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Influence of Length and Position of Tapping Cut and Direction and Frequency of Tapping on Yield of Clone PR 107

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The results of tapping experiments started by I.R.C.C. in 1966 are presented for the period up to November 1967. They give rise to the following conclusions with respect to the tapping of young PR 107:

Exploitation from panels situated more than 1.5 m from the ground is not to be recommended.

Upward tapping is no more profitable than downward tapping when the cuts are of equal length and are located at the same height.

Better drainage of the panel can be obtained by the use of shorter, regularly spaced tapping cuts.

The effect of balanced tapping of the cuts on a d/3–d/4 basis is pronounced.

On 1 January 1967, more than 10 000 hectares, representing 24% of the area planted in Cambodia since 1930, were covered by PR 107: between 1964 and 1966 this clone accounted for some 39% of the newly planted and replanted surface (LANGLOIS, 1967). It is also to be recorded that PR 107 occupies nearly 4% of the area planted in Malaysia between 1946 and 1965, equivalent to more than 18 000 hectares. It was thus of the greatest importance to start tapping experiments in order to be able to open young plantings of this clone in the best possible way, and to acquire maximal information concerning tapping in general.

To accomplish this, four experiments on PR 107 were started in 1966. They involve measurement of the latex, volumetric determination of the d.r.c. and, where necessary, weighing of the cup scrap. In order to eliminate interference by the factors 'hour of tapping' and 'tapper', tapping always takes place between 06.00 and 08.30 hours, except when delayed by rain, and the tappers operate on a permanent rotation both with respect to the point where tapping is started and to the order of treatments to be tapped. The measurements refer in general to the entire latex output since they are only made when flow has ceased. In November, December and January, when the latex flows for a very long time, it has sometimes been the practice to weigh the scrap after cup coagulation by addition of formic acid.

The main results of these experiments are examined briefly; the results for the first year of tapping have formed the basis of a preliminary publication (LANGLOIS, 1967).

EXPERIMENT 1—POSITIONING OF TAPPING CUTS ON THE TRUNK: YIELDS IN COMPARISON WITH FULL-SPIRAL OR S–15

This experiment involves an area of 3.07 hectares made up of 13 treatments of 28 points and 4 replications; the experimental design has been randomised. The details for this piece of land are as follows:

(1)	Type of soil	: red soil (pH 4.4)
(2)	Previous vegetation	: rubber (replanting)
(3)	Year of planting	: 1959
(4)	Planted area	: 24.2367 hectares
(5)	Spacing	: 6.50 m × 3.25 m
(6)	Type of planting	: planted as budded stumps.

The production from the field, which was opened on 18 April 1966, was 930 kg/ha at the end of December 1966 and altogether 1130

kg/ha up to the tapping pause initiated on 18 February 1967 (LANGLOIS, 1967). From the resumption of tapping on 17 April 1967 until the end of November 1967 the yield was 1180 kg/ha. There were 93 tappings during the 1966–1967 exploitation period, and 69 from the resumption until the end of November: the tapping frequency was d/3–d/4. A total of 945 trees, equivalent to 65% of the total points, were in tapping in 1966; this number increased to 1233, 85% of the total, on resumption of tapping in 1967. Only those trees exceeding 50 cm in circumference at 1 m above ground level were opened.

In the results obtained for different treatments and the conclusions drawn from them, reference is being made solely to PR 107 for the first 17 months of tapping. The results are expressed in grams per metre-circumference with the object of eliminating, at least in part, the heterogeneity of the treatments and the variations due to making up the number of tappable trees on resumption of tapping in 1967.

Figure 1 shows the yields obtained from the time the experiment was first tapped. The values underlined correspond to results obtained during the 1966–1967 periods, and those not underlined to results from the resumption until the end of November 1967. *Table 1* provides more detailed results.

Following statistical analysis on the basis of the Fischer treatment for randomised blocks, there emerges a very highly significant difference between treatments with respect to yield. There is no longer a significant difference between blocks: this was the case in 1966 but the incorporation of new trees in 1967 eliminates the regular south-north topographical variation.

During 1967 the minimum significant difference at the threshold value $P = 0.05$ is 500 g, equivalent to 9.6% of the control output (full-spiral, Treatment 2). At the level $P = 0.001$, it is 886 g. In 1966, $P = 0.05$ corresponded to 7%.

Statistical analyses of results from circumference measurements will not be considered since they are primarily dependent on the swelling of the panels under the influence of

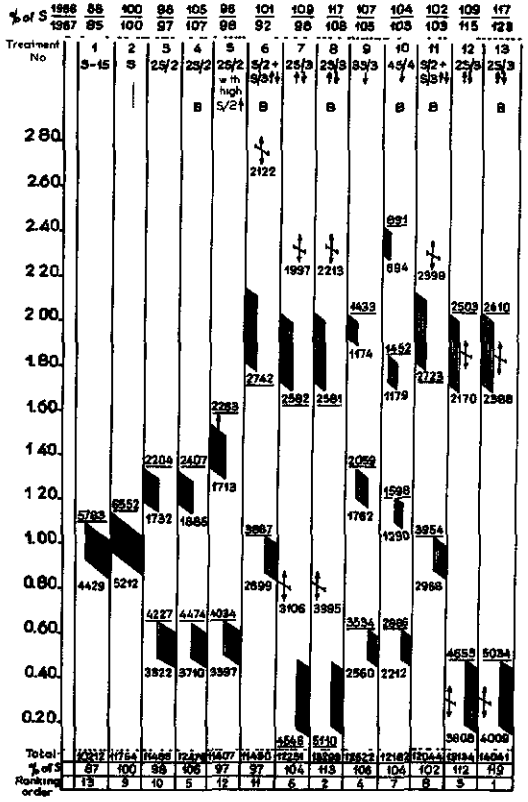

Figure 1. Positioning of tapping cuts on the trunk: yields for 1966 and 1967 (to the end of November) compared with full-spiral tapping.

tapping. The figures in *Table 1* are merely provided as examples, but they are nevertheless a valid indication of growth. It is to be noted that the growth of untapped trees varies from 7–10 cm during the same period.

Examination of the various treatments gives rise to the following observations:

There is a difference in yield between the control Treatment 2 (full-spiral at 1 m, opened in 1966) and Treatment 1 (S-15 cm at 1 m) which was very highly significant in 1966 and is highly significant in 1967. The mean circumference of the trees being about 56 cm in February 1967 one can take the intensity of tapping as about 77% of full-spiral, and the output in 1967 as 85%. From the start of the

TABLE 1. PRINCIPAL RESULTS FROM EXPERIMENT 1

Treatment No.	Tapping cut	Height of opening		Yield in 1966 – 1967					Mean d.r.c.		△ circ. 66 – 67†
		1966	1967	g/m circumference	% of Treatment 2	g/tree	g/cm tapp. cut		1966	1967	
							1966	1967			
1	S-15 cm	1.0 m	—	10.212	87	5.634	63	50	30.3	34.3	5.6
2	S	1.0 m	—	11.764	100	6.361	57	46	29.0	32.0	6.2
3	S/2	0.6 m	—	7.549	98	4.089	68	55	29.4	33.2	6.3
	S/2	1.3 m	—	3.936		2.136	37	30	26.9	31.1	
4*	S/2	0.6 m	—	8.184	106	4.505	73	62	29.4	33.9	7.2
	S/2	1.3 m	—	4.292		2.385	41	33	27.4	30.7	
5	S/2	0.6 m	—	7.431	97	4.030	66	52	29.8	33.7	6.0
	S/2 ↗	1.3 m	—	3.976		2.150	38	28	27.0	30.7	
9	S/3	0.6 m	—	6.094	106	3.365	85	63	29.9	33.4	6.4
	S/3	1.3 m	—	3.821		2.123	52	45	27.8	31.9	
	S/3	2.0 m	—	2.607		1.437	33	28	25.0	30.3	
10*	S/4	0.6 m	—	5.078	104	2.733	91	73	30.8	34.5	5.2
	S/4	1.2 m	—	2.888		1.599	53	44	28.1	32.0	
	S/4	1.8 m	—	2.631		1.404	48	39	28.1	31.7	
	S/4	2.4 m	—	1.585		0.862	27	22	25.5	28.3	
6*	S/2	1.0 m	—	6.586	97	3.571	60	46	28.9	32.9	5.0
	S/3 ↗	1.9 m	2.7 m	4.864		2.638	30	26	26.5	30.5	
11*	S/2	1.0 m	—	6.922	102	3.736	65	50	29.4	32.8	4.8
	S/3 ↗	1.9 m	2.3 m	5.122		2.795	31	29	26.6	30.0	
7	S/3 ↗	0.3 m	0.8 m	7.652	104	4.150	55	39	29.0	31.4	3.9
	S/3 ↗	1.8 m	2.3 m	4.579		2.484	31	25	26.3	30.1	
12	S/3 ↗	0.3 m	0.3 m	8.461	112	4.669	57	47	29.5	32.0	3.5
	S/3 ↗	1.8 m	1.8 m	4.673		2.567	29	26	26.5	29.9	
8*	S/3 ↗	0.3 m	0.8 m	8.505	113	4.605	63	41	28.7	30.8	4.5
	S/3 ↗	1.8 m	2.3 m	4.794		2.591	32	27	25.3	29.2	
13*	S/3 ↗	0.3 m	0.3 m	9.043	119	4.955	61	50	28.7	31.0	4.0
	S/3 ↗	1.8 m	1.8 m	4.998		2.740	32	30	25.7	28.8	

*Balanced tapping

†Solely with reference to trees in tapping

experiment until the end of November 1967 the average yield was 87% of that from full-spiral (or rather, full-spiral gave 14% more than S-15 cm). In an identical experiment at I.R.C.A. (INSTITUT DES RECHERCHES SUR LE CAOUTCHOUC EN AFRIQUE, 1966), full-spiral gave 27% more than S-15 cm after 3 years of tapping. In terms of production in g/cm tapping cut the discrepancy between the two treatments tends to decrease. As has already been shown elsewhere (RUBBER RESEARCH INSTITUTE OF MALAYA, 1967), and is apparent from *Table 1*, the d.r.c. for full-spiral is less than that for S-15 cm; this difference tends to increase with time. One also observes deformation of the panel in the region of the 'bridge' of untapped bark.

Treatment 3 involves simultaneous tapping on 2S/2 opened at 1.3 m and 0.6 m. The difference in yield compared with the control (full-spiral) is not significant.

In this respect it is to be noted that CHEMARA RESEARCH STATION (1966) considers PR 107 to give the best results from full-spiral d/4 rather than from S/2. d/2; the same conclusion has been reached at this Institute in the case of GT 1. KNECHT AND MARTINEAU (1965) also observed that PR 107 gave a good response to both full-spiral and reduced-spiral tapping. It was noted at I.R.C.I. that buddings appeared to give a better yield from two half-spirals than from full-spiral at the same tapping frequency; there were however some exceptions (INSTITUT DES RECHERCHES SUR LE CAOUTCHOUC EN INDOCHINE, 1954).

This is apparently the case with PR 107, which is at present giving a better yield from full-spiral; there has accordingly been no indication so far that opening on 2S/2 would prove more profitable. It was however noted that the duration of latex flow for 2S/2 was about a third shorter than for full-spiral.

The yield from the lower tapping cut represents 66% of the total. The ratio between the yield per cm tapping cut from the upper and lower S/2 remains constant, the upper cut giving only 54% of the production per cm of the lower S/2.

Treatment 4 is the same as Treatment 3 but with balanced* tapping. By comparison with Treatment 3, this results in an increase of approximately 9% for the yields from the upper tapping cut in 1966 and 1967, and 6% (1966) and 12% (1967) for the yields from the lower cut. Altogether this gives an increase in production of the order of 9% since the commencement of tapping, almost significant at a threshold $P = 0.05$ in 1966 and significant at this level in 1967.

Just as in the case of Treatment 3, the yield from the lower cut represents 66% of the total. In terms of g/cm tapping cut, the ratio between the upper and lower S/2 tends to decrease; the upper S/2 gave 56% of the output of the lower S/2 in 1966 but only 53% in 1967, although the annual cycle is not yet completed.

Under this treatment growth is the best in whole experiment: balanced tapping accordingly promotes both yield and growth.

Treatment 5 is also based on two half-spirals opened at the same heights as in the two previous treatments, but the upper half-spiral is tapped upwards. The difference in yield by comparison with Treatments 2 and 3 is not significant. In 1966 it was possible to see that after having been less productive than the upper cut (under ↙ tapping) of Treatment 3 for several months, the ↗ -tapped upper cut gave in the end an equal, even slightly better yield for the year. For 1967 the productions are equal up to the end of November, and the totals for the lower half-spirals for both 1966 and 1967 are identical. Expressed in terms of g/tree and g/cm tapping cut the results are virtually equivalent to those for Treatment 3, 2 S/2 ↙↙.

Treatments 6 and 11 are both tapped under a balanced S/2 + S/3 ↙ regime. In 1966 the positions of the tapping cuts were identical and the average differences in yield were less than 1%, which lends considerable weight to the following observations. The same was true for Treatments 7 and 12, as well as 8 and 13.

In 1966 Treatments 6 and 11 carried a half-spiral opened at 1 m above ground level and S/3 ↙ at 1.9 m. Their yield was very slightly (1–2%) but uniformly higher than for full-spiral.

*That is to say, it does not take place at the same time, on the same day, but is effected, for example, by tapping one cut one day and the other the next.

In 1967 the upper S/3 ↗ systems for these treatments were modified while exploitation of the lower S/2 was continued as usual. For Treatment 6 the S/3 ↗ was located 2.7 m from the ground and moreover, often on a branch of the fork, while Treatment 11 was merely tapped at 2.3 m. As a consequence the difference between the two in 1967 was significant. It was noted that not only was the yield from the upper cut of Treatment 6 lower, as is to be expected, but that from the lower cut was also less than in Treatment 11. One explanation for this could be that, in contrast to Treatment 11, the high cut in Treatment 6 has no stimulating effect on the lower one.

In view of the outcome, it appears in any case unprofitable to apply such a system to young PR 107: since tapping of the high panels fails to give a yield in proportion to the tapping intensity, and there is the additional necessity of using a ladder, this method is inadmissible as a means of economic exploitation.

With respect to growth, this type of tapping is even more severe than full-spiral.

Treatments 7 and 12 were exploited in the same way during the first year of tapping (2S/3 ↗, opened in 1966 at 0.3 m and 1.8 m, and tapped simultaneously). In 1967 the 2S/3 ↗ of Treatment 7 were raised 0.5 m and displaced in the same direction, one-third of the circumference round the tree. In the case of Treatment 12 the S/3 ↗ were indeed displaced, but they were opened at the same heights, in the proximity of the S/3 ↗ opened in 1966. If yields were equivalent in 1966, this was not the case in 1967: the difference between them, essentially attributable to the lower panels, is highly significant.

Growth is also severely checked by these systems.

It is therefore emphasised once more that exploitation of high panels on relatively young PR 107 is not recommended because:

yield does not correspond to the intensity of tapping;

a stool or even a ladder has to be used; and

tapping is tricky.

Treatments 8 and 13 are respectively identical with Treatments 7 and 12 but tapping is balanced. Their production in 1966 was 17 % greater than that from full-spiral: in 1967 it was only 8 % greater for Treatment 8 but 23 % more in the case of Treatment 13. Balanced tapping, which we had shown to influence mainly the lower S/3 ↗ in 1966, seems to give rise to nearly identical over-productions from each of the S/3 ↗ in 1967 (up to the end of November). Although it had been noted during the previous year that the yield from S/3 ↗ opened at 1.9 m was a mere 17 % higher than that from a half-spiral (of lesser overall tapping length) opened at 1.3 m, the difference appears to become greater in 1967.

Balanced tapping on 2S/3 ↗ checks growth severely, as the values given in *Table 1* demonstrate.

Trees receiving Treatment 9 (with 3S/3 ↙) were under balanced tapping in 1966 but were tapped simultaneously in 1967. This system gave 7 % more than full-spiral in 1966 and 5 % more in 1967. The low S/3 is alone responsible for 49 % of the output while the high S/3 gives only 21 % and must in addition be tapped from a stool. The changes in the d.r.c. for this treat-

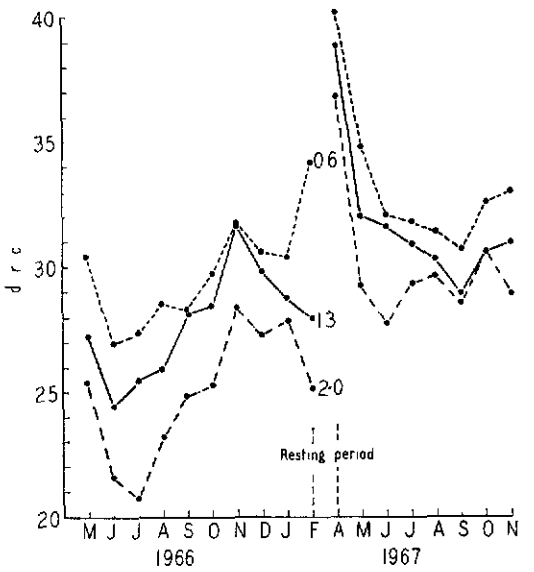

Figure 2. Variation in the monthly averages for the d.r.c. in Treatment 9: 3 S/3, descending, under balanced tapping in 1966 and simultaneous tapping in 1967.

ment from the start of the experiment are shown in *Figure 2*.

In full conformity with *Table 1* data, a very marked increase can be seen in the d.r.c. in 1967. The average d.r.c. of the highest tapping cut is greater than 30, and the lowest monthly average, in June, is 27.8.

For the moment, growth of the trees seems to be identical with that obtained under full-spiral tapping.

Treatment 10 is made up of 4S/4 spaced 60 cm apart, the lowest being 0.6 m from the ground when opened: tapping is balanced. It yields an average only 4% greater than full-spiral and the difference is not significant. The yields given in *Table 1* are a good illustration of the unprofitability associated with the opening of young trees at too great a height. The growth recorded for this treatment is lower than that for Treatment 2 (full-spiral).

Insofar as yield in g per cm tapping cut is concerned, and according to MAAS (1925), it is established that the shorter the cut, the greater the output. The flow rate from short tapping cuts has been observed to be faster than from long cuts: for example, the duration of flow from half-spiral at 1.3 m is one-third less prolonged than for full-spiral. This is also apparent for S-15 cm. The most prolonged flow times are given by full-spiral; the treatments carrying low S/3 ↙ ; and after these the reduced-spiral.

In the case of the last two systems (3S/3 or 4S/4), it is established that S/4 gives a greater yield per cm cut than S/3. For the S/4 spaced 60 cm apart the following overall values, in g/cm tapping cut, have been calculated for the period from the commencement of tapping:

S/4 at 2.4 m = 49
S/4 at 1.8 m = 87
S/4 at 1.2 m = 97
S/4 at 0.6 m = 164

This underlines the value of opening at a low level in order to secure a good yield from the start.

With respect to average d.r.c., observations made in 1966 confirm that:

the higher the tapping cut, the lower the d.r.c. as shown in *Figure 2*;

the heights of the cuts being equal, balanced tapping generally decreases d.r.c.; and

panels placed very high on the trunk, or more often on the branches, tend to give a higher d.r.c.; this was observed in 1967 for Treatment 6, but is subject to confirmation in 1968.

In addition, it is to be noted that the rather low d.r.c. of these young PR 107 trees in 1966 (only rarely exceeding 30) has increased very markedly in 1967 (see *Figure 2*).

EXPERIMENT 2—YIELD FROM TAPPING ON 2S/2 ↙ AS A FUNCTION OF DISTANCE BETWEEN TAPPING CUTS

This experiment is made up of 20 treatments (10 under simultaneous, 10 under balanced tapping), each of 5 trees. The object is firstly to investigate the yields from 2S/2 when the distance between them is systematically varied and subsequently to examine the effect of balanced tapping in relation to this variation.

In each treatment the lower S/2 was opened at 0.6 m, whereas the height of opening the upper S/2 was varied in steps of 20 cm from 0.6 to 2.4 m. During 1966 tapping was on a d/3–d/4 basis while from the resumption of tapping in 1967 it has been on a d/2–d/3. 2m/3 pattern. Monthly resting periods have been applied from 17 June–17 July and 17 September–17 October. The object of this modification is to see whether balanced tapping is not more satisfactory, per tapping, when applied to a regime which during the months of exploitation is relatively more intense. In addition an attempt is being made to see whether balanced tapping, if possible for a whole tapping year, can compensate for the diminished yield shown to result (RUBBER RESEARCH INSTITUTE OF MALAYA, 1967) from the adoption of periodic tapping systems of equivalent intensity.

The results obtained from the commencement of tapping up to the end of November 1967 are given in *Figure 3*.

It can be seen that:

there is a steady diminution in yield corresponding to the increase in height of the upper tapping cut;

in contrast to the previous year there is

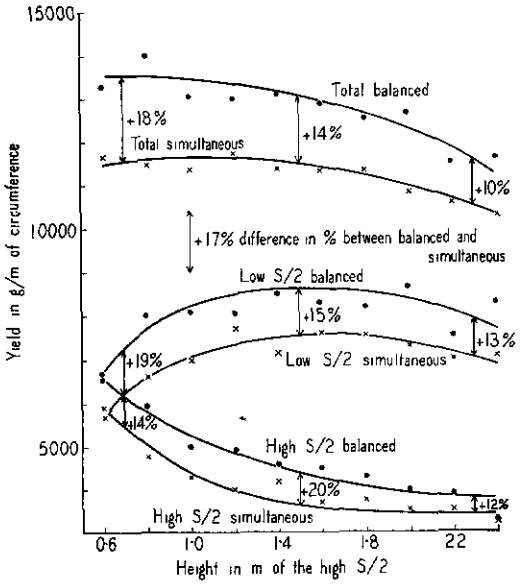

Figure 3. Output per tapping cut, relative to total production, for Experiment 2, April 1966–November 1967.

no lack of improvement here due to the balanced tapping of the high cuts, as the over-production is still in the region of 12% at about 2.3 m: this is qualified by the fact that the tapping system was intensified suddenly in 1967 and balanced tapping is accordingly more productive;

in deciding the optimal spacing for 2S/2 under simultaneous tapping, the lower cut being opened at 0.6 m, it appears that the yield remains almost constant up to a spacing of around 0.9 m: in effect, it is at about this difference that the yield from the lower S/2 reaches a ceiling level;

at this displacement of about 0.9 m the improvement in yield is of the order of 14%, 15% coming from the lower cut and 20% from the upper one;

in terms of g/cm tapping cut, the yield from balanced tapping is greater than that from simultaneous tapping, for both the higher and the lower cuts;

attempts to establish by means of circumference measurements whether displacement of the tapping cuts had any effect on the growth of the trees proved unsuccessful because of excessive interference by *Corticium*.

EXPERIMENT 3—INVESTIGATION OF YIELDS FROM DIFFERENT TAPPING CUTS

This is made up of 9 treatments of 10 trees each and serves as a basis for more fundamental studies designed to answer the questions below; tapping was only started in July 1966.

(1) In view of the difficulty in exploiting a low S/3 ↙, and given that it is possible to maintain a $\frac{2}{3}$ spiral low on the panel for an extended period and with the same bark consumption, can the lower S/3 ↙ of a 2S/3 ↙ system be replaced by $\frac{2}{3}$ S ↙?

Compared with 2S/3 ↙ at 0.3 m and 1.8 m the system based on $\frac{2}{3}$ S ↙ at 0.3 m and S/3 ↙ at 1.8 m gives a 6% increase in yield, attributable to a 3% improvement on the lower panel and 12% on the upper one. These values correspond to the totals for 1966–1967: for 1966 they were respectively 7, 6 and 8%. It is to be noted that the yield from the upper panel of the $\frac{2}{3}$ S ↙ treatment is greater than that from the upper panel of the other treatment; this is even more obvious in 1967 than in 1966 and no doubt arises from a less intense drainage of the upper region by the exclusively downward tapping of the lower panel.

(2) What are the respective contributions of the S/3 ↗ and S/3 ↙ of a high and low S/3 ↙ system to the total yield?

This has been investigated by means of two systems: the first involves separation of the two tapping cuts by a 2 cm bark bridge, whereas in the second the cuts are displaced laterally by 3 cm. These treatments, which correspond to Treatments 12 and 7 of Experiment 1, gave similar results in 1966:

In the case of the S/3 ↙ 30 cm from the ground, 27 to 29% of the latex output came from the S/3 ↗. In 1967 the S/3 ↙ panel of the first treatment (equivalent to Treatment 12 of Experiment 1) was maintained at the same height but placed on the adjacent third of the tree. The S/3 ↗ gave approximately 34% of the total output. The new third on the second treatment (comparable with treatment 7 of Experiment 1) was opened at 0.8 m, the pro-

portion produced by the upper cut then exceeding 36%.

In the case of the S/3↙ at 1.8 m from the ground the S/3↗ produces 48 to 49% of the total: one can say that each S/3 yields effectively the same amount of latex. In 1967 the upper S/3↙ of the first treatment was kept at the same height (1.8 m) but its location on the trunk was changed (Treatment 12 of Experiment 1). The yield from the S/3↗ remains the same: 48%. For the second treatment (Treatment 7 of Experiment 1) the upper S/3↙ was opened at 2.3 m in 1967: 47% of the output comes from the S/3↗.

Summarising with respect to the first two questions, it appears that opening of a low S/3↗ is not to be recommended, and that it is preferable to open only descending cuts on the low panels; where the upper panels are concerned it seems that the yields from the ascending and descending cuts are equal.

(3) What are the respective yields under d/3–d/4 tapping of a single S/2 at 0.6 m and one at 1.3 m compared with a full-spiral at 1 m?

The results obtained in 1966 and 1967 are given in *Table 2*, to which have been added the details relevant to question No. 4.

It is immediately apparent that in 1966 the output from the S/2 at 0.6 m was 72% of that from full-spiral, whereas for 1967 it only stands at 65% at the end of November. This is actually quite normal, for the year 1967 is not yet completed and it is especially at the end of the year that the yield of the low S/2 increases, to the extent that on certain days it even exceeds that of full-spiral.

The upper S/2 opened at 1.3 m in 1966 shows an increase relative to the yields for full-spiral and low S/2; this has already been noted

TABLE 2. YIELDS FROM FULL-SPIRAL AND HALF-SPIRAL CUTS *UNDER D/3–D/4 TAPPING—EXPERIMENT 3*

Year	Yield	Full-spiral at 1 m	S/2 at 0.6 m	S/2 at 1.3 m	S/2 isolated from above
1966	In g/m circumference	4667	3352	2246	3047
	As % of full-spiral at 1 m	100	72	48	65
	As % of S/2 at 0.6 m	139	100	67	91
1967	In g/m circumference	4951	3205	2736	2874
	As % of full-spiral at 1 m	100	65	55	58
	As % of S/2 at 0.6 m	154	100	85	90
Totals	In g/m circumference	9618	6557	4982	5921
	As % of full-spiral at 1 m	100	68	52	62
	As % of S/2 at 0.6 m	147	100	76	90
	Growth in cm in 20 months	5.8	7.1	8.3	5.7

by RUBBER RESEARCH INSTITUTE OF MALAYA (1967).

The growth recorded for full-spiral is normal and corresponds to that obtained in Experiment 1. Without attaching any significance to the difference between them, it will be noted that excellent growth was observed for the S/2 treatments.

(4) When a half-spiral at 0.6 m is isolated from the upper panel, how does its yield compare with that from a normal S/2?

This comparison was suggested by LUSTINEC (1966). A tapping cut was isolated from the flow of latex coming from the upper part of the trunk by means of a saw cut (made with a hot saw) projecting 10 cm beyond the tapping cut; the flow from below being no longer checked there is no proportional reduction in yield.

In fact, there is merely 9–10% less output than from a normal S/2 at the same height, despite the fact that LUSTINEC (1966) has found that about 30% of the latex flowing from a half-spiral comes from above.

(5) Is rolling tapping by means of needles fixed to a rotating disc feasible?

In view of the sometimes high output both from tappings made with a pin and from microtappings (LUSTINEC, 1966), 'rolling' tapping, *i.e.*, tapping by means of a disc carrying 4 mm needles at 3 cm intervals, has been attempted. The disc is rolled parallel to the trunk along a steep half-spiral tapping cut opened at 0.3 m from the ground and ending at 1.5 m. The cut was first renewed every fortnight, subsequently every week, and the needle disc was used on d/2–d/2–d/3.

The yields obtained in 1966 were disappointing, amounting to less than 10 g per cm tapping cut from July until the tapping pause, *i.e.*, 25% of the yield (in g/cm) given by full-spiral d/3–d/4 for the same period. The method required in addition much more time and care than normal tapping; and added to this it resulted in a very large number of bark wounds and excessive bark consumption. The trees subjected to this treatment were rested when tapping was resumed in 1967.

To conclude, tapping by 'roulette' is of no interest whatever from a practical standpoint.

EXPERIMENT 4—EFFECT ON YIELD OF AN ARRANGEMENT OF S/3 TAPPING CUTS ON TRUNK

This experiment is based on 5 treatments, of 10 trees each, the control being always full-spiral d/3–d/4. The treatments are detailed in *Table 3*, which gives the results obtained for the period from the start of tapping (August 1966) until the end of November 1967.

Expressed as a percentage of Treatment 1 the total yields are suggestive of superiority on the part of Treatments 4 and 5; but expressed in terms of Treatment 1 with respect to intensity of tapping it is clear that Treatment 4 (3S/3 ↙ d/3–d/4), with 29% over-production, is the most interesting. In 1966, under balanced tapping, this regime gave 25% more than Treatment 1, and in 1967, under simultaneous tapping, 32% more. It seems, moreover, that the extra output had a tendency to increase with time.

The yields from the individual tapping cuts of Treatment 4, expressed as percentages of the total output, are identical with those obtained for Treatment 9 of Experiment 1.

It appeared from this experiment that this 3S/3. d/3–d/4 treatment is of the greatest interest, the more so in that tapping is simultaneous and necessitates the use of only a single piece of equipment: the distance between the cuts could be reduced to 45 or 40 cm.

Treatment 2 is also of interest in that its output relative to intensity of tapping is better than that of the control, and its growth is excellent.

Treatment 3 (S/3. d/1. 6d/7) has given only 86% of the yield of full-spiral d/3–d/4 since the start of the experiment, whereas it gave 95% in 1966. This can be attributed to a certain degree of localised panel exhaustion, and to the fact that it is only towards the end of the year that the yields from short tapping cuts are markedly better than those from longer cuts. The treatment seems to be entirely without practical interest, although its growth is very good.

Treatment 5, which in terms of tapping intensity merely gave 97% of the control output in 1966, is giving a 5% over-production since the start of the experiment. This regime being balanced it is unlikely to have any immediate

TABLE 3. PRINCIPAL RESULTS FROM EXPERIMENT 4

Treatment No.	Tapping system	Height of tapping cuts at opening	Theoretical intensity as % of Treatment 1	Yields				△ Circumference in cm/20 months
				Total as % of Treatment 1	as a function of the intensity of Treatment 1	per tapping cut, as % of total for Treatment 1	per tapping cut, as % of total for Treatment 1	
1	S/1 d/3–d/4	1.0 m	100	100	100	100	100	5.4
2	S/2 d/2–d/2–d/3	1.0 m	75	82	109	100	82	8.6
3	S/3 d/1.6d/7	1.0 m	100	86	86	100	86	8.7
4	3S/3 d/3–d/4	1.5 m	100	129	129	20	26	5.0
		1.0 m				31	41	
		0.5 m				49	62	
5	4S/3* of which 1S/3 ↙ d/3–d/4	1.5 m ↗	133	139	105	15	21	4.9
		1.5 m ↙				19	26	
		1.0 m				24	33	
		0.5 m				42	58	

*Balanced tapping

practical interest with respect to PR 107 during the first two years of tapping; nevertheless, its yield has a tendency to increase and it could be that a tapping system based on 3 S/3 ↙. d/3–d/4, changed a few years later to 4S/3 (one of which would be S/3↗), d/3–d/4 (balanced) could be of value.

On examination of the monthly yields for Treatments 4 and 5 it could be seen that only from June onwards did the 3S/3 system clearly overtake the full-spiral, and the 4S/3 only exceeded the 3S/3 from August onwards.

It was also noted in the course of these experiments that as a general rule short tapping cuts appear more effective at the end of the year than at the beginning: this can be attributed to the fact that fast-flowing tapping cuts benefit to a greater extent from favourable climatic conditions, since such conditions do not persist throughout the day.

Lastly, it will be noted that in all the experiments considered here tapping was always completed before 09.00 hours: this can have a definite influence on the results which were obtained.

DISCUSSION

It appears from the results of these experiments as a whole that tapping of young PR 107 under regimes more intense than that represented by full-spiral generally fails to achieve overproductions commensurate with the intensity in question; nor is this merely a consequence of tapping on panels which are too high up. Apart from the tapping system based on 3S/3 spaced 50 cm apart, d/3–d/4, it seems at the moment that the traditional full-spiral opening is the most satisfactory. The question as to the height at which this spiral should be opened is debatable; the importance of the depression in yield when it is raised has been stressed (RUBBER RESEARCH INSTITUTE OF MALAYA, 1965). A low opening of the spiral, at 0.8 m for example, could be an improvement to the

extent that the depression can be eliminated by stimulation.

Stimulation is moreover a means of increasing production without increasing tapping intensity. Experiments on young PR 107 have been undertaken to this end, and at the same time ways are being sought to compensate for the diminished tapping intensity by means of hormone stimulation.

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DISCUSSION

Chairman: Mr. C. W. Brookson

(Paper presented by Dr. F. Ninane)

Mr. E.C. Paardekooper observed that the higher yields were obtained from the systems of higher intensity. Furthermore, recent experiments in Malaysia (at the Chemara Research Station and the Rubber Research Institute of Malaya) and Thailand (Rubber Research Centre, Haadyai) showed no differences in yield between tapping the two cuts of double cut tapping systems on the same day or on separate (alternate tapping) days.