Forage Resources in Malaysian Rubber Estates

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Abstract

A survey of forage resources was undertaken in three age groups of rubber (1-2, 3-5 and 6-10 years) in five estates in the central region of Malaysia. Standing forage dry matter declined from 2600 kg/ha in young rubber to just over 500 kg/ha in mature plantations. Botanical composition varied with age of rubber and therefore light transmission. *Pueraria phaseoloides* was the dominant species in the interrows during the first 1-2 years. In 3-5 years old rubber the dominant plant species were the volunteer grass *Ottochloa nodosa* and the planted legume *Calopogonium caeruleum*. In 6-10 year old rubber ferns made up nearly 50% of the vegetation but volunteer grasses also contributed to the total biomass.

The Botanal method of sampling used in this study permitted the recording of larger numbers of samples in the field for yield and botanical composition than was possible using conventional systems of cutting and weighing quadrats.

IN Malaysia, the area planted with rubber is estimated at 1.86 million ha (RRIM 1988). This vast cultivated area has tremendous potential for integration with livestock. To date sheep have proven to be very successful because their husbandry is sound economically and there is no requirement to clear new land purely for the purpose of growing pastures for animal production. The system maximises the use of agricultural land, provides returns from the sale of animals, and reduces the use of herbicides and the cost of weed control.

The amount and quality of forage resources have been shown to be important factors in sheep production under perennial crops of rubber and oil palm. Chen et al. (1978) reported that there were up to 60 different plant species in plantations, and 70% of these have been reported to be palatable to livestock (Wan Mohamed 1978). The age of the tree crops has a marked influence on the botanical composition and yield of forage (Wan Mohamed 1978, Chen and Othman, 1983). They reported a rapid decline in legume composition (except *Calopogonium caeruleum)* with age, and legume species accounted for less than 20% of the total dry matter yield when the tree crops were more than three years old. The standing dry matter biomass under rubber declined rapidly from 1600 kg/ha during the first two years to less than 600 kg/ha when the trees were 3-3.5 years old. These forage yields were much lower than those reported earlier by Mahyuddin et al. (1978) and Devendra (1982) and need further verification under the variable agro-management, climatic and soil conditions that can be found under the plantations of Malaysia. There is also a need for an appropriate survey methodology which can be used to quantify the forage resources under rubber. These data can then be used as base data for the estimation of the sheep production potential under rubber.

This study reports the results of a survey of factors influencing forage yield and composition in the rubber plantations of the central region of Malaysia.

Materials and Methods

The survey method adopted in this study of forage yield and botanical composition was a modified version of the Botanal method (Jones and Tothill 1985). Five rubber estates in the central region of Malaysia which did not raise sheep were selected for the survey. The estates were Sg. Rinching, Sg. Chinoh, Galloway, Bradwall and Sg. Jemih. At each site, the survey was conducted for 3 age groups of rubber: 1–2 years, 3–5 years and 6–10 years. Initially, a general view of the fields was obtained with the aid of field maps and the staff of the estates. A representative site was then selected. The survey was carried out with a series of 6–8 quadrats (1.0 x 0.5 m) taken across the rubber interrows in a band pattern. The bands were chosen every 10 trees in a systematic grid pattern. In each quadrat, the botanical composition was visually estimated and the relative yield was ranked between 1 and 10, based on

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the Botanal method where 1 = lowest yield, 5 = medium yield and 10 = highest yield. This ranking system was calibrated against quadrats which served as references and were subsequently cut at 2 cm above ground level, dried and weighed. Three recorders were involved who independently scored each quadrat. A total of 30 bands were ranked by each recorder. After sampling the field, each recorder cut a total of 20 samples to determine the relationship between yield and individual Botanal ranking. For each rubber age group, photosynthetically active radiation (PAR) readings were taken to determine the light transmission under the rubber trees. These readings were taken with two integrating PAR recorders, one outside the plantation in full light while the second was moved in a systematic pattern through the plantation. Integrated readings were taken over a lo-minute period between 1000 and 1400 hours.

Site Description

The soil texture of the estates is as follows: Sg. Rinching (clay), Sg. Chenoh (clay/laterite), Galloway (clay/sandy clay), Broadwall (clay/laterite), and Sg. Jemih (clay, quartzite/laterite). The rubber clones were Sg. Rinching (RRIM 600, PB 235, 314 and 340), Sg. Chenoh (PB 260, 310 and 314), Galloway (PB 312, 235 and 260), Bradwall (PB 217, 260, 310, 311 338 and RRIM 600), Sg. Jemih (PB 255, 260 and RRIM 600). The planting distances between the rows varied from 6.3 x 2.7 m to 3.0 x 8.0 m for l-2 years old rubber, 4.2 x 4.2 m to 5.7 x 4.1 m for 5 years old rubber, and 3.7 x 4.8 m to 4.0 x 8.1 m for 6- 10 years old rubber. At these planting distances, the number of plants/ha for 1-2, 3-5 and 6-10 years old rubber were 417-588, 428-567 and 309-563, respectively. The mean girth of rubber trees at 127 cm above ground level for 1-2, 3-5 and 6-10 years old rubber was 8.4, 35.4 and 63.5 cm, respectively. Mean legume seeding rates planted in the interrows were 3.6 kg/ha of *Pueraria phaseoloides*, 1.6 kg/ha of *Calopogonium mucunoides*, 0.5 kg/ha of *Centrosema pubescens* and 0.6 kg/ha of *Calopogonium caeruleum*. The average annual rainfall varied from 1566 to 4232 mm/year.

Results and Discussion

Forage yield

The mean standing dry matter yield of forage (kg/ha) and PAR values in the interrows of the three age groups of rubber in the five estates are given in Tables 1 and 2 respectively.

The mean yield of forage was highest (2602 kg/ha) for 1-2 years old rubber while the lowest yield (537.5 kg/ha) was recorded for the 6-10 years old rubber.

The low yield under the 6-10 years old rubber was due to the closure of the canopy and the reduced light transmitted to the inter-rows. This was confirmed by the light transmission data which was 92% for 1-2 years old rubber and only 9% for 6-10 years old rubber. Forage yields obtained in this study were higher than the yields reported by Wan Mohamed (1978) for all age groups. The amount of forage

Table 1. Standing forage dry matter yield (kg/ha) in three different age groups of rubber.

Age of rubber (years)	Estates					Mean	S.E.
	Sg. Rinching	Sg. Chinoh	Galloway	Bradwall	Sg. Jernih		
1 - 2	3250	2493	2974	2323	1970	2602	228
3 - 5	2080	995	1187	1032	940	1247	212
6 - 1 0	700	694	432	324	470	524	95

Table 2. Photosynthetically active radiation (%) in three different age groups of rubber.

Age of rubber (years)	Estates					Mean	S.E.
	Sg. Rinching	Sg. Chinoh	Galloway	Bradwall	Sg. Jernih		
1 - 2	85	89	93	94	99	92	1.4
3 - 5	31	27	16	15	19	21	1.7
6 - 10	14	8	6	9	12	10	0.9

present in the different age groups of rubber will determine the potential stocking rate per unit area under rubber. However, it must be emphasised that these yields are of standing biomass only and do not reflect the potential yield of regularly defoliated herbage which would be higher in young rubber.

Forage composition

Details of the forage composition for the three age groups of rubber are given in Table 3. The main forage species in the 1-2 years old rubber, where light transmission was highest, were legumes, with only some grasses. The main species were the planted cover crops *Pueraria phaseoloides* (79%), the volunteer grass *Ottochloa nodosa* (7%), and *Paspalum conjugatum* (6%). In the second age group (3-5 years), the composition of forage species had changed and the proportion of the previously dominant legumes had declined, while the proportion of grasses and broadleafed species had increased. The main forage species in this age group were *Ottochloa nodosa* (28%) and *Calopogonium caeruleum* (25%). *Aystaysia intrusa* (11%) was dominant in one of the estates only. In the oldest age group (6-10 years), where the light transmission was low, the composition had further changed to broadleafed plants and grasses. The dominant plant species were ferns (41%), and the grass *Ottochloa nodosa* (20%). These forage species are known to be relatively shade-tolerant.

In the 1-2 years rubber, the legume *Pueraria phaseoloides* was the dominant species partly because the interrows of the five surveyed sites were sown with high seeding rates of this species (3.65 kg/ha). The *Pueraria phaseoloides* composition decreased quickly from 79% to 12% and 1% for 1-2, 3-5 and 6-10 year groups respectively. This was probably related to the decreasing light transmission due to the closure of the canopy as the rubber matured.

The more shade-tolerant *Calopogonium caeruleum* became the dominant legume species. The composition of *Calopogonium caeruleum* in the 3-5 year group was 25% while for the 6-10 years old was only 9%. The increase in the content of volunteer grasses and broadleafed species, as the canopy closed, was shown earlier by Wan Mohamed (1978). In mature rubber only shade-tolerant species were found and ferns dominated.

Table 3. Forage composition (%) in three different age groups of rubber

Age of rubber (years)	Location (estates)	Grasses			Legumes		Broadleafed Species		
		Co	On	PC	Cc	Pp	Asy	Mc	Fer
1 - 2	Sg. Rinching	0	9	15	0	75	0	0	0
	Sg. Chinoh	1	14	12	0	68	1	1	0
	Galloway	0	3	2	0	94	1	0	0
	Bradwall	1	5	0	1	77	1	0	0
	Sg. Jernih	0	5	1	0	80	1	3	0
Mean		1	7	6	0	79	1	1	0
3 - 5	Sg. Rinching	0	16	5	33	3	10	21	1
	Sg. Chinoh	0	48	0	34	1	0	3	1
	Galloway	0	35	2	0	46	0	15	0
	Bradwall	3	18	4	4	10	5	4	0
	Sg. Jernih	2	22	2	7	2	39	12	13
Mean		1	28	2	25	12	11	11	3
6 - 10	Sg. Rinching	45	17	8	8	0	2	4	11
	Sg. Chinoh	2	36	2	22	0	0	2	27
	Galloway	9	44	6	2	6	19	1	2
	Bradwall	0	0	0	13	0	0	0	87
	Sg. Jemih	3	1	8	0	1	0	1	80
Mean		12	20	5	9	1	4	1	41

Asy = *Asystasia intrusa*
Cc = *Calopogonium caeruleum*
Co = *Cyrtococcum oxyphyllum*
Fer = Ferns
Mc = *Mikania micrantha*
On = *Ottochloa nodosa*
PC = *Paspalum conjugatum*
Pp = *Pueraria phaseoloides*

Note: Minor species not included in Table.

Botanal method

The correlation coefficients between the Botanal ranking scores and forage dry weight in the three rubber age groups were highly significant. The Botanal visual ranking method was therefore appropriate for the determination of forage yield under rubber. The experience obtained in using the method can be adopted in the survey of forage resources in other perennial tree crops.

Conclusion

The study of the forage resources under three age groups of rubber (1-2 years, 3-5 years and 6-10 years) in five estates in the central region of Malaysia has quantified the standing biomass yields of forages under different light transmissions. The amount of forages available will determine the stocking rate per unit area at the different ages of rubber that can be sustained.

There was a succession of plant species as the rubber canopy closed. *Pueraria phaseoloides* was the dominant species in the interrows during the first 1 to 2 years. As the canopy closed and shade increased (3-5 years old rubber), the amount of standing forage declined. The dominant plant species were mainly volunteer grasses *(Ottochloa nodosa),* planted legumes *(Calopogonium caeruleum* and *Pueraria phaseoloides)* and broadleaved weeds *(Mikania micranrha* and *Aysraysia intrusa).* The potential for animal production is therefore greatest during the immature period because of the higher forage dry matter availability at this time. It will be a challenge to introduce higher-yielding cultivated pastures into the rubber interrows which will be productive at lower light intensities. More studies are recommended to identify suitable forage species which have a high production potential and are able to sustain regular grazing in shaded environments.

The Botanal method used in this study was a useful technique. Using this method, we were able to record large numbers of samples in the field for yield and botanical composition as compared to the conventional system of cutting and weighing quadrats. The technique can be adopted for surveying forage resources under other plantation crops such as oil palm and coconut. Surveys of this nature are expensive in terms of labour requirement and time, and need to be well planned with objectives well defined. However, the baseline data obtained will be a useful guide for estimation of the animal production potential under different plantation crops and management systems.

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