from as high as 1067 to as low as 40 kg ha^{-1} $harvest^{-1}$ with the corresponding legume percentage change from 48 to 2 respectively.

The highest yielder was accession CPI 34662 with a legume composition of 48% and a mean yield ratio of 1.91. This accession was

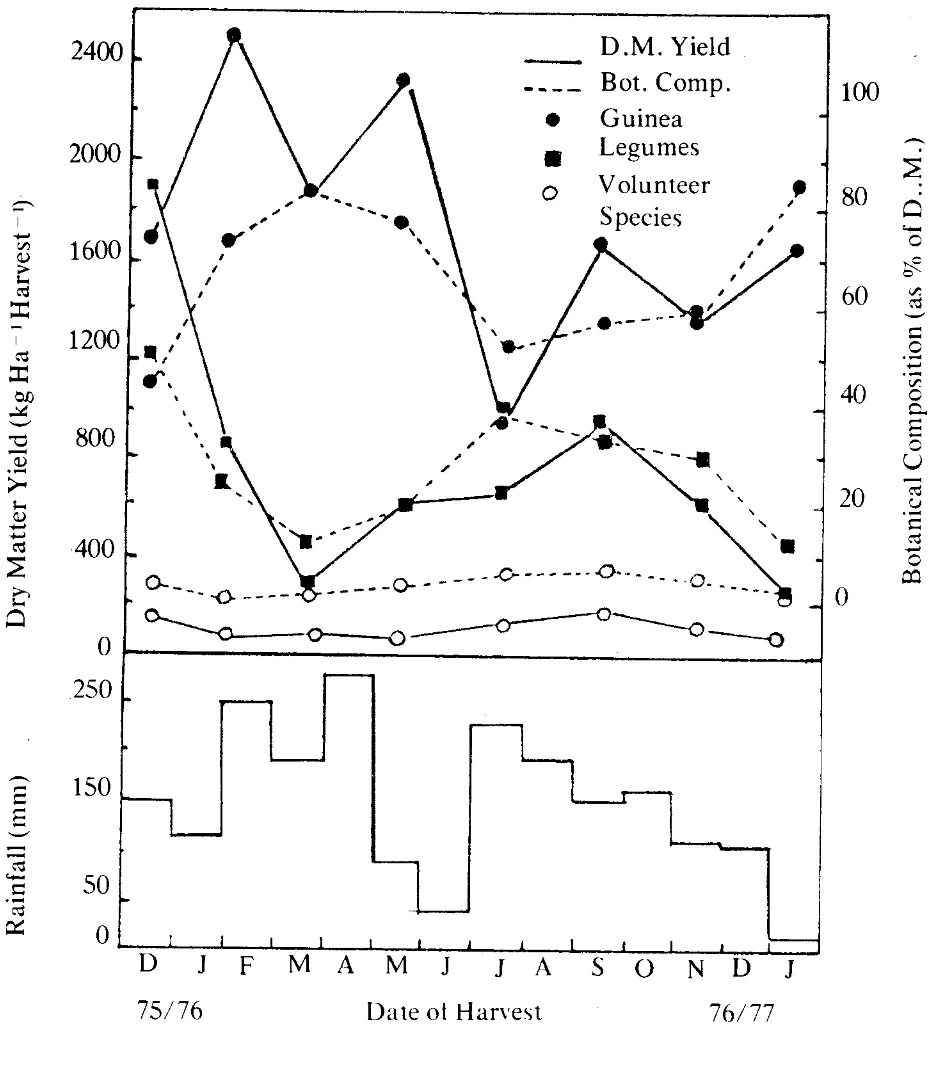

Figure 1: Monthly rainfall, dry matter yield (kg Ha^{-1} Harvest^{-1}) and botanical composition (%) of sown legume, guinea and volunteer species averaged over 36 grass/legume mixtures under cutting at MARDI, Serdang.

TABLE 3. EMERGENCE COUNT (PLANT M^{-2}), GROWTH HABIT, FLOWERING BEHAVIOUR AND VIGOUR SCORE OF THE *STYLOSANTHES* ACCESSION AND *DESMODIUM SPECIES* DURING ESTABLISHMENT PERIOD

Accession No. CPI	MA-Group	Cultivar	Emergence Legume	Count Grass	Growth Habit	Vigour Score	Days to 1st Flowering	Flowering Behaviour
34927	5A	—	39.1	11.0	erect	8	95	freely
33034	7A	—	9.1	16.2	semi-erect	3	—	non-flowering
5630—I	7A	Schofield	31.0	13.3	semi-erect	9	—	non-flowering
5630A—II	7A	Local Schofield	4.9	19.7	semi-erect	5	—	non-flowering
5630A—III	7A	Schofield	14.0	18.3	semi-erect	8	—	non-flowering
Q8255	7A	—	35.7	12.7	semi-erect	7	—	non-flowering
34662	7A	—	22.7	12.7	semi-erect	7	—	non-flowering
33437	7A	—	54.5	31.7	erect	10	130	late and uneven
17210A	7A	—	5.9	12.3	prostrate	5	123	poor
37512	7B	—	35.7	24.0	semi-erect	9	—	non-flowering
34440	8A	—	16.8	14.3	prostrate	5	109	freely
38754	8A	Cook	22.7	33.0	semi-erect	10	118	freely
41211B	8A	Endeavour	13.0	10.7	semi-erect	6	95	freely
Q8231	8A	—	16.0	11.7	erect	9	116	poor
33978	8A	—	31.5	23.7	prostrate	10	98	freely
34000	8A	—	10.1	14.7	semi-erect	7	130	poor
34911B	8A	—	33.8	9.3	semi-erect	9	102	freely
38222	8A	—	28.5	12.3	semi-erect	9	95	freely
41209C	8A	—	15.0	18.0	prostrate	5	88	freely

Table 3.—(*cont.*)

Accession No. CPI	MA-Group	Cultivar	Emergence Legume	Count Grass	Growth Habit	Vigour Score	Days to 1st Flowering	Flowering Behaviour
41218	8A	—	12.4	10.0	prostrate	8	125	freely
34659	8C	—	5.9	13.7	semi-erect	3	85	uneven
47396	10A−1	—	12.3	18.0	prostrate	7	79	freely
T. No. II	10A−1	—	35.9	17.3	prostrate	9	116	fair
33706B	10A−2	—	8.7	19.0	prostrate	6	130	uneven
37204A	10A−3	—	11.1	13.3	prostrate	4	116	freely
38391	10B−1	—	33.9	9.0	semi-erect	10	109	uneven
40294	10B−3	—	45.6	16.0	semi-erect	8	118	freely
40255	10B−3	—	75.2	13.3	semi-erect	9	59	freely
34906	14A	—	18.4	12.7	semi-erect	1	130	poor
34920	14A	—	34.0	16.3	erect	7	130	poor
34749	14A	—	34.9	20.3	erect	8	130	uneven
40205	17	—	19.6	19.7	erect	10	79	freely
40292	18	—	0.8	11.7	erect	2	111	freely
38842A	28A	Verano	3.5	8	semi-erect	1	60	freely
D. heterophyllum	—	Hetero	0.1	10.3	prostrate	1	—	non-flowering
D. ovalifolium	—	—	0	10.3	prostrate	1	—	non-flowering
Mean	—	—	21.1	15.1	—	6.6	—	—
LSD 0.05	—	—	15.8	NS	—	—	—	—
LSD 0.01	—	—	21.1	NS	—	—	—	—

significantly higher (P 0.05) than all the other accessions except CPI 38754 (Cook cultivar), 40255, 33437, 40294, 5630A−I (Schofield stylo) 5630A−III (Schofield stylo) and 34927 which had dry matter yields ranging from 1012 to 802 kg ha^{-1} harvest and the mean legume yield ratios from 1.54 to 1.36 (*Table 4*). Accession CPI 5630A−II (Local Schofield stylo) was however significantly lower ($P<0.05$) in dry matter yield than these highest yielders.

In terms of botanical composition, these highest yielders, accessions CPI 34662, 40294 and 40255, continued to rank top (*Table 4*) with an average percentage of over 40. *Stylosanthes scabra* (CPI 40205) was ranked 17 in dry matter yield while CPI 40292 and CPI 38842A were placed 33 and 35 respectively (*Table 7*). Their mean yield ratios were amongst the lowest (less than 1). The two *Desmodium* species were the poorest yielders forming less than 6% in the total mixture yield.

(ii) **Continuous Grazing**

When the mixtures were grazed continuously at a stocking rate of 3.8 cattle ha^{-1}, the legume yield continued to decline but the accession responses were different to those under cutting. The legume yield on offer average over all the accessions was only 286 kg ha^{-1} making up about 18% of the total mixture yield.

Although statistically the individual legume yields were not significant (*Table 5*), *Stylosanthes scabra* CPI 40205 and 40292 emerged as the highest yielders (575 and 492 kg ha^{-1}) with a legume composition of 24%.

Accession CPI 40294, 34927 and 337068 were also productive and their yield ratios were high under grazing (1.76−1.48). However, accessions CPI 38754 (Cook cultivar), 40255 and 33437 which were among the top our in dry matter ranking under cutting, were placed 36, 13, and 23 respectively under continuous grazing (*Table 7*). Nevertheless, accession CPI 40294, 40255, Q8231, 33978, 41218 and 34662 performed well under both management systems. Accession CPI 5630A−I, II and III (Schofield stylo) were ranked 20, 15, and 28 while ovalifolium desmodium and hetero desmodium were placed 17 and 32 respectively. Accession CPI 38842A (*S. hamata* cv. Varano) was ranked 30 (*Table 7*).

B) **Grass**

(i) **Cutting Management**

The guinea grass yields averaged over the 36 accessions under cutting varied considerably with low production during the period of low rainfall (*Figure 1*). Mean guinea yield of the mixtures over the eight harvests declined from 2226 to 976 kg ha^{-1} $harvest^{-1}$ (*Table 4*). Analysis of variance of guinea grass yield showed significant differences ($P<0.05$) (*Table 4*). The guinea from the ovalifolium desmodium was the highest in dry matter yield. This was followed by guinea grown in plots with low legume yields namely hetero desmodium, CPI 38391, 38842A, 34906, 34440, 34749 and 47396 (*Table 4*). The reduced yield of the legume components in the mixtures could be attributed to their poor competitive ability compared to that of common guinea. The yield of guinea was inversely related to the legume yield ($r = 0.68$). The overall mean composition of guinea in the mixtures was 70% under cutting.

(ii) **Continuous Grazing**

Under continuous grazing, the guinea yield on offer averaged over

TABLE 4. DRY MATTER YIELD (KG HA^{-1} HARVEST^{-1}), LEGUME YIELD RATIO AND BOTANICAL COMPOSITION OF THE 36 GRASS/LEGUME MIXTURES CUT AT 6 WEEKLY INTERVALS (MEAN OF 8 HARVESTS)

	D.M. Yield (Kg Ha^{-1} Harvest^{-1})					Botanical Composition (%)		
Accession No.	Legume	Grass	Legume + grass	Total pasture yield	Mean yield ratio of legume	Legume	Grass	Volunteer species
34927	802	1546	2348	2362	1.36	34	65.5	0.5
33034	452	1372	1824	1830	1.02	24.7	75.0	0.3
5630A – I	881	1085	1966	2009	1.46	43.8	54.0	2.2
5630A – II	571	1393	1964	1942	1.19	29.4	71.8	1.2
5630A – III	850	1524	2375	2371	1.45	35.9	64.3	0.2
Q8255	624	1453	2117	2148	1.08	29.1	69.5	1.4
34662	1067	1152	2219	2227	1.91	47.9	51.7	0.4
33437	955	1100	2055	2064	1.45	46.3	53.3	0.4
17210	567	1403	1969	1975	1.04	28.7	71.0	0.3
37512	727	1213	1940	1965	1.30	37.0	61.7	1.3
34440	468	1664	2132	2142	0.86	21.9	77.7	0.4
38754	1012	1349	2361	2368	1.54	42.7	57.0	0.3
41211B	432	1564	1936	2002	0.91	21.6	78.1	0.3
Q8231	881	1195	2076	2097	1.52	42.0	57.0	1.0
33978	664	1212	1876	1876	0.96	35.4	64.6	0.
34000	529	1319	1848	1866	0.84	28.4	70.7	0.9
34911B	605	976	1581	1599	1.07	37.9	61.1	1.0
38222	649	1289	1938	1962	0.97	33.1	65.7	1.2
41209C	446	1300	1746	1762	0.70	25.3	73.8	0.9
41218	647	1545	2921	2217	0.97	29.2	69.7	1.1
34659	455	1525	1980	2026	1.14	22.5	75.3	2.2
47396	462	1652	2114	2148	0.79	21.5	76.9	1.6
T. No. 11	677	1366	2043	2056	1.18	32.9	66.4	0.7
33706B	526	1408	1934	1935	1.03	27.2	72.8	0.1

TABLE 4. DRY MATTER YIELD (KG HA $^{-1}$ HARVEST $^{-1}$), LEGUME YIELD RATIO AND BOTANICAL COMPOSITION OF THE 36 GRASS/LEGUME MIXTURES CUT AT 6 WEEKLY INTERVALS (MEAN OF 8 HARVESTS)—(*cont.*)

Accession No.	D.M. Yield (Kg Ha $^{-1}$ Harvest $^{-1}$)				Mean yield ratio of legume	Botanical Composition (%)		
	Legume	Grass	Legume + grass	Total pasture yield		Legume	Grass	Volunteer species
37204A	476	1560	2036	2045	1.11	23.2	76.2	0.6
38391	477	1710	2187	2213	0.69	21.5	77.3	1.2
40294	906	1033	1937	1931	1.55	46.9	53.5	0.4
40255	956	1187	2143	2180	1.02	43.8	54.5	1.7
34906	455	1746	2201	2208	0.72	20.6	79.1	0.3
34920	630	1173	1803	1823	1.02	34.6	64.3	1.1
34749	449	1658	2107	2150	0.51	20.9	77.1	2.0
40205	613	1599	2212	2210	0.71	27.7	72.4	0.1
40292	304	1548	1852	1836	0.58	16.6	84.3	0.9
38842A	103	1727	1830	1853	0.24	5.5	93.2	1.3
D. heterophyllum	40	1914	1954	1968	0.09	2.0	97.3	0.7
D. ovalifolium	122	2226	2348	2363	0.29	5.2	94.2	0.6
Mean	597	1437	2031	2048	—	—	—	—
LSD 0.05	281	547	—	NS	—	—	—	—
LSD 0.01	373	729	—	NS	—	—	—	—

TABLE 5. DRY MATTER YIELD (KG HA^{-1} HA^{-1}), LEGUME YIELD RATIO AND BOTANICAL COMPOSITION OF THE 36 GRASS/LEGUME MIXTURES GRAZED AT 3.8 KEDAH/KELANTAN CATTLE HA^{-1} FROM JANUARY 1976—FEBRUARY 1978. (MEAN OF 8 HARVESTS)

Accession No.	D.M. Yield (kg ha^{-1}) Legume	Grass	Legume + grass	Total pasture yield (x)	($\sqrt{x}$)* legume	Mean yield ratio of	Botanical Composition (%) Legume	Grass	Volunteer species
34927	446	1848	2294	2452	(49.5)	1.51	18.2	75.4	6.4
33034	307	1120	1427	1678	(41.0)	0.57	18.3	66.8	14.9
5630A—I	259	1332	1591	1657	(40.7)	0.72	15.6	80.4	4.0
5630A—II	270	938	1208	1388	(37.3)	0.84	19.5	67.6	12.9
5630A—III	204	1119	1323	1501	(38.7)	0.44	13.6	74.6	11.8
Q8255	153	1324	1477	1684	(41.0)	0.56	9.1	78.6	12.3
34662	366	1037	1403	1486	(38.6)	1.43	24.6	69.8	5.6
33437	238	1285	1523	1737	(41.7)	0.78	13.7	74.0	12.3
17210	127	1415	1542	1730	(41.6)	0.44	7.3	81.8	10.9
37512	266	1145	1411	1525	(39.1)	1.13	17.4	75.1	7.5
34440	210	1334	1544	1714	(41.4)	0.62	12.3	87.5	0.2
38754	85	1017	1102	1315	(36.3)	0.22	6.5	77.3	16.2
41211B	246	1123	1369	1450	(39.2)	0.82	17.0	77.2	5.5
Q8231	352	1444	1796	1868	(43.2)	1.10	5.4	77.3	9.1
33978	334	1461	1795	1932	(44.0)	0.58	17.3	75.6	7.1
34000	237	1132	1369	1408	(37.5)	0.21	16.8	80.4	2.8
34911B	295	1340	1563	1744	(41.8)	0.66	12.8	76.8	10.5
38222	361	1382	1743	1818	(42.6)	0.98	19.9	76.0	4.1
41209C	263	1153	1416	1579	(39.7)	0.83	27.9	73.0	10.4
41218	378	1090	1468	1592	(39.9)	1.35	23.7	68.5	7.8
34659	228	1047	1275	1464	(38.3)	0.56	15.6	71.5	12.9
47396	258	1501	1759	1934	(44.0)	0.82	13.3	77.6	9.1
T. No. 11	206	1424	1630	1738	(41.7)	0.75	11.9	81.9	6.2

TABLE 5. DRY MATTER YIELD (KG HA $^{-1}$ HA $^{-1}$), LEGUME YIELD RATIO AND BOTANICAL COMPOSITION OF THE 36 GRASS/LEGUME MIXTURES GRAZED AT 3.8 KEDAH/KELANTAN CATTLE HA $^{-1}$ FROM JANUARY 1976—FEBRUARY 1978. (MEAN OF 8 HARVESTS)—(*cont.*)

Accession No.	D.M. Yield (kg ha $^{-1}$)					Mean yield ratio of	Botanical Composition (%)		
	Legume	Grass	Legume + grass	Total pasture yield (x)	($\sqrt{x}$)* legume		Legume	Grass	Volunteer species
33706B	430	1318	1748	1879	(43.3)	1.48	22.9	70.1	7.0
37204A	380	1219	1599	1844	(42.9)	0.65	20.6	66.1	13.3
38391	92	1481	1573	1708	(41.3)	0.52	5.4	86.7	7.9
40294	475	1053	1528	1669	(40.9)	1.76	28.5	63.1	8.4
40255	325	1024	1349	1449	(38.1)	1.31	22.4	70.7	6.9
34906	374	1277	1651	1753	(41.9)	1.11	11.9	72.9	15.2
34920	265	1635	1900	2004	(44.7)	0.60	13.2	81.6	5.2
34749	264	1107	1371	1567	(39.6)	0.54	16.8	70.6	12.6
40205	575	1550	2125	2368	(48.7)	2.92	24.3	65.5	10.2
40292	492	1350	1842	2052	(45.3)	4.35	24.0	64.8	10.2
38842A	193	1101	1294	1378	(37.1)	1.15	14.0	79.9	6.1
D. heterophyllum	189	1873	2062	2140	(46.3)	0.46	8.8	87.3	3.7
D. ovalifolium	163	1365	1528	1792	(42.3)	1.43	9.1	63.8	27.1
Mean	286	1288	1519	1722	(41.7)	—	—	—	—
LSD 0.05	NS	471	—	—	(5.9)	—	—	—	—
LSD 0.01	NS	628	—	—	(7.8)	—	—	—	—

*Square root of Total Pasture Yield.

the 36 accessions was 1288 kg ha^{-1} comprising 72% of the total pasture yield (*Table 5*). The dry matter yields of guinea on offer were significant ($P<0.05$) amongst the accessions. the highest yielder was from the plot sown with hetero desmodium followed by guinea in association with CPI 34927, 34920, 40205, 38391 and 33978 due to guinea being more aggressive than the poorly-adapted legumes.

(iii) **Total Pasture Yield (grass + legume + volunteer species)**

Total pasture yields averaged over the eight harvests under cutting were not significant. The volunteer species (mainly *Boreria latifolia, Axonopus compressus* and *Ottochloa nodosa*) formed a relatively low percentage (*Table 4*). However, when the mixture were grazed continuously, the mean total pasture yields were significant ($P<0.05$) possibly due to increased volunteer species (16%) in some plots (*Table 5*). The highest total pasture yield means were from plots sown with CPI 40205, 40292, 34927 and *hereto desmodium* which were significant higher ($P<0.05$) than the others.

V. **Vigour and Basal Ground Cover Scores**

The vigour and basal ground cover scores at the end of the experiment were indicative of the relative persistence of the accessions under continuous grazing. These scores were significantly different ($P<0.05$) (*Table 6*). Accession CPI 33706B, 40294, 47396, 33437 and ovalifolium desmodium had the highest scores in the two attributes. Naturally,

TABLE 6. VIGOUR, BASAL GROUND COVER AND VIGOUR × GROUND COVER SCORES OF *STYLOSANTHES* ACCESSIONS AND *DESMODIUM* SPECIES GROWN IN ASSOCIATION WITH COMMON GUINEA AND GRAZED AT A STOCKING RATE OF 3.8 KEDAH/KELANTAN CATTLE HA^{-1}

Accession No. CPI	Vigour	Basal Ground Cover	Vigour X Basal Ground Cover
34927	5.1	2.3	12.0
13034	2.4	1.0	2.0
5630A – I	3.4	3.3	7.5
5630A – II	5.1	3.3	17.3
5630A – III	3.8	2.0	8.0
Q8255	2.8	1.2	3.5
34662	3.9	2.7	12.7
33437	5.9	5.7	35.7
17210	1.9	0.7	1.7
37512	4.5	2.0	11.7
3440	4.1	3.3	13.3
38754	4.3	4.0	19.3
41211B	5.0	4.3	25.0
Q8231	5.4	3.0	25.7
33978	5.0	5.7	30.3

TABLE 6. VIGOUR, BASAL GROUND COVER AND VIGOUR × GROUND COVER SCORES OF *STYLOSANTHES* ACCESSIONS AND *DESMODIUM* SPECIES GROWN IN ASSOCIATION WITH COMMON GUINEA AND GRAZED AT A STOCKING RATE OF 3.8 KEDAH/KELANTAN CATTLE HA^{-1}—(*cont.*)

Accession No. CPI	Vigour	Basal Ground Cover	Vigour X Basal Ground Cover
34000	2.2	1.0	3.0
34911B	6.0	4.3	27.2
38222	4.9	4.0	22.0
41209C	3.9	3.8	17.7
41218	5.5	4.3	24.7
34659	4.5	3.0	13.3
47396	6.3	6.3	36.0
T. No. 11	6.0	3.3	19.0
33706B	7.5	7.3	55.3
37204A	4.0	2.7	10.7
38391	5.2	3.5	19.3
40294	6.6	7.3	49.3
40255	4.8	4.7	23.3
34906	3.8	13.0	11.0
34920	3.3	1.5	7.2
34749	3.6	1.8	5.8
40205	4.4	3.7	17.0
40292	4.6	5.3	27.7
38842A	2.8	3.0	8.3
D. heterophyllum	*3.7*	*3.2*	*14.3*
D. ovalifolium	6.3	9.0	57.0
Mean	4.5	3.7	19.3
LSD 0.05	2.4	2.7	19.9
LSD 0.01	3.1	3.5	26.5

the vigour X ground cover scores for the above accessions were also high, with ovalifolium desmodium, CPI 33706B and 40294 being significantly higher than the others (P 0.05). Accession CPI 5630A−II (Local Schofield stylo) was better in vigour score compared to that of the two Schofield stylo (CPI 5630A−I and III). The two accessions of the top yielding *Stylosanthes scabra* Vog. under grazing had average rating for basal ground cover and vigour except CPI 40292 which had 5.3 for basal ground cover. Accession CPI 38754 (Cook cultivar) ranked 20 in vigour (4.3 and 13 in basal ground cover (4.0) while CPI 41211B (Endeavour cultivar) rank 12 and 10 respectively (*Table 7*). Hetero desmodium and CPI 38842A (*S. hamata* cv. Verano) performed poorly in these scores and so was CPI 34662 despite its high dry matter yield under cutting and high legume percentage under grazing (*Table 4* and *5*).

VI. **Overall accession comparison**

From the 10 attributes considered, accession CPI 40294 gave the best overall performance with a mean rank of 6.8 (*Table 7*).

This was followed by CPI 40255, 33437, Q8231, 34927, 40205, 33978 and 41218 which were superior in ranking to Schofield stylo (CPI 5630A–I, II and III) in most of the attributes studied. The commercial cultivars, Cook and Endeavour, ranked 19 and 23 respectively. Ovalifolium desmodium ranked 17 while *S. scrabra* CPI 40292 was 14 and *S. hamata* cv. Verano (CPI 38842A) 34.

DISCUSSION

The assessment of the leguminous accessions under cutting and subsequently under grazing had its merits and demerits. With such a large number of grass/legume mixtures to evaluate, several frequent cutting followed by communal grazing offered a rapid and yet effective technique in the identification of persistent legumes. Under such management conditions, the legume yield would be low and declined with each successive harvest or grazing as obtained in the experiment. This would be expected as only the highly productive and competitive accessions in association with guinea were able to persist while the non-adapted legumes would eventually be eliminated.

Dry matter yield is not of paramount importance of this stage as legume persistence would be the over-riding factor in early evaluation of tropical legumes. Later, the subtle differences among the ecotypes could be determined. Thus in selecting the promising legume, it is generally easier to discard the poorly performed accessions rather than to identify the better ones. The ranking procedure was adopted in order to provide an overall agronomic assessment of the performance of the legumes under the local environment.

In Malaysia, *Stylosanthes* had been shown to nodulate freely without prior inoculation of the seed with exotic or local rhizobium strains (CHANDAPILLAI, 1972). However, to ensure effective nodulation, accessions non-specific in their rhizobial requirements were inoculated with CB75b while the others were treated with their specific rhizobia.

Using the above basis of selection and screening, accession CPI 40294 (MA-ground 10B) was the most outstanding. It had a mean rank of 6.8 and was superior to the existing cultivars, Schofield, Cook and Endeavour in emergence count, dry matter production, vigour and basal ground cover scores and grass and legume percentage under cutting and grazing as indicated by its legume percentage (*Table 4* and *5*). Accession CPI 40294 also bloomed readily and set seed (*Table 3*). This is an important attribute in *Stylosanthes* as it affects bothyield and regeneration ability.

The next promising accessions were CPI 40255, 33437, Q8231, 34927, 40205, 33978, 41214 and 33706B. Accession 40255 (MA-group 10B) and Q8321 (MA-group 8A) have been reported as suitable for the wet tropical areas (EDYE *et al.* 1976b, 1977) while MCIVOR *et al.*, (1979) included accessions CPI 40294 and 41218. Undoubtedly, these accessions have shown their adaptability to the wet tropics in this experiment except for the low grass/legume yield on offer under grazing in CPI 40255, low seedling count in Q8231. Accession CPI 33437 was low in legume yield and percentage under grazing while CPI 33706B performed poorly at the early stages of the experiment particularly during the cutting management (*Table 6*).

OF 10 ATTRIBUTES AT SERDANG, MARDI (RANKING 1 BEST TO 36 WORST)

Rank	Accession No.	Seedling Count	Cutting			Grazing			Score			Mean Rank
			Legume Yield	Legume + Guinea	Legume (%)	Legume Yield	Legume + Guinea	Legume (%)	Vigour	Basal Ground Cover	Vigour × Ground Cover	
1	40294	3	5	23	2	3	22	1	2	2	3	6.8
2	40255	1	3	10	4	13	32	7	15	8	12	10.5
3	33437	2	4	16	3	23	17	25	6	5	5	10.6
4	Q8231	19	6	15	7	11	10	12	9	8	9	10.6
5	34927	4	9	2	13	4	1	20	10	28	25	11.0
6	40205	16	17	6	21	1	2	3	19	16	18	11.9
7	33978	11	12	29	11	12	7	16	12	5	6	12.1
8	41218	24	14	8	11	7	24	5	7	10	11	12.1
9	33706B	29	22	28	22	5	9	6	1	2	2	12.6
10	34662	14	1	5	1	9	29	2	24	26	24	13.5
11	47396	25	26	13	30	21	6	26	3	4	4	15.8
12	38222	12	13	27	36	10	12	10	14	13	13	16.0
13	37512	5	10	24	9	16	27	15	17	29	26	16.9
14	40292	34	33	30	33	2	4	4	16	7	7	17.0
15	T. No. 11	6	11	11	15	27	16	30	22	18	16	17.2
16	34906	17	28	7	32	8	14	8	26	23	23	18.6
17	*D. ovalifolium*	36	34	2	35	32	13	31	3	1	1	18.8
18	5630A−I	15	7	21	5	20	23	21	30	18	30	19.0
19	38754	13	2	15	6	36	36	35	20	13	14	19.0
20	5630A−II	32	19	22	16	15	34	11	7	18	18	19.2
21	37204A	26	24	18	25	6	11	9	23	26	27	19.5
22	5630A−III	22	8	1	10	28	28	24	26	29	29	20.5
23	41211B	23	32	26	28	22	31	17	12	10	9	21.0
24	34920	8	15	34	12	17	5	27	31	32	31	21.2
25	34440	18	25	11	27	26	19	29	21	18	21	21.5
26	34911B	10	18	6	6	29	15	28	35	35	34	21.6
27	34749	7	30	14	31	18	26	18	29	31	32	21.6
28	38391	9	23	25	29	35	20	36	9	17	14	21.7
29	34659	30	27	30	24	25	30	22	17	23	22	24.0
30	Q8255	20	19	12	18	33	8	32	32	33	33	24.0
31	33034	28	29	10	24	14	21	13	34	34	35	24.2
32	*D. heterophyllum*	35	36	14	29	23	3	33	22	20	29	24.9
33	41209C	21	31	35	30	35	25	20	24	15	17	25.2
34	28842A	33	35	32	34	30	35	23	33	23	28	27.2
35	34000	27	21	31	20	24	33	19	35	35	34	27.9
36	17210	31	20	5	19	34	29	34	36	36	36	28.0

Accession CPI 34927 had low legume percentage under grazing and had poor score in basal ground cover. Accession CPI 34662, although the highest yielder under cutting was ranked 10 in the overall comparison partly due to the low score in vigour and ground cover coupled with poor grass/legume yield on offer under continuous grazing. The accession was also poor in flowering.

Most of the top 10 accessions flowered readily within the 4½ months after sowing except CPI 33706B, Q8231 and 33437 which bloomed late and rather scantily. The late maturity type tended to have high yield in the humid tropics as indicated in this experiment by CPI 34662 (EDYE *et al.,* 1976b) but the high seed-producing legumes are generally more persistent due to self-regeneration from seed than the poor seed producers.

Interesting to note is the variable responses of the accessions to different management systems (cutting vs. grazing). Grazing selectivity, grazing pressure, growth pattern of above and below-ground plank parts, differental responses to fertilization and drought tolerance of grass and legume component could affect the ability of the legume to compete and persist in association with the grass. In CPI 34662, Cook cultivar and 33437, their dry matter yields under cutting were ranked 1, 2 and 4 respectively but when continuously grazed, they declined to 9, 36 and 23 resulting in low score in vigour and basal ground cover except CPI 33437 (*Table 6*).

On the other hand, CPI 33706B performed poorly under cutting but was among the top under grazing in legume yield, percentage and vigour. Its poor performance under cutting could be attributed to the initial low seedling density (*Table 3*). Similarly, CPI 47396 and ovalifolium desmodium were not outstanding in dry matter production and legume composition under cutting and grazing but were rated high in vigour and ground cover score. This could be due to the slow establishment initially and the prostrate habit of the plant as well as their lower acceptability by grazing animals particularly ovalifolium desmodium (CIAT 1979, WONG 1982).

MA-groups, 8A and 10B were shown to contain accessions adapted to the humid tropics (EDYE *et al.* 1976a, b). In this experiment, the majority of the promising accessions other than CPI 33437, belonged to these two groups. Accessions in MA-group 10B were highly persistent and relatively vigorous as exemplified by CPI 40294 and 40255. In contrast, MA-groups 8A accessions were moderately persistent but highly vigorous as indicated by Cook cultivar which had high yield that declined with time while Endeavour cultivar was not persistent enough to maintain high production of dry matter.

Likewise, Schofield stylo (CPI 5630A – I, II and III) belonging to MA-group 7A were good yielders initially but did not persist well under grazing. Poor scores in vigour, basal ground cover as well as low dry matter yield were obtained (*Table 4* and *5*).

Persistence is an important factor determining the success of tropical legumes but it can be affected by palatability and animal grazing selectivity. In this experiment, *S. scabra* CPI 40205 and 40292 ranked top in dry matter yield on offer under continuous grazing whereas they ranked 21 and 33 respectively under cutting. Although they have been considered highly persistent and vigorous in the dry tropics (EDYE *et al.* 1976a), their vigour and basal ground cover ratings were average. Their better performance under grazing could be attributed to their lower grazing acceptability compared to the others as their swards were not readily grazed. The *S. scabra* accessions are erect woody shrubs with dense viscid bristles on the stems that could make them less palatable.

Stylosanthes hamata cv. Verano (CPI 38842A) was found to be relatively unproductive. This could be due to the initial poor establishment of the legume (*Table 3*). Nevertheless, its potential on Bris soils was highlighted by IZHAM *et al.* (1981) although the legume was known for its poor persistence but relatively high vigour in the dry tropics (EDYE *et al.,* 1975).

In view of the identification of some accession superior to the commercial cultivars, there is a need to evaluate these promising selections under a greater range of climative edaphic and cultural management conditions so that their genetic potential for forage production in the humid tropics could be fully explored.

SUMMARY

Thirty-four accessions comprising *Stylosanthes guianensis* (Aubl.) SW., *S. hamta* (L.) Taub. and *S. scabra* Vog. and two *Desmodium* species were evaluated in sward grown with common guinea (Panicum *maximum* Jacq.) at Serdang. The mixture swards were harvested at 6-weekly frequency over an 18-month period initially, but subsequently were grazed continuously at a stocking rate of 3.8 cattle ha^{-1}. Over three years of evaluation, the promising accessions based on high dry matter yield, legume percentage, persistence, vigour and basal ground cover scores were CPI 40294, 40255, 33437, Q8231, 33978, 41218 and 33706B. These accessions belonged to the MA-groups 8A and 10B. *Desmodium ovalifolium* (Linn.) DC although slow in establishment, was outstanding in vigour and basal ground cover. *Stylosanthes scabra* CPI 40205 and 40292 persisted well under grazing while the commercial stylo cultivars namely Cook, Endeavour and Schofield had their dry matter yields declined over time. *Stylosanthes hamata* cv. Verano performed poorly throughout the experiment.

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