Journal of the Rubber Research Institute of Sri Lanka, (2000) **83**, 49-61

EVALUATION OF d/3 TAPPING WITH STIMULATION TO ALLEVIATE PROBLEMS RELATED TO d/2 TAPPING OF *HEVEA*

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(Accepted 21 September 2001)

ABSTRACT

½S d/2 system of tapping of Hevea is time tested to harvest economic yields from clones widely grown in Sri Lanka. However, both the Plantation and the Smallholder sectors do not have sufficient tappers, currently, to adopt this system. It is apparent that in the Plantation Sector ca. *28.5% of the potential crop is lost each year due to ca. 28% unskilled tappers and 21.5% vacant blocks. This situation leads to low land and tapper productivity whilst escalating cost of production.*

With Low Frequency Tapping (LFT) the tapper requirement is less. Nevertheless yield stimulants need to be used to overcome yield losses due to lesser number of tappings/tree/annum. ½S d/3 tapping with 3 rounds of stimulation using 2.5% ethrel has given 86% of yield possible through ½S d/2 system. In a situation where 28.5% of the potential crop is lost due to tapper related problems ½ S d/3 tapping with stimulation gives better returns to the estate. Apart from lower tapping costs due to increased tapper productivity, LFT systems have the advantage of low bark consumption rates. The 30 year replanting cycle possible with ½S d/2 tapping can be increased upto 36 years with ½S d/3 tapping with stimulation. This results in a higher revenue extent in the plantation and hence a higher total production and a reduced cost of production (COP). LFT with stimulation has not retarded the vegetative growth of rubber trees. Moreover, the incidence of Tapping Panel Dryness (TPD) is similar to that with conventional ½S d/2 system. These are expected as ½S d/3 tapping system with stimulation does not result in a dry rubber yield higher than with ½S d/2 system.

Key words: low frequency tapping, productivity, replanting cycle, stimulation, tapper shortage

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Evaluation of d/3 tapping with stimulation

INTRODUCTION

In Sri Lanka currently more than 95% of the mature rubber extent is made up of clones PB 86, RRIC 100, RRIC 102 and RRIC 121. These clones are being tapped at ½ S d/2 either from the first year of tapping, *i.e.* PB 86 or from the second year of tapping, *i.e.* RRIC 100, 102 and 121. Therefore, the tapping system mainly adopted in Sri Lanka is ½S d/2. ½S d/2 tapping is a time tested method of harvesting economic yields during the entire tapping cycle. Nevertheless, estates/smallholders are now finding it increasingly difficult to find sufficient tappers to adopt this system of tapping. Therefore, vacant tapping blocks, *i.e.* untapped tapping blocks and use of unskilled tappers are on the increase creating adverse effects to land and tapper productivity. Moreover, with unskilled tappers the tapping cycle is shorten due to high bark consumption rates and also due to the inability to tap renewed bark as a result of damages to cambium during the tapping of virgin bark. These tapper related problems together with current poor trading of rubber erodes profitability in both plantation and smallholder sectors, threatening the survival of the natural rubber (NR) industry. Therefore, the possibility of using yield stimulants for conservation of bark and reduction of labour inputs have become thrust areas of research in all natural rubber producing countries (Vijayakumar *et al.*, 2000). Use of Low Frequency Tapping (LFT) (Sivakumaran & Hastrian, 1995; Gohet *et al.*, 1991; Fain *et al.*, 1991) and also LFT coupled with higher task size (Vijayakumar *et al.*, 2000) are some approaches made to overcome the tapper shortage situation. When a higher task size is given the skilled tapper does the tapping, where as collection and other related activities are done by unskilled workers (RRIM, 1993). Higher task size though reduces tapper requirement, whilst improving tapper productivity could lead to low land productivity due to late taping and early collection in some trees of the task. From recently gaseous methods of yield stimulation like HLE (Guha *et al.*, 1992). RRIMFLOW, REACTORRIM (RRIM 1993) are being looked into. Drying and wounding of bark are serious limitations for commercial adoption of such recent stimulation methods.

In this study the limitations for adopting d/2 tapping system, *i.e.* tapper availability and skill and possible yield losses due to them were studied. Further, to what extent low frequency tapping could help in alleviating such yield losses was also looked into.

MATERIALS AND METHODS

Tapper availability and skill

The questionnaire "The present status with regard to tappers in the plantation sector" (Annexure 1) was sent to all rubber estates in the country. The information collected on the number of vacant tapping blocks and the availability of skilled and unskilled tappers during the year 1999 were summarized separately for different plantation management companies.

Experimental area for testing LFT

A RRIC 100 clearing tapped for a period of one year was selected for the study. In this clearing eight tapping blocks each having *ca.* 300 trees were selected and the following tapping treatments were allocated to them randomly. The treatments were designed to compare the conventional ½S d/2 system of tapping with LFT systems.

Treatment	Tapping system
1	½ S d/3 + E (2.5%ET, Ba 1.6[2.5] 4/y)
2	½ S d/3 + E (1%ET, Ba 1.6[2.5] 4/y)
3	½ S d/2

Three randomly selected tapping blocks were assigned to each of the two d/3 tapping systems and the remaining two blocks to the ½S d/2 system. One tapper was assigned to each tapping system, tested.

Data

Yield per tree per tapping (g/t/t)

The daily intake of a tapper was recorded separately for each tapping block. At the end of each year the mean annual intake per tapper for each block was calculated and this was divided by the number of trees in tapping in the relevant tapping block to calculate the mean annual yield per tree per tapping (g/t/t) of each tapping block.

$$\text{Mean annual g/t/t} = \frac{\text{mean annual intake per tapper (kg)} \times 1000}{\text{trees in tapping}}$$

Mean yield per tree per annum (y/t/a)

The number of tapping days were recorded separately for each tapping block. Mean annual g/t/t was multiplied by the total number of tappings per tree per year to calculate the mean yield per tree per annum.

$$\text{Mean yield/tree/annum (y/t/a)} = \text{mean annual g/t/t} \times \text{tappings/tree/year}$$

Tapping cost for different tapping systems

For the entire period of the study, *i.e.* six years, the mean tapping days/tree/annum and the mean yield/tree/year were calculated for the different treatments. Subsequently the tapping cost/kg was calculated for different treatments using the following formula.

$$\text{Tapping cost (Rs)/kg} = \frac{\text{Daily wage (Rs.)}}{\text{Task size}} \cdot \frac{\text{mean tapping days/tree/annum}}{\text{mean yield/tree/year (kg)}}$$

Growth and bark consumption

At the end of six years, 50 trees were selected randomly from each tapping task and the girth at 5 feet from the union and the total bark consumption were measured. Total bark consumption was divided by number of years tapped to calculate annual bark consumption rate.

Incidence of TPD

A census of trees having TPD was taken from each tapping block at the end of the sixth year.

RESULTS

Tapper availability and skill

Survey data indicates that the percentage of unskilled tappers in an estate varies from 13.2 to 47.6%. The number of vacant blocks in estates due to lack of tappers varies significantly between normal and late tapping days. On normal tapping days it ranges from 3.9 to 37.2% whilst on late tapping days it is significantly higher and varies between 18.9 to 41.2% (Table 1).

Table 1. *The percentage of unskilled tappers and vacant blocks of estates managed by different plantation companies during the year 1999. Percentage vacant tapping blocks are given for normal and late tapping days, separately*

Company	Tapper %		Vacant blocks %	
	Skilled	Unskilled	Normal Tapping	Late Tapping
1	61.4	38.6	19.9	18.9
2	76.7	23.3	30.7	29.7
3	77.2	22.8	22.0	32.6
4	70.2	29.8	37.2	39.3
5	52.4	47.6	6.8	24.8
6	74.9	25.1	19.3	26.5
7	83.9	16.1	25.9	19.0
8	86.0	13.2	28.1	25.4
9	62.8	37.2	3.9	41.2
Mean	71.8	28.2	21.5	28.6

In the estate sector the mean percentage of unskilled tappers and the vacant blocks separately for normal and late tapping days are 28.2, 21.5 and 28.6 respectively during 1999.

Mean annual yield/tree/tapping (g/t/t)

Amongst the different tapping treatments tested ½S d/3 with stimulation using 2.5% ethrel has given the highest mean annual yield/tree/tapping. The differences were significant except for two years during the six year period of the study (Table 2).

Table 2. *Mean annual yield per tree per tapping (g/t/t) recorded from different tapping treatments tested*

Tapping	Year and g/t/t					
Systems	1995	1996	1997	1998	1999	2000
½ S d/3+E	22.9 A	26.5 A	31.4 A	38.4 A	39.4 A	35.1 A
½ S d/3+E*	20.0 AB	24.5 AB	29.1 A	33.2 A	33.1 B	30.6 B
½ S d/2	17.9 B	20.9 B	25.3 B	32.2 A	31.3 B	25.4 B

E 2.5% ET, Ba 1.6 (2.5), 4/y E* 1.0% ET, Ba 1.6 (2.5), 4/y
[Within a year, means with same letter are not significantly different]

Mean yield per tree per annum (y/t/a)

The mean yield per tree per annum is high in the conventional ½S d/2 system during each year of the entire six year period of the study (Table 3). The differences were significant apart from two years of the study period.

Table 3. *Mean yield per tree per annum recorded separately for each year for different tapping systems tested. The number of tappings per tree for each year are given within brackets*

Tapping	Year and y/t/a (kg)					
Systems	1995	1996	1997	1998	1999	2000
½ S d/3+E	2.1 B (90)	2.3 B (90)	2.9 A (88)	3.6 B (91)	3.5 B (86)	2.9 B (83)
½ S d/3+E*	1.8 B (90)	2.3 B (90)	2.5 A (88)	3.0 C (91)	2.8 C (86)	2.4 C (80)
½ S d/2	2.3 A (120)	2.8 A (133)	3.3 A (131)	4.5 A (138)	4.0 A (127)	3.2 A (124)

E 2.5% ET, Ba 1.6(2.5), 4/y E* 1.0% ET, Ba 1.6(2.5). 4/y

Tapping cost

Based on the annual mean tappings/tree and the annual mean yield/tree for the six year study period the cost of tapping was calculated for different tapping systems. The tapping cost per kg. of rubber is lowest for ½S d/3 tapping with stimulation using 2.5% ethrel (Table 4).

Table 4. *Tapping cost/kg for different tapping systems tested*

Tapping systems	Mean tappings/ tree/year	Mean yield/ tree/year	Tapping Cost Rs./kg.
½ S d/3 + E	86	2.9	12.72 (79)
½ S d/3 + E*	86	2.5	14.87 (93)
½ S d/2	129	3.4	16.02 (100)

E 2.5% ET, Ba 1.6(2.5), 4/y
E* 1.0% ET, Ba 1.6(2.5), 4/y
(Assumptions : 1. Task size = 300 2. Total daily wage = Rs.125)

Growth and bark consumption

Treatment differences were not significant with regard to the growth as evident by the girth of trees (Table 5). The mean annual bark consumption was significantly low with d/3 tapping (Table 5).

Table 5. *The girth (cm) and annual bark consumption rates [BCR (cm)] of trees tapped using different tapping systems*

Tapping system	Girth (cm)	BCR (cm)
½ S d/3 + E	68.8[a]	14.6[b]
½ S d/3 + E*	66.1[a]	14.2[b]
½ S d/2	65.8[a]	19.2[a]

E.2.5% ET, Ba 1.6(2.5), 4/y
E*1.0% ET, Ba 1.6(2.5), 4/y

(for each parameter means with same letter are not significantly different)

Incidence of Tapping Panel Dryness (TPD)

Treatment differences were not significant with regard to incidence of Tapping Panel Dryness (TPD) (Table 6).

Table 6. *The percentage incidence of dryness (TPD) recorded for different tapping systems*

Tapping system	TPD %
½ S d/3 + E	11.2[a]
½ S d/3 + E*	6.8[a]
½ S d/2	9.0[a]

E 2.5% ET, Ba 1.6(2.5), 4/y
E*1.0% ET, Ba 1.6(2.5) 4/y
(means with same letter are not significantly different)

DISCUSSION

Scarcity of skilled tappers is threatening the survival of the natural rubber industry in all natural rubber producing countries. This study shows that in the plantation sector in Sri Lanka *ca.* 28% of the tappers are unskilled. Apart from long – term yield losses due to high bark consumption rates and damages to cambium, the average intake of an unskilled tapper is *ca.* 25% less from that of a skilled tapper. Therefore, due to 28% of unskilled tappers, an estate will loose *ca.* 7% of the potential crop. Further, on a normal tapping day *ca.* 21.5% of the tapping blocks are vacant due to lack of tappers. Therefore, both situations, *i.e.* unskilled tappers and vacant blocks, will result in *ca.* 28.5% loss of crop from the potential. The situation is expected to deteriorate further in the future and will be the biggest threat for the survival of the natural rubber industry.

Low frequency tapping (LFT) systems reduce the tapper requirement of an estate. Nevertheless, the number of tappings per tree per annum will be less with LFT and this can lead to less yield per tree per annum and land productivity. Therefore, low frequency tapping is generally undertaken with yield stimulation to arrest any possible decline in productivity due to less tapping days.

In this study the annual mean yield per tree per tapping was significantly higher in low frequency tapping system with 2.5% ethrel stimulation than from conventional ½ S d/2 tapping system through out the study period. Though g/t/t was marginally higher than in ½S d/2 with LFT using 1% of ethrel, the differences were not significant (Table 2). The number of tappings per tree per annum is less with LFT and hence the mean yield per tree per annum is significantly less in LFT system with 2.5% ethrel stimulation. The mean yield/tree/annum for the six year period (Table 4) indicate that the drop in land productivity with LFT can be *ca.* 14% relative to conventional ½S d/2 system (Table 3). This decline in land productivity will also increase some of the cost items, *i.e.* general charges, mature areaup-keep by same margin. In each year of the six year study period only three out of intended 4 rounds of stimulations were undertaken. With the intended 4 rounds of stimulation which is possible with the use of rainguards the 14% decline in land productivity may have been arrested.

The increase in cost of production due to low land productivity from LFT in the absence of rainguards will be partly compensated by reduction in tapping costs. The mean values for the six year period shows that LFT with stimulation can reduce the tpaping costs by *ca*. 20% (Table 4) through a better g/t/t possible with it.

Further, as mentioned previously in this report due to unskilled tappers the estates loose about 7% of potential crop whilst *ca*.21.5% of potential crop is lost due to vacant tapping blocks. In the plantation sector 40 and 60% of the Cost of Production (COP) is for tapping and other costs, *i.e.* general charges, mature area upkeep and cost of manufacture. The impact of current situation with regard to tappers, *i.e.* 28% unskilled tappers and 21.5% vacant blocks and the implementation of LFT with 2.5% ethrel stimulation on the COP of estates where similar tapper related problems exist, is shown in Table 7.

Table 7. *The impact of tapper shortage situation and the adoption of LFT on the COP of rubber*

Cost Items	Different scenarios and relative costs (kg)		
	½ S d/2 with Adequate tappers (1)	½S d/2 with Tapper shortage (2)	½S d/3 with stimulation (3)
Tapping	40	42.8	32
Others	60	77.1	68
Total	100	119.9	100

The current situation with regard to tappers increase the tapping cost by *ca*.2.8% and other costs by 17.1% (Table 7 – Scenario 2). Therefore, the total COP is increased by 19.9%. With LFT, the tapping cost is reduced by 8% due to higher g/t/t but the other costs are increased by 8% due to low land productivity than from ½ S d/2 with adequate tappers (Table 7 – Scenario 3). Therefore, it is apparent that the COP with ½S d/2 tapping under a tapper shortage situation as evident from this study can be reduced by *ca*. 19.9% (difference between scenario 2 and 3 in Table 7) with the adoption of the LFT systems.

Growth of plants studied by measuring the girth at 5' from the union shows that LFT with stimulation has not negatively affected the growth of plants. This is expected as LFT does not result in extracting more latex from a tree than from ½S d/2 system (Table 6).

The annual bark consumption rate with conventional and LFT systems is 19.2 and 14.6 cm respectively. Therefore, the period taken for tapping of panels BO-1, BO-2 and BI – 1 (a total of 360 cm of bark) will be *ca*. 18 and 24 years with ½ S d/2 and ½S d/3 systems respectively. As there will be no change in the intensification period of tapping, LFT will therefore increase tapping cycle by 6 years, there-by increasing the replanting cycle from 30 to 36 years. This will increase the mature extent of an estate from 80.2 to 83.4%, *i.e.* an increase of 3.2%. Hence, there will be a similar increase in total estate production and as a result the general charges component of the COP will reduce by same margin. As the general charges component is about 25% of the total COP, the reduction in total COP will be about 0.8%. Therefore, the collective reduction in COP with LFT will be *ca.* 19.9% + 0.8% = 20.7% in estates having an average tapper shortage situation.

With the current tapper situation in estates, by adopting the LFT system which performed best in this study, the COP can be reduced by *ca.* 20.7%. Further, as only the skilled tappers will be involved in tapping, quality of tapping will also improve preventing any long-term crop losses as well.

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(Received 25 July 2001)

Annexure 1

The present status with regard to tappers in the Plantation Sector

1. Estate Particulars	
1.1 Name	
1.2 Address	
1.3 Company	
1.4 Telephone No.	

2. Tapper requirement of Estate					
		Year			
		1998		1999	
2.1 Total mature extent					
2.2 Mean mature stand					
2.3 Tapping task and No. Tapping blocks		Tapping task	Tapping blocks	Tapping task	Tapping blocks
(½S d/3)	67%				
(½S d/2)	100%				
(2x½S d/3)	133%				
(2x½S d/2 + ¼ S d/2)	150%				
(2x½S d/2)	200%				
(4x ½S d/2)	400%				
2.4 Total tapper requirement/day					

3. Tapper availability in the Estate		
	Year	
	1998	1999
3.1 Skilled tappers		
3.2 Unskilled tappers		
3.3 Male		
3.4 Female		
3.5 Resident		
3.6 Non Resident		
3.7 Age (Years)		
> 20		
21-30		
31-40		
41-50		
51-60		
< 60		

4. Tapper out-turn during 1998						
	Tapper out-turn on					
	Normal Tapping			Late Tapping		
Month	Days	Tappers/ month	Tappers/ To-date	Days	Tappers/ month	Tappers/ to-date
January						
February						
March						
April						
May						
June						
July						
August						
September						
October						
November						
December						

5. Tapper out-turn during 1999						
	Tapper out-turn on					
	Normal Tapping			Late Tapping		
Month	Days	Tappers/ month	Tappers/ to-date	Days	Tappers/ month	Tappers/ to-date
January						
February						
March						
April						
May						
June						
July						
August						
September						
October						
November						
December						

6. Minimizing Vacant Tapping Blocks in the Estate - 1998												
	Normal Tapping						Late Tapping					
	PT/ month	PT/ to-date	ST/ month	ST/ to-date	VB/ month	VB/ to-date	PT/ month	PT/ to-date	ST/ month	ST/ to-date	VB/ month	VB/ to-date
Jan.												
Feb.												
Mar.												
Apr.												
May												
June												
July												
Aug.												
Sept.												
Oct.												
Nov.												
Dec.												

7. Minimizing Vacant Tapping Blocks in the Estate - 1999												
	Normal Tapping						Late Tapping					
	PT/ month	PT/ to-date	ST/ month	ST/ to-date	VB/ month	VB/ to-date	PT/ month	PT/ to-date	ST/ month	ST/ to-date	VB/ month	VB/ to-date
Jan.												
Feb.												
Mar.												
Apr.												
May												
June												
July												
Aug.												
Sept.												
Oct.												
Nov.												
Dec.												

PT – Permanent Tappers
ST – Substitute Tappers
VB – Vacant Blocks