

Forage Species for Rubber Plantations in Malaysia

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Abstract

Two experiments were conducted at the Rubber Research Institute of Malaysia Research Station at Sungei Buloh in 1988-89 to evaluate the performance, in terms of dry matter yield and persistence under regular cutting, of 41 grass and 46 legume species in experiment 1, and 10 grass and 14 legume species in experiment 2. Most species were selected for their assumed shade tolerance from the CSIRO forage germplasm collection held in Brisbane, Australia.

Species which showed good regrowth and persistence under the declining light environments of maturing rubber over six harvests were the grasses *Panicum maximum* cv. Riversdale, *Panicum maximum* cv. Vencedor, *Brachiaria brizantha*, *B. humidicola*, *B. dictyoneura* and *Paspalum notatum* CPI 11864; and the legumes *Stylosanthes scabra* cv. Seca and *S. guianensis* CIAT 184. Other species which were lower-yielding but which showed promise were the grasses *Paspalum wettsteinii* and *Stenotaphrum secundatum*, and some *Arachis* spp.

IN rubber plantations and in organised smallholder land schemes such as FELDA, FELCRA, RISDA and other State-run schemes, it has been management policy to grow leguminous covers in the rubber inter-rows. It is also normal practice to plant a mixture of covers, such as *Calopogonium mucunoides*, *Pueraria phaseoloides* and *Calopogonium caeruleum* or *Centrosema pubescens*. These legume mixtures will persist under rubber up to the third or fourth year of rubber growth except for *Calopogonium caeruleum*, which may persist even after the rubber trees have attained maturity.

In the smallholder sector, the scenario is somewhat different. The smallholdings are either cultivated with short-term cash crops which help to generate some income during the first 1-2 years of rubber growth, or the interrows are left to natural weed species. With the cessation of intercropping, eventually both grass and broadleaved weed species will dominate. The major limitation to optimum livestock production, and particularly sheep in Malaysia, is therefore the shortage of high quality forage for animal feeding (Wong 1989).

Work on evaluation of introduced grass and legume species for forage production in the open began in 1972 (Wong et al. 1982). However, no evaluation of introduced species has ever been carried out under rubber.

For these reasons, an experiment was established to evaluate a number of introduced grass and legume species in terms of their yield, persistence and degree of shade tolerance for sheep grazing under rubber.

Materials and Methods

Two independent trials were set up, designated as experiment 1 and experiment 2 in field 14 of the Rubber Research Institute of Malaysia Experiment Station at Sg. Buloh. In experiment 1, a total of 41 grass, 46 legume and 2 broad-leaved species were evaluated under rubber with an initial PAR light transmission of 65% in the rubber inter-rows. In experiment 2, 10 grass, 14 legume and 1 broad-leaved species were evaluated under rubber with an initial PAR light transmission of 90%.

Experiment 1 was planted in January 1989. Basal application of NPK fertilizers was given to the whole experimental site plus magnesium limestone prior to planting at rates of 20 kg/ha N, 45 kg/ha P₂O₅, 25 kg/ha K₂O, and 500 kg/ha magnesium lime. Plot size was 1 x 1m with 25 plants/plot. Yield samples were taken from the central 9 plants (0.36 m²). The experimental site was maintained weed-free. The first harvest commenced 73 days after planting. Subsequent harvests up to the third were carried out at 2-monthly intervals, thereafter, due to slow regrowth, at 3-monthly intervals.

In experiment 2, a smaller range of high-yielding species was selected from a preliminary small plot trial and planted in March 1989. The basal fertilizer application was as for experiment 1. The first harvest

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was in May 1989, 67 days after planting. Subsequent harvests were carried out at 2-monthly intervals.

Both the experiments were replicated twice. The total rainfall during the growing period is shown in Table I. The soil texture and nutrient levels are shown in Table 2.

Table 1. Rainfall distribution at RRIM Experiment Station at Sg. Buloh, Selangor (1989-90).

Month	Year	
	1989 (mm)	1990 (mm)
January	174	60
February	241	172
March	241	122
April	170	213
May	117	211
June	88	
July	43	
August	150	
September	344	
October	276	
November	279	
December	260	
Total	2383	

Table 2. The physical and chemical properties of soil in experiments 1 and 2 at the RRIM Experiment Station, Sg. Buloh.

Parameter	Analysis
Soil series	Sg. Buloh
Coarse sand (%)	61
Fine sand (%)	27
Silt (%)	4
Clay (%)	8
pH	4.5
Organic C (%)	3.10
Total N (%)	0.25
P available (ppm)	30
K exch. (m.e. %)	0.10
Ca exch. (m.e. %)	0.09
Mg exch. (m.e. %)	0.06
Mn total (p.p.m)	14

Different cutting heights were adopted depending on the growth habit of the species. Tall species were cut at 20 cm, medium height species at 15 cm, and the low-growing species at 10 or 5 cm from the ground. Data on dry matter yield, coverage, susceptibility to pests and disease, and seeding behaviour were recorded.

Results and Discussion

Experiment 1

The dry matter yields of the best performing species are presented in Table 3. In Table 3, the overall mean yields of the 20 grass species indicated that there was a decreasing trend from harvests I to 6. This reduction in yield could possibly be attributed to two factors, viz., a drastic decline in light transmission from 53% at harvests I and 2 to 19% at harvests 5 and 6, and, secondly the cutting pressure of the 6 harvests spread over 16 months.

The ten high-yielding grass species, based on dry matter yield, were all *Panicum maximum* or *Brachiaria* spp. The highest yielding species, *Panicum maximum* cv. Riversdale recorded a yield of 20 t/ha/yr against 7 t/ha/yr for *Asystasia intrusa*, a three-fold improvement. Dry matter yields of *Asystasia intrusa* ranging from 3-10 t/ha/yr have been reported by Wong (1989).

If yield of species from harvests 5 and 6 is considered an indication of persistence under regular cutting and declining light, the five most persistent species were *Panicum maximum* cv. Riversdale and Vencedor, *Brachiaria dictyoneura* MARDI, *Brachiaria humidicola* MARDI and *Paspalum notatum* CPI 11864.

The mean yield of legume species was generally much lower than those of the grasses. The high-yielding legume species were *Stylosanthes scabra* cv. Seca, *Stylosanthes guianensis* CIAT 184, *Stylosanthes hamata* cv. Verano, *Stylosanthes guianensis* cv. Endeavour and Graham, and *Centrosema macrocarpum* all of which recorded a yield exceeding 36 g/m²/month. All species showed a dramatic decline at the last two harvests. It was reported that *Stylosanthes guianensis* cv. Endeavour and Cook produced higher yield than the other legume species evaluated (Eng et al. 1978), although these two species died out 3-5 years after planting.

Experiment 2

A list of grass species evaluated in Experiment 2 is shown in Table 4. Due to higher light transmission in this trial (reduced from 90% at harvest 1 to 50% at harvest 6), the mean dry weight of species was greater than that of the same species in experiment 1. Similarly the reduction in yield from harvests 1 and 2 to harvests 5 and 6 was less.

The highest-yielding species over the six harvests were *Panicum maximum* cv. Vencedor, *Brachiaria brizantha* and *Panicum maximum* cv. Riversdale. The highest-yielding species at the final harvest were *Brachiaria humidicola*, *B. brizantha*, *B. dictyoneura* and *Panicum maximum* cv. Riversdale, indicating the persistence of these species.

The dry matter yield of the legume species in

Table 3. Dry matter yields of best-performing species in experiment 1.

Species	Dry matter yields (g/m ² /month)			Mean
	Harvests 1 and 2 (L.T. 53%)	Harvests 3 and 4 (L.T. 30%)	Harvests 5 and 6 (L.T. 19%)	
Grasses				
<i>Panicum maximum</i> cv. Riversdale	272	156	72	167
<i>Brachiaria decumbens</i> cv. Basilisk	292	175	5	157
<i>Brachiaria brizantha</i>	231	158	22	137
<i>Panicum maximum</i> cv. Vencedor	194	144	55	131
<i>Brachiaria dictyoneura</i>	181	161	42	128
<i>Panicum maximum</i> cv. Gatton	161	150	39	117
<i>Panicum maximum</i> cv. Embu	172	114	11	99
<i>Brachiaria decumbens</i> MARDI	97	133	50	93
<i>Brachiaria humidicola</i> MARDI	83	133	58	93
<i>Panicum maximum</i> cv. Rumuruti	131	119	22	91
<i>Digitaria setivalva</i>	131	111	28	90
<i>Asystasia intrusa</i>	106	69	14	63
<i>Paspalum notatum</i> CPI 11864	31	56	44	44
<i>Paspalum wettsteinii</i>	42	50	22	38
<i>Paspalum simplex</i>	42	53	14	36
<i>Paspalum notatum</i> cv. Competidor	28	50	22	33
<i>Paspalum conjugatum</i>	44	36	14	31
<i>Axonopus compressus</i>	31	31	14	25
<i>Cyrtococcum oxyphyllum</i>	31	25	3	20
<i>Stenotaphrum secundatum</i>	18	19	5	14
Mean	116	97	28	80
Legumes				
<i>Stylosanthes scabra</i> cv. Seca	78	92	50	73
<i>Stylosanthes guianensis</i> CIAT 184	92	92	33	72
<i>Stylosanthes hamata</i> cv. Verano	75	89	16	60
<i>Stylosanthes guianensis</i> cv. Graham	111	44	16	57
<i>Stylosanthes guianensis</i> cv. Endeavour	78	53	19	50
<i>Centrosema macrocarpum</i>	67	42	0	36
<i>Arachis</i> sp. CPI 12121	33	36	14	28
<i>Centrosema pubescens</i>	42	17	8	22
<i>Centrosema pubescens</i> cv. Belalto	36	28	3	22
<i>Arachis</i> sp. CPI 29986	28	19	14	20
<i>Pueraria phaseoloides</i>	28	25	8	20
<i>Arachis pintoi</i> cv. Amarillo	44	11	1	20
<i>Calopogonium caeruleum</i>	25	25	3	18
<i>Calopogonium mucunoides</i>	31	0	0	10
Mean	55	41	13	36

* L.T. = light transmission

experiment 2 showed a similar trend to that observed for the grasses with higher initial yields and smaller declines in yield with each subsequent harvest (Table 4). In general, most *Stylosanthes* species performed well with *Stylosanthes scabra* cv. Seca, *Stylosanthes guianensis* CIAT 184, *Stylosanthes guianensis* cvv.

Cook and Endeavour outstanding. The highest yielder, *Stylosanthes scabra* cv. Seca, gave 1.5 times more than the local *Asystasia intrusa* and 3.0 times more than the local *Pueraria phaseoloides*. Persistence of yield was best in *Stylosanthes guianensis* CIAT 184.

Table 4. Dry matter yields of best performing species in experiment 2.

Species	Dry matter yields (g/m ² /month)			Mean
	Harvests 1 and 2 (L.T. 78%)	Harvests 3 and 4 (L.T. 60%)	Harvests 5 and 6 (L.T. 55%)	
Grasses				
<i>Panicum maximum</i> cv. Vencedor	508	392	167	356
<i>Brachiaria hrizantha</i> MARDI	236	514	208	319
<i>Panicum maximum</i> cv. Riversdale	458	286	192	312
<i>Brachiaria humidicola</i>	153	294	272	240
<i>Panicum maximum</i> cv. Rumuruti	211	300	156	222
<i>Brachiaria dictyoneura</i> MARDI	167	275	197	213
<i>Setaria sphacelata</i> cv. Splenda	300	197	58	185
<i>Panicum maximum</i> cv. Petrie	267	178	67	171
<i>Setaria sphacelata</i> cv. Kazungula	256	150	47	151
<i>Digitaria setivalva</i>	161	158	44	121
Mean	272	274	141	229
Legumes				
<i>Stylosanthes scabra</i> cv. Seca	161	200	92	151
<i>Stylosanthes guianensis</i> CIAT 184	139	183	128	150
<i>Stylosanthes guianensis</i> cv. Cook	178	172	47	132
<i>Stylosanthes guianensis</i> cv. Endeavour	144	178	58	127
<i>Stylosanthes hamata</i> cv. Amiga	217	119	19	118
<i>Stylosanthes hamata</i> cv. Verano	144	156	33	111
<i>Asystasia intrusa</i> Local	97	164	33	98
<i>Stylosanthes capitata</i> CPI 55843	106	94	22	74
<i>Stylosanthes guianensis</i> cv. Graham	136	47	28	70
<i>Stylosanthes humilis</i> cv. Gordon	108	72	0	60
<i>Centrosema pubescens</i> Local	119	22	17	53
<i>Pueraria phaseoloides</i> Local	50	61	33	48
<i>Centrosema pubescens</i> x <i>C. macrocarpum</i> cross MARDI	47	44	22	38
<i>Stylosanthes humilis</i> Commercial	81	25	6	37
<i>Calopogonium caeruleum</i> local	64	28	11	34
Mean	119	104	37	87

* L.T. = light transmission

Conclusions

The results presented indicate that a number of introduced species, both grasses and legumes, out-yielded the local species by two- or three- fold. In selecting species for planting under rubber in Malaysia, other desirable features, besides dry matter yield should be taken into consideration. These are persistence, shade tolerance, quick ground coverage, non-competitiveness with rubber, and ability to produce seeds locally.

Since the legume species evaluated in both experiments on average recorded a yield of about half

that of the grasses, it is suggested that grass-legume combinations be adopted to ensure that both adequate biomass and high quality forage is made available to animals.

The grass species which showed both high and persistent yield in the two experiments were:-

Panicum maximum cv. Riversdale, *Panicum maximum* cv. Vencedor, *Brachiaria brizantha*, *B. humidicola* MARDI, *B. dictyoneura* and *Paspalum notatum* CPI 11864. Other grass species which were poor-yielding but appeared to provide a vigorous low-growing cover with little weed invasion were *Paspalum wettsteinii* and *Stenotaphrum secundatum*.

The legume species which showed both high and persistent yield were:

Stylosanthes scabra cv. Seca and *Stylosanthes guianensis* CIAT 184. The *Arachis* species, although low yielding provided a good vigorous cover and indicated some potential for long term persistence at low light.

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