EFFECT OF PUNCTURE VS CONVENTIONAL TAPPING ON THE YIELD AND GIRTH OF *HEVEA*

By

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ABSTRACT

Puncture tapping of trees 35 cm or more in girth has resulted in higher kg/area yields than conventional tapping of trees 45 cm or more girth, during 4 months of a 12 month period whilst yield in terms of grams per tree per month was always greater with conventional tapping. Puncture tapped trees have a higher girth increase than do conventionally tapped trees of the same initial girth although annual yields are lower.

INTRODUCTION

Clonal rubber (*Hevea brasiliensis* Muell. Arg.) is usually exploited when the tappable girth of 50 cm is reached at a height of 90 cm from the highest point of the stock-scion union. The unproductive period prior to reaching the tappable girth may vary from 5 to 7 years, and is largely determined by clone, nutrition and climate. Puncture tapping (Tupy, 1973) has been suggested as an alternative method to the conventional, continuous excision method of tapping now widely used. Puncture tapping is primarily envisaged as a means of early exploitation of rubber trees which would thereby reduce the uneconomic period. Experiments at the RRISL (Waidyanatha & Angammana, 1981) have shown that there is a correlation between yield and the number of punctures and quantity of stimulant applied.

Earlier studies relied on the extrapolation of results from small plots and were anyway more concerned with determining the best combination of the above factors for puncture tapping. This study was carried out to observe the use of puncture tapping, compared directly with conventional tapping, under commercial plantation conditions in Sri Lanka.

In the experiment reported below, we compared a typical median number of punctures, length of band and quantity of stimulant, which could be applied in practice in Sri Lanka, with the half spiral conventional tapping cut.

MATERIALS AND METHODS

A large scale field experiment was set down in an area which was replanted with clone PB 86 in May and June of 1974, at Eladuwa State Plantation, Paiyagala, in the Kalutara District, South West Sri Lanka. The soil is red-yellow podsolic (Moorman & Panabokke, 1961) and well drained, except for an area of about 0·25 hectare which becomes waterlogged and where tree growth is retarded. The mean annual rainfall is about 3500 mm, normally distributed mainly during May to July and September to November.

The area was divided into 12 tasks, each with approximately 300 trees (Table 1). Each task was then divided into two approximately equal halves, taking care to divide along the gradient (across contours) thus ensuring that the terrain of the two half tasks was alike as far as possible. The two tapping treatments were then allocated randomly between the two half tasks, giving twelve treatment replicates.

Table 1. *Composition of tapping tasks and the number of trees tapped in each half task (replicate)*

Tapping task number	Total	a. Conventional tapping			Total	b. Puncture tapping	
		Total	Tapped Sept. 1981 to Aug. 1982	Tapped Sept. 1982 onwards		Tapped Sept. 1981 to Aug. 1982	Tapped Sept. 1982 onwards
1	287	141	84	102	146	136	141
2	280	132	66	81	148	130	133
3	271	123	75	87	148	124	128
4	267	131	75	86	136	121	123
5	298	139	82	103	159	141	146
6	307	131	87	102	176	151	154
7	284	143	103	114	141	130	132
8	300	166	107	112	134	120	127
9	297	146	99	108	151	137	140
10	289	153	110	120	136	127	128
11	305	148	83	100	157	131	145
12	287	139	68	89	148	111	118
Total	3472	1692	1039	1204	1780	1576	1632

Tapping method and stimulation of puncture tapping

Puncture tapping was carried out on a 1 m vertical band, starting from just above the stock-scion union using six punctures per tapping. The 1 cm wide band was divided into six equal segments of approximately 16·6 cm length, marked by shallow horizontal lines, and a single puncture made in each segment per tapping. On subsequent tappings, new punctures are made leaving a margin of about 1 cm from punctures made during the previous tapping. Punctures were made with a 1·5 mm wide needle, to reach as close to the vascular cambium as possible and in an upward direction of 30° - 45° to the vertical so that latex flow was facilitated and the risk of infection by a water borne pathogen was minimised.

The stimulant, Ethrel (Amchem Products Inc., USA), was applied on the vertical band at the rate of 1 g of 5% solution per tree. Only one application was made per band. Puncture tapping bands were shifted laterally by 1 cm at monthly intervals, thereby necessitating monthly applications of stimulant to each new band. Only trees with a girth of 35 cm or more, when measured at 90 cm from the highest point of the stock-scion union, were exploited in this manner.

Continuous excision tapping

This conventional method of tapping was carried out using a Michie-Golledge knife to exploit a ½ S (half spiral) tapping cut. Only trees which had reached a girth of 45 cm or more, at the same height as above, were tapped. This differs from the recommendation for commercial tapping which is 50 cm at the same height.

Tapping frequency

Both treatments were tapped on the d/2 (alternate daily) system. The tapping tasks were arranged so that six tasks were tapped on one day and the other six on the next.

International notation

The two treatments have the following notation :—

(i) Puncture tapping : 6 PI/100 (0·5) d/2

(ii) Continuous excision tapping : ½S d/2
Stimulation notation for puncture tapping is : ET 5% Ga 1 (0·5) 12/y(m)

Estimation of dry rubber content

This area was first tapped in September 1981. Trees were tapped whilst walking along the contours, which resulted in alternate conventional and puncture tapping, there by reducing variation in yield caused by time differences which may have occurred if a tapper had first tapped the half task containing one treatment and then the half task containing the other. Latex from each tapping treatment of each task was collected into separate containers. The volume from each replicate was then measured and a 50 ml sample removed and coagulated with 10% formic acid. The coagula were milled to expel serum and dried to a constant weight. Tree scrap was also collected and weighed. Half task latex dry rubber content (DRC) was then estimated as follows :—

$$\frac{\text{Total Volume}}{250} \times \text{DRC of 50 ml} + \text{Wt of scrap} = \text{Total dry rubber per half task}$$

Daily records were maintained in this manner during the period 1 April 1982 to 31 March 1983, the results of which are presented below.

RESULTS

Yield

Analysis of variance of the mean monthly yield data for the period April 1982 to March 1983 showed that there was a significant difference in yields between months, for both tapping treatments, in a pattern which was non-linear, non-quadratic and therefore of a fluctuating nature (Table 2). During April 1982 and January, February and March 1983, yields (kg ½ task) from puncture tapped areas were higher, although significantly so only in April 1982 and January 1983. Conventional tapping gave higher yields during the remaining 8 months, the difference being significant during the months June to October 1982.

Table 2. *Mean monthly yields from puncture and conventional tapping*

Period (month)	Mean Yield (kg/½ task) PT	CT	Paired t test
April '82	1245	1030	3·1042*
May '82	1156	1174	- 0·3547 NS
June '82	1141	1419	- 4·2559**
July '82	1128	1749	- 7·2876***
Aug. '82	1258	1902	- 6·5858***
Sept. '82	1510	1746	- 2·5804*
Oct. '82	1610	1803	2·2516*
Nov. '82	1646	1824	- 1·5924 NS
Dec. '82	1895	1910	- 0·1689 NS
Jan. '83	1846	1658	2·3431*
Feb. '83	1411	1290	1·6379 NS
Mar. '83	1174	1073	1·8513 NS

Mean yields of puncture and conventional tapping during the monthly stimulation cycles of puncture tapped trees (Fig. 1) showed that there was a period of about 10 days during which puncture tapping gave a higher mean yield per area than those conventionally tapped. However, when considered on the basis of grams per tree per tapping (g/t/t) during the stimulation cycle, at no time did the yield from puncture tapped trees exceed

that of conventionally tapped trees (Fig. 2). When data from the 4 months period (April 1982, January, February & March 1983) during which puncture tapping gave a higher mean yield than conventional tapping were separated from the rest of the data and the resultant sets plotted, two distinctly different patterns were seen. Mean yield data from the 8 months period May to December 1982 showed that, at no time during the stimulation cycle did puncture tapping yields (g/t/t) exceed conventional tapping yields (Fig. 3). However, during the 4 months referred to above, puncture tapping yields (g/t/t) exceeded conventional tapping yields for a period of about 1 week (Fig. 4) in the early stages of the monthly stimulation cycle, and this may be as long as 25 days when measured as kg/½ task.

There were less trees tapped using the conventional method because of the different standard girths at which trees of the two treatments became tappable (35 cm and 45 cm, respectively). In September 1982, following a girth census, new trees were brought into tapping. The numbers of trees tapped are shown in Table 1.

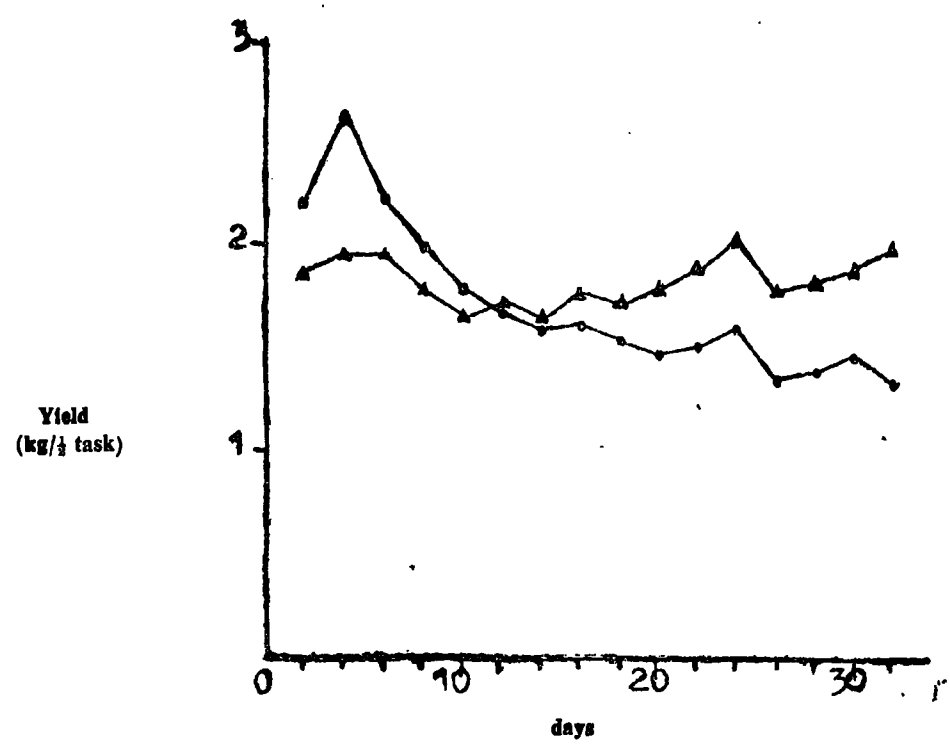

Fig. 1. Variation in yield (kg/½ task) during the monthly stimulation cycle of puncture tapped trees (stimulated) compared with conventionally tapped trees (unstimulated)—●—●—●— = Puncture tapping,—▲—▲—▲— = Conventional tapping April 1981 to March 1982.

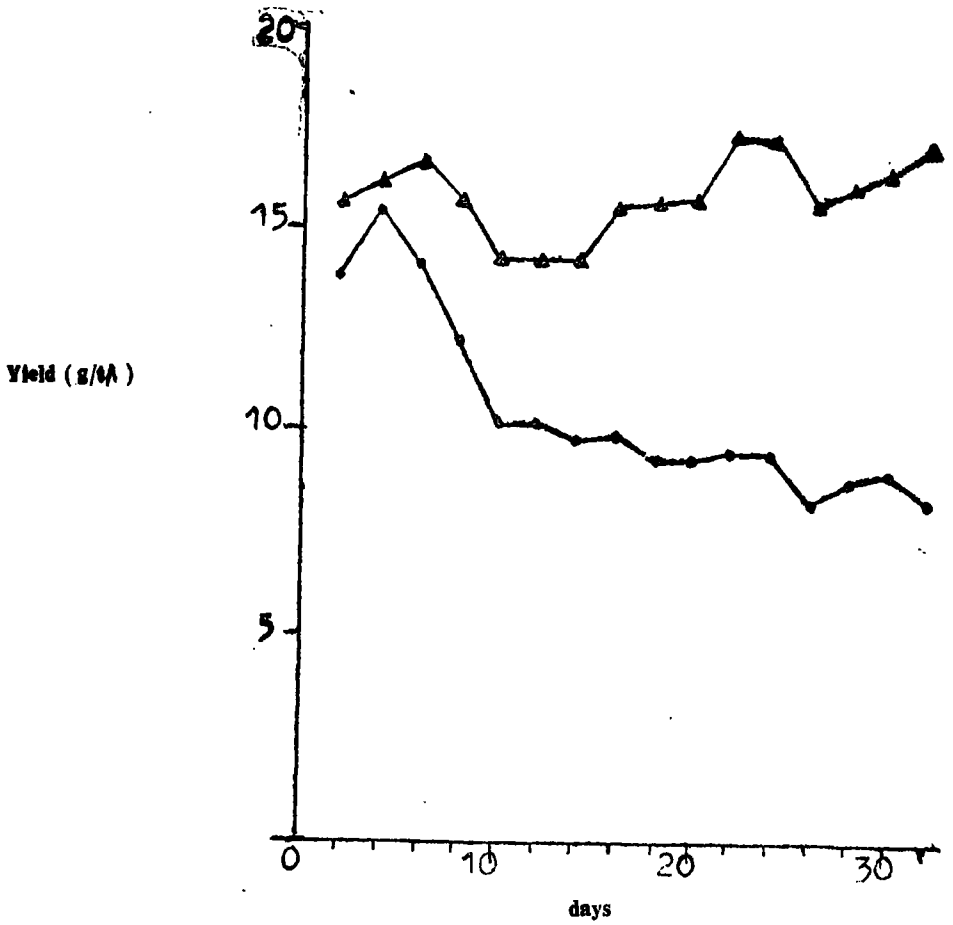

Fig. 2. Variation in yield (g/t/t) during the monthly stimulation cycle of puncture tapped trees (stimulated) compared with conventionally tapped trees (unstimulated)—⊛—●—●— = Puncture tapping, —▲—▲—▲— = Conventional tapping April 1981 to March 1982.

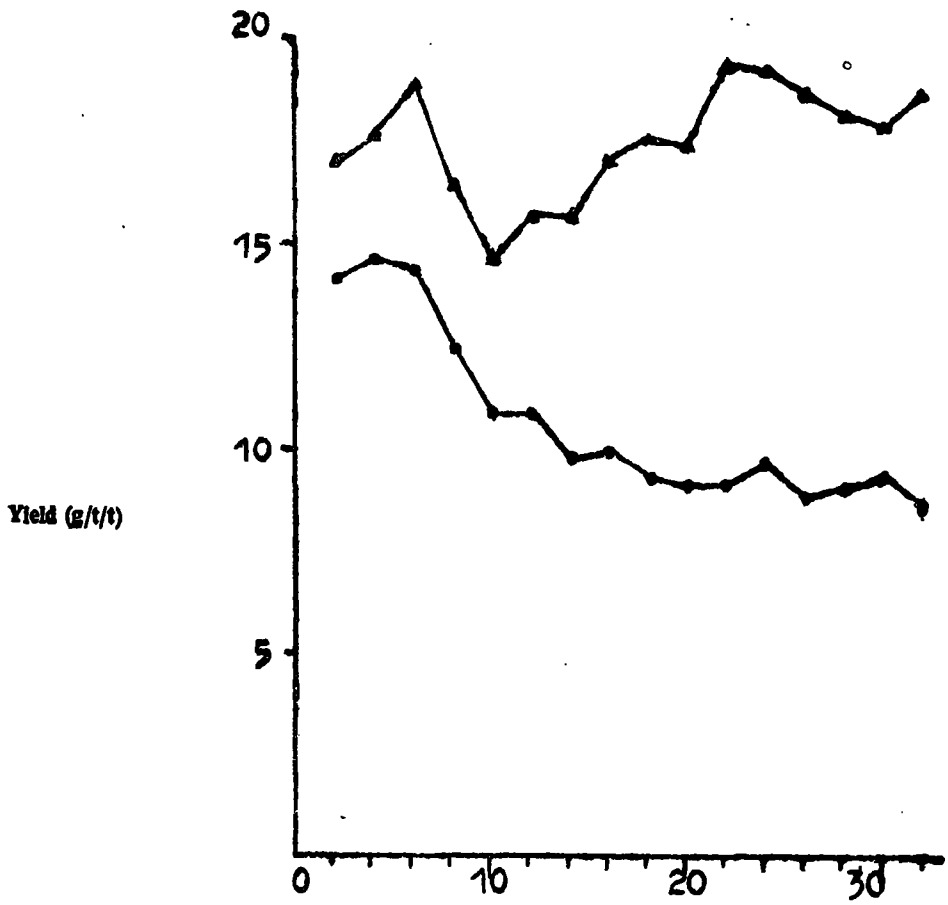

Fig. 3. Mean yields during the stimulation cycle of the 8 month period from May to December 1982 for puncture tapped (—●—●—) and conventionally tapped (—▲—▲—▲—) trees.

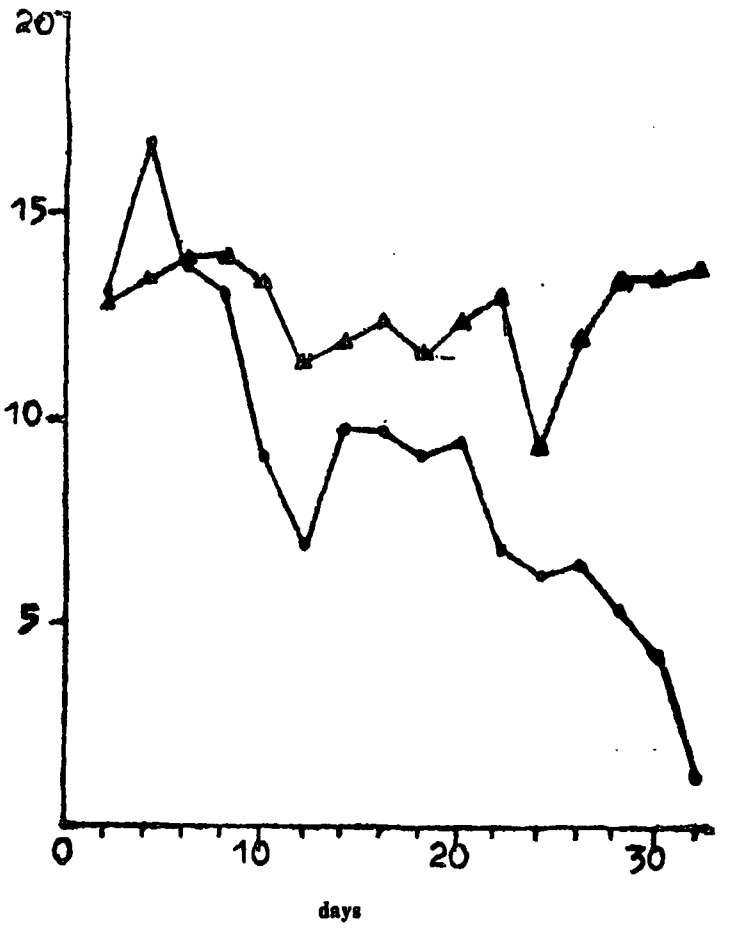

Fig. 4. Mean yields during the stimulation cycle of the four month period, April 1982, and January, February & March 1983 for puncture tapped (—●—●—) and conventionally tapped (—▲—▲—▲—) trees.

Girth

The girths of individual trees within half task were taken before tapping treatments were imposed. The trees were classified by their girth, into six different classes, I — VI. At the end of 1 year of tapping, in August 1982, another girth census was taken from which individual tree girth increment was calculated.

Statistical analyses were carried out using the mean values for girth increase of trees which initially belonged to a particular girth class. The results are shown in Table 3.

Table 3. *Mean girth increases of trees initially belonging to one of six girth classes*

Girth class	Inclusive girth (cm)	Mean girth increase (cm) conventional tapping	puncture tapping	Paired 't' test	Tapping status
i	0 - 34·9	1·94	1·63	- 0·149 NS	NT
ii	35·0 - 39·9	2·50	1·30	- 4·049 NS	PT
iii	40·0 - 44·9	2·44	1·61	- 3·583 NS	PT
iv	45·0 - 49·9	1·68	1·80	0·925 NS	PT & CT
v	50·0 - 54·9	1·64	1·99	3·849 **	PT & CT
vi	55·0 - 70·0	1·56	2·33	4·230 **	PT & CT
		LSD	LSD		
		0·424	0·321		

NT = not tapped, PT = puncture tapped, CT = conventionally tapped

Comparison of puncture and conventional tapping

The mean girth increases shown by trees belonging to the various tapping regimes : untapped, puncture tapped or conventionally tapped, were statistically analysed using the paired t test (Table 3). In the cases of girth classes II and III, the paired t test is effectively a comparison between puncture tapped trees belonging to these girth classes and untapped trees of the same girth. There was no significant difference in girth increase between these two treatments. However, in the case of classes V and VI, puncture tapped trees performed significantly better than conventionally tapped trees of the same girth.

DISCUSSION AND CONCLUSION

The differences between g/t/t and kg/½ task yields are due to the greater number of trees, minimum girth 35·0 cm, being puncture tapped (PT) compred to those, minimum girth 45·0 cm, being conventionally tapped (CT), resulting in a depression of g/t/t yields from the PT treatment. Our results suggest that the stimulant, Ethrel, is washed off the puncture groove or that tapping during the high yielding period, soon after application, is reduced in the wet months, May - December, thereby reducing its efficacy, and that it is anyway more effective at a time when conventional tapping yields are low. This is reflected in certain low yielding clones which give PT yields at least comparable to ½S

d/2 CT yields (de Soyza & Wilbert, 1981). There is evidence to suggest that PT yields improve in the second year of tapping and are comparable with CT yields (Waidyanatha & Angammana, 1981) but that on subsequent CT of previously PT trees, total yields fall below those that would have been obtained if the trees had been tapped on CT only (de Vernou & Tonnelier, 1983).

Girth increase is distinctly better on PT trees, as expected, since very little regeneration of tissue is required compared to CT. However it has also been shown that PT retards growth of smaller trees which would normally be untapped. This also may be a clonal characteristic (de Vernou & Tonnelier, 1983), in that PT may retard growth of some clones more than others.

Further work in this field is required whereby the long term effects of puncture tapping and stimulation can be better understood. Additionally, a change in emphasis on the use of PT may increase the viability of this method. The use of stimulated PT bands for 2 weeks only, use of this method only during the dry 4 month wintering period (CT during the rest of the year), increase of the minimum PT tappable girth to about 40 cm are all factors suggested by our results so far.

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