

## TOWARDS SHORTER IMMATURITY AND IMPROVED YIELDS BY MULCHING WITH RICE STRAW

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### ABSTRACT

In this study with immature *Hevea brasiliensis*, mulching with paddy straw around the base of the tree was found to be a better agronomic practice than growing leguminous cover crops such as *Pueraria phasecoloides* and *Desmodium ovalifolium* or allowing natural vegetation to grow in the inter-row area. Girdling had been much higher with mulching which resulted in the reduction of the immature, unproductive period by approximately 18 and 12 months in comparison with naturals and creeping legumes respectively. In addition to early tapping, yield of latex was also higher during the early stages, increases in the region of 33% and 40% in comparison with creeping legumes and naturals respectively.

The present value of the benefit achieved from mulching amounts to Rs. 31,088/= per hectare of which Rs.19,740/= is due to extra yield and the balance of Rs. 11,348/= is the savings on inputs as a result of early maturity. Consequently, a Net Present Value (NPV) of Rs.7.8 million at national level can be achieved with the above practice at 50% level of adoption.

### INTRODUCTION

In rubber cultivation with monocultural cropping system, the adoption of the same agro-management practices over the last several years, has resulted in longer immature, unproductive period and a decline in total rubber production. It is therefore important to identify the possible agronomic constraints to improved performance of rubber under Sri Lankan conditions and devise suitable agronomic practices that could be adopted to alleviate this problem.

As efficient management of soil is an important aspect of rubber cultivation in a tropical country like Sri Lanka with poor soil characteristics and high rate of precipitation it is important that attempts should be made to conserve the soil and available moisture and also to preserve soil fertility. Cover crops are known to help

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in this regard. (Yogaratnam *et al.*, 1977 and 1984). On the other hand both legumes and naturals are equally detrimental in effecting evapotranspiration losses. Use of dead mulch has the advantage over these practices, because in addition to conserving the available moisture (Samarappuli and Yogaratnam, 1984) there is no competition for moisture by mulch. Mulching had also been found to be very effective in avoiding evapotranspiration and improving soil fertility (Samarappuli, 1992; Samarappuli *et al.*, 1992).

Although plant residues, particularly rice straw are rich in potassium and contain lot of other plant nutrients, insufficient attention has been paid in the tropics towards finding suitable methods of returning straw to the land and in the evaluation of savings which can be effected thereby. Large quantities of straw are being burnt in the paddy fields every year. Besides being a loss of valuable nutrients and organic matter, burning can cause a serious problem of atmospheric pollution and health hazards.

An investigation was therefore undertaken to study the effect of rice straw on the performance of immature *Hevea* plants and to evaluate the economic benefits of such practices.

## MATERIALS AND METHODS

A field experiment was started in 1982 at Dorset Division, Clyde State Plantation, Tebuwana to study the effects of different soil management practices and their influence on growth and latex production of PB 86 plants. Three ground cover management practices that were studied in a randomized block design with six replicates are

- a. Natural cover (weeds)
- b. Mixed legumes (*Pueraria phaseoloides* and *Desmodium ovalifolium*)
- c. Mixed legumes + Dead mulch (rice straw) around the base, 5kg/plant/application, once in 6 months

The soil classified as *Boralu* series (Silva, 1964) is shallow, gravelly loam, brown to reddish yellow in colour and overlying cabook. N,P,K and Mg fertilizers were applied uniformly according to the normal recommendations (RRISL, 1980) to all plots consisting of 25-30 effective trees. Each plot was surrounded by a single guard row on all four sides.

Girth measurements were recorded at monthly intervals from 1983 to 1985 and thereafter, annually. Trees that reached a girth of 50cm, at 90cm from the highest point of bud union were recorded and expressed as the percentage of tappable trees. Mean yield recorded as grams per tree per tapping (g/t/t) and collected twice a month are presented in kilograms per hectare per year.

An economic analysis was done using the above data which were obtained up to the 11th year of planting.

## RESULTS

Growth of *Hevea* as assessed by measuring tree girth indicated that the trees in mulched plots were superior to the trees in legumes and natural plots (Fig. 1). Better growth during immaturity resulted in higher rate of tappareability of the rubber plants at the end of 6 years (Table 1).

Table 1. *Effect of different soil management practices on tappareability (%) of rubber plants at the end of 6 years*

Treatment	Tappareability percentage*
Naturals	13.17 <sup>a</sup>
Legumes	25.58 <sup>b</sup>
Dead mulch	66.85 <sup>c</sup>

\* Value followed by the same letter do not differ significantly at 0.05 significance level

Yield data obtained during the early stages of the tapping cycle showed that the trees under mulch were superior ( $P < 0.01$ ) to the trees in legumes and naturals (Table 2). Monthly yield recorded during the year 1991 (18 months from the commencement of tapping) also exhibited a higher yield with mulch in comparison with the other two management practices (Fig. 2).

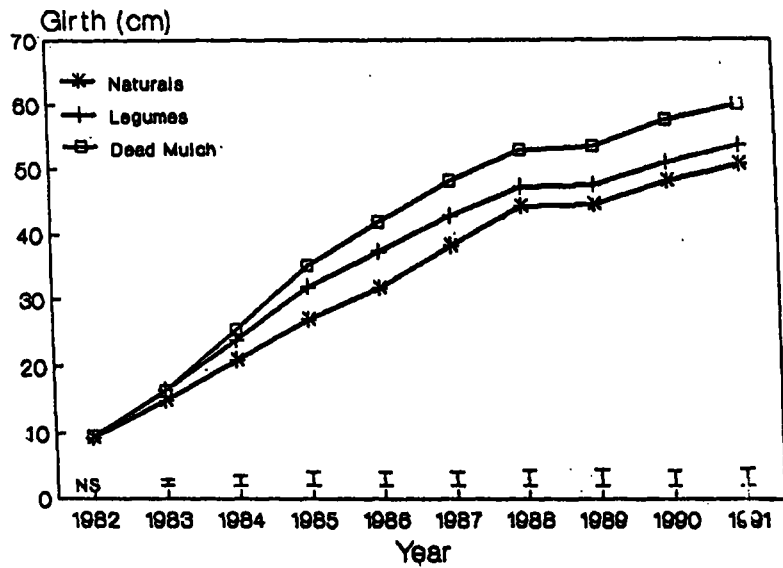


Fig. 1 Effect of different soil management practices on girth of rubber plants

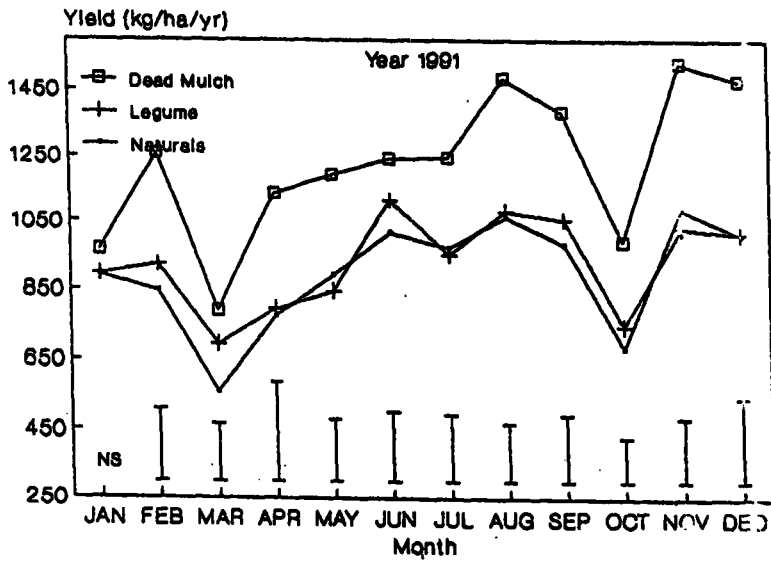


Fig. 2 Effect of different soil management practices on monthly yield of rubber

Table 2. *Effect of different soil management practices on early yield of Hevea*

Treatment	Yield (kg/ha/yr)		
	1989	1990	1991
Naturals	803 <sup>a</sup>	878 <sup>a</sup>	899 <sup>a</sup>
Legumes	850 <sup>a</sup>	907 <sup>a</sup>	928 <sup>a</sup>
Dead Mulch	953 <sup>b</sup>	1035 <sup>b</sup>	1235 <sup>b</sup>

The present value of the benefit achieved from mulching amounts to Rs. 31,088/= per hectare of which Rs.19,740/= is due to extra yield (Table 3) and the balance of Rs.11,348/= is the savings on inputs due to early maturity<sup>1</sup>. Total expenditure/ha is Rs.6489/= of which material cost (straw) and labour charges are Rs. 5407/= and Rs.1082/= respectively (Table 4).

The Net Present Value (NPV) per hectare and the corresponding "Benefit cost ratio" (B/C) formulated under four different situation are presented in Table 5. The minimum paddy extent required according to rubber holding sizes to obtain the recommended straw requirements is given in Table 6.

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<sup>1</sup>Mulching will bring the trees into bearing one year prior to the conventional method, thereby saving one year's expenditure on inputs. Assuming an average yield of 1000 kg/ha/yr and C.O.P. of Rs. 20/kg this years expenditure will be Rs.11,348 (assuming the savings on inputs were obtained in the 5th yr of planting with a compound factor of 0.5674).

**Table 3. Increase in yield and income in response to mulching – upto 11th year of planting**

Year of planting	Yield (kg/ha/yr)		Yield increase due to mulching (Kg/ha/yr)	Benefit due to extra yield <sup>1'</sup>	Discount factor for 1' at 12% interest	Present value of Benefit (Rs/ha/yr)
	Mulching with straw	Legumes only (Conventional method)				
Year 6	325	Nil	325	10075	0.5066	5103
Year 7	760	285	475	14725	0.4523	6660
Year 8	953	675	278	8618	0.4039	3481
Year 9	1035	907	128	3968	0.3606	1431
Year 10	1235	928	307	9517	0.3220	3065
Net Present Value (NPV) of Benefit ----->						19740

1' – @ Rs 31 per kg

Table 4. Cost of Mulching with Straw (Rs/ha)

Year of Planting	Material cost		Labour cost <sup>3/</sup>	Discount Factor for 1 at 12% interest	Present value of cost (Rs/ha/yr)		
	Amount 1/ (Kg/ha/yr)	Cost 2/ (Rs/ha/yr)			Material Cost	Labour cost	Total cost 4/
Year 1	5000	1500	300	0.8929	1339	268	1607
Year 2	5000	1500	300	0.7472	1196	239	1435
Year 3	5000	1500	300	0.7118	1068	214	1282
Year 4	5000	1500	300	0.6355	953	191	1144
Year 5	5000	1500	300	0.5674	851	170	1021
				Net Present Worth	5407	1082	6489

1/ - 500 plants/ha @ 5kg/plant/application - 2 applications /yr

2/ - @ = /30 per kg

3/ - 2.5 labourers/application/ha @ Rs 60/= 2 applications /yr

4/ - Excluding transport cost

**Table 5. Net Present Value of Benefit and Benefit/Cost ratio under different situations**

<b>Situation</b>	<b>Net Present Value (Rs/ha)</b>	<b>Benefit/Cost Ratio</b>	<b>NPV at macro level (Rs/3000ha/yr)</b>
<b>i. Value of extra yield upto 11th year of planting (excluding cost of straw)</b>	<b>14837</b>	<b>14.7</b>	<b>4.4 million</b>
<b>ii. Value of extra yield upto 11th year of planting and savings on inputs (excluding cost of straw)</b>	<b>26185</b>	<b>25.2</b>	<b>7.8 million</b>
<b>iii. Value of extra yield upto 11th year of planting (including cost of straw)</b>	<b>9430</b>	<b>2.5</b>	<b>2.8 million</b>
<b>iv. Value of extra yield upto 11th year of planting and savings on one years inputs (including cost of straw)</b>	<b>20778</b>	<b>4.2</b>	<b>6.2 million</b>

**Table 6. Extent of minimum paddy holding for supply of annual straw requirement according to rubber holding sizes**

Size of rubber holding (ha)	Straw requirement (kg/ha/yr)	Equivalent paddy holding size (ha) <sup>1/</sup>
0.2	1000	0.08
0.4	2000	0.17
0.6	3000	0.25
0.8	4000	0.33
1.0	5000	0.42
1.5	7500	0.63
2.0	10,000	0.83
2.5	12,500	1.04

<sup>1/</sup> 6000 kg/harvest/ha - 2 harvesting seasons /yr

## DISCUSSION

Proper use of land and development of simple, effective and economical agronomic practices must be ensured in order to preserve the productivity and fertility of the soil. Results of this study have proved that mulching of soil is a very good practice in this regard. Among the mulching practices possible under rubber growing situations in Sri Lanka, use of dead mulch with paddy straw has been proved to be superior to growing creeping legumes such as *Pueraria phaseoloides* and *Desmodium ovalifolium* and still much better than allowing natural vegetation to grow. The natural vegetation seen in the plots under naturals in this study were mainly grasses like *Axonopus* and *Hedyoties*. It is accepted that these vegetation compete for moisture and nutrients with young rubber and are inferior with regard to returning of essential nutrients to the soil. Although creeping legumes are known to improve soil fertility by their contribution of nutrients in addition to biological fixation of nitrogen, use of dead mulch of paddy straw has had more significant and marked effect on the performance of young rubber plants. Growth in terms of girthing had been much higher with this practice which resulted in the reduction of the immature unproductive period by approximately 18 months in comparison with naturals and approximately 12 months in comparison with creeping legumes. This led to the trees reaching the required tappableability at a much earlier date.

Several innovations developed in order to reduce the immature period, such as brown budding (Sivanadyan *et.al.*, 1975), green budding (Hurov, 1960), developments in green budding (Tinley, 1962), budded materials in polybags (Tinley, 1962), induction of branching (Yoon, 1972), stumped buddings (Strivens, 1962), white washing the stem with lime, stumped buddings, with agronomic manipulations and polybag raised plants (Yoon *et.al.*, 1976), fertilizer application at greater frequencies (Sivanadyan *et.al.*, 1973) and manipulation of fertilizer programmes (Yogarathnam and Weerasuriya, 1984) have not been used extensively due to various set back and also the reduction in immaturity that has been achieved was only by few months. Reduction of 12 to 18 months recorded in this study with mulching practice is therefore considered a very significant and marked benefit to the rubber industry. With this practice of mulching, in addition to early tapping, it has also been possible to obtain higher yield at the early stages, increases in the region of 33% and 40% in comparison with legumes and naturals, respectively.

In Sri Lanka, the Rubber smallholder sector covers approximately 75% of the total rubber area. In this sector, 93% of the holdings are less than 1.6 ha which shows that rubber sector is dominated by small units and in large numbers. The value of extra yield, excluding the cost of straw and value of extra yield with savings on inputs, excluding the cost of straw show the highest B/C ratios of 14.7 and 25.2

respectively. These situations would therefore benefit the rubber smallholder sector most as they would normally have mulching materials on the site at no extra cost. In general the NPV/ha increased from Rs.9430/= (Value of extra yield including cost of straw) to Rs.26185/= (Value of extra yield with savings on inputs excluding the cost of straw) with a mean value of Rs.17808/= and the B/C ratio increased from 2.5 to 25.2 respectively with a mean of 11.7. Consequently, the NPV at national level can be increased from Rs.2.8 million (Situation iii) to Rs.7.8 million (Situation ii) if a 50% adoption level of this particular mulching technique can be achieved.

The concept of value/cost (V/C) ratio which is similar to B/C ratio discussed here, is very often used to assess the profitability of fertilizer use. This concept was introduced by the FAO for similar field programmes. This refers to the ratio of the value of increased production following an agronomic practice to the cost of this practice. A B/C ratio of 2 or more is generally considered to suggest that it would be profitable to implement this practice. The above economic indicators *viz.* NPV, B/C ratio, clearly show very significant financial and economic importance of the "mulching technique", which will eventually contribute to the increase in net returns due to higher yields and cut down in C.O.P. due to early maturity. It should also be noted that in addition to the above analysis (based on quantifiable benefits and costs) there exists a number of unquantifiable benefits that have to be taken into account in long run analysis such as the value of further differences in yields due to mulching effect from 11th year of planting onwards, the value of substitution of chemical fertilizers and the improvements in soil physical, chemical and biological properties which will further enhance the overall profit maximization process of mulching with rice straw.

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